Handbook of Basic Atomic Spectroscopic Data

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For uniformity we have assigned an intensity of 1000 to the strongest line(s) of each spectrum. In most cases the chosen line (or lines) can reasonably be regarded as the ultimate line (Sec IV). The relative intensities for most spectra here are based on values from [RCWM80] . We have attempted to give improved intensities for some spectra by using more recent and apparently more accurate data than those available to the compilers of [RCWM80] . It should be noted that the intensities in [RCWM80] for lines of neutral and singly-ionized atoms of about half the elements (mainly nd- and nf-shell metals) were taken at least in part from [MCS75] . These intensities were obtained from observations of 10-A, 220-V direct-current arc discharges between copper electrodes having 0.1% of the element under investigation. The relative intensities were put on a linear scale by the use of standardized lamps. For several spectra we have altered some of the intensities found in the literature to give smoother transitions between wavelength regions covered by different observers. We have also adjusted reported intensities given in a single reference in some cases where the reported values were clearly affected by strong self-absorption and/or by large wavelength-dependent non-linearities. Such adjustments were necessary in order to assign the largest intensities to the inherently strongest persistent lines (usually the ultimate

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In general, the character of a line depends on the spectroscopic source used, the resolution of the spectrometer, etc. Most of the line characterizations in our tables are quoted from [RCWM80] , so that the characters given for lines of metallic elements usually pertain to the arc source used by Meggers et al. [MCS75] (see above). In some cases we have given character notations from [RCWM80] for lines for which the tabulated wavelengths were obtained with a very different (low-pressure) source. IV. Persistent-Line Tables In spectroscopic observations made with low concentrations of a particular element relative to other substances in the source, the number of observable lines of the element is found to decrease with decreasing concentration until only the most "persistent" or "sensitive" lines remain. Some authors refer to the last such line(s) as the raie(s) ultime, i.e., the ultimate line(s). Although the ultimate lines depend in principle on the source, the spectrometer, and other features of the experiment, a relatively small group of lines can be specified for each element that will include the ultimate lines as observed over a broad range of experimental conditions. We designate our selection of these lines "persistent lines". The strongest persistent lines usually include one or more resonance lines, i.e. transitions to the ground level or term. We include at least one of the resonance lines in our persistent line table for each spectrum. The most sensitive or ultimate lines for many spectra lie in the vacuum-ultraviolet region (wavelength < 2000 Å). In such cases we have tried to include some lines above 2000 Å in the persistent lines list. We have also tried to make these tables more generally useful for many spectra by covering broader wavelength ranges than most tables of this sort. In addition to the information given in the strong lines table, the list of persistent lines includes the energy levels involved in the transition, complete with configuration, term designations, and J values. Where available, the transition probability is also given, along with the reference from which it is taken. A. Transition Probabilities The values are listed as A ki in units of 10 8 s -1 . These A ki values can easily be converted to oscillator strengths, f ik , g i f ik , or log(g i f ik), or line strength, S , by using the following formula: g i f ik = 1.499x10 -8 A ki 2 g k = 303.8 -1 S , where i refers to the lower energy level, k refers to the upper level, is the wavelength in Ångstroms, and g = 2J+1 for a given level. The transition probability data are taken primarily from three compilations and from references cited therein. The NIST compilation [FW96] contains transition probabilities for about 9000 lines, covering most elements. Major recent compilations by Morton for elements from H to Ga [M91 , M02] and from Ge to Bi (plus Th and U) [M00] have data for lines longward of the Lyman limit (911.754 Å) and include a number of useful new references. The NIST transition-probability compilations include values with uncertainties ranging from 1% to larger than 50%, with an approximate uncertainty range being indicated for each line by an assigned letter. We have not included or assigned such letters here, but this information is given in the NIST publications and in the ASD for all transition-probability values taken from these sources. For data taken from the original literature or from non-NIST compilations, the user can consult the cited references for accuracy estimates. B. Energy-Level Classifications The values of the two levels classifying each line are given under "Energy Levels," with the lower level on the left. The energy-level classifications for a few persistent lines are not known, as indicated by the absence of level values. Clicking on one of the level values yields another page showing the configurations, term names, and J values for the levels classifying the line. The accuracies and spectroscopic designations of the levels are discussed in the next section. V. Energy Level Tables The tabulated energy levels represent a selection of the available data for each spectrum, including all levels involved in the persistent-line classifications. At least the lower levels of the ground configuration and other low-lying configurations are given. The levels of some of the simpler spectra are

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The values are listed as A ki in units of 10 8 s -1 . These A ki values can easily be converted to oscillator strengths, f ik , g i f ik , or log(g i f ik), or line strength, S , by using the following formula: g i f ik = 1.499x10 -8 A ki 2 g k = 303.8 -1 S , where i refers to the lower energy level, k refers to the upper level, is the wavelength in Ångstroms, and g = 2J+1 for a given level. The transition probability data are taken primarily from three compilations and from references cited therein. The NIST compilation [FW96] contains transition probabilities for about 9000 lines, covering most elements. Major recent compilations by Morton for elements from H to Ga [M91 , M02] and from Ge to Bi (plus Th and U) [M00] have data for lines longward of the Lyman limit (911.754 Å) and include a number of useful new references. 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Elements in Alphabetical Order

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Actinium Gold Promethium Aluminum Hafnium Protactinium Americium Helium Radium Antimony Holmium Radon Argon Hydrogen Rhenium Arsenic Indium Rhodium Astatine Iodine Rubidium Barium Iridium Ruthenium Berkelium Iron Samarium Beryllium Krypton Scandium Bismuth Lanthanum Selenium Boron Lead Silicon Bromine Lithium Silver Cadmium Lutetium Sodium Calcium Magnesium Strontium Californium Manganese Sulfur Carbon Mercury Tantalum Cerium Molybdenum Technetium Cesium Neodymium Tellurium Chlorine Neon Terbium Chromium Neptunium Thallium Cobalt Nickel Thorium Copper Niobium Thulium Curium Nitrogen Tin Dysprosium Osmium Titanium Einsteinium Oxygen Tungsten Erbium Palladium Uranium Europium Phosphorus Vanadium Fluorine Platinum Xenon Francium Plutonium Ytterbium Gadolinium Polonium Yttrium Gallium Potassium Zinc Germanium Praseodymium Zirconium

Elements Ordered by Atomic Number

Elements Ordered by Atomic Number

1 Hydrogen 34 Selenium 67 Holmium 2 Helium 35 Bromine 68 Erbium 3 Lithium 36 Krypton 69 Thulium 4 Beryllium 37 Rubidium 70 Ytterbium 5 Boron 38 Strontium 71 Lutetium 6 Carbon 39 Yttrium 72 Hafnium 7 Nitrogen 40 Zirconium 73 Tantalum 8 Oxygen 41 Niobium 74 Tungsten 9 Fluorine 42 Molybdenum 75 Rhenium 10 Neon 43 Technetium 76 Osmium 11 Sodium 44 Ruthenium 77 Iridium 12 Magnesium 45 Rhodium 78 Platinum 13 Aluminum 46 Palladium 79 Gold 14 Silicon 47 Silver 80 Mercury 15 Phosphorus 48 Cadmium 81 Thallium 16 Sulfur 49 Indium 82 Lead 17 Chlorine 50 Tin 83 Bismuth 18 Argon 51 Antimony 84 Polonium 19 Potassium 52 Tellurium 85 Astatine 20 Calcium 53 Iodine 86 Radon 21 Scandium 54 Xenon 87 Francium 22 Titanium 55 Cesium 88 Radium 23 Vanadium 56 Barium 89 Actinium 24 Chromium 57 Lanthanum 90 Thorium 25 Manganese 58 Cerium 91 Protactinium 26 Iron 59 Praseodymium 92 Uranium 27 Cobalt 60 Neodymium 93 Neptunium 28 Nickel 61 Promethium 94 Plutonium 29 Copper 62 Samarium 95 Americium 30 Zinc 63 Europium 96 Curium 31 Gallium 64 Gadolinium 97 Berkelium 32 Germanium 65 Terbium 98 Californium 33 Arsenic 66 Dysprosium 99 Einsteinium

Handbook of Basic Atomic Spectroscopic Data

Select an element to access data. H He Li Be B C N O F Ne Na Mg Al Si P S Cl Ar K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe Cs Ba Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn Fr Ra La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu Ac Th Pa U Np Pu Am Cm Bk Cf Es

Energy Levels of Neutral Helium (He I)

Energy Levels of Neutral Helium (He I)

Configuration Term J Level(cm -1) Ref. 1 s 2 1 S 0 0.000 M02 1 s 2 s 3 S 1 159855.9745 M02 1 s 2 s 1 S 0 166277.4403 M02 1 s 2 p 3 P° 2 169086.7666 M02 1 s 2 p 3 P° 1 169086.8430 M02 1 s 2 p 3 P° 0 169087.8309 M02 1 s 2 p 1 P° 1 171134.8970 M02 1 s 3 s 3 S 1 183236.7918 M02 1 s 3 s 1 S 0 184864.8294 M02 1 s 3 p 3 P° 2 185564.5620 M02 1 s 3 p 3 P° 1 185564.5840 M02 1 s 3 p 3 P° 0 185564.8547 M02 1 s 3 d 3 D 3 186101.5463 M02 1 s 3 d 3 D 2 186101.5488 M02 1 s 3 d 3 D 1 186101.5930 M02 1 s 3 d 1 D 2 186104.9668 M02 1 s 3 p 1 P° 1 186209.3651 M02 1 s 4 p 1 P° 1 191492.7120 M02 He II (2 S 1 / 2) Limit 198310.6691 M02

Energy Levels of Neutral Hydrogen (H I)

Energy Levels of Neutral Hydrogen (H I)

Configuration Term J Level(cm -1) Ref. 1 s 2 S 1 / 2 0.0000 MK00a 2 p 2 P° 1 / 2 82258.9191 MK00a 2 p 2 P° 3 / 2 82259.2850 MK00a 2 s 2 S 1 / 2 82258.9544 MK00a 3 p 2 P° 1 / 2 97492.2112 MK00a 3 p 2 P° 3 / 2 97492.3196 MK00a 3 s 2 S 1 / 2 97492.2217 MK00a 3 d 2 D 3 / 2 97492.3195 MK00a 3 d 2 D 5 / 2 97492.3556 MK00a 4 p 2 P° 1 / 2 102823.8486 MK00a 4 p 2 P° 3 / 2 102823.8943 MK00a 4 s 2 S 1 / 2 102823.8530 MK00a 4 d 2 D 3 / 2 102823.8942 MK00a 4 d 2 D 5 / 2 102823.9095 MK00a 4 f 2 F° 5 / 2 102823.9095 MK00a 4 f 2 F° 7 / 2 102823.9171 MK00a 5 p 2 P° 1 / 2 105291.6287 MK00a 5 p 2 P° 3 / 2 105291.6521 MK00a 5 s 2 S 1 / 2 105291.6309 MK00a 5 d 2 D 3 / 2 105291.6520 MK00a 5 d 2 D 5 / 2 105291.6599 MK00a 5 f 2 F° 5 / 2 105291.6598 MK00a 5 f 2 F° 7 / 2 105291.6637 MK00a 5 g 2 G 7 / 2 105291.6637 MK00a 5 g 2 G 9 / 2 105291.6661 MK00a H Limit 109678.7717 MK00a

Energy Levels of Neutral Lithium (Li I)

Energy Levels of Neutral Lithium (Li I)

Configuration Term J Level(cm -1) Ref. 2 s 2 S 1 / 2 0.000 REB95 2 p 2 P° 1 / 2 14903.622 REB95 2 p 2 P° 3 / 2 14903.957 REB95 3 s 2 S 1 / 2 27206.066 REB95 3 p 2 P° 1 / 2 30925.517 REB95 3 p 2 P° 3 / 2 30925.613 REB95 3 d 2 D 3 / 2 31283.018 REB95 3 d 2 D 5 / 2 31283.053 REB95 4 p 2 P° 1 / 2 36469.714 REB95 4 p 2 P° 3 / 2 36469.754 REB95 4 d 2 D 3 / 2 36623.297 REB95 4 d 2 D 5 / 2 36623.312 REB95 Li II 1 s 2 (1 S 0) Limit 43487.150 K87

Energy Levels of Neutral Beryllium (Be I)

Energy Levels of Neutral Beryllium (Be I)

Configuration Term J Level(cm -1) Ref. 2 s 2 1 S 0 0.000 KM97 2 s 2 p 3 P° 0 21978.28 KM97 2 s 2 p 3 P° 1 21978.925 KM97 2 s 2 p 3 P° 2 21981.27 KM97 2 s 2 p 1 P° 1 42565.35 KM97 2 s 3 s 3 S 1 52080.94 KM97 2 s 3 s 1 S 0 54677.26 KM97 2 p 2 1 D 2 56882.43 KM97 2 s 3 p 3 P° 0,1 58907.45 KM97 2 s 3 p 3 P° 2 58907.83 KM97 2 p 2 3 P 0 59693.65 KM97 2 p 2 3 P 1 59695.07 KM97 2 p 2 3 P 2 59697.08 KM97 2 s 3 p 1 P° 1 60187.34 KM97 2 s 3 d 3 D 1,2,3 62053.72 KM97 2 s 3 d 1 D 2 64428.31 KM97 Be II (2 S 1 / 2) Limit 75192.64 KM97

Energy Levels of Neutral Boron (B I)

Energy Levels of Neutral Boron (B I)

Configuration Term J Level(cm -1) Ref. 2 s 2 2 p 2 P° 1 / 2 0.000 JLKK93 2 s 2 2 p 2 P° 3 / 2 15.287 JLKK93 2 s 2 p 2 4 P 1 / 2 28870.0+x RT76 2 s 2 p 2 4 P 3 / 2 28875.0+x RT76 2 s 2 p 2 4 P 5 / 2 28881.3+x RT76 2 s 2 3 s 2 S 1 / 2 40039.695 JLKK93 2 s 2 p 2 2 D 5 / 2 47856.807 JLKK93 2 s 2 p 2 2 D 3 / 2 47857.127 JLKK93 2 s 2 3 p 2 P° 1 / 2 48611.872 EL01 2 s 2 3 p 2 P° 3 / 2 48613.655 EL01 2 s 2 3 d 2 D 3 / 2 54767.698 EL01 2 s 2 3 d 2 D 5 / 2 54767.844 EL01 2 s 2 4 s 2 S 1 / 2 55010.236 EL01 2 s 2 4 p 2 P° 1 / 2 57786.436 EL01 2 s 2 4 p 2 P° 3 / 2 57787.071 EL01 2 s 2 4 f 2 F° 5 / 2 , 7 / 2 60031.085 EL01 B II (1 S 0) Limit 66928.04 R02

Energy Levels of Neutral Carbon (C I)

Energy Levels of Neutral Carbon (C I)

Configuration Term J Level(cm -1) Ref. 2 s 2 2 p 2 3 P 0 0.00000 YS91 2 s 2 2 p 2 3 P 1 16.41671 YS91 2 s 2 2 p 2 3 P 2 43.41350 YS91 , CSBE86 2 s 2 2 p 2 1 D 2 10192.66 KW66 2 s 2 2 p 2 1 S 0 21648.02 KW66 2 s 2 p 3 5 S° 2 33735.22 J66 2 s 2 2 p (2 P°)3 s 3 P° 0 60333.43 CG98 2 s 2 2 p (2 P°)3 s 3 P° 1 60352.64 CG98 2 s 2 2 p (2 P°)3 s 3 P° 2 60393.15 CG98 2 s 2 2 p (2 P°)3 s 1 P° 1 61981.82 CG98 2 s 2 p 3 3 D° 3 64086.95 CG98 2 s 2 p 3 3 D° 1 64089.86 CG98 2 s 2 p 3 3 D° 2 64090.97 CG98 2 s 2 2 p (2 P°)3 p 1 P 1 68856.34 CG98 2 s 2 2 p (2 P°)3 p 3 D 1 69689.47 CG98 2 s 2 2 p (2 P°)3 p 3 D 2 69710.67 CG98 2 s 2 2 p (2 P°)3 p 3 D 3 69744.03 CG98 2 s 2 2 p (2 P°)3 p 3 S 1 70743.95 CG98 2 s 2 2 p (2 P°)3 p 3 P 0 71352.52 CG98 2 s 2 2 p (2 P°)3 p 3 P 1 71364.92 CG98 2 s 2 2 p (2 P°)3 p 3 P 2 71385.39 CG98 2 s 2 2 p (2 P°)3 p 1 D 2 72610.73 CG98 2 s 2 2 p (2 P°)3 p 1 S 0 73975.91 CG98 2 s 2 p 3 3 P° 1 75253.98 CG98 2 s 2 p 3 3 P° 2 75255.28 CG98 2 s 2 p 3 3 P° 0 75256.15 CG98 2 s 2 2 p (2 P°)3 d 1 D° 2 77679.83 CG98 2 s 2 2 p (2 P°)4 s 3 P° 0 78104.97 CG98 2 s 2 2 p (2 P°)4 s 3 P° 1 78116.75 CG98 2 s 2 2 p (2 P°)4 s 3 P° 2 78148.09 CG98 2 s 2 2 p (2 P°)3 d 3 F° 2 78199.06 CG98 2 s 2 2 p (2 P°)3 d 3 F° 3 78215.50 CG98 2 s 2 2 p (2 P°)3 d 3 F° 4 78249.93 CG98 2 s 2 2 p (2 P°)3 d 3 D° 1 78293.50 CG98 2 s 2 2 p (2 P°)3 d 3 D° 2 78307.62 CG98 2 s 2 2 p (2 P°)3 d 3 D° 3 78318.23 CG98 2 s 2 2 p (2 P°)3 d 1 P° 1 78731.28 CG98 C II (2 P° 1 / 2) Limit 90820.45 J66

Energy Levels of Neutral Fluorine (F I)

Energy Levels of Neutral Fluorine (F I)

Configuration Term J Level(cm -1) Ref. 2 s 2 2 p 5 2 P° 3 / 2 0.000 LB82 2 s 2 2 p 5 2 P° 1 / 2 404.141 LB82 2 s 2 2 p 4 (3 P)3 s 4 P 5 / 2 102405.714 A95 2 s 2 2 p 4 (3 P)3 s 4 P 3 / 2 102680.439 A95 2 s 2 2 p 4 (3 P)3 s 4 P 1 / 2 102840.378 A95 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 104731.048 A95 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 105056.283 A95 2 s 2 2 p 4 (3 P)3 p 4 P° 5 / 2 115917.904 A95 2 s 2 2 p 4 (3 P)3 p 4 P° 3 / 2 116040.880 A95 2 s 2 2 p 4 (3 P)3 p 4 P° 1 / 2 116143.578 A95 2 s 2 2 p 4 (3 P)3 p 4 D° 7 / 2 116987.391 A95 2 s 2 2 p 4 (3 P)3 p 4 D° 5 / 2 117164.002 A95 2 s 2 2 p 4 (3 P)3 p 4 D° 3 / 2 117308.552 A95 2 s 2 2 p 4 (3 P)3 p 4 D° 1 / 2 117391.945 A95 2 s 2 2 p 4 (3 P)3 p 2 D° 5 / 2 117622.917 A95 2 s 2 2 p 4 (3 P)3 p 2 D° 3 / 2 117872.917 A95 2 s 2 2 p 4 (3 P)3 p 2 S° 1 / 2 118405.256 A95 2 s 2 2 p 4 (3 P)3 p 4 S° 3 / 2 118427.814 A95 2 s 2 2 p 4 (3 P)3 p 2 P° 3 / 2 118936.791 A95 2 s 2 2 p 4 (3 P)3 p 2 P° 1 / 2 119081.814 A95 F II (3 P 2) Limit 140524.5 L49

Energy Levels of Neutral Neon (Ne I)

Energy Levels of Neutral Neon (Ne I)

Configuration Term J Level(cm -1) Ref. 2 p 6 1 S 0 0.00 SS04 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 2 134041.8400 SS04 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 1 134459.2871 SS04 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 0 134818.6405 SS04 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 1 135888.7173 SS04 2 p 5 (2 P° 3 / 2)3 p 2 [1 / 2] 1 148257.7898 SS04 2 p 5 (2 P° 3 / 2)3 p 2 [1 / 2] 0 150917.4307 SS04 2 p 5 (2 P° 3 / 2)3 p 2 [5 / 2] 3 149657.0393 SS04 2 p 5 (2 P° 3 / 2)3 p 2 [5 / 2] 2 149824.2215 SS04 2 p 5 (2 P° 3 / 2)3 p 2 [3 / 2] 1 150121.5922 SS04 2 p 5 (2 P° 3 / 2)3 p 2 [3 / 2] 2 150315.8612 SS04 2 p 5 (2 P° 1 / 2)3 p 2 [3 / 2] 1 150772.1118 SS04 2 p 5 (2 P° 1 / 2)3 p 2 [3 / 2] 2 150858.5079 SS04 2 p 5 (2 P° 1 / 2)3 p 2 [1 / 2] 1 151038.4524 SS04 2 p 5 (2 P° 1 / 2)3 p 2 [1 / 2] 0 152970.7328 SS04 2 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 158601.1152 SS04 2 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 1 158795.9924 SS04 2 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 0 159379.9935 SS04 2 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 1 159534.6196 SS04 2 p 5 (2 P° 3 / 2)3 d 2 [1 / 2]° 0 161509.6305 SS04 2 p 5 (2 P° 3 / 2)3 d 2 [1 / 2]° 1 161524.1739 SS04 2 p 5 (2 P° 3 / 2)3 d 2 [7 / 2]° 4 161590.3412 SS04 2 p 5 (2 P° 3 / 2)3 d 2 [7 / 2]° 3 161592.1200 SS04 2 p 5 (2 P° 3 / 2)3 d 2 [3 / 2]° 2 161607.2609 SS04 2 p 5 (2 P° 3 / 2)3 d 2 [3 / 2]° 1 161636.6175 SS04 2 p 5 (2 P° 3 / 2)3 d 2 [5 / 2]° 2 161699.6613 SS04 2 p 5 (2 P° 3 / 2)3 d 2 [5 / 2]° 3 161701.4486 SS04 2 p 5 (2 P° 1 / 2)3 d 2 [5 / 2]° 2 162408.6536 SS04 2 p 5 (2 P° 1 / 2)3 d 2 [5 / 2]° 3 162410.1736 SS04 2 p 5 (2 P° 1 / 2)3 d 2 [3 / 2]° 2 162419.9818 SS04 2 p 5 (2 P° 1 / 2)3 d 2 [3 / 2]° 1 162435.6780 SS04 2 p 5 (2 P° 1 / 2)4 p 2 [1 / 2] 0 164285.8872 SS04 2 p 5 (2 P° 3 / 2)4 d 2 [7 / 2]° 4 167000.0317 SS04 Ne II (2 P° 3 / 2) Limit 173929.75 KM72

Energy Levels of Neutral Nitrogen (N I)

Energy Levels of Neutral Nitrogen (N I)

Configuration Term J Level(cm -1) Ref. 2 s 2 2 p 3 4 S° 3 / 2 0.000 M75a 2 s 2 2 p 3 2 D° 5 / 2 19224.464 M75a 2 s 2 2 p 3 2 D° 3 / 2 19233.177 M75a 2 s 2 2 p 3 2 P° 1 / 2 28838.920 M75a 2 s 2 2 p 3 2 P° 3 / 2 28839.306 M75a 2 s 2 2 p 2 (3 P)3 s 4 P 1 / 2 83284.070 M75a 2 s 2 2 p 2 (3 P)3 s 4 P 3 / 2 83317.830 M75a 2 s 2 2 p 2 (3 P)3 s 4 P 5 / 2 83364.620 M75a 2 s 2 2 p 2 (3 P)3 s 2 P 1 / 2 86137.350 M75a 2 s 2 2 p 2 (3 P)3 s 2 P 3 / 2 86220.510 M75a 2 s 2 p 4 4 P 5 / 2 88107.260 M75a 2 s 2 p 4 4 P 3 / 2 88151.170 M75a 2 s 2 p 4 4 P 1 / 2 88170.570 M75a 2 s 2 2 p 2 (3 P)3 p 2 S° 1 / 2 93581.550 M75a 2 s 2 2 p 2 (3 P)3 p 4 D° 1 / 2 94770.880 M75a 2 s 2 2 p 2 (3 P)3 p 4 D° 3 / 2 94793.490 M75a 2 s 2 2 p 2 (3 P)3 p 4 D° 5 / 2 94830.890 M75a 2 s 2 2 p 2 (3 P)3 p 4 D° 7 / 2 94881.820 M75a 2 s 2 2 p 2 (3 P)3 p 4 P° 1 / 2 95475.310 M75a 2 s 2 2 p 2 (3 P)3 p 4 P° 3 / 2 95493.690 M75a 2 s 2 2 p 2 (3 P)3 p 4 P° 5 / 2 95532.150 M75a 2 s 2 2 p 2 (3 P)3 p 4 S° 3 / 2 96750.840 M75a 2 s 2 2 p 2 (3 P)3 p 2 D° 3 / 2 96787.680 M75a 2 s 2 2 p 2 (3 P)3 p 2 D° 5 / 2 96864.050 M75a 2 s 2 2 p 2 (3 P)3 p 2 P° 1 / 2 97770.180 M75a 2 s 2 2 p 2 (3 P)3 p 2 P° 3 / 2 97805.840 M75a 2 s 2 2 p 2 (1 D)3 s 2 D 5 / 2 99663.427 M75a 2 s 2 2 p 2 (1 D)3 s 2 D 3 / 2 99663.912 M75a 2 s 2 2 p 2 (3 P)4 s 4 P 1 / 2 103622.51 M75a 2 s 2 2 p 2 (3 P)4 s 4 P 3 / 2 103667.16 M75a 2 s 2 2 p 2 (3 P)4 s 4 P 5 / 2 103735.48 M75a 2 s 2 2 p 2 (3 P)4 s 2 P 1 / 2 104144.820 M75a 2 s 2 2 p 2 (3 P)4 s 2 P 3 / 2 104221.630 M75a 2 s 2 2 p 2 (3 P)3 d 2 P 3 / 2 104615.470 M75a 2 s 2 2 p 2 (3 P)3 d 2 P 1 / 2 104654.030 M75a 2 s 2 2 p 2 (3 P)3 d 4 F 3 / 2 104664.130 M75a 2 s 2 2 p 2 (3 P)3 d 4 F 5 / 2 104683.060 M75a 2 s 2 2 p 2 (3 P)3 d 4 F 7 / 2 104716.950 M75a 2 s 2 2 p 2 (3 P)3 d 4 F 9 / 2 104765.77 M75a 2 s 2 2 p 2 (3 P)3 d 2 F 5 / 2 104810.360 M75a 2 s 2 2 p 2 (3 P)3 d 2 F 7 / 2 104881.350 M75a N II (3 P 0) Limit 117225.7 M75a

Energy Levels of Neutral Oxygen (O I)

Energy Levels of Neutral Oxygen (O I)

Configuration Term J Level(cm -1) Ref. 2 s 2 2 p 4 3 P 2 0.000 MG93 2 s 2 2 p 4 3 P 1 158.265 MG93 2 s 2 2 p 4 3 P 0 226.977 MG93 2 s 2 2 p 4 1 D 2 15867.862 MG93 2 s 2 2 p 4 1 S 0 33792.583 MG93 2 s 2 2 p 3 (4 S°)3 s 5 S° 2 73768.200 MG93 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 76794.978 MG93 2 s 2 2 p 3 (4 S°)3 p 5 P 1 86625.757 MG93 2 s 2 2 p 3 (4 S°)3 p 5 P 2 86627.778 MG93 2 s 2 2 p 3 (4 S°)3 p 5 P 3 86631.454 MG93 2 s 2 2 p 3 (4 S°)3 p 3 P 2 88631.146 MG93 2 s 2 2 p 3 (4 S°)3 p 3 P 1 88630.587 MG93 2 s 2 2 p 3 (4 S°)3 p 3 P 0 88631.303 MG93 2 s 2 2 p 3 (4 S°)4 s 5 S° 2 95476.728 MG93 2 s 2 2 p 3 (4 S°)4 s 3 S° 1 96225.049 MG93 2 s 2 2 p 3 (4 S°)3 d 5 D° 4 97420.630 MG93 2 s 2 2 p 3 (4 S°)3 d 5 D° 3 97420.716 MG93 2 s 2 2 p 3 (4 S°)3 d 5 D° 2 97420.839 MG93 2 s 2 2 p 3 (4 S°)3 d 5 D° 1 97420.942 MG93 2 s 2 2 p 3 (4 S°)3 d 5 D° 0 97420.991 MG93 2 s 2 2 p 3 (4 S°)3 d 3 D° 1 97488.378 MG93 2 s 2 2 p 3 (4 S°)3 d 3 D° 2 97488.448 MG93 2 s 2 2 p 3 (4 S°)3 d 3 D° 3 97488.538 MG93 O II (4 S° 3 / 2) Limit 109837.02 MG93

Energy Levels of Neutral Sodium (Na I)

Energy Levels of Neutral Sodium (Na I)

Configuration Term J Level(cm -1) Ref. 3 s 2 S 1 / 2 0.000 MZ81 3 p 2 P° 1 / 2 16956.172 MZ81 3 p 2 P° 3 / 2 16973.368 MZ81 4 s 2 S 1 / 2 25739.991 MZ81 3 d 2 D 5 / 2 29172.839 MZ81 3 d 2 D 3 / 2 29172.889 MZ81 4 p 2 P° 1 / 2 30266.99 MZ81 4 p 2 P° 3 / 2 30272.58 MZ81 4 f 2 F° 5 / 2 , 7 / 2 34586.92 MZ81 5 p 2 P° 1 / 2 35040.38 MZ81 5 p 2 P° 3 / 2 35042.85 MZ81 Na II 2 s 2 2 p 6 (1 S 0) Limit 41449.451 BBLB98

Energy Levels of Neutral Aluminum (Al I)

Energy Levels of Neutral Aluminum (Al I)

Configuration Term J Level(cm -1) Ref. 3 s 2 (1 S)3 p 2 P° 1 / 2 0.000 MZ79 3 s 2 (1 S)3 p 2 P° 3 / 2 112.061 MZ79 , BE99 3 s 2 (1 S)4 s 2 S 1 / 2 25347.756 MZ79 3 s 3 p 2 4 P 1 / 2 29020.41 MZ79 3 s 3 p 2 4 P 3 / 2 29066.96 MZ79 3 s 3 p 2 4 P 5 / 2 29142.78 MZ79 3 s 2 (1 S)3 d 2 D 3 / 2 32435.453 MZ79 3 s 2 (1 S)3 d 2 D 5 / 2 32436.796 MZ79 3 s 2 (1 S)4 p 2 P° 1 / 2 32949.807 MZ79 3 s 2 (1 S)4 p 2 P° 3 / 2 32965.639 MZ79 3 s 2 (1 S)5 s 2 S 1 / 2 37689.407 MZ79 3 s 2 (1 S)4 d y 2 D 3 / 2 38929.413 MZ79 3 s 2 (1 S)4 d y 2 D 5 / 2 38933.968 MZ79 3 s 2 (1 S)5 p 2 P° 1 / 2 40271.978 MZ79 3 s 2 (1 S)5 p 2 P° 3 / 2 40277.883 MZ79 3 s 2 (1 S)4 f 2 F° 5 / 2 41319.390 MZ79 3 s 2 (1 S)4 f 2 F° 7 / 2 41319.398 MZ79 3 s 2 (1 S)6 s 2 S 1 / 2 42144.411 MZ79 3 s 2 (1 S)4 d 2 D 3 / 2 42233.742 MZ79 3 s 2 (1 S)4 d 2 D 5 / 2 42237.783 MZ79 3 s 2 (1 S)6 p 2 P° 1 / 2 43335.024 MZ79 3 s 2 (1 S)6 p 2 P° 3 / 2 43337.889 MZ79 3 s 2 (1 S)5 f 2 F° 5 / 2 43831.101 MZ79 3 s 2 (1 S)5 f 2 F° 7 / 2 43831.105 MZ79 3 s 2 (1 S)5 g 2 G 7 / 2 , 9 / 2 43875.749 MZ79 3 s 2 (1 S)5 d 2 D 3 / 2 44166.398 MZ79 3 s 2 (1 S)5 d 2 D 5 / 2 44168.847 MZ79 Al II (1 S 0) Limit 48278.48 KM91b

Energy Levels of Neutral Argon (Ar I)

Energy Levels of Neutral Argon (Ar I)

Configuration Term J Level(cm -1) Ref. 3 p 6 1 S 0 0.000 VHU99 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 93143.7653 M73 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 1 93750.6031 M73 3 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 0 94553.6705 M73 3 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 1 95399.8329 VHU99 3 p 5 (2 P° 3 / 2)4 p 2 [1 / 2] 1 104102.1043 M73 3 p 5 (2 P° 3 / 2)4 p 2 [1 / 2] 0 107054.2773 M73 3 p 5 (2 P° 3 / 2)4 p 2 [5 / 2] 3 105462.7649 M73 3 p 5 (2 P° 3 / 2)4 p 2 [5 / 2] 2 105617.2753 M73 3 p 5 (2 P° 3 / 2)4 p 2 [3 / 2] 1 106087.2651 M73 3 p 5 (2 P° 3 / 2)4 p 2 [3 / 2] 2 106237.5571 M73 3 p 5 (2 P° 1 / 2)4 p 2 [3 / 2] 1 107131.7139 M73 3 p 5 (2 P° 1 / 2)4 p 2 [3 / 2] 2 107289.7054 M73 3 p 5 (2 P° 1 / 2)4 p 2 [1 / 2] 1 107496.4219 M73 3 p 5 (2 P° 1 / 2)4 p 2 [1 / 2] 0 108722.6247 M73 3 p 5 (2 P° 3 / 2)3 d 2 [1 / 2]° 0 111667.771 M73 3 p 5 (2 P° 3 / 2)3 d 2 [1 / 2]° 1 111818.033 M73 3 p 5 (2 P° 3 / 2)3 d 2 [3 / 2]° 2 112138.929 M73 3 p 5 (2 P° 3 / 2)3 d 2 [3 / 2]° 1 114147.737 M73 3 p 5 (2 P° 3 / 2)3 d 2 [7 / 2]° 4 112750.158 M73 3 p 5 (2 P° 3 / 2)3 d 2 [7 / 2]° 3 113020.360 M73 3 p 5 (2 P° 3 / 2)3 d 2 [5 / 2]° 2 113425.969 M73 3 p 5 (2 P° 3 / 2)3 d 2 [5 / 2]° 3 113716.560 M73 3 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 113468.478 M73 3 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 113643.265 M73 3 p 5 (2 P° 1 / 2)3 d 2 [5 / 2]° 2 114640.997 M73 3 p 5 (2 P° 1 / 2)3 d 2 [5 / 2]° 3 114821.944 M73 3 p 5 (2 P° 1 / 2)3 d 2 [3 / 2]° 2 114805.140 M73 3 p 5 (2 P° 1 / 2)3 d 2 [3 / 2]° 1 115366.871 M73 3 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 0 114861.640 M73 3 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 1 114975.024 M73 Ar II (2 P° 3 / 2) Limit 127109.842 VHU99

Energy Levels of Neutral Chlorine (Cl I)

Energy Levels of Neutral Chlorine (Cl I)

Configuration Term J Level(cm -1) Ref. 3 s 2 3 p 5 2 P° 3 / 2 0.00 RK69 3 s 2 3 p 5 2 P° 1 / 2 882.35 UH87 3 s 2 3 p 4 (3 P)4 s 4 P 5 / 2 71958.363 RK69 3 s 2 3 p 4 (3 P)4 s 4 P 3 / 2 72488.568 RK69 3 s 2 3 p 4 (3 P)4 s 4 P 1 / 2 72827.038 RK69 3 s 2 3 p 4 (3 P)4 s 2 P 3 / 2 74225.846 RK69 3 s 2 3 p 4 (3 P)4 s 2 P 1 / 2 74865.667 RK69 3 s 2 3 p 4 (3 P)4 p 4 P° 5 / 2 82918.893 RK69 3 s 2 3 p 4 (3 P)4 p 4 P° 3 / 2 83130.900 RK69 3 s 2 3 p 4 (3 P)4 p 4 P° 1 / 2 83364.927 RK69 3 s 2 3 p 4 (3 P)4 p 4 D° 7 / 2 83894.037 RK69 3 s 2 3 p 4 (3 P)4 p 4 D° 5 / 2 84132.262 RK69 3 s 2 3 p 4 (3 P)4 p 4 D° 3 / 2 84485.309 RK69 3 s 2 3 p 4 (3 P)4 p 4 D° 1 / 2 84688.637 RK69 3 s 2 3 p 4 (1 D)4 s 2 D 5 / 2 84120.263 RK69 3 s 2 3 p 4 (1 D)4 s 2 D 3 / 2 84121.872 RK69 3 s 2 3 p 4 (3 P)4 p 2 D° 5 / 2 84648.100 RK69 3 s 2 3 p 4 (3 P)4 p 2 D° 3 / 2 84988.480 RK69 3 s 2 3 p 4 (3 P)4 p 2 P° 1 / 2 85244.330 RK69 3 s 2 3 p 4 (3 P)4 p 2 P° 3 / 2 85442.430 RK69 3 s 3 p 6 2 S 1 / 2 85678.94 RK69 3 s 2 3 p 4 (3 P)4 p 4 S° 3 / 2 85735.091 RK69 Cl II (3 P 2) Limit 104591.0 RK69

Energy Levels of Neutral Magnesium (Mg I)

Energy Levels of Neutral Magnesium (Mg I)

Configuration Term J Level(cm -1) Ref. 3 s 2 1 S 0 0.000 MZ80 3 s 3 p 3 P° 0 21850.405 MZ80 3 s 3 p 3 P° 1 21870.464 MZ80 3 s 3 p 3 P° 2 21911.178 MZ80 3 s 3 p 1 P° 1 35051.264 MZ80 3 s 4 s 3 S 1 41197.403 MZ80 3 s 4 s 1 S 0 43503.333 MZ80 3 s 3 d 1 D 2 46403.065 MZ80 3 s 4 p 3 P° 0 47841.119 MZ80 3 s 4 p 3 P° 1 47844.414 MZ80 3 s 4 p 3 P° 2 47851.162 MZ80 3 s 3 d 3 D 2 47957.027 MZ80 3 s 3 d 3 D 3 47957.045 MZ80 3 s 3 d 3 D 1 47957.058 MZ80 3 s 4 p 1 P° 1 49346.729 MZ80 3 s 5 s 3 S 1 51872.526 MZ80 3 s 5 s 1 S 0 52556.206 MZ80 3 s 4 d 1 D 2 53134.642 MZ80 3 s 4 d 3 D 3 54192.256 MZ80 3 s 4 d 3 D 2 54192.294 MZ80 3 s 4 d 3 D 1 54192.335 MZ80 3 s 5 p 3 P° 0 54248.809 MZ80 3 s 5 p 3 P° 1 54250.086 MZ80 3 s 5 p 3 P° 2 54252.726 MZ80 3 s 4 f 1 F° 3 54676.438 MZ80 3 s 4 f 3 F° 2 54676.654 MZ80 3 s 4 f 3 F° 3 54676.701 MZ80 3 s 4 f 3 F° 4 54676.755 MZ80 3 s 5 p 1 P° 1 54706.536 MZ80 3 s 6 s 3 S 1 55891.80 MZ80 3 s 6 s 1 S 0 56186.873 MZ80 3 s 5 d 1 D 2 56308.381 MZ80 3 s 5 d 3 D 3 56968.218 MZ80 3 s 5 d 3 D 2 56968.248 MZ80 3 s 5 d 3 D 1 56968.271 MZ80 3 s 6 p 3 P° 0 57017.078 MZ80 3 s 6 p 3 P° 1 57017.724 MZ80 3 s 6 p 3 P° 2 57019.025 MZ80 3 s 5 f 1 F° 3 57204.163 MZ80 3 s 5 f 3 F° 2 57204.228 MZ80 3 s 5 f 3 F° 3 57204.267 MZ80 3 s 5 f 3 F° 4 57204.305 MZ80 3 s 6 p 1 P° 1 57214.992 MZ80 3 s 5 g G 3,4 57262.760 MZ80 3 p 2 3 P 0 57812.77 MZ80 3 p 2 3 P 1 57833.40 MZ80 3 p 2 3 P 2 57873.94 MZ80 Mg II (2 S 1 / 2) Limit 61671.05 KM91a

Energy Levels of Neutral Phosphorus (P I)

Energy Levels of Neutral Phosphorus (P I)

Configuration Term J Level(cm -1) Ref. 3 s 2 3 p 3 4 S° 3 / 2 0.00 MZM85 3 s 2 3 p 3 2 D° 3 / 2 11361.02 MZM85 3 s 2 3 p 3 2 D° 5 / 2 11376.63 MZM85 3 s 2 3 p 3 2 P° 1 / 2 18722.71 MZM85 3 s 2 3 p 3 2 P° 3 / 2 18748.01 MZM85 3 s 2 3 p 2 (3 P)4 s 4 P 1 / 2 55939.421 MZM85 3 s 2 3 p 2 (3 P)4 s 4 P 3 / 2 56090.626 MZM85 3 s 2 3 p 2 (3 P)4 s 4 P 5 / 2 56339.656 MZM85 3 s 2 3 p 2 (3 P)4 s 2 P 1 / 2 57876.574 MZM85 3 s 2 3 p 2 (3 P)4 s 2 P 3 / 2 58174.366 MZM85 3 s 3 p 4 4 P 5 / 2 59534.549 MZM85 3 s 3 p 4 4 P 3 / 2 59715.921 MZM85 3 s 3 p 4 4 P 1 / 2 59820.371 MZM85 3 s 2 3 p 2 (3 P)4 p 2 S° 1 / 2 64239.591 MZM85 3 s 2 3 p 2 (1 D)4 s 2 D 3 / 2 65156.242 MZM85 3 s 2 3 p 2 (1 D)4 s 2 D 5 / 2 65157.126 MZM85 3 s 2 3 p 2 (3 P)4 p 4 D° 1 / 2 65373.556 MZM85 3 s 2 3 p 2 (3 P)4 p 4 D° 3 / 2 65450.125 MZM85 3 s 2 3 p 2 (3 P)4 p 4 D° 5 / 2 65585.130 MZM85 3 s 2 3 p 2 (3 P)4 p 4 D° 7 / 2 65788.455 MZM85 3 s 2 3 p 2 (3 P)4 p 4 P° 1 / 2 66343.438 MZM85 3 s 2 3 p 2 (3 P)4 p 4 P° 3 / 2 66360.282 MZM85 3 s 2 3 p 2 (3 P)4 p 4 P° 5 / 2 66544.243 MZM85 3 s 2 3 p 2 (3 P)4 p 2 D° 3 / 2 66813.271 MZM85 3 s 2 3 p 2 (3 P)4 p 2 D° 5 / 2 67113.870 MZM85 3 s 2 3 p 2 (3 P)4 p 4 S° 3 / 2 66834.648 MZM85 P II (3 P 0) Limit 84580.83 MZM85

Energy Levels of Neutral Silicon (Si I)

Energy Levels of Neutral Silicon (Si I)

Configuration Term J Level(cm -1) Ref. 3 s 2 3 p 2 3 P 0 0.000 MKMD94 3 s 2 3 p 2 3 P 1 77.112 MKMD94 3 s 2 3 p 2 3 P 2 223.157 MKMD94 3 s 2 3 p 2 1 D 2 6298.847 MKMD94 3 s 2 3 p 2 1 S 0 15394.362 MKMD94 3 s 3 p 3 5 S° 2 33326.040 MKMD94 3 s 2 3 p 4 s 3 P° 0 39683.158 MKMD94 3 s 2 3 p 4 s 3 P° 1 39760.285 MKMD94 3 s 2 3 p 4 s 3 P° 2 39955.051 MKMD94 3 s 2 3 p 4 s 1 P° 1 40991.888 MKMD94 3 s 3 p 3 3 D° 1 45276.187 MKMD94 3 s 3 p 3 3 D° 2 45293.623 MKMD94 3 s 3 p 3 3 D° 3 45321.848 MKMD94 3 s 2 3 p 4 p 1 P 1 47284.057 MKMD94 3 s 2 3 p 3 d 1 D° 2 47351.553 MKMD94 3 s 2 3 p 4 p 3 D 1 48020.074 MKMD94 3 s 2 3 p 4 p 3 D 2 48102.321 MKMD94 3 s 2 3 p 4 p 3 D 3 48264.290 MKMD94 3 s 2 3 p 4 p 3 P 0 49028.291 MKMD94 3 s 2 3 p 4 p 3 P 1 49060.599 MKMD94 3 s 2 3 p 4 p 3 P 2 49188.615 MKMD94 3 s 2 3 p 4 p 3 S 1 49399.669 MKMD94 3 s 2 3 p 3 d 3 F° 2 49850.832 MKMD94 3 s 2 3 p 3 d 3 F° 3 49933.783 MKMD94 3 s 2 3 p 3 d 3 F° 4 50054.811 MKMD94 3 s 2 3 p 4 p 1 D 2 50189.391 MKMD94 3 s 2 3 p 3 d 3 P° 2 50499.843 MKMD94 3 s 2 3 p 3 d 3 P° 1 50566.414 MKMD94 3 s 2 3 p 3 d 3 P° 0 50602.435 MKMD94 3 s 2 3 p 4 p 1 S 0 51612.009 MKMD94 3 s 2 3 p 3 d 1 F° 3 53362.258 MKMD94 3 s 2 3 p 3 d 1 P° 1 53387.342 MKMD94 3 s 2 3 p 3 d 3 D° 1 54185.257 MKMD94 3 s 2 3 p 3 d 3 D° 2 54205.083 MKMD94 3 s 2 3 p 3 d 3 D° 3 54257.574 MKMD94 3 s 2 3 p 5 s 3 P° 0 54245.021 MKMD94 3 s 2 3 p 5 s 3 P° 1 54313.817 MKMD94 3 s 2 3 p 5 s 3 P° 2 54528.218 MKMD94 3 s 2 3 p 5 s 1 P° 1 54871.027 MKMD94 3 s 2 3 p 4 d 1 D° 2 56503.348 MKMD94 3 s 2 3 p 4 d 3 P° 2 56690.902 MKMD94 3 s 2 3 p 4 d 3 P° 1 56700.225 MKMD94 3 s 2 3 p 4 d 3 P° 0 56733.370 MKMD94 3 s 2 3 p 5 p 1 P 1 56780.429 MKMD94 3 s 2 3 p 5 p 3 D 1 56978.251 MKMD94 3 s 2 3 p 5 p 3 D 2 57017.502 MKMD94 3 s 2 3 p 5 p 3 D 3 57198.013 MKMD94 3 s 2 3 p 5 p 3 P 0 57295.880 MKMD94 3 s 2 3 p 5 p 3 P 1 57328.785 MKMD94 3 s 2 3 p 5 p 3 P 2 57468.244 MKMD94 3 s 2 3 p 4 d 3 F° 2 57372.302 MKMD94 3 s 2 3 p 4 d 3 F° 3 57450.583 MKMD94 3 s 2 3 p 4 d 3 F° 4 57583.657 MKMD94 3 s 2 3 p 5 p 3 S 1 57541.915 MKMD94 3 s 2 3 p 5 p 1 D 2 57798.080 MKMD94 3 s 2 3 p 5 p 1 S 0 58311.667 MKMD94 3 s 2 3 p (2 P° 1 / 2)4 f 2 [5 / 2] 3 58774.365 MKMD94 3 s 2 3 p (2 P° 1 / 2)4 f 2 [5 / 2] 2 58775.442 MKMD94 3 s 2 3 p (2 P° 1 / 2)4 f 2 [7 / 2] 3 58786.852 MKMD94 3 s 2 3 p (2 P° 1 / 2)4 f 2 [7 / 2] 4 58788.878 MKMD94 3 s 2 3 p 4 d 1 P° 1 58801.525 MKMD94 3 s 2 3 p 4 d 1 F° 3 58893.362 MKMD94 3 s 2 3 p 4 d 3 D° 2 59032.174 MKMD94 3 s 2 3 p 4 d 3 D° 1 59056.494 MKMD94 3 s 2 3 p 4 d 3 D° 3 59117.991 MKMD94 3 s 2 3 p (2 P° 3 / 2)4 f 2 [7 / 2] 3 59034.988 MKMD94 3 s 2 3 p (2 P° 3 / 2)4 f 2 [7 / 2] 4 59037.043 MKMD94 3 s 2 3 p (2 P° 3 / 2)4 f 2 [5 / 2] 3 59109.956 MKMD94 3 s 2 3 p (2 P° 3 / 2)4 f 2 [5 / 2] 2 59110.890 MKMD94 3 s 2 3 p (2 P° 3 / 2)4 f 2 [9 / 2] 5 59128.407 MKMD94 3 s 2 3 p (2 P° 3 / 2)4 f 2 [9 / 2] 4 59131.908 MKMD94 3 s 2 3 p (2 P° 3 / 2)4 f 2 [3 / 2] 1 59190.444 MKMD94 3 s 2 3 p (2 P° 3 / 2)4 f 2 [3 / 2] 2 59191.066 MKMD94 Si II (2 P° 1 / 2) Limit 65747.76 MKMD94

Energy Levels of Neutral Sulfur (S I)

Energy Levels of Neutral Sulfur (S I)

Configuration Term J Level(cm -1) Ref. 3 s 2 3 p 4 3 P 2 0.000 MZM90 3 s 2 3 p 4 3 P 1 396.055 MZM90 3 s 2 3 p 4 3 P 0 573.640 MZM90 3 s 2 3 p 4 1 D 2 9238.609 MZM90 3 s 2 3 p 4 1 S 0 22179.954 MZM90 3 s 2 3 p 3 (4 S°)4 s 5 S° 2 52623.640 MZM90 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 55330.811 MZM90 3 s 2 3 p 3 (4 S°)4 p 5 P 1 63446.065 MZM90 3 s 2 3 p 3 (4 S°)4 p 5 P 2 63457.142 MZM90 3 s 2 3 p 3 (4 S°)4 p 5 P 3 63475.051 MZM90 3 s 2 3 p 3 (4 S°)4 p 3 P 1 64888.964 MZM90 3 s 2 3 p 3 (4 S°)4 p 3 P 0 64891.386 MZM90 3 s 2 3 p 3 (4 S°)4 p 3 P 2 64892.582 MZM90 3 s 2 3 p 3 (2 D°)4 s 3 D° 1 67816.351 MZM90 3 s 2 3 p 3 (2 D°)4 s 3 D° 2 67825.188 MZM90 3 s 2 3 p 3 (2 D°)4 s 3 D° 3 67842.867 MZM90 3 s 2 3 p 3 (4 S°)3 d 5 D° 4 67877.635 MZM90 3 s 2 3 p 3 (4 S°)3 d 5 D° 0 67884.158 MZM90 3 s 2 3 p 3 (4 S°)3 d 5 D° 1 67885.535 MZM90 3 s 2 3 p 3 (4 S°)3 d 5 D° 2 67887.805 MZM90 3 s 2 3 p 3 (4 S°)3 d 5 D° 3 67890.016 MZM90 3 s 2 3 p 3 (2 D°)4 s 1 D° 2 69237.886 MZM90 3 s 2 3 p 3 (4 S°)3 d 3 D° 1 70164.650 MZM90 3 s 2 3 p 3 (4 S°)3 d 3 D° 2 70166.195 MZM90 3 s 2 3 p 3 (4 S°)3 d 3 D° 3 70173.968 MZM90 3 s 2 3 p 3 (4 S°)5 s 5 S° 2 70702.790 MZM90 3 s 2 3 p 3 (4 S°)5 s 3 S° 1 71351.399 MZM90 3 s 3 p 5 3 P° 2 72023.495 MZM90 3 s 3 p 5 3 P° 1 72382.328 MZM90 3 s 3 p 5 3 P° 0 72571.630 MZM90 3 s 2 3 p 3 (4 S°)5 p 5 P 1 73911.259 MZM90 3 s 2 3 p 3 (4 S°)5 p 5 P 2 73914.928 MZM90 3 s 2 3 p 3 (4 S°)5 p 5 P 3 73920.961 MZM90 3 s 2 3 p 3 (4 S°)5 p 3 P 2 74268.547 MZM90 3 s 2 3 p 3 (4 S°)5 p 3 P 1 74269.600 MZM90 3 s 2 3 p 3 (4 S°)5 p 3 P 0 74271.651 MZM90 3 s 2 3 p 3 (4 S°)4 d 5 D° 4 74973.14 MZM90 3 s 2 3 p 3 (4 S°)4 d 5 D° 3 74974.10 MZM90 3 s 2 3 p 3 (4 S°)4 d 5 D° 2 74975.19 MZM90 3 s 2 3 p 3 (4 S°)4 d 5 D° 1 74976.06 MZM90 3 s 2 3 p 3 (4 S°)4 d 5 D° 0 74976.61 MZM90 3 s 2 3 p 3 (4 S°)4 d 3 D° 1 75951.95 MZM90 3 s 2 3 p 3 (4 S°)4 d 3 D° 2 75952.35 MZM90 3 s 2 3 p 3 (4 S°)4 d 3 D° 3 75956.53 MZM90 3 s 2 3 p 3 (4 S°)6 s 5 S° 2 76464.06 MZM90 3 s 2 3 p 3 (4 S°)4 f 5 F 4 76654.767 MZM90 3 s 2 3 p 3 (4 S°)4 f 5 F 5 76654.769 MZM90 3 s 2 3 p 3 (4 S°)4 f 5 F 3 76654.794 MZM90 3 s 2 3 p 3 (4 S°)4 f 5 F 2 76654.811 MZM90 3 s 2 3 p 3 (4 S°)4 f 5 F 1 76654.847 MZM90 3 s 2 3 p 3 (4 S°)4 f 3 F 4 76656.324 MZM90 3 s 2 3 p 3 (4 S°)4 f 3 F 3 76656.330 MZM90 3 s 2 3 p 3 (4 S°)4 f 3 F 2 76656.358 MZM90 3 s 2 3 p 3 (4 S°)6 s 3 S° 1 76720.65 MZM90 3 s 2 3 p 3 (2 P°)4 s 3 P° 0 77135.52 MZM90 3 s 2 3 p 3 (2 P°)4 s 3 P° 1 77150.14 MZM90 3 s 2 3 p 3 (2 P°)4 s 3 P° 2 77181.15 MZM90 3 s 2 3 p 3 (2 D°)4 p 1 P 1 77854.906 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 D 2 78152.071 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 D 1 78152.336 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 D 3 78203.180 MZM90 3 s 2 3 p 3 (2 P°)4 s 1 P° 1 78288.44 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 F 2 78409.89 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 F 3 78435.81 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 F 4 78463.04 MZM90 3 s 2 3 p 3 (2 D°)4 p 1 F 3 78639.923 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 P 2 79375.80 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 P 1 79405.30 MZM90 3 s 2 3 p 3 (2 D°)4 p 3 P 0 79418.01 MZM90 3 s 2 3 p 3 (2 D°)3 d 1 P° 1 81438.30 MZM90 S II (4 S° 3 / 2) Limit 83559.1 MZM90

Energy Levels of Neutral Calcium (Ca I)

Energy Levels of Neutral Calcium (Ca I)

Configuration Term J Level(cm -1) Ref. 4 s 2 1 S 0 0.000 SC85 4 s 4 p 3 P° 0 15157.901 SC85 4 s 4 p 3 P° 1 15210.063 SC85 4 s 4 p 3 P° 2 15315.943 SC85 3 d 4 s 3 D 1 20335.360 SC85 3 d 4 s 3 D 2 20349.260 SC85 3 d 4 s 3 D 3 20371.000 SC85 3 d 4 s 1 D 2 21849.634 SC85 4 s 4 p 1 P° 1 23652.304 SC85 4 s 5 s 3 S 1 31539.495 SC85 4 s 5 s 1 S 0 33317.264 SC85 3 d 4 p 3 F° 2 35730.454 SC85 3 d 4 p 3 F° 3 35818.713 SC85 3 d 4 p 3 F° 4 35896.889 SC85 3 d 4 p 1 D° 2 35835.413 SC85 4 s 5 p 3 P° 0 36547.688 SC85 4 s 5 p 3 P° 1 36554.749 SC85 4 s 5 p 3 P° 2 36575.119 SC85 4 s 5 p 1 P° 1 36731.615 SC85 4 s 4 d 1 D 2 37298.287 SC85 4 s 4 d 3 D 1 37748.197 SC85 4 s 4 d 3 D 2 37751.867 SC85 4 s 4 d 3 D 3 37757.449 SC85 3 d 4 p 3 D° 1 38192.392 SC85 3 d 4 p 3 D° 2 38219.118 SC85 3 d 4 p 3 D° 3 38259.124 SC85 4 p 2 3 P 0 38417.543 SC85 4 p 2 3 P 1 38464.808 SC85 4 p 2 3 P 2 38551.558 SC85 Ca II (2 S 1 / 2) Limit 49305.95 SC85

Energy Levels of Neutral Chromium (Cr I)

Energy Levels of Neutral Chromium (Cr I)

Configuration Term J Level(cm -1) Ref. 3 d 5 (6 S)4 s a 7 S 3 0.00 SC85 3 d 5 (6 S)4 s a 5 S 2 7593.16 SC85 3 d 4 4 s 2 a 5 D 0 7750.78 SC85 3 d 4 4 s 2 a 5 D 1 7810.82 SC85 3 d 4 4 s 2 a 5 D 2 7927.47 SC85 3 d 4 4 s 2 a 5 D 3 8095.21 SC85 3 d 4 4 s 2 a 5 D 4 8307.57 SC85 3 d 5 (4 G)4 s a 5 G 2 20517.40 SC85 3 d 5 (4 G)4 s a 5 G 6 20519.60 SC85 3 d 5 (4 G)4 s a 5 G 3 20520.92 SC85 3 d 5 (4 G)4 s a 5 G 4 20523.69 SC85 3 d 5 (4 G)4 s a 5 G 5 20523.94 SC85 3 d 5 (4 P)4 s a 5 P 3 21840.84 SC85 3 d 5 (4 P)4 s a 5 P 2 21847.88 SC85 3 d 5 (4 P)4 s a 5 P 1 21856.94 SC85 3 d 4 4 s 2 a 3 P 0 23163.27 SC85 3 d 4 4 s 2 a 3 P 1 23512.00 SC85 3 d 4 4 s 2 a 3 P 2 24093.16 SC85 3 d 5 (6 S)4 p z 7 P° 2 23305.01 SC85 3 d 5 (6 S)4 p z 7 P° 3 23386.35 SC85 3 d 5 (6 S)4 p z 7 P° 4 23498.84 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 F° 0 24971.21 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 F° 1 25010.64 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 F° 2 25089.20 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 F° 3 25206.02 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 F° 4 25359.62 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 F° 5 25548.64 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 F° 6 25771.40 SC85 3 d 5 (6 S)4 p z 5 P° 3 26787.50 SC85 3 d 5 (6 S)4 p z 5 P° 2 26796.28 SC85 3 d 5 (6 S)4 p z 5 P° 1 26801.93 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 D° 1 27300.19 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 D° 2 27382.18 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 D° 3 27500.37 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 D° 4 27649.71 SC85 3 d 4 (5 D)4 s 4 p (3 P°) z 7 D° 5 27825.45 SC85 3 d 4 (5 D)4 s 4 p (3 P°) y 7 P° 2 27728.87 SC85 3 d 4 (5 D)4 s 4 p (3 P°) y 7 P° 3 27820.23 SC85 3 d 4 (5 D)4 s 4 p (3 P°) y 7 P° 4 27935.26 SC85 Cr II (6 S 5 / 2) Limit 54575.6 SC85

Energy Levels of Neutral Manganese (Mn I)

Energy Levels of Neutral Manganese (Mn I)

Configuration Term J Level(cm -1) Ref. 3 d 5 4 s 2 a 6 S 5 / 2 0.00 SC85 3 d 6 (5 D)4 s a 6 D 9 / 2 17052.29 SC85 3 d 6 (5 D)4 s a 6 D 7 / 2 17282.00 SC85 3 d 6 (5 D)4 s a 6 D 5 / 2 17451.52 SC85 3 d 6 (5 D)4 s a 6 D 3 / 2 17568.48 SC85 3 d 6 (5 D)4 s a 6 D 1 / 2 17637.15 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 8 P° 5 / 2 18402.46 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 8 P° 7 / 2 18531.64 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 8 P° 9 / 2 18705.37 SC85 3 d 6 (5 D)4 s a 4 D 7 / 2 23296.67 SC85 3 d 6 (5 D)4 s a 4 D 5 / 2 23549.20 SC85 3 d 6 (5 D)4 s a 4 D 3 / 2 23719.52 SC85 3 d 6 (5 D)4 s a 4 D 1 / 2 23818.87 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 6 P° 3 / 2 24779.32 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 6 P° 5 / 2 24788.05 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 6 P° 7 / 2 24802.25 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 4 P° 5 / 2 31001.15 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 4 P° 3 / 2 31076.42 SC85 3 d 5 (6 S)4 s 4 p (3 P°) z 4 P° 1 / 2 31124.95 SC85 3 d 5 (6 S)4 s 4 p (1 P°) y 6 P° 3 / 2 35689.98 SC85 3 d 5 (6 S)4 s 4 p (1 P°) y 6 P° 5 / 2 35725.85 SC85 3 d 5 (6 S)4 s 4 p (1 P°) y 6 P° 7 / 2 35769.97 SC85 3 d 6 (5 D)4 p z 6 D° 9 / 2 41789.48 SC85 3 d 6 (5 D)4 p z 6 D° 7 / 2 41932.64 SC85 3 d 6 (5 D)4 p z 6 D° 5 / 2 42053.73 SC85 3 d 6 (5 D)4 p z 6 D° 3 / 2 42143.57 SC85 3 d 6 (5 D)4 p z 6 D° 1 / 2 42198.56 SC85 3 d 6 (5 D)4 p z 6 F° 1 1 / 2 43314.23 SC85 3 d 6 (5 D)4 p z 6 F° 9 / 2 43428.58 SC85 3 d 6 (5 D)4 p z 6 F° 7 / 2 43524.08 SC85 3 d 6 (5 D)4 p z 6 F° 5 / 2 43595.50 SC85 3 d 6 (5 D)4 p z 6 F° 3 / 2 43644.45 SC85 3 d 6 (5 D)4 p z 6 F° 1 / 2 43672.66 SC85 3 d 5 (4 P)4 s 4 p (3 P°) v 6 P° 7 / 2 49888.01 SC85 3 d 5 (4 P)4 s 4 p (3 P°) v 6 P° 5 / 2 50012.50 SC85 3 d 5 (4 P)4 s 4 p (3 P°) v 6 P° 3 / 2 50099.03 SC85 Mn II (7 S 3) Limit 59959.4 SC85

Energy Levels of Neutral Potassium (K I)

Energy Levels of Neutral Potassium (K I)

Configuration Term J Level(cm -1) Ref. 4 s 2 S 1 / 2 0.000 E99 4 p 2 P° 1 / 2 12985.186 E99 4 p 2 P° 3 / 2 13042.896 E99 3 d 2 D 5 / 2 21534.700 SC85 3 d 2 D 3 / 2 21537.004 SC85 5 p 2 P° 1 / 2 24701.382 SC85 5 p 2 P° 3 / 2 24720.139 SC85 K II (1 S 0) Limit 35009.8140 SC85

Energy Levels of Neutral Scandium (Sc I)

Energy Levels of Neutral Scandium (Sc I)

Configuration Term J Level(cm -1) Ref. 3 d 4 s 2 2 D 3 / 2 0.00 SC85 3 d 4 s 2 2 D 5 / 2 168.34 SC85 3 d 2 (3 F)4 s 4 F 3 / 2 11519.99 SC85 3 d 2 (3 F)4 s 4 F 5 / 2 11557.69 SC85 3 d 2 (3 F)4 s 4 F 7 / 2 11610.28 SC85 3 d 2 (3 F)4 s 4 F 9 / 2 11677.38 SC85 3 d 2 (3 F)4 s 2 F 5 / 2 14926.07 SC85 3 d 2 (3 F)4 s 2 F 7 / 2 15041.92 SC85 3 d 4 s (3 D)4 p 4 F° 3 / 2 15672.58 SC85 3 d 4 s (3 D)4 p 4 F° 5 / 2 15756.57 SC85 3 d 4 s (3 D)4 p 4 F° 7 / 2 15881.75 SC85 3 d 4 s (3 D)4 p 4 F° 9 / 2 16026.62 SC85 3 d 4 s (3 D)4 p 4 D° 1 / 2 16009.77 SC85 3 d 4 s (3 D)4 p 4 D° 3 / 2 16021.82 SC85 3 d 4 s (3 D)4 p 4 D° 5 / 2 16141.06 SC85 3 d 4 s (3 D)4 p 4 D° 7 / 2 16210.85 SC85 3 d 4 s (1 D)4 p 2 D° 5 / 2 16022.73 SC85 3 d 4 s (1 D)4 p 2 D° 3 / 2 16096.90 SC85 3 d 4 s (3 D)4 p 4 P° 1 / 2 18504.06 SC85 3 d 4 s (3 D)4 p 4 P° 3 / 2 18515.69 SC85 3 d 4 s (3 D)4 p 4 P° 5 / 2 18571.41 SC85 4 s 2 4 p 2 P° 1 / 2 18711.02 SC85 4 s 2 4 p 2 P° 3 / 2 18855.74 SC85 3 d 4 s (1 D)4 p 2 F° 5 / 2 21032.75 SC85 3 d 4 s (1 D)4 p 2 F° 7 / 2 21085.85 SC85 3 d 4 s (1 D)4 p 2 P° 1 / 2 24656.72 SC85 3 d 4 s (1 D)4 p 2 P° 3 / 2 24656.88 SC85 3 d 4 s (3 D)4 p 2 D° 3 / 2 24866.17 SC85 3 d 4 s (3 D)4 p 2 D° 5 / 2 25014.21 SC85 3 d 4 s (3 D)4 p 2 F° 5 / 2 25584.64 SC85 3 d 4 s (3 D)4 p 2 F° 7 / 2 25724.68 SC85 3 d 2 (3 F)4 p 4 G° 5 / 2 29022.82 SC85 3 d 2 (3 F)4 p 4 G° 7 / 2 29096.18 SC85 3 d 2 (3 F)4 p 4 G° 9 / 2 29189.84 SC85 3 d 2 (3 F)4 p 4 G° 1 1 / 2 29303.51 SC85 3 d 4 s (3 D)4 p 2 P° 1 / 2 30573.17 SC85 3 d 4 s (3 D)4 p 2 P° 3 / 2 30706.66 SC85 Sc II (3 D 1) Limit 52922.0 SC85

Energy Levels of Neutral Titanium (Ti I)

Energy Levels of Neutral Titanium (Ti I)

Configuration Term J Level(cm -1) Ref. 3 d 2 4 s 2 a 3 F 2 0.000 F91 3 d 2 4 s 2 a 3 F 3 170.134 F91 3 d 2 4 s 2 a 3 F 4 386.875 F91 3 d 3 (4 F)4 s a 5 F 1 6556.833 F91 3 d 3 (4 F)4 s a 5 F 2 6598.764 F91 3 d 3 (4 F)4 s a 5 F 3 6661.004 F91 3 d 3 (4 F)4 s a 5 F 4 6742.755 F91 3 d 3 (4 F)4 s a 5 F 5 6842.965 F91 3 d 2 4 s 2 a 1 D 2 7255.354 F91 3 d 2 4 s 2 a 3 P 0 8436.617 F91 3 d 2 4 s 2 a 3 P 1 8492.421 F91 3 d 2 4 s 2 a 3 P 2 8602.342 F91 3 d 3 (4 F)4 s b 3 F 2 11531.759 F91 3 d 3 (4 F)4 s b 3 F 3 11639.810 F91 3 d 3 (4 F)4 s b 3 F 4 11776.811 F91 3 d 2 4 s 2 a 1 G 4 12118.394 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 G° 2 15877.080 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 G° 3 15975.630 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 G° 4 16106.075 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 G° 5 16267.481 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 G° 6 16458.672 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 F° 1 16817.160 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 F° 2 16875.121 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 F° 3 16961.441 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 F° 4 17075.258 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 F° 5 17215.389 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 D° 0 18462.721 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 D° 1 18482.772 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 D° 2 18525.059 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 D° 3 18593.946 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 5 D° 4 18695.133 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 F° 2 19322.984 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 F° 3 19421.580 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 F° 4 19573.973 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 D° 1 19937.852 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 D° 2 20006.042 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 D° 3 20126.060 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 G° 3 21469.487 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 G° 4 21588.494 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 3 G° 5 21739.707 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 1 D° 2 22081.187 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 1 F° 3 22404.740 F91 3 d 2 (3 F)4 s 4 p (3 P°) z 1 G° 4 24694.892 F91 3 d 2 (3 P)4 s 4 p (3 P°) z 3 S° 1 24921.115 F91 3 d 2 (3 P)4 s 4 p (3 P°) z 5 S° 2 25102.874 F91 3 d 2 (3 F)4 s 4 p (1 P°) y 3 F° 2 25107.410 F91 3 d 2 (3 F)4 s 4 p (1 P°) y 3 F° 3 25227.220 F91 3 d 2 (3 F)4 s 4 p (1 P°) y 3 F° 4 25388.331 F91 3 d 3 (4 F)4 p y 3 D° 1 25317.815 F91 3 d 3 (4 F)4 p y 3 D° 2 25438.906 F91 3 d 3 (4 F)4 p y 3 D° 3 25643.699 F91 3 d 2 (1 D)4 s 4 p (3 P°) z 3 P° 2 25493.734 F91 3 d 2 (1 D)4 s 4 p (3 P°) z 3 P° 1 25537.284 F91 3 d 2 (1 D)4 s 4 p (3 P°) z 3 P° 0 25574.909 F91 3 d 2 (3 P)4 s 4 p (3 P°) y 5 D° 0 25612.387 F91 3 d 2 (3 P)4 s 4 p (3 P°) y 5 D° 1 25635.723 F91 3 d 2 (3 P)4 s 4 p (3 P°) y 5 D° 2 25699.984 F91 3 d 2 (3 P)4 s 4 p (3 P°) y 5 D° 3 25797.594 F91 3 d 2 (3 P)4 s 4 p (3 P°) y 5 D° 4 25926.766 F91 3 d 3 (4 F)4 p y 5 G° 2 26494.330 F91 3 d 3 (4 F)4 p y 5 G° 3 26564.398 F91 3 d 3 (4 F)4 p y 5 G° 4 26657.416 F91 3 d 3 (4 F)4 p y 5 G° 5 26772.969 F91 3 d 3 (4 F)4 p y 5 G° 6 26910.712 F91 3 d 2 (1 D)4 s 4 p (3 P°) x 3 F° 2 26803.420 F91 3 d 2 (1 D)4 s 4 p (3 P°) x 3 F° 3 26892.935 F91 3 d 2 (1 D)4 s 4 p (3 P°) x 3 F° 4 27025.658 F91 3 d 2 (1 D)4 s 4 p (3 P°) x 3 D° 1 27355.059 F91 3 d 2 (1 D)4 s 4 p (3 P°) x 3 D° 2 27418.030 F91 3 d 2 (1 D)4 s 4 p (3 P°) x 3 D° 3 27480.066 F91 3 d 2 (3 F)4 s 4 p (1 P°) y 3 G° 3 27498.983 F91 3 d 2 (3 F)4 s 4 p (1 P°) y 3 G° 4 27614.678 F91 3 d 2 (3 F)4 s 4 p (1 P°) y 3 G° 5 27750.136 F91 3 d 3 (4 F)4 p x 5 D° 0 29829.111 F91 3 d 3 (4 F)4 p x 5 D° 1 29855.255 F91 3 d 3 (4 F)4 p x 5 D° 2 29907.286 F91 3 d 3 (4 F)4 p x 5 D° 3 29986.197 F91 3 d 3 (4 F)4 p x 5 D° 4 30060.338 F91 Ti II (4 F 3 / 2) Limit 55072.5 SZK90

Energy Levels of Neutral Vanadium (V I)

Energy Levels of Neutral Vanadium (V I)

Configuration Term J Level(cm -1) Ref. 3 d 3 4 s 2 a 4 F 3 / 2 0.00 DA78 3 d 3 4 s 2 a 4 F 5 / 2 137.38 DA78 3 d 3 4 s 2 a 4 F 7 / 2 323.46 DA78 3 d 3 4 s 2 a 4 F 9 / 2 552.96 DA78 3 d 4 (5 D)4 s a 6 D 1 / 2 2112.28 DA78 3 d 4 (5 D)4 s a 6 D 3 / 2 2153.21 DA78 3 d 4 (5 D)4 s a 6 D 5 / 2 2220.11 DA78 3 d 4 (5 D)4 s a 6 D 7 / 2 2311.36 DA78 3 d 4 (5 D)4 s a 6 D 9 / 2 2424.78 DA78 3 d 4 (5 D)4 s a 4 D 1 / 2 8413.00 DA78 3 d 4 (5 D)4 s a 4 D 3 / 2 8476.23 DA78 3 d 4 (5 D)4 s a 4 D 5 / 2 8578.53 DA78 3 d 4 (5 D)4 s a 4 D 7 / 2 8715.76 DA78 3 d 3 4 s 2 a 4 P 1 / 2 9544.63 DA78 3 d 3 4 s 2 a 4 P 3 / 2 9637.03 DA78 3 d 3 4 s 2 a 4 P 5 / 2 9824.61 DA78 3 d 4 (5 D)4 p z 6 P° 3 / 2 24648.11 DA78 3 d 4 (5 D)4 p z 6 P° 5 / 2 24727.86 DA78 3 d 4 (5 D)4 p z 6 P° 7 / 2 24838.55 DA78 3 d 4 (5 D)4 p z 4 P° 1 / 2 24770.68 DA78 3 d 4 (5 D)4 p z 4 P° 3 / 2 24915.14 DA78 3 d 4 (5 D)4 p z 4 P° 5 / 2 25131.00 DA78 3 d 4 (5 D)4 p y 6 F° 1 / 2 24789.38 DA78 3 d 4 (5 D)4 p y 6 F° 3 / 2 24830.23 DA78 3 d 4 (5 D)4 p y 6 F° 5 / 2 24898.77 DA78 3 d 4 (5 D)4 p y 6 F° 7 / 2 24992.88 DA78 3 d 4 (5 D)4 p y 6 F° 9 / 2 25111.47 DA78 3 d 4 (5 D)4 p y 6 F° 1 1 / 2 25253.43 DA78 3 d 4 (5 D)4 p y 4 F° 3 / 2 25930.55 DA78 3 d 4 (5 D)4 p y 4 F° 5 / 2 26004.23 DA78 3 d 4 (5 D)4 p y 4 F° 7 / 2 26122.08 DA78 3 d 4 (5 D)4 p y 4 F° 9 / 2 26171.92 DA78 3 d 4 (5 D)4 p y 4 D° 1 / 2 26182.63 DA78 3 d 4 (5 D)4 p y 4 D° 3 / 2 26249.48 DA78 3 d 4 (5 D)4 p y 4 D° 5 / 2 26352.65 DA78 3 d 4 (5 D)4 p y 4 D° 7 / 2 26480.29 DA78 3 d 4 (5 D)4 p y 6 D° 1 / 2 26397.54 DA78 3 d 4 (5 D)4 p y 6 D° 3 / 2 26437.64 DA78 3 d 4 (5 D)4 p y 6 D° 5 / 2 26505.93 DA78 3 d 4 (5 D)4 p y 6 D° 7 / 2 26604.80 DA78 3 d 4 (5 D)4 p y 6 D° 9 / 2 26738.32 DA78 3 d 3 (4 P)4 s 4 p (3 P°) y 6 P° 3 / 2 29202.75 DA78 3 d 3 (4 P)4 s 4 p (3 P°) y 6 P° 5 / 2 29296.38 DA78 3 d 3 (4 P)4 s 4 p (3 P°) y 6 P° 7 / 2 29418.07 DA78 3 d 3 (2 G)4 s 4 p (3 P°) x 4 F° 3 / 2 31200.15 DA78 3 d 3 (2 G)4 s 4 p (3 P°) x 4 F° 5 / 2 31229.03 DA78 3 d 3 (2 G)4 s 4 p (3 P°) x 4 F° 7 / 2 31268.11 DA78 3 d 3 (2 G)4 s 4 p (3 P°) x 4 F° 9 / 2 31317.44 DA78 3 d 3 (4 F)4 s 4 p (1 P°) x 4 G° 5 / 2 31397.83 DA78 3 d 3 (4 F)4 s 4 p (1 P°) x 4 G° 7 / 2 31541.15 DA78 3 d 3 (4 F)4 s 4 p (1 P°) x 4 G° 9 / 2 31721.71 DA78 3 d 3 (4 F)4 s 4 p (1 P°) x 4 G° 1 1 / 2 31937.27 DA78 V II (5 D 0) Limit 54411.7 JKLC94

Energy Levels of Neutral Arsenic (As I)

Energy Levels of Neutral Arsenic (As I)

Configuration Term J Level(cm -1) Ref. 4 p 3 4 S° 3 / 2 0.000 HA85 4 p 3 2 D° 3 / 2 10592.666 HA85 4 p 3 2 D° 5 / 2 10914.866 HA85 4 p 3 2 P° 1 / 2 18186.328 HA85 4 p 3 2 P° 3 / 2 18647.663 HA85 4 p 2 (3 P)5 s 4 P 1 / 2 50693.897 HA85 4 p 2 (3 P)5 s 4 P 3 / 2 51610.393 HA85 4 p 2 (3 P)5 s 4 P 5 / 2 52898.056 HA85 4 p 2 (3 P)5 s 2 P 1 / 2 53135.750 HA85 4 p 2 (3 P)5 s 2 P 3 / 2 54605.491 HA85 4 p 2 (1 D)5 s 2 D 5 / 2 60815.218 HA85 4 p 2 (1 D)5 s 2 D 3 / 2 60834.954 HA85 As II (3 P 0) Limit 78950 BJ71

Energy Levels of Neutral Cobalt (Co I)

Energy Levels of Neutral Cobalt (Co I)

Configuration Term J Level(cm -1) Ref. 3 d 7 4 s 2 a 4 F 9 / 2 0.000 PT96 3 d 7 4 s 2 a 4 F 7 / 2 816.000 PT96 3 d 7 4 s 2 a 4 F 5 / 2 1406.852 PT96 3 d 7 4 s 2 a 4 F 3 / 2 1809.313 PT96 3 d 8 (3 F)4 s b 4 F 9 / 2 3482.780 PT96 3 d 8 (3 F)4 s b 4 F 7 / 2 4142.631 PT96 3 d 8 (3 F)4 s b 4 F 5 / 2 4690.141 PT96 3 d 8 (3 F)4 s b 4 F 3 / 2 5075.788 PT96 3 d 8 (3 F)4 s a 2 F 7 / 2 7442.399 PT96 3 d 8 (3 F)4 s a 2 F 5 / 2 8460.783 PT96 3 d 7 4 s 2 a 4 P 5 / 2 13795.491 PT96 3 d 7 4 s 2 a 4 P 3 / 2 14036.241 PT96 3 d 7 4 s 2 a 4 P 1 / 2 14399.220 PT96 3 d 8 (3 P)4 s b 4 P 5 / 2 15184.013 PT96 3 d 8 (3 P)4 s b 4 P 3 / 2 15774.009 PT96 3 d 8 (3 P)4 s b 4 P 1 / 2 16195.610 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 F° 9 / 2 28345.814 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 F° 7 / 2 28777.236 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 F° 5 / 2 29216.332 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 F° 3 / 2 29563.111 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 G° 1 1 / 2 28845.165 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 G° 9 / 2 29269.675 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 G° 7 / 2 29735.131 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 G° 5 / 2 30102.912 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 D° 7 / 2 29294.482 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 D° 5 / 2 29948.730 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 D° 3 / 2 30443.596 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 4 D° 1 / 2 30742.605 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 2 G° 9 / 2 31699.638 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 2 G° 7 / 2 32733.008 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 2 F° 7 / 2 31871.118 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 2 F° 5 / 2 32781.672 PT96 3 d 8 (3 F)4 p y 4 D° 7 / 2 32027.440 PT96 3 d 8 (3 F)4 p y 4 D° 5 / 2 32654.463 PT96 3 d 8 (3 F)4 p y 4 D° 3 / 2 33150.616 PT96 3 d 8 (3 F)4 p y 4 D° 1 / 2 33449.086 PT96 3 d 8 (3 F)4 p y 4 G° 1 1 / 2 32430.535 PT96 3 d 8 (3 F)4 p y 4 G° 9 / 2 32464.688 PT96 3 d 8 (3 F)4 p y 4 G° 7 / 2 33466.823 PT96 3 d 8 (3 F)4 p y 4 G° 5 / 2 33674.326 PT96 3 d 8 (3 F)4 p y 4 F° 9 / 2 32841.916 PT96 3 d 8 (3 F)4 p y 4 F° 7 / 2 33173.313 PT96 3 d 8 (3 F)4 p y 4 F° 5 / 2 33945.846 PT96 3 d 8 (3 F)4 p y 4 F° 3 / 2 34196.147 PT96 3 d 8 (3 F)4 p y 2 G° 9 / 2 33439.661 PT96 3 d 8 (3 F)4 p y 2 G° 7 / 2 34133.537 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 2 D° 5 / 2 33462.795 PT96 3 d 7 (4 F)4 s 4 p (3 P°) z 2 D° 3 / 2 34352.358 PT96 3 d 8 (3 F)4 p y 2 F° 7 / 2 35450.505 PT96 3 d 8 (3 F)4 p y 2 F° 5 / 2 36329.834 PT96 3 d 8 (3 F)4 p y 2 D° 5 / 2 36092.420 PT96 3 d 8 (3 F)4 p y 2 D° 3 / 2 36875.089 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 D° 7 / 2 39649.124 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 D° 5 / 2 40345.908 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 D° 3 / 2 40827.712 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 D° 1 / 2 41101.756 PT96 3 d 7 (4 P)4 s 4 p (3 P°) z 4 S° 3 / 2 40621.588 PT96 3 d 7 (4 P)4 s 4 p (3 P°) 6 P° 7 / 2 41041.348 PT96 3 d 7 (4 P)4 s 4 p (3 P°) 6 P° 5 / 2 41104.912 PT96 3 d 7 (4 P)4 s 4 p (3 P°) 6 P° 3 / 2 41247.585 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 F° 9 / 2 41225.710 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 F° 7 / 2 41918.353 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 F° 5 / 2 42434.160 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 F° 3 / 2 42796.626 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 G° 1 1 / 2 41528.455 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 G° 9 / 2 42269.229 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 G° 7 / 2 42811.351 PT96 3 d 7 (4 F)4 s 4 p (1 P°) x 4 G° 5 / 2 43199.624 PT96 Co II (3 F 4) Limit 63564.6 PG90

Energy Levels of Neutral Copper (Cu I)

Energy Levels of Neutral Copper (Cu I)

Configuration Term J Level(cm -1) Ref. 3 d 1 0 (1 S)4 s 2 S 1 / 2 0.000 SM90 3 d 9 4 s 2 2 D 5 / 2 11202.565 SM90 3 d 9 4 s 2 2 D 3 / 2 13245.423 SM90 3 d 1 0 (1 S)4 p 2 P° 1 / 2 30535.302 SM90 3 d 1 0 (1 S)4 p 2 P° 3 / 2 30783.686 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 P° 5 / 2 39018.652 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 P° 3 / 2 40113.99 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 P° 1 / 2 40943.73 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 F° 9 / 2 40909.138 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 F° 7 / 2 41153.433 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 F° 5 / 2 41562.895 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 F° 3 / 2 42302.47 SM90 3 d 1 0 (1 S)5 s 2 S 1 / 2 43137.209 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 D° 7 / 2 43513.95 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 D° 5 / 2 44406.268 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 D° 3 / 2 44544.153 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 4 D° 1 / 2 44915.61 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 2 P° 1 / 2 45821.00 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 2 P° 3 / 2 45879.311 SM90 3 d 9 (2 D)4 s 4 p (3 P°) 3 / 2 46172.842 SM90 3 d 1 0 (1 S)4 d 2 D 3 / 2 49935.200 SM90 3 d 1 0 (1 S)4 d 2 D 5 / 2 49942.057 SM90 3 d 9 (2 D)4 s 4 p (1 P°) 2 F° 7 / 2 56029.95 SM90 3 d 9 (2 D)4 s 4 p (1 P°) 2 F° 5 / 2 58119.28 SM90 Cu II (1 S 0) Limit 62317.44 SM90

Energy Levels of Neutral Gallium (Ga I)

Energy Levels of Neutral Gallium (Ga I)

Configuration Term J Level(cm -1) Ref. 4 s 2 4 p 2 P° 1 / 2 0.000 JL67 4 s 2 4 p 2 P° 3 / 2 826.19 JL67 4 s 2 5 s 2 S 1 / 2 24788.530 ND82 4 s 2 5 p 2 P° 1 / 2 33044.05 JL67 4 s 2 5 p 2 P° 3 / 2 33155.07 JL67 4 s 2 4 d 2 D 3 / 2 34781.66 JL67 4 s 2 4 d 2 D 5 / 2 34787.85 JL67 4 s 2 6 s 2 S 1 / 2 37584.79 JL67 Ga II (1 S 0) Limit 48387.634 ND82

Energy Levels of Neutral Germanium (Ge I)

Energy Levels of Neutral Germanium (Ge I)

Configuration Term J Level(cm -1) Ref. 4 s 2 4 p 2 3 P 0 0.0000 SM93b 4 s 2 4 p 2 3 P 1 557.1341 SM93b 4 s 2 4 p 2 3 P 2 1409.9609 SM93b 4 s 2 4 p 2 1 D 2 7125.2989 SM93b 4 s 2 4 p 2 1 S 0 16367.3332 SM93b 4 s 2 4 p 5 s 3 P° 0 37451.6893 SM93b 4 s 2 4 p 5 s 3 P° 1 37702.3054 SM93b 4 s 2 4 p 5 s 3 P° 2 39117.9021 SM93b 4 s 2 4 p 5 s 1 P° 1 40020.5604 SM93b 4 s 4 p 3 5 S° 2 41926.726 SM93b 4 s 2 4 p 5 p 3 D 1 45985.592 SM93b 4 s 2 4 p 5 p 3 D 2 46834.3798 SM93b 4 s 2 4 p 5 p 3 D 3 48104.1003 SM93b 4 s 2 4 p 5 p 1 P 1 46765.2705 SM93b 4 s 2 4 p 5 p 3 P 0 47502.6257 SM93b 4 s 2 4 p 5 p 3 P 1 48088.3504 SM93b 4 s 2 4 p 5 p 3 P 2 48726.1143 SM93b 4 s 2 4 p 4 d 1 D° 2 48480.048 SM93b 4 s 2 4 p 4 d 3 D° 2 48882.263 SM93b 4 s 2 4 p 4 d 3 D° 1 48962.783 SM93b 4 s 2 4 p 4 d 3 D° 3 49144.397 SM93b 4 s 2 4 p 5 p 3 S 1 49075.8917 SM93b 4 s 2 4 p 5 p 1 D 2 49649.5807 SM93b 4 s 2 4 p 4 d 3 F° 2 50068.954 SM93b 4 s 2 4 p 4 d 3 F° 3 50323.465 SM93b 4 s 2 4 p 4 d 3 F° 4 50786.79 SM93b 4 s 2 4 p 5 p 1 S 0 51011.4392 SM93b 4 s 2 4 p 4 d 3 P° 2 51437.802 SM93b 4 s 2 4 p 4 d 3 P° 1 51705.020 SM93b 4 s 2 4 p 4 d 3 P° 0 51978.15 SM93b 4 s 2 4 p 4 d 1 F° 3 52592.224 SM93b 4 s 2 4 p 4 d 1 P° 1 52847.215 SM93b Ge II (2 P° 1 / 2) Limit 63713.24 SM93b

Energy Levels of Neutral Iron (Fe I)

Energy Levels of Neutral Iron (Fe I)

Configuration Term J Level(cm -1) Ref. 3 d 6 4 s 2 a 5 D 4 0.000 NJLT94 3 d 6 4 s 2 a 5 D 3 415.933 NJLT94 3 d 6 4 s 2 a 5 D 2 704.007 NJLT94 3 d 6 4 s 2 a 5 D 1 888.132 NJLT94 3 d 6 4 s 2 a 5 D 0 978.074 NJLT94 3 d 7 (4 F)4 s a 5 F 5 6928.268 NJLT94 3 d 7 (4 F)4 s a 5 F 4 7376.764 NJLT94 3 d 7 (4 F)4 s a 5 F 3 7728.059 NJLT94 3 d 7 (4 F)4 s a 5 F 2 7985.784 NJLT94 3 d 7 (4 F)4 s a 5 F 1 8154.713 NJLT94 3 d 7 (4 F)4 s a 3 F 4 11976.238 NJLT94 3 d 7 (4 F)4 s a 3 F 3 12560.933 NJLT94 3 d 7 (4 F)4 s a 3 F 2 12968.553 NJLT94 3 d 7 (4 P)4 s a 5 P 3 17550.180 NJLT94 3 d 7 (4 P)4 s a 5 P 2 17726.987 NJLT94 3 d 7 (4 P)4 s a 5 P 1 17927.381 NJLT94 3 d 6 4 s 2 a 3 P 2 18378.185 NJLT94 3 d 6 4 s 2 a 3 P 1 19552.477 NJLT94 3 d 6 4 s 2 a 3 P 0 20037.815 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 D° 5 19350.892 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 D° 4 19562.440 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 D° 3 19757.033 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 D° 2 19912.494 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 D° 1 20019.634 NJLT94 3 d 6 4 s 2 a 3 H 6 19390.167 NJLT94 3 d 6 4 s 2 a 3 H 5 19621.005 NJLT94 3 d 6 4 s 2 a 3 H 4 19788.250 NJLT94 3 d 6 4 s 2 b 3 F 4 20641.109 NJLT94 3 d 6 4 s 2 b 3 F 3 20874.481 NJLT94 3 d 6 4 s 2 b 3 F 2 21038.986 NJLT94 3 d 7 (2 G)4 s a 3 G 5 21715.731 NJLT94 3 d 7 (2 G)4 s a 3 G 4 21999.129 NJLT94 3 d 7 (2 G)4 s a 3 G 3 22249.428 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 F° 6 22650.414 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 F° 5 22845.867 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 F° 4 22996.672 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 F° 3 23110.937 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 F° 2 23192.498 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 F° 1 23244.836 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 F° 0 23270.382 NJLT94 3 d 7 (4 P)4 s b 3 P 2 22838.321 NJLT94 3 d 7 (4 P)4 s b 3 P 1 22946.814 NJLT94 3 d 7 (4 P)4 s b 3 P 0 23051.748 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 P° 4 23711.454 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 P° 3 24180.860 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 7 P° 2 24506.915 NJLT94 3 d 6 4 s 2 b 3 G 5 23783.617 NJLT94 3 d 6 4 s 2 b 3 G 4 24118.817 NJLT94 3 d 6 4 s 2 b 3 G 3 24338.765 NJLT94 3 d 7 (2 P)4 s c 3 P 2 24335.764 NJLT94 3 d 7 (2 P)4 s c 3 P 1 24772.016 NJLT94 3 d 7 (2 P)4 s c 3 P 0 25091.597 NJLT94 3 d 7 (2 G)4 s a 1 G 4 24574.653 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 D° 4 25899.987 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 D° 3 26140.177 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 D° 2 26339.694 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 D° 1 26479.379 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 D° 0 26550.477 NJLT94 3 d 7 (2 H)4 s b 3 H 6 26105.906 NJLT94 5 26351.038 NJLT94 4 26627.607 NJLT94 3 d 7 (a 2 D)4 s a 3 D 3 26224.967 NJLT94 2 26623.733 NJLT94 1 26406.463 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 5 26874.548 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 4 27166.818 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 3 27394.689 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 2 27559.581 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 1 27666.346 NJLT94 3 d 7 (2 P)4 s a 1 P 1 27543.001 NJLT94 3 d 7 (a 2 D)4 s a 1 D 2 28604.611 NJLT94 3 d 7 (2 H)4 s a 1 H 5 28819.952 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 P° 3 29056.322 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 P° 2 29469.022 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 5 P° 1 29732.734 NJLT94 3 d 6 4 s 2 a 1 I 6 29313.006 NJLT94 3 d 6 4 s 2 b 3 D 3 29371.810 NJLT94 3 d 6 4 s 2 b 3 D 2 29356.742 NJLT94 3 d 6 4 s 2 b 3 D 1 29320.024 NJLT94 3 d 6 4 s 2 b 1 G 4 29798.934 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 F° 4 31307.243 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 F° 3 31805.069 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 F° 2 32133.989 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 D° 3 31322.611 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 D° 2 31686.349 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 D° 1 31937.323 NJLT94 3 d 8 c 3 F 4 32873.630 NJLT94 3 d 8 c 3 F 3 33412.715 NJLT94 3 d 8 c 3 F 2 33765.304 NJLT94 3 d 7 (4 F)4 p y 5 D° 4 33095.939 NJLT94 3 d 7 (4 F)4 p y 5 D° 3 33507.121 NJLT94 3 d 7 (4 F)4 p y 5 D° 2 33801.570 NJLT94 3 d 7 (4 F)4 p y 5 D° 1 34017.101 NJLT94 3 d 7 (4 F)4 p y 5 D° 0 34121.601 NJLT94 3 d 7 (4 F)4 p y 5 F° 5 33695.395 NJLT94 3 d 7 (4 F)4 p y 5 F° 4 34039.514 NJLT94 3 d 7 (4 F)4 p y 5 F° 3 34328.750 NJLT94 3 d 7 (4 F)4 p y 5 F° 2 34547.209 NJLT94 3 d 7 (4 F)4 p y 5 F° 1 34692.146 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 P° 2 33946.931 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 P° 1 34362.871 NJLT94 3 d 6 (5 D)4 s 4 p (3 P) z 3 P° 0 34555.595 NJLT94 3 d 6 4 s 2 b 1 D 2 34636.790 NJLT94 3 d 7 (4 F)4 p z 5 G° 6 34843.955 NJLT94 3 d 7 (4 F)4 p z 5 G° 5 34782.419 NJLT94 3 d 7 (4 F)4 p z 5 G° 4 35257.322 NJLT94 3 d 7 (4 F)4 p z 5 G° 3 35611.623 NJLT94 3 d 7 (4 F)4 p z 5 G° 2 35856.400 NJLT94 3 d 7 (4 F)4 p z 3 G° 5 35379.206 NJLT94 3 d 7 (4 F)4 p z 3 G° 4 35767.562 NJLT94 3 d 7 (4 F)4 p z 3 G° 3 36079.370 NJLT94 3 d 7 (4 F)4 p y 3 F° 4 36686.174 NJLT94 3 d 7 (4 F)4 p y 3 F° 3 37162.744 NJLT94 3 d 7 (4 F)4 p y 3 F° 2 37521.158 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) y 5 P° 3 36766.964 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) y 5 P° 2 37157.564 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) y 5 P° 1 37409.552 NJLT94 3 d 7 (2 F)4 s d 3 F 2 36940.588 NJLT94 3 d 7 (2 F)4 s d 3 F 3 36975.586 NJLT94 3 d 7 (2 F)4 s d 3 F 4 37045.932 NJLT94 3 d 7 (4 F)4 p y 3 D° 3 38175.352 NJLT94 3 d 7 (4 F)4 p y 3 D° 2 38678.036 NJLT94 3 d 7 (4 F)4 p y 3 D° 1 38995.733 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 D° 4 39625.801 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 D° 3 39969.850 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 D° 2 40231.333 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 D° 1 40404.515 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 D° 0 40491.281 NJLT94 3 d 5 (6 S)4 s 2 4 p y 7 P° 4 40421.935 NJLT94 3 d 5 (6 S)4 s 2 4 p y 7 P° 3 40207.088 NJLT94 3 d 5 (6 S)4 s 2 4 p y 7 P° 2 40052.032 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 F° 5 40257.311 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 F° 4 40594.429 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 F° 3 40842.151 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 F° 2 41018.048 NJLT94 3 d 6 (5 D)4 s 4 p (1 P) x 5 F° 1 41130.596 NJLT94 3 d 8 c 3 P 2 40871.409 NJLT94 3 d 8 c 3 P 1 41178.409 NJLT94 3 d 8 c 3 P 0 41234.502 NJLT94 3 d 6 (3 P)4 s 4 p (3 P) z 5 S° 2 40894.987 NJLT94 3 d 6 (3 P)4 s 4 p (3 P) x 5 P° 3 42532.738 NJLT94 3 d 6 (3 P)4 s 4 p (3 P) x 5 P° 2 42859.775 NJLT94 3 d 6 (3 P)4 s 4 p (3 P) x 5 P° 1 43079.020 NJLT94 3 d 6 (3 H)4 s 4 p (3 P) y 5 G° 6 42784.349 NJLT94 3 d 6 (3 H)4 s 4 p (3 P) y 5 G° 5 42911.914 NJLT94 3 d 6 (3 H)4 s 4 p (3 P) y 5 G° 4 43022.

Energy Levels of Neutral Nickel (Ni I)

Energy Levels of Neutral Nickel (Ni I)

Configuration Term J Level(cm -1) Ref. 3 d 8 (3 F)4 s 2 3 F 4 0.000 LBT93 3 d 8 (3 F)4 s 2 3 F 3 1332.164 LBT93 3 d 8 (3 F)4 s 2 3 F 2 2216.550 LBT93 3 d 9 (2 D)4 s 3 D 3 204.787 LBT93 3 d 9 (2 D)4 s 3 D 2 879.816 LBT93 3 d 9 (2 D)4 s 3 D 1 1713.087 LBT93 3 d 9 (2 D)4 s 1 D 2 3409.937 LBT93 3 d 8 (1 D)4 s 2 1 D 2 13521.347 LBT93 3 d 1 0 1 S 0 14728.840 LBT93 3 d 8 (3 P)4 s 2 3 P 2 15609.844 LBT93 3 d 8 (3 P)4 s 2 3 P 1 15734.001 LBT93 3 d 8 (3 P)4 s 2 3 P 0 16017.306 LBT93 3 d 8 (1 G)4 s 2 1 G 4 22102.325 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 D° 4 25753.553 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 D° 3 26665.887 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 D° 2 27414.868 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 D° 1 27943.524 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 D° 0 28212.998 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 G° 6 27260.894 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 G° 5 27580.391 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 G° 4 28068.065 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 G° 3 28578.018 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 G° 2 29013.206 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 F° 5 28542.105 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 F° 4 29084.456 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 F° 3 29832.779 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 F° 2 30163.124 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 5 F° 1 30392.003 LBT93 3 d 9 (2 D)4 p 3 P° 2 28569.203 LBT93 3 d 9 (2 D)4 p 3 P° 1 29500.674 LBT93 3 d 9 (2 D)4 p 3 P° 0 30192.251 LBT93 3 d 9 (2 D)4 p 3 F° 4 29480.989 LBT93 3 d 9 (2 D)4 p 3 F° 3 29320.762 LBT93 3 d 9 (2 D)4 p 3 F° 2 30619.414 LBT93 3 d 9 (2 D)4 p 3 D° 3 29668.893 LBT93 3 d 9 (2 D)4 p 3 D° 2 29888.477 LBT93 3 d 9 (2 D)4 p 3 D° 1 30912.817 LBT93 3 d 9 (2 D)4 p ° 3 29668.918 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 G° 5 30922.734 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 G° 4 30979.749 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 G° 3 31786.162 LBT93 3 d 9 (2 D)4 p 1 F° 3 31031.020 LBT93 3 d 9 (2 D)4 p 1 D° 2 31441.635 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 F° 4 32973.376 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 F° 3 33112.334 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 F° 2 34163.264 LBT93 3 d 9 (2 D)4 p 1 P° 1 32982.260 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 D° 3 33500.822 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 D° 2 33610.890 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 3 D° 1 34408.555 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 1 G° 4 33590.130 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 1 F° 3 35639.122 LBT93 3 d 8 (3 F)4 s 4 p (3 P°) 1 D° 2 36600.791 LBT93 3 d 8 (3 P)4 s 4 p (3 P°) 5 P° 3 40361.249 LBT93 3 d 8 (3 P)4 s 4 p (3 P°) 5 P° 2 40484.212 LBT93 3 d 8 (3 P)4 s 4 p (3 P°) 5 P° 1 40768.996 LBT93 3 d 8 (1 D)4 s 4 p (3 P°) 3 F° 4 42585.212 LBT93 3 d 8 (1 D)4 s 4 p (3 P°) 3 F° 3 42767.853 LBT93 3 d 8 (1 D)4 s 4 p (3 P°) 3 F° 2 42954.203 LBT93 3 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 3 42605.945 LBT93 3 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 2 42790.010 LBT93 3 d 8 (1 D)4 s 4 p (3 P°) 3 D° 3 42620.994 LBT93 3 d 8 (1 D)4 s 4 p (3 P°) 3 D° 2 42653.661 LBT93 3 d 8 (1 D)4 s 4 p (3 P°) 3 D° 1 42656.289 LBT93 3 d 8 (3 F)4 s 4 p (1 P°) 3 G° 5 43089.578 LBT93 3 d 8 (3 F)4 s 4 p (1 P°) 3 G° 4 44314.904 LBT93 3 d 8 (3 F)4 s 4 p (1 P°) 3 G° 3 44565.037 LBT93 3 d 8 (3 F)4 s 4 p (1 P°) 3 F° 4 43258.726 LBT93 3 d 8 (3 F)4 s 4 p (1 P°) 3 F° 3 45281.089 LBT93 3 d 8 (3 F)4 s 4 p (1 P°) 3 F° 2 45418.804 LBT93 Ni II (2 D 5 / 2) Limit 61619 PG90

Energy Levels of Neutral Zinc (Zn I)

Energy Levels of Neutral Zinc (Zn I)

Configuration Term J Level(cm -1) Ref. 4 s 2 1 S 0 0.000 GL00 4 s 4 p 3 P° 0 32311.319 GL00 4 s 4 p 3 P° 1 32501.399 GL00 4 s 4 p 3 P° 2 32890.327 GL00 4 s 4 p 1 P° 1 46745.404 GL00 4 s 5 s 3 S 1 53672.240 GL00 4 s 5 s 1 S 0 55789.213 GL00 4 s 4 d 1 D 2 62458.533 GL00 4 s 4 d 3 D 1 62768.747 GL00 4 s 4 d 3 D 2 62772.014 GL00 4 s 4 d 3 D 3 62776.981 GL00 4 s 5 d 3 D 1 68579.141 GL00 4 s 5 d 3 D 2 68580.705 GL00 4 s 5 d 3 D 3 68583.083 GL00 Zn II (2 S 1 / 2) Limit 75769.33 SM95

Energy Levels of Neutral Bromine (Br I)

Energy Levels of Neutral Bromine (Br I)

Configuration Term J Level(cm -1) Ref. 4 p 5 2 P° 3 / 2 0.00 T63 4 p 5 2 P° 1 / 2 3685.24 T63 4 p 4 (3 P)5 s 4 P 5 / 2 63436.45 T63 4 p 4 (3 P)5 s 4 P 3 / 2 64907.19 T63 4 p 4 (3 P)5 s 4 P 1 / 2 66883.87 T63 4 p 4 (3 P)5 s 2 P 3 / 2 67183.58 T63 4 p 4 (3 P)5 s 2 P 1 / 2 68970.21 T63 4 p 4 (3 P)5 p 4 P° 5 / 2 74672.32 T63 4 p 4 (3 P)5 p 4 P° 3 / 2 75009.13 T63 4 p 4 (3 P)5 p 4 P° 1 / 2 75814.00 T63 4 p 4 (3 P)5 p 4 D° 7 / 2 75521.50 T63 4 p 4 (3 P)5 p 4 D° 5 / 2 75697.05 T63 4 p 4 (3 P)5 p 4 D° 3 / 2 76743.08 T63 4 p 4 (3 P)5 p 4 D° 1 / 2 78865.72 T63 4 p 4 (3 P)5 p 2 D° 5 / 2 78511.60 T63 4 p 4 (3 P)5 p 2 D° 3 / 2 78676.65 T63 4 p 4 (3 P)5 p 2 S° 1 / 2 78076.00 T63 4 p 4 (3 P)5 p 4 S° 3 / 2 79178.33 T63 4 p 4 (3 P)5 p 2 P° 3 / 2 79695.89 T63 4 p 4 (3 P)5 p 2 P° 1 / 2 79868.03 T63 4 p 4 (1 D)5 s 2 D 5 / 2 75890.33 T63 4 p 4 (1 D)5 s 2 D 3 / 2 75908.53 T63 4 p 4 (1 D)5 p 2 F° 5 / 2 87061.23 T63 4 p 4 (1 D)5 p 2 F° 7 / 2 87225.16 T63 4 p 4 (1 D)5 p 2 D° 3 / 2 88438.78 T63 4 p 4 (1 D)5 p 2 D° 5 / 2 88483.42 T63 4 p 4 (1 D)5 p 2 P° 3 / 2 87259.29 T63 4 p 4 (1 D)5 p 2 P° 1 / 2 87499.03 T63 4 p 4 (1 S)5 s 2 S 1 / 2 91937.95 T63 Br II (3 P 2) Limit 95284.8 T63

Energy Levels of Neutral Krypton (Kr I)

Energy Levels of Neutral Krypton (Kr I)

Configuration Term J Level(cm -1) Ref. 4 p 6 1 S 0 0.000 K93 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 79971.7422 K93 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 80916.7685 K93 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 0 85191.6171 K93 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 1 85846.7051 K93 4 p 5 (2 P° 3 / 2)5 p 2 [1 / 2] 1 91168.5155 K93 4 p 5 (2 P° 3 / 2)5 p 2 [1 / 2] 0 94092.8631 K93 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 3 92294.4017 K93 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 2 92307.3791 K93 4 p 5 (2 P° 3 / 2)5 p 2 [3 / 2] 1 92964.3948 K93 4 p 5 (2 P° 3 / 2)5 p 2 [3 / 2] 2 93123.3414 K93 4 p 5 (2 P° 1 / 2)5 p 2 [3 / 2] 1 97595.9158 K93 4 p 5 (2 P° 1 / 2)5 p 2 [3 / 2] 2 97945.1669 K93 4 p 5 (2 P° 1 / 2)5 p 2 [1 / 2] 1 97919.1473 K93 4 p 5 (2 P° 1 / 2)5 p 2 [1 / 2] 0 98855.0703 K93 4 p 5 (2 P° 3 / 2)4 d 2 [7 / 2]° 4 97797.287 K93 4 p 5 (2 P° 3 / 2)4 d 2 [7 / 2]° 3 98226.268 K93 4 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 99626.883 K93 4 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 99894.048 K93 Kr II (2 P° 3 / 2) Limit 112914.50 YG94 , BHU02

Energy Levels of Neutral Niobium (Nb I)

Energy Levels of Neutral Niobium (Nb I)

Configuration Term J Level(cm -1) Ref. 4 d 4 (a 5 D)5 s a 6 D 1 / 2 0.00 M52 4 d 4 (a 5 D)5 s a 6 D 3 / 2 154.19 M52 4 d 4 (a 5 D)5 s a 6 D 5 / 2 391.99 M52 4 d 4 (a 5 D)5 s a 6 D 7 / 2 695.25 M52 4 d 4 (a 5 D)5 s a 6 D 9 / 2 1050.26 M52 4 d 3 5 s 2 a 4 F 3 / 2 1142.79 M52 4 d 3 5 s 2 a 4 F 5 / 2 1586.90 M52 4 d 3 5 s 2 a 4 F 7 / 2 2154.11 M52 4 d 3 5 s 2 a 4 F 9 / 2 2805.36 M52 4 d 3 5 s 2 a 4 P 1 / 2 4998.17 M52 4 d 3 5 s 2 a 4 P 3 / 2 5297.92 M52 4 d 3 5 s 2 a 4 P 5 / 2 5965.45 M52 4 d 4 (a 5 D)5 s a 4 D 1 / 2 8410.90 M52 4 d 4 (a 5 D)5 s a 4 D 3 / 2 8705.32 M52 4 d 4 (a 5 D)5 s a 4 D 5 / 2 9043.14 M52 4 d 4 (a 5 D)5 s a 4 D 7 / 2 9497.52 M52 4 d 3 5 s 2 a 2 D 3 / 2 9439.08 M52 4 d 3 5 s 2 a 2 D 5 / 2 10237.51 M52 4 d 4 (b 3 F)5 s b 4 F 9 / 2 13145.71 M52 4 d 4 (a 5 D)5 p y 6 F° 1 / 2 23984.87 M52 4 d 4 (a 5 D)5 p y 6 F° 3 / 2 24164.79 M52 4 d 4 (a 5 D)5 p y 6 F° 5 / 2 24396.80 M52 4 d 4 (a 5 D)5 p y 6 F° 7 / 2 24769.91 M52 4 d 4 (a 5 D)5 p y 6 F° 9 / 2 25199.81 M52 4 d 4 (a 5 D)5 p y 6 F° 1 1 / 2 25680.36 M52 4 d 4 (a 5 D)5 p x 6 D° 7 / 2 27427.07 M52 4 d 3 5 s (a 5 P)5 p y 6 P° 3 / 2 28278.25 M52 4 d 3 5 s (a 5 P)5 p y 6 P° 5 / 2 28652.66 M52 4 d 3 5 s (a 5 P)5 p y 6 P° 7 / 2 28973.12 M52 4 d 3 5 s (a 5 F)5 p x 4 G° 5 / 2 31056.60 M52 4 d 3 5 s (a 5 F)5 p x 4 G° 7 / 2 31485.20 M52 4 d 3 5 s (a 5 F)5 p x 4 G° 9 / 2 32004.63 M52 4 d 3 5 s (a 5 F)5 p x 4 G° 1 1 / 2 32572.72 M52 4 d 3 5 s (a 5 P)5 p x 4 P° 3 / 2 34867.68 M52 4 d 4 (c 3 F)5 p u 4 G° 9 / 2 37523.53 M52 Nb II (5 D 0) Limit 54513.8 RMBH87

Energy Levels of Neutral Rubidium (Rb I)

Energy Levels of Neutral Rubidium (Rb I)

Configuration Term J Level(cm -1) Ref. 5 s 2 S 1 / 2 0.000 J61b 5 p 2 P° 1 / 2 12578.950 J61b 5 p 2 P° 3 / 2 12816.545 J61b 4 d 2 D 5 / 2 19355.203 J61b 4 d 2 D 3 / 2 19355.649 J61b 6 s 2 S 1 / 2 20132.510 J61b 6 p 2 P° 1 / 2 23715.081 J61b 6 p 2 P° 3 / 2 23792.591 J61b Rb II (1 S 0) Limit 33690.81 J61b

Energy Levels of Neutral Selenium (Se I)

Energy Levels of Neutral Selenium (Se I)

Configuration Term J Level(cm -1) Ref. 4 p 4 3 P 2 0.00 E72 4 p 4 3 P 1 1989.497 E72 4 p 4 3 P 0 2534.36 E72 4 p 4 1 D 2 9576.149 E72 4 p 4 1 S 0 22446.202 E72 4 p 3 (4 S°)5 s 5 S° 2 48182.420 MV74 , LP77 4 p 3 (4 S°)5 s 3 S° 1 50997.161 MV74 , LP77 4 p 3 (4 S°)5 p 5 P 1 59243.028 MV74 , LP77 4 p 3 (4 S°)5 p 5 P 2 59288.048 MV74 , LP77 4 p 3 (4 S°)5 p 5 P 3 59391.536 MV74 , LP77 4 p 3 (4 S°)5 p 3 P 1 60622.532 MV74 , LP77 4 p 3 (4 S°)5 p 3 P 2 60677.618 MV74 , LP77 4 p 3 (4 S°)5 p 3 P 0 60696.219 MV74 , LP77 4 p 3 (2 D°)5 s 3 D° 1 61681.493 MV74 , LP77 4 p 3 (2 D°)5 s 3 D° 2 61828.723 MV74 , LP77 4 p 3 (2 D°)5 s 3 D° 3 62247.832 MV74 , LP77 4 p 3 (4 S°)4 d 5 D° 4 63370.165 MV74 , LP77 4 p 3 (4 S°)4 d 5 D° 2 63373.374 MV74 , LP77 4 p 3 (4 S°)4 d 5 D° 0 63381.104 MV74 , LP77 4 p 3 (4 S°)4 d 5 D° 1 63382.996 MV74 , LP77 4 p 3 (4 S°)4 d 5 D° 3 63387.646 MV74 , LP77 4 p 3 (2 D°)5 s 1 D° 2 63479.487 MV74 , LP77 4 p 3 (4 S°)4 d 3 D° 2 65278.169 MV74 , LP77 4 p 3 (4 S°)4 d 3 D° 1 65299.784 MV74 , LP77 4 p 3 (4 S°)4 d 3 D° 3 65339.968 MV74 , LP77 4 p 3 (4 S°)6 p 5 P 1 69263.466 MV74 , LP77 4 p 3 (4 S°)6 p 5 P 2 69277.846 MV74 , LP77 4 p 3 (4 S°)6 p 5 P 3 69314.635 MV74 , LP77 4 p 3 (2 P°)5 s 1 P° 1 72568.72 LP77 Se II (4 S° 3 / 2) Limit 78658.35 MV74 , LP77

Energy Levels of Neutral Strontium (Sr I)

Energy Levels of Neutral Strontium (Sr I)

Configuration Term J Level(cm -1) Ref. 5 s 2 1 S 0 0.000 M52 5 s 5 p 3 P° 0 14317.520 M52 5 s 5 p 3 P° 1 14504.351 M52 5 s 5 p 3 P° 2 14898.563 M52 5 s 4 d 3 D 1 18159.056 M52 5 s 4 d 3 D 2 18218.795 M52 5 s 4 d 3 D 3 18319.267 M52 5 s 4 d 1 D 2 20149.700 M52 5 s 5 p 1 P° 1 21698.482 M52 5 s 6 s 3 S 1 29038.795 M52 5 s 6 s 1 S 0 30591.80 M52 4 d 5 p 3 F° 2 33266.872 M52 4 d 5 p 3 F° 3 33589.724 M52 4 d 5 p 3 F° 4 33919.330 M52 4 d 5 p 1 D° 2 33826.927 M52 5 s 5 d 1 D 2 34727.483 M52 5 s 5 d 3 D 1 35006.943 M52 5 s 5 d 3 D 2 35022.015 M52 5 s 5 d 3 D 3 35045.055 M52 5 p 2 3 P 0 35193.47 M52 5 p 2 3 P 1 35400.138 M52 5 p 2 3 P 2 35674.668 M52 4 d 5 p 3 D° 1 36264.181 M52 4 d 5 p 3 D° 2 36381.769 M52 4 d 5 p 3 D° 3 36559.514 M52 4 d 5 p 3 P° 0 37292.106 M52 4 d 5 p 3 P° 1 37302.760 M52 4 d 5 p 3 P° 2 37336.616 M52 Sr II (2 S 1 / 2) Limit 45932.09 RB78

Energy Levels of Neutral Yttrium (Y I)

Energy Levels of Neutral Yttrium (Y I)

Configuration Term J Level(cm -1) Ref. 4 d 5 s 2 2 D 3 / 2 0.000 P77 4 d 5 s 2 2 D 5 / 2 530.351 P77 5 s 2 5 p 2 P° 1 / 2 10529.169 P77 5 s 2 5 p 2 P° 3 / 2 11359.757 P77 4 d 2 (3 F)5 s 4 F 3 / 2 10937.390 P77 4 d 2 (3 F)5 s 4 F 5 / 2 11078.614 P77 4 d 2 (3 F)5 s 4 F 7 / 2 11277.928 P77 4 d 2 (3 F)5 s 4 F 9 / 2 11532.096 P77 4 d (3 D)5 s 5 p 4 F° 3 / 2 14948.994 P77 4 d (3 D)5 s 5 p 4 F° 5 / 2 15245.803 P77 4 d (3 D)5 s 5 p 4 F° 7 / 2 15712.522 P77 4 d (3 D)5 s 5 p 4 F° 9 / 2 16234.382 P77 4 d 2 (3 P)5 s 4 P 1 / 2 15221.633 P77 4 d 2 (3 P)5 s 4 P 3 / 2 15328.865 P77 4 d 2 (3 P)5 s 4 P 5 / 2 15476.533 P77 4 d 2 (3 F)5 s 2 F 5 / 2 15326.741 P77 4 d 2 (3 F)5 s 2 F 7 / 2 15864.481 P77 4 d 2 (1 D)5 s 2 D 3 / 2 15994.045 P77 4 d 2 (1 D)5 s 2 D 5 / 2 16158.865 P77 4 d (3 D)5 s 5 p 2 D° 5 / 2 16066.064 P77 4 d (3 D)5 s 5 p 2 D° 3 / 2 16146.138 P77 4 d (3 D)5 s 5 p 4 D° 1 / 2 16435.907 P77 4 d (3 D)5 s 5 p 4 D° 3 / 2 16597.304 P77 4 d (3 D)5 s 5 p 4 D° 5 / 2 16816.641 P77 4 d (3 D)5 s 5 p 4 D° 7 / 2 17116.156 P77 4 d 2 (1 G)5 s 2 G 9 / 2 18499.315 P77 4 d 2 (1 G)5 s 2 G 7 / 2 18512.402 P77 4 d (3 D)5 s 5 p 4 P° 1 / 2 18976.366 P77 4 d (3 D)5 s 5 p 4 P° 3 / 2 19027.593 P77 4 d (3 D)5 s 5 p 4 P° 5 / 2 19147.983 P77 4 d (1 D)5 s 5 p 2 D° 3 / 2 24131.250 P77 4 d (1 D)5 s 5 p 2 D° 5 / 2 24746.573 P77 4 d (3 D)5 s 5 p 2 F° 5 / 2 24518.751 P77 4 d (3 D)5 s 5 p 2 F° 7 / 2 24899.632 P77 Y II (1 S 0) Limit 50145.6 GRTE73 , JS00

Energy Levels of Neutral Zirconium (Zr I)

Energy Levels of Neutral Zirconium (Zr I)

Configuration Term J Level(cm -1) Ref. 4 d 2 5 s 2 a 3 F 2 0.00 M52 4 d 2 5 s 2 a 3 F 3 570.41 M52 4 d 2 5 s 2 a 3 F 4 1240.84 M52 4 d 2 5 s 2 a 3 P 2 4186.11 M52 4 d 2 5 s 2 a 3 P 0 4196.85 M52 4 d 2 5 s 2 a 3 P 1 4376.28 M52 4 d 3 (b 4 F)5 s a 5 F 1 4870.53 M52 4 d 3 (b 4 F)5 s a 5 F 2 5023.41 M52 4 d 3 (b 4 F)5 s a 5 F 3 5249.07 M52 4 d 3 (b 4 F)5 s a 5 F 4 5540.54 M52 4 d 3 (b 4 F)5 s a 5 F 5 5888.93 M52 4 d 2 5 s 2 a 1 D 2 5101.68 M52 4 d 2 5 s 2 a 1 G 4 8057.30 M52 4 d 3 (b 4 P)5 s a 5 P 1 10885.36 M52 4 d 3 (b 4 P)5 s a 5 P 2 11016.65 M52 4 d 3 (b 4 P)5 s a 5 P 3 11258.38 M52 4 d 3 (b 4 F)5 s b 3 F 2 11640.72 M52 4 d 3 (b 4 F)5 s b 3 F 3 11956.33 M52 4 d 3 (b 4 F)5 s b 3 F 4 12342.37 M52 4 d 3 (a 4 G)5 s a 3 G 3 12503.44 M52 4 d 3 (a 4 G)5 s a 3 G 4 12760.66 M52 4 d 3 (a 4 G)5 s a 3 G 5 12772.78 M52 4 d 2 5 s 2 a 1 S 0 13141.76 M52 4 d 3 (b 2 D)5 s a 3 D 1 14123.01 M52 4 d 3 (b 2 D)5 s a 3 D 2 14348.78 M52 4 d 3 (b 2 D)5 s a 3 D 3 14697.03 M52 4 d 2 5 s (a 4 F)5 p z 5 G° 2 14783.54 M52 4 d 2 5 s (a 4 F)5 p z 5 G° 3 15201.26 M52 4 d 2 5 s (a 4 F)5 p z 5 G° 4 15720.36 M52 4 d 2 5 s (a 4 F)5 p z 5 G° 5 16316.96 M52 4 d 2 5 s (a 4 F)5 p z 5 G° 6 16978.29 M52 4 d 2 5 s (a 4 F)5 p z 3 F° 2 16296.51 M52 4 d 2 5 s (a 4 F)5 p z 3 F° 3 16843.93 M52 4 d 2 5 s (a 4 F)5 p z 3 F° 4 17556.26 M52 4 d 2 5 s (a 4 F)5 p z 5 F° 1 16786.93 M52 4 d 2 5 s (a 4 F)5 p z 5 F° 2 17059.61 M52 4 d 2 5 s (a 4 F)5 p z 5 F° 3 17422.17 M52 4 d 2 5 s (a 4 F)5 p z 5 F° 4 17833.73 M52 4 d 2 5 s (a 4 F)5 p z 5 F° 5 18276.92 M52 4 d 2 5 s (a 4 F)5 p z 5 D° 0 18976.36 M52 4 d 2 5 s (a 4 F)5 p z 5 D° 1 19096.53 M52 4 d 2 5 s (a 4 F)5 p z 5 D° 2 19323.84 M52 4 d 2 5 s (a 4 F)5 p z 5 D° 3 19625.58 M52 4 d 2 5 s (a 4 F)5 p z 5 D° 4 19833.78 M52 4 d 2 5 s (a 4 F)5 p z 3 G° 3 21849.33 M52 4 d 2 5 s (a 4 F)5 p z 3 G° 4 22144.08 M52 4 d 2 5 s (a 4 F)5 p z 3 G° 5 22563.89 M52 4 d 2 5 s (a 2 D)5 p x 3 F° 2 26061.70 M52 4 d 2 5 s (a 2 D)5 p x 3 F° 3 26443.88 M52 4 d 2 5 s (a 2 D)5 p x 3 F° 4 26938.42 M52 4 d 2 5 s (a 2 F)5 p z 5 G° 4 26931.35 M52 4 d 3 (b 4 F)5 p y 5 G° 5 26765.66 M52 4 d 3 (b 4 F)5 p y 5 G° 6 27214.89 M52 4 d 2 5 s (a 2 F)5 p w 3 F° 2 27876.16 M52 4 d 2 5 s (a 2 F)5 p w 3 F° 3 28157.42 M52 4 d 2 5 s (a 2 F)5 p w 3 F° 4 28528.36 M52 4 d 2 5 s (a 2 F)5 p x 3 G° 3 28404.26 M52 4 d 2 5 s (a 2 F)5 p x 3 G° 4 28749.80 M52 4 d 2 5 s (a 2 F)5 p x 3 G° 5 29001.65 M52 4 d 3 (b 4 F)5 p y 5 F° 4 29122.71 M52 4 d 3 (b 4 F)5 p y 5 F° 5 29535.48 M52 4 d 3 (b 4 F)5 p x 5 D° 3 30087.33 M52 4 d 3 (b 4 F)5 p x 5 D° 4 30384.50 M52 Zr II (4 F 3 / 2) Limit 53506.0 HHMR86

Energy Levels of Neutral Antimony (Sb I)

Energy Levels of Neutral Antimony (Sb I)

Configuration Term J Level(cm -1) Ref. 5 s 2 5 p 3 4 S° 3 / 2 0.000 HARV88 5 s 2 5 p 3 2 D° 3 / 2 8512.125 HARV88 5 s 2 5 p 3 2 D° 5 / 2 9854.018 HARV88 5 s 2 5 p 3 2 P° 1 / 2 16395.359 HARV88 5 s 2 5 p 3 2 P° 3 / 2 18464.202 HARV88 5 s 2 5 p 2 (3 P)6 s 4 P 1 / 2 43249.337 HARV88 5 s 2 5 p 2 (3 P)6 s 4 P 3 / 2 45945.340 HARV88 5 s 2 5 p 2 (3 P)6 s 4 P 5 / 2 48332.424 HARV88 5 s 2 5 p 2 (3 P)6 s 2 P 1 / 2 46991.058 HARV88 5 s 2 5 p 2 (3 P)6 s 2 P 3 / 2 49391.133 HARV88 5 s 2 5 p 2 (3 P)5 d 4 P 5 / 2 53442.967 HARV88 5 s 2 5 p 2 (3 P)5 d 4 P 3 / 2 56151.802 HARV88 5 s 2 5 p 2 (3 P)5 d 4 P 1 / 2 56698.608 HARV88 5 s 2 5 p 2 (3 P)5 d 4 F 3 / 2 53527.956 HARV88 5 s 2 5 p 2 (3 P)5 d 4 F 5 / 2 55120.943 HARV88 5 s 2 5 p 2 (3 P)5 d 4 F 7 / 2 56528.132 HARV88 5 s 2 5 p 2 (1 D)6 s 2 D 3 / 2 55232.963 HARV88 5 s 2 5 p 2 (1 D)6 s 2 D 5 / 2 55728.264 HARV88 5 s 2 5 p 2 (3 P)5 d 2 F 5 / 2 57287.052 HARV88 5 s 2 5 p 2 (3 P)5 d 2 F 7 / 2 61125.741 HARV88 5 s 2 5 p 2 (1 S)6 s 2 S 1 / 2 65654.41 HARV88 Sb II (3 P 0) Limit 69431.34 BW86

Energy Levels of Neutral Cadmium (Cd I)

Energy Levels of Neutral Cadmium (Cd I)

Configuration Term J Level(cm -1) Ref. 5 s 2 1 S 0 0.000 BA56 5 s 5 p 3 P° 0 30113.990 BA56 5 s 5 p 3 P° 1 30656.087 BA56 5 s 5 p 3 P° 2 31826.952 BA56 5 s 5 p 1 P° 1 43692.384 BA56 5 s 6 s 3 S 1 51483.980 BA56 5 s 6 s 1 S 0 53310.101 BA56 5 s 5 d 1 D 2 59219.734 BA56 5 s 5 d 3 D 1 59485.768 BA56 5 s 5 d 3 D 2 59497.868 BA56 5 s 5 d 3 D 3 59515.980 BA56 Cd II (2 S 1 / 2) Limit 72540.07 BTG75

Energy Levels of Neutral Indium (In I)

Energy Levels of Neutral Indium (In I)

Configuration Term J Level(cm -1) Ref. 5 p 2 P° 1 / 2 0.000 JL67 , DMZ53 5 p 2 P° 3 / 2 2212.598 JL67 , DMZ53 6 s 2 S 1 / 2 24372.956 JL67 , DMZ53 6 p 2 P° 1 / 2 31816.96 JL67 6 p 2 P° 3 / 2 32115.22 JL67 5 d 2 D 3 / 2 32892.21 JL67 5 d 2 D 5 / 2 32915.54 JL67 5 s 5 p 2 4 P 1 / 2 34977.68 P38 5 s 5 p 2 4 P 3 / 2 36020.82 P38 5 s 5 p 2 4 P 5 / 2 37451.94 P38 7 s 2 S 1 / 2 36301.84 JL67 6 d 2 D 3 / 2 39048.53 JL67 6 d 2 D 5 / 2 39098.38 JL67 In II (1 S 0) Limit 46670.11 ND81 , JL67 5 s 5 p 2 2 S 1 / 2 56905 G54 5 s 5 p 2 2 P 1 / 2 59657 G54 5 s 5 p 2 2 P 3 / 2 60654 G54

Energy Levels of Neutral Molybdenum (Mo I)

Energy Levels of Neutral Molybdenum (Mo I)

Configuration Term J Level(cm -1) Ref. 4 d 5 (6 S)5 s a 7 S 3 0.000 WB88 4 d 5 (6 S)5 s a 5 S 2 10768.332 WB88 4 d 4 5 s 2 a 5 D 0 10965.947 WB88 4 d 4 5 s 2 a 5 D 1 11142.784 WB88 4 d 4 5 s 2 a 5 D 2 11454.362 WB88 4 d 4 5 s 2 a 5 D 3 11858.499 WB88 4 d 4 5 s 2 a 5 D 4 12346.280 WB88 4 d 5 (4 G)5 s a 5 G 2 16641.081 WB88 4 d 5 (4 G)5 s a 5 G 3 16692.905 WB88 4 d 5 (4 G)5 s a 5 G 4 16747.720 WB88 4 d 5 (4 G)5 s a 5 G 6 16783.856 WB88 4 d 5 (4 G)5 s a 5 G 5 16784.522 WB88 4 d 5 (6 S)5 p z 7 P° 2 25614.367 WB88 4 d 5 (6 S)5 p z 7 P° 3 25871.887 WB88 4 d 5 (6 S)5 p z 7 P° 4 26320.420 WB88 4 d 5 (6 S)5 p z 5 P° 1 28715.242 WB88 4 d 5 (6 S)5 p z 5 P° 2 28836.592 WB88 4 d 5 (6 S)5 p z 5 P° 3 28923.668 WB88 4 d 4 5 s (6 D)5 p z 7 D° 1 30846.584 WB88 4 d 4 5 s (6 D)5 p z 7 D° 2 31154.935 WB88 4 d 4 5 s (6 D)5 p z 7 D° 3 31654.786 WB88 4 d 4 5 s (6 D)5 p z 7 D° 4 32123.128 WB88 4 d 4 5 s (6 D)5 p z 7 D° 5 32611.837 WB88 4 d 4 5 s (6 D)5 p y 7 P° 2 31299.876 WB88 4 d 4 5 s (6 D)5 p y 7 P° 3 31533.206 WB88 4 d 4 5 s (6 D)5 p y 7 P° 4 31913.171 WB88 4 d 5 (4 G)5 p z 5 G° 5 39445.182 WB88 4 d 5 (4 G)5 p z 5 H° 6 40653.701 WB88 4 d 5 (4 G)5 p y 5 F° 5 41347.664 WB88 Mo II (6 S 5 / 2) Limit 57204.3 RMBH87

Energy Levels of Neutral Palladium (Pd I)

Energy Levels of Neutral Palladium (Pd I)

Configuration Term J Level(cm -1) Ref. 4 d 1 0 1 S 0 0.000 ELLW98 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 3 6564.148 ELLW98 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 2 7755.025 ELLW98 4 d 9 (2 D 3 / 2)5 s 2 [3 / 2] 1 10093.992 ELLW98 4 d 9 (2 D 3 / 2)5 s 2 [3 / 2] 2 11721.809 ELLW98 4 d 8 5 s 2 3 F 4 25101.235 ELLW98 4 d 8 5 s 2 3 F 3 28213.767 ELLW98 4 d 8 5 s 2 3 F 2 29711.109 ELLW98 4 d 9 (2 D 5 / 2)5 p 2 [3 / 2]° 2 34068.977 ELLW98 4 d 9 (2 D 5 / 2)5 p 2 [3 / 2]° 1 36180.677 ELLW98 4 d 9 (2 D 5 / 2)5 p 2 [7 / 2]° 3 35451.443 ELLW98 4 d 9 (2 D 5 / 2)5 p 2 [7 / 2]° 4 35927.948 ELLW98 4 d 9 (2 D 5 / 2)5 p 2 [5 / 2]° 2 36975.973 ELLW98 4 d 9 (2 D 5 / 2)5 p 2 [5 / 2]° 3 37393.762 ELLW98 4 d 9 (2 D 3 / 2)5 p 2 [1 / 2]° 0 38088.192 ELLW98 4 d 9 (2 D 3 / 2)5 p 2 [1 / 2]° 1 40838.874 ELLW98 4 d 9 (2 D 3 / 2)5 p 2 [5 / 2]° 2 38811.896 ELLW98 4 d 9 (2 D 3 / 2)5 p 2 [5 / 2]° 3 39858.361 ELLW98 4 d 9 (2 D 3 / 2)5 p 2 [3 / 2]° 1 40368.796 ELLW98 4 d 9 (2 D 3 / 2)5 p 2 [3 / 2]° 2 40771.510 ELLW98 Pd II (2 D 5 / 2) Limit 67242 CHR88a

Energy Levels of Neutral Rhodium (Rh I)

Energy Levels of Neutral Rhodium (Rh I)

Configuration Term J Level(cm -1) Ref. 4 d 8 (3 F)5 s a 4 F 9 / 2 0.00 M58 4 d 8 (3 F)5 s a 4 F 7 / 2 1529.97 M58 4 d 8 (3 F)5 s a 4 F 5 / 2 2598.03 M58 4 d 8 (3 F)5 s a 4 F 3 / 2 3472.68 M58 4 d 9 a 2 D 5 / 2 3309.86 M58 4 d 9 a 2 D 3 / 2 5657.97 M58 4 d 8 (3 F)5 s a 2 F 7 / 2 5690.97 M58 4 d 8 (3 F)5 s a 2 F 5 / 2 7791.23 M58 4 d 8 (3 F)5 p z 4 D° 7 / 2 27075.26 M58 4 d 8 (3 F)5 p z 4 D° 5 / 2 28859.64 M58 4 d 8 (3 F)5 p z 4 D° 3 / 2 30397.27 M58 4 d 8 (3 F)5 p z 4 D° 1 / 2 31146.68 M58 4 d 8 (3 F)5 p z 4 G° 9 / 2 28542.69 M58 4 d 8 (3 F)5 p z 4 G° 1 1 / 2 29104.71 M58 4 d 8 (3 F)5 p z 4 G° 7 / 2 31101.75 M58 4 d 8 (3 F)5 p z 4 G° 5 / 2 32243.32 M58 4 d 8 (3 F)5 p z 4 F° 9 / 2 29430.86 M58 4 d 8 (3 F)5 p z 4 F° 7 / 2 29866.34 M58 4 d 8 (3 F)5 p z 4 F° 5 / 2 31474.50 M58 4 d 8 (3 F)5 p z 4 F° 3 / 2 32277.43 M58 4 d 8 (3 F)5 p z 2 G° 9 / 2 31613.78 M58 4 d 8 (3 F)5 p z 2 G° 7 / 2 33043.91 M58 Rh II (3 F 4) Limit 60160.1 CHR88a

Energy Levels of Neutral Ruthenium (Ru I)

Energy Levels of Neutral Ruthenium (Ru I)

Configuration Term J Level(cm -1) Ref. 4 d 7 (a 4 F)5 s a 5 F 5 0.00 M58 4 d 7 (a 4 F)5 s a 5 F 4 1190.64 M58 4 d 7 (a 4 F)5 s a 5 F 3 2091.54 M58 4 d 7 (a 4 F)5 s a 5 F 2 2713.24 M58 4 d 7 (a 4 F)5 s a 5 F 1 3105.49 M58 4 d 7 (a 4 F)5 s a 3 F 4 6545.03 M58 4 d 7 (a 4 F)5 s a 3 F 3 8084.12 M58 4 d 7 (a 4 F)5 s a 3 F 2 9183.66 M58 4 d 6 5 s 2 a 5 D 4 7483.07 M58 4 d 6 5 s 2 a 5 D 3 8575.42 M58 4 d 6 5 s 2 a 5 D 2 9057.64 M58 4 d 6 5 s 2 a 5 D 1 9072.98 M58 4 d 6 5 s 2 a 5 D 0 9492.37 M58 4 d 7 (a 4 P)5 s a 5 P 2 8043.69 M58 4 d 7 (a 4 P)5 s a 5 P 3 8770.93 M58 4 d 7 (a 4 P)5 s a 5 P 1 9620.29 M58 4 d 7 (a 4 F)5 p z 5 D° 4 26312.83 M58 4 d 7 (a 4 F)5 p z 5 D° 3 27506.59 M58 4 d 7 (a 4 F)5 p z 5 D° 2 28465.69 M58 4 d 7 (a 4 F)5 p z 5 D° 1 29118.49 M58 4 d 7 (a 4 F)5 p z 5 D° 0 29569.90 M58 4 d 7 (a 4 F)5 p z 5 F° 5 26816.23 M58 4 d 7 (a 4 F)5 p z 5 F° 4 28014.79 M58 4 d 7 (a 4 F)5 p z 5 F° 3 28890.47 M58 4 d 7 (a 4 F)5 p z 5 F° 2 29427.32 M58 4 d 7 (a 4 F)5 p z 5 F° 1 29693.57 M58 4 d 7 (a 4 F)5 p z 3 G° 5 28495.10 M58 4 d 7 (a 4 F)5 p z 3 G° 4 29890.91 M58 4 d 7 (a 4 F)5 p z 3 G° 3 31852.90 M58 4 d 7 (a 4 F)5 p z 5 G° 6 28571.89 M58 4 d 7 (a 4 F)5 p z 5 G° 5 30279.68 M58 4 d 7 (a 4 F)5 p z 5 G° 3 30537.06 M58 4 d 7 (a 4 F)5 p z 5 G° 2 30958.80 M58 4 d 7 (a 4 F)5 p z 5 G° 4 31345.79 M58 4 d 7 (a 4 F)5 p z 3 F° 4 30348.45 M58 4 d 7 (a 4 F)5 p z 3 F° 3 32391.95 M58 4 d 7 (a 4 F)5 p z 3 F° 2 33172.02 M58 Ru II (4 F 9 / 2) Limit 59366.4 CHR88a

Energy Levels of Neutral Silver (Ag I)

Energy Levels of Neutral Silver (Ag I)

Configuration Term J Level(cm -1) Ref. 4 d 1 0 (1 S)5 s 2 S 1 / 2 0.000 PZ01 4 d 1 0 (1 S)5 p 2 P° 1 / 2 29552.061 PZ01 4 d 1 0 (1 S)5 p 2 P° 3 / 2 30472.703 PZ01 4 d 9 5 s 2 2 D 5 / 2 30242.291 PZ01 4 d 9 5 s 2 2 D 3 / 2 34714.305 PZ01 4 d 1 0 (1 S)6 s 2 S 1 / 2 42556.152 PZ01 4 d 1 0 (1 S)6 p 2 P° 1 / 2 48297.402 PZ01 4 d 1 0 (1 S)6 p 2 P° 3 / 2 48500.805 PZ01 4 d 1 0 (1 S)5 d 2 D 3 / 2 48743.969 PZ01 4 d 1 0 (1 S)5 d 2 D 5 / 2 48764.219 PZ01 4 d 1 0 (1 S)7 s 2 S 1 / 2 51886.971 PZ01 4 d 1 0 (1 S)7 p 2 P° 1 / 2 54040.99 M58 4 d 1 0 (1 S)7 p 2 P° 3 / 2 54121.129 PZ01 4 d 1 0 (1 S)6 d 2 D 3 / 2 54203.119 PZ01 4 d 1 0 (1 S)6 d 2 D 5 / 2 54213.570 PZ01 4 d 1 0 (1 S)4 f 2 F° 5 / 2 , 3 / 2 54204.73 M58 Ag II (1 S 0) Limit 61106.45 LBS99

Energy Levels of Neutral Technetium (Tc I)

Energy Levels of Neutral Technetium (Tc I)

Configuration Term J Level(cm -1) Ref. 4 d 5 5 s 2 a 6 S 5 / 2 0.00 BCT68 4 d 6 (5 D)5 s a 6 D 9 / 2 2572.89 BCT68 4 d 6 (5 D)5 s a 6 D 7 / 2 3250.91 BCT68 4 d 6 (5 D)5 s a 6 D 5 / 2 3700.54 BCT68 4 d 6 (5 D)5 s a 6 D 3 / 2 4002.57 BCT68 4 d 6 (5 D)5 s a 6 D 1 / 2 4178.75 BCT68 4 d 6 (5 D)5 s a 4 D 7 / 2 10516.53 BCT68 4 d 6 (5 D)5 s a 4 D 5 / 2 11063.07 BCT68 4 d 6 (5 D)5 s a 4 D 3 / 2 11578.60 BCT68 4 d 6 (5 D)5 s a 4 D 1 / 2 11890.70 PW99 4 d 5 5 s (7 S)5 p z 8 P° 5 / 2 16428.71 BCT68 4 d 5 5 s (7 S)5 p z 8 P° 7 / 2 16874.51 BCT68 4 d 5 5 s (7 S)5 p z 8 P° 9 / 2 17522.92 BCT68 4 d 5 5 s (7 S)5 p z 6 P° 7 / 2 23265.32 BCT68 4 d 5 5 s (7 S)5 p z 6 P° 5 / 2 23455.21 BCT68 4 d 5 5 s (7 S)5 p z 6 P° 3 / 2 23588.40 BCT68 4 d 6 (5 D)5 p z 6 D° 9 / 2 27369.79 BCT68 4 d 6 (5 D)5 p z 6 D° 7 / 2 27660.10 BCT68 4 d 6 (5 D)5 p z 6 D° 5 / 2 27940.73 BCT68 4 d 6 (5 D)5 p z 6 D° 3 / 2 28151.28 BCT68 4 d 6 (5 D)5 p z 6 D° 1 / 2 28296.67 BCT68 4 d 6 (5 D)5 p z 6 F° 1 1 / 2 30067.29 BCT68 4 d 6 (5 D)5 p z 6 F° 9 / 2 30133.26 BCT68 4 d 6 (5 D)5 p z 6 F° 7 / 2 30382.06 BCT68 4 d 6 (5 D)5 p z 6 F° 5 / 2 30528.86 BCT68 4 d 6 (5 D)5 p z 6 F° 3 / 2 30630.62 BCT68 4 d 6 (5 D)5 p z 6 F° 1 / 2 30689.12 BCT68 4 d 6 (5 D)5 p z 4 F° 9 / 2 31114.08 BCT68 4 d 6 (5 D)5 p z 4 F° 5 / 2 31605.00 BCT68 4 d 6 (5 D)5 p z 4 F° 5 / 2 32014.81 BCT68 4 d 6 (5 D)5 p z 4 F° 3 / 2 32253.65 BCT68 4 d 6 (5 D)5 p y 6 P° 5 / 2 31406.74 BCT68 4 d 6 (5 D)5 p y 6 P° 7 / 2 31414.05 BCT68 4 d 6 (5 D)5 p y 6 P° 3 / 2 31503.93 BCT68 Tc II (7 S 3) Limit 58700 M58

Energy Levels of Neutral Tellurium (Te I)

Energy Levels of Neutral Tellurium (Te I)

Configuration Term J Level(cm -1) Ref. 5 p 4 3 P 2 0.000 MV75 5 p 4 3 P 0 4706.500 MV75 5 p 4 3 P 1 4750.712 MV75 5 p 4 1 D 2 10557.877 MV75 5 p 4 1 S 0 23198.392 MV75 5 p 3 (4 S)6 s 5 S° 2 44253.000 MV75 5 p 3 (4 S)6 s 3 S° 1 46652.738 MV75 5 p 3 (4 S)6 p 5 P 1 54160.094 MV75 5 p 3 (4 S)6 p 5 P 2 54199.122 MV75 5 p 3 (4 S)6 p 5 P 3 54535.345 MV75 5 p 3 (2 D)6 s 3 D° 1 54683.886 MV75 5 p 3 (2 D)6 s 3 D° 2 54880.070 MV75 5 p 3 (4 S)6 p 3 P 1 55355.672 MV75 5 p 3 (4 S)6 p 3 P 2 55667.758 MV75 5 p 3 (4 S)6 p 3 P 0 55809.132 MV75 5 p 3 (4 S)5 d 5 D° 3 55677.722 MV75 5 p 3 (4 S)5 d 5 D° 4 55816.219 MV75 5 p 3 (4 S)5 d 5 D° 2 55817.311 MV75 5 p 3 (4 S)5 d 5 D° 0 55826.538 MV75 5 p 3 (4 S)5 d 5 D° 1 55851.533 MV75 5 p 3 (2 D)6 s 1 D° 2 57114.206 MV75 5 p 3 (4 S)5 d 3 D° 2 58592.434 MV75 5 p 3 (4 S)5 d 3 D° 1 58746.074 MV75 5 p 3 (4 S)5 d 3 D° 3 58826.951 MV75 Te II (4 S° 3 / 2) Limit 72667 M58

Energy Levels of Neutral Tin (Sn I)

Energy Levels of Neutral Tin (Sn I)

Configuration Term J Level(cm -1) Ref. 5 p 2 3 P 0 0.000 B64 5 p 2 3 P 1 1691.806 B64 5 p 2 3 P 2 3427.673 B64 5 p 2 1 D 2 8612.955 B64 5 p 2 1 S 0 17162.499 B64 5 p 6 s 3 P° 0 34640.758 B64 5 p 6 s 3 P° 1 34914.282 B64 5 p 6 s 3 P° 2 38628.876 B64 5 p 6 s 1 P° 1 39257.053 B64 5 s 5 p 3 5 S° 2 39625.506 B64 5 p 6 p 3 D 1 42342.216 B64 5 p 6 p 3 D 2 43430.135 B64 5 p 6 p 3 D 3 47006.830 B64 5 p 6 p 1 P 1 43368.634 B64 5 p 5 d 1 D° 2 43682.737 B64 5 p 6 p 3 P 0 43799.085 B64 5 p 6 p 3 P 1 46603.517 B64 5 p 6 p 3 P 2 47235.221 B64 5 p 5 d 3 D° 2 44144.368 B64 5 p 5 d 3 D° 1 44508.677 B64 5 p 5 d 3 D° 3 44576.006 B64 5 p 5 d 3 F° 2 47145.684 B64 5 p 5 d 3 F° 3 47487.696 B64 5 p 5 d 3 F° 4 48107.27 B64 5 p 6 p 3 S 1 47805.840 B64 5 p 6 p 1 D 2 48189.791 B64 5 p 5 d 3 P° 2 48669.409 B64 5 p 5 d 3 P° 1 48981.934 B64 5 p 5 d 3 P° 0 49487.127 B64 5 p 6 p 1 S 0 49406.162 B64 5 p 5 d 1 F° 3 49893.823 B64 5 p 5 d 1 P° 1 50125.971 B64 Sn II (2 P° 1 / 2) Limit 59232.7 BTG77

Energy Levels of Neutral Barium (Ba I)

Energy Levels of Neutral Barium (Ba I)

Configuration Term J Level(cm -1) Ref. 6 s 2 1 S 0 0.000 KL99 6 s 5 d 3 D 1 9033.966 KL99 6 s 5 d 3 D 2 9215.501 KL99 6 s 5 d 3 D 3 9596.533 KL99 6 s 5 d 1 D 2 11395.350 KL99 6 s 6 p 3 P° 0 12266.024 KL99 6 s 6 p 3 P° 1 12636.623 KL99 6 s 6 p 3 P° 2 13514.745 KL99 6 s 6 p 1 P° 1 18060.261 KL99 5 d 6 p 3 F° 2 22064.645 KL99 5 d 6 p 3 F° 3 22947.423 KL99 5 d 6 p 3 F° 4 23757.049 KL99 5 d 6 p 1 D° 2 23074.387 KL99 5 d 6 p 3 D° 1 24192.033 KL99 5 d 6 p 3 D° 2 24531.513 KL99 5 d 6 p 3 D° 3 24979.834 KL99 5 d 6 p 1 P° 1 28554.221 KL99 6 s 7 p 1 P° 1 32547.033 KL99 Ba II (2 S 1 / 2) Limit 42034.91 PVHA85

Energy Levels of Neutral Cerium (Ce I)

Energy Levels of Neutral Cerium (Ce I)

Configuration Term J Level(cm -1) Ref. 4 f 5 d 6 s 2 1 G° 4 0.000 MZH78 4 f 5 d 6 s 2 3 F° 2 228.849 MZH78 4 f 5 d 6 s 2 3 F° 3 1663.120 MZH78 4 f 5 d 6 s 2 3 F° 4 3100.151 MZH78 4 f 5 d 6 s 2 3 H° 4 1279.424 MZH78 4 f 5 d 6 s 2 3 H° 5 2208.657 MZH78 4 f 5 d 6 s 2 3 H° 6 3976.104 MZH78 4 f 5 d 6 s 2 3 G° 3 1388.941 MZH78 4 f 5 d 6 s 2 3 G° 5 4199.367 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 H° 3 2369.068 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 H° 4 2437.629 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 H° 6 4746.627 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 H° 7 5802.108 MZH78 4 f 5 d 6 s 2 1 D° 2 2378.827 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 4 3196.607 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 5 3764.008 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 6 4455.756 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 7 5315.803 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 8 6809.128 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 5 3210.583 MZH78 4 f 5 d 6 s 2 ° 4 3312.240 MZH78 4 f 5 d 6 s 2 3 D° 1 3710.513 MZH78 4 f 5 d 6 s 2 3 D° 2 4766.323 MZH78 4 f 5 d 6 s 2 3 D° 3 5006.719 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 0 3974.503 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 1 4020.954 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 3 G° 3 4160.283 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 4 4173.494 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 5 4417.618 MZH78 4 f 2 6 s 2 3 H 4 4762.718 MZH78 4 f 2 6 s 2 3 H 5 6238.934 MZH78 4 f 2 6 s 2 3 H 6 7780.202 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 3 S° 1 5097.777 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 2 5210.906 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 G° 2 5409.236 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 G° 3 6234.792 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 G° 4 6856.559 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 G° 5 7467.160 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 G° 6 8055.526 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 3 5519.751 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 0 5571.156 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 4 5572.074 MZH78 4 f 5 d 6 s 2 ° 1 5637.233 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 F° 1 5674.829 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 F° 2 5904.006 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 F° 3 6337.061 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 F° 4 7174.156 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 F° 5 7933.558 MZH78 4 f 5 d 6 s 2 ° 2 6303.984 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (2 F) ° 4 6475.540 MZH78 4 f 5 d 6 s 2 ° 3 6621.892 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 5 6663.226 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 2 6836.628 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 3 7169.751 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (2 F) ° 4 7348.299 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 6 7696.210 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F)? ° 5 7715.236 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (2 F)? ° 5 7841.955 MZH78 4 f (2 F°) 5 d 2 (1 D)6 s (2 D) ° 1 7853.119 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 4 7890.429 MZH78 4 f (2 F°) 5 d 2 (3 P)6 s (4 P) 5 G° 2 8088.912 MZH78 4 f (2 F°) 5 d 2 (3 P)6 s (4 P) 5 G° 3 8307.309 MZH78 4 f (2 F°) 5 d 2 (3 P)6 s (4 P) 5 G° 4 8762.126 MZH78 4 f (2 F°) 5 d 2 (3 P)6 s (4 P) 5 G° 5 9462.705 MZH78 4 f (2 F°) 5 d 2 (3 P)6 s (4 P) 5 G° 6 11030.470 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 P° 2 8101.187 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 P° 3 8270.249 MZH78 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 P° 1 8430.846 MZH78 4 f 2 6 s 2 3 F 2 8235.605 MZH78 4 f 2 6 s 2 3 F 3 9206.305 MZH78 4 f 2 6 s 2 3 F 4 9379.148 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 K 5 19791.740 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 K 6 20591.937 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 K 7 21654.060 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 K 8 22864.055 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 K 9 24350.503 MZH78 4 f 5 d (3 G°)6 s 6 p (3 P°) 5 20338.893 MZH78 4 f (2 F°)5 d 2 (3 F) (4 H°)6 p 5 I 6 20842.504 MZH78 4 f (2 F°)5 d 2 (3 F) (4 H°)6 p 5 I 7 22063.473 MZH78 4 f (2 F°)5 d 2 (3 F) (4 H°)6 p 5 I 8 23282.722 MZH78 4 f 5 d (3 H°)6 s 6 p (3 P°) 5 21581.408 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 I 5 21725.348 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 I 6 22321.098 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 I 7 23452.626 MZH78 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 I 8 24657.245 MZH78 3 23154.693 MZH78 4 f 2 (3 H 4)6 s 6 p (1 P° 1) (4,1)° 5 23819.871 MZH78 4 f 2 (3 H 4)6 s 6 p (1 P° 1) (4,1)° 4 23901.786 MZH78 4 f 2 (3 H 4)6 s 6 p (1 P° 1) (4,1)° 3 _ 6 24691.432 MZH78 4 f 2 (3 H 6)6 s 6 p (1 P° 1)? (6,1)°? 7 27149.080? M75c 4 f 2 (3 H 6)6 s 6 p (1 P° 1)? (6,1)°? 5 27192.300? MZH78 4 f 2 (3 H 6)6 s 6 p (1 P° 1)? (6,1)°? 6 27491.670 MZH78 Ce II (4 H° 7 / 2) Limit 44672 WSPC78

Energy Levels of Neutral Cesium (Cs I)

Energy Levels of Neutral Cesium (Cs I)

Configuration Term J Level(cm -1) Ref. 5 p 6 (1 S)6 s 2 S 1 / 2 0.0000 WS87 5 p 6 (1 S)6 p 2 P° 1 / 2 11178.2686 WS87 5 p 6 (1 S)6 p 2 P° 3 / 2 11732.3079 EW70 5 p 6 (1 S)7 s 2 S 1 / 2 18535.529 WS87 5 p 6 (1 S)7 p 2 P° 1 / 2 21765.35 WS87 5 p 6 (1 S)7 p 2 P° 3 / 2 21946.396 K62b 5 p 6 (1 S)5 d 2 D 3 / 2 14499.2584 WS87 5 p 6 (1 S)5 d 2 D 5 / 2 14596.8423 WS87 5 p 6 (1 S)6 d 2 D 3 / 2 22588.8210 EJN64 5 p 6 (1 S)6 d 2 D 5 / 2 22631.6863 EJN64 Cs II (1 S 0) Limit 31406.46766 WS87

Energy Levels of Neutral Iodine (I I)

Energy Levels of Neutral Iodine (I I)

Configuration Term J Level(cm -1) Ref. 5 p 5 2 P° 3 / 2 0.00 M62 5 p 5 2 P° 1 / 2 7603.15 M62 5 p 4 (3 P 2)6 s 2 [2] 5 / 2 54633.46 M62 5 p 4 (3 P 2)6 s 2 [2] 3 / 2 56092.88 M62 5 p 4 (3 P 0)6 s 2 [0] 1 / 2 60896.23 M62 5 p 4 (3 P 1)6 s 2 [1] 3 / 2 61819.76 M62 5 p 4 (3 P 1)6 s 2 [1] 1 / 2 63186.75 M62 5 p 4 (3 P 2)6 p 2 [2]° 5 / 2 64906.31 M62 5 p 4 (3 P 2)6 p 2 [2]° 3 / 2 64990.00 M62 5 p 4 (3 P 2)6 p 2 [3]° 5 / 2 65644.49 M62 5 p 4 (3 P 2)6 p 2 [3]° 7 / 2 65669.99 M62 5 p 4 (3 P 2)6 p 2 [1]° 1 / 2 65856.96 M62 5 p 4 (3 P 2)6 p 2 [1]° 3 / 2 67062.09 M62 5 p 4 (3 P 2)5 d 2 [1] 3 / 2 66355.10 M62 5 p 4 (3 P 2)5 d 2 [1] 1 / 2 67298.33 M62 5 p 4 (1 D 2)6 s 2 [2] 3 / 2 68549.75 M62 5 p 4 (1 D 2)6 s 2 [2] 5 / 2 68587.87 M62 5 p 4 (3 P 1)6 p 2 [0]° 1 / 2 71501.47 M62 5 p 4 (3 P 0)6 p 2 [1]° 1 / 2 71813.90 M62 5 p 4 (3 P 0)6 p 2 [1]° 3 / 2 71976.72 M62 5 p 4 (3 P 1)6 p 2 [2]° 5 / 2 72529.16 M62 5 p 4 (3 P 1)6 p 2 [2]° 3 / 2 72807.13 M62 5 p 4 (3 P 1)6 p 2 [1]° 3 / 2 73054.54 M62 5 p 4 (3 P 1)6 p 2 [1]° 1 / 2 73387.15 M62 5 p 4 (3 P 1)5 d 2 [1] 1 / 2 73477.24 M62 5 p 4 (3 P 1)5 d 2 [1] 3 / 2 74587.42 M62 5 p 4 (3 P 2)7 p 2 [1] 1 / 2 75303.13 M62 5 p 4 (3 P 2)7 p 2 [1] 3 / 2 75621.41 M62 5 p 4 (1 D 2)6 p 2 [1]° 3 / 2 78415.25 M62 5 p 4 (1 D 2)6 p 2 [1]° 1 / 2 79701.59 M62 5 p 4 (1 D 2)6 p 2 [3]° 5 / 2 78592.55 M62 5 p 4 (1 D 2)6 p 2 [3]° 7 / 2 79003.61 M62 5 p 4 (1 D 2)6 p 2 [2]° 3 / 2 80039.82 M62 5 p 4 (1 D 2)6 p 2 [2]° 5 / 2 80125.45 M62 I II (3 P 2) Limit 84295.14 M62

Energy Levels of Neutral Lanthanum (La I)

Energy Levels of Neutral Lanthanum (La I)

Configuration Term J Level(cm -1) Ref. 5 d 6 s 2 2 D 3 / 2 0.000 MZH78 5 d 6 s 2 2 D 5 / 2 1053.164 MZH78 5 d 2 (3 F)6 s 4 F 3 / 2 2668.188 MZH78 5 d 2 (3 F)6 s 4 F 5 / 2 3010.002 MZH78 5 d 2 (3 F)6 s 4 F 7 / 2 3494.526 MZH78 5 d 2 (3 F)6 s 4 F 9 / 2 4121.572 MZH78 5 d 2 (3 F)6 s 2 F 5 / 2 7011.909 MZH78 5 d 2 (3 F)6 s 2 F 7 / 2 8052.162 MZH78 5 d 2 (3 P)6 s 4 P 1 / 2 7231.407 MZH78 5 d 2 (3 P)6 s 4 P 3 / 2 7490.521 MZH78 5 d 2 (3 P)6 s 4 P 5 / 2 7679.939 MZH78 5 d 2 (1 D)6 s 2 D 3 / 2 8446.044 MZH78 5 d 2 (1 D)6 s 2 D 5 / 2 9183.797 MZH78 5 d 2 (3 P)6 s 2 P 1 / 2 9044.214 MZH78 5 d 2 (3 P)6 s 2 P 3 / 2 9719.439 MZH78 5 d 2 (1 G)6 s 2 G 9 / 2 9919.821 MZH78 5 d 2 (1 G)6 s 2 G 7 / 2 9960.904 MZH78 5 d 3 4 F 3 / 2 12430.609 MZH78 5 d 3 4 F 5 / 2 12787.404 MZH78 5 d 3 4 F 7 / 2 13238.323 MZH78 5 d 3 4 F 9 / 2 13747.276 MZH78 5 d 6 s (3 D)6 p 4 F° 3 / 2 13260.38 MZH78 5 d 6 s (3 D)6 p 4 F° 5 / 2 14804.08 MZH78 5 d 6 s (3 D)6 p 4 F° 7 / 2 15019.51 MZH78 5 d 6 s (3 D)6 p 4 F° 9 / 2 16243.17 MZH78 5 d 6 s (3 D)6 p ° 5 / 2 13631.04 MZH78 5 d 6 s (3 D)6 p 4 D° 1 / 2 14095.69 MZH78 5 d 6 s (3 D)6 p 4 D° 3 / 2 14708.92 MZH78 5 d 6 s (3 D)6 p 4 D° 5 / 2 15503.64 MZH78 5 d 6 s (3 D)6 p 4 D° 7 / 2 16099.29 MZH78 5 d 6 s (3 D)6 p ° 3 / 2 15031.64 MZH78 4 f 6 s 2 2 F° 5 / 2 15196.83 MZH78 4 f 6 s 2 2 F° 7 / 2 16538.39 MZH78 5 d 6 s (3 D)6 p ° 1 / 2 15219.89 MZH78 6 s 2 (1 S)6 p ° 3 / 2 16280.26 MZH78 5 d 3 4 P 1 / 2 16617.30 MZH78 5 d 3 4 P 3 / 2 16735.14 MZH78 5 d 3 4 P 5 / 2 17099.38 MZH78 5 d 2 (3 F)6 p ° 5 / 2 16856.80 MZH78 5 d 2 (1 S)6 s 2 S 1 / 2 16991.42 MZH78 5 d 3 2 G 7 / 2 17023.36 MZH78 5 d 3 2 G 9 / 2 17140.90 MZH78 5 d 6 s (3 D)6 p 4 P° 1 / 2 17567.49 MZH78 5 d 6 s (3 D)6 p 4 P° 3 / 2 17797.29 MZH78 5 d 6 s (3 D)6 p 4 P° 5 / 2 18156.97 MZH78 5 d 2 (3 F)6 p ° 7 / 2 17910.17 MZH78 5 d 2 (3 F)6 p 4 G° 5 / 2 17947.13 MZH78 5 d 2 (3 F)6 p 4 G° 7 / 2 18603.92 MZH78 5 d 2 (3 F)6 p 4 G° 9 / 2 19129.31 MZH78 5 d 2 (3 F)6 p 4 G° 1 1 / 2 20117.38 MZH78 5 d 2 (3 F)6 p 2 D° 3 / 2 18172.35 MZH78 5 d 2 (3 F)6 p 2 D° 5 / 2 19379.40 MZH78 5 d 2 (3 F)6 p 4 F° 3 / 2 20082.98 MZH78 5 d 2 (3 F)6 p 4 F° 5 / 2 20338.25 MZH78 5 d 2 (3 F)6 p 4 F° 7 / 2 20763.21 MZH78 5 d 2 (3 F)6 p 4 F° 9 / 2 21384.00 MZH78 5 d 6 s (1 D)6 p ° 1 / 2 20197.34 MZH78 5 d 2 (3 F)6 p 4 D° 1 / 2 22246.64 MZH78 5 d 2 (3 F)6 p 4 D° 3 / 2 22439.36 MZH78 5 d 2 (3 F)6 p 4 D° 5 / 2 22804.25 MZH78 5 d 2 (3 F)6 p 4 D° 7 / 2 23303.26 MZH78 5 d 6 s (3 D)6 p ° 7 / 2 23221.10 MZH78 5 d 6 s (3 D)6 p ° 5 / 2 23874.95 MZH78 4 f 5 d (1 G°)6 s ° 7 / 2 24409.68 MZH78 4 f 5 d (3 G°)6 s 4 G° 5 / 2 27022.62 MZH78 4 f 5 d (3 G°)6 s 4 G° 7 / 2 27455.31 MZH78 4 f 5 d (3 G°)6 s 4 G° 9 / 2 28089.17 MZH78 4 f 5 d (3 G°)6 s 4 G° 1 1 / 2 28743.24 MZH78 4 f 5 d (3 D°)6 s ° 3 / 2 27968.54 MZH78 La II (3 F 2) Limit 44981 MZH78

Energy Levels of Neutral Praseodymium (Pr I)

Energy Levels of Neutral Praseodymium (Pr I)

Configuration Term J Level(cm -1) Ref. 4 f 3 6 s 2 4 I° 9 / 2 0.00 MZH78 4 f 3 6 s 2 4 I° 1 1 / 2 1376.60 MZH78 4 f 3 6 s 2 4 I° 1 3 / 2 2846.75 MZH78 4 f 3 6 s 2 4 I° 1 5 / 2 4381.10 MZH78 4 f 2 (3 H)5 d 6 s 2 4 I 9 / 2 4432.22 MZH78 4 f 2 (3 H)5 d 6 s 2 4 I 1 1 / 2 6313.23 MZH78 4 f 2 (3 H)5 d 6 s 2 4 I 1 3 / 2 7951.31 MZH78 4 f 2 (3 H)5 d 6 s 2 4 I 1 5 / 2 _ 4 f 2 (3 H)5 d 6 s 2 4 K 1 1 / 2 4866.54 MZH78 4 f 2 (3 H)5 d 6 s 2 4 K 1 3 / 2 6603.60 MZH78 4 f 2 (3 H)5 d 6 s 2 4 K 1 5 / 2 8363.91* MZH78 4 f 2 (3 H)5 d 6 s 2 4 K 1 7 / 2 _ 4 f 2 (3 H)5 d 6 s 2 2 H 9 / 2 5822.87 MZH78 4 f 2 (3 H)5 d 6 s 2 2 H 1 1 / 2 6892.95 MZH78 4 f 2 (3 H)5 d 6 s 2 4 H 7 / 2 6535.51 MZH78 4 f 2 (3 H)5 d 6 s 2 4 H 9 / 2 8029.24 MZH78 4 f 2 (3 H)5 d 6 s 2 4 H 1 1 / 2 9675.01 MZH78 4 f 2 (3 H)5 d 6 s 2 4 H 1 3 / 2 _ 4 f 2 (3 H)5 d 2 (3 F) (5 L)6 s 6 L 1 1 / 2 6714.22 MZH78 4 f 2 (3 H)5 d 2 (3 F) (5 L)6 s 6 L 1 3 / 2 7630.16 MZH78 4 f 2 (3 H)5 d 2 (3 F) (5 L)6 s 6 L 1 5 / 2 _ 4 f 2 (3 H)5 d 2 (3 F) (5 L)6 s 6 L 1 7 / 2 _ 4 f 2 (3 H)5 d 2 (3 F) (5 L)6 s 6 L 1 9 / 2 _ 4 f 2 (3 H)5 d 2 (3 F) (5 L)6 s 6 L 2 1 / 2 _ 4 f 3 6 s 6 p ? 4 I? 1 1 / 2 19474.75 MZH78 4 f 3 (4 I°)6 s 6 p (1 P°)? 4 I? 9 / 2 20190.85 MZH78 7 / 2 21105.88 MZH78 4 f 3 (4 I°)6 s 6 p ? 4 K? 1 3 / 2 21263.71 MZH78 1 1 / 2 21677.15 MZH78 1 5 / 2 22498.81 MZH78 9 / 2 22509.40 MZH78 4 f 3 6 s 6 p ? 4 K? 1 5 / 2 22762.55 MZH78 9 / 2 22924.39 MZH78 4 f 3 6 s 6 p ? 4 I? 1 3 / 2 23085.08 MZH78 4 f 3 6 s 6 p ? 4 K? 1 7 / 2 24195.13 MZH78 Pr II (4 I° 9 / 2)6 s (9 / 2 , 1 / 2)° 4 Limit 44140 WSPC78

Energy Levels of Neutral Xenon (Xe I)

Energy Levels of Neutral Xenon (Xe I)

Configuration Term J Level(cm -1) Ref. 5 p 6 1 S 0 0.000 BVHU01 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 67067.547 BVHU01 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 68045.156 BVHU01 5 p 5 (2 P° 1 / 2)6 s 2 [1 / 2]° 0 76196.767 BVHU01 5 p 5 (2 P° 1 / 2)6 s 2 [1 / 2]° 1 77185.040 BVHU01 5 p 5 (2 P° 3 / 2)6 p 2 [1 / 2] 1 77269.144 HP70b 5 p 5 (2 P° 3 / 2)6 p 2 [1 / 2] 0 80118.962 HP70b 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 2 78119.798 HP70b 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 3 78403.060 HP70b 5 p 5 (2 P° 3 / 2)6 p 2 [3 / 2] 1 78956.031 HP70b 5 p 5 (2 P° 3 / 2)6 p 2 [3 / 2] 2 79212.464 HP70b 5 p 5 (2 P° 3 / 2)5 d 2 [1 / 2]° 0 79771.268 HP70b 5 p 5 (2 P° 3 / 2)5 d 2 [1 / 2]° 1 79986.619 HP70b 5 p 5 (2 P° 3 / 2)5 d 2 [7 / 2]° 4 80196.629 HP70b 5 p 5 (2 P° 3 / 2)5 d 2 [7 / 2]° 3 80970.439 HP70b 5 p 5 (2 P° 3 / 2)5 d 2 [3 / 2]° 2 80322.747 HP70b 5 p 5 (2 P° 3 / 2)5 d 2 [3 / 2]° 1 83889.971 HP70b 5 p 5 (2 P° 3 / 2)5 d 2 [5 / 2]° 2 81925.515 HP70b 5 p 5 (2 P° 3 / 2)5 d 2 [5 / 2]° 3 82430.205 HP70b 5 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 85188.774 HP70b 5 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 1 85440.014 HP70b 5 p 5 (2 P° 1 / 2)6 p 2 [3 / 2] 1 88379.126 HP70b 5 p 5 (2 P° 1 / 2)6 p 2 [3 / 2] 2 89162.355 HP70b 5 p 5 (2 P° 1 / 2)6 p 2 [1 / 2] 1 89278.706 HP70b 5 p 5 (2 P° 1 / 2)6 p 2 [1 / 2] 0 89860.015 HP70b 5 p 5 (2 P° 1 / 2)5 d 2 [5 / 2]° 2 91152.671 HP70b 5 p 5 (2 P° 1 / 2)5 d 2 [5 / 2]° 3 91746.575 HP70b Xe II (2 P° 3 / 2) Limit 97833.787 BVHU01 , KW85

Energy Levels of Neutral Dysprosium (Dy I)

Energy Levels of Neutral Dysprosium (Dy I)

Configuration Term J Level(cm -1) Ref. 4 f 1 0 6 s 2 5 I 8 0.000 NG00 4 f 1 0 6 s 2 5 I 7 4134.222 NG00 4 f 1 0 6 s 2 5 I 6 7050.603 NG00 4 f 1 0 6 s 2 5 I 5 9211.591 NG00 4 f 1 0 6 s 2 5 I 4 10925.277 NG00 4 f 9 (6 H°)5 d 6 s 2 7 H° 8 7565.610 NG00 4 f 9 (6 H°)5 d 6 s 2 7 H° 7 8519.210 NG00 4 f 9 (6 H°)5 d 6 s 2 7 H° 6 10088.802 NG00 4 f 9 (6 H°)5 d 6 s 2 7 H° 5 12298.551 NG00 4 f 9 (6 H°)5 d 6 s 2 7 H° 4 13952.001 NG00 4 f 9 (6 H°)5 d 6 s 2 7 H° 3 15254.936 NG00 4 f 9 (6 H°)5 d 6 s 2 7 H° 2 _ 4 f 9 (6 H°)5 d 6 s 2 7 I° 9 9990.974 NG00 4 f 9 (6 H°)5 d 6 s 2 7 I° 8 12007.121 NG00 4 f 9 (6 H°)5 d 6 s 2 7 I° 7 14367.806 NG00 4 f 9 (6 H°)5 d 6 s 2 7 I° 6 14970.701 NG00 4 f 9 (6 H°)5 d 6 s 2 7 I° 5 16684.731 NG00 4 f 9 (6 H°)5 d 6 s 2 7 I° 4 _ 4 f 9 (6 H°)5 d 6 s 2 7 I° 3 _ 4 f 9 (6 H°)5 d 6 s 2 5 K° 9 13495.932 NG00 4 f 9 (6 H°)5 d 6 s 2 5 K° 8 19688.595 NG00 4 f 9 (6 H°)5 d 6 s 2 5 K° 7 21783.407 NG00 4 f 9 (6 H°)5 d 6 s 2 5 K° 6 23464.019 NG00 4 f 9 (6 H°)5 d 6 s 2 5 K° 5 24881.867 NG00 4 f 1 0 (5 I 8)6 s 6 p (1 P° 1) (8,1)° 9 23736.610 NG00 4 f 1 0 (5 I 8)6 s 6 p (1 P° 1) (8,1)° 8 23877.739 NG00 4 f 1 0 (5 I 8)6 s 6 p (1 P° 1) (8,1)° 7 24708.971 NG00 4 f 9 (6 H°)5 d 2 (3 F) (8 K°)6 s ° 8 23832.060 NG00 4 f 1 0 (5 I 7)6 s 6 p (1 P° 1) (7,1)° 8 27818.000 NG00 4 f 1 0 (5 I 7)6 s 6 p (1 P° 1) (7,1)° 7 27834.933 NG00 4 f 1 0 (5 I 7)6 s 6 p (1 P° 1) (7,1)° 6 28119.931 NG00 4 f 9 (6 H°)5 d 2 (3 P) (8 I°)6 s ° 8 27851.435 NG00 4 f 9 (6 H°)5 d 2 (3 F) (8 L°)6 s ° 7 27984.513 NG00 4 f 1 0 (5 I 6)6 s 6 p (1 P° 1) (6,1)° 7 30711.717 NG00 4 f 1 0 (5 I 6)6 s 6 p (1 P° 1) (6,1)° 6 30778.958 NG00 4 f 1 0 (5 I 6)6 s 6 p (1 P° 1) (6,1)° 5 - Dy II (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 7 / 2 Limit 47900 WSPC78

Energy Levels of Neutral Europium (Eu I)

Energy Levels of Neutral Europium (Eu I)

Configuration Term J Level(cm -1) Ref. 4 f 7 6 s 2 a 8 S° 7 / 2 0.00 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 1 0 D° 5 / 2 12923.72 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 1 0 D° 7 / 2 13048.90 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 1 0 D° 9 / 2 13222.04 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 1 0 D° 1 1 / 2 13457.21 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 1 0 D° 1 3 / 2 13778.68 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 1 0 P 7 / 2 14067.86 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 1 0 P 9 / 2 14563.57 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 1 0 P 1 1 / 2 15581.58 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 8 D° 3 / 2 15137.72 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 8 D° 5 / 2 15248.76 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 8 D° 7 / 2 15421.25 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 8 D° 9 / 2 15680.28 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s a 8 D° 1 1 / 2 16079.76 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 8 P 5 / 2 15890.53 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 8 P 7 / 2 15952.31 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 8 P 9 / 2 16611.79 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 6 P 7 / 2 17340.65 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 6 P 5 / 2 17707.42 MZH78 4 f 7 (8 S°)6 s 6 p (3 P°) z 6 P 3 / 2 17945.49 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s a 6 D° 9 / 2 19273.24 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s a 6 D° 7 / 2 19364.50 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s a 6 D° 5 / 2 19462.05 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s a 6 D° 3 / 2 19543.69 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s a 6 D° 1 / 2 19599.16 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s b 8 D° 1 1 / 2 19447.19 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s b 8 D° 9 / 2 19631.26 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s b 8 D° 7 / 2 19712.15 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s b 8 D° 5 / 2 19763.78 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s b 8 D° 3 / 2 19794.21 MZH78 4 f 7 (8 S°)6 s 6 p (1 P°) y 8 P 5 / 2 21444.58 MZH78 4 f 7 (8 S°)6 s 6 p (1 P°) y 8 P 7 / 2 21605.17 MZH78 4 f 7 (8 S°)6 s 6 p (1 P°) y 8 P 9 / 2 21761.26 MZH78 4 f 6 (7 F)5 d 6 s 2 8 D 3 / 2 _ 4 f 6 (7 F)5 d 6 s 2 8 D 5 / 2 27852.90 MZH78 4 f 6 (7 F)5 d 6 s 2 8 D 7 / 2 28827.83 MZH78 4 f 6 (7 F)5 d 6 s 2 8 D 9 / 2 29838.59 MZH78 4 f 6 (7 F)5 d 6 s 2 8 D 1 1 / 2 30819.44 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 F 3 / 2 28519.97 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 F 5 / 2 28667.39 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 F 7 / 2 28918.17 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 F 9 / 2 29186.32 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 F 1 1 / 2 29612.69 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 F 1 3 / 2 30211.09 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 F 1 5 / 2 30923.71 MZH78 4 f 6 (7 F)5 d 6 s 2 8 P 5 / 2 29982.50 MZH78 4 f 6 (7 F)5 d 6 s 2 8 P 7 / 2 31116.38 MZH78 4 f 6 (7 F)5 d 6 s 2 8 P 9 / 2 32130.25 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 D 5 / 2 30945.07 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 D 7 / 2 31138.11 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 D 9 / 2 31382.61 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 D 1 1 / 2 31725.93 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 D 1 3 / 2 32117.10 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p y 1 0 P 7 / 2 32398.25 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p y 1 0 P 9 / 2 32596.31 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p y 1 0 P 1 1 / 2 32948.41 MZH78 Eu II (9 S° 4) Limit 45734.74 NRCA00

Energy Levels of Neutral Gadolinium (Gd I)

Energy Levels of Neutral Gadolinium (Gd I)

Configuration Term J Level(cm -1) Ref. 4 f 7 (8 S°)5 d 6 s 2 9 D° 2 0.000 MZH78 4 f 7 (8 S°)5 d 6 s 2 9 D° 3 215.124 MZH78 4 f 7 (8 S°)5 d 6 s 2 9 D° 4 532.977 MZH78 4 f 7 (8 S°)5 d 6 s 2 9 D° 5 999.121 MZH78 4 f 7 (8 S°)5 d 6 s 2 9 D° 6 1719.087 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 2 6378.146 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 3 6550.395 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 4 6786.184 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 5 7103.420 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 6 7480.348 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 7 7947.294 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 8 8498.434 MZH78 4 f 7 (8 S°)5 d 6 s 2 7 D° 5 6976.508 MZH78 4 f 7 (8 S°)5 d 6 s 2 7 D° 4 7234.910 MZH78 4 f 7 (8 S°)5 d 6 s 2 7 D° 3 7426.710 MZH78 4 f 7 (8 S°)5 d 6 s 2 7 D° 2 7562.457 MZH78 4 f 7 (8 S°)5 d 6 s 2 7 D° 1 7653.927 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 9 F° 1 10222.233 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 9 F° 2 10359.905 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 9 F° 3 10576.410 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 9 F° 4 10883.505 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 9 F° 5 11296.465 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 9 F° 6 11830.393 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 9 F° 7 12486.547 MZH78 4 f 8 6 s 2 7 F 6 10947.210 MZH78 4 f 8 6 s 2 7 F 5 12519.997 MZH78 4 f 8 6 s 2 7 F 4 13506.051 MZH78 4 f 8 6 s 2 7 F 3 14253.948 MZH78 4 f 8 6 s 2 7 F 2 14777.975 MZH78 4 f 8 6 s 2 7 F 1 15121.220 MZH78 4 f 8 6 s 2 7 F 0 15289.035 MZH78 4 f 7 (8 S°)5 d 2 (3 P) (1 0 P°)6 s 1 1 P° 4 11685.594 MZH78 4 f 7 (8 S°)5 d 2 (3 P) (1 0 P°)6 s 1 1 P° 5 12057.164 MZH78 4 f 7 (8 S°)5 d 2 (3 P) (1 0 P°)6 s 1 1 P° 6 12345.966 MZH78 4 f 7 (8 S°)6 s 2 6 p 9 P 3 13433.851 MZH78 4 f 7 (8 S°)6 s 2 6 p 9 P 4 13926.311 MZH78 4 f 7 (8 S°)6 s 2 6 p 9 P 5 15665.424 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (3 P°) 1 1 F 2 14036.026 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (3 P°) 1 1 F 3 14298.311 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (3 P°) 1 1 F 4 14669.148 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (3 P°) 1 1 F 5 15174.000 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (3 P°) 1 1 F 6 15852.245 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (3 P°) 1 1 F 7 16775.024 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (3 P°) 1 1 F 8 17909.944 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 2 22334.508 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 9 D 3 22563.824 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 9 D 4 22820.895 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 9 D 5 23196.410 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 9 D 6 23229.298 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 9 D 2 24655.639 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 23103.660 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 3 23389.782 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 5 23999.912 MZH78 4 f 8 (7 F)5 d (8 G)6 s 9 G 7 24255.103 MZH78 4 f 8 (7 F)5 d (8 G)6 s 9 G 8 _ 4 f 8 (7 F)5 d (8 G)6 s 9 G 6 24854.297 MZH78 4 f 8 (7 F)5 d (8 G)6 s 9 G 5 25380.885 MZH78 4 f 8 (7 F)5 d (8 G)6 s 9 G 4 25820.720 MZH78 4 f 8 (7 F)5 d (8 G)6 s 9 G 3 26247.609 MZH78 4 f 8 (7 F)5 d (8 G)6 s 9 G 2 26588.338 MZH78 4 f 8 (7 F)5 d (8 G)6 s 9 G 1 26834.311 MZH78 4 f 8 (7 F)5 d (8 G)6 s 9 G 0 27089.815 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 6 24430.425 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 4 24849.514 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 5 25043.649 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 1 25069.179 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 2 25164.640 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 3 25403.265 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 4 25571.672* MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 5 25940.122 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 6 26337.071 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 7 26870.393 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 8 27536.397 MZH78 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 9 28432.859 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 7 25376.313 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 6 25661.340 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 9 P 3 27135.695 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 4 27425.245 MZH78 Gd II (1 0 D° 5 / 2) Limit 49601.45 MOW98

Energy Levels of Neutral Neodymium (Nd I)

Energy Levels of Neutral Neodymium (Nd I)

Configuration Term J Level(cm -1) Ref. 4 f 4 6 s 2 5 I 4 0.000 MZH78 4 f 4 6 s 2 5 I 5 1128.056 MZH78 4 f 4 6 s 2 5 I 6 2366.597 MZH78 4 f 4 6 s 2 5 I 7 3681.696 MZH78 4 f 4 6 s 2 5 I 8 5048.602 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 L° 6 6764.211 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 L° 7 8402.487 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 L° 8 10160.612 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 L° 9 12162.142 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 L° 10 _ 4 f 3 (4 I°)5 d 6 s 2 5 K° 5 6853.994 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 K° 6 8411.900 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 K° 7 10017.790 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 K° 8 11704.640 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 K° 9 _ 4 f 4 (5 I)5 d 6 s (3 D) 7 L 5 8475.355 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 L 6 9115.092 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 L 7 9939.704 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 L 8 10897.998 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 L 9 11959.761 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 L 10 13101.411 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 L 11 14304.110 MZH78 4 f 3 (4 I°)5 d 2 (3 F) (6 M°)6 s 7 M° 6 8800.392 MZH78 4 f 3 (4 I°)5 d 2 (3 F) (6 M°)6 s 7 M° 7 9692.277 MZH78 4 f 3 (4 I°)5 d 2 (3 F) (6 M°)6 s 7 M° 8 10784.929 MZH78 4 f 3 (4 I°)5 d 2 (3 F) (6 M°)6 s 7 M° 9 11887.735 MZH78 4 f 3 (4 I°)5 d 2 (3 F) (6 M°)6 s 7 M° 10 _ 4 f 3 (4 I°)5 d 2 (3 F) (6 M°)6 s 7 M° 11 _ 4 f 3 (4 I°)5 d 2 (3 F) (6 M°)6 s 7 M° 12 _ 4 f 3 (4 I°)5 d 6 s 2 5 I° 4 9083.813 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 I° 5 10004.583 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 I° 6 11179.045 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 I° 7 12927.232 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 I° 8 14732.200 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 K 4 9814.683 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 K 5 10376.842 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 K 6 11109.167 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 K 7 11918.353 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 K 8 12902.422 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 K 9 13953.585 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 7 K 10 15073.203 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 H° 3 9927.387 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 H° 4 10672.571 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 H° 5 12394.260 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 H° 6 14308.080 MZH78 4 f 3 (4 I°)5 d 6 s 2 5 H° 7 15396.590 MZH78 4 f 4 6 s 2 5 F 1 10118.968 MZH78 4 f 4 6 s 2 5 F 2 10469.468 MZH78 4 f 4 6 s 2 5 F 3 11118.466 MZH78 4 f 4 6 s 2 5 F 4 11866.108 ABK92 4 f 4 6 s 2 5 F 5 12894.721 ABK92 4 f 4 (5 I)5 d 6 s (3 D) 5 L 6 10774.927 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 5 L 7 12056.824 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 5 L 8 13333.505 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 5 L 9 14687.945 MZH78 4 f 4 (5 I)5 d 6 s (3 D) 5 L 10 16092.06 MZH78 ° 5 20176.912 MZH78 4 f 4 6 s 6 p 5 K° 5 20300.875 MZH78 4 f 4 6 s 6 p 5 K° 6 21543.326 MZH78 4 f 4 6 s 6 p 5 K° 7 22761.440 MZH78 4 f 4 6 s 6 p 5 K° 8 24121.478 MZH78 4 f 4 6 s 6 p 5 K° 9 25518.700 MZH78 ° 4 21184.881 MZH78 ° 6 21345.572 MZH78 ° 4 21345.837 MZH78 4 f 4 6 s 6 p 5 H° 3 21572.610 MZH78 ° 6 23996.513 MZH78 Nd II (6 I 7 / 2) Limit 44562 WSPC78

Energy Levels of Neutral Promethium (Pm I)

Energy Levels of Neutral Promethium (Pm I)

Configuration Term J Level(cm -1) Ref. 4 f 5 6 s 2 6 H° 5 / 2 0.00 RD67 4 f 5 6 s 2 6 H° 7 / 2 803.82 RD67 4 f 5 6 s 2 6 H° 9 / 2 1748.78 RD67 4 f 5 6 s 2 6 H° 1 1 / 2 2797.10 RD67 4 f 5 6 s 2 6 H° 1 3 / 2 3919.03 RD67 4 f 5 6 s 2 6 H° 1 5 / 2 5089.79 RD67 4 f 5 6 s 2 6 F° 1 / 2 5249.48 RD67 4 f 5 6 s 2 6 F° 3 / 2 5460.50 RD67 4 f 5 6 s 2 6 F° 5 / 2 5872.84 RD67 4 f 5 6 s 2 6 F° 7 / 2 6562.86 RD67 4 f 5 6 s 2 6 F° 9 / 2 7497.99 RD67 4 f 5 6 s 2 6 F° 1 1 / 2 8609.21 RD67 7 / 2 17104.72 RD67 3 / 2 20006.04 RD67 7 / 2 20157.85 RD67 5 / 2 20265.98 RD67 5 / 2 20567.76 RD67 9 / 2 21237.49 RD67 7 / 2 21371.05 RD67 9 / 2 21625.45 RD67 9 / 2 21920.49 RD67 9 / 2 22294.96 RD67 1 1 / 2 22414.17 RD67 1 1 / 2 23345.07 RD67 1 3 / 2 23629.06 RD67 1 3 / 2 23740.42 RD67 1 1 / 2 24912.34 RD67 1 7 / 2 26096.75 RD67 9 / 2 28274.21 RD67 Pm II (7 H° 2) Limit 45020 WSPC78

Energy Levels of Neutral Samarium (Sm I)

Energy Levels of Neutral Samarium (Sm I)

Configuration Term J Level(cm -1) Ref. 4 f 6 6 s 2 7 F 0 0.00 MZH78 4 f 6 6 s 2 7 F 1 292.58 MZH78 4 f 6 6 s 2 7 F 2 811.92 MZH78 4 f 6 6 s 2 7 F 3 1489.55 MZH78 4 f 6 6 s 2 7 F 4 2273.09 MZH78 4 f 6 6 s 2 7 F 5 3125.46 MZH78 4 f 6 6 s 2 7 F 6 4020.66 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 1 10801.10 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 2 11044.90 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 3 11406.50 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 4 11877.50 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 5 12445.35 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 6 13095.75 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 7 13814.90 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 8 14591.70 MZH78 4 f 6 (7 F)5 d (8 H)6 s 9 H 9 15418.65 MZH78 4 f 6 (7 F)5 d (8 D)6 s 9 D 2 12313.11 MZH78 4 f 6 (7 F)5 d (8 D)6 s 9 D 3 12846.64 MZH78 4 f 6 (7 F)5 d (8 D)6 s 9 D 4 13458.46 MZH78 4 f 6 (7 F)5 d (8 D)6 s 9 D 5 14202.85 MZH78 4 f 6 (7 F)5 d (8 D)6 s 9 D 6 15082.94 MZH78 4 f 6 (7 F)5 d (8 H)6 s 7 H 2 13050.05 MZH78 4 f 6 (7 F)5 d (8 H)6 s 7 H 3 13542.80 MZH78 4 f 6 (7 F)5 d (8 H)6 s 7 H 4 14154.30 MZH78 4 f 6 (7 F)5 d (8 H)6 s 7 H 5 14856.20 MZH78 4 f 6 (7 F)5 d (8 H)6 s 7 H 6 15617.45 MZH78 4 f 6 (7 F)5 d (8 H)6 s 7 H 7 16392.93 MZH78 4 f 6 (7 F)5 d (8 H)6 s 7 H 8 17270.96 MZH78 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 1 21193.68 MZH78 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 2 21813.22 MZH78 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 3 22632.30 MZH78 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 4 23594.84 MZH78 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 5 24323.51 MZH78 4 f 6 (7 F)6 s 6 p (1 P°) 7 G° 1 22914.07 MZH78 4 f 5 (6 F°)5 d 6 s 2 ° 4 24633.75 MZH78 4 f 6 (7 F)6 s 6 p (1 P°) ° 5 24668.79 MZH78 ° 6 26180.92 MZH78 4 f 5 (6 F°)5 d 6 s 2 7 F° 0 _ 4 f 5 (6 F°)5 d 6 s 2 7 F° 1 26281.09 MZH78 4 f 5 (6 F°)5 d 6 s 2 7 F° 2 26786.80 MZH78 4 f 5 (6 F°)5 d 6 s 2 7 F° 3 27425.50 MZH78 4 f 5 (6 F°)5 d 6 s 2 7 F° 4 28180.95 MZH78 4 f 5 (6 F°)5 d 6 s 2 7 F° 5 29023.96 MZH78 4 f 5 (6 F°)5 d 6 s 2 7 F° 6 30092.53 MZH78 4 f 6 (7 F)6 s 6 p (1 P°) 7 G° 7 27287.58 MZH78 Sm II (8 F 1 / 2) Limit 45519.6 JRB00

Energy Levels of Neutral Terbium (Tb I)

Energy Levels of Neutral Terbium (Tb I)

Configuration Term J Level(cm -1) Ref. 4 f 9 6 s 2 6 H° 1 5 / 2 0.000 B01 4 f 9 6 s 2 6 H° 1 3 / 2 2771.675 B01 4 f 9 6 s 2 6 H° 1 1 / 2 4670.450 B01 4 f 9 6 s 2 6 H° 9 / 2 6174.920 B01 4 f 9 6 s 2 6 H° 7 / 2 _ 4 f 9 6 s 2 6 H° 5 / 2 _ 4 f 8 (7 F)5 d 6 s 2 8 G 1 3 / 2 285.530 B01 4 f 8 (7 F)5 d 6 s 2 8 G 1 5 / 2 462.120 B01 4 f 8 (7 F)5 d 6 s 2 8 G 1 1 / 2 509.855 B01 4 f 8 (7 F)5 d 6 s 2 8 G 7 / 2 2419.470 B01 4 f 8 (7 F)5 d 6 s 2 8 G 9 / 2 2840.170 B01 4 f 8 (7 F)5 d 6 s 2 8 G 5 / 2 3174.575 B01 4 f 8 (7 F)5 d 6 s 2 8 G 3 / 2 3705.790 B01 4 f 8 (7 F)5 d 6 s 2 8 G 1 / 2 4018.160 B01 4 f 8 (7 F)5 d 6 s 2 9 / 2 1371.050 B01 4 f 8 (7 F)5 d 6 s 2 8 D 1 1 / 2 2310.120 B01 4 f 8 (7 F)5 d 6 s 2 8 D 7 / 2 3819.850 B01 4 f 8 (7 F)5 d 6 s 2 8 D 5 / 2 4695.495 B01 4 f 8 (7 F)5 d 6 s 2 8 D 3 / 2 5483.985 B01 4 f 8 (7 F)5 d 6 s 2 8 F 1 3 / 2 3719.720 B01 4 f 8 (7 F)5 d 6 s 2 8 F 1 1 / 2 5353.370 B01 4 f 8 (7 F)5 d 6 s 2 8 F 9 / 2 5829.845 B01 4 f 8 (7 F)5 d 6 s 2 8 F 1 / 2 6259.095 B01 4 f 8 (7 F)5 d 6 s 2 8 F 7 / 2 6488.275 B01 4 f 8 (7 F)5 d 6 s 2 8 F 5 / 2 6801.175 B01 4 f 8 (7 F)5 d 6 s 2 8 F 3 / 2 6849.725 B01 4 f 8 (7 F)5 d 6 s 2 8 H 1 7 / 2 4646.825 B01 4 f 8 (7 F)5 d 6 s 2 8 H 1 5 / 2 5425.065 B01 4 f 8 (7 F)5 d 6 s 2 8 H 1 3 / 2 6351.750 B01 4 f 8 (7 F)5 d 6 s 2 8 H 1 1 / 2 6988.795 B01 4 f 8 (7 F)5 d 6 s 2 8 H 9 / 2 7441.020 B01 4 f 8 (7 F)5 d 6 s 2 8 H 7 / 2 7839.820 B01 4 f 8 (7 F)5 d 6 s 2 8 H 5 / 2 8130.685 B01 4 f 8 (7 F)5 d 6 s 2 8 H 3 / 2 8336.310 B01 4 f 8 5 d 6 s 6 p ? ° 1 7 / 2 19131.480 B01 4 f 9 (6 H° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 3 / 2 23043.310 B01 4 f 9 (6 H° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 7 / 2 23107.025 B01 4 f 9 (6 H° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 5 / 2 23147.820 B01 ° 1 5 / 2 25076.265 B01 4 f 9 (6 H° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 1 / 2 25637.845 B01 4 f 9 (6 H° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 3 / 2 25717.655 B01 4 f 9 (6 H° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 5 / 2 25825.505 B01 4 f 8 5 d 6 s 6 p ? ° 1 7 / 2 26087.175 B01 ° 1 5 / 2 26386.005 B01 ° 1 1 / 2 27102.955 B01 Tb II (1 5 / 2 , 1 / 2)° 8 Limit 47296 WSPC78

Energy Levels of Neutral Erbium (Er I)

Energy Levels of Neutral Erbium (Er I)

Configuration Term J Level(cm -1) Ref. 4 f 1 2 6 s 2 3 H 6 0.000 MZH78 4 f 1 2 6 s 2 3 H 5 6958.329 MZH78 4 f 1 2 6 s 2 3 H 4 10750.982 MZH78 4 f 1 2 6 s 2 3 F 4 5035.193 MZH78 4 f 1 2 6 s 2 3 F 3 12377.534 MZH78 4 f 1 2 6 s 2 3 F 2 13097.906 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 3 / 2 6 s 2 (1 5 / 2 , 3 / 2)° 6 7176.503 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 3 / 2 6 s 2 (1 5 / 2 , 3 / 2)° 7 7696.956 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 3 / 2 6 s 2 (1 5 / 2 , 3 / 2)° 9 8620.565 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 3 / 2 6 s 2 (1 5 / 2 , 3 / 2)° 8 9350.106 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 6 s 2 (1 5 / 2 , 5 / 2)° 10 9655.848 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 6 s 2 (1 5 / 2 , 5 / 2)° 9 10557.916 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 6 s 2 (1 5 / 2 , 5 / 2)° 5 11401.197 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 6 s 2 (1 5 / 2 , 5 / 2)° 8 11557.670 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 6 s 2 (1 5 / 2 , 5 / 2)° 6 11799.778 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 6 s 2 (1 5 / 2 , 5 / 2)° 7 11887.503 MZH78 4 f 1 1 (4 I° 1 3 / 2)5 d 3 / 2 6 s 2 (1 3 / 2 , 3 / 2)° 8 15083.114 MZH78 4 f 1 1 (4 I° 1 3 / 2)5 d 3 / 2 6 s 2 (1 3 / 2 , 3 / 2)° 5 15185.352 MZH78 4 f 1 1 (4 I° 1 3 / 2)5 d 3 / 2 6 s 2 (1 3 / 2 , 3 / 2)° 7 15846.549 MZH78 4 f 1 1 (4 I° 1 3 / 2)5 d 3 / 2 6 s 2 (1 3 / 2 , 3 / 2)° 6 16070.095 MZH78 4 f 1 2 (3 H 6)6 s 6 p (3 P° 0) (6,0)° 6 16321.110 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 2 6 p 1 / 2 (1 5 / 2 , 1 / 2) 7 16464.934 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 2 6 p 1 / 2 (1 5 / 2 , 1 / 2) 8 16727.479 MZH78 4 f 1 2 (3 H 6)6 s 6 p (3 P° 1) (6,1)° 6 17073.800 MZH78 4 f 1 2 (3 H 6)6 s 6 p (3 P° 1) (6,1)° 7 17157.307 MZH78 4 f 1 2 (3 H 6)6 s 6 p (3 P° 1) (6,1)° 5 17347.860 MZH78 4 f 1 1 (4 I° 1 1 / 2)5 d 5 / 2 6 s 2 (1 1 / 2 , 5 / 2)° 3 19269.640 MZH78 4 f 1 1 (4 I° 1 1 / 2)5 d 5 / 2 6 s 2 (1 1 / 2 , 5 / 2)° 8 20566.805 MZH78 4 f 1 1 (4 I° 1 1 / 2)5 d 5 / 2 6 s 2 (1 1 / 2 , 5 / 2)° 4 20619.731 MZH78 4 f 1 1 (4 I° 1 1 / 2)5 d 5 / 2 6 s 2 (1 1 / 2 , 5 / 2)° 7 21168.430 MZH78 4 f 1 1 (4 I° 1 1 / 2)5 d 5 / 2 6 s 2 (1 1 / 2 , 5 / 2)° 5 21392.817 MZH78 4 f 1 1 (4 I° 1 1 / 2)5 d 5 / 2 6 s 2 (1 1 / 2 , 5 / 2)° 6 21701.885 MZH78 4 f 1 2 (3 H)6 s 6 p ° 5 24083.166 MZH78 4 f 1 1 (4 I°)5 d 6 s 2 ° 6 24457.139 MZH78 4 f 1 2 (3 H)6 s 6 p ° 7 24943.272 MZH78 ° 7 25159.143 MZH78 4 f 1 1 (4 I°)5 d 6 s 2 ° 5 25162.553 MZH78 4 f 1 1 (4 F°)5 d 6 s 2 ° 6 25392.779 MZH78 4 f 1 1 (4 F°)5 d 6 s 2 ° 5 25681.933 MZH78 4 f 1 2 (3 H)6 s 6 p ° 6 25880.274 MZH78 4 f 1 1 (4 I°)5 d 2 (3 F) (4 F°)6 s ° 5 30380.282 MZH78 4 f 1 2 (3 H)6 s 6 p ° 6 31823.748 MZH78 Er II (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 Limit 49262 WSPC78

Energy Levels of Neutral Hafnium (Hf I)

Energy Levels of Neutral Hafnium (Hf I)

Configuration Term J Level(cm -1) Ref. 5 d 2 6 s 2 3 F 2 0.00 MM76 5 d 2 6 s 2 3 F 3 2356.68 MM76 5 d 2 6 s 2 3 F 4 4567.64 MM76 5 d 2 6 s 2 3 P 0 5521.77 MM76 5 d 2 6 s 2 3 P 1 6572.54 MM76 5 d 2 6 s 2 3 P 2 8983.74 MM76 5 d 2 6 s 2 1 D 2 5638.61 MM76 5 d 6 s 2 6 p 3 F° 2 10508.88 MM76 , MS96 5 d 6 s 2 6 p 3 F° 3 14541.66 MM76 5 d 6 s 2 6 p 3 F° 4 18224.97 MM76 5 d 2 6 s 2 1 G 4 10532.55 MM76 5 d 6 s 2 6 p 3 D° 1 14017.81 MM76 5 d 6 s 2 6 p 3 D° 2 16163.35 MM76 5 d 6 s 2 6 p 3 D° 3 18381.50 MM76 5 d 6 s 2 6 p 1 D° 2 14435.12 MM76 , MS96 5 d 6 s 2 6 p 3 P° 1 18143.39 MM76 5 d 6 s 2 6 p 3 P° 0 18270.12 MM76 5 d 6 s 2 6 p 3 P° 2 19791.29 MM76 5 d 2 6 s 2 1 S 0 20328.36 W78 5 d 6 s 2 6 p 1 F° 3 23644.74 MM76 5 d 2 (3 F)6 s (4 F)6 p 5 D° 3 26305.78 MM76 5 d 6 s 2 6 p 1 P° 1 26463.93 MM76 5 d 2 (3 F)6 s (4 F)6 p 3 F° 2 27149.64 MM76 5 d 2 (3 F)6 s (2 F)6 p 3 G° 3 32533.32 MM76 5 d 2 (1 G)6 s (2 G)6 p 3 F° 2 33994.86 MM76 5 d 2 (3 F)6 s (2 F)6 p 1 F° 3 34877.04 MM76 5 d 2 (1 G)6 s (2 G)6 p 3 G° 4 36850.04 MM76 5 d 2 (1 G)6 s (2 G)6 p 3 G° 5 38845.45 MM76 5 d 2 (3 F)6 s (2 F)6 p 1 G° 4 38987.85 MM76 Hf II (2 D 3 / 2) Limit 55047.9 CHR88b

Energy Levels of Neutral Holmium (Ho I)

Energy Levels of Neutral Holmium (Ho I)

Configuration Term J Level(cm -1) Ref. 4 f 1 1 6 s 2 4 I° 1 5 / 2 0.00 MZH78 4 f 1 1 6 s 2 4 I° 1 3 / 2 5419.70 MZH78 4 f 1 1 6 s 2 4 I° 1 1 / 2 8605.16 MZH78 4 f 1 1 6 s 2 4 I° 9 / 2 10695.75 MZH78 4 f 1 0 (5 I 8)5 d 3 / 2 6 s 2 (8, 3 / 2) 1 7 / 2 8378.91 MZH78 4 f 1 0 (5 I 8)5 d 3 / 2 6 s 2 (8, 3 / 2) 1 5 / 2 8427.11 MZH78 4 f 1 0 (5 I 8)5 d 3 / 2 6 s 2 (8, 3 / 2) 1 3 / 2 9147.08 MZH78 4 f 1 0 (5 I 8)5 d 3 / 2 6 s 2 (8, 3 / 2) 1 9 / 2 9741.50 MZH78 4 f 1 0 (5 I 8)5 d 5 / 2 6 s 2 (8, 5 / 2) 2 1 / 2 11322.31 MZH78 4 f 1 0 (5 I 8)5 d 5 / 2 6 s 2 (8, 5 / 2) 1 7 / 2 11530.56 MZH78 4 f 1 0 (5 I 8)5 d 5 / 2 6 s 2 (8, 5 / 2) 1 9 / 2 11689.77 MZH78 4 f 1 0 (5 I 8)5 d 5 / 2 6 s 2 (8, 5 / 2) 1 5 / 2 12339.04 MZH78 4 f 1 0 (5 I 8)5 d 5 / 2 6 s 2 (8, 5 / 2) 1 1 / 2 16937.43 MZH78 4 f 1 0 (5 I 7)5 d 3 / 2 6 s 2 (7, 3 / 2) 1 3 / 2 12344.55 MZH78 4 f 1 0 (5 I 7)5 d 3 / 2 6 s 2 (7, 3 / 2) 1 1 / 2 13082.93 MZH78 4 f 1 0 (5 I 7)5 d 3 / 2 6 s 2 (7, 3 / 2) 1 7 / 2 15130.31 MZH78 4 f 1 0 (5 I 7)5 d 3 / 2 6 s 2 (7, 3 / 2) 1 5 / 2 15136.06 MZH78 4 f 1 1 6 s 2 4 F° 9 / 2 13094.42 KWL97 4 f 1 0 (5 I)5 d 6 s 2 1 3 / 2 15081.12 MZH78 4 f 1 0 (5 I)5 d 6 s 2 1 1 / 2 15792.13 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (3 P° 0) (1 5 / 2 ,0) 1 5 / 2 15855.28 MZH78 4 f 1 0 5 d 6 s 2 1 5 / 2 16154.21 MZH78 4 f 1 0 (5 I 7)5 d 5 / 2 6 s 2 (7, 5 / 2) 1 7 / 2 16438.01 MZH78 4 f 1 0 (5 I 7)5 d 5 / 2 6 s 2 (7, 5 / 2) 1 9 / 2 16683.52 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (3 P° 1) (1 5 / 2 ,1) 1 7 / 2 16709.82 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (3 P° 1) (1 5 / 2 ,1) 1 5 / 2 16882.28 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (3 P° 1) (1 5 / 2 ,1) 1 3 / 2 17059.35 MZH78 4 f 1 0 (5 I 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 1 3 / 2 20241.31 MZH78 4 f 1 0 (5 I 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 1 3 / 2 22978.19 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (3 P° 2) (1 3 / 2 ,2) 1 7 / 2 23498.57 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (3 P° 2) (1 3 / 2 ,2) 1 5 / 2 23834.94 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (3 P° 2) (1 3 / 2 ,2) 9 / 2 23861.17 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (3 P° 2) (1 3 / 2 ,2) 1 1 / 2 23946.16 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (3 P° 2) (1 3 / 2 ,2) 1 3 / 2 23955.69 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (3 P° 2) (1 3 / 2 ,2) 7 / 2 _ 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 3 / 2 24014.22 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 7 / 2 24360.81 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 5 / 2 24660.80 MZH78 4 f 1 0 5 d 6 s 2 1 3 / 2 24740.52 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 1 / 2 29069.78 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 5 / 2 29642.60 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 3 / 2 29751.91 MZH78 Ho II (4 I° 1 5 / 2)6 s (1 5 / 2 , 1 / 2)° 8 Limit 48567 WSPC78

Energy Levels of Neutral Lutetium (Lu I)

Energy Levels of Neutral Lutetium (Lu I)

Configuration Term J Level(cm -1) Ref. 5 d (2 D)6 s 2 2 D 3 / 2 0.00 MZH78 5 d (2 D)6 s 2 2 D 5 / 2 1993.92 MZH78 6 s 2 (1 S)6 p 2 P° 1 / 2 4136.00 MZH78 6 s 2 (1 S)6 p 2 P° 3 / 2 7476.35 MZH78 5 d 6 s (3 D)6 p 4 F° 3 / 2 17427.28 MZH78 5 / 2 18504.56 MZH78 7 / 2 20432.53 MZH78 9 / 2 22609.46 MZH78 5 d 2 (3 F)6 s 4 F 3 / 2 18851.31 MZH78 5 / 2 19403.31 MZH78 7 / 2 20247.29 VW78 9 / 2 21242.26 VW78 5 d 6 s (3 D)6 p 4 D° 1 / 2 20762.42 MZH78 3 / 2 21195.37 MZH78 5 / 2 22221.64 MZH78 7 / 2 23524.24 MZH78 5 d 6 s (3 D)6 p 2 D° 5 / 2 21462.35 MZH78 5 d 6 s (3 D)6 p 2 D° 3 / 2 22124.70 MZH78 5 d 2 (3 P)6 s 4 P 1 / 2 21472.33 MZH78 3 / 2 22467.53 MZH78 5 / 2 25860.76 MZH78 5 d 6 s (3 D)6 p 4 P° 1 / 2 24108.72 MZH78 3 / 2 24308.20 MZH78 5 / 2 25191.57 MZH78 6 s 2 (1 S)7 s 2 S 1 / 2 24125.86 MZH78 5 d 2 (1 D?)6 s 2 D 3 / 2 24518.16 MZH78 5 / 2 24711.19 MZH78 5 d 2 (1 G)6 s 2 G 7 / 2 26570.40 MZH78 9 / 2 26671.32 MZH78 5 d 2 (3 F)6 s 2 F 5 / 2 _ 7 / 2 27991.75 MZH78 5 d 6 s (1 D)6 p 2 F° 5 / 2 28020.18 MZH78 7 / 2 29486.94 MZH78 5 d 2 (3 P?)6 s 2 P 1 / 2 28793.34 MZH78 3 / 2 29937.81 MZH78 6 s 2 (1 S)7 p 2 P° 1 / 2 29430.90 MZH78 6 s 2 (1 S)7 p 2 P° 3 / 2 30488.62 MZH78 5 d 6 s (1 D)6 p 2 D° 3 / 2 29607.98 MZH78 5 d 6 s (3 D)6 p 2 F° 5 / 2 30183.55 MZH78 5 d 6 s (3 D)6 p 2 F° 7 / 2 31751.17 MZH78 5 d 2 (1 S)6 s 2 S 1 / 2 30747.18 MZH78 5 d 6 s (1 D)6 p 2 P° 3 / 2 31523.14 MZH78 1 / 2 33443.20 MZH78 6 s 2 (1 S)6 d 2 D 3 / 2 31542.24 MZH78 6 s 2 (1 S)6 d 2 D 5 / 2 31713.60 MZH78 5 d 6 s (3 D)6 p 2 P° 1 / 2 32058.1 MZH78 5 d 6 s (3 D)6 p 2 P° 3 / 2 34436.49 MZH78 5 d 6 s (1 D)6 p 2 D° 5 / 2 32456.87 MZH78 Lu II (1 S 0) Limit 43762.50 CT72 , MMMS89

Energy Levels of Neutral Tantalum (Ta I)

Energy Levels of Neutral Tantalum (Ta I)

Configuration Term J Level(cm -1) Ref. 5 d 3 6 s 2 4 F 3 / 2 0.00 M58 5 d 3 6 s 2 4 F 5 / 2 2010.10 M58 5 d 3 6 s 2 4 F 7 / 2 3963.92 M58 5 d 3 6 s 2 4 F 9 / 2 5621.04 M58 5 d 3 6 s 2 4 P 1 / 2 6049.42 M58 5 d 3 6 s 2 4 P 3 / 2 6068.91 M58 5 d 3 6 s 2 4 P 5 / 2 9253.43 M58 5 d 3 6 s 2 2 G 7 / 2 9705.38 M58 5 d 3 6 s 2 2 G 9 / 2 10690.32 M58 1 3 / 2 10950.22 M58 5 d 3 6 s 2 2 P 1 / 2 11792.13 M58 5 d 3 6 s 2 2 P 3 / 2 15903.77 M58 5 d 3 6 s 2 2 D2 5 / 2 12865.97 M58 5 d 3 6 s 2 2 D2 3 / 2 25876.05 DAGW97 5 d 3 6 s 2 2 H 1 1 / 2 15114.14 M58 5 d 3 6 s 2 2 H 9 / 2 15391.01 M58 5 d 3 6 s 2 2 F 5 / 2 17224.47 M58 5 d 3 6 s 2 2 F 7 / 2 17383.12 M58 5 d 3 6 s (5 F)6 p 4 F° 5 / 2 23363.09 M58 5 d 3 6 s (5 F)6 p 6 G° 1 1 / 2 25008.83 M58 10° 3 / 2 34078.42 M58 5 d 3 6 s (5 P)6 p 6 D° 7 / 2 34094.66 M58 11° 7 / 2 35746.18 M58 12° 1 1 / 2 35813.47 M58 13° 5 / 2 36825.97 M58 14° 5 / 2 37630.09 M58 15° 3 / 2 37760.67 M58 16° 5 / 2 38253.39 M58 17° 5 / 2 39059.52 M58 18° 5 / 2 39688.20 M58 19° 7 / 2 40333.03 M58 5 d 3 6 s (3 G)6 p ? 4 G° ? 9 / 2 40686.42 M58 20° 1 1 / 2 43185.09 M58 Ta II (5 F 1) Limit 60891.4 SKJ94

Energy Levels of Neutral Thulium (Tm I)

Energy Levels of Neutral Thulium (Tm I)

Configuration Term J Level(cm -1) Ref. 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 0.000 MZH78 4 f 1 3 (2 F°)6 s 2 2 F° 5 / 2 8771.243 MZH78 4 f 1 2 (3 H 6)5 d 3 / 2 6 s 2 (6, 3 / 2) 9 / 2 13119.610 MZH78 4 f 1 2 (3 H 6)5 d 3 / 2 6 s 2 (6, 3 / 2) 1 5 / 2 15271.002 MZH78 4 f 1 2 (3 H 6)5 d 3 / 2 6 s 2 (6, 3 / 2) 1 1 / 2 15587.811 MZH78 4 f 1 2 (3 H 6)5 d 3 / 2 6 s 2 (6, 3 / 2) 1 3 / 2 17454.818 MZH78 4 f 1 2 (3 H 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 1 7 / 2 16456.913 MZH78 4 f 1 2 (3 H 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 7 / 2 16957.006 MZH78 4 f 1 2 (3 H 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 1 5 / 2 18693.074 MZH78 4 f 1 2 (3 H 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 9 / 2 18837.385 MZH78 4 f 1 2 (3 H 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 1 1 / 2 18853.823 MZH78 4 f 1 2 (3 H 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 1 3 / 2 19466.663 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 0) (7 / 2 ,0) 7 / 2 16742.237 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 1) (7 / 2 ,1) 7 / 2 17343.374 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 1) (7 / 2 ,1) 9 / 2 17613.659 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 1) (7 / 2 ,1) 5 / 2 17752.634 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 2) (7 / 2 ,2) 1 1 / 2 18990.406 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 2) (7 / 2 ,2) 3 / 2 19132.245 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 2) (7 / 2 ,2) 5 / 2 19548.834 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 2) (7 / 2 ,2) 9 / 2 19748.543 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 2) (7 / 2 ,2) 7 / 2 19753.830 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [3 / 2]° 5 / 2 20406.840 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [3 / 2]° 3 / 2 21799.380 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [3 / 2]° 1 / 2 24160.63 MZH78 4 f 1 2 (3 F 4)5 d 3 / 2 6 s 2 (4, 3 / 2) 7 / 2 21120.836 MZH78 4 f 1 2 (3 F 4)5 d 3 / 2 6 s 2 (4, 3 / 2) 5 / 2 21161.401 MZH78 4 f 1 2 (3 F 4)5 d 3 / 2 6 s 2 (4, 3 / 2) 9 / 2 21737.685 MZH78 4 f 1 2 (3 F 4)5 d 3 / 2 6 s 2 (4, 3 / 2) 1 1 / 2 21997.473 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [1 1 / 2]° 9 / 2 22419.764 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [1 1 / 2]° 1 1 / 2 22559.502 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [1 1 / 2]° 1 3 / 2 22742.777 MZH78 4 f 1 2 (3 H 6)6 s 2 6 p 1 / 2 (6, 1 / 2)° 1 1 / 2 22468.046 MZH78 4 f 1 2 (3 H 6)6 s 2 6 p 1 / 2 (6, 1 / 2)° 1 3 / 2 22902.127 MZH78 4 f 1 2 (3 H 5)5 d 3 / 2 6 s 2 (5, 3 / 2) 7 / 2 22791.176 MZH78 4 f 1 2 (3 H 5)5 d 3 / 2 6 s 2 (5, 3 / 2) 1 3 / 2 23374.681 MZH78 4 f 1 2 (3 H 5)5 d 3 / 2 6 s 2 (5, 3 / 2) 9 / 2 24348.692 MZH78 4 f 1 2 (3 H 5)5 d 3 / 2 6 s 2 (5, 3 / 2) 1 1 / 2 25488.545 MZH78 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 5 / 2 22929.717 MZH78 4 f 1 2 (3 F 4)5 d 5 / 2 6 s 2 (4, 5 / 2) 1 1 / 2 23309.979 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [5 / 2]° 7 / 2 23335.111 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [5 / 2]° 5 / 2 23431.844 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [5 / 2]° 3 / 2 23574.415 MZH78 4 f 1 2 (3 F 4)5 d 5 / 2 6 s 2 (4, 5 / 2) 9 / 2 23781.698 MZH78 4 f 1 2 (3 F 4)5 d 5 / 2 6 s 2 7 / 2 23873.207 MZH78 4 f 1 2 (3 F 4)5 d 5 / 2 6 s 2 3 / 2 23882.41 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [7 / 2]° 9 / 2 23941.071 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [7 / 2]° 5 / 2 24611.303 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [7 / 2]° 7 / 2 24708.041 MZH78 4 f 1 2 (3 F 4)5 d 5 / 2 6 s 2 1 3 / 2 24137.196 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [9 / 2]° 7 / 2 24246.425 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [9 / 2]° 9 / 2 24701.058 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [9 / 2]° 1 1 / 2 24957.469 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) (7 / 2 ,1) 5 / 2 24418.018 MZH78 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 1 5 / 2 25130.453 MZH78 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 7 / 2 25717.197 MZH78 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 9 / 2 26889.125 MZH78 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 1 3 / 2 27377.13 MZH78 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 1 1 / 2 27491.31 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) 5 / 2 25745.117 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) 7 / 2 26701.325 MZH78 4 f 1 3 (2 F° 5 / 2)6 s 6 p (1 P° 1) (5 / 2 ,1) 7 / 2 34297.17 MZH78 Tm II (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 Limit 49879.8 C71

Energy Levels of Neutral Ytterbium (Yb I)

Energy Levels of Neutral Ytterbium (Yb I)

Configuration Term J Level(cm -1) Ref. 4 f 1 4 (1 S)6 s 2 1 S 0 0.000 MT78 4 f 1 4 (1 S)6 s 6 p 3 P° 0 17288.439 MT78 4 f 1 4 (1 S)6 s 6 p 3 P° 1 17992.007 MT78 4 f 1 4 (1 S)6 s 6 p 3 P° 2 19710.388 MT78 4 f 1 3 (2 F° 7 / 2)5 d 3 / 2 6 s 2 (7 / 2 , 3 / 2)° 2 23188.518 MT78 4 f 1 3 (2 F° 7 / 2)5 d 3 / 2 6 s 2 (7 / 2 , 3 / 2)° 5 25859.682 MT78 4 f 1 3 (2 F° 7 / 2)5 d 3 / 2 6 s 2 (7 / 2 , 3 / 2)° 3 27445.638 MT78 4 f 1 3 (2 F° 7 / 2)5 d 3 / 2 6 s 2 (7 / 2 , 3 / 2)° 4 28184.512 MT78 4 f 1 4 (1 S)5 d 6 s 3 D 1 24489.102 MT78 4 f 1 4 (1 S)5 d 6 s 3 D 2 24751.948 MT78 4 f 1 4 (1 S)5 d 6 s 3 D 3 25270.902 MT78 4 f 1 4 (1 S)6 s 6 p 1 P° 1 25068.222 MT78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 6 s 2 (7 / 2 , 5 / 2)° 6 27314.919 MT78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 6 s 2 (7 / 2 , 5 / 2)° 2 28195.960 MT78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 6 s 2 (7 / 2 , 5 / 2)° 1 28857.014 MT78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 6 s 2 (7 / 2 , 5 / 2)° 4 29774.958 MT78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 6 s 2 (7 / 2 , 5 / 2)° 3 30207.380 MT78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 6 s 2 (7 / 2 , 5 / 2)° 5 30524.714 MT78 4 f 1 4 (1 S)5 d 6 s 1 D 2 27677.665 MT78 4 f 1 3 (2 F° 7 / 2)6 s 2 6 p 1 / 2 (7 / 2 , 1 / 2) 3 32065.282 MT78 4 f 1 3 (2 F° 7 / 2)6 s 2 6 p 1 / 2 (7 / 2 , 1 / 2) 4 32273.597 MT78 4 f 1 4 (1 S)6 s 7 s 3 S 1 32694.692 MT78 4 f 1 4 (1 S)6 s 7 s 1 S 0 34350.65 MT78 4 f 1 3 (2 F° 7 / 2)6 s 2 6 p 3 / 2 (7 / 2 , 3 / 2) 5 35178.78 MT78 4 f 1 3 (2 F° 7 / 2)6 s 2 6 p 3 / 2 (7 / 2 , 3 / 2) 2 35196.98 MT78 4 f 1 3 (2 F° 7 / 2)6 s 2 6 p 3 / 2 (7 / 2 , 3 / 2) 3 35807.52 MT78 4 f 1 3 (2 F° 7 / 2)6 s 2 6 p 3 / 2 (7 / 2 , 3 / 2) 4 36060.98 MT78 4 f 1 3 (2 F°)5 d 6 s 2 ° 1 37414.59 MT78 4 f 1 4 (1 S)6 s 7 p 3 P° 0 38090.71 MT78 4 f 1 4 (1 S)6 s 7 p 3 P° 1 38174.17 MT78 4 f 1 4 (1 S)6 s 7 p 3 P° 2 38551.93 MT78 4 f 1 3 (2 F°)5 d 6 s 2 3 D° 1 38422.36 MT78 4 f 1 4 (1 S)6 s 6 d 3 D 1 39808.72 MT78 4 f 1 4 (1 S)6 s 6 d 3 D 2 39838.04 MT78 4 f 1 4 (1 S)6 s 6 d 3 D 3 39966.09 MT78 4 f 1 3 (2 F° 7 / 2) 5 d (2 D)6 s 6 p (3 P°) (4 F° 3 / 2) (7 / 2 , 3 / 2) 2 39880.26 MT78 4 f 1 3 (2 F° 7 / 2) 5 d (2 D)6 s 6 p (3 P°) (4 F° 3 / 2) (7 / 2 , 3 / 2) 5 42935.78 MT78 4 f 1 3 (2 F° 7 / 2) 5 d (2 D)6 s 6 p (3 P°) (4 F° 3 / 2) (7 / 2 , 3 / 2) 4 44984.75 MT78 4 f 1 3 (2 F° 7 / 2) 5 d (2 D)6 s 6 p (3 P°) (4 F° 3 / 2) (7 / 2 , 3 / 2) 3 45462.54 MT78 4 f 1 4 (1 S)6 s 6 d 1 D 2 40061.51 MT78 4 f 1 4 (1 S)6 s 7 p 1 P° 1 40563.97 MT78 4 f 1 4 (1 S)6 s 8 s 3 S 1 41615.04 MT78 4 f 1 3 (2 F° 7 / 2) 5 d (2 D)6 s 6 p (3 P°) (4 F° 5 / 2) (7 / 2 , 5 / 2) 3 41827.30 MT78 4 f 1 4 (1 S)6 s 8 s 1 S 0 41939.90 MT78 4 f 1 3 (2 F° 7 / 2) 5 d (2 D)6 s 6 p (3 P°) (4 F° 5 / 2) (7 / 2 , 5 / 2) 1 42436.70 MT78 4 f 1 4 (1 S)6 p 2 3 P 0 42436.91 MT78 4 f 1 4 (1 S)6 p 2 3 P 1 43805.42 MT78 4 f 1 4 (1 S)6 p 2 3 P 2 44760.37 MT78 Yb II (2 S 1 / 2)) Limit 50443.2 A80

Energy Levels of Neutral Bismuth (Bi I)

Energy Levels of Neutral Bismuth (Bi I)

Configuration Term J Level(cm -1) Ref. 6 p 3 4 S° 3 / 2 0.000 GMV85 6 p 3 2 D° 3 / 2 11419.039 GMV85 6 p 3 2 D° 5 / 2 15437.501 GMV85 6 p 3 2 P° 1 / 2 21660.914 GMV85 6 p 3 2 P° 3 / 2 33164.805 GMV85 6 p 2 (3 P 0)7 s 2 [0] 1 / 2 32588.221 GMV85 6 p 2 (3 P 0)7 p 2 [1]° 1 / 2 41124.985 GMV85 6 p 2 (3 P 0)7 p 2 [1]° 3 / 2 42940.519 GMV85 6 p 2 (3 P 0)6 d 2 [2] 3 / 2 43912.374 GMV85 6 p 2 (3 P 0)6 d 2 [2] 5 / 2 44816.841 GMV85 6 p 2 (3 P 1)7 s 2 [1] 3 / 2 44865.076 GMV85 6 p 2 (3 P 1)7 s 2 [1] 1 / 2 45915.883 GMV85 6 p 2 (3 P 0)8 s 2 [0] 1 / 2 47373.477 GMV85 6 p 2 (3 P 2)7 s 2 [2] 5 / 2 48489.869 GMV85 6 p 2 (3 P 2)7 s 2 [2] 3 / 2 49460.910 GMV85 6 p 2 (3 P 0)7 d 2 [2] 3 / 2 51019.090 GMV85 6 p 2 (3 P 0)7 d 2 [2] 5 / 2 51158.494 GMV85 Bi II (3 P 0) Limit 58761.65 MGGB89

Energy Levels of Neutral Gold (Au I)

Energy Levels of Neutral Gold (Au I)

Configuration Term J Level(cm -1) Ref. 5 d 1 0 6 s 2 S 1 / 2 0.000 ED71 5 d 9 6 s 2 2 D 5 / 2 9161.177 ED71 5 d 9 6 s 2 2 D 3 / 2 21435.191 ED71 5 d 1 0 6 p 2 P° 1 / 2 37358.991 ED71 5 d 1 0 6 p 2 P° 3 / 2 41174.613 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 0) (5 / 2 ,0)° 5 / 2 42163.530 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 1) (5 / 2 ,1)° 7 / 2 45537.195 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 1) (5 / 2 ,1)° 5 / 2 46174.979 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 1) (5 / 2 ,1)° 3 / 2 47007.433 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 9 / 2 48697.147 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 7 / 2 51028.894 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 3 / 2 51231.530 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 5 / 2 51653.460 ED71 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 1 / 2 53196.32 BG78 5 d 1 0 7 s 2 S 1 / 2 54485.235 ED71 5 d 9 (2 D 3 / 2)6 s 6 p (3 P° 0) (3 / 2 ,0)° 3 / 2 56105.748 ED71 5 d 9 (2 D 3 / 2)6 s 6 p (3 P° 1) (3 / 2 ,1)° 5 / 2 58616.764 ED71 5 d 9 (2 D 3 / 2)6 s 6 p (1 P° 1) (3 / 2 ,1)° 3 / 2 58845.414 ED71 5 d 1 0 7 p 2 P° 1 / 2 60032.85 BG78 5 d 1 0 7 p 2 P° 3 / 2 60728.49 BG78 Au II (1 S 0) Limit 74408.88 BG78

Energy Levels of Neutral Iridium (Ir I)

Energy Levels of Neutral Iridium (Ir I)

Configuration Term J Level(cm -1) Ref. 5 d 7 6 s 2 4 F 9 / 2 0.00 K57 5 d 7 6 s 2 4 F 7 / 2 7106.63 K57 5 d 7 6 s 2 4 F 5 / 2 9877.58 K57 5 d 7 6 s 2 4 F 3 / 2 11831.13 K57 5 d 8 (3 F)6 s 4 F 9 / 2 2834.99 K57 5 d 8 (3 F)6 s 4 F 7 / 2 6323.96 K57 5 d 8 (3 F)6 s 4 F 3 / 2 10578.70 K57 5 d 8 (3 F)6 s 4 F 5 / 2 12218.50 K57 5 d 7 6 s 2 2 P 3 / 2 4078.95 K57 5 d 7 6 s 2 2 P 1 / 2 12505.75 K57 5 d 8 (3 F)6 s 2 D 5 / 2 5784.63 K57 5 d 8 (3 F)6 s 2 D 3 / 2 22110.29 K57 5 d 7 6 s 2 4 P 5 / 2 12951.73 K57 5 d 7 6 s 2 4 P 3 / 2 18547.10 K57 5 d 7 6 s 2 4 P 1 / 2 20236.75 K57 5 d 8 (3 F)6 s 2 F 7 / 2 13087.94 K57 5 d 8 (3 F)6 s 2 F 5 / 2 19060.68 K57 5 d 7 6 s 2 2 G 9 / 2 13939.83 K57 5 d 7 6 s 2 2 G 7 / 2 17779.30 K57 5 d 8 (3 P)6 s 4 P 5 / 2 16103.37 K57 5 d 8 (3 P)6 s 4 P 3 / 2 16565.41 K57 5 d 8 (3 P)6 s 4 P 1 / 2 16681.27 K57 5 d 7 6 s 2 2 D2 3 / 2 23310.40 K57 5 d 7 6 s 2 2 D2 1 / 2 26229.51 K57 5 d 8 (3 F)6 s 2 G 9 / 2 23505.94 K57 5 d 8 (3 F)6 s 2 G 7 / 2 26365.19 K57 5 d 7 6 s 2 2 F 5 / 2 26404.22 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 D° 9 / 2 26307.49 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 D° 7 / 2 30529.67 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 D° 3 / 2 32463.60 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 D° 5 / 2 33064.84 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 D° 1 / 2 35647.96 K57 5 d 9 2 D 3 / 2 27970.06 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 F° 1 1 / 2 28452.31 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 F° 9 / 2 32513.42 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 F° 7 / 2 33874.44 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 G° 1 1 / 2 34180.46 K57 5 d 7 (4 F)6 s 6 p (3 P°) 6 G° 9 / 2 35080.70 K57 5 d 7 (4 P)6 s 6 p (3 P°) 6 P° 7 / 2 37515.32 K57 5 d 7 (4 P)6 s 6 p (3 P°) 6 D° 9 / 2 37871.69 K57 5 d 6 6 s 2 (5 D)6 p 6 F° 1 1 / 2 39940.37 K57 5 d 6 6 s 2 (5 D)6 p 6 F° 9 / 2 40389.83 K57 5 d 8 (3 F)6 p 4 G° 1 1 / 2 42131.84 K57 1° 1 1 / 2 47858.45 K57 2° 9 / 2 49158.63 K57 Ir II (5 F 5) Limit 72323.9 CLS97

Energy Levels of Neutral Lead (Pb I)

Energy Levels of Neutral Lead (Pb I)

Configuration Term J Level(cm -1) Ref. 6 p 2 1 / 2 (1 / 2 , 1 / 2) 0 0.000 WA68 6 p 1 / 2 6 p 3 / 2 (1 / 2 , 3 / 2) 1 7819.263 WA68 6 p 1 / 2 6 p 3 / 2 (1 / 2 , 3 / 2) 2 10650.327 WA68 6 p 2 3 / 2 (3 / 2 , 3 / 2) 2 21457.798 WA68 6 p 2 3 / 2 (3 / 2 , 3 / 2) 0 29466.830 WA68 6 p 1 / 2 7 s 1 / 2 (1 / 2 , 1 / 2)° 0 34959.908 WA68 6 p 1 / 2 7 s 1 / 2 (1 / 2 , 1 / 2)° 1 35287.224 WA68 6 p 1 / 2 7 p 1 / 2 (1 / 2 , 1 / 2) 1 42918.643 WA68 6 p 1 / 2 7 p 1 / 2 (1 / 2 , 1 / 2) 0 44400.890 WA68 6 p 1 / 2 7 p 3 / 2 (1 / 2 , 3 / 2) 1 44674.986 WA68 6 p 1 / 2 7 p 3 / 2 (1 / 2 , 3 / 2) 2 44809.364 WA68 6 p 1 / 2 6 d 2 [5 / 2]° 2 45443.171 WA68 6 p 1 / 2 6 d 2 [5 / 2]° 3 46328.667 WA68 6 p 1 / 2 6 d 2 [3 / 2]° 2 46060.836 WA68 6 p 1 / 2 6 d 2 [3 / 2]° 1 46068.438 WA68 6 p 3 / 2 7 s 1 / 2 (3 / 2 , 1 / 2)° 2 48188.630 WA68 6 p 3 / 2 7 s 1 / 2 (3 / 2 , 1 / 2)° 1 49439.616 WA68 6 p 1 / 2 8 s 1 / 2 (1 / 2 , 1 / 2)° 1 48686.934 WA68 6 p 1 / 2 7 d 2 [5 / 2]° 2 52101.660 WA68 6 p 1 / 2 7 d 2 [5 / 2]° 3 52412.325 WA68 6 p 1 / 2 7 d 2 [3 / 2]° 2 52311.315 WA68 6 p 1 / 2 7 d 2 [3 / 2]° 1 52499.639 WA68 Pb II (2 P° 1 / 2) Limit 59819.2 WA68

Energy Levels of Neutral Mercury (Hg I)

Energy Levels of Neutral Mercury (Hg I)

Configuration Term J Level(cm -1) Ref. 5 d 1 0 (1 S)6 s 2 1 S 0 0.000 BAL50 5 d 1 0 (1 S)6 s 6 p 3 P° 0 37645.080 BAL50 5 d 1 0 (1 S)6 s 6 p 3 P° 1 39412.300 BAL50 5 d 1 0 (1 S)6 s 6 p 3 P° 2 44042.977 BAL50 5 d 1 0 (1 S)6 s 6 p 1 P° 1 54068.781 BAL50 5 d 1 0 (1 S)6 s 7 s 3 S 1 62350.456 BAL50 5 d 1 0 (1 S)6 s 7 s 1 S 0 63928.243 BAL50 5 d 9 6 s 2 6 p 3 P° 2 68886.60 M58 5 d 1 0 (1 S)6 s 7 p 3 P° 0 69516.66 M58 5 d 1 0 (1 S)6 s 7 p 3 P° 1 69661.89 M58 5 d 1 0 (1 S)6 s 7 p 3 P° 2 71207.51 M58 5 d 1 0 (1 S)6 s 7 p 1 P° 1 71295.15 M58 5 d 1 0 (1 S)6 s 6 d (1 / 2 , 3 / 2) 2 71333.182 BAL50 5 d 1 0 (1 S)6 s 6 d (1 / 2 , 3 / 2) 1 71336.164 BAL50 5 d 1 0 (1 S)6 s 6 d (1 / 2 , 5 / 2) 2 71396.220 BAL50 5 d 1 0 (1 S)6 s 6 d (1 / 2 , 5 / 2) 3 71431.311 BAL50 Hg II (2 S 1 / 2) Limit 84184.1 B83

Energy Levels of Neutral Osmium (Os I)

Energy Levels of Neutral Osmium (Os I)

Configuration Term J Level(cm -1) Ref. 5 d 6 6 s 2 5 D 4 0.00 KK61 5 d 6 6 s 2 5 D 3 4159.32 KK61 5 d 6 6 s 2 5 D 2 2740.49 KK61 5 d 6 6 s 2 5 D 1 5766.14 KK61 5 d 6 6 s 2 5 D 0 6092.79 KK61 5 d 7 (4 F)6 s 5 F 5 5143.92 KK61 5 d 7 (4 F)6 s 5 F 4 8742.83 KK61 5 d 7 (4 F)6 s 5 F 3 11378.00 KK61 5 d 7 (4 F)6 s 5 F 2 12774.38 KK61 5 d 7 (4 F)6 s 5 F 1 13020.07 KK61 5 d 6 6 s 2 3 P 2 10165.98 KK61 5 d 6 6 s 2 3 P 1 17667.34 KK61 5 d 6 6 s 2 3 P 0 18301.40 KK61 5 d 7 (4 F)6 s 3 F 4 11030.58 KK61 5 d 7 (4 F)6 s 3 F 3 14091.37 KK61 5 d 7 (4 F)6 s 3 F 2 13364.83 KK61 5 d 6 6 s (6 D)6 p 7 D° 5 23462.90 KK61 5 d 6 6 s (6 D)6 p 7 D° 4 22615.69 KK61 5 d 6 6 s (6 D)6 p 7 D° 3 25012.93 KK61 5 d 6 6 s (6 D)6 p 7 D° 2 25275.42 KK61 5 d 6 6 s (6 D)6 p 7 D° 1 27786.79 KK61 5 d 6 6 s (6 D)6 p 7 F° 5 30279.95 KK61 5 d 6 6 s (6 D)6 p 7 F° 4 32684.61 KK61 5 d 6 6 s (6 D)6 p 7 P° 4 30591.45 KK61 5 d 6 6 s (6 D)6 p 7 P° 3 33124.48 KK61 5 d 6 6 s (6 D)6 p 5 F° 5 34365.33 KK61 5 d 6 6 s (6 D)6 p 5 F° 4 34803.82 KK61 5 d 6 6 s (6 D)6 p 5 P° 3 35615.92 KK61 5 d 6 6 s (6 D)6 p 5 D° 4 36826.39 KK61 5 d 6 6 s (4 D)6 p 5 D° 4 37908.77 KK61 5 d 6 6 s (4 D)6 p 3 F° 4 40361.92 KK61 5 d 7 (4 F)6 p 3 D° 3 46776.29 KK61 ° 5 48062.22 KK61 ° 3 48874.93 KK61 ° 3 49138.11 KK61 ° 5 49534.28 KK61 Os II (6 D 9 / 2) Limit 68058.9 CLS97

Energy Levels of Neutral Platinum (Pt I)

Energy Levels of Neutral Platinum (Pt I)

Configuration Term J Level(cm -1) Ref. 5 d 9 6 s 3 D 3 0.000 BVWE92 5 d 9 6 s 3 D 2 6567.461 BVWE92 5 d 9 6 s 3 D 1 10131.887 BVWE92 5 d 9 6 s 1 D 2 775.892 BVWE92 5 d 8 6 s 2 3 F 4 823.678 BVWE92 5 d 8 6 s 2 3 F 3 10116.729 BVWE92 5 d 8 6 s 2 3 F 2 15501.845 BVWE92 5 d 1 0 1 S 0 6140.180 BVWE92 5 d 8 6 s 2 3 P 2 13496.271 BVWE92 5 d 8 6 s 2 3 P 0 16983.492 BVWE92 5 d 8 6 s 2 3 P 1 18566.558 BVWE92 5 d 8 6 s 2 1 G 4 21967.111 BVWE92 5 d 8 6 s 2 1 D 2 26638.591 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 D° 4 30156.854 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 D° 3 35321.653 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 D° 2 40516.243 BVWE92 5 d 9 6 p 3 P° 2 32620.018 BVWE92 5 d 9 6 p 3 P° 1 36844.710 BVWE92 5 d 9 6 p 3 P° 2 37342.101 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 F° 5 33680.402 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 F° 5 38536.160 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 F° 4 40194.228 BVWE92 5 d 9 6 p 3 F° 3 34122.165 BVWE92 5 d 9 6 p 3 F° 4 37590.569 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 G° 4 36296.310 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 G° 6 36781.551 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 G° 5 38536.160 BVWE92 5 d 8 (3 F)6 s 6 p (3 P°) 5 G° 3 40970.165 BVWE92 5 d 9 6 p 3 D° 3 37769.073 BVWE92 5 d 8 (1 D)6 s 6 p (3 P°) 3 F° 2 38815.908 BVWE92 5 d 8 (3 P)6 s 6 p (3 P°) 5 P° 2 40787.857 BVWE92 5 d 8 (1 D)6 s 6 p (3 P°) 3 P° 0 40873.529 BVWE92 Pt II (2 D 5 / 2) Limit 72257.3 MMHS95 , JS00

Energy Levels of Neutral Rhenium (Re I)

Energy Levels of Neutral Rhenium (Re I)

Configuration Term J Level(cm -1) Ref. 5 d 5 6 s 2 6 S 5 / 2 0.00 KMVC57 5 d 5 6 s 2 1 5 / 2 11583.96 KMVC57 5 d 6 (5 D)6 s 6 D 9 / 2 11754.52 KMVC57 5 d 6 (5 D)6 s 6 D 7 / 2 14216.86 KMVC57 5 d 6 (5 D)6 s 6 D 5 / 2 15770.42 KMVC57 5 d 6 (5 D)6 s 6 D 3 / 2 16327.51 KMVC57 5 d 6 (5 D)6 s 6 D 1 / 2 17238.30 KMVC57 5 d 5 6 s 2 2 3 / 2 13826.12 KMVC57 5 d 5 6 s 2 3 5 / 2 14621.46 KMVC57 5 d 5 6 s 2 4 G 7 / 2 15058.19 KMVC57 5 d 5 6 s 2 4 G 1 1 / 2 16307.15 KMVC57 5 d 5 6 s 2 4 G 9 / 2 16619.28 KMVC57 5 d 5 6 s 2 4 1 / 2 15165.89 KMVC57 5 d 5 6 s 2 5 7 / 2 17330.82 KMVC57 5 d 5 6 s (7 S)6 p 8 P° 5 / 2 18950.1 KMVC57 5 d 5 6 s (7 S)6 p 8 P° 7 / 2 20447.8 KMVC57 5 d 5 6 s (7 S)6 p 8 P° 9 / 2 23631.82 KMVC57 5 d 5 6 s 2 6 5 / 2 19457.89 KMVC57 5 d 5 6 s 2 7 1 / 2 19757.91 KMVC57 5 d 5 6 s 2 8 3 / 2 20481.73 KMVC57 5 d 5 6 s (7 S)6 p 6 P° 5 / 2 28854.18 KMVC57 5 d 5 6 s (7 S)6 p 6 P° 7 / 2 28889.72 KMVC57 5 d 5 6 s (7 S)6 p 6 P° 3 / 2 28961.55 KMVC57 5 d 5 6 s (5 P)6 p 6 D° 7 / 2 40946.53 KMVC57 10° 7 / 2 41163.91 KMVC57 5 d 6 (5 D)6 p 6 F° 1 1 / 2 45082.63 KMVC57 11° 5 / 2 46112.24 KMVC57 12° 7 / 2 47669.01 KMVC57 5 d 6 (5 D)6 p 6 F° 7 / 2 47932.55 KMVC57 13° 7 / 2 48184.20 KMVC57 14° 7 / 2 48786.35 KMVC57 15° 5 / 2 49540.96 KMVC57 16° 3 / 2 49895.57 KMVC57 5 d 5 6 s (7 S)6 d e 8 D 1 1 / 2 50464.34 KMVC57 Re II (7 S 3) Limit 63181.6 CS96

Energy Levels of Neutral Thallium (Tl I)

Energy Levels of Neutral Thallium (Tl I)

Configuration Term J Level(cm -1) Ref. 5 d 1 0 6 s 2 6 p 2 P° 1 / 2 0.0 M58 5 d 1 0 6 s 2 6 p 2 P° 3 / 2 7792.7 M58 5 d 1 0 6 s 2 7 s 2 S 1 / 2 26477.5 M58 5 d 1 0 6 s 2 7 p 2 P° 1 / 2 34159.9 M58 5 d 1 0 6 s 2 7 p 2 P° 3 / 2 35161.1 M58 5 d 1 0 6 s 2 6 d 2 D 3 / 2 36117.9 M58 5 d 1 0 6 s 2 6 d 2 D 5 / 2 36199.9 M58 5 d 1 0 6 s 2 8 s 2 S 1 / 2 38745.9 M58 5 d 1 0 6 s 2 8 p 2 P° 1 / 2 41368.1 M58 5 d 1 0 6 s 2 8 p 2 P° 3 / 2 41740.8 M58 5 d 1 0 6 s 2 7 d 2 D 3 / 2 42011.4 M58 5 d 1 0 6 s 2 7 d 2 D 5 / 2 42049.0 M58 Tl II (1 S 0) Limit 49265.91 BC85

Energy Levels of Neutral Tungsten (W I)

Energy Levels of Neutral Tungsten (W I)

Configuration Term J Level(cm -1) Ref. 5 d 4 6 s 2 5 D 0 0.00 LC68 5 d 4 6 s 2 5 D 1 1670.29 LC68 5 d 4 6 s 2 5 D 2 3325.53 LC68 5 d 4 6 s 2 5 D 3 4830.00 LC68 5 d 4 6 s 2 5 D 4 6219.33 LC68 5 d 5 (6 S)6 s 7 S 3 2951.29 LC68 5 d 4 6 s 2 a 3 P 0 9258.06 LC68 5 d 4 6 s 2 a 3 P 1 13307.10 LC68 5 d 4 6 s 2 a 3 P 2 19253.56 LC68 5 d 4 (5 D)6 s 6 p (3 P°) 7 D° 3 26189.20 LC68 5 d 5 (6 S)6 p 7 P° 2 26229.77 LC68 5 d 5 (6 S)6 p 7 P° 3 27488.11 LC68 5 d 5 (6 S)6 p 7 P° 4 27889.68 LC68 5 d 4 (5 D)6 s 6 p (3 P°) 5 P° 3 30586.64 LC68 368° 3 36874.36 LC68 369° 2 36904.16 LC68 373° 5 37309.16 LC68 374° 2 37466.30 LC68 382° 4 38259.40 LC68 391° 1 39183.20 LC68 396° 3 39646.41 LC68 402° 4 40233.97 LC68 W II (6 D 1 / 2) Limit 63427.7 CS96

Energy Levels of Neutral Actinium (Ac I)

Energy Levels of Neutral Actinium (Ac I)

Configuration Term J Level(cm -1) Ref. 6 d 7 s 2 2 D 3 / 2 0.00 MFT57 6 d 7 s 2 2 D 5 / 2 2231.43 MFT57 6 d 2 7 s 4 F 3 / 2 9217.28 MFT57 6 d 2 7 s 4 F 5 / 2 9863.59 MFT57 6 d 2 7 s 4 F 7 / 2 10906.02 MFT57 6 d 2 7 s 4 F 9 / 2 12078.07 MFT57 6 d 7 s (3 D)7 p 4 F° 3 / 2 13712.90 MFT57 6 d 7 s (3 D)7 p 4 F° 5 / 2 14940.72 MFT57 6 d 7 s (3 D)7 p 4 F° 7 / 2 17683.87 MFT57 6 d 7 s (3 D)7 p 4 D° 1 / 2 17199.71 MFT57 6 d 7 s (3 D)7 p 4 D° 3 / 2 19012.46 MFT57 6 d 7 s (3 D)7 p 4 D° 5 / 2 21195.87 MFT57 6 d 7 s (3 D)7 p 4 D° 7 / 2 23475.94 MFT57 6 d 7 s (3 D)7 p 2 D° 3 / 2 17736.26 MFT57 6 d 7 s (3 D)7 p 2 D° 5 / 2 17950.71 MFT57 6 d 7 s (3 D)7 p 4 P° 1 / 2 22401.52 MFT57 6 d 7 s (3 D)7 p 4 P° 3 / 2 22801.10 MFT57 6 d 7 s (3 D)7 p 4 P° 5 / 2 23898.86 MFT57 6 d 7 s (3 D)7 p 2 F° 5 / 2 23916.84 MFT57 6 d 7 s (3 D)7 p 2 F° 7 / 2 24969.30 MFT57 6 d 7 s (3 D)7 p 2 P° 1 / 2 25729.03 MFT57 6 d 7 s (3 D)7 p 2 P° 3 / 2 27009.84 MFT57 6 d 7 s (1 D)7 p 2 D° 3 / 2 26066.04 MFT57 6 d 7 s (1 D)7 p 2 D° 5 / 2 26533.16 MFT57 6 d 7 s (1 D)7 p 2 F° 5 / 2 26836.20 MFT57 6 d 7 s (1 D)7 p 2 F° 7 / 2 28568.40 MFT57 6 d 7 s (1 D)7 p 2 P° 3 / 2 30396.61 MFT57 6 d 2 (3 F)7 p 4 G° 5 / 2 31494.68 MFT57 6 d 2 (3 F)7 p 4 G° 7 / 2 32219.62 MFT57 6 d 2 (3 F)7 p 4 G° 9 / 2 32867.39 MFT57 6 d 2 (3 F)7 p 4 G° 1 1 / 2 33429.76 MFT57 Ac II (1 S 0) Limit 41700 S74

Energy Levels of Neutral Astatine (At I)

Energy Levels of Neutral Astatine (At I)

Configuration Term J Level(cm -1) Ref. 6 p 5 2 P° 3 / 2 0.0 M64a 6 p 4 (3 P)7 s 4 P 5 / 2 44549.3 ? M64a 6 p 4 (3 P)7 s 4 P 3 / 2 46233.6 ? M64a At II (3 P 2) Limit

Energy Levels of Neutral Francium (Fr I)

Energy Levels of Neutral Francium (Fr I)

Configuration Term J Level(cm -1) Ref. 7 s 2 S 1 / 2 0.000 ABDJ90 7 p 2 P° 1 / 2 12237.409 ABDJ90 7 p 2 P° 3 / 2 13923.998 ABDJ90 8 p 2 P° 1 / 2 23112.960 ABDJ90 8 p 2 P° 3 / 2 23658.306 ABDJ90 Fr II (1 S 0) Limit 32848.872 ABDJ90

Energy Levels of Neutral Polonium (Po I)

Energy Levels of Neutral Polonium (Po I)

Configuration Term J Level(cm -1) Ref. 6 p 4 3 P 2 0.00 C66a 6 p 4 3 P 0 7514.69 C66a 6 p 4 3 P 1 16831.61 C66a 6 p 4 1 D 2 21679.11 C66a 6 p 3 (4 S°)7 s 5 S° 2 39081.19 C66a 6 p 3 (4 S°)7 s 3 S° 1 40802.70 C66a Po II (4 S° 3 / 2) Limit 67860 C66a

Energy Levels of Neutral Protactinium (Pa I)

Energy Levels of Neutral Protactinium (Pa I)

Configuration Term J Level(cm -1) Ref. 5 f 2 (3 H)6 d 7 s 2 4 K 1 1 / 2 0.000 BW92b 5 f 2 (3 H)6 d 7 s 2 4 K 1 3 / 2 3711.625 BW92b 5 f 2 (3 H)6 d 7 s 2 4 K 1 5 / 2 7512.695 BW92b 5 f 2 (3 H)6 d 7 s 2 4 K 1 7 / 2 11198.270 BW92b 5 f 2 (3 H)6 d 7 s 2 4 I 9 / 2 825.415 BW92b 5 f 2 (3 H)6 d 7 s 2 4 I 1 1 / 2 4121.450 BW92b 5 f 2 (3 H)6 d 7 s 2 4 I 1 3 / 2 7383.295 BW92b 5 f 2 (3 H)6 d 7 s 2 4 I 1 5 / 2 10049.875 BW92b 5 f 2 6 d 7 s 2 a 4 G 5 / 2 1618.325 BW92b 5 f 2 6 d 7 s 2 a 4 G 7 / 2 4713.870 BW92b 5 f 2 6 d 7 s 2 a 4 G 9 / 2 7330.815 BW92b 5 f (2 F)6 d 2 (3 F)7 s 2 4 H° 7 / 2 1978.220 BW92b 5 f (2 F)6 d 2 (3 F)7 s 2 4 H° 9 / 2 5335.730 BW92b 5 f (2 F)6 d 2 (3 F)7 s 2 4 H° 1 1 / 2 8419.075 BW92b 5 f (2 F)6 d 2 (3 F)7 s 2 4 H° 1 3 / 2 11498.725 BW92b 5 f (2 F)6 d 2 (3 F)7 s 2 4 I° 9 / 2 2659.405 BW92b 5 f 2 6 d 7 s 2 a 4 H 7 / 2 2966.530 BW92b 5 f 2 (3 H)6 d 7 s 2 9 / 2 3323.860 BW92b 5 f 2 (3 H)6 d 7 s 2 1 1 / 2 4576.005 BW92b 5 f 2 6 d 7 s 2 b 4 H 7 / 2 5149.465 BW92b 5 f 2 (3 H)6 d 7 s 2 5 / 2 5938.650 BW92b 5 f 2 6 d 7 s 2 a 4 H 9 / 2 6149.805 BW92b 5 f (2 F)6 d 2 (3 F)7 s 2 4 I° 1 1 / 2 6302.230 BW92b ° 7 / 2 6425.830 BW92b 5 f 2 6 d 7 s 2 b 4 G 5 / 2 6708.56 BW92b 5 f 2 (3 H)6 d 2 (3 F)(5 L)7 s 6 L 1 1 / 2 7000.290 BW92b 5 f 2 7 s 2 7 p 1 / 2 (4, 1 / 2)° 9 / 2 11444.705 BW92b 5 f 2 7 s 2 7 p 1 / 2 (4, 1 / 2)° 7 / 2 12118.750 BW92b ° 7 / 2 12911.260 BW92b 5 f 3 7 s 2 4 I° 9 / 2 13018.610 BW92b 5 f 2 6 d 7 s 7 p 6 L° 1 1 / 2 14393.410 BW92b ° 5 / 2 14519.355 BW92b ° 5 / 2 14683.005 BW92b ° 9 / 2 14876.545 BW92b 5 f 3 7 s 2 4 I° 1 1 / 2 16147.025 BW92b ° 9 / 2 16463.970 BW92b ° 7 / 2 16665.690 BW92b ° 1 1 / 2 16819.670 BW92b 5 f 2 6 d 7 s 7 p 6 K° 1 1 / 2 17156.785 BW92b ° 9 / 2 18661.700 BW92b ° 1 3 / 2 20606.365 BW92b ° 1 1 / 2 25104.455 BW92b ° 9 / 2 28316.365 BW92b Pa II (5 f 2 7 s 2 3 H 4) Limit 47500 S74

Energy Levels of Neutral Radium (Ra I)

Energy Levels of Neutral Radium (Ra I)

Configuration Term J Level(cm -1) Ref. 7 s 2 1 S 0 0.00 M58 7 s 7 p 3 P° 0 13078.44 M58 7 s 7 p 3 P° 1 13999.38 M58 7 s 7 p 3 P° 2 16688.54 M58 7 s 6 d 3 D 1 13715.85 M58 7 s 6 d 3 D 2 13993.97 M58 7 s 6 d 3 D 3 14707.35 M58 7 s 6 d 1 D 2 17081.45 M58 7 s 7 p 1 P° 1 20715.71 M58 7 s 8 s 3 S 1 26754.05 M58 6 d 7 p 3 F° 2 28038.05 M58 6 d 7 p 3 F° 3 30117.78 M58 6 d 7 p 3 F° 4 32367.78 M58 6 d 7 p 1 D° 2 30918.14 M58 7 s 8 p 3 P° 0 31085.88 M58 7 s 8 p 3 P° 1 31563.29 M58 7 s 8 p 3 P° 2 31874.44 M58 Ra II (2 S 1 / 2) Limit 42573.36 AWT80

Energy Levels of Neutral Radon (Rn I)

Energy Levels of Neutral Radon (Rn I)

Configuration Term J Level(cm -1) Ref. 6 p 6 1 S 0 0.0 M58 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 54620.35 M58 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 1 55989.03 M58 6 p 5 (2 P° 3 / 2)7 p 2 [1 / 2] 1 66244.97 M58 6 p 5 (2 P° 3 / 2)7 p 2 [1 / 2] 0 69743.98 M58 6 p 5 (2 P° 3 / 2)7 p 2 [5 / 2] 2 66707.53 M58 6 p 5 (2 P° 3 / 2)7 p 2 [5 / 2] 3 68039.48 M58 6 p 5 (2 P° 3 / 2)6 d 2 [1 / 2]° 0 67906.52 M58 6 p 5 (2 P° 3 / 2)6 d 2 [1 / 2]° 1 68891.34 M58 6 p 5 (2 P° 3 / 2)7 p 2 [3 / 2] 1 68332.10 M58 6 p 5 (2 P° 3 / 2)7 p 2 [3 / 2] 2 68789.93 M58 6 p 5 (2 P° 1 / 2)7 s 2 [1 / 2]° 0 85976 M58 6 p 5 (2 P° 1 / 2)7 s 2 [1 / 2]° 1 87053 M58 Rn II (2 P° 3 / 2) Limit 86692.5 R33

Energy Levels of Neutral Thorium (Th I)

Energy Levels of Neutral Thorium (Th I)

Configuration Term J Level(cm -1) Ref. 6 d 2 7 s 2 3 F 2 0.000 BW92b 6 d 2 7 s 2 3 F 3 2869.259 BW92b 6 d 2 7 s 2 3 F 4 4961.659 BW92b 6 d 2 7 s 2 3 P 0 2558.057 BW92b 6 d 2 7 s 2 3 P 2 3687.987 BW92b 6 d 2 7 s 2 3 P 1 3865.475 BW92b 6 d 3 (4 F)7 s 5 F 1 5563.142 BW92b 6 d 3 (4 F)7 s 5 F 2 6362.396 BW92b 6 d 3 (4 F)7 s 5 F 3 7502.288 BW92b 6 d 3 (4 F)7 s 5 F 4 8800.251 BW92b 6 d 3 (4 F)7 s 5 F 5 9804.807 BW92b 6 d 2 7 s 2 1 D 2 7280.124 BW92b 5 f 6 d 7 s 2 3 H° 4 7795.275 BW92b 5 f 6 d 7 s 2 3 H° 5 11197.031 BW92b 5 f 6 d 7 s 2 3 H° 6 14481.869 BW92b 6 d 2 7 s 2 1 G 4 8111.005 BW92b 5 f 6 d 7 s 2 3 F° 2 8243.601 BW92b 5 f 6 d 7 s 2 3 F° 3 11241.730 BW92b 5 f 6 d 7 s 2 3 F° 4 14206.917 BW92b 5 f 6 d 7 s 2 1 G° 4 10414.136 BW92b 5 f 6 d 7 s 2 3 G° 3 10526.544 BW92b 5 f 6 d 7 s 2 3 G° 4 13175.113 BW92b 5 f 6 d 7 s 2 3 G° 5 15490.077 BW92b 6 d 7 s 2 7 p 3 F° 2 10783.154 BW92b 6 d 7 s 2 7 p 3 F° 3 13945.307 BW92b 6 d 3 (4 P)7 s 5 P 1 11601.031 BW92b 6 d 3 (4 P)7 s 5 P 2 11802.934 BW92b 6 d 3 (4 P)7 s 5 P 3 12847.971 BW92b 5 f 6 d 7 s 2 3 D° 1 17354.639 BW92b 6 d 2 7 s 7 p 5 F° 4 19948.395 BW92b 5 f 6 d 7 s 2 3 D° 3 21165.096 BW92b 6 d 2 7 s 7 p 5 P° 1 21668.956 BW92b 5 f 6 d 7 s 7 p 5 I 4 22098.187 BW92b 5 f 6 d 7 s 7 p 5 I 5 23277.387 BW92b 5 f 6 d 7 s 7 p 5 I 6 26997.247 BW92b ° 2 24307.749 BW92b ° 2 26113.270 BW92b 6 d 2 7 s 7 p 3 D° 1 26287.049 BW92b 6 d 2 7 s 7 p 3 G° 3 26878.162 BW92b 4 27521.527 BW92b ° 2 27784.366 BW92b ° 2 29853.143 BW92b ° 4 30160.003 BW92b ° 3 30255.452 BW92b 5 f 6 d 7 s 7 p 3 H 4 33459.180 BW92b ° 5 34182.708 BW92b ° 5 35081.017 BW92b Th II (3 / 2) Limit 50867 KDEE97

Energy Levels of Neutral Uranium (U I)

Energy Levels of Neutral Uranium (U I)

Configuration Term J Level(cm -1) Ref. 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 0.000 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 L° 7 3800.829 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 L° 8 7645.645 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 L° 9 11308.153 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 L° 10 14845.326 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 K° 5 620.323 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 K° 6 4275.707 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 K° 7 7326.118 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 K° 8 10685.787 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 K° 9 13535.186 BW92b 5 f 3 (4 I°)6 d 7 s 2 ° 3 3868.486 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 I° 4 4453.419 BW92b 5 f 3 (4 I°)6 d 7 s 2 ° 5 5762.079 BW92b 5 f 3 (4 F°)6 d 7 s 2 ° 0 5988.061 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 H° 4 5991.314 BW92b 5 f 3 (4 I°)6 d 2 (2 F)7 s 7 M° 6 6249.029 BW92b 5 f 3 (4 I°)6 d 7 s 2 ° 6 7005.532 BW92b 5 f 4 7 s 2 5 I 4 7020.709 BW92b 5 f 4 7 s 2 5 I 5 10051.312 BW92b 5 f 4 7 s 2 5 I 6 12643.378 BW92b 5 f 4 7 s 2 5 I 7 14858.786 BW92b 5 f 4 7 s 2 5 I 8 16862.069 BW92b 5 f 3 (4 I°)6 d 7 s 2 ° 3 7103.921 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 G° 2 7191.682 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 K° 7 7326.118 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 L° 8 7645.645 BW92b 5 f 3 (4 I°)6 d 7 s 2 5 I° 5 7864.204 BW92b 5 f 3 (4 I°)6 d 2 (2 F)7 s 7 M° 7 8118.632 BW92b 5 f 3 6 d 7 s 2 5 H° 4 8133.291 BW92b 5 f 3 (4 F°)6 d 7 s 2 ° 2 8856.992 BW92b 5 f 3 (4 F°)6 d 7 s 2 ° 3 8878.547 BW92b 5 f 3 6 d 7 s 7 p 7 M 7 16900.386 BW92b 5 f 3 6 d 7 s 7 p 5 L 7 22918.553 BW92b 6 23572.086 BW92b 7 24066.566 BW92b 6 24671.388 BW92b 6 25348.977 BW92b 6 25825.565 BW92b 6 26225.569 BW92b 5 f 3 6 d 2 7 p 7 N 7 27886.995 BW92b 6 27941.253 BW92b 5 28444.517 BW92b 5 28650.294 BW92b 7 29837.643 BW92b 6 31871.569 BW92b U II (4 I° 9 / 2) Limit 49958.4 CABC82

Energy Levels of Neutral Americium (Am I)

Energy Levels of Neutral Americium (Am I)

Configuration Term J Level(cm -1) Ref. 5 f 7 (8 S°)7 s 2 8 S° 7 / 2 0.00 BW92b 5 f 6 (7 F)6 d 7 s 2 8 H 3 / 2 10683.57 BW92b 5 f 6 (7 F)6 d 7 s 2 8 H 5 / 2 12974.03 BW92b 5 f 6 (7 F)6 d 7 s 2 8 D 3 / 2 13292.51 BW92b 5 f 7 (8 S°)6 d 7 s 1 0 D° 5 / 2 14506.92 BW92b 5 f 7 (8 S°)6 d 7 s 1 0 D° 7 / 2 14752.02 BW92b 5 f 7 (8 S°)6 d 7 s 1 0 D° 9 / 2 15136.02 BW92b 5 f 7 (8 S°)6 d 7 s 1 0 D° 1 1 / 2 15764.81 BW92b 5 f 7 (8 S°)6 d 7 s 1 0 D° 1 3 / 2 - 5 f 6 (7 F)6 d 7 s 2 8 G 1 / 2 14943.63 BW92b 5 f 7 (8 S°)7 s 2 6 P° 7 / 2 15017.69 BW92b 5 f 6 (7 F)6 d 7 s 2 8 H 7 / 2 15273.16 BW92b 5 f 7 (8 S° 7 / 2)7 s 7 p (3 P° 1) (7 / 2 ,1) 9 / 2 16511.82 BW92b 5 f 7 (8 S° 7 / 2)7 s 7 p (3 P° 2) (7 / 2 ,2) 7 / 2 21440.37 BW92b 9 / 2 23307.41 BW92b 5 f 7 (8 S° 7 / 2)7 s 7 p (1 P° 1) (7 / 2 ,1) 5 / 2 27217.14 BW92b 5 f 7 (8 S° 7 / 2)7 s 7 p (1 P° 1) (7 / 2 ,1) 7 / 2 28009.81 BW92b 5 f 7 (8 S° 7 / 2)7 s 7 p (1 P° 1) (7 / 2 ,1) 9 / 2 28480.87 BW92b Am II (9 S° 4) Limit 48182 KDEE97

Energy Levels of Neutral Berkelium (Bk I)

Energy Levels of Neutral Berkelium (Bk I)

Configuration Term J Level(cm -1) Ref. 5 f 9 7 s 2 6 H° 1 5 / 2 0.000 BW92b 5 f 9 7 s 2 6 H° 1 3 / 2 6530.720 BW92b 5 f 9 7 s 2 6 H° 1 1 / 2 9535.130 BW92b 5 f 9 7 s 2 6 H° 9 / 2 10605.570 BW92b 5 f 9 7 s 2 6 H° 7 / 2 12067.63 BW92b 5 f 9 7 s 2 6 F° 1 1 / 2 5416.690 BW92b 5 f 9 7 s 2 6 F° 9 / 2 5757.440 BW92b 5 f 9 7 s 2 6 F° 7 / 2 10985.83 BW92b 5 f 9 7 s 2 6 F° 5 / 2 12568.38 BW92b 5 f 8 6 d 7 s 2 8 G 1 3 / 2 9141.115 BW92b 5 f 8 6 d 7 s 2 8 G 1 5 / 2 10587.345 BW92b 5 f 8 6 d 7 s 2 8 G 7 / 2 13191.915 BW92b 5 f 8 6 d 7 s 2 8 G 9 / 2 13439.485 BW92b 5 f 8 6 d 7 s 2 8 G 1 1 / 2 13769.315 BW92b 5 f 8 6 d 7 s 2 8 G 5 / 2 13931.000 BW92b 5 f 8 6 d 7 s 2 8 G 3 / 2 15626.860 BW92b 5 f 8 6 d 7 s 2 8 G 1 / 2 16145.840 BW92b 5 f 8 6 d 7 s 2 8 D 1 1 / 2 9300.585 BW92b 5 f 8 6 d 7 s 2 8 D 9 / 2 10735.955 BW92b 5 f 8 6 d 7 s 2 8 D 7 / 2 14920.166 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 0) (1 5 / 2 ,0) 1 5 / 2 16913.770 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 1) (1 5 / 2 ,1) 1 7 / 2 17665.980 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 1) (1 5 / 2 ,1) 1 5 / 2 19179.210 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 1) (1 5 / 2 ,1) 1 3 / 2 19334.710 BW92b 5 f 8 (7 F 6)7 s 2 7 p 1 / 2 (6, 1 / 2)° 1 1 / 2 17777.808 BW92b 5 f 8 (7 F 6)7 s 2 7 p 1 / 2 (6, 1 / 2)° 1 3 / 2 17993.628 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 2) (1 5 / 2 ,2) 1 7 / 2 22382.830 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 2) (1 5 / 2 ,2) 1 5 / 2 22910.225 BW92b 1 3 / 2 25493.793 BW92b 1 5 / 2 27695.870 BW92b 5 f 9 (6 H° 1 3 / 2)7 s 7 p (3 P° 2) (1 3 / 2 ,2) 1 5 / 2 29038.930 BW92b 5 f 9 (6 H° 1 3 / 2)7 s 7 p (3 P° 2) (1 3 / 2 ,2) 1 7 / 2 29172.103 BW92b 1 3 / 2 35814.60 BW92b Bk II ((1 5 / 2 , 1 / 2)° 8) Limit 49989 KDEE97

Energy Levels of Neutral Californium (Cf I)

Energy Levels of Neutral Californium (Cf I)

Configuration Term J Level(cm -1) Ref. 5 f 1 0 7 s 2 5 I 8 0.000 BW92b 5 f 1 0 7 s 2 5 I 7 9078.145 BW92b 5 f 1 0 7 s 2 5 I 6 11074.390 BW92b 5 f 1 0 7 s 2 5 I 4 15375.470 BW92b 5 f 1 0 7 s 2 5 I 5 15846.145 BW92b 5 f 1 0 7 s 2 5 F 5 8516.380 BW92b 5 f 1 0 7 s 2 3 P 2 10589.250 BW92b 5 f 1 0 7 s 2 5 F 4 13965.750 BW92b 5 f 9 (6 H° 1 5 / 2)6 d 3 / 2 7 s 2 (1 5 / 2 , 3 / 2)° 8 16909.535 BW92b 5 f 9 (6 H° 1 5 / 2)6 d 3 / 2 7 s 2 (1 5 / 2 , 3 / 2)° 7 17308.170 BW92b 5 f 9 (6 H° 1 5 / 2)6 d 3 / 2 7 s 2 (1 5 / 2 , 3 / 2)° 6 19055.82 BW92b 5 f 9 (6 H° 1 5 / 2)6 d 3 / 2 7 s 2 (1 5 / 2 , 3 / 2)° 9 19907.460 BW92b 5 f 1 0 (5 I 8)7 s 7 p (3 P° 0) (8,0)° 8 17459.210 BW92b 5 f 1 0 (5 I 8)7 s 7 p (3 P° 1) (8,1)° 9 18483.060 BW92b 5 f 1 0 (5 I 8)7 s 7 p (3 P° 1) (8,1)° 8 19303.065 BW92b 5 f 1 0 (5 I 8)7 s 7 p (3 P° 1) (8,1)° 7 19322.220 BW92b 5 f 1 0 (5 I 8)7 s 7 p (3 P° 2) (8,2)° 9 23093.355 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 2 7 p 1 / 2 (1 5 / 2 , 1 / 2) 7 24727.600 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 2 7 p 1 / 2 (1 5 / 2 , 1 / 2) 8 25281.530 BW92b 5 f 1 0 (5 I 8)7 s 7 p (1 P° 1) (8,1)° 9 27779.345 BW92b 5 f 9 6 d 7 s 2 ° 8 29818.055 BW92b ° 7 30311.400 BW92b 5 f 9 (6 H° 1 5 / 2)7 s 2 7 p 3 / 2 (1 5 / 2 , 3 / 2) 9 32187.145 BW92b Cf II (5 f 1 0 (5 I 8)7 s (8, 1 / 2) 1 7 / 2) Limit 50665 KDEE97

Energy Levels of Neutral Curium (Cm I)

Energy Levels of Neutral Curium (Cm I)

Configuration Term J Level(cm -1) Ref. 5 f 7 6 d 7 s 2 9 D° 2 0.000 BW92b 5 f 7 6 d 7 s 2 9 D° 3 302.153 BW92b 5 f 7 6 d 7 s 2 9 D° 4 815.655 BW92b 5 f 7 6 d 7 s 2 9 D° 5 1764.268 BW92b 5 f 7 6 d 7 s 2 9 D° 6 3809.355 BW92b 5 f 8 7 s 2 7 F 6 1214.203 BW92b 5 f 8 7 s 2 7 F 4 4877.610 BW92b 5 f 8 7 s 2 7 F 5 5136.519 BW92b 5 f 8 7 s 2 7 F 3 7208.827 BW92b 5 f 8 7 s 2 7 F 2 7521.122 BW92b 5 f 8 7 s 2 7 F 1 8696.688 BW92b 5 f 8 7 s 2 7 F 0 8887.265 BW92b 5 f 7 6 d 7 s 2 7 D° 4 8958.447 BW92b 5 f 7 6 d 7 s 2 7 D° 5 9064.880 BW92b 5 f 7 6 d 7 s 2 7 D° 3 9458.053 BW92b 5 f 7 6 d 7 s 2 7 D° 2 9671.692 BW92b 5 f 7 6 d 7 s 2 7 D° 1 10133.857 BW92b 5 f 7 (8 S°)7 s 2 7 p (7 / 2 , 1 / 2) 3 9263.374 BW92b 5 f 7 (8 S°)7 s 2 7 p (7 / 2 , 1 / 2) 4 9784.543 BW92b 5 f 7 6 d 7 s 7 p 1 1 F 3 15677.750 BW92b 5 f 7 (8 S°)7 s 2 7 p (7 / 2 , 3 / 2) 5 15721.679 BW92b 5 f 8 (7 F 6)7 s 7 p (3 P° 1) (6,1)° 7 18009.483 BW92b 5 f 7 6 d 7 s 7 p 9 F 5 22013.913 BW92b 5 f 7 6 d 7 s 7 p 9 D 3 23083.822 BW92b 5 f 8 ()7 s 7 p (3 P° 2) (6,2)° 7 22907.611 BW92b 5 f 8 ()7 s 7 p (3 P° 2) (6,2)° 6 23633.638 BW92b 5 f 7 6 d 2 7 s 9 F° 7 24951.328 BW92b 5 f 7 6 d 7 s 7 p 7 D 3 25023.578 BW92b 5 f 8 ()7 s 7 p (1 P° 1) (6,1)° 7 26609.213 BW92b ° 7 27410.123 BW92b ° 5 30121.545 BW92b ° 7 31464.053 BW92b 5 f 7 6 d 7 s 7 p 5 P 2 32078.886 BW92b 5 f 7 6 d 7 s 7 p 6 32762.036 BW92b 5 f 7 6 d 7 s 7 p 4 32770.516 BW92b 5 f 7 6 d 7 s 2 ° 6 33362.424 BW92b Cm II (8 S° 7 / 2) Limit 48324 KDEE97

Energy Levels of Neutral Einsteinium (Es I)

Energy Levels of Neutral Einsteinium (Es I)

Configuration Term J Level(cm -1) Ref. 5 f 1 1 7 s 2 4 I° 1 5 / 2 0.00 BW92b 5 f 1 1 7 s 2 4 F° 9 / 2 7894.54 BW92b 5 f 1 1 7 s 2 2 H° 1 1 / 2 8759.27 BW92b 5 f 1 1 7 s 2 ° 1 3 / 2 10244.29 BW92b 5 f 1 1 7 s 7 p 6 I 1 5 / 2 17803.09 BW92b 5 f 1 1 7 s 7 p 6 I 1 7 / 2 19209.15 BW92b 5 f 1 0 6 d 7 s 2 6 I 1 7 / 2 19367.85 BW92b 5 f 1 1 7 s 7 p 1 3 / 2 , 1 5 / 2 19788.32 BW92b 5 f 1 0 6 d 7 s 2 1 3 / 2 28118.65 BW92b 5 f 1 0 6 d 7 s 2 1 3 / 2 , 1 5 / 2 , 1 7 / 2 28372.78 BW92b 5 f 1 1 7 s 7 p 1 3 / 2 28447.02 BW92b 5 f 1 0 6 d 7 s 2 1 5 / 2 , 1 7 / 2 28578.60 BW92b 5 f 1 0 6 d 7 s 2 1 5 / 2 , 1 7 / 2 28689.74 BW92b 1 5 / 2 , 1 7 / 2 29159.28 BW92b 5 f 1 1 7 s 7 p 1 3 / 2 29204.89 BW92b 1 1 / 2 31829.03 BW92b 5 f 1 0 6 d 7 s 2 1 3 / 2 31886.3 BW92b 1 3 / 2 32770.06 BW92b 5 f 1 1 (4 I° 1 5 / 2)7 s 8 s (3 S 1) (1 5 / 2 ,1)° 1 7 / 2 33829.35 BW92b 5 f 1 1 (4 I° 1 5 / 2)7 s 8 s (3 S 1) (1 5 / 2 ,1)° 1 5 / 2 34068.94 BW92b 9 / 2 34192.6 BW92b 1 3 / 2 35507.74 BW92b 1 1 / 2 38634.04 BW92b Es II ((1 5 / 2 , 1 / 2)° 8) Limit 51800 S74

Energy Levels of Neutral Neptunium (Np I)

Energy Levels of Neutral Neptunium (Np I)

Configuration Term J Level(cm -1) Ref. 5 f 4 (5 I)6 d 7 s 2 6 L 1 1 / 2 0.000 BW92b 5 f 4 (5 I)6 d 7 s 2 6 L 1 3 / 2 3502.855 BW92b 5 f 4 (5 I)6 d 7 s 2 6 L 1 5 / 2 6903.440 BW92b 5 f 4 (5 I)6 d 7 s 2 6 L 1 7 / 2 10020.990 BW92b 5 f 4 (5 I)6 d 7 s 2 6 L 1 9 / 2 12930.155 BW92b 5 f 4 (5 I)6 d 7 s 2 6 L 2 1 / 2 16051.925 BW92b 5 f 4 (5 I)6 d 7 s 2 6 K 9 / 2 2033.965 BW92b 5 f 4 (5 I)6 d 7 s 2 6 K 1 1 / 2 5185.015 BW92b 5 f 4 (5 I)6 d 7 s 2 6 K 1 3 / 2 7792.035 BW92b 5 f 4 (5 I)6 d 7 s 2 6 K 1 5 / 2 10502.850 BW92b 5 f 4 (5 I)6 d 7 s 2 6 K 1 7 / 2 12948.015 BW92b 5 f 4 (5 I)6 d 7 s 2 6 K 1 9 / 2 15319.605 BW92b 5 f 4 (5 I)6 d 7 s 2 6 I 7 / 2 3450.995 BW92b 5 f 4 (5 I)6 d 7 s 2 6 I 9 / 2 6643.510 BW92b 5 f 4 (5 I)6 d 7 s 2 6 I 1 1 / 2 9694.045 BW92b 5 f 4 (5 I)6 d 7 s 2 6 I 1 3 / 2 11382.815 BW92b 5 f 4 (5 I)6 d 7 s 2 6 I 1 5 / 2 13049.900 BW92b 5 f 4 (5 I)6 d 7 s 2 6 I 1 7 / 2 14870.460 BW92b 5 f 4 (5 I)6 d 7 s 2 4 G 5 / 2 4615.670 BW92b 5 f 4 (5 I)6 d 7 s 2 6 G 3 / 2 6474.180 BW92b 5 f 4 (5 I)6 d 7 s 2 7 / 2 6892.085 BW92b 5 f 4 (5 I)6 d 7 s 2 6 H 5 / 2 7015.155 BW92b 5 f 4 (5 I)6 d 2 (3 F)7 s 8 M 1 1 / 2 7112.430 BW92b 5 f 4 (5 I 4)7 s 2 7 p 1 / 2 ° 9 / 2 11940.075 BW92b 5 f 4 (5 I 4)7 s 2 7 p 1 / 2 ° 7 / 2 12692.765 BW92b 5 f 4 (5 I)6 d 7 s 7 p 8 M° 1 1 / 2 14338.880 BW92b 5 f 4 (5 I 5)7 s 2 7 p 1 / 2 ° 1 1 / 2 15743.235 BW92b 5 f 4 (5 I)6 d 7 s 7 p 8 M° 1 3 / 2 16334.010 BW92b 5 f 4 (5 I)6 d 7 s 7 p 8 L° 9 / 2 16459.340 BW92b 5 f 4 6 d 7 s 7 p 6 M° 1 3 / 2 17007.700 BW92b 5 f 4 (5 I 4)7 s 2 7 p 3 / 2 ° 5 / 2 18194.400 BW92b ° 9 / 2 18200.530 BW92b ° 9 / 2 19100.810 BW92b 5 f 4 (5 I)6 d 7 s 7 p 8 M° 1 5 / 2 19827.885 BW92b ° 9 / 2 19985.980 BW92b ° 9 / 2 21851.300 BW92b ° 1 3 / 2 25075.145 BW92b ° 1 3 / 2 28551.035 BW92b ° 1 3 / 2 28711.465 BW92b Np II (5 f 4 6 d 7 s 7 L 5) Limit 50536 KDEE97

Energy Levels of Neutral Plutonium (Pu I)

Energy Levels of Neutral Plutonium (Pu I)

Configuration Term J Level(cm -1) Ref. 5 f 6 7 s 2 7 F 0 0.000 BW92b 5 f 6 7 s 2 7 F 1 2203.606 BW92b 5 f 6 7 s 2 7 F 2 4299.659 BW92b 5 f 6 7 s 2 7 F 3 6144.515 BW92b 5 f 6 7 s 2 7 F 4 7774.653 BW92b 5 f 6 7 s 2 7 F 5 9179.262 BW92b 5 f 6 7 s 2 7 F 6 10238.473 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 K° 4 6313.866 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 K° 5 9386.801 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 K° 6 12351.522 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 K° 7 15074.958 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 K° 8 17554.704 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 K° 9 19872.154 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 K° 10 22710.37 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 H° 2 8768.139 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 H° 3 11840.715 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 H° 4 14025.007 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 H° 5 16155.109 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 H° 6 18672.411 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 H° 7 20697.436 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 H° 8 22160.184 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 I° 3 9724.351 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 I° 4 12159.465 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 I° 5 14292.176 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 I° 6 16888.909 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 I° 7 19236.116 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 I° 8 20830.616 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 I° 9 22719.717 BW92b 5 f 5 (6 H°)6 d 7 s 2 7 G° 1 15406.760 BW92b 5 f 5 (6 F°)6 d 7 s 2 7 G° 1 15856.888 BW92b 5 f 5 (6 F°)6 d 7 s 2 7 F° 2 17615.482 BW92b 5 f 5 (6 H° 5 / 2)7 s 2 7 p 1 / 2 (5 / 2 , 1 / 2) 3 17897.919 BW92b 5 f 5 6 d 7 s (8 K°)7 p 9 L 4 20828.477 BW92b 5 f 5 7 s 7 p 7 D° 1 23766.139 BW92b 5 f 5 6 d 2 7 s 1 25959.849 BW92b 5 f 6 7 s 7 p 1 26633.288 BW92b 5 f 6 7 s 7 p 2 27979.161 BW92b 1 28690.480 BW92b 5 f 6 7 s 7 p 0 28820.548 BW92b 6 36838.42 BW92b Pu II (8 F 1 / 2) Limit 48603 WCJP93 , KDEE97

Energy Levels of Singly Ionized Beryllium (Be II)

Energy Levels of Singly Ionized Beryllium (Be II)

Configuration Term J Level(cm -1) Ref. 1 s 2 2 s 2 S 1 / 2 0.000 BWWI85 1 s 2 2 p 2 P° 1 / 2 31928.744 BWWI85 1 s 2 2 p 2 P° 3 / 2 31935.320 BWWI85 1 s 2 3 s 2 S 1 / 2 88231.89 KM00 1 s 2 3 p 2 P° 1 / 2 96495.34 KM00 1 s 2 3 p 2 P° 3 / 2 96497.26 KM00 1 s 2 3 d 2 D 3 / 2 98054.55 KM00 1 s 2 3 d 2 D 5 / 2 98055.10 KM00 1 s 2 4 s 2 S 1 / 2 115464.38 KM00 1 s 2 4 p 2 P° 1 / 2 118760.51 KM00 1 s 2 4 p 2 P° 3 / 2 118761.30 KM00 1 s 2 4 d 2 D 3 / 2 119421.18 KM00 1 s 2 4 d 2 D 5 / 2 119421.42 KM00 1 s 2 4 f 2 F° 5 / 2 119446.59 KM00 1 s 2 4 f 2 F° 7 / 2 119446.71 KM00 Be III (1 S 0) Limit 146882.84 KM00

Energy Levels of Singly Ionized Boron (B II)

Energy Levels of Singly Ionized Boron (B II)

Configuration Term J Level(cm -1) Ref. 2 s 2 1 S 0 0.00 LZJK98 2 s 2 p 3 P° 0 37335.54 R98 2 s 2 p 3 P° 1 37341.65 R98 2 s 2 p 3 P° 2 37357.80 R98 2 s 2 p 1 P° 1 73396.51 LZJK98 2 p 2 3 P 0 98911.38 R98 2 p 2 3 P 1 98919.87 R98 2 p 2 3 P 2 98933.26 R98 2 p 2 1 D 2 102362.77 LZJK98 2 p 2 1 S 0 127661.19 LZJK98 2 s 3 s 3 S 1 129773.21 R98 2 s 3 p 3 P° 0 143989.33 R98 2 s 3 p 3 P° 2 143989.94 R98 2 s 3 p 3 P° 1 143993.49 R98 2 s 3 p 1 P° 1 144102.81 R98 2 s 3 d 3 D 1,2,3 150649.09 R98 2 s 3 d 1 D 2 154685.96 R98 B III (2 S 1 / 2) Limit 202887.0 R98

Energy Levels of Singly Ionized Carbon (C II)

Energy Levels of Singly Ionized Carbon (C II)

Configuration Term J Level(cm -1) Ref. 2 s 2 (1 S)2 p 2 P° 1 / 2 0.00 MG93 2 s 2 (1 S)2 p 2 P° 3 / 2 63.42 MG93 2 s 2 p 2 4 P 1 / 2 43003.3 MG93 2 s 2 p 2 4 P 3 / 2 43025.3 MG93 2 s 2 p 2 4 P 5 / 2 43053.6 MG93 2 s 2 p 2 2 D 5 / 2 74930.10 MG93 2 s 2 p 2 2 D 3 / 2 74932.62 MG93 2 s 2 p 2 2 S 1 / 2 96493.74 MG93 2 s 2 p 2 2 P 1 / 2 110624.17 MG93 2 s 2 p 2 2 P 3 / 2 110665.56 MG93 2 s 2 (1 S)3 s 2 S 1 / 2 116537.65 MG93 2 s 2 (1 S)3 p 2 P° 1 / 2 131724.37 MG93 2 s 2 (1 S)3 p 2 P° 3 / 2 131735.52 MG93 2 p 3 4 S° 3 / 2 142027.1 MG93 2 s 2 (1 S)3 d 2 D 3 / 2 145549.27 MG93 2 s 2 (1 S)3 d 2 D 5 / 2 145550.70 MG93 2 p 3 2 D° 5 / 2 150461.58 MG93 2 p 3 2 D° 3 / 2 150466.69 MG93 2 s 2 (1 S)4 s 2 S 1 / 2 157234.07 MG93 2 s 2 (1 S)4 p 2 P° 1 / 2 162517.89 MG93 2 s 2 (1 S)4 p 2 P° 3 / 2 162524.57 MG93 2 s 2 p (3 P°)3 s 4 P° 1 / 2 166967.13 MG93 2 s 2 p (3 P°)3 s 4 P° 3 / 2 166990.73 MG93 2 s 2 p (3 P°)3 s 4 P° 5 / 2 167035.71 MG93 2 s 2 (1 S)4 d 2 D 3 / 2 168123.74 MG93 2 s 2 (1 S)4 d 2 D 5 / 2 168124.45 MG93 2 p 3 2 P° 1 / 2 168729.53 MG93 2 p 3 2 P° 3 / 2 168748.30 MG93 2 s 2 (1 S)4 f 2 F° 5 / 2 , 7 / 2 168978.34 MG93 C III (1 S 0) Limit 196664.7 MG93

Energy Levels of Singly Ionized Helium (He II)

Energy Levels of Singly Ionized Helium (He II)

Configuration Term J Level(cm -1) Ref. 1 s 2 S 1 / 2 0.0000 MK00b 2 p 2 P° 1 / 2 329179.2940 MK00b 2 p 2 P° 3 / 2 329185.1511 MK00b 2 s 2 S 1 / 2 329179.7623 MK00b 3 p 2 P° 1 / 2 390140.8250 MK00b 3 p 2 P° 3 / 2 390142.5605 MK00b 3 s 2 S 1 / 2 390140.9646 MK00b 3 d 2 D 3 / 2 390142.5576 MK00b 3 d 2 D 5 / 2 390143.1361 MK00b 4 p 2 P° 1 / 2 411477.1228 MK00b 4 p 2 P° 3 / 2 411477.8550 MK00b 4 s 2 S 1 / 2 411477.1818 MK00b 4 d 2 D 3 / 2 411477.8537 MK00b 4 d 2 D 5 / 2 411478.0978 MK00b 4 f 2 F° 5 / 2 411478.0973 MK00b 4 f 2 F° 7 / 2 411478.2193 MK00b He Limit 438908.8789 MK00b

Energy Levels of Singly Ionized Hydrogen (H II)

Energy Levels of Singly Ionized Hydrogen (H II)

Sorry! No data are available.

Energy Levels of Singly Ionized Lithium (Li II)

Energy Levels of Singly Ionized Lithium (Li II)

Configuration Term J Level(cm -1) Ref. 1 s 2 1 S 0 0. HM59 1 s 2 s 3 S 1 476034.24 HM59 1 s 2 s 1 S 0 491373.58 TE62 1 s 2 p 3 P° 1 494260.32 HM59 1 s 2 p 3 P° 2 494262.48 HM59 1 s 2 p 3 P° 0 494265.57 HM59 1 s 2 p 1 P° 1 501807.59 HM59 1 s 3 s 3 S 1 554753.69 HM59 1 s 3 s 1 S 0 558776.88 HM59 1 s 3 p 3 P° 1 559499.53 HM59 1 s 3 p 3 P° 2 559500.39 HM59 1 s 3 p 3 P° 0 559501.32 HM59 1 s 3 p 1 P° 1 561751.50 DM01 Li III 1 s (2 S 1 / 2) Limit 610078.4 DM01

Energy Levels of Singly Ionized Aluminum (Al II)

Energy Levels of Singly Ionized Aluminum (Al II)

Configuration Term J Level(cm -1) Ref. 3 s 2 1 S 0 0.00 MZ79 3 s 3 p 3 P° 0 37393.03 MZ79 3 s 3 p 3 P° 1 37453.91 MZ79 3 s 3 p 3 P° 2 37577.79 MZ79 3 s 3 p 1 P° 1 59852.02 MZ79 3 p 2 1 D 2 85481.35 MZ79 3 s 4 s 3 S 1 91274.50 MZ79 3 p 2 3 P 0 94084.96 MZ79 3 p 2 3 P 1 94147.46 MZ79 3 p 2 3 P 2 94268.68 MZ79 3 s 4 s 1 S 0 95350.60 MZ79 3 s 3 d 3 D 3 95549.42 MZ79 3 s 3 d 3 D 2 95550.51 MZ79 3 s 3 d 3 D 1 95551.44 MZ79 3 s 4 p 3 P° 0 105427.52 MZ79 3 s 4 p 3 P° 1 105441.50 MZ79 3 s 4 p 3 P° 2 105470.93 MZ79 3 s 4 p 1 P° 1 106920.56 MZ79 3 s 3 d 1 D 2 110089.83 MZ79 3 p 2 1 S 0 111637.33 MZ79 3 s 5 s 3 S 1 120092.919 MZ79 3 s 5 s 1 S 0 121366.725 MZ79 3 s 4 d 3 D 3 121483.50 MZ79 3 s 4 d 3 D 2 121483.92 MZ79 3 s 4 d 3 D 1 121484.252 MZ79 3 s 4 f 3 F° 2 123418.48 MZ79 3 s 4 f 3 F° 3 123420.45 MZ79 3 s 4 f 3 F° 4 123423.36 MZ79 3 s 4 f 1 F° 3 123470.5 MZ79 3 s 4 d 1 D 2 124794.13 MZ79 Al III (2 S 1 / 2) Limit 151862.5 KM91b

Energy Levels of Singly Ionized Fluorine (F II)

Energy Levels of Singly Ionized Fluorine (F II)

Configuration Term J Level(cm -1) Ref. 2 s 2 2 p 4 3 P 2 0.00 P69 2 s 2 2 p 4 3 P 1 341.1400 P69 , BZE98 2 s 2 2 p 4 3 P 0 489.6845 P69 , BZE98 2 s 2 2 p 4 1 D 2 20873.4 P69 2 s 2 2 p 4 1 S 0 44918.1 P69 2 s 2 p 5 3 P° 2 164797.88 P69 2 s 2 p 5 3 P° 1 165106.66 P69 2 s 2 p 5 3 P° 0 165279.19 P69 2 s 2 2 p 3 (4 S°)3 s 5 S° 2 176493.93 P69 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 182864.40 P69 2 s 2 2 p 3 (4 S°)3 p 5 P 1 202449.35 P69 2 s 2 2 p 3 (4 S°)3 p 5 P 2 202460.69 P69 2 s 2 2 p 3 (4 S°)3 p 5 P 3 202480.26 P69 2 s 2 2 p 3 (4 S°)3 p 3 P 1 207699.07 P69 2 s 2 2 p 3 (4 S°)3 p 3 P 0 207702.04 P69 2 s 2 2 p 3 (4 S°)3 p 3 P 2 207703.79 P69 2 s 2 2 p 3 (2 D°)3 s 3 D° 3 211866.13 P69 2 s 2 2 p 3 (2 D°)3 s 3 D° 2 211887.19 P69 2 s 2 2 p 3 (2 D°)3 s 3 D° 1 211900.26 P69 2 s 2 2 p 3 (2 D°)3 s 1 D° 2 215069.59 P69 2 s 2 2 p 3 (2 P°)3 s 1 P° 1 227228.42 P69 2 s 2 2 p 3 (2 P°)3 s 3 P° 2 229550.11 P69 2 s 2 2 p 3 (2 P°)3 s 3 P° 1 229551.79 P69 2 s 2 2 p 3 (2 P°)3 s 3 P° 0 229554.45 P69 F III (4 S° 3 / 2) Limit 282058.6 P69

Energy Levels of Singly Ionized Magnesium (Mg II)

Energy Levels of Singly Ionized Magnesium (Mg II)

Configuration Term J Level(cm -1) Ref. 3 s 2 S 1 / 2 0.00 MZ80 3 p 2 P° 1 / 2 35669.31 MZ80 3 p 2 P° 3 / 2 35760.88 MZ80 4 s 2 S 1 / 2 69804.95 MZ80 3 d 2 D 5 / 2 71490.19 MZ80 3 d 2 D 3 / 2 71491.06 MZ80 4 p 2 P° 1 / 2 80619.50 MZ80 4 p 2 P° 3 / 2 80650.02 MZ80 5 s 2 S 1 / 2 92790.51 MZ80 4 d 2 D 5 / 2 93310.59 MZ80 4 d 2 D 3 / 2 93311.11 MZ80 4 f 2 F° 5 / 2 93799.63 MZ80 4 f 2 F° 7 / 2 93799.75 MZ80 5 p 2 P° 1 / 2 97455.12 MZ80 5 p 2 P° 3 / 2 97468.92 MZ80 6 s 2 S 1 / 2 103196.75 MZ80 Mg III (1 S 0) Limit 121267.64 KM91a

Energy Levels of Singly Ionized Neon (Ne II)

Energy Levels of Singly Ionized Neon (Ne II)

Configuration Term J Level(cm -1) Ref. 2 s 2 2 p 5 2 P° 3 / 2 0.00 P71 2 s 2 2 p 5 2 P° 1 / 2 780.34 P71 2 s 2 p 6 2 S 1 / 2 217047.61 P71 2 s 2 2 p 4 (3 P)3 s 4 P 5 / 2 219130.78 P71 2 s 2 2 p 4 (3 P)3 s 4 P 3 / 2 219648.44 P71 2 s 2 2 p 4 (3 P)3 s 4 P 1 / 2 219947.46 P71 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 224087.02 P71 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 224699.27 P71 2 s 2 2 p 4 (3 P)3 p 4 P° 5 / 2 246192.45 P71 2 s 2 2 p 4 (3 P)3 p 4 P° 3 / 2 246415.04 P71 2 s 2 2 p 4 (3 P)3 p 4 P° 1 / 2 246597.71 P71 2 s 2 2 p 4 (1 D)3 s 2 D 5 / 2 246394.13 P71 2 s 2 2 p 4 (1 D)3 s 2 D 3 / 2 246397.49 P71 2 s 2 2 p 4 (3 P)3 p 4 D° 7 / 2 249108.64 P71 2 s 2 2 p 4 (3 P)3 p 4 D° 5 / 2 249445.99 P71 2 s 2 2 p 4 (3 P)3 p 4 D° 3 / 2 249695.53 P71 2 s 2 2 p 4 (3 P)3 p 4 D° 1 / 2 249839.63 P71 2 s 2 2 p 4 (3 P)3 p 2 S° 1 / 2 252798.48 P71 2 s 2 2 p 4 (3 P)3 p 4 S° 3 / 2 252953.54 P71 2 s 2 2 p 4 (3 P)3 p 2 P° 3 / 2 254165.01 P71 2 s 2 2 p 4 (3 P)3 p 2 P° 1 / 2 254292.19 P71 2 s 2 2 p 4 (1 D)3 p 2 P° 3 / 2 276276.85 P71 2 s 2 2 p 4 (1 D)3 p 2 P° 1 / 2 276511.82 P71 2 s 2 2 p 4 (1 S)3 s 2 S 1 / 2 276677.13 P71 2 s 2 2 p 4 (3 P)3 d 4 D 5 / 2 279218.66 P71 2 s 2 2 p 4 (3 P)3 d 2 F 7 / 2 280700.77 P71 2 s 2 2 p 4 (3 P)3 d 2 P 3 / 2 281720.28 P71 2 s 2 2 p 4 (3 P)4 s 2 P 3 / 2 283322.35 P71 Ne III (3 P 2) Limit 330388.6 P71

Energy Levels of Singly Ionized Nitrogen (N II)

Energy Levels of Singly Ionized Nitrogen (N II)

Configuration Term J Level(cm -1) Ref. 2 s 2 (1 S)2 p 2 3 P 0 0.00 BVEC94 2 s 2 (1 S)2 p 2 3 P 1 48.67 BVEC94 2 s 2 (1 S)2 p 2 3 P 2 130.80 BVEC94 2 s 2 (1 S)2 p 2 1 D 2 15316.17 S95 2 s 2 (1 S)2 p 2 1 S 0 32688.64 E83 2 s (2 S)2 p 3 5 S° 2 46784.56 E83 2 s (2 S)2 p 3 3 D° 3 92236.46 E83 2 s (2 S)2 p 3 3 D° 2 92249.91 E83 2 s (2 S)2 p 3 3 D° 1 92251.46 E83 2 s (2 S)2 p 3 3 P° 1 109216.44 E83 2 s (2 S)2 p 3 3 P° 2 109216.93 E83 2 s (2 S)2 p 3 3 P° 0 109223.34 E83 2 s (2 S)2 p 3 1 D° 2 144187.94 M75a 2 s 2 2 p (2 P°)3 s 3 P° 0 148908.59 M75a 2 s 2 2 p (2 P°)3 s 3 P° 1 148940.17 M75a 2 s 2 2 p (2 P°)3 s 3 P° 2 149076.52 M75a 2 s 2 2 p (2 P°)3 s 1 P° 1 149187.80 M75a 2 s (2 S)2 p 3 3 S° 1 155126.73 M75a 2 s 2 2 p (2 P°)3 p 1 P 1 164610.76 M75a 2 s 2 2 p (2 P°)3 p 3 D 1 166521.69 M75a 2 s 2 2 p (2 P°)3 p 3 D 2 166582.45 M75a 2 s 2 2 p (2 P°)3 p 3 D 3 166678.64 M75a 2 s (2 S)2 p 3 1 P° 1 166765.66 M75a 2 s 2 2 p (2 P°)3 p 3 S 1 168892.21 M75a 2 s 2 2 p (2 P°)3 p 3 P 0 170572.61 M75a 2 s 2 2 p (2 P°)3 p 3 P 1 170607.89 M75a 2 s 2 2 p (2 P°)3 p 3 P 2 170666.23 M75a 2 s 2 2 p (2 P°)3 p 1 D 2 174212.03 M75a 2 s 2 2 p (2 P°)3 p 1 S 0 178273.38 M75a 2 s 2 2 p (2 P°)3 d 3 F° 2 186511.58 M75a 2 s 2 2 p (2 P°)3 d 3 F° 3 186570.98 M75a 2 s 2 2 p (2 P°)3 d 3 F° 4 186652.49 M75a 2 s 2 2 p (2 P°)3 d 1 D° 2 187091.37 M75a 2 s 2 2 p (2 P°)3 d 3 D° 1 187437.56 M75a 2 s 2 2 p (2 P°)3 d 3 D° 2 187461.56 M75a 2 s 2 2 p (2 P°)3 d 3 D° 3 187491.90 M75a 2 s 2 2 p (2 P°)3 d 3 P° 2 188857.37 M75a 2 s 2 2 p (2 P°)3 d 3 P° 1 188909.17 M75a 2 s 2 2 p (2 P°)3 d 3 P° 0 188937.24 M75a 2 s 2 2 p (2 P°)3 d 1 F° 3 189335.16 M75a N III (2 P° 1 / 2) Limit 238750.3 E83

Energy Levels of Singly Ionized Oxygen (O II)

Energy Levels of Singly Ionized Oxygen (O II)

Configuration Term J Level(cm -1) Ref. 2 s 2 2 p 3 4 S° 3 / 2 0.00 MKM93 2 s 2 2 p 3 2 D° 5 / 2 26810.55 MKM93 2 s 2 2 p 3 2 D° 3 / 2 26830.57 MKM93 2 s 2 2 p 3 2 P° 3 / 2 40468.01 MKM93 2 s 2 2 p 3 2 P° 1 / 2 40470.00 MKM93 2 s 2 p 4 4 P 5 / 2 119837.21 MKM93 2 s 2 p 4 4 P 3 / 2 120000.43 MKM93 2 s 2 p 4 4 P 1 / 2 120082.86 MKM93 2 s 2 p 4 2 D 5 / 2 165988.46 MKM93 2 s 2 p 4 2 D 3 / 2 165996.50 MKM93 2 s 2 2 p 2 (3 P)3 s 4 P 1 / 2 185235.281 MKM93 2 s 2 2 p 2 (3 P)3 s 4 P 3 / 2 185340.577 MKM93 2 s 2 2 p 2 (3 P)3 s 4 P 5 / 2 185499.124 MKM93 2 s 2 2 p 2 (3 P)3 s 2 P 1 / 2 188888.543 MKM93 2 s 2 2 p 2 (3 P)3 s 2 P 3 / 2 189068.514 MKM93 2 s 2 p 4 2 S 1 / 2 195710.47 MKM93 2 s 2 2 p 2 (3 P)3 p 2 S° 1 / 2 203942.288 MKM93 2 s 2 2 p 2 (3 P)3 p 4 D° 1 / 2 206730.762 MKM93 2 s 2 2 p 2 (3 P)3 p 4 D° 3 / 2 206786.286 MKM93 2 s 2 2 p 2 (3 P)3 p 4 D° 5 / 2 206877.865 MKM93 2 s 2 2 p 2 (3 P)3 p 4 D° 7 / 2 207002.482 MKM93 2 s 2 2 p 2 (1 D)3 s 2 D 5 / 2 206971.68 MKM93 2 s 2 2 p 2 (1 D)3 s 2 D 3 / 2 206972.72 MKM93 2 s 2 2 p 2 (3 P)3 p 4 P° 1 / 2 208346.104 MKM93 2 s 2 2 p 2 (3 P)3 p 4 P° 3 / 2 208392.258 MKM93 2 s 2 2 p 2 (3 P)3 p 4 P° 5 / 2 208484.202 MKM93 2 s 2 2 p 2 (3 P)3 p 2 D° 3 / 2 211522.117 MKM93 2 s 2 2 p 2 (3 P)3 p 2 D° 5 / 2 211712.732 MKM93 2 s 2 2 p 2 (3 P)3 p 4 S° 3 / 2 212161.881 MKM93 2 s 2 p 4 2 P 3 / 2 212593.82 MKM93 2 s 2 p 4 2 P 1 / 2 212762.25 MKM93 2 s 2 2 p 2 (3 P)3 p 2 P° 1 / 2 214169.920 MKM93 2 s 2 2 p 2 (3 P)3 p 2 P° 3 / 2 214229.671 MKM93 2 s 2 2 p 2 (1 D)3 p 2 F° 5 / 2 228723.84 MKM93 2 s 2 2 p 2 (1 D)3 p 2 F° 7 / 2 228747.45 MKM93 2 s 2 2 p 2 (1 D)3 p 2 D° 5 / 2 229947.07 MKM93 2 s 2 2 p 2 (1 D)3 p 2 D° 3 / 2 229968.44 MKM93 2 s 2 2 p 2 (1 S)3 s 2 S 1 / 2 230609.45 MKM93 2 s 2 2 p 2 (3 P)3 d 4 F 3 / 2 231296.126 MKM93 2 s 2 2 p 2 (3 P)3 d 4 F 5 / 2 231350.087 MKM93 2 s 2 2 p 2 (3 P)3 d 4 F 7 / 2 231427.970 MKM93 2 s 2 2 p 2 (3 P)3 d 4 F 9 / 2 231530.246 MKM93 2 s 2 2 p 2 (3 P)3 d 4 P 5 / 2 232462.724 MKM93 2 s 2 2 p 2 (3 P)3 d 4 P 3 / 2 232535.949 MKM93 2 s 2 2 p 2 (3 P)3 d 4 P 1 / 2 232602.492 MKM93 2 s 2 2 p 2 (1 D)3 p 2 P° 1 / 2 232480.44 MKM93 2 s 2 2 p 2 (1 D)3 p 2 P° 3 / 2 232527.09 MKM93 2 s 2 2 p 2 (3 P)3 d 4 D 1 / 2 232711.642 MKM93 2 s 2 2 p 2 (3 P)3 d 4 D 3 / 2 232745.981 MKM93 2 s 2 2 p 2 (3 P)3 d 4 D 5 / 2 232747.562 MKM93 2 s 2 2 p 2 (3 P)3 d 4 D 7 / 2 232753.816 MKM93 2 s 2 2 p 2 (3 P)3 d 2 F 5 / 2 232796.298 MKM93 2 s 2 2 p 2 (3 P)3 d 2 F 7 / 2 232959.210 MKM93 2 s 2 2 p 2 (3 P)3 d 2 P 3 / 2 233430.53 MKM93 2 s 2 2 p 2 (3 P)3 d 2 P 1 / 2 233544.59 MKM93 2 s 2 2 p 2 (3 P)3 d 2 D 3 / 2 234402.797 MKM93 2 s 2 2 p 2 (3 P)3 d 2 D 5 / 2 234454.634 MKM93 2 s 2 2 p 2 (3 P)4 s 4 P 1 / 2 238627.46 MKM93 2 s 2 2 p 2 (3 P)4 s 4 P 3 / 2 238732.65 MKM93 2 s 2 2 p 2 (3 P)4 s 4 P 5 / 2 238893.96 MKM93 O III (3 P 0) Limit 283270.9 MKM93

Energy Levels of Singly Ionized Silicon (Si II)

Energy Levels of Singly Ionized Silicon (Si II)

Configuration Term J Level(cm -1) Ref. 3 s 2 (1 S)3 p 2 P° 1 / 2 0.00 MZ83 3 s 2 (1 S)3 p 2 P° 3 / 2 287.24 MZ83 3 s 3 p 2 4 P 1 / 2 42824.29 MZ83 3 s 3 p 2 4 P 3 / 2 42932.62 MZ83 3 s 3 p 2 4 P 5 / 2 43107.91 MZ83 3 s 3 p 2 2 D 3 / 2 55309.35 MZ83 3 s 3 p 2 2 D 5 / 2 55325.18 MZ83 3 s 2 (1 S)4 s 2 S 1 / 2 65500.47 MZ83 3 s 3 p 2 2 S 1 / 2 76665.35 MZ83 3 s 2 (1 S)3 d 2 D 3 / 2 79338.50 MZ83 3 s 2 (1 S)3 d 2 D 5 / 2 79355.02 MZ83 3 s 2 (1 S)4 p 2 P° 1 / 2 81191.34 MZ83 3 s 2 (1 S)4 p 2 P° 3 / 2 81251.32 MZ83 3 s 3 p 2 2 P 1 / 2 83801.95 MZ83 3 s 3 p 2 2 P 3 / 2 84004.26 MZ83 3 s 2 (1 S)5 s 2 S 1 / 2 97972.09 MZ83 3 s 2 (1 S)4 d 2 D 3 / 2 101023.05 MZ83 3 s 2 (1 S)4 d 2 D 5 / 2 101024.35 MZ83 3 s 2 (1 S)4 f 2 F° 7 / 2 103556.03 MZ83 3 s 2 (1 S)4 f 2 F° 5 / 2 103556.16 MZ83 3 s 2 (1 S)5 p 2 P° 1 / 2 103860.74 MZ83 3 s 2 (1 S)5 p 2 P° 3 / 2 103885.25 MZ83 3 s 3 p (3 P°)3 d 2 D° 3 / 2 108778.7 MZ83 3 s 3 p (3 P°)3 d 2 D° 5 / 2 108820.6 MZ83 3 s 2 (1 S)5 d 2 D 3 / 2 112394.56 MZ83 3 s 2 (1 S)5 d 2 D 5 / 2 112394.72 MZ83 3 s 2 (1 S)5 f 2 F° 7 / 2 113760.15 MZ83 3 s 2 (1 S)5 f 2 F° 5 / 2 113760.32 MZ83 3 s 2 (1 S)5 g 2 G 7 / 2 , 9 / 2 114177.1 MZ83 3 s 3 p (3 P°)3 d 4 F° 3 / 2 114265.64 MZ83 3 s 3 p (3 P°)3 d 4 F° 5 / 2 114327.15 MZ83 3 s 3 p (3 P°)3 d 4 F° 7 / 2 114414.58 MZ83 3 s 3 p (3 P°)3 d 4 F° 9 / 2 114529.14 MZ83 3 s 3 p (3 P°)4 s 4 P° 1 / 2 116862.38 MZ83 3 s 3 p (3 P°)4 s 4 P° 3 / 2 116978.38 MZ83 3 s 3 p (3 P°)4 s 4 P° 5 / 2 117178.06 MZ83 3 s 3 p (3 P°)4 s 2 P° 1 / 2 121444.12 MZ83 3 s 3 p (3 P°)4 s 2 P° 3 / 2 121590.19 MZ83 3 p 3 4 S° 3 / 2 123033.5 MZ83 3 s 3 p (3 P°)3 d 4 D° 5 / 2 124316.9 MZ83 3 s 3 p (3 P°)3 d 4 D° 3 / 2 124325.3 MZ83 3 s 3 p (3 P°)3 d 4 D° 1 / 2 124337.3 MZ83 3 s 3 p (3 P°)3 d 4 D° 7 / 2 124449.5 MZ83 3 s 3 p (3 P°)3 d 4 P° 5 / 2 124567.4 MZ83 3 s 3 p (3 P°)3 d 4 P° 3 / 2 124615.6 MZ83 3 s 3 p (3 P°)3 d 4 P° 1 / 2 124638.9 MZ83 3 s 3 p (3 P°)3 d 2 P° 3 / 2 126236.4 MZ83 3 s 3 p (3 P°)3 d 2 P° 1 / 2 126279.0 MZ83 3 s 3 p (3 P°)3 d 2 F° 5 / 2 131677.1 MZ83 3 s 3 p (3 P°)3 d 2 F° 7 / 2 131918.8 MZ83 3 s 3 p (3 P°)4 p 4 D 1 / 2 131784.9 MZ83 3 s 3 p (3 P°)4 p 4 D 3 / 2 131861.93 MZ83 3 s 3 p (3 P°)4 p 4 D 5 / 2 131988.05 MZ83 3 s 3 p (3 P°)4 p 4 D 7 / 2 132162.29 MZ83 Si III (1 S 0) Limit 131838.14 MZ83

Energy Levels of Singly Ionized Sodium (Na II)

Energy Levels of Singly Ionized Sodium (Na II)

Configuration Term J Level(cm -1) Ref. 2 p 6 1 S 0 0.00 MZ81 2 p 5 3 s 3 P° 2 264924.32 MZ81 2 p 5 3 s 3 P° 1 265689.62 MZ81 2 p 5 3 s 3 P° 0 266281.62 MZ81 2 p 5 3 s 1 P° 1 268762.96 MZ81 2 p 5 3 p 3 S 1 293220.33 MZ81 2 p 5 3 p 3 D 3 297248.82 MZ81 2 p 5 3 p 3 D 2 297635.61 MZ81 2 p 5 3 p 3 D 1 298165.44 MZ81 2 p 5 3 p 1 D 2 299189.96 MZ81 2 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 1 333162.94 MZ81 Na III (2 P° 3 / 2) Limit 381390.2 MZ81

Energy Levels of Singly Ionized Argon (Ar II)

Energy Levels of Singly Ionized Argon (Ar II)

Configuration Term J Level(cm -1) Ref. 3 s 2 3 p 5 2 P° 3 / 2 0.0000 YKH85 3 s 2 3 p 5 2 P° 1 / 2 1431.5831 YKH85 3 s 3 p 6 2 S 1 / 2 108721.53 M71 3 s 2 3 p 4 (3 P)3 d 4 D 7 / 2 132327.3621 WACB95 3 s 2 3 p 4 (3 P)3 d 4 D 5 / 2 132481.2071 WACB95 3 s 2 3 p 4 (3 P)3 d 4 D 3 / 2 132630.7281 WACB95 3 s 2 3 p 4 (3 P)3 d 4 D 1 / 2 132737.7041 WACB95 3 s 2 3 p 4 (3 P)4 s 4 P 5 / 2 134241.7392 WACB95 3 s 2 3 p 4 (3 P)4 s 4 P 3 / 2 135085.9960 M71 3 s 2 3 p 4 (3 P)4 s 4 P 1 / 2 135601.7336 WACB95 3 s 2 3 p 4 (3 P)4 s 2 P 3 / 2 138243.6442 WACB95 3 s 2 3 p 4 (3 P)4 s 2 P 1 / 2 139258.3384 WACB95 3 s 2 3 p 4 (3 P)3 d 4 F 9 / 2 142186.3157 WACB95 3 s 2 3 p 4 (3 P)3 d 4 F 7 / 2 142717.0967 WACB95 3 s 2 3 p 4 (3 P)3 d 4 F 5 / 2 143107.6804 WACB95 3 s 2 3 p 4 (3 P)3 d 4 F 3 / 2 143371.4365 WACB95 3 s 2 3 p 4 (1 D)4 s 2 D 3 / 2 148620.1411 WACB95 3 s 2 3 p 4 (1 D)4 s 2 D 5 / 2 148842.4674 WACB95 3 s 2 3 p 4 (3 P)3 d 2 D 3 / 2 150474.9900 WACB95 3 s 2 3 p 4 (3 P)3 d 2 D 5 / 2 151087.3128 WACB95 3 s 2 3 p 4 (3 P)4 p 4 P° 5 / 2 155043.1622 WACB95 3 s 2 3 p 4 (3 P)4 p 4 P° 3 / 2 155351.1209 WACB95 3 s 2 3 p 4 (3 P)4 p 4 P° 1 / 2 155708.1080 WACB95 3 s 2 3 p 4 (3 P)4 p 4 D° 7 / 2 157234.0200 WACB95 3 s 2 3 p 4 (3 P)4 p 4 D° 5 / 2 157673.4136 WACB95 3 s 2 3 p 4 (3 P)4 p 4 D° 3 / 2 158167.8003 WACB95 3 s 2 3 p 4 (3 P)4 p 4 D° 1 / 2 158428.1087 WACB95 3 s 2 3 p 4 (3 P)4 p 2 D° 5 / 2 158730.2997 WACB95 3 s 2 3 p 4 (3 P)4 p 2 D° 3 / 2 159393.3850 WACB95 3 s 2 3 p 4 (3 P)4 p 2 P° 1 / 2 159706.5334 WACB95 3 s 2 3 p 4 (3 P)4 p 2 P° 3 / 2 160239.4280 WACB95 3 s 2 3 p 4 (1 D)4 p 2 F° 5 / 2 170401.0168 WACB95 3 s 2 3 p 4 (1 D)4 p 2 F° 7 / 2 170530.4041 WACB95 3 s 2 3 p 4 (1 D)4 p 2 P° 3 / 2 172213.8800 WACB95 3 s 2 3 p 4 (1 D)4 p 2 P° 1 / 2 172816.2926 WACB95 Ar III (3 P 2) Limit 222848.3 M60b

Energy Levels of Singly Ionized Calcium (Ca II)

Energy Levels of Singly Ionized Calcium (Ca II)

Configuration Term J Level(cm -1) Ref. 4 s 2 S 1 / 2 0.000 L99 3 d 2 D 3 / 2 13650.20 SC85 3 d 2 D 5 / 2 13710.89 SC85 4 p 2 P° 1 / 2 25191.518 L99 4 p 2 P° 3 / 2 25414.414 L99 5 s 2 S 1 / 2 52166.94 SC85 4 d 2 D 3 / 2 56839.26 SC85 4 d 2 D 5 / 2 56858.47 SC85 5 p 2 P° 1 / 2 60533.03 SC85 5 p 2 P° 3 / 2 60611.29 SC85 4 f 2 F° 5 / 2 , 7 / 2 68056.92 SC85 6 s 2 S 1 / 2 70677.63 SC85 Ca III (1 S 0) Limit 95751.88 SC85

Energy Levels of Singly Ionized Chlorine (Cl II)

Energy Levels of Singly Ionized Chlorine (Cl II)

Configuration Term J Level(cm -1) Ref. 3 s 2 3 p 4 3 P 2 0.00 RK74 3 s 2 3 p 4 3 P 1 696.00 RK74 3 s 2 3 p 4 3 P 0 996.47 RK74 3 s 2 3 p 4 1 D 2 11653.58 RK74 3 s 2 3 p 4 1 S 0 27878.02 RK74 3 s 3 p 5 3 P° 2 93367.56 RK74 3 s 3 p 5 3 P° 1 93999.88 RK74 3 s 3 p 5 3 P° 0 94333.84 RK74 3 s 2 3 p 3 (4 S°)4 s 5 S° 2 107879.66 RK74 3 s 2 3 p 3 (4 S°)3 d 5 D° 4 110296.84 RK74 3 s 2 3 p 3 (4 S°)3 d 5 D° 3 110297.72 RK74 3 s 2 3 p 3 (4 S°)3 d 5 D° 2 110300.56 RK74 3 s 2 3 p 3 (4 S°)3 d 5 D° 1 110303.12 RK74 3 s 2 3 p 3 (4 S°)3 d 5 D° 0 110304.52 RK74 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 112609.36 RK74 3 s 2 3 p 3 (2 D°)3 d 1 P° 1 115657.77 RK74 3 s 2 3 p 3 (4 S°)3 d 3 D° 2 119800.32 RK74 3 s 2 3 p 3 (4 S°)3 d 3 D° 3 119811.22 RK74 3 s 2 3 p 3 (4 S°)3 d 3 D° 1 119843.31 RK74 3 s 2 3 p 3 (2 D°)3 d 1 S° 0 125245.89 RK74 3 s 2 3 p 3 (2 D°)3 d 3 F° 2 126033.54 RK74 3 s 2 3 p 3 (2 D°)3 d 3 F° 3 126220.74 RK74 3 s 2 3 p 3 (2 D°)3 d 3 F° 4 126458.10 RK74 3 s 2 3 p 3 (2 D°)4 s 3 D° 1 126726.70 RK74 3 s 2 3 p 3 (2 D°)4 s 3 D° 2 126744.97 RK74 3 s 2 3 p 3 (2 D°)4 s 3 D° 3 126784.37 RK74 3 s 2 3 p 3 (4 S°)4 p 5 P 1 128622.99 RK74 3 s 2 3 p 3 (4 S°)4 p 5 P 2 128663.57 RK74 3 s 2 3 p 3 (4 S°)4 p 5 P 3 128730.82 RK74 3 s 2 3 p 3 (2 D°)4 s 1 D° 2 129066.96 RK74 3 s 2 3 p 3 (4 S°)4 p 3 P 1 131756.12 RK74 3 s 2 3 p 3 (4 S°)4 p 3 P 2 131768.66 RK74 3 s 2 3 p 3 (4 S°)4 p 3 P 0 131769.41 RK74 3 s 2 3 p 3 (2 D°)3 d 3 G° 3 132164.13 RK74 3 s 2 3 p 3 (2 D°)3 d 3 G° 4 132175.11 RK74 3 s 2 3 p 3 (2 D°)3 d 3 G° 5 132193.12 RK74 3 s 2 3 p 3 (2 D°)3 d 1 G° 4 134393.27 RK74 3 s 2 3 p 3 (2 P°)4 s 3 P° 0 137771.77 RK74 3 s 2 3 p 3 (2 P°)4 s 3 P° 1 137806.15 RK74 3 s 2 3 p 3 (2 P°)4 s 3 P° 2 137879.37 RK74 3 s 2 3 p 3 (2 P°)3 d 1 D° 2 138624.73 RK74 3 s 2 3 p 3 (2 P°)4 s 3 P° 1 140260.64 RK74 3 s 2 3 p 3 (2 D°)3 d 3 D° 1 140741.80 RK74 3 s 2 3 p 3 (2 D°)3 d 3 D° 2 141011.58 RK74 3 s 2 3 p 3 (2 D°)3 d 3 D° 3 141351.14 RK74 3 s 2 3 p 3 (2 P°)3 d 3 F° 4 143998.08 RK74 3 s 2 3 p 3 (2 P°)3 d 3 F° 3 144176.42 RK74 3 s 2 3 p 3 (2 P°)3 d 3 F° 2 144345.56 RK74 3 s 2 3 p 3 (2 P°)3 d 3 P° 0 145175.45 RK74 3 s 2 3 p 3 (2 P°)3 d 3 P° 1 145421.24 RK74 3 s 2 3 p 3 (2 P°)3 d 3 P° 2 146014.75 RK74 3 s 2 3 p 3 (2 D°)4 p 1 P 1 145470.16 RK74 3 s 2 3 p 3 (2 D°)4 p 3 D 1 146331.76 RK74 3 s 2 3 p 3 (2 D°)4 p 3 D 2 146335.55 RK74 3 s 2 3 p 3 (2 D°)4 p 3 D 3 146470.64 RK74 3 s 2 3 p 3 (2 D°)4 p 3 F 2 147055.61 RK74 3 s 2 3 p 3 (2 D°)4 p 3 F 3 147127.57 RK74 3 s 2 3 p 3 (2 D°)4 p 3 F 4 147200.24 RK74 3 s 2 3 p 3 (2 D°)4 p 1 F 3 147607.37 RK74 3 s 2 3 p 3 (2 D°)4 p 3 P 2 149800.12 RK74 3 s 2 3 p 3 (2 D°)4 p 3 P 1 149954.18 RK74 3 s 2 3 p 3 (2 D°)4 p 3 P 0 150020.90 RK74 3 s 2 3 p 3 (2 P°)3 d 3 D° 3 150683.38 RK74 3 s 2 3 p 3 (2 P°)3 d 3 D° 2 151020.06 RK74 3 s 2 3 p 3 (2 P°)3 d 3 D° 1 151135.31 RK74 3 s 2 3 p 3 (2 D°)3 d 3 S° 1 150813.12 RK74 3 s 2 3 p 3 (2 D°)3 d 1 F° 3 151094.06 RK74 3 s 2 3 p 3 (4 S°)5 s 5 S° 2 152234.91 RK74 3 s 2 3 p 3 (2 D°)4 p 1 D 2 153258.61 RK74 3 s 2 3 p 3 (4 S°)5 s 3 S° 1 153634.97 RK74 3 s 2 3 p 3 (4 S°)4 d 5 D° 0 154618.09 RK74 3 s 2 3 p 3 (4 S°)4 d 5 D° 1 154619.10 RK74 3 s 2 3 p 3 (4 S°)4 d 5 D° 2 154620.97 RK74 3 s 2 3 p 3 (4 S°)4 d 5 D° 3 154623.57 RK74 3 s 2 3 p 3 (4 S°)4 d 5 D° 4 154624.66 RK74 Cl III (4 S° 3 / 2) Limit 192070 RK74

Energy Levels of Singly Ionized Phosphorus (P II)

Energy Levels of Singly Ionized Phosphorus (P II)

Configuration Term J Level(cm -1) Ref. 3 s 2 3 p 2 3 P 0 0.00 MZM85 3 s 2 3 p 2 3 P 1 164.90 MZM85 3 s 2 3 p 2 3 P 2 469.12 MZM85 3 s 2 3 p 2 1 D 2 8882.31 MZM85 3 s 2 3 p 2 1 S 0 21575.63 MZM85 3 s 3 p 3 5 S° 2 45697.02 MZM85 3 s 3 p 3 3 D° 1 65251.45 MZM85 3 s 3 p 3 3 D° 2 65272.35 MZM85 3 s 3 p 3 3 D° 3 65307.17 MZM85 3 s 3 p 3 3 P° 2 76764.06 MZM85 3 s 3 p 3 3 P° 1 76812.33 MZM85 3 s 3 p 3 3 P° 0 76823.11 MZM85 3 s 2 3 p 3 d 1 D° 2 77710.19 MZM85 3 s 2 3 p 4 s 3 P° 0 86597.55 MZM85 3 s 2 3 p 4 s 3 P° 1 86743.96 MZM85 3 s 2 3 p 4 s 3 P° 2 87124.60 MZM85 3 s 2 3 p 3 d 3 F° 2 87804.10 MZM85 3 s 2 3 p 3 d 3 F° 3 87966.81 MZM85 3 s 2 3 p 3 d 3 F° 4 88192.13 MZM85 3 s 2 3 p 4 s 1 P° 1 88893.22 MZM85 3 s 2 3 p 4 p 1 P 1 101635.69 MZM85 3 s 2 3 p 3 d 1 P° 1 102798.26 MZM85 3 s 2 3 p 4 p 3 D 1 103165.61 MZM85 3 s 2 3 p 4 p 3 D 2 103339.14 MZM85 3 s 2 3 p 4 p 3 D 3 103667.86 MZM85 3 s 2 3 p 3 d 3 P° 2 103629.70 MZM85 3 s 2 3 p 3 d 3 P° 1 103755.91 MZM85 3 s 2 3 p 3 d 3 P° 0 103940.38 MZM85 3 s 2 3 p 3 d 3 D° 3 104050.27 MZM85 3 s 2 3 p 3 d 3 D° 1 104053.81 MZM85 3 s 2 3 p 3 d 3 D° 2 104101.75 MZM85 3 s 2 3 p 4 p 3 P 0 105224.06 MZM85 3 s 2 3 p 4 p 3 P 1 105302.37 MZM85 3 s 2 3 p 4 p 3 P 2 105549.67 MZM85 3 s 2 3 p 4 p 3 S 1 106001.25 MZM85 3 s 2 3 p 3 d 1 F° 3 107360.25 MZM85 3 s 2 3 p 4 p 1 D 2 107922.93 MZM85 3 s 3 p 3 3 S° 1 110254.77 MZM85 3 s 2 3 p 4 p 1 S 0 111507.66 MZM85 3 s 3 p 3 1 D° 2 112606.86 MZM85 3 s 3 p 3 1 P° 1 118341.71 MZM85 3 s 2 3 p 5 s 3 P° 0 123344.19 MZM85 3 s 2 3 p 5 s 3 P° 1 123455.46 MZM85 3 s 2 3 p 5 s 3 P° 2 123890.81 MZM85 3 s 2 3 p 5 s 1 P° 1 124432.26 MZM85 3 s 2 3 p 4 d 3 F° 2 124946.73 MZM85 3 s 2 3 p 4 d 3 F° 3 125128.87 MZM85 3 s 2 3 p 4 d 3 F° 4 125391.13 MZM85 P III (2 P° 1 / 2) Limit 159451.5 MZM85

Energy Levels of Singly Ionized Potassium (K II)

Energy Levels of Singly Ionized Potassium (K II)

Configuration Term J Level(cm -1) Ref. 3 p 6 1 S 0 0.0 SC85 3 p 5 4 s 3 P° 2 162507.0 SC85 3 p 5 4 s 3 P° 1 163237.0 SC85 3 p 5 4 s 3 P° 0 165149.5 SC85 3 p 5 3 d 3 P° 0 163436.3 SC85 3 p 5 3 d 3 P° 1 164496.1 SC85 3 p 5 3 d 3 P° 2 164932.3 SC85 3 p 5 4 s 1 P° 1 166461.5 SC85 K III (2 P° 3 / 2) Limit 255100 K87

Energy Levels of Singly Ionized Scandium (Sc II)

Energy Levels of Singly Ionized Scandium (Sc II)

Configuration Term J Level(cm -1) Ref. 3 d 4 s 3 D 1 0.00 SC85 3 d 4 s 3 D 2 67.72 SC85 3 d 4 s 3 D 3 177.76 SC85 3 d 4 s 1 D 2 2540.95 SC85 3 d 2 3 F 2 4802.87 SC85 3 d 2 3 F 3 4883.57 SC85 3 d 2 3 F 4 4987.79 SC85 3 d 2 1 D 2 10944.56 SC85 4 s 2 1 S 0 11736.36 SC85 3 d 2 3 P 0 12074.10 SC85 3 d 2 3 P 1 12101.50 SC85 3 d 2 3 P 2 12154.42 SC85 3 d 2 1 G 4 14261.32 SC85 3 d 2 1 S 0 25955.2 SC85 3 d 4 p 1 D° 2 26081.34 SC85 3 d 4 p 3 F° 2 27443.71 SC85 3 d 4 p 3 F° 3 27602.45 SC85 3 d 4 p 3 F° 4 27841.35 SC85 3 d 4 p 3 D° 1 27917.78 SC85 3 d 4 p 3 D° 2 28021.29 SC85 3 d 4 p 3 D° 3 28161.17 SC85 3 d 4 p 3 P° 0 29736.27 SC85 3 d 4 p 3 P° 1 29742.16 SC85 3 d 4 p 3 P° 2 29823.93 SC85 3 d 4 p 1 P° 1 30815.70 SC85 3 d 4 p 1 F° 3 32349.98 SC85 Sc III (2 D 3 / 2) Limit 103237.1 SC85

Energy Levels of Singly Ionized Sulfur (S II)

Energy Levels of Singly Ionized Sulfur (S II)

Configuration Term J Level(cm -1) Ref. 3 s 2 3 p 3 4 S° 3 / 2 0.00 MZM90 3 s 2 3 p 3 2 D° 3 / 2 14852.94 MZM90 3 s 2 3 p 3 2 D° 5 / 2 14884.73 MZM90 3 s 2 3 p 3 2 P° 1 / 2 24524.83 MZM90 3 s 2 3 p 3 2 P° 3 / 2 24571.54 MZM90 3 s 3 p 4 4 P 5 / 2 79395.39 MZM90 3 s 3 p 4 4 P 3 / 2 79756.83 MZM90 3 s 3 p 4 4 P 1 / 2 79962.61 MZM90 3 s 3 p 4 2 D 3 / 2 97890.74 MZM90 3 s 3 p 4 2 D 5 / 2 97918.86 MZM90 3 s 2 3 p 2 (3 P)3 d 2 P 3 / 2 105599.06 MZM90 3 s 2 3 p 2 (3 P)3 d 2 P 1 / 2 106044.24 MZM90 3 s 2 3 p 2 (3 P)4 s 4 P 1 / 2 109560.69 MZM90 3 s 2 3 p 2 (3 P)4 s 4 P 3 / 2 109831.59 MZM90 3 s 2 3 p 2 (3 P)4 s 4 P 5 / 2 110268.60 MZM90 3 s 2 3 p 2 (3 P)3 d 4 F 3 / 2 110177.02 MZM90 3 s 2 3 p 2 (3 P)3 d 4 F 5 / 2 110313.40 MZM90 3 s 2 3 p 2 (3 P)3 d 4 F 7 / 2 110508.71 MZM90 3 s 2 3 p 2 (3 P)3 d 4 F 9 / 2 110766.56 MZM90 3 s 2 3 p 2 (3 P)4 s 2 P 1 / 2 112937.57 MZM90 3 s 2 3 p 2 (3 P)4 s 2 P 3 / 2 113461.54 MZM90 3 s 2 3 p 2 (3 P)3 d 4 D 1 / 2 114162.30 MZM90 3 s 2 3 p 2 (3 P)3 d 4 D 3 / 2 114200.54 MZM90 3 s 2 3 p 2 (3 P)3 d 4 D 5 / 2 114231.04 MZM90 3 s 2 3 p 2 (3 P)3 d 4 D 7 / 2 114279.33 MZM90 3 s 2 3 p 2 (3 P)3 d 2 F 5 / 2 114804.37 MZM90 3 s 2 3 p 2 (3 P)3 d 2 F 7 / 2 115285.61 MZM90 3 s 3 p 4 2 S 1 / 2 119783.77 MZM90 3 s 2 3 p 2 (1 D)4 s 2 D 3 / 2 121528.72 MZM90 3 s 2 3 p 2 (1 D)4 s 2 D 5 / 2 121530.02 MZM90 3 s 2 3 p 2 (3 P)4 p 2 S° 1 / 2 125485.29 MZM90 3 s 2 3 p 2 (1 D)3 d 2 G 7 / 2 127127.10 MZM90 3 s 2 3 p 2 (1 D)3 d 2 G 9 / 2 127128.35 MZM90 3 s 2 3 p 2 (3 P)4 p 4 D° 1 / 2 127825.08 MZM90 3 s 2 3 p 2 (3 P)4 p 4 D° 3 / 2 127976.34 MZM90 3 s 2 3 p 2 (3 P)4 p 4 D° 5 / 2 128233.20 MZM90 3 s 2 3 p 2 (3 P)4 p 4 D° 7 / 2 128599.16 MZM90 3 s 2 3 p 2 (3 P)4 p 4 P° 1 / 2 129787.83 MZM90 3 s 2 3 p 2 (3 P)4 p 4 P° 3 / 2 129858.18 MZM90 3 s 2 3 p 2 (3 P)4 p 4 P° 5 / 2 130134.16 MZM90 3 s 2 3 p 2 (3 P)3 d 4 P 5 / 2 130602.21 MZM90 3 s 2 3 p 2 (3 P)3 d 4 P 3 / 2 130818.85 MZM90 3 s 2 3 p 2 (3 P)3 d 4 P 1 / 2 130948.94 MZM90 3 s 2 3 p 2 (3 P)4 p 2 D° 3 / 2 130641.11 MZM90 3 s 2 3 p 2 (3 P)4 p 2 D° 5 / 2 131187.19 MZM90 3 s 2 3 p 2 (3 P)4 p 4 S° 3 / 2 131028.85 MZM90 3 s 2 3 p 2 (3 P)4 p 2 P° 1 / 2 133268.68 MZM90 3 s 2 3 p 2 (3 P)4 p 2 P° 3 / 2 133399.97 MZM90 3 s 2 3 p 2 (3 P)3 d 2 D 3 / 2 133360.86 MZM90 3 s 2 3 p 2 (3 P)3 d 2 D 5 / 2 133814.84 MZM90 3 s 2 3 p 2 (1 S)4 s 2 S 1 / 2 136328.79 MZM90 3 s 2 3 p 2 (1 D)3 d 2 F 5 / 2 138509.17 MZM90 3 s 2 3 p 2 (1 D)3 d 2 F 7 / 2 138527.98 MZM90 3 s 2 3 p 2 (1 D)3 d 2 P 1 / 2 139844.99 MZM90 3 s 2 3 p 2 (1 D)3 d 2 P 3 / 2 140016.77 MZM90 3 s 2 3 p 2 (1 D)4 p 2 F° 5 / 2 140230.10 MZM90 3 s 2 3 p 2 (1 D)4 p 2 F° 7 / 2 140319.23 MZM90 S III (3 P 0) Limit 188232.7 MZM90

Energy Levels of Singly Ionized Titanium (Ti II)

Energy Levels of Singly Ionized Titanium (Ti II)

Configuration Term J Level(cm -1) Ref. 3 d 2 (3 F)4 s a 4 F 3 / 2 0.00 SC85 3 d 2 (3 F)4 s a 4 F 5 / 2 94.10 SC85 3 d 2 (3 F)4 s a 4 F 7 / 2 225.73 SC85 3 d 2 (3 F)4 s a 4 F 9 / 2 393.44 SC85 3 d 3 b 4 F 3 / 2 908.02 SC85 3 d 3 b 4 F 5 / 2 983.89 SC85 3 d 3 b 4 F 7 / 2 1087.32 SC85 3 d 3 b 4 F 9 / 2 1215.84 SC85 3 d 2 (3 F)4 s a 2 F 5 / 2 4628.58 SC85 3 d 2 (3 F)4 s a 2 F 7 / 2 4897.65 SC85 3 d 2 (1 D)4 s a 2 D 3 / 2 8710.44 SC85 3 d 2 (1 D)4 s a 2 D 5 / 2 8744.25 SC85 3 d 3 a 2 G 7 / 2 8997.71 SC85 3 d 3 a 2 G 9 / 2 9118.26 SC85 3 d 3 a 4 P 1 / 2 9363.62 SC85 3 d 3 a 4 P 3 / 2 9395.71 SC85 3 d 3 a 4 P 5 / 2 9518.06 SC85 3 d 3 a 2 P 1 / 2 9850.90 SC85 3 d 3 a 2 P 3 / 2 9975.92 SC85 3 d 2 (3 P)4 s b 4 P 1 / 2 9872.73 SC85 3 d 2 (3 P)4 s b 4 P 3 / 2 9930.69 SC85 3 d 2 (3 P)4 s b 4 P 5 / 2 10024.73 SC85 3 d 3 b 2 D 3 / 2 12628.73 SC85 3 d 3 b 2 D 5 / 2 12758.11 SC85 3 d 3 a 2 H 9 / 2 12676.97 SC85 3 d 3 a 2 H 1 1 / 2 12774.69 SC85 3 d 2 (1 G)4 s b 2 G 9 / 2 15257.43 SC85 3 d 2 (1 G)4 s b 2 G 7 / 2 15265.62 SC85 3 d 2 (3 P)4 s b 2 P 1 / 2 16515.86 SC85 3 d 2 (3 P)4 s b 2 P 3 / 2 16625.11 SC85 3 d 3 b 2 F 7 / 2 20891.66 SC85 3 d 3 b 2 F 5 / 2 20951.62 SC85 3 d 4 s 2 c 2 D 3 / 2 24961.03 SC85 3 d 4 s 2 c 2 D 5 / 2 25192.79 SC85 3 d 2 (3 F)4 p z 4 G° 5 / 2 29544.37 SC85 3 d 2 (3 F)4 p z 4 G° 7 / 2 29734.54 SC85 3 d 2 (3 F)4 p z 4 G° 9 / 2 29968.30 SC85 3 d 2 (3 F)4 p z 4 G° 1 1 / 2 30240.88 SC85 3 d 2 (3 F)4 p z 4 F° 3 / 2 30836.32 SC85 3 d 2 (3 F)4 p z 4 F° 5 / 2 30958.50 SC85 3 d 2 (3 F)4 p z 4 F° 7 / 2 31113.65 SC85 3 d 2 (3 F)4 p z 4 F° 9 / 2 31301.01 SC85 3 d 2 (3 F)4 p z 2 F° 5 / 2 31207.42 SC85 3 d 2 (3 F)4 p z 2 F° 7 / 2 31490.82 SC85 3 d 2 (3 F)4 p z 2 D° 3 / 2 31756.51 SC85 3 d 2 (3 F)4 p z 2 D° 5 / 2 32025.47 SC85 3 d 2 (1 S)4 s a 2 S 1 / 2 31787.75 SC85 3 d 3 d 2 D1 3 / 2 32275.32 SC85 3 d 3 d 2 D1 5 / 2 32332.73 SC85 3 d 2 (3 F)4 p z 4 D° 1 / 2 32532.21 SC85 3 d 2 (3 F)4 p z 4 D° 3 / 2 32602.55 SC85 3 d 2 (3 F)4 p z 4 D° 5 / 2 32697.99 SC85 3 d 2 (3 F)4 p z 4 D° 7 / 2 32767.07 SC85 3 d 2 (3 F)4 p z 2 G° 7 / 2 34543.26 SC85 3 d 2 (3 F)4 p z 2 G° 9 / 2 34748.40 SC85 Ti III (3 F 2) Limit 109494 SC85

Energy Levels of Singly Ionized Chromium (Cr II)

Energy Levels of Singly Ionized Chromium (Cr II)

Configuration Term J Level(cm -1) Ref. 3 d 5 a 6 S 5 / 2 0.00 SC85 3 d 4 (5 D)4 s a 6 D 1 / 2 11961.81 SC85 3 d 4 (5 D)4 s a 6 D 3 / 2 12032.58 SC85 3 d 4 (5 D)4 s a 6 D 5 / 2 12147.82 SC85 3 d 4 (5 D)4 s a 6 D 7 / 2 12303.86 SC85 3 d 4 (5 D)4 s a 6 D 9 / 2 12496.44 SC85 3 d 4 (5 D)4 s a 4 D 1 / 2 19528.25 SC85 3 d 4 (5 D)4 s a 4 D 3 / 2 19631.17 SC85 3 d 4 (5 D)4 s a 4 D 5 / 2 19797.88 SC85 3 d 4 (5 D)4 s a 4 D 7 / 2 20024.01 SC85 3 d 5 a 4 G 5 / 2 20512.06 SC85 3 d 5 a 4 G 1 1 / 2 20512.10 SC85 3 d 5 a 4 G 7 / 2 20517.83 SC85 3 d 5 a 4 G 9 / 2 20519.33 SC85 3 d 5 a 4 P 5 / 2 21822.52 SC85 3 d 5 a 4 P 1 / 2 21823.84 SC85 3 d 5 a 4 P 3 / 2 21824.11 SC85 3 d 4 (5 D)4 p z 6 F° 1 / 2 46823.39 SC85 3 d 4 (5 D)4 p z 6 F° 3 / 2 46905.17 SC85 3 d 4 (5 D)4 p z 6 F° 5 / 2 47040.35 SC85 3 d 4 (5 D)4 p z 6 F° 7 / 2 47227.24 SC85 3 d 4 (5 D)4 p z 6 F° 9 / 2 47464.55 SC85 3 d 4 (5 D)4 p z 6 F° 1 1 / 2 47751.62 SC85 3 d 4 (5 D)4 p z 6 P° 3 / 2 48398.95 SC85 3 d 4 (5 D)4 p z 6 P° 5 / 2 48491.10 SC85 3 d 4 (5 D)4 p z 6 P° 7 / 2 48632.12 SC85 3 d 4 (5 D)4 p z 4 P° 1 / 2 48749.36 SC85 3 d 4 (5 D)4 p z 4 P° 3 / 2 49005.93 SC85 3 d 4 (5 D)4 p z 4 P° 5 / 2 49706.33 SC85 3 d 4 (5 D)4 p z 6 D° 5 / 2 49351.80 SC85 3 d 4 (5 D)4 p z 6 D° 1 / 2 49492.77 SC85 3 d 4 (5 D)4 p z 6 D° 3 / 2 49564.60 SC85 3 d 4 (5 D)4 p z 6 D° 7 / 2 49645.77 SC85 3 d 4 (5 D)4 p z 6 D° 9 / 2 49838.38 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 D° 1 / 2 81649.19 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 D° 3 / 2 81707.87 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 D° 5 / 2 81816.29 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 D° 7 / 2 81978.08 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 D° 9 / 2 82192.59 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 1 / 2 81735.02 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 3 / 2 81824.40 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 5 / 2 81962.29 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 7 / 2 82143.15 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 9 / 2 82362.19 SC85 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 1 1 / 2 82612.69 SC85 Cr III (5 D 0) Limit 132966 SC85

Energy Levels of Singly Ionized Cobalt (Co II)

Energy Levels of Singly Ionized Cobalt (Co II)

Configuration Term J Level(cm -1) Ref. 3 d 8 a 3 F 4 0.000 PRUJ98 3 d 8 a 3 F 3 950.324 PRUJ98 3 d 8 a 3 F 2 1597.197 PRUJ98 3 d 7 (4 F)4 s a 5 F 5 3350.494 PRUJ98 3 d 7 (4 F)4 s a 5 F 4 4028.988 PRUJ98 3 d 7 (4 F)4 s a 5 F 3 4560.789 PRUJ98 3 d 7 (4 F)4 s a 5 F 2 4950.062 PRUJ98 3 d 7 (4 F)4 s a 5 F 1 5204.698 PRUJ98 3 d 7 (4 F)4 s b 3 F 4 9812.859 PRUJ98 3 d 7 (4 F)4 s b 3 F 3 10708.330 PRUJ98 3 d 7 (4 F)4 s b 3 F 2 11321.859 PRUJ98 3 d 7 (4 F)4 p z 5 F° 5 45197.708 PRUJ98 3 d 7 (4 F)4 p z 5 F° 4 45378.751 PRUJ98 3 d 7 (4 F)4 p z 5 F° 3 45972.033 PRUJ98 3 d 7 (4 F)4 p z 5 F° 2 46452.697 PRUJ98 3 d 7 (4 F)4 p z 5 F° 1 46786.406 PRUJ98 3 d 7 (4 F)4 p z 5 D° 4 46320.829 PRUJ98 3 d 7 (4 F)4 p z 5 D° 3 47039.102 PRUJ98 3 d 7 (4 F)4 p z 5 D° 2 47537.362 PRUJ98 3 d 7 (4 F)4 p z 5 D° 1 47848.778 PRUJ98 3 d 7 (4 F)4 p z 5 D° 0 47995.591 PRUJ98 3 d 7 (4 F)4 p z 5 G° 6 47078.491 PRUJ98 3 d 7 (4 F)4 p z 5 G° 5 47345.842 PRUJ98 3 d 7 (4 F)4 p z 5 G° 4 47807.490 PRUJ98 3 d 7 (4 F)4 p z 5 G° 3 48150.937 PRUJ98 3 d 7 (4 F)4 p z 5 G° 2 48388.439 PRUJ98 Co III (4 F 9 / 2) Limit 137795 SC85

Energy Levels of Singly Ionized Copper (Cu II)

Energy Levels of Singly Ionized Copper (Cu II)

Configuration Term J Level(cm -1) Ref. 3 d 1 0 1 S 0 0.000 SM90 3 d 9 4 s 3 D 3 21928.754 SM90 3 d 9 4 s 3 D 2 22847.131 SM90 3 d 9 4 s 1 D 2 26264.568 SM90 3 d 9 4 p 3 P° 2 66418.687 SM90 3 d 9 4 p 3 P° 1 67916.555 SM90 3 d 9 4 p 3 P° 0 68850.260 SM90 3 d 9 4 p 3 F° 3 68447.741 SM90 3 d 9 4 p 3 F° 4 68730.893 SM90 3 d 9 4 p 3 F° 2 69867.983 SM90 3 d 9 4 p 1 F° 3 70841.470 SM90 3 d 9 4 p 3 D° 3 71920.102 SM90 3 d 9 4 p 3 D° 1 73102.038 SM90 3 d 9 4 p 3 D° 2 73353.292 SM90 3 d 9 4 p 1 P° 1 73595.813 SM90 Cu III (2 D 5 / 2) Limit 163669.2 SM90

Energy Levels of Singly Ionized Iron (Fe II)

Energy Levels of Singly Ionized Iron (Fe II)

Configuration Term J Level(cm -1) Ref. 3 d 6 (5 D)4 s a 6 D 9 / 2 0.000 J78 3 d 6 (5 D)4 s a 6 D 7 / 2 384.790 J78 3 d 6 (5 D)4 s a 6 D 5 / 2 667.683 J78 3 d 6 (5 D)4 s a 6 D 3 / 2 862.613 J78 3 d 6 (5 D)4 s a 6 D 1 / 2 977.053 J78 3 d 7 a 4 F 9 / 2 1872.567 J78 3 d 7 a 4 F 7 / 2 2430.097 J78 3 d 7 a 4 F 5 / 2 2837.950 J78 3 d 7 a 4 F 3 / 2 3117.461 J78 3 d 6 (5 D)4 s a 4 D 7 / 2 7955.299 J78 3 d 6 (5 D)4 s a 4 D 5 / 2 8391.938 J78 3 d 6 (5 D)4 s a 4 D 3 / 2 8680.454 J78 3 d 6 (5 D)4 s a 4 D 1 / 2 8846.768 J78 3 d 7 a 4 P 5 / 2 13474.411 J78 3 d 7 a 4 P 3 / 2 13673.185 J78 3 d 7 a 4 P 1 / 2 13904.824 J78 3 d 7 a 2 G 9 / 2 15844.65 J78 3 d 7 a 2 G 7 / 2 16369.36 J78 3 d 7 a 2 P 3 / 2 18360.646 J78 3 d 7 a 2 P 1 / 2 18886.780 J78 3 d 7 a 2 H 1 1 / 2 20340.30 J78 3 d 7 a 2 H 9 / 2 20805.77 J78 3 d 7 a 2 D2 5 / 2 20516.960 J78 3 d 7 a 2 D2 3 / 2 21308.04 J78 3 d 6 (3 P 2)4 s b 4 P 5 / 2 20830.582 J78 3 d 6 (3 P 2)4 s b 4 P 3 / 2 21812.055 J78 3 d 6 (3 P 2)4 s b 4 P 1 / 2 22409.852 J78 3 d 6 (3 H)4 s a 4 H 1 3 / 2 21251.608 J78 3 d 6 (3 H)4 s a 4 H 1 1 / 2 21430.359 J78 3 d 6 (3 H)4 s a 4 H 9 / 2 21581.638 J78 3 d 6 (3 H)4 s a 4 H 7 / 2 21711.917 J78 3 d 6 (3 F 2)4 s b 4 F 9 / 2 22637.205 J78 3 d 6 (3 F 2)4 s b 4 F 7 / 2 22810.357 J78 3 d 6 (3 F 2)4 s b 4 F 5 / 2 22939.358 J78 3 d 6 (3 F 2)4 s b 4 F 3 / 2 23031.300 J78 3 d 5 4 s 2 a 6 S 5 / 2 23317.633 J78 3 d 6 (3 G)4 s a 4 G 1 1 / 2 25428.784 J78 3 d 6 (3 G)4 s a 4 G 9 / 2 25805.328 J78 3 d 6 (3 G)4 s a 4 G 7 / 2 25981.629 J78 3 d 6 (3 G)4 s a 4 G 5 / 2 26055.423 J78 3 d 6 (3 P 2)4 s b 2 P 3 / 2 25787.598 J78 3 d 6 (3 P 2)4 s b 2 P 1 / 2 26932.748 J78 3 d 6 (3 H)4 s b 2 H 1 1 / 2 26170.181 J78 3 d 6 (3 H)4 s b 2 H 9 / 2 26352.766 J78 3 d 6 (3 F 2)4 s a 2 F 7 / 2 27314.922 J78 3 d 6 (3 F 2)4 s a 2 F 5 / 2 27620.412 J78 3 d 6 (3 G)4 s b 2 G 9 / 2 30388.542 J78 3 d 6 (3 G)4 s b 2 G 7 / 2 30764.485 J78 3 d 6 (3 D)4 s b 4 D 3 / 2 31364.440 J78 3 d 6 (3 D)4 s b 4 D 1 / 2 31368.450 J78 3 d 6 (3 D)4 s b 4 D 5 / 2 31387.948 J78 3 d 6 (3 D)4 s b 4 D 7 / 2 31483.176 J78 3 d 7 b 2 F 5 / 2 31811.822 J78 3 d 7 b 2 F 7 / 2 31999.048 J78 3 d 6 (1 I)4 s a 2 I 1 3 / 2 32875.646 J78 3 d 6 (1 I)4 s a 2 I 1 1 / 2 32909.905 J78 3 d 6 (1 G 2)4 s c 2 G 9 / 2 33466.463 J78 3 d 6 (1 G 2)4 s c 2 G 7 / 2 33501.253 J78 3 d 6 (3 D)4 s b 2 D 3 / 2 36126.387 J78 3 d 6 (3 D)4 s b 2 D 5 / 2 36252.918 J78 3 d 6 (1 S 2)4 s a 2 S 1 / 2 37227.326 J78 3 d 6 (1 D 2)4 s c 2 D 5 / 2 38164.194 J78 3 d 6 (1 D 2)4 s c 2 D 3 / 2 38214.507 J78 3 d 6 (5 D)4 p z 6 D° 9 / 2 38458.981 J78 3 d 6 (5 D)4 p z 6 D° 7 / 2 38660.043 J78 3 d 6 (5 D)4 p z 6 D° 5 / 2 38858.958 J78 3 d 6 (5 D)4 p z 6 D° 3 / 2 39013.206 J78 3 d 6 (5 D)4 p z 6 D° 1 / 2 39109.307 J78 3 d 6 (5 D)4 p z 6 F° 1 1 / 2 41968.046 J78 3 d 6 (5 D)4 p z 6 F° 9 / 2 42114.818 J78 3 d 6 (5 D)4 p z 6 F° 7 / 2 42237.033 J78 3 d 6 (5 D)4 p z 6 F° 5 / 2 42334.822 J78 3 d 6 (5 D)4 p z 6 F° 3 / 2 42401.302 J78 3 d 6 (5 D)4 p z 6 F° 1 / 2 42439.822 J78 3 d 6 (5 D)4 p z 6 P° 7 / 2 42658.224 J78 3 d 6 (5 D)4 p z 6 P° 5 / 2 43238.586 J78 3 d 6 (5 D)4 p z 6 P° 3 / 2 43620.957 J78 3 d 6 (5 D)4 p z 4 F° 9 / 2 44232.512 J78 3 d 6 (5 D)4 p z 4 F° 7 / 2 44753.799 J78 3 d 6 (5 D)4 p z 4 F° 5 / 2 45079.879 J78 3 d 6 (5 D)4 p z 4 F° 3 / 2 45289.801 J78 3 d 6 (5 D)4 p z 4 D° 7 / 2 44446.878 J78 3 d 6 (5 D)4 p z 4 D° 5 / 2 44784.761 J78 3 d 6 (5 D)4 p z 4 D° 3 / 2 45044.168 J78 3 d 6 (5 D)4 p z 4 D° 1 / 2 45206.450 J78 3 d 6 (1 F)4 s c 2 F 7 / 2 44915.046 J78 3 d 6 (1 F)4 s c 2 F 5 / 2 44929.55 J78 3 d 6 (5 D)4 p z 4 P° 5 / 2 46967.444 J78 3 d 6 (5 D)4 p z 4 P° 3 / 2 47389.779 J78 3 d 6 (5 D)4 p z 4 P° 1 / 2 47626.076 J78 3 d 7 d 2 D1 3 / 2 47674.721 J78 3 d 7 d 2 D1 5 / 2 48039.090 J78 3 d 6 (3 P 1)4 s c 4 P 1 / 2 49100.976 J78 3 d 6 (3 P 1)4 s c 4 P 3 / 2 49506.934 J78 3 d 6 (3 P 1)4 s c 4 P 5 / 2 50212.826 J78 3 d 6 (3 F 1)4 s c 4 F 3 / 2 50075.910 J78 3 d 6 (3 F 1)4 s c 4 F 5 / 2 50142.786 J78 3 d 6 (3 F 1)4 s c 4 F 9 / 2 50157.452 J78 3 d 6 (3 F 1)4 s c 4 F 7 / 2 50187.813 J78 3 d 5 (6 S)4 s 4 p (3 P°) z 8 P° 5 / 2 52299.39 J78 3 d 5 (6 S)4 s 4 p (3 P°) z 8 P° 7 / 2 52582.51 J78 3 d 5 (6 S)4 s 4 p (3 P°) z 8 P° 9 / 2 52965.82 J78 3 d 6 (3 P 1)4 s c 2 P 1 / 2 54063.459 J78 3 d 6 (3 P 1)4 s c 2 P 3 / 2 54902.315 J78 3 d 5 4 s 2 b 4 G 1 1 / 2 54232.195 J78 3 d 5 4 s 2 b 4 G 9 / 2 54273.641 J78 3 d 5 4 s 2 b 4 G 5 / 2 54275.637 J78 3 d 5 4 s 2 b 4 G 7 / 2 54283.220 J78 3 d 6 (3 F 1)4 s d 2 F 5 / 2 54870.528 J78 3 d 6 (3 F 1)4 s d 2 F 7 / 2 54904.222 J78 3 d 5 4 s 2 d 4 P 5 / 2 57411.065 J78 3 d 5 4 s 2 d 4 P 3 / 2 57493.321 J78 3 d 5 4 s 2 d 4 P 1 / 2 57578.484 J78 3 d 6 (1 G 1)4 s d 2 G 9 / 2 58631.531 J78 3 d 6 (1 G 1)4 s d 2 G 7 / 2 58666.258 J78 3 d 6 (3 P 2)4 p z 4 S° 3 / 2 59663.456 J78 3 d 5 4 s 2 c 4 D 7 / 2 60270.339 J78 3 d 5 4 s 2 c 4 D 1 / 2 60384.370 J78 3 d 5 4 s 2 c 4 D 3 / 2 60441.033 J78 3 d 5 4 s 2 c 4 D 5 / 2 60445.275 J78 3 d 6 (3 P 2)4 p y 4 P° 5 / 2 60402.342 J78 3 d 6 (3 P 2)4 p y 4 P° 1 / 2 61035.287 J78 3 d 6 (3 P 2)4 p y 4 P° 3 / 2 61332.764 J78 3 d 6 (3 H)4 p z 4 G° 1 1 / 2 60625.449 J78 3 d 6 (3 H)4 p z 4 G° 9 / 2 60807.230 J78 3 d 6 (3 H)4 p z 4 G° 7 / 2 60956.781 J78 3 d 6 (3 H)4 p z 4 G° 5 / 2 61041.748 J78 3 d 6 (3 H)4 p z 4 H° 1 3 / 2 60837.569 J78 3 d 6 (3 H)4 p z 4 H° 1 1 / 2 60887.598 J78 3 d 6 (3 H)4 p z 4 H° 9 / 2 60989.444 J78 3 d 6 (3 H)4 p z 4 H° 7 / 2 61156.835 J78 3 d 6 (3 P 2)4 p z 2 D° 5 / 2 61093.413 J78 3 d 6 (3 P 2)4 p z 2 D° 3 / 2 62125.600 J78 3 d 6 (3 H)4 p z 4 I° 1 5 / 2 61347.614 J78 3 d 6 (3 H)4 p z 4 I° 9 / 2 61512.634 J78 3 d 6 (3 H)4 p z 4 I° 1 3 / 2 61527.616 J78 3 d 6 (3 H)4 p z 4 I° 1 1 / 2 61587.214 J78 Fe III (5 D 4) Limit 130563 SC85

Energy Levels of Singly Ionized Manganese (Mn II)

Energy Levels of Singly Ionized Manganese (Mn II)

Configuration Term J Level(cm -1) Ref. 3 d 5 (6 S)4 s a 7 S 3 0.00 SC85 3 d 5 (6 S)4 s a 5 S 2 9472.97 SC85 3 d 6 a 5 D 4 14325.86 SC85 3 d 6 a 5 D 3 14593.82 SC85 3 d 6 a 5 D 2 14781.19 SC85 3 d 6 a 5 D 1 14901.18 SC85 3 d 6 a 5 D 0 14959.84 SC85 3 d 5 (4 G)4 s a 5 G 6 27547.25 SC85 3 d 5 (4 G)4 s a 5 G 5 27571.25 SC85 3 d 5 (4 G)4 s a 5 G 4 27583.57 SC85 3 d 5 (4 G)4 s a 5 G 3 27588.50 SC85 3 d 5 (4 G)4 s a 5 G 2 27589.28 SC85 3 d 5 (6 S)4 p z 7 P° 2 38366.18 SC85 3 d 5 (6 S)4 p z 7 P° 3 38543.08 SC85 3 d 5 (6 S)4 p z 7 P° 4 38806.67 SC85 3 d 5 (6 S)4 p z 5 P° 3 43370.51 SC85 3 d 5 (6 S)4 p z 5 P° 2 43484.64 SC85 3 d 5 (6 S)4 p z 5 P° 1 43557.14 SC85 Mn III (6 S 5 / 2) Limit 126145.0 SC85

Energy Levels of Singly Ionized Nickel (Ni II)

Energy Levels of Singly Ionized Nickel (Ni II)

Configuration Term J Level(cm -1) Ref. 3 d 9 2 D 5 / 2 0.00 S70 3 d 9 2 D 3 / 2 1506.94 S70 3 d 8 (3 F)4 s 4 F 9 / 2 8393.90 S70 3 d 8 (3 F)4 s 4 F 7 / 2 9330.04 S70 3 d 8 (3 F)4 s 4 F 5 / 2 10115.66 S70 3 d 8 (3 F)4 s 4 F 3 / 2 10663.89 S70 3 d 8 (3 F)4 s 2 F 7 / 2 13550.39 S70 3 d 8 (3 F)4 s 2 F 5 / 2 14995.57 S70 3 d 8 (3 P)4 s 4 P 5 / 2 23108.28 S70 3 d 8 (3 P)4 s 4 P 3 / 2 24788.20 S70 3 d 8 (3 P)4 s 4 P 1 / 2 24835.93 S70 3 d 8 (1 D)4 s 2 D 3 / 2 23796.18 S70 3 d 8 (1 D)4 s 2 D 5 / 2 25036.38 S70 3 d 8 (3 P)4 s 2 P 3 / 2 29070.93 S70 3 d 8 (3 P)4 s 2 P 1 / 2 29593.46 S70 3 d 8 (1 G)4 s 2 G 9 / 2 32499.53 S70 3 d 8 (1 G)4 s 2 G 7 / 2 32523.54 S70 3 d 7 4 s 2 4 F 9 / 2 51045.46 S70 3 d 7 4 s 2 4 F 7 / 2 52205.95 S70 3 d 7 4 s 2 4 F 5 / 2 53037.93 S70 3 d 7 4 s 2 4 F 3 / 2 53601.19 S70 3 d 8 (3 F)4 p 4 D° 7 / 2 51557.85 S70 3 d 8 (3 F)4 p 4 D° 5 / 2 52738.45 S70 3 d 8 (3 F)4 p 4 D° 3 / 2 53634.62 S70 3 d 8 (3 F)4 p 4 D° 1 / 2 54176.26 S70 3 d 8 (3 F)4 p 4 G° 9 / 2 53365.17 S70 3 d 8 (3 F)4 p 4 G° 1 1 / 2 53496.49 S70 3 d 8 (3 F)4 p 4 G° 7 / 2 54262.63 S70 3 d 8 (3 F)4 p 4 G° 5 / 2 55018.71 S70 3 d 8 (3 F)4 p 4 F° 9 / 2 54557.05 S70 3 d 8 (3 F)4 p 4 F° 7 / 2 55417.83 S70 3 d 8 (3 F)4 p 4 F° 5 / 2 56075.26 S70 3 d 8 (3 F)4 p 4 F° 3 / 2 56424.49 S70 3 d 8 (3 F)4 p 2 G° 9 / 2 55299.65 S70 3 d 8 (3 F)4 p 2 G° 7 / 2 56371.41 S70 3 d 8 (3 F)4 p 2 F° 7 / 2 57080.55 S70 3 d 8 (3 F)4 p 2 F° 5 / 2 58493.21 S70 3 d 8 (3 F)4 p 2 D° 5 / 2 57420.16 S70 3 d 8 (3 F)4 p 2 D° 3 / 2 58705.95 S70 3 d 8 (3 P)4 p 4 P° 5 / 2 66571.34 S70 3 d 8 (3 P)4 p 4 P° 3 / 2 66579.71 S70 3 d 8 (3 P)4 p 4 P° 1 / 2 67031.02 S70 3 d 8 (1 D)4 p 2 F° 5 / 2 67694.64 S70 3 d 8 (1 D)4 p 2 F° 7 / 2 68131.21 S70 3 d 7 4 s 2 4 P 5 / 2 67880.16 S70 3 d 7 4 s 2 4 P 3 / 2 68156.57 S70 3 d 7 4 s 2 4 P 1 / 2 68709.76 S70 3 d 8 (1 D)4 p 2 D° 3 / 2 68154.31 S70 3 d 8 (1 D)4 p 2 D° 5 / 2 68735.98 S70 3 d 8 (1 D)4 p 2 P° 1 / 2 68281.62 S70 3 d 8 (1 D)4 p 2 P° 3 / 2 68965.65 S70 3 d 7 4 s 2 2 G 9 / 2 70358.94 S70 3 d 7 4 s 2 2 G 7 / 2 71457.74 S70 3 d 8 (3 P)4 p 4 D° 5 / 2 70635.46 S70 3 d 8 (3 P)4 p 4 D° 3 / 2 70706.77 S70 3 d 8 (3 P)4 p 4 D° 1 / 2 70748.70 S70 3 d 8 (3 P)4 p 4 D° 7 / 2 70778.12 S70 3 d 8 (3 F)4 d 4 D 7 / 2 98467.25 S70 3 d 8 (3 F)4 d 4 D 5 / 2 99559.33 S70 3 d 8 (3 F)4 d 4 D 1 / 2 100010.17 S70 3 d 8 (3 F)4 d 4 D 3 / 2 100078.78 S70 3 d 8 (3 F)4 d 4 P 5 / 2 98561.22 S70 3 d 8 (3 F)4 d 4 P 1 / 2 100845.41 S70 3 d 8 (3 F)4 d 4 P 3 / 2 100490.95 S70 3 d 8 (3 F)4 d 4 H 1 3 / 2 98822.55 S70 3 d 8 (3 F)4 d 4 H 1 1 / 2 100309.29 S70 3 d 8 (3 F)4 d 4 H 9 / 2 100332.09 S70 3 d 8 (3 F)4 d 4 H 7 / 2 101144.63 S70 3 d 8 (3 F)4 d 2 H 1 1 / 2 98969.44 S70 3 d 8 (3 F)4 d 2 H 9 / 2 101357.20 S70 Ni III (3 F 4) Limit 146541.56 S70

Energy Levels of Singly Ionized Vanadium (V II)

Energy Levels of Singly Ionized Vanadium (V II)

Configuration Term J Level(cm -1) Ref. 3 d 4 a 5 D 0 0.00 ICL88 3 d 4 a 5 D 1 36.05 ICL88 3 d 4 a 5 D 2 106.63 ICL88 3 d 4 a 5 D 3 208.89 ICL88 3 d 4 a 5 D 4 339.21 ICL88 3 d 3 (4 F)4 s a 5 F 1 2604.88 ICL88 3 d 3 (4 F)4 s a 5 F 2 2687.11 ICL88 3 d 3 (4 F)4 s a 5 F 3 2808.82 ICL88 3 d 3 (4 F)4 s a 5 F 4 2968.27 ICL88 3 d 3 (4 F)4 s a 5 F 5 3162.80 ICL88 3 d 3 (4 F)4 s a 3 F 2 8640.31 ICL88 3 d 3 (4 F)4 s a 3 F 3 8841.97 ICL88 3 d 3 (4 F)4 s a 3 F 4 9097.83 ICL88 3 d 3 (4 F)4 p z 5 G° 2 34592.75 ICL88 3 d 3 (4 F)4 p z 5 G° 3 34745.72 ICL88 3 d 3 (4 F)4 p z 5 G° 4 34946.55 ICL88 3 d 3 (4 F)4 p z 5 G° 5 35193.13 ICL88 3 d 3 (4 F)4 p z 5 G° 6 35483.39 ICL88 3 d 3 (4 F)4 p z 5 F° 2 36673.48 ICL88 3 d 3 (4 F)4 p z 5 F° 3 36919.21 ICL88 3 d 3 (4 F)4 p z 5 F° 1 36954.63 ICL88 3 d 3 (4 F)4 p z 5 F° 4 37150.51 ICL88 3 d 3 (4 F)4 p z 5 F° 5 37352.45 ICL88 3 d 3 (4 F)4 p z 5 D° 0 37201.35 ICL88 3 d 3 (4 F)4 p z 5 D° 1 37259.39 ICL88 3 d 3 (4 F)4 p z 5 D° 2 37368.96 ICL88 3 d 3 (4 F)4 p z 5 D° 3 37520.57 ICL88 3 d 3 (4 F)4 p z 5 D° 4 37531.08 ICL88 3 d 3 (4 F)4 p z 3 G° 3 39234.05 ICL88 3 d 3 (4 F)4 p z 3 G° 4 39403.74 ICL88 3 d 3 (4 F)4 p z 3 G° 5 39612.96 ICL88 3 d 3 (4 F)4 p z 3 F° 2 40001.70 ICL88 3 d 3 (4 F)4 p z 3 F° 3 40195.52 ICL88 3 d 3 (4 F)4 p z 3 F° 4 40430.04 ICL88 V III (4 F 3 / 2) Limit 117900 ICL88

Energy Levels of Singly Ionized Arsenic (As II)

Energy Levels of Singly Ionized Arsenic (As II)

Configuration Term J Level(cm -1) Ref. 4 p 2 3 P 0 0.0 LA71 4 p 2 3 P 1 1063.49 LA71 4 p 2 3 P 2 2541.35 LA71 4 p 2 1 D 2 10095.82 LA71 4 p 2 1 S 0 22598.6 LA71 4 s 4 p 3 5 S° 2 54817.08 LA71 4 s 4 p 3 3 D° 1 73749.89 LA71 4 s 4 p 3 3 D° 2 73862.33 LA71 4 s 4 p 3 3 D° 3 74244.42 LA71 4 p 5 s (1 / 2 , 1 / 2)° 0 78730.893 LA71 4 p 5 s (1 / 2 , 1 / 2)° 1 79128.33 LA71 4 p 5 s (3 / 2 , 1 / 2)° 2 81508.925 LA71 4 p 5 s (3 / 2 , 1 / 2)° 1 82819.214 LA71 4 p 4 d 1 D° 2 83100.804 LA71 4 p 4 d 3 P° 1 84636.186 LA71 4 p 4 d 3 P° 0 84648.426 LA71 4 p 4 d 3 P° 2 85105.86 LA71 As III (2 P° 1 / 2) Limit 149932 LA71

Energy Levels of Singly Ionized Bromine (Br II)

Energy Levels of Singly Ionized Bromine (Br II)

Configuration Term J Level(cm -1) Ref. 4 p 4 3 P 2 0.0 MT84 4 p 4 3 P 1 3136.5 MT84 4 p 4 3 P 0 3837.4 MT84 4 p 4 1 D 2 12089.1 MT84 4 p 4 1 S 0 27867.1 MT84 4 p 3 (4 S°)5 s 5 S° 2 93921.36 MT84 4 s 4 p 5 3 P° 2 96433.28 MT84 4 s 4 p 5 3 P° 1 98801.10 MT84 4 s 4 p 5 3 P° 0 100236.18 MT84 4 p 3 (4 S°)5 s 3 S° 1 98470.12 MT84 4 p 3 (4 S°)4 d 5 D° 3 104038.64 MT84 4 p 3 (4 S°)4 d 5 D° 2 104080.24 MT84 4 p 3 (4 S°)4 d 5 D° 4 104091.43 MT84 4 p 3 (4 S°)4 d 5 D° 1 104145.53 MT84 4 p 3 (4 S°)4 d 5 D° 0 104199.96 MT84 4 p 3 (2 D°)5 s 3 D° 1 109422.21 MT84 4 p 3 (2 D°)5 s 3 D° 2 109676.51 MT84 4 p 3 (2 D°)5 s 3 D° 3 110372.20 MT84 4 p 3 (4 S°)4 d 3 D° 2 111524.25 MT84 4 p 3 (4 S°)4 d 3 D° 1 112389.85 MT84 4 p 3 (4 S°)4 d 3 D° 3 112454.52 MT84 4 p 3 (2 D°)5 s 1 D° 2 112933.31 MT84 4 s 4 p 5 1 P° 1 113336.75 MT84 4 p 3 (4 S°)5 p 5 P 1 114676.79 MT84 4 p 3 (4 S°)5 p 5 P 2 114812.00 MT84 4 p 3 (4 S°)5 p 5 P 3 115170.02 MT84 4 p 3 (4 S°)5 p 3 P 1 117555.18 MT84 4 p 3 (4 S°)5 p 3 P 2 117761.14 MT84 4 p 3 (4 S°)5 p 3 P 0 117828.36 MT84 Br III (4 S° 3 / 2) Limit 174140 M98

Energy Levels of Singly Ionized Gallium (Ga II)

Energy Levels of Singly Ionized Gallium (Ga II)

Configuration Term J Level(cm -1) Ref. 4 s 2 1 S 0 0.00 IL85 4 s 4 p 3 P° 0 47367.51 IL85 4 s 4 p 3 P° 1 47814.05 IL85 4 s 4 p 3 P° 2 48749.74 IL85 4 s 4 p 1 P° 1 70701.27 IL85 4 s 5 s 3 S 1 102944.55 IL85 4 s 5 s 1 S 0 106662.21 IL85 4 p 2 1 D 2 107720.56 IL85 4 s 4 d 3 D 1 113815.92 IL85 4 s 4 d 3 D 2 113842.19 IL85 4 s 4 d 3 D 3 113883.19 IL85 4 s 5 p 3 P° 0 118430.02 IL85 4 s 5 p 3 P° 1 118518.47 IL85 4 s 5 p 3 P° 2 118727.89 IL85 Ga III (2 S 1 / 2) Limit 165465.8 IL85

Energy Levels of Singly Ionized Germanium (Ge II)

Energy Levels of Singly Ionized Germanium (Ge II)

Configuration Term J Level(cm -1) Ref. 4 s 2 4 p 2 P° 1 / 2 0.000 SM93b 4 s 2 4 p 2 P° 3 / 2 1767.357 SM93b 4 s 4 p 2 4 P 1 / 2 51575.885 SM93b 4 s 4 p 2 4 P 3 / 2 52290.942 SM93b 4 s 4 p 2 4 P 5 / 2 53366.738 SM93b 4 s 2 5 s 2 S 1 / 2 62403.028 SM93b 4 s 4 p 2 2 D 3 / 2 65015.672 SM93b 4 s 4 p 2 2 D 5 / 2 65184.738 SM93b 4 s 2 5 p 2 P° 1 / 2 79006.853 SM93b 4 s 2 5 p 2 P° 3 / 2 79366.494 SM93b 4 s 2 4 d 2 D 3 / 2 80836.880 SM93b 4 s 2 4 d 2 D 5 / 2 81012.598 SM93b 4 s 4 p 2 2 S 1 / 2 85890.55 SM93b 4 s 4 p 2 2 P 1 / 2 91016.2 SM93b 4 s 4 p 2 2 P 3 / 2 92122.7 SM93b 4 s 2 6 s 2 S 1 / 2 94784.381 SM93b 4 s 2 5 d 2 D 3 / 2 100089.970 SM93b 4 s 2 5 d 2 D 5 / 2 100130.812 SM93b 4 s 2 4 f 2 F° 7 / 2 100317.283 SM93b 4 s 2 4 f 2 F° 5 / 2 100317.976 SM93b Ge III (1 S 0) Limit 128521.3 SM93b

Energy Levels of Singly Ionized Krypton (Kr II)

Energy Levels of Singly Ionized Krypton (Kr II)

Configuration Term J Level(cm -1) Ref. 4 p 5 2 P° 3 / 2 0.00 SM91 4 p 5 2 P° 1 / 2 5370.10 SM91 4 s 4 p 6 2 S 1 / 2 109000.36 SM91 4 p 4 (3 P)5 s 4 P 5 / 2 112828.27 SM91 4 p 4 (3 P)5 s 4 P 3 / 2 115092.01 SM91 4 p 4 (3 P)5 s 4 P 1 / 2 117603.02 SM91 4 p 4 (3 P)5 s 2 P 3 / 2 118474.36 SM91 4 p 4 (3 P)5 s 2 P 1 / 2 121002.15 SM91 4 p 4 (3 P)4 d 4 D 7 / 2 120209.87 SM91 4 p 4 (3 P)4 d 4 D 5 / 2 120426.93 SM91 4 p 4 (3 P)4 d 4 D 3 / 2 121000.37 SM91 4 p 4 (3 P)4 d 4 D 1 / 2 121779.54 SM91 4 p 4 (3 P)4 d 4 F 9 / 2 126000.82 SM91 4 p 4 (3 P)4 d 4 F 7 / 2 127929.52 SM91 4 p 4 (3 P)4 d 4 F 5 / 2 129697.19 SM91 4 p 4 (3 P)4 d 4 F 3 / 2 130512.73 SM91 4 p 4 (1 D)5 s 2 D 3 / 2 127597.49 SM91 4 p 4 (1 D)5 s 2 D 5 / 2 127861.51 SM91 4 p 4 (3 P)5 p 4 P° 5 / 2 133923.86 SM91 4 p 4 (3 P)5 p 4 P° 3 / 2 134286.67 SM91 4 p 4 (3 P)5 p 4 P° 1 / 2 135781.26 SM91 4 p 4 (3 P)5 p 4 D° 7 / 2 135781.42 SM91 4 p 4 (3 P)5 p 4 D° 5 / 2 136069.23 SM91 4 p 4 (3 P)5 p 4 D° 3 / 2 138379.61 SM91 4 p 4 (3 P)5 p 4 D° 1 / 2 140161.46 SM91 4 p 4 (3 P)5 p 2 P° 1 / 2 139101.57 SM91 4 p 4 (3 P)5 p 2 P° 3 / 2 140135.40 SM91 4 p 4 (3 P)5 p 2 D° 5 / 2 140117.23 SM91 4 p 4 (3 P)5 p 2 D° 3 / 2 141993.94 SM91 Kr III (3 P 2) Limit 196475.4 SM91

Energy Levels of Singly Ionized Rubidium (Rb II)

Energy Levels of Singly Ionized Rubidium (Rb II)

Configuration Term J Level(cm -1) Ref. 4 p 6 1 S 0 0.00 R75 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 133341.607 R75 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 134869.751 R75 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 0 138794.380 R75 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 1 140610.047 R75 4 p 5 4 d 3 P° 0 143022.335 R75 4 p 5 4 d 3 P° 1 143461.977 R75 4 p 5 4 d 3 P° 2 143955.871 R75 4 p 5 (2 P° 3 / 2)5 p 2 [1 / 2] 1 154273.980 R75 4 p 5 (2 P° 3 / 2)5 p 2 [1 / 2] 0 161200.171 R75 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 2 156737.011 R75 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 3 156895.486 R75 4 p 5 (2 P° 3 / 2)5 p 2 [3 / 2] 1 158151.666 R75 4 p 5 (2 P° 3 / 2)5 p 2 [3 / 2] 2 158711.854 R75 4 p 5 (2 P° 1 / 2)5 p 2 [3 / 2] 1 163924.55 R75 4 p 5 (2 P° 1 / 2)5 p 2 [3 / 2] 2 164968.007 R75 4 p 5 (2 P° 1 / 2)5 p 2 [1 / 2] 1 165089.580 R75 4 p 5 (2 P° 1 / 2)5 p 2 [1 / 2] 0 167632.436 R75 4 p 5 4 d 1 P° 1 169658.536 R75 4 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 179735.123 R75 4 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 180168.372 R75 Rb III (2 P° 3 / 2) Limit 220105.0 R75

Energy Levels of Singly Ionized Selenium (Se II)

Energy Levels of Singly Ionized Selenium (Se II)

Configuration Term J Level(cm -1) Ref. 4 s 2 4 p 3 4 S° 3 / 2 0.0 M35 4 s 2 4 p 3 2 D° 3 / 2 13168.2 M35 4 s 2 4 p 3 2 D° 5 / 2 13784.4 M35 4 s 2 4 p 3 2 P° 1 / 2 23038.3 M35 4 s 2 4 p 3 2 P° 3 / 2 23894.8 M35 4 s 4 p 4 4 P 5 / 2 83876.7 M35 4 s 4 p 4 4 P 3 / 2 85579.5 M35 4 s 4 p 4 4 P 1 / 2 86437.7 M35 4 s 2 4 p 2 (3 P)5 s 4 P 1 / 2 95270.0 M35 4 s 2 4 p 2 (3 P)5 s 4 P 3 / 2 96753.3 M35 4 s 2 4 p 2 (3 P)5 s 4 P 5 / 2 98674.4 M35 7 3 / 2 104873.7 M35 4 s 2 4 p 2 (3 P)5 p 4 D° 1 / 2 114299.0 M35 4 s 2 4 p 2 (3 P)5 p 4 D° 3 / 2 114711.7 M35 4 s 2 4 p 2 (3 P)5 p 4 D° 5 / 2 116068.1 M35 4 s 2 4 p 2 (3 P)5 p 4 D° 7 / 2 117798.7 M35 4 s 2 4 p 2 (3 P)5 p 2 P 1 / 2 121273.2 M35 4 s 2 4 p 2 (3 P)5 p 2 P 3 / 2 121381.9 M35 4 s 2 4 p 2 (3 P)5 d 4 F 9 / 2 141710.1 M35 Se III (3 P 0) Limit 170900 CR58

Energy Levels of Singly Ionized Strontium (Sr II)

Energy Levels of Singly Ionized Strontium (Sr II)

Configuration Term J Level(cm -1) Ref. 5 s 2 S 1 / 2 0.00 M52 4 d 2 D 3 / 2 14555.90 M52 4 d 2 D 5 / 2 14836.24 M52 5 p 2 P° 1 / 2 23715.19 M52 5 p 2 P° 3 / 2 24516.65 M52 6 s 2 S 1 / 2 47736.53 M52 5 d 2 D 3 / 2 53286.31 M52 5 d 2 D 5 / 2 53372.97 M52 6 p 2 P° 1 / 2 55769.7 M52 6 p 2 P° 3 / 2 56057.9 M52 4 f 2 F° 5 / 2 60991.7 M52 4 f 2 F° 7 / 2 M52 7 s 2 S 1 / 2 64964.10 M52 Sr III (1 S 0) Limit 88964.0 M52

Energy Levels of Singly Ionized Yttrium (Y II)

Energy Levels of Singly Ionized Yttrium (Y II)

Configuration Term J Level(cm -1) Ref. 5 s 2 1 S 0 0.000 NJK91 4 d 5 s 3 D 1 840.198 NJK91 4 d 5 s 3 D 2 1045.076 NJK91 4 d 5 s 3 D 3 1449.752 NJK91 4 d 5 s 1 D 2 3296.180 NJK91 4 d 2 3 F 2 8003.126 NJK91 4 d 2 3 F 3 8328.039 NJK91 4 d 2 3 F 4 8743.322 NJK91 4 d 2 3 P 0 13883.379 NJK91 4 d 2 3 P 1 14018.267 NJK91 4 d 2 3 P 2 14098.076 NJK91 4 d 2 1 D 2 14832.862 NJK91 4 d 2 1 G 4 15682.905 NJK91 5 s 5 p 3 P° 0 23445.063 NJK91 5 s 5 p 3 P° 1 23776.245 NJK91 5 s 5 p 3 P° 2 24647.121 NJK91 4 d 5 p 1 D° 2 26147.252 NJK91 4 d 5 p 3 F° 2 27227.027 NJK91 4 d 5 p 3 F° 3 27532.321 NJK91 4 d 5 p 3 F° 4 28394.177 NJK91 4 d 5 p 1 P° 1 27516.699 NJK91 4 d 5 p 3 D° 1 28595.285 NJK91 4 d 5 p 3 D° 2 28730.010 NJK91 4 d 5 p 3 D° 3 29213.958 NJK91 4 d 5 p 3 P° 0 32048.788 NJK91 4 d 5 p 3 P° 1 32124.054 NJK91 4 d 5 p 3 P° 2 32283.420 NJK91 Y III (2 D 3 / 2) Limit 98590 NJK91

Energy Levels of Singly Ionized Zinc (Zn II)

Energy Levels of Singly Ionized Zinc (Zn II)

Configuration Term J Level(cm -1) Ref. 3 d 1 0 4 s 2 S 1 / 2 0.000 GL00 3 d 1 0 4 p 2 P° 1 / 2 48481.077 GL00 3 d 1 0 4 p 2 P° 3 / 2 49355.003 GL00 3 d 9 4 s 2 2 D 5 / 2 62722.506 GL00 3 d 9 4 s 2 2 D 3 / 2 65411.745 GL00 3 d 1 0 5 s 2 S 1 / 2 88437.149 GL00 3 d 1 0 4 d 2 D 3 / 2 96909.893 GL00 3 d 1 0 4 d 2 D 5 / 2 96960.588 GL00 3 d 1 0 5 p 2 P° 1 / 2 101366.038 GL00 3 d 1 0 5 p 2 P° 3 / 2 101611.418 GL00 3 d 1 0 4 f 2 F° 7 / 2 117263.558 GL00 3 d 1 0 4 f 2 F° 5 / 2 117264.063 GL00 Zn III (1 S 0) Limit 144892.6 SM95

Energy Levels of Singly Ionized Cadmium (Cd II)

Energy Levels of Singly Ionized Cadmium (Cd II)

Configuration Term J Level(cm -1) Ref. 4 d 1 0 5 s 2 S 1 / 2 0.00 SP49 4 d 1 0 5 p 2 P° 1 / 2 44136.08 SP49 4 d 1 0 5 p 2 P° 3 / 2 46618.55 SP49 4 d 9 5 s 2 2 D 5 / 2 69258.91 SP49 4 d 9 5 s 2 2 D 3 / 2 74893.66 SP49 4 d 1 0 6 s 2 S 1 / 2 82990.66 SP49 4 d 1 0 5 d 2 D 3 / 2 89689.25 SP49 4 d 1 0 5 d 2 D 5 / 2 89843.78 SP49 Cd III (1 S 0) Limit 136374.74 SP49

Energy Levels of Singly Ionized Indium (In II)

Energy Levels of Singly Ionized Indium (In II)

Configuration Term J Level(cm -1) Ref. 5 s 2 1 S 0 0.0 SM02 5 s 5 p 3 P° 0 42276.4 SM02 5 s 5 p 3 P° 1 43350.9 SM02 5 s 5 p 3 P° 2 45829.6 SM02 5 s 5 p 1 P° 1 63038.18 SM02 5 s 6 s 3 S 1 93923.40 SM02 5 s 6 s 1 S 0 97029.73 SM02 5 p 2 1 D 2 97627.98 SM02 5 p 2 3 P 0 101607.7 SM02 5 p 2 3 P 1 103248.84 SM02 5 p 2 3 P 2 105564.56 SM02 5 s 5 d 3 D 1 102088.00 SM02 5 s 5 d 3 D 2 102174.00 SM02 5 s 5 d 3 D 3 102307.60 SM02 5 s 6 p 3 P° 0 107662.24 SM02 5 s 6 p 3 P° 1 107841.54 SM02 5 s 6 p 3 P° 2 108429.89 SM02 5 s 6 p 1 P° 1 109779.76 SM02 5 s 5 d 1 D 2 113884.44 SM02 5 p 2 1 S 0 121289.08 SM02 In III (2 S 1 / 2) Limit 152199 SM02

Energy Levels of Singly Ionized Molybdenum (Mo II)

Energy Levels of Singly Ionized Molybdenum (Mo II)

Configuration Term J Level(cm -1) Ref. 4 d 5 a 6 S 5 / 2 0.00 K58 4 d 4 (5 D)5 s a 6 D 1 / 2 11783.36 K58 4 d 4 (5 D)5 s a 6 D 3 / 2 12034.06 K58 4 d 4 (5 D)5 s a 6 D 5 / 2 12417.28 K58 4 d 4 (5 D)5 s a 6 D 7 / 2 12900.33 K58 4 d 4 (5 D)5 s a 6 D 9 / 2 13460.70 K58 4 d 5 a 4 G 5 / 2 15199.25 K58 4 d 5 a 4 G 7 / 2 15330.56 K58 4 d 5 a 4 G 9 / 2 15427.73 K58 4 d 5 a 4 G 1 1 / 2 15446.97 K58 4 d 4 (5 D)5 p z 6 F° 1 / 2 45853.08 K58 4 d 4 (5 D)5 p z 6 F° 3 / 2 46148.12 K58 4 d 4 (5 D)5 p z 6 F° 5 / 2 46614.14 K58 4 d 4 (5 D)5 p z 6 F° 7 / 2 47231.98 K58 4 d 4 (5 D)5 p z 6 F° 9 / 2 47999.47 K58 4 d 4 (5 D)5 p z 6 F° 1 1 / 2 48959.68 K58 4 d 4 (5 D)5 p z 4 P° 1 / 2 47208.36 K58 4 d 4 (5 D)5 p z 4 P° 3 / 2 48022.45 K58 4 d 4 (5 D)5 p z 4 P° 5 / 2 48860.57 K58 4 d 4 (5 D)5 p z 6 P° 3 / 2 49040.82 K58 4 d 4 (5 D)5 p z 6 P° 7 / 2 49481.04 K58 4 d 4 (5 D)5 p z 6 P° 5 / 2 49608.74 K58 4 d 4 (3 H)5 p y 4 G° 7 / 2 62917.94 K58 4 d 4 (3 H)5 p y 4 G° 9 / 2 62953.75 K58 4 d 4 (3 H)5 p y 4 G° 5 / 2 63041.47 K58 4 d 4 (3 H)5 p y 4 G° 1 1 / 2 63207.43 K58 1° 7 / 2 63012.24 K58 4 d 4 (a 3 F)5 p y 4 F° 7 / 2 63104.63 K58 Mo III (5 D 0) Limit 130300 SM88

Energy Levels of Singly Ionized Niobium (Nb II)

Energy Levels of Singly Ionized Niobium (Nb II)

Configuration Term J Level(cm -1) Ref. 4 d 4 5 D 0 0.000 RCL00 4 d 4 5 D 1 158.984 RCL00 4 d 4 5 D 2 438.361 RCL00 4 d 4 5 D 3 801.326 RCL00 4 d 4 5 D 4 1224.823 RCL00 4 d 3 (4 F)5 s 5 F 1 2356.816 RCL00 4 d 3 (4 F)5 s 5 F 2 2629.132 RCL00 4 d 3 (4 F)5 s 5 F 3 3029.629 RCL00 4 d 3 (4 F)5 s 5 F 4 3542.561 RCL00 4 d 3 (4 F)5 s 5 F 5 4146.037 RCL00 4 d 4 3 P 0 5562.241 RCL00 4 d 4 3 P 1 6192.310 RCL00 4 d 4 3 P 2 7261.324 RCL00 4 d 3 (2 P)5 s 3 P 1 14626.199 RCL00 4 d 3 (2 P)5 s 3 P 2 14660.755 RCL00 4 d 3 (2 P)5 s 3 P 0 14678.318 RCL00 4 d 3 (4 F)5 p 5 G° 2 33351.090 RCL00 4 d 3 (4 F)5 p 5 G° 3 33919.244 RCL00 4 d 3 (4 F)5 p 5 G° 4 34632.033 RCL00 4 d 3 (4 F)5 p 5 G° 5 35474.197 RCL00 4 d 3 (4 F)5 p 5 G° 6 36455.457 RCL00 4 d 3 (4 F)5 p 5 F° 1 36731.805 RCL00 4 d 3 (4 F)5 p 5 F° 2 36962.774 RCL00 4 d 3 (4 F)5 p 5 F° 3 37376.901 RCL00 4 d 3 (4 F)5 p 5 F° 4 37528.382 RCL00 4 d 3 (4 F)5 p 5 F° 5 38024.336 RCL00 4 d 3 (4 F)5 p 5 D° 0 37298.242 RCL00 4 d 3 (4 F)5 p 5 D° 1 37480.076 RCL00 4 d 3 (4 F)5 p 5 D° 2 37797.316 RCL00 4 d 3 (4 F)5 p 5 D° 3 38216.387 RCL00 4 d 3 (4 F)5 p 5 D° 4 38291.252 RCL00 4 d 2 (3 F)5 s 5 p (3 P) 5 F° 5 51537.014 RCL00 4 d 2 (3 F)5 s 5 p (3 P) 5 D° 3 52714.892 RCL00 4 d 2 (3 F)5 s 5 p (3 P) 5 D° 4 53407.279 RCL00 Nb III (4 F 3 / 2) Limit 113000 M52

Energy Levels of Singly Ionized Palladium (Pd II)

Energy Levels of Singly Ionized Palladium (Pd II)

Configuration Term J Level(cm -1) Ref. 4 d 9 2 D 5 / 2 0.000 LLTL01 4 d 9 2 D 3 / 2 3539.242 LLTL01 4 d 8 (3 F)5 s 4 F 9 / 2 25084.270 LLTL01 4 d 8 (3 F)5 s 4 F 7 / 2 27097.084 LLTL01 4 d 8 (3 F)5 s 4 F 5 / 2 28929.419 LLTL01 4 d 8 (3 F)5 s 4 F 3 / 2 29948.151 LLTL01 4 d 8 (3 F)5 s 2 F 7 / 2 32280.538 LLTL01 4 d 8 (3 F)5 s 2 F 5 / 2 34424.689 LLTL01 4 d 8 (3 F)5 p 4 D° 7 / 2 65250.309 LLTL01 4 d 8 (3 F)5 p 4 D° 5 / 2 67964.621 LLTL01 4 d 8 (3 F)5 p 4 D° 3 / 2 70122.300 LLTL01 4 d 8 (3 F)5 p 4 D° 1 / 2 71181.651 LLTL01 4 d 8 (3 F)5 p 1° 9 / 2 67301.702 LLTL01 4 d 8 (3 F)5 p 4 G° 1 1 / 2 68615.072 LLTL01 4 d 8 (3 F)5 p 4 G° 7 / 2 69612.887 LLTL01 4 d 8 (3 F)5 p 4 G° 5 / 2 71072.300 LLTL01 4 d 8 (3 F)5 p 4 G° 9 / 2 72288.057 LLTL01 4 d 8 (3 F)5 p 4 F° 9 / 2 69881.432 LLTL01 4 d 8 (3 F)5 p 4 F° 3 / 2 72350.620 LLTL01 4 d 8 (3 F)5 p 4 F° 5 / 2 72735.273 LLTL01 4 d 8 (3 F)5 p 4 F° 7 / 2 73330.436 LLTL01 4 d 8 (3 F)5 p 2 F° 7 / 2 71247.547 LLTL01 4 d 8 (3 F)5 p 2° 5 / 2 73115.191 LLTL01 4 d 8 (3 F)5 p 2 G° 7 / 2 74321.209 LLTL01 4 d 8 (3 F)5 p 4 F° 3 / 2 75100.265 LLTL01 4 d 8 (3 F)5 p 3° 5 / 2 75756.251 LLTL01 4 d 8 (3 P)5 p 4 P° 3 / 2 76757.777 LLTL01 4 d 8 (3 P)5 p 4 P° 5 / 2 76770.145 LLTL01 4 d 8 (3 P)5 p 4 P° 1 / 2 76810.059 LLTL01 4 d 8 (1 D)5 p 2 D° 5 / 2 82059.859 LLTL01 4 d 8 (1 D)5 p 7° 7 / 2 83058.933 LLTL01 4 d 8 (3 P)5 p 2 D° 5 / 2 83805.443 LLTL01 4 d 8 (3 P)5 p 2 D° 3 / 2 84375.505 LLTL01 4 d 8 (3 P)5 p 2 P° 3 / 2 85154.023 LLTL01 4 d 8 (3 P)5 p 2 P° 1 / 2 88041.479 LLTL01 4 d 8 (1 G)5 p 2 F° 7 / 2 86046.027 LLTL01 4 d 8 (1 G)5 p 2 F° 5 / 2 87122.977 LLTL01 Pd III (3 F 4) Limit 156700 M58

Energy Levels of Singly Ionized Rhodium (Rh II)

Energy Levels of Singly Ionized Rhodium (Rh II)

Configuration Term J Level(cm -1) Ref. 4 d 8 a 3 F 4 0.0 S58 4 d 8 a 3 F 3 2401.3 S58 4 d 8 a 3 F 2 3580.7 S58 4 d 8 a 3 P 2 8164.4 S58 4 d 8 a 3 P 1 10515.0 S58 4 d 8 a 3 P 0 10760.8 S58 4 d 8 a 1 D 2 11643.7 S58 4 d 8 a 1 G 4 14855.4 S58 4 d 7 (4 F)5 s a 5 F 5 16884.8 S58 4 d 7 (4 F)5 s a 5 F 4 18540.4 S58 4 d 7 (4 F)5 s a 5 F 3 19792.4 S58 4 d 7 (4 F)5 s a 5 F 2 20646.9 S58 4 d 7 (4 F)5 s a 5 F 1 21180.0 S58 4 d 7 (4 F)5 s b 3 F 4 25376.9 S58 4 d 7 (4 F)5 s b 3 F 3 27439.4 S58 4 d 7 (4 F)5 s b 3 F 2 28834.6 S58 4 d 7 (4 F)5 p z 5 F° 4 56547.3 S58 4 d 7 (4 F)5 p z 5 F° 5 57020.8 S58 4 d 7 (4 F)5 p z 5 F° 3 58358.5 S58 4 d 7 (4 F)5 p z 5 F° 2 59698.6 S58 4 d 7 (4 F)5 p z 5 F° 1 60573.2 S58 4 d 7 (4 F)5 p z 5 D° 4 59161.5 S58 4 d 7 (4 F)5 p z 5 D° 3 60448.4 S58 4 d 7 (4 F)5 p z 5 D° 2 61355.9 S58 4 d 7 (4 F)5 p z 5 D° 1 61881.1 S58 4 d 7 (4 F)5 p z 5 D° 0 62012.5 S58 4 d 7 (4 F)5 p z 5 G° 6 59702.4 S58 4 d 7 (4 F)5 p z 5 G° 5 59729.4 S58 4 d 7 (4 F)5 p z 5 G° 4 61173.1 S58 4 d 7 (4 F)5 p z 5 G° 3 61939.8 S58 4 d 7 (4 F)5 p z 5 G° 2 62288.3 S58 4 d 7 (4 F)5 p z 3 G° 5 62194.4 S58 4 d 7 (4 F)5 p z 3 G° 4 63959.5 S58 4 d 7 (4 F)5 p z 3 G° 3 65321.2 S58 4 d 7 (4 F)5 p z 3 F° 4 62326.1 S58 4 d 7 (4 F)5 p z 3 F° 3 63454.9 S58 4 d 7 (4 F)5 p z 3 F° 2 64970.4 S58 Rh III (4 F 9 / 2) Limit 145800 M58

Energy Levels of Singly Ionized Ruthenium (Ru II)

Energy Levels of Singly Ionized Ruthenium (Ru II)

Configuration Term J Level(cm -1) Ref. 4 d 7 a 4 F 9 / 2 0.0 SM58 4 d 7 a 4 F 7 / 2 1523.1 SM58 4 d 7 a 4 F 5 / 2 2493.9 SM58 4 d 7 a 4 F 3 / 2 3104.2 SM58 4 d 7 a 4 P 5 / 2 8256.7 SM58 4 d 7 a 4 P 3 / 2 8477.7 SM58 4 d 7 a 4 P 1 / 2 9373.9 SM58 4 d 6 (5 D)5 s a 6 D 9 / 2 9151.4 SM58 4 d 6 (5 D)5 s a 6 D 7 / 2 10150.4 SM58 4 d 6 (5 D)5 s a 6 D 5 / 2 10851.7 SM58 4 d 6 (5 D)5 s a 6 D 3 / 2 11303.8 SM58 4 d 6 (5 D)5 s a 6 D 1 / 2 11604.0 SM58 4 d 6 (5 D)5 s a 4 D 7 / 2 19378.7 SM58 4 d 6 (5 D)5 s a 4 D 5 / 2 20515.0 SM58 4 d 6 (5 D)5 s a 4 D 3 / 2 21246.4 SM58 4 d 6 (5 D)5 s a 4 D 1 / 2 21645.6 SM58 4 d 6 (5 D)5 p z 6 D° 9 / 2 46471.0 SM58 4 d 6 (5 D)5 p z 6 D° 7 / 2 46711.5 SM58 4 d 6 (5 D)5 p z 6 D° 5 / 2 47285.1 SM58 4 d 6 (5 D)5 p z 6 D° 3 / 2 47708.6 SM58 4 d 6 (5 D)5 p z 6 D° 1 / 2 47983.8 SM58 4 d 6 (5 D)5 p z 6 F° 1 1 / 2 50758.3 SM58 4 d 6 (5 D)5 p z 6 F° 9 / 2 50845.3 SM58 4 d 6 (5 D)5 p z 6 F° 7 / 2 50862.5 SM58 4 d 6 (5 D)5 p z 6 F° 5 / 2 51179.7 SM58 4 d 6 (5 D)5 p z 6 F° 3 / 2 51317.0 SM58 4 d 6 (5 D)5 p z 6 F° 1 / 2 51380.1 SM58 4 d 6 (5 D)5 p z 6 P° 7 / 2 51548.8 SM58 4 d 6 (5 D)5 p z 6 P° 5 / 2 52820.3 SM58 4 d 6 (5 D)5 p z 6 P° 3 / 2 53685.2 SM58 4 d 6 (5 D)5 p z 4 F° 9 / 2 52964.4 SM58 4 d 6 (5 D)5 p z 4 F° 7 / 2 54225.5 SM58 4 d 6 (5 D)5 p z 4 F° 5 / 2 54794.3 SM58 4 d 6 (5 D)5 p z 4 F° 3 / 2 55224.2 SM58 4 d 6 (5 D)5 p z 4 D° 7 / 2 53317.1 SM58 4 d 6 (5 D)5 p z 4 D° 5 / 2 54065.4 SM58 4 d 6 (5 D)5 p z 4 D° 3 / 2 54663.4 SM58 4 d 6 (5 D)5 p z 4 D° 1 / 2 54981.5 SM58 Ru III (5 D 4) Limit 135200 SM58

Energy Levels of Singly Ionized Silver (Ag II)

Energy Levels of Singly Ionized Silver (Ag II)

Configuration Term J Level(cm -1) Ref. 4 d 1 0 1 S 0 0.000 KLLT02 4 d 9 (2 D)5 s 3 D 3 39167.986 KLLT02 4 d 9 (2 D)5 s 3 D 2 40745.335 KLLT02 4 d 9 (2 D)5 s 3 D 1 43742.702 KLLT02 4 d 9 (2 D)5 s 1 D 2 46049.029 KLLT02 4 d 9 (2 D)5 p 3 P° 2 80176.425 KLLT02 4 d 9 (2 D)5 p 3 P° 1 83625.479 KLLT02 4 d 9 (2 D)5 p 3 P° 0 86140.050 KLLT02 4 d 9 (2 D)5 p 3 F° 3 82171.697 KLLT02 4 d 9 (2 D)5 p 3 F° 4 83669.614 KLLT02 4 d 9 (2 D)5 p 3 F° 2 85200.721 KLLT02 4 d 9 (2 D)5 p 3 D° 3 86460.616 KLLT02 4 d 9 (2 D)5 p 3 D° 1 90334.836 KLLT02 4 d 9 (2 D)5 p 3 D° 2 90887.806 KLLT02 4 d 9 (2 D)5 p 1 D° 2 86888.063 KLLT02 4 d 9 (2 D)5 p 1 F° 3 89134.688 KLLT02 4 d 9 (2 D)5 p 1 P° 1 89895.502 KLLT02 Ag III (2 D 5 / 2) Limit 173227.4 BJK75

Energy Levels of Singly Ionized Technetium (Tc II)

Energy Levels of Singly Ionized Technetium (Tc II)

Configuration Term J Level(cm -1) Ref. 4 d 5 (6 S)5 s a 7 S 3 0.00 M58 4 d 6 a 5 D 4 3461.27 M58 4 d 6 a 5 D 3 4217.17 M58 4 d 6 a 5 D 2 4669.22 M58 4 d 6 a 5 D 1 4961.14 M58 4 d 6 a 5 D 0 5100.98 M58 4 d 5 (6 S)5 s a 5 S 2 12617.20 M58 4 d 5 (6 S)5 p z 7 P° 2 37767.21 M58 4 d 5 (6 S)5 p z 7 P° 3 38302.80 M58 4 d 5 (6 S)5 p z 7 P° 4 39308.38 M58 4 d 5 (6 S)5 p z 5 P° 3 43500.96 M58 4 d 5 (6 S)5 p z 5 P° 2 43741.33 M58 4 d 5 (6 S)5 p z 5 P° 1 43905.00 M58 Tc III (6 S 5 / 2) Limit 123100 M58

Energy Levels of Singly Ionized Tin (Sn II)

Energy Levels of Singly Ionized Tin (Sn II)

Configuration Term J Level(cm -1) Ref. 5 s 2 (1 S)5 p 2 P° 1 / 2 0.000 B64 5 s 2 (1 S)5 p 2 P° 3 / 2 4251.494 B64 5 s 5 p 2 4 P 1 / 2 46464.291 B64 5 s 5 p 2 4 P 3 / 2 48368.188 B64 5 s 5 p 2 4 P 5 / 2 50730.255 B64 5 s 2 (1 S)6 s 2 S 1 / 2 56886.365 B64 5 s 5 p 2 2 D 3 / 2 58844.182 B64 5 s 5 p 2 2 D 5 / 2 59463.482 B64 5 s 2 (1 S)5 d 2 D 3 / 2 71406.139 B64 5 s 2 (1 S)5 d 2 D 5 / 2 72048.257 B64 5 s 2 (1 S)6 p 2 P° 1 / 2 71494.275 B64 5 s 2 (1 S)6 p 2 P° 3 / 2 72377.450 B64 5 s 2 (1 S)4 f 2 F° 7 / 2 89288.248 B64 5 s 2 (1 S)4 f 2 F° 5 / 2 89294.052 B64 5 s 2 (1 S)6 d 2 D 3 / 2 90241.555 B64 5 s 2 (1 S)6 d 2 D 5 / 2 90351.894 B64 Sn III (1 S 0) Limit 118017.0 M58

Energy Levels of Singly Ionized Zirconium (Zr II)

Energy Levels of Singly Ionized Zirconium (Zr II)

Configuration Term J Level(cm -1) Ref. 4 d 2 (a 3 F)5 s a 4 F 3 / 2 0.000 J98 4 d 2 (a 3 F)5 s a 4 F 5 / 2 314.673 J98 4 d 2 (a 3 F)5 s a 4 F 7 / 2 763.428 J98 4 d 2 (a 3 F)5 s a 4 F 9 / 2 1322.730 J98 4 d 3 b 4 F 3 / 2 2572.372 J98 4 d 3 b 4 F 5 / 2 2895.097 J98 4 d 3 b 4 F 7 / 2 3299.732 J98 4 d 3 b 4 F 9 / 2 3757.732 J98 4 d 2 (a 1 D)5 s a 2 D 3 / 2 4248.165 J98 4 d 2 (a 1 D)5 s a 2 D 5 / 2 4505.496 J98 4 d 2 (a 3 P)5 s a 2 P 1 / 2 5724.150 J98 4 d 2 (a 3 P)5 s a 2 P 3 / 2 6111.529 J98 4 d 2 (a 3 F)5 s a 2 F 5 / 2 5752.868 J98 4 d 2 (a 3 F)5 s a 2 F 7 / 2 6467.509 J98 4 d 2 (a 3 F)5 p z 4 G° 5 / 2 27983.864 J98 4 d 2 (a 3 F)5 p z 4 G° 7 / 2 28908.930 J98 4 d 2 (a 3 F)5 p z 4 G° 9 / 2 29839.821 J98 4 d 2 (a 3 F)5 p z 4 G° 1 1 / 2 30795.649 J98 4 d 2 (a 3 F)5 p z 4 F° 3 / 2 29777.624 J98 4 d 2 (a 3 F)5 p z 4 F° 5 / 2 30551.468 J98 4 d 2 (a 3 F)5 p z 4 F° 7 / 2 31249.288 J98 4 d 2 (a 3 F)5 p z 4 F° 9 / 2 31866.493 J98 4 d 2 (a 3 F)5 p z 2 F° 7 / 2 30561.752 J98 4 d 2 (a 3 F)5 p z 2 G° 7 / 2 34485.338 J98 4 d 2 (a 3 F)5 p z 2 G° 9 / 2 35185.385 J98 4 d 2 (a 3 P)5 p y 4 D° 7 / 2 38041.326 J98 4 d 5 s (a 3 D)5 p y 4 F° 5 / 2 36868.921 J98 4 d 5 s (a 3 D)5 p y 4 F° 9 / 2 38644.130 J98 4 d 5 s (a 3 D)5 p x 4 D° 5 / 2 39640.238 J98 4 d 5 s (a 3 D)5 p x 4 D° 7 / 2 40238.668 J98 Zr III (3 F 2) Limit 106000 J98

Energy Levels of Singly Ionized Antimony (Sb II)

Energy Levels of Singly Ionized Antimony (Sb II)

Configuration Term J Level(cm -1) Ref. 5 s 2 5 p 2 3 P 0 0.0 AJK89 5 s 2 5 p 2 3 P 1 3054.6 AJK89 5 s 2 5 p 2 3 P 2 5658.2 AJK89 5 s 2 5 p 2 1 D 2 12789.8 AJK89 5 s 2 5 p 2 1 S 0 23905.5 AJK89 5 s 5 p 3 5 S° 2 51722.9 AJK89 5 s 5 p 3 3 D° 1 66291.6 AJK89 5 s 5 p 3 3 D° 2 66502.3 AJK89 5 s 5 p 3 3 D° 3 67887.5 AJK89 5 s 2 5 p 6 s 3 P° 0 69137.3 AJK89 5 s 2 5 p 6 s 3 P° 1 69535.7 AJK89 5 s 2 5 p 6 s 3 P° 2 75274.5 AJK89 5 s 2 5 p 5 d 1 D° 2 72389.7 AJK89 5 s 2 5 p 6 s 1 P° 1 75898.9 AJK89 5 s 2 5 p 5 d 3 F° 2 76691.8 AJK89 5 s 2 5 p 5 d 3 F° 3 77726.9 AJK89 5 s 2 5 p 5 d 3 F° 4 81083.0 AJK89 5 s 5 p 3 3 P° 0 76857.8 AJK89 5 s 5 p 3 3 P° 1 77139.4 AJK89 5 s 5 p 3 3 P° 2 78390.9 AJK89 5 s 2 5 p 6 p 3 D 1 83826.4 C66b 5 s 2 5 p 6 p 3 D 2 86183.6 C66b 5 s 2 5 p 6 p 3 D 3 91583.2 C66b 5 s 2 5 p 5 d 3 D° 1 85094.1 AJK89 5 s 2 5 p 5 d 3 D° 2 86027.3 AJK89 5 s 2 5 p 5 d 3 D° 3 88259.7 AJK89 5 s 2 5 p 5 d 1 F° 3 91225.0 AJK89 5 s 2 5 p 6 p 1 D 2 93853.2 C66b Sb III (2 P° 1 / 2) Limit 134100 C66b

Energy Levels of Singly Ionized Barium (Ba II)

Energy Levels of Singly Ionized Barium (Ba II)

Configuration Term J Level(cm -1) Ref. 6 s 2 S 1 / 2 0.000 KL99 5 d 2 D 3 / 2 4873.852 KL99 5 d 2 D 5 / 2 5674.807 KL99 6 p 2 P° 1 / 2 20261.561 KL99 6 p 2 P° 3 / 2 21952.404 KL99 7 s 2 S 1 / 2 42355.175 KL99 6 d 2 D 3 / 2 45949.472 KL99 6 d 2 D 5 / 2 46154.847 KL99 4 f 2 F° 5 / 2 48258.617 KL99 4 f 2 F° 7 / 2 48483.332 KL99 7 p 2 P° 1 / 2 49389.822 KL99 7 p 2 P° 3 / 2 50011.340 KL99 Ba III (1 S 0) Limit 80686.30 KL99

Energy Levels of Singly Ionized Cesium (Cs II)

Energy Levels of Singly Ionized Cesium (Cs II)

Configuration Term J Level(cm -1) Ref. 5 p 6 1 S 0 0.0 S81 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 107401.5602 S81 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 110954.3607 S81 5 p 5 (2 P° 3 / 2)5 d 2 [1 / 2]° 0 107572.0610 S81 5 p 5 (2 P° 3 / 2)5 d 2 [1 / 2]° 1 107914.1587 S81 5 p 5 (2 P° 3 / 2)5 d 2 [3 / 2]° 2 112804.3010 S81 5 p 5 (2 P° 3 / 2)5 d 2 [3 / 2]° 1 123645.5813 S81 5 p 5 (2 P° 1 / 2)6 s 2 [1 / 2]° 0 122374.8156 S81 5 p 5 (2 P° 1 / 2)6 s 2 [1 / 2]° 1 122875.4487 S81 5 p 5 (2 P° 3 / 2)6 p 2 [1 / 2] 1 126527.5324 S81 5 p 5 (2 P° 3 / 2)6 p 2 [1 / 2] 0 133162.6932 S81 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 2 128098.9117 S81 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 3 129116.7070 S81 5 p 5 (2 P° 3 / 2)6 p 2 [3 / 2] 1 129998.9106 S81 Cs III (2 P° 3 / 2) Limit 186777.4 S81

Energy Levels of Singly Ionized Iodine (I II)

Energy Levels of Singly Ionized Iodine (I II)

Configuration Term J Level(cm -1) Ref. 5 p 4 3 P 2 0.0 MC60 5 p 4 3 P 1 7087.0 MC60 5 p 4 3 P 0 6447.9 MC60 5 p 4 1 D 2 13727.2 MC60 5 p 4 1 S 0 29501.3 MC60 5 p 3 (4 S)6 s 5 S° 2 81032.70 MC60 5 p 3 (4 S)6 s 3 S° 1 84842.87 MC60 5 s 5 p 5 3 P° 2 81907.83 MC60 5 s 5 p 5 3 P° 1 84222.19 MC60 5 s 5 p 5 3 P° 0 90404.95 MC60 5 p 3 (4 S)5 d 5 D° 0 85384.15 MC60 5 p 3 (4 S)5 d 5 D° 1 87734.06 MC60 5 p 3 (4 S)5 d 5 D° 2 86164.86 MC60 5 p 3 (4 S)5 d 5 D° 3 85727.98 MC60 5 p 3 (4 S)5 d 5 D° 4 86036.32 MC60 5 p 3 (2 D°)6 s 3 D° 1 94825.33 MC60 5 p 3 (2 D°)6 s 3 D° 2 93691.35 MC60 5 p 3 (2 D°)6 s 3 D° 3 96650.55 MC60 5 p 3 (2 D°)6 s 1 D° 2 97700.81 MC60 5 p 3 (4 S)6 p 5 P 1 99219.61 MC60 5 p 3 (4 S)6 p 5 P 2 99327.14 MC60 5 p 3 (4 S)6 p 5 P 3 100402.68 MC60 5 p 3 (4 S)6 p 3 P 2 102613.52 MC60 5 p 3 (4 S)6 p 3 P 1 101644.21 MC60 5 p 3 (4 S)6 p 3 P 0 103004.04 MC60 5 p 3 (2 D°)6 p 3 F 2 111298.09 MC60 5 p 3 (2 D°)6 p 3 F 3 112419.04 MC60 5 p 3 (2 D°)6 p 3 F 4 115353.94 MC60 I III (4 S° 3 / 2) Limit 154304 MC60

Energy Levels of Singly Ionized Lanthanum (La II)

Energy Levels of Singly Ionized Lanthanum (La II)

Configuration Term J Level(cm -1) Ref. 5 d 2 a 3 F 2 0.00 MZH78 5 d 2 a 3 F 3 1016.10 MZH78 5 d 2 a 3 F 4 1970.70 MZH78 5 d 2 2 1394.46 MZH78 5 d 6 s a 3 D 1 1895.15 MZH78 5 d 6 s a 3 D 2 2591.60 MZH78 5 d 6 s a 3 D 3 3250.35 MZH78 5 d 2 a 3 P 0 5249.70 MZH78 5 d 2 a 3 P 1 5718.12 MZH78 5 d 2 a 3 P 2 6227.42 MZH78 6 s 2 a 1 S 0 7394.57 MZH78 5 d 2 a 1 G 4 7473.32 MZH78 5 d 6 s 2 10094.86 MZH78 4 f (2 F° 5 / 2)6 s 1 / 2 (5 / 2 , 1 / 2)° 2 14147.98 MZH78 4 f (2 F° 5 / 2)6 s 1 / 2 (5 / 2 , 1 / 2)° 3 14375.17 MZH78 4 f (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 15698.74 MZH78 4 f (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 15773.77 MZH78 4 f 5 d z 1 G° 4 16599.17 MZH78 4 f 5 d y 3 F° 2 17211.93 MZH78 4 f 5 d y 3 F° 3 18235.56 MZH78 4 f 5 d y 3 F° 4 19214.54 MZH78 4 f 5 d z 3 H° 4 17825.62 MZH78 4 f 5 d z 3 H° 5 18580.41 MZH78 4 f 5 d z 3 H° 6 19749.62 MZH78 4 f 5 d z 1 D° 2 18895.41 MZH78 4 f 5 d z 3 G° 3 20402.82 MZH78 4 f 5 d z 3 G° 4 21331.60 MZH78 4 f 5 d z 3 G° 5 22282.90 MZH78 4 f 5 d z 3 D° 1 21441.73 MZH78 4 f 5 d z 3 D° 2 22106.02 MZH78 4 f 5 d z 3 D° 3 22537.30 MZH78 4 f 5 d z 3 P° 0 22683.70 MZH78 4 f 5 d z 3 P° 1 22705.15 MZH78 4 f 5 d z 3 P° 2 23246.93 MZH78 5 d 6 p y 1 D° 2 24462.66 MZH78 4 f 5 d y 1 F° 3 24522.70 MZH78 5 d 6 p y 3 D° 1 25973.37 MZH78 5 d 6 p y 3 D° 2 27388.11 MZH78 5 d 6 p y 3 D° 3 28315.25 MZH78 5 d 6 p x 3 F° 2 26414.01 MZH78 5 d 6 p x 3 F° 3 26837.66 MZH78 5 d 6 p x 3 F° 4 28565.40 MZH78 5 d 6 p ° 1 27423.91 MZH78 6 s 6 p y 3 P° 0 27545.85 MZH78 6 s 6 p ° 1 28154.55 MZH78 4 f 5 d z 1 H° 5 28525.71 MZH78 6 s 6 p ° 2 29498.05 MZH78 4 f 5 d y 1 P° 1 30353.33 MZH78 5 d 6 p x 3 P° 0 31785.82 MZH78 1 32160.99 MZH78 5 d 6 p x 1 F° 3 32201.05 MZH78 La III (2 D 3 / 2) Limit 89200 SR65

Energy Levels of Singly Ionized Tellurium (Te II)

Energy Levels of Singly Ionized Tellurium (Te II)

Configuration Term J Level(cm -1) Ref. 5 s 2 5 p 3 4 S° 3 / 2 0.000 E74 5 s 2 5 p 3 2 D° 3 / 2 10222.385 E74 5 s 2 5 p 3 2 D° 5 / 2 12421.854 E74 5 s 2 5 p 3 2 P° 1 / 2 20546.591 E74 5 s 2 5 p 3 2 P° 3 / 2 24032.095 E74 5 s 5 p 4 4 P 5 / 2 71192.53 E74 5 s 5 p 4 4 P 3 / 2 74893.40 E74 1 1 / 2 76300.87 HM64 2 1 / 2 78448.22 HM64 3 3 / 2 81895.43 HM64 4 3 / 2 82743.33 HM64 5 1 / 2 83577.41 HM64 6 5 / 2 85049.41 HM64 7 3 / 2 85159.66 HM64 8 5 / 2 85591.83 HM64 9 3 / 2 86759.90 HM64 10 5 / 2 87404.54 HM64 11 7 / 2 87899.86 HM64 12 1 / 2 88796.16 HM64 13 9 / 2 90519.67 HM64 14 7 / 2 90797.21 HM64 15 3 / 2 92191.47 HM64 16 1 / 2 92691.51 HM64 17 5 / 2 92793.22 HM64 5 s 2 5 p 2 (3 P)6 p 4 D° 1 / 2 93978.93 HM64 5 s 2 5 p 2 (3 P)6 p 4 D° 3 / 2 96144.74 HM64 5 s 2 5 p 2 (3 P)6 p 4 D° 5 / 2 100112.10 HM64 5 s 2 5 p 2 (3 P)6 p 4 D° 7 / 2 103105.86 HM64 5 s 2 5 p 2 (3 P)6 p 2 S° 1 / 2 97780.09 HM64 5 s 2 5 p 2 (3 P)6 p 20° 3 / 2 99584.59 HM64 5 s 2 5 p 2 (3 P)6 p 21° 3 / 2 101220.97 HM64 5 s 2 5 p 2 (3 P)6 p 4 P° 1 / 2 101370.86 HM64 5 s 2 5 p 2 (3 P)6 p 22° 5 / 2 102324.49 HM64 5 s 2 5 p 2 (3 P)6 p 23° 3 / 2 103935.90 HM64 5 s 2 5 p 2 (3 P)6 p 2 P° 3 / 2 105006.08 HM64 5 s 2 5 p 2 (3 P)6 p 24° 5 / 2 105583.02 HM64 5 s 2 5 p 2 (3 P)6 p 2 P° 1 / 2 106119.20 HM64 Te III (3 P 0) Limit 150000 M58

Energy Levels of Singly Ionized Xenon (Xe II)

Energy Levels of Singly Ionized Xenon (Xe II)

Configuration Term J Level(cm -1) Ref. 5 p 5 2 P° 3 / 2 0.00 HP87 5 p 5 2 P° 1 / 2 10537.01 HP87 5 s 5 p 6 2 S 1 / 2 90873.83 HP87 5 p 4 (3 P)6 s 4 P 5 / 2 93068.44 HP87 5 p 4 (3 P)6 s 4 P 3 / 2 95064.38 HP87 5 p 4 (3 P)6 s 4 P 1 / 2 101157.48 HP87 5 p 4 (3 P)5 d 4 D 7 / 2 95437.67 HP87 5 p 4 (3 P)5 d 4 D 5 / 2 95396.74 HP87 5 p 4 (3 P)5 d 4 D 3 / 2 96033.48 HP87 5 p 4 (3 P)6 s 2 P 3 / 2 102799.07 HP87 5 p 4 (3 P)6 s 2 P 1 / 2 106906.12 HP87 5 p 4 (3 P)6 p 4 P° 5 / 2 111958.89 HP87 5 p 4 (3 P)6 p 4 P° 3 / 2 111792.17 HP87 5 p 4 (3 P)6 p 4 P° 1 / 2 113672.89 HP87 5 p 4 (3 P)6 p 4 D° 7 / 2 113705.40 HP87 5 p 4 (3 P)6 p 4 D° 5 / 2 113512.36 HP87 5 p 4 (3 P)6 p 2 S° 1 / 2 121179.80 HP87 5 p 4 (3 P)6 p 4 S° 3 / 2 121628.82 HP87 Xe III (3 P 2) Limit 169175 HP87

Energy Levels of Singly Ionized Cerium (Ce II)

Energy Levels of Singly Ionized Cerium (Ce II)

Configuration Term J Level(cm -1) Ref. 4 f (2 F°)5 d 2 (3 F) 4 H° 7 / 2 0.000 C73 4 f (2 F°)5 d 2 (3 F) 4 H° 9 / 2 2581.257 C73 4 f (2 F°)5 d 2 (3 F) 4 H° 1 1 / 2 2879.695 C73 4 f (2 F°)5 d 2 (3 F) 4 H° 1 3 / 2 4203.934 C73 4 f (2 F°)5 d 2 (3 F) ° 9 / 2 987.611 C73 4 f (2 F°)5 d 2 (3 F) 4 I° 9 / 2 1410.304 C73 4 f (2 F°)5 d 2 (3 F) 4 I° 1 1 / 2 2563.233 C73 4 f (2 F°)5 d 2 (3 F) 4 I° 1 3 / 2 3793.634 C73 4 f (2 F°)5 d 2 (3 F) 4 I° 1 5 / 2 5455.845 C73 4 f (2 F°)5 d 2 (3 F) ° 7 / 2 1873.934 C73 4 f (2 F°)5 d 2 (3 F) ° 1 / 2 2140.492 C73 4 f 5 d (1 G°)6 s ° 9 / 2 2382.246 C73 4 f 5 d (3 F°)6 s 4 F° 3 / 2 2595.644 C73 4 f 5 d (3 F°)6 s 4 F° 5 / 2 3363.427 C73 4 f 5 d (3 F°)6 s 4 F° 7 / 2 4459.872 C73 4 f 5 d (3 F°)6 s 4 F° 9 / 2 5675.763 C73 4 f 5 d (3 F°)6 s ° 5 / 2 2634.666 C73 4 f 5 d (1 G°)6 s ° 7 / 2 2641.559 C73 4 f (2 F°)5 d 2 (3 F) 2 S° 1 / 2 3508.470 C73 4 f 5 d (1 G°)6 s ° 9 / 2 3593.882 C73 4 f (2 F°)5 d 2 (3 F) ° 7 / 2 3703.594 C73 4 f (2 F°)5 d 2 (3 F) 4 D° 3 / 2 3745.475 C73 4 f 2 (3 H)6 s 4 H 7 / 2 3854.012 C73 4 f 2 (3 H)6 s 4 H 9 / 2 4165.550 C73 4 f 2 (3 H)6 s 4 H 1 1 / 2 5513.709 C73 4 f 2 (3 H)6 s 4 H 1 3 / 2 6967.547 C73 4 f 5 d (3 H°)6 s 4 H° 7 / 2 3995.460 C73 4 f 5 d (3 H°)6 s 4 H° 9 / 2 4523.033 C73 4 f 5 d (3 H°)6 s 4 H° 1 1 / 2 5651.357 C73 4 f 5 d (3 H°)6 s 4 H° 1 3 / 2 6913.392 C73 4 f (2 F°)5 d 2 (3 F) 4 F° 3 / 2 4201.893 C73 4 f (2 F°)5 d 2 (3 F) 4 F° 5 / 2 5010.870 C73 4 f (2 F°)5 d 2 (3 F) 4 F° 7 / 2 5964.896 C73 4 f (2 F°)5 d 2 (3 F) 4 F° 9 / 2 7059.072 C73 4 f 5 d (3 G°)6 s ° 7 / 2 4266.397 C73 4 f 5 d (3 G°)6 s ° 5 / 2 4322.708 C73 4 f 5 d (3 G°)6 s 4 G° 5 / 2 4511.257 C73 4 f (2 F°)5 d 2 (3 F) ° 5 / 2 4737.373 C73 4 f (2 F°)5 d 2 (3 F) ° 3 / 2 4844.644 C73 4 f 5 d (3 H°)6 s ° 1 1 / 2 4910.963 C73 4 f 5 d (1 D°)6 s ° 5 / 2 5118.806 C73 4 f (2 F°)5 d 2 (1 D) ° 1 / 2 5283.029 C73 4 f (2 F°)5 d 2 (3 F) 4 G° 7 / 2 5437.422 C73 4 f (2 F°)5 d 2 (3 F) 4 G° 9 / 2 6389.942 C73 4 f (2 F°)5 d 2 (3 F) 4 G° 1 1 / 2 7522.622 C73 4 f 2 (3 H)6 s 2 H 9 / 2 5616.739 C73 4 f 2 (3 H)6 s 2 H 1 1 / 2 7341.007 C73 4 f (2 F°)5 d 2 (3 F) ° 7 / 2 5716.216 C73 4 f 5 d (3 G°)6 s ° 9 / 2 5819.113 C73 4 f (2 F°)5 d 2 (3 F) ° 3 / 2 5924.204 C73 4 f (2 F°)5 d 2 (3 F) ° 7 / 2 5942.798 C73 4 f (2 F°)5 d 2 (1 G) ° 1 1 / 2 5969.007 C73 4 f 5 d (3 F°)6 s ° 5 / 2 6517.619 C73 4 f 5 d (3 D°)6 s ° 3 / 2 6521.332 C73 4 f 5 d (3 F°)6 s ° 5 / 2 6549.908 C73 4 f (2 F°)5 d 2 (3 F) ° 9 / 2 6638.258 C73 4 f 2 (3 H)5 d 2 H 9 / 2 7011.804 C73 4 f 2 (3 H)5 d 2 H 1 1 / 2 8278.054 C73 4 f 5 d (3 D°)6 s 4 D° 1 / 2 7061.838 C73 4 f 5 d (3 D°)6 s 4 D° 3 / 2 7818.147 C73 4 f 5 d (3 D°)6 s 4 D° 5 / 2 8175.863 C73 4 f 5 d (3 D°)6 s 4 D° 7 / 2 8402.668 C73 4 f 2 (3 H)5 d 4 K 1 1 / 2 7092.265 C73 4 f 2 (3 H)5 d 4 K 1 3 / 2 8423.672 C73 4 f 2 (3 H)5 d 4 K 1 5 / 2 9771.956 C73 4 f 2 (3 H)5 d 4 K 1 7 / 2 11165.796 C73 4 f (2 F°)5 d 2 (3 P) 4 G° 5 / 2 7202.529 C73 4 f (2 F°)5 d 2 (3 P) 4 G° 7 / 2 7878.328 C73 4 f (2 F°)5 d 2 (3 P) 4 G° 9 / 2 8804.224 C73 4 f (2 F°)5 d 2 (3 P) 4 G° 1 1 / 2 10035.711 C73 4 f 5 d (3 G°)6 s 4 G° 1 1 / 2 7233.627 C73 4 f 5 d (3 F°)6 s ° 7 / 2 7259.075 C73 4 f (2 F°)5 d 2 (3 F) 4 P° 3 / 2 7278.922 C73 4 f (2 F°)5 d 2 (3 F) 4 P° 1 / 2 7522.458 C73 4 f (2 F°)5 d 2 (3 F) 4 P° 5 / 2 7746.185 C73 4 f (2 F°)5 d 2 (3 F) 2 I° 1 3 / 2 7293.938 C73 4 f 2 (3 F)6 s 4 F 3 / 2 7454.951 C73 4 f 2 (3 F)6 s 4 F 5 / 2 7722.285 C73 4 f 2 (3 F)6 s 4 F 7 / 2 8531.678 C73 4 f 2 (3 F)6 s 4 F 9 / 2 8774.064 C73 4 f (2 F°)5 d 2 (1 G) ° 9 / 2 7713.089 C73 4 f 2 (3 H)5 d 4 I 9 / 2 8131.217 C73 4 f 2 (3 H)5 d 4 I 1 1 / 2 8896.729 C73 4 f 2 (3 H)5 d 4 I 1 3 / 2 10058.226 C73 4 f 2 (3 H)5 d 4 I 1 5 / 2 11309.972 C73 4 f (2 F°)5 d 2 (3 F) 4 S° 3 / 2 8169.698 C73 4 f (2 F°)5 d 2 (3 P) 2 D° 5 / 2 8280.946 C73 4 f (2 F°)5 d 2 (3 P) 2 D° 3 / 2 8702.444 C73 4 f 2 (3 H)5 d 4 G 5 / 2 8448.641 C73 4 f 2 (3 H)5 d 4 G 7 / 2 9316.912 C73 4 f 2 (3 H)5 d 4 G 9 / 2 10314.162 C73 4 f 2 (3 H)5 d 4 G 1 1 / 2 11458.353 C73 4 f 2 (3 F)6 s 2 F 5 / 2 8789.380 C73 4 f 2 (3 F)6 s 2 F 7 / 2 9053.629 C73 4 f 5 d (3 H°)6 s ° 1 1 / 2 8927.514 C73 4 f (2 F°)5 d 2 (1 G) 2 G° 7 / 2 9198.326 C73 4 f (2 F°)5 d 2 (3 P) ° 1 / 2 9269.826 C73 4 f 5 d (3 P°)6 s 4 P° 1 / 2 9491.493 C73 4 f 5 d (3 P°)6 s 4 P° 3 / 2 9634.186 C73 4 f 5 d (3 P°)6 s 4 P° 5 / 2 10641.442 C73 4 f (2 F°)5 d 2 (1 G) ° 9 / 2 9723.335 C73 4 f 2 (3 H)5 d 4 H 7 / 2 9725.733 C73 4 f 2 (3 H)5 d 4 H 9 / 2 10703.305 C73 4 f 2 (3 H)5 d 4 H 1 1 / 2 11759.467 C73 4 f 2 (3 H)5 d 4 H 1 3 / 2 13027.758 C73 4 f (2 F°)6 s 2 2 F° 5 / 2 9778.986 C73 4 f 5 d (3 F°)6 p 4 G 5 / 2 25359.686 C73 4 f 5 d (3 F°)6 p 4 G 7 / 2 27187.047 C73 4 f 5 d (3 F°)6 p 4 G 9 / 2 29166.597 C73 4 f 5 d (3 F°)6 p 4 G 1 1 / 2 31089.731 C73 4 f 2 (3 H 4)6 p 1 / 2 (4, 1 / 2)° 9 / 2 25766.355 C73 4 f 2 (3 H 4)6 p 1 / 2 (4, 1 / 2)° 7 / 2 26268.203 C73 4 f 5 d (1 G°)6 p 7 / 2 25945.396 C73 4 f 5 d (1 G°)6 p 1 1 / 2 27379.949 C73 4 f 2 (3 H 4)6 p 3 / 2 (4, 3 / 2)° 9 / 2 27432.782 C73 4 f 2 (3 H 4)6 p 3 / 2 (4, 3 / 2)° 1 1 / 2 28327.071 C73 4 f 2 (3 H 4)6 p 3 / 2 (4, 3 / 2)° 7 / 2 28349.582 C73 4 f 2 (3 H 4)6 p 3 / 2 (4, 3 / 2)° 5 / 2 28396.150 C73 4 f 5 d (3 H°)6 p 9 / 2 27934.638 C73 4 f 5 d (3 G°)6 p 4 H 7 / 2 28297.473 C73 4 f 5 d (3 G°)6 p 4 H 9 / 2 29908.904 C73 4 f 5 d (3 G°)6 p 4 H 1 1 / 2 31738.484 C73 4 f 5 d (3 G°)6 p 4 H 1 3 / 2 33531.388 C73 4 f 5 d (3 H°)6 p 9 / 2 28334.756 C73 4 f 5 d (3 H°)6 p 1 1 / 2 29438.817 C73 4 f 2 (3 H 6)6 p 3 / 2 (6, 3 / 2)° 1 5 / 2 30846.582 C73 4 f 2 (3 H 6)6 p 3 / 2 (6, 3 / 2)° 1 1 / 2 31151.534 C73 4 f 2 (3 H 6)6 p 3 / 2 (6, 3 / 2)° 1 3 / 2 31340.393 C73 4 f 2 (3 H 6)6 p 3 / 2 (6, 3 / 2)° 9 / 2 32372.621 C73 4 f 5 d (3 H°)6 p 4 I 1 5 / 2 32269.252 C73 Ce III (3 H 4) Limit 87500 SR65

Energy Levels of Singly Ionized Europium (Eu II)

Energy Levels of Singly Ionized Europium (Eu II)

Configuration Term J Level(cm -1) Ref. 4 f 7 (8 S°)6 s a 9 S° 4 0.00 MZH78 4 f 7 (8 S°)6 s a 7 S° 3 1669.21 MZH78 4 f 7 (8 S°)5 d a 9 D° 2 9923.00 MZH78 4 f 7 (8 S°)5 d a 9 D° 3 10081.65 MZH78 4 f 7 (8 S°)5 d a 9 D° 4 10312.82 MZH78 4 f 7 (8 S°)5 d a 9 D° 5 10643.48 MZH78 4 f 7 (8 S°)5 d a 9 D° 6 11128.22 MZH78 4 f 7 (8 S°)5 d a 7 D° 5 16860.72 MZH78 4 f 7 (8 S°)5 d a 7 D° 4 17004.06 MZH78 4 f 7 (8 S°)5 d a 7 D° 3 17140.87 MZH78 4 f 7 (8 S°)5 d a 7 D° 2 17247.67 MZH78 4 f 7 (8 S°)5 d a 7 D° 1 17324.66 MZH78 4 f 7 (8 S° 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2) 3 23774.28 MZH78 4 f 7 (8 S° 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2) 4 24207.86 MZH78 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 5 26172.83 MZH78 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 4 26838.50 MZH78 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 3 27104.07 MZH78 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 2 27256.35 MZH78 4 f 6 (7 F)5 d (8 D)6 s z 9 D 2 30189.31 MZH78 4 f 6 (7 F)5 d (8 D)6 s z 9 D 3 31500.82 MZH78 4 f 6 (7 F)5 d (8 D)6 s z 9 D 4 32486.10 MZH78 4 f 6 (7 F)5 d (8 D)6 s z 9 D 5 33420.20 MZH78 4 f 6 (7 F)5 d (8 D)6 s z 9 D 6 34764.97 MZH78 101 4 33779.95 MZH78 102 3 33919.70 MZH78 103 2 33944.49 MZH78 4 f 6 (7 F)5 d (8 P)6 s y 9 P 3 34393.57 MZH78 4 f 6 (7 F)5 d (8 P)6 s y 9 P 4 35527.02 MZH78 4 f 6 (7 F)5 d (8 P)6 s y 9 P 5 36648.95 MZH78 Eu III (8 S° 7 / 2) Limit 90700 SR65

Energy Levels of Singly Ionized Gadolinium (Gd II)

Energy Levels of Singly Ionized Gadolinium (Gd II)

Configuration Term J Level(cm -1) Ref. 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 5 / 2 0.000 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 7 / 2 261.841 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 9 / 2 633.273 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 1 1 / 2 1158.943 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 1 3 / 2 1935.310 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 8 D° 3 / 2 2856.678 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 8 D° 5 / 2 3082.011 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 8 D° 7 / 2 3427.274 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 8 D° 9 / 2 3972.167 MZH78 4 f 7 (8 S°)5 d (9 D°)6 s 8 D° 1 1 / 2 4841.106 MZH78 4 f 7 (8 S°)6 s 2 8 S° 7 / 2 3444.235 MZH78 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 3 / 2 4027.161 MZH78 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 5 / 2 4212.756 MZH78 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 7 / 2 4483.854 MZH78 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 9 / 2 4852.304 MZH78 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 1 1 / 2 5339.477 MZH78 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 1 3 / 2 5897.264 MZH78 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 1 5 / 2 6605.154 MZH78 4 f 8 (7 F)6 s 8 F 1 3 / 2 7992.268 MZH78 4 f 8 (7 F)6 s 8 F 1 1 / 2 9092.491 MZH78 4 f 8 (7 F)6 s 8 F 9 / 2 10292.567 MZH78 4 f 8 (7 F)6 s 8 F 7 / 2 11084.335 MZH78 4 f 8 (7 F)6 s 8 F 5 / 2 11669.863 MZH78 4 f 8 (7 F)6 s 8 F 3 / 2 12071.778 MZH78 4 f 8 (7 F)6 s 8 F 1 / 2 12309.508 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 8 D° 1 1 / 2 8551.049 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 8 D° 9 / 2 8884.809 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 8 D° 7 / 2 9142.904 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 8 D° 5 / 2 9328.864 MZH78 4 f 7 (8 S°)5 d (7 D°)6 s 8 D° 3 / 2 9451.697 MZH78 4 f 8 (7 F)6 s 6 F 1 1 / 2 9943.779 MZH78 4 f 8 (7 F)6 s 6 F 9 / 2 11343.525 MZH78 4 f 8 (7 F)6 s 6 F 7 / 2 12318.288 MZH78 4 f 8 (7 F)6 s 6 F 5 / 2 13030.786 MZH78 4 f 8 (7 F)6 s 6 F 3 / 2 13515.189 MZH78 4 f 8 (7 F)6 s 6 F 1 / 2 13800.345 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 3 / 2 25960.073 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 5 / 2 26211.912 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 7 / 2 26595.222 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 9 / 2 27162.224 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 1 1 / 2 27864.534 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 1 3 / 2 29353.344 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 1 5 / 2 31145.651 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 5 / 2 27297.741 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 7 / 2 27988.074 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 9 / 2 29045.291 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 1 1 / 2 30366.818 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 1 3 / 2 30996.851 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 8 D 3 / 2 29877.937 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 8 D 5 / 2 29965.752 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 8 D 7 / 2 30008.894 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 8 D 9 / 2 30027.378 MZH78 4 f 7 (8 S°)5 d (9 D°)6 p 1 1 / 2 30101.366 MZH78 4 f 8 (7 F 6)6 p 1 / 2 (6, 1 / 2)° 1 1 / 2 32595.348 MZH78 4 f 8 (7 F 6)6 p 1 / 2 (6, 1 / 2)° 1 3 / 2 32677.540 MZH78 Gd III (9 D° 2) Limit 97500 SR73

Energy Levels of Singly Ionized Neodymium (Nd II)

Energy Levels of Singly Ionized Neodymium (Nd II)

Configuration Term J Level(cm -1) Ref. 4 f 4 (5 I)6 s 6 I 7 / 2 0.000 BWDA84 4 f 4 (5 I)6 s 6 I 9 / 2 513.330 BWDA84 4 f 4 (5 I)6 s 6 I 1 1 / 2 1470.105 BWDA84 4 f 4 (5 I)6 s 6 I 1 3 / 2 2585.460 BWDA84 4 f 4 (5 I)6 s 6 I 1 5 / 2 3801.930 BWDA84 4 f 4 (5 I)6 s 6 I 1 7 / 2 5085.640 BWDA84 4 f 4 (5 I)6 s 4 I 9 / 2 1650.205 BWDA84 4 f 4 (5 I)6 s 4 I 1 1 / 2 3066.755 BWDA84 4 f 4 (5 I)6 s 4 I 1 3 / 2 4512.495 BWDA84 4 f 4 (5 I)6 s 4 I 1 5 / 2 5985.580 BWDA84 4 f 4 (5 I)5 d 6 L 1 1 / 2 4437.560 BWDA84 4 f 4 (5 I)5 d 6 L 1 3 / 2 5487.655 BWDA84 4 f 4 (5 I)5 d 6 L 1 5 / 2 6637.430 BWDA84 4 f 4 (5 I)5 d 6 L 1 7 / 2 7868.910 BWDA84 4 f 4 (5 I)5 d 6 L 1 9 / 2 9166.210 BWDA84 4 f 4 (5 I)5 d 6 L 2 1 / 2 10516.790 BWDA84 4 f 4 (5 I)5 d 6 K 9 / 2 6005.270 BWDA84 4 f 4 (5 I)5 d 6 K 1 1 / 2 6931.800 BWDA84 4 f 4 (5 I)5 d 6 K 1 3 / 2 7950.075 BWDA84 4 f 4 (5 I)5 d 6 K 1 5 / 2 9042.760 BWDA84 4 f 4 (5 I)5 d 6 K 1 7 / 2 10194.805 BWDA84 4 f 4 (5 I)5 d 6 K 1 9 / 2 11392.190 BWDA84 4 f 4 (5 I)5 d 6 I 7 / 2 7524.735 BWDA84 4 f 4 (5 I)5 d 6 I 9 / 2 8420.320 BWDA84 4 f 4 (5 I)5 d 6 I 1 1 / 2 9357.910 BWDA84 4 f 4 (5 I)5 d 6 I 1 3 / 2 10337.100 BWDA84 4 f 4 (5 I)5 d 6 I 1 5 / 2 11373.475 BWDA84 4 f 4 (5 I)5 d 6 I 1 7 / 2 12459.995 BWDA84 4 f 4 (5 I)5 d 6 G 3 / 2 8716.445 BWDA84 4 f 4 (5 I)5 d 6 G 5 / 2 8796.365 BWDA84 4 f 4 (5 I)5 d 6 G 7 / 2 9198.395 BWDA84 4 f 4 (5 I)5 d 6 G 9 / 2 10883.250 BWDA84 4 f 4 (5 I)5 d 6 G 1 1 / 2 12021.340 BWDA84 4 f 4 (5 I)5 d 6 G 1 3 / 2 12334.230 BWDA84 4 f 3 (4 I°)5 d 2 (3 F) 6 M° 1 3 / 2 8009.810 BWDA84 4 f 3 (4 I°)5 d 2 (3 F) 6 M° 1 5 / 2 9448.185 BWDA84 4 f 3 (4 I°)5 d 2 (3 F) 6 M° 1 7 / 2 10980.540 BWDA84 4 f 3 (4 I°)5 d 2 (3 F) 6 M° 1 9 / 2 12600.805 BWDA84 4 f 3 (4 I°)5 d 2 (3 F) 6 M° 2 1 / 2 14299.295 BWDA84 4 f 3 (4 I°)5 d 2 (3 F) 6 M° 2 3 / 2 16064.085 BWDA84 4 f 4 (5 I)5 d 6 H 5 / 2 9674.835 BWDA84 4 f 4 (5 I)5 d 6 H 7 / 2 10666.780 BWDA84 4 f 4 (5 I)5 d 6 H 9 / 2 11709.615 BWDA84 4 f 4 (5 I)5 d 6 H 1 1 / 2 12887.085 BWDA84 4 f 4 (5 I)5 d 6 H 1 3 / 2 13298.880 BWDA84 4 f 4 (5 I)5 d 6 H 1 5 / 2 14481.970 BWDA84 4 f 4 (5 I)6 p 6 K° 9 / 2 23229.980 BWDA84 4 f 4 (5 I)6 p 6 K° 1 1 / 2 24445.380 BWDA84 4 f 4 (5 I)6 p 6 K° 1 3 / 2 25524.470 BWDA84 4 f 4 (5 I)6 p 6 K° 1 5 / 2 26912.765 BWDA84 4 f 4 (5 I)6 p 6 K° 1 7 / 2 28418.970 BWDA84 4 f 4 (5 I)6 p 6 K° 1 9 / 2 30002.310 BWDA84 ° 9 / 2 23537.380 BWDA84 4 f 4 (5 I)6 p 6 I° 7 / 2 25044.645 BWDA84 4 f 4 (5 I)6 p 6 I° 9 / 2 25877.160 BWDA84 4 f 4 (5 I)6 p 6 I° 1 1 / 2 26772.080 BWDA84 4 f 4 (5 I)6 p 6 I° 1 3 / 2 27744.190 BWDA84 4 f 4 (5 I)6 p 6 I° 1 5 / 2 28856.895 BWDA84 4 f 4 (5 I)6 p 6 I° 1 7 / 2 30246.770 BWDA84 4 f 4 (5 I)6 p 6 H° 5 / 2 25876.545 BWDA84 4 f 4 (5 I)6 p 6 H° 7 / 2 26640.080 BWDA84 4 f 4 (5 I)6 p 6 H° 9 / 2 27425.000 BWDA84 4 f 4 (5 I)6 p 6 H° 1 1 / 2 28285.610 BWDA84 4 f 4 (5 I)6 p 6 H° 1 3 / 2 29434.255 BWDA84 4 f 4 (5 I)6 p 6 H° 1 5 / 2 30707.280 BWDA84 ° 1 3 / 2 26210.740 BWDA84 4 f 4 (5 I)6 p 4 I° 9 / 2 27921.385 BWDA84 4 f 4 (5 I)6 p 4 I° 1 1 / 2 29484.605 BWDA84 4 f 4 (5 I)6 p 4 I° 1 3 / 2 31153.855 BWDA84 4 f 4 (5 I)6 p 4 I° 1 5 / 2 32464.635 BWDA84 ° 1 5 / 2 28540.945 BWDA84 ° 1 5 / 2 29362.520 BWDA84 Nd III (5 I 4) Limit 86500 SR65

Energy Levels of Singly Ionized Praseodymium (Pr II)

Energy Levels of Singly Ionized Praseodymium (Pr II)

Configuration Term J Level(cm -1) Ref. 4 f 3 (4 I° 9 / 2)6 s 1 / 2 (9 / 2 , 1 / 2)° 4 0.00 MZH78 4 f 3 (4 I° 9 / 2)6 s 1 / 2 (9 / 2 , 1 / 2)° 5 441.95 MZH78 4 f 3 (4 I° 1 1 / 2)6 s 1 / 2 (1 1 / 2 , 1 / 2)° 6 1649.01 MZH78 4 f 3 (4 I° 1 1 / 2)6 s 1 / 2 (1 1 / 2 , 1 / 2)° 5 1743.72 MZH78 4 f 3 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 7 2998.36 MZH78 4 f 3 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 6 3403.21 MZH78 4 f 3 (4 I°)5 d 5 L° 6 3893.46 G89 4 f 3 (4 I°)5 d 5 L° 7 5108.40 G89 4 f 3 (4 I°)5 d 5 L° 8 6417.83 G89 4 f 3 (4 I°)5 d 5 L° 9 7805.61 G89 4 f 3 (4 I°)5 d 5 L° 10 9255.19 G89 4 f 3 (4 I°)5 d 5 K° 5 4097.58 G89 4 f 3 (4 I°)5 d 5 K° 6 5226.52 G89 4 f 3 (4 I°)5 d 5 K° 7 6413.93 G89 4 f 3 (4 I°)5 d 5 K° 8 7659.72 G89 4 f 3 (4 I°)5 d 5 K° 9 8958.44 G89 4 f 3 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 4437.14 MZH78 4 f 3 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 5079.34 MZH78 4 f 2 (3 H)5 d 2 (3 F) 5 L 6 5854.54 G89 4 f 2 (3 H)5 d 2 (3 F) 5 I 4 7228.00 G89 4 f 3 (4 I°)6 p 5 K 5 22675.44 G89 4 f 3 (4 I°)6 p 5 K 6 24115.48 G89 4 f 3 (4 I°)6 p 5 K 7 25569.19 G89 4 f 3 (4 I°)6 p 5 K 8 27128.00 G89 4 f 3 (4 I°)6 p 5 K 9 28816.25 G89 4 f 3 (4 I°)6 p 5 I 4 23660.08 G89 4 f 3 (4 I°)6 p 5 I 5 24716.04 G89 4 f 3 (4 I°)6 p 5 I 6 25656.69 G89 4 f 3 (4 I°)6 p 5 I 7 26860.95 G89 4 f 3 (4 I°)6 p 5 I 8 28201.95 G89 4 f 2 5 d 2 6 27604.94 G89 4 f 3 (4 I°)6 p 3 K 7 28009.80 G89 Pr III (4 I° 9 / 2) Limit 85100 SR65

Energy Levels of Singly Ionized Promethium (Pm II)

Energy Levels of Singly Ionized Promethium (Pm II)

Configuration Term J Level(cm -1) Ref. 4 f 5 (6 H°)6 s 7 H° 2 0.00 MZH78 4 f 5 (6 H°)6 s 7 H° 3 446.45 MZH78 4 f 5 (6 H°)6 s 7 H° 4 1133.45 MZH78 4 f 5 (6 H°)6 s 7 H° 5 1983.52 MZH78 4 f 5 (6 H°)6 s 7 H° 6 2950.31 MZH78 4 f 5 (6 H°)6 s 7 H° 7 4000.15 MZH78 4 f 5 (6 H°)6 s 7 H° 8 _ 4 f 5 (6 H°)6 s 5 H° 3 1602.97 MZH78 4 f 5 (6 H°)6 s 5 H° 4 2666.76 MZH78 4 f 5 (6 H°)6 s 5 H° 5 3812.31 MZH78 4 f 5 (6 H°)6 s 5 H° 6 5017.77 MZH78 4 f 5 (6 H°)6 s 5 H° 7 _ 4 f 5 (6 F°)6 s 7 F° 0 5280.88 MZH78 4 f 5 (6 F°)6 s 7 F° 1 5391.46 MZH78 4 f 5 (6 F°)6 s 7 F° 2 5632.40 MZH78 4 f 5 (6 F°)6 s 7 F° 3 6048.50 MZH78 4 f 5 (6 F°)6 s 7 F° 4 6705.18 MZH78 4 f 5 (6 F°)6 s 7 F° 5 _ 4 f 5 (6 F°)6 s 7 F° 6 _ 4 f 5 (6 H°)5 d 7 K° 4 5332.36 OHRW95 4 f 5 (6 H°)5 d 7 K° 5 6131.47 OHRW95 4 f 5 (6 H°)5 d 7 K° 6 7040.66 OHRW95 4 f 5 (6 H°)5 d 7 K° 7 8041.72 OHRW95 4 f 5 (6 H°)5 d 7 K° 8 9119.34 OHRW95 4 f 5 (6 H°)5 d 7 K° 9 _ 4 f 5 (6 H°)5 d 7 K° 10 _ 4 f 5 (6 F°)6 s 5 F° 1 6629.40 MZH78 4 f 5 (6 F°)6 s 5 F° 2 7012.87 MZH78 4 f 5 (6 F°)6 s 5 F° 3 7701.09 MZH78 4 f 5 (6 F°)6 s 5 F° 4 _ 4 f 5 (6 F°)6 s 5 F° 5 _ 4 f 5 (6 H°)6 p 7 I 3 23261.30 MZH78 4 f 5 (6 H°)6 p 7 I 4 24157.20 MZH78 4 f 5 (6 H°)6 p 7 I 5 25015.69 MZH78 4 f 5 (6 H°)6 p 7 I 6 26027.56 MZH78 4 f 5 (6 H°)6 p 7 I 7 27110.08 MZH78 3 23761.98 MZH78 3 24466.32 MZH78 3 24527.89 MZH78 5 26132.87 MZH78 6 27379.79 MZH78 7 28516.85 MZH78 Pm III (6 H° 5 / 2) Limit 87900 SR65

Energy Levels of Singly Ionized Samarium (Sm II)

Energy Levels of Singly Ionized Samarium (Sm II)

Configuration Term J Level(cm -1) Ref. 4 f 6 (7 F)6 s 8 F 1 / 2 0.00 MZH78 4 f 6 (7 F)6 s 8 F 3 / 2 326.64 MZH78 4 f 6 (7 F)6 s 8 F 5 / 2 838.22 MZH78 4 f 6 (7 F)6 s 8 F 7 / 2 1489.16 MZH78 4 f 6 (7 F)6 s 8 F 9 / 2 2237.97 MZH78 4 f 6 (7 F)6 s 8 F 1 1 / 2 3052.65 MZH78 4 f 6 (7 F)6 s 8 F 1 3 / 2 3909.62 MZH78 4 f 6 (7 F)6 s 6 F 1 / 2 1518.29 MZH78 4 f 6 (7 F)6 s 6 F 3 / 2 2003.23 MZH78 4 f 6 (7 F)6 s 6 F 5 / 2 2688.69 MZH78 4 f 6 (7 F)6 s 6 F 7 / 2 3499.12 MZH78 4 f 6 (7 F)6 s 6 F 9 / 2 4386.03 MZH78 4 f 6 (7 F)6 s 6 F 1 1 / 2 5317.56 MZH78 4 f 6 (7 F)5 d 8 H 3 / 2 7135.06 MZH78 4 f 6 (7 F)5 d 8 H 5 / 2 7524.86 MZH78 4 f 6 (7 F)5 d 8 H 7 / 2 8046.00 MZH78 4 f 6 (7 F)5 d 8 H 9 / 2 8679.23 MZH78 4 f 6 (7 F)5 d 8 H 1 1 / 2 9406.63 MZH78 4 f 6 (7 F)5 d 8 H 1 3 / 2 10214.38 MZH78 4 f 6 (7 F)5 d 8 H 1 5 / 2 11094.06 MZH78 4 f 6 (7 F)5 d 8 H 1 7 / 2 12045.10 MZH78 4 f 6 (7 F)5 d 8 D 3 / 2 8578.70 MZH78 4 f 6 (7 F)5 d 8 D 5 / 2 9410.00 MZH78 4 f 6 (7 F)5 d 8 D 7 / 2 10180.70 MZH78 4 f 6 (7 F)5 d 8 D 9 / 2 10960.16 MZH78 4 f 6 (7 F)5 d 8 D 1 1 / 2 11791.05 MZH78 4 f 6 (7 F)6 p ° 1 1 / 2 26505.53 MZH78 , RAVS90 4 f 5 5 d 6 s ° 1 3 / 2 26540.12 MZH78 , RAVS90 4 f 5 5 d 6 s ? 8 G° 1 / 2 26690.30 MZH78 4 f 5 5 d 6 s ? ° 3 / 2 27063.30 MZH78 4 f 5 5 d 6 s ° 1 5 / 2 27263.25 MZH78 , RAVS90 4 f 5 5 d 6 s ? ° 1 3 / 2 27695.96 MZH78 4 f 6 (7 F)6 p ° 1 1 / 2 28540.12 MZH78 , RAVS90 4 f 5 5 d 6 s ? ° 9 / 2 28997.14 MZH78 4 f 6 (7 F)6 p ? ° 1 3 / 2 29640.51 MZH78 4 f 5 5 d 6 s ? ° 1 1 / 2 29934.80 MZH78 4 f 5 5 d 6 s ? ° 1 3 / 2 30879.74 MZH78 ° 1 1 / 2 31122.17 MZH78 4 f 5 5 d 6 s ? ° 1 5 / 2 31926.40 MZH78 Sm III (7 F 0) Limit 89300 SR65

Energy Levels of Singly Ionized Terbium (Tb II)

Energy Levels of Singly Ionized Terbium (Tb II)

Configuration Term J Level(cm -1) Ref. 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 0.000 B01 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 1016.380 B01 4 f 9 (6 H° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 7 3010.050 B01 4 f 9 (6 H° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 6 3542.400 B01 4 f 8 (7 F)5 d (8 G)6 s 9 G 7 3235.190 B01 4 f 8 (7 F)5 d (8 G)6 s 9 G 8 3423.295 B01 4 f 8 (7 F)5 d (8 G)6 s 6 3440.825 B01 4 f 8 (7 F)5 d (8 G)6 s 5 4158.785 B01 8 21035.56 B01 7 21521.06 B01 8 25138.450 B01 4 f 9 (6 H° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 7 25804.650 B01 4 f 9 (6 H° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 8 25975.160 B01 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 8 28014.875 B01 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 7 28209.430 B01 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 6 28339.285 B01 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 9 28488.810 B01 4 f 9 (6 H° 1 3 / 2)6 p 1 / 2 (1 3 / 2 , 1 / 2) 7 28649.095 B01 4 f 8 5 d 6 p ? ° 6 29912.930 B01 ° 5 29992.75 B01 4 f 8 5 d 6 p ? ° 7 30225.865 B01 4 f 8 5 d 6 p ? ° 8 30809.590 B01 4 f 9 (6 H° 1 3 / 2)6 p 3 / 2 (1 3 / 2 , 3 / 2) 8 31078.460 B01 ° 9 33495.130 B01 Tb III (6 H° 1 5 / 2) Limit 92900 SR65

Energy Levels of Singly Ionized Dysprosium (Dy II)

Energy Levels of Singly Ionized Dysprosium (Dy II)

Configuration Term J Level(cm -1) Ref. 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 7 / 2 0.000 NG00 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 828.314 NG00 4 f 1 0 (5 I 7)6 s 1 / 2 (7, 1 / 2) 1 5 / 2 4341.104 NG00 4 f 1 0 (5 I 7)6 s 1 / 2 (7, 1 / 2) 1 3 / 2 4755.673 NG00 4 f 1 0 (5 I 6)6 s 1 / 2 (6, 1 / 2) 1 1 / 2 7463.905 NG00 4 f 1 0 (5 I 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 7485.117 NG00 4 f 1 0 (5 I 5)6 s 1 / 2 (5, 1 / 2) 9 / 2 9432.105 NG00 4 f 1 0 (5 I 5)6 s 1 / 2 (5, 1 / 2) 1 1 / 2 9871.028 NG00 4 f 9 (6 H°)5 d (7 H°)6 s 8 H° 1 7 / 2 10594.197 NG00 4 f 9 (6 H°)5 d (7 H°)6 s 8 H° 1 5 / 2 11394.912 NG00 4 f 9 (6 H°)5 d (7 H°)6 s 8 H° 1 3 / 2 12674.694 NG00 4 f 9 (6 H°)5 d (7 H°)6 s 8 H° 1 1 / 2 14347.205 NG00 4 f 9 (6 H°)5 d (7 H°)6 s 8 H° 9 / 2 16015.394 NG00 4 f 9 (6 H°)5 d (7 H°)6 s 8 H° 7 / 2 _ 4 f 9 (6 H°)5 d (7 H°)6 s 8 H° 5 / 2 _ 4 f 9 (6 H°)5 d (7 H°)6 s 8 H° 3 / 2 _ 4 f 1 0 (5 I 4)6 s 1 / 2 (4, 1 / 2) 7 / 2 10953.984 NG00 4 f 1 0 (5 I 4)6 s 1 / 2 (4, 1 / 2) 9 / 2 11801.052 NG00 4 f 9 6 s 2 6 H° 1 5 / 2 12336.314 NG00 4 f 9 6 s 2 6 H° 1 3 / 2 15822.169 NG00 4 f 9 6 s 2 6 H° 1 1 / 2 18121.480 NG00 4 f 9 6 s 2 6 H° 9 / 2 _ 4 f 9 6 s 2 6 H° 7 / 2 _ 4 f 9 6 s 2 6 H° 5 / 2 _ 4 f 1 0 (5 I)6 p ° 1 5 / 2 25192.039 NG00 4 f 9 (6 H°)5 d 2 (3 P) ° 1 7 / 2 25343.427 NG00 4 f 1 0 (5 I)6 p ° 1 7 / 2 25818.435 NG00 4 f 9 (6 H°)5 d 2 (3 P) ° 1 5 / 2 27435.132 NG00 4 f 9 (6 H°)5 d 2 (3 F) ° 1 5 / 2 27885.593 NG00 4 f 9 (6 H°)5 d 2 (1 G) ° 1 7 / 2 28252.357 NG00 4 f 1 0 (5 I)6 p 6 K° 1 9 / 2 28306.843 NG00 4 f 1 0 (5 I)6 p ° 1 5 / 2 28885.393 NG00 4 f 1 0 (5 I)6 p 6 I° 1 7 / 2 29336.093 NG00 4 f 1 0 (5 I)6 p ° 1 5 / 2 29436.610 NG00 4 f 1 0 (5 I)6 p 4 H° 1 3 / 2 30361.810 NG00 4 f 9 (6 H°)5 d 2 (3 F) ° 1 5 / 2 30399.107 NG00 4 f 1 0 (5 I)6 p 6 K° 1 7 / 2 31879.655 NG00 4 f 9 (6 H°)5 d 2 (3 F) ° 1 7 / 2 32613.423 NG00 Dy III (5 I 8) Limit 94100 MZH78

Energy Levels of Singly Ionized Erbium (Er II)

Energy Levels of Singly Ionized Erbium (Er II)

Configuration Term J Level(cm -1) Ref. 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 0.000 MZH78 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 1 / 2 440.434 MZH78 4 f 1 2 (3 F 4)6 s 1 / 2 (4, 1 / 2) 9 / 2 5132.608 MZH78 4 f 1 2 (3 F 4)6 s 1 / 2 (4, 1 / 2) 7 / 2 5403.688 MZH78 4 f 1 1 6 s 2 4 I° 1 5 / 2 6824.774 MZH78 4 f 1 1 6 s 2 4 I° 1 3 / 2 13338.777 MZH78 4 f 1 1 6 s 2 4 I° 1 1 / 2 16948.197 MZH78 4 f 1 1 6 s 2 4 I° 9 / 2 _ 4 f 1 2 (3 H 5)6 s 1 / 2 (5, 1 / 2) 1 1 / 2 7149.630 MZH78 4 f 1 2 (3 H 5)6 s 1 / 2 (5, 1 / 2) 9 / 2 7195.355 MZH78 4 f 1 1 (4 I°)5 d 6 s ° 1 3 / 2 10667.186 MZH78 4 f 1 2 (3 H 4)6 s 1 / 2 (4, 1 / 2) 7 / 2 10893.936 MZH78 4 f 1 2 (3 H 4)6 s 1 / 2 (4, 1 / 2) 9 / 2 11042.640 MZH78 ° 1 1 / 2 25382.379 MZH78 4 f 1 2 (3 H 6)6 p 1 / 2 ? (6, 1 / 2)°? 1 1 / 2 25592.343 MZH78 4 f 1 2 (3 H 6)6 p 1 / 2 ? (6, 1 / 2)°? 1 3 / 2 26098.972 MZH78 ° 1 3 / 2 27513.555 MZH78 ° 1 1 / 2 27642.658 MZH78 4 f 1 2 (3 H 6)6 p 3 / 2 ? (6, 3 / 2)°? 9 / 2 29011.015 MZH78 4 f 1 2 (3 H 6)6 p 3 / 2 ? (6, 3 / 2)°? 1 1 / 2 29492.329 MZH78 4 f 1 2 (3 H 6)6 p 3 / 2 ? (6, 3 / 2)°? 1 5 / 2 29640.863 MZH78 4 f 1 2 (3 H 6)6 p 3 / 2 ? (6, 3 / 2)°? 1 3 / 2 30621.102 MZH78 ° 1 5 / 2 29472.789 MZH78 ° 1 1 / 2 31385.667 MZH78 Er III (3 H 6) Limit 96200 SR65

Energy Levels of Singly Ionized Hafnium (Hf II)

Energy Levels of Singly Ionized Hafnium (Hf II)

Configuration Term J Level(cm -1) Ref. 5 d 6 s 2 2 D 3 / 2 0.00 M58 5 d 6 s 2 2 D 5 / 2 3050.88 M58 5 d 2 (3 F)6 s 4 F 3 / 2 3644.65 M58 5 d 2 (3 F)6 s 4 F 5 / 2 4904.85 M58 5 d 2 (3 F)6 s 4 F 7 / 2 6344.34 M58 5 d 2 (3 F)6 s 4 F 9 / 2 8361.76 M58 5 d 2 (3 P)6 s 4 P 5 / 2 13485.56 M58 5 d 6 s (3 D)6 p 4 F° 3 / 2 28068.79 M58 5 d 6 s (3 D)6 p 4 F° 5 / 2 29405.12 M58 5 d 6 s (3 D)6 p 4 F° 7 / 2 33776.24 M58 5 d 6 s (3 D)6 p 4 F° 9 / 2 38185.67 M58 5 d 6 s (3 D)6 p 2 P° 3 / 2 42770.6 M58 5 d 2 (3 F)6 p 4 F° 9 / 2 46124.89 M58 5 d 2 (3 F)6 p 4 G° 5 / 2 34942.36 M58 5 d 2 (3 F)6 p 4 G° 7 / 2 38498.53 M58 5 d 2 (3 F)6 p 4 G° 9 / 2 42391.09 M58 5 d 2 (3 F)6 p 4 G° 1 1 / 2 46209.05 M58 5 d 2 (3 P)6 p 4 D° 3 / 2 52717.46 M58 5 d 2 (1 G)6 p 2 F° 5 / 2 62774.9 M58 Hf III (3 F 2) Limit 120000 M58

Energy Levels of Singly Ionized Holmium (Ho II)

Energy Levels of Singly Ionized Holmium (Ho II)

Configuration Term J Level(cm -1) Ref. 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 0.00 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 637.40 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 7 5617.04 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 6 5849.74 MZH78 4 f 1 1 (4 I° 1 1 / 2)6 s 1 / 2 (1 1 / 2 , 1 / 2)° 5 8850.55 MZH78 4 f 1 1 (4 I° 1 1 / 2)6 s 1 / 2 (1 1 / 2 , 1 / 2)° 6 9001.65 MZH78 4 f 1 1 (4 I° 9 / 2)6 s 1 / 2 (9 / 2 , 1 / 2)° 4 10838.85 MZH78 4 f 1 1 (4 I° 9 / 2)6 s 1 / 2 (9 / 2 , 1 / 2)° 5 11204.50 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 3 / 2 (1 5 / 2 , 3 / 2)° 6 16281.60 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 3 / 2 (1 5 / 2 , 3 / 2)° 7 16748.98 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 3 / 2 (1 5 / 2 , 3 / 2)° 9 17713.75 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 3 / 2 (1 5 / 2 , 3 / 2)° 8 18404.87 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 (1 5 / 2 , 5 / 2)° 10 18258.95 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 (1 5 / 2 , 5 / 2)° 9 19111.47 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 (1 5 / 2 , 5 / 2)° 5 19882.92 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 (1 5 / 2 , 5 / 2)° 8 20029.35 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 (1 5 / 2 , 5 / 2)° 6 20314.90 MZH78 4 f 1 1 (4 I° 1 5 / 2)5 d 5 / 2 (1 5 / 2 , 5 / 2)° 7 20492.00 MZH78 ° 5 19000.54 MZH78 7,8 21688.7 MZH78 7 24712.0 MZH78 7,8 26008.3 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 7 26234.19 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 8 26330.85 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 9 28926.70 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 8 29412.38 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 6 29588.49 MZH78 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 7 29899.21 MZH78 6 29074.26 MZH78 7,8 29275.0 MZH78 7,8 29325.2 MZH78 7 29810.85 MZH78 7,8 30884.7 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 p 1 / 2 (1 3 / 2 , 1 / 2) 6 31505.0 MZH78 4 f 1 1 (4 I° 1 3 / 2)6 p 1 / 2 (1 3 / 2 , 1 / 2) 7 31556.3 MZH78 Ho III (4 I° 1 5 / 2) Limit 95200 MZH78

Energy Levels of Singly Ionized Lutetium (Lu II)

Energy Levels of Singly Ionized Lutetium (Lu II)

Configuration Term J Level(cm -1) Ref. 6 s 2 1 S 0 0.00 MZH78 5 d 6 s 3 D 1 11796.24 MZH78 5 d 6 s 3 D 2 12435.32 MZH78 5 d 6 s 3 D 3 14199.08 MZH78 5 d 6 s 1 D 2 17332.58 MZH78 6 s 6 p 3 P° 0 27264.40 MZH78 6 s 6 p 3 P° 1 28503.16 MZH78 6 s 6 p 3 P° 2 32453.26 MZH78 5 d 2 3 F 2 29406.70 MZH78 3 30889.09 MZH78 4 32503.62 MZH78 5 d 2 3 P 0 35652.1 MZH78 1 36557.05 MZH78 2 38574.94 MZH78 5 d 2 2 36098.18 MZH78 6 s 6 p 1 P° 1 38223.49 MZH78 5 d 6 p 3 F° 2 41224.96 MZH78 5 d 6 p 3 F° 3 44918.68 MZH78 5 d 6 p 3 F° 4 48536.83 MZH78 5 d 6 p 1 D° 2 45458.56 MZH78 5 d 6 p 3 D° 1 45532.33 MZH78 5 d 6 p 3 D° 2 46904.38 MZH78 5 d 6 p 3 D° 3 48733.19 MZH78 5 d 6 p 3 P° 0 49963.58 MZH78 5 d 6 p 3 P° 1 50049.20 MZH78 5 d 6 p 3 P° 2 51201.66 MZH78 5 d 6 p 1 F° 3 53079.33 MZH78 5 d 6 p 1 P° 1 59122.4 MZH78 6 s 7 s 3 S 1 63774.3 MZH78 6 s 7 s 1 S 0 68988.80 MZH78 Lu III (2 S 1 / 2) Limit 112000 MZH78

Energy Levels of Singly Ionized Tantalum (Ta II)

Energy Levels of Singly Ionized Tantalum (Ta II)

Configuration Term J Level(cm -1) Ref. 5 d 3 (4 F)6 s 5 F 1 0.00 K62a 5 d 3 (4 F)6 s 5 F 2 1031.36 K62a 5 d 3 (4 F)6 s 5 F 3 2642.26 K62a 5 d 3 (4 F)6 s 5 F 4 4415.79 K62a 5 d 3 (4 F)6 s 5 F 5 6186.81 K62a 5 d 2 6 s 2 3 F 2 3180.04 K62a 5 d 2 6 s 2 3 F 3 6831.31 K62a 5 d 2 6 s 2 3 F 4 9746.28 K62a 5 d 2 6 s 2 3 P 0 4124.85 K62a 5 d 2 6 s 2 3 P 1 5330.77 K62a 5 d 2 6 s 2 3 P 2 5657.90 K62a 5 d 3 (4 F)6 s 3 F 2 9690.47 K62a 5 d 3 (4 F)6 s 3 F 3 14581.07 K62a 5 d 3 (4 F)6 s 3 F 4 18493.66 K62a 1° 2 37230.75 K62a 2° 2 38515.55 K62a 3° 3 38962.32 K62a 4° 1 41355.11 K62a 5° 1 45233.91 K62a 6° 2 45446.85 K62a 7° 5 46295.03 K62a 8° 4 47280.89 K62a 9° 1 47595.98 K62a 10° 6 47829.75 K62a 11° 2 49055.18 K62a 12° 3 49646.62 K62a 13° 4 49937.74 K62a Ta III (4 F 3 / 2) Limit

Energy Levels of Singly Ionized Thulium (Tm II)

Energy Levels of Singly Ionized Thulium (Tm II)

Configuration Term J Level(cm -1) Ref. 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 0.00 MZH78 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 236.95 MZH78 4 f 1 3 (2 F° 5 / 2)6 s 1 / 2 (5 / 2 , 1 / 2)° 2 8769.68 MZH78 4 f 1 3 (2 F° 5 / 2)6 s 1 / 2 (5 / 2 , 1 / 2)° 3 8957.47 MZH78 4 f 1 2 (3 H)6 s 2 3 H 6 12457.29 MZH78 4 f 1 2 (3 H)6 s 2 3 H 5 20619.05 MZH78 4 f 1 2 (3 H)6 s 2 3 H 4 24932.00 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 1) (6,1) 5 16567.47 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 1) (6,1) 7 19619.08 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 1) (6,1) 6 22355.43 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 3 / 2 (7 / 2 , 3 / 2)° 2 17624.65 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 3 / 2 (7 / 2 , 3 / 2)° 5 20228.75 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 3 / 2 (7 / 2 , 3 / 2)° 3 21713.74 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 3 / 2 (7 / 2 , 3 / 2)° 4 22457.51 MZH78 4 f 1 2 (3 F)6 s 2 3 F 4 17974.30 MZH78 4 f 1 2 (3 F)6 s 2 3 F 3 26578.77 MZH78 4 f 1 2 (3 F)6 s 2 3 F 2 _ 4 f 1 2 (3 H 6)5 d 6 s (3 D 2) (6,2) 4 18291.37 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 2) (6,2) 6 19526.82 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 2) (6,2) 8 19682.97 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 2) (6,2) 7 22052.39 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 3) (6,3) 9 20465.82 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 3) (6,3) 3 21608.26 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 3) (6,3) 8 23024.29 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 3) (6,3) 5 23768.84 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 3) (6,3) 6 23904.43 MZH78 4 f 1 2 (3 H 6)5 d 6 s (3 D 3) (6,3) 7 23961.60 MZH78 4 f 1 2 5 d 6 s 5 21021.98 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 (7 / 2 , 5 / 2)° 6 21133.68 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 (7 / 2 , 5 / 2)° 2 21978.77 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 (7 / 2 , 5 / 2)° 1 22141.96 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 (7 / 2 , 5 / 2)° 4 23524.09 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 (7 / 2 , 5 / 2)° 3 23934.73 MZH78 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 (7 / 2 , 5 / 2)° 5 24273.20 MZH78 4 f 1 2 5 d 6 s 4 22308.82 MZH78 4 f 1 2 5 d 6 s 4 23803.28 MZH78 4 f 1 3 6 p 3 25980.02 MZH78 4 f 1 2 5 d 6 s 4 26574.66 MZH78 4 f 1 2 5 d 6 s 4 27009.39 MZH78 4 f 1 2 5 d 6 s 4 27254.42 MZH78 4 f 1 2 5 d 6 s 5 28875.12 MZH78 4 f 1 2 5 d 6 s 4 29183.39 MZH78 4 f 1 3 6 p 2 29285.72 MZH78 4 f 1 2 5 d 6 s 3 29424.98 MZH78 4 f 1 2 5 d 6 s 2 29967.17 MZH78 4 f 1 2 5 d 6 s 5 31926.82 MZH78 Tm III (2 F° 7 / 2) Limit 92700 SR65

Energy Levels of Singly Ionized Tungsten (W II)

Energy Levels of Singly Ionized Tungsten (W II)

Configuration Term J Level(cm -1) Ref. 5 d 4 (5 D)6 s 6 D 1 / 2 0.000 EKM00 5 d 4 (5 D)6 s 6 D 3 / 2 1518.829 EKM00 5 d 4 (5 D)6 s 6 D 5 / 2 3172.473 EKM00 5 d 4 (5 D)6 s 6 D 7 / 2 4716.278 EKM00 5 d 4 (5 D)6 s 6 D 9 / 2 6147.085 EKM00 5 d 5 6 S 5 / 2 7420.261 EKM00 5 d 4 (a 3 F)6 s 4 F 3 / 2 8711.274 EKM00 5 d 4 (a 3 F)6 s 4 F 5 / 2 11301.024 EKM00 5 d 4 (a 3 F)6 s 4 F 7 / 2 13411.939 EKM00 1 9 / 2 14857.160 EKM00 5 d 4 6 p 1° 1 / 2 36165.356 EKM00 2° 3 / 2 39129.460 EKM00 5 d 4 (5 D)6 p 3° 3 / 2 42298.223 EKM00 5 d 3 (4 F)6 s 6 p 6 F° 1 / 2 44455.212 EKM00 4° 5 / 2 49242.042 EKM00 5° 3 / 2 51254.429 EKM00 5 d 4 (5 D)6 p 6 F° 1 1 / 2 51495.054 EKM00 6° 5 / 2 53113.533 EKM00 7° 9 / 2 54056.594 EKM00 8° 3 / 2 54137.225 EKM00 9° 1 1 / 2 54229.082 EKM00 10° 7 / 2 54498.608 EKM00 11° 9 / 2 55392.446 EKM00 12° 9 / 2 56413.649 EKM00 W III (5 D 0) Limit 130000 MH84

Energy Levels of Singly Ionized Ytterbium (Yb II)

Energy Levels of Singly Ionized Ytterbium (Yb II)

Configuration Term J Level(cm -1) Ref. 4 f 1 4 (1 S)6 s 2 S 1 / 2 0.00 M67 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 21418.75 M67 4 f 1 3 (2 F°)6 s 2 2 F° 5 / 2 31568.08 M67 4 f 1 4 (1 S)5 d 2 D 3 / 2 22960.80 M67 4 f 1 4 (1 S)5 d 2 D 5 / 2 24332.69 M67 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [3 / 2]° 5 / 2 26759.02 M67 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [3 / 2]° 3 / 2 28757.98 M67 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [3 / 2]° 1 / 2 33653.86 M67 4 f 1 4 (1 S)6 p 2 P° 1 / 2 27061.82 M67 4 f 1 4 (1 S)6 p 2 P° 3 / 2 30392.23 M67 4 f 1 3 (2 F° 7 / 2)5 d 6 s (1 D) 1 [3 / 2]° 3 / 2 34575.37 M67 4 f 1 3 (2 F° 5 / 2)5 d 6 s (3 D) ° 3 / 2 44940.61 M67 4 f 1 3 (2 F° 7 / 2)5 d 2 (3 F) ° 3 / 2 45737.29 M67 4 f 1 3 (2 F° 5 / 2)5 d 6 s (1 D) 1 [3 / 2]° 3 / 2 47005.46 M67 4 f 1 3 (2 F° 5 / 2)5 d 6 s (1 D) 1 [1 / 2]° 1 / 2 47228.96 M67 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) (7 / 2 ,1) 9 / 2 57765.32 M67 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) 7 / 2 59090.13 M67 Yb III (1 S 0) Limit 98207 SK79

Energy Levels of Singly Ionized Astatine (At II)

Energy Levels of Singly Ionized Astatine (At II)

Sorry! No data are available.

Energy Levels of Singly Ionized Bismuth (Bi II)

Energy Levels of Singly Ionized Bismuth (Bi II)

Configuration Term J Level(cm -1) Ref. 6 p 2 (1 / 2 , 1 / 2) 0 0.000 DLW02 6 p 2 (3 / 2 , 1 / 2) 1 13325.401 DLW02 6 p 2 (3 / 2 , 1 / 2) 2 17031.698 DLW02 6 p 2 (3 / 2 , 3 / 2) 2 33938.718 DLW02 6 p 2 (3 / 2 , 3 / 2) 0 44173.768 DLW02 6 p 7 s (1 / 2 , 1 / 2)° 0 69133.891 DLW02 6 p 7 s (1 / 2 , 1 / 2)° 1 69598.475 DLW02 6 s 6 p 3 5 S° 2 76148.712 DLW02 6 p 6 d (1 / 2 , 3 / 2)° 2 79091.141 DLW02 6 p 6 d (1 / 2 , 3 / 2)° 1 80577.071 DLW02 6 p 6 d (1 / 2 , 5 / 2)° 2 82049.632 DLW02 6 p 6 d (1 / 2 , 5 / 2)° 3 82257.251 DLW02 6 p 7 p (1 / 2 , 1 / 2) 1 84280.446 DLW02 6 p 7 p (1 / 2 , 1 / 2) 0 87078.777 DLW02 6 p 7 p (1 / 2 , 3 / 2) 1 88566.685 DLW02 6 p 7 p (1 / 2 , 3 / 2) 2 88789.478 DLW02 6 p 7 s (3 / 2 , 1 / 2)° 2 88771.443 DLW02 6 p 7 s (3 / 2 , 1 / 2)° 1 89885.675 DLW02 6 s 6 p 3 3 D° 1 94442.227 DLW02 6 s 6 p 3 3 D° 2 94930.640 DLW02 6 s 6 p 3 3 D° 3 96062.356 DLW02 6 p 5 f (1 / 2 , 7 / 2) 3 105289.732 DLW02 6 p 5 f (1 / 2 , 7 / 2) 4 105728.060 DLW02 6 p 5 f (1 / 2 , 5 / 2) 3 105451.045 DLW02 6 p 7 d (1 / 2 , 3 / 2)° 2 105527.197 DLW02 6 p 7 p (3 / 2 , 3 / 2) 3 108280.656 DLW02 Bi III (2 P° 1 / 2) Limit 134720 JM86

Energy Levels of Singly Ionized Gold (Au II)

Energy Levels of Singly Ionized Gold (Au II)

Configuration Term J Level(cm -1) Ref. 5 d 1 0 1 S 0 0.00 RW97 5 d 9 (2 D 5 / 2)6 s (5 / 2 , 1 / 2) 3 15039.572 RW97 5 d 9 (2 D 5 / 2)6 s (5 / 2 , 1 / 2) 2 17640.616 RW97 5 d 9 (2 D 3 / 2)6 s (3 / 2 , 1 / 2) 1 27765.758 RW97 5 d 9 (2 D 3 / 2)6 s (3 / 2 , 1 / 2) 2 29621.249 RW97 5 d 8 6 s 2 3 F 4 40478.750 RW97 5 d 8 6 s 2 3 F 3 52176.508 RW97 5 d 8 6 s 2 1 2 48510.894 RW97 5 d 8 6 s 2 2 2 58191.630 RW97 5 d 8 6 s 2 3 P 0 58550.226 RW97 5 d 8 6 s 2 3 P 1 61749.419 RW97 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 1 / 2)° 2 63053.318 RW97 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 1 / 2)° 3 65003.594 RW97 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 3 / 2)° 4 72495.129 RW97 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 3 / 2)° 2 73178.291 RW97 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 3 / 2)° 1 73403.839 RW97 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 3 / 2)° 3 74791.477 RW97 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 1 / 2)° 2 76659.700 RW97 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 1 / 2)° 1 81659.828 RW97 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 3 / 2)° 0 82613.781 RW97 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 3 / 2)° 3 85700.201 RW97 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 3 / 2)° 1 85707.570 RW97 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 3 / 2)° 2 86565.667 RW97 5 d 9 (2 D 5 / 2)7 s (5 / 2 , 1 / 2) 3 108172.952 RW97 5 d 9 (2 D 5 / 2)7 s (5 / 2 , 1 / 2) 2 108631.442 RW97 5 d 9 (2 D 5 / 2)6 d (5 / 2 , 3 / 2) 1 116050.55 RW97 5 d 9 (2 D 5 / 2)6 d (5 / 2 , 3 / 2) 4 116946.327 RW97 5 d 9 (2 D 5 / 2)6 d (5 / 2 , 3 / 2) 2 117065.629 RW97 5 d 9 (2 D 5 / 2)6 d (5 / 2 , 3 / 2) 3 117511.998 RW97 5 d 9 (2 D 5 / 2)7 p (5 / 2 , 1 / 2)° 2 119446.50 RW97 5 d 9 (2 D 5 / 2)7 p (5 / 2 , 1 / 2)° 3 120257.120 RW97 5 d 9 (2 D 3 / 2)7 s (3 / 2 , 1 / 2) 1 120822.927 RW97 5 d 9 (2 D 3 / 2)7 s (3 / 2 , 1 / 2) 2 121118.779 RW97 Au III (2 D 5 / 2) Limit 162950 RW97

Energy Levels of Singly Ionized Iridium (Ir II)

Energy Levels of Singly Ionized Iridium (Ir II)

Configuration Term J Level(cm -1) Ref. 5 d 7 (4 F)6 s 5 F 5 0.00 KM78 5 d 7 (4 F)6 s 5 F 4 4787.93 KM78 5 d 7 (4 F)6 s 5 F 3 8186.96 KM78 5 d 7 (4 F)6 s 5 F 2 11307.32 KM78 5 d 7 (4 F)6 s 5 F 1 11957.70 KM78 5 d 8 3 F 4 2262.75 KM78 5 d 8 3 F 3 9927.83 KM78 5 d 8 3 F 2 17413.24 KM78 a 3 P 2 3090.17 KM78 a 3 P 1 9062.14 KM78 a 3 P 0 11211.93 KM78 1 2 8975.01 KM78 2 4 11719.09 KM78 5 d 7 (4 P)6 s 5 P 3 12714.64 KM78 5 d 7 (4 P)6 s 5 P 2 15676.35 KM78 5 d 7 (4 P)6 s 5 P 1 18676.50 KM78 5 d 6 6 s 2 5 D 4 17210.14 KM78 5 d 7 (2 G)6 s 3 G 5 17477.92 KM78 5 d 7 (4 F)6 s 3 F 3 17499.29 KM78 5 d 7 (4 F 9 / 2)6 p 1 / 2 (9 / 2 , 1 / 2)° 4 44575.66 KM78 5 d 7 (4 F 9 / 2)6 p 1 / 2 (9 / 2 , 1 / 2)° 5 47003.98 KM78 5 d 7 (4 F 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2)° 3 51226.62 KM78 5 d 7 (4 F 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2)° 4 53525.25 KM78 Ir III (4 F 9 / 2) Limit

Energy Levels of Singly Ionized Lead (Pb II)

Energy Levels of Singly Ionized Lead (Pb II)

Configuration Term J Level(cm -1) Ref. 6 s 2 6 p 2 P° 1 / 2 0.000 WRSH74 6 s 2 6 p 2 P° 3 / 2 14081.074 WRSH74 6 s 6 p 2 4 P 1 / 2 57910.48 WRSH74 6 s 6 p 2 4 P 3 / 2 66124.53 WRSH74 6 s 6 p 2 4 P 5 / 2 73905.708 WRSH74 6 s 2 7 s 2 S 1 / 2 59448.56 WRSH74 6 s 2 6 d 2 D 5 / 2 68964.310 WRSH74 6 s 2 6 d 2 D 3 / 2 69739.603 WRSH74 6 s 2 7 p 2 P° 1 / 2 74458.99 WRSH74 6 s 2 7 p 2 P° 3 / 2 77272.57 WRSH74 6 s 6 p 2 2 D 5 / 2 88972.16 WRSH74 6 s 2 8 s 2 S 1 / 2 89180.18 WRSH74 6 s 2 5 f 2 F° 7 / 2 92515.24 WRSH74 6 s 2 5 f 2 F° 5 / 2 92530.66 WRSH74 6 s 2 7 d 2 D 3 / 2 94284.58 WRSH74 6 s 2 7 d 2 D 5 / 2 95304.25 WRSH74 6 s 2 6 g 2 G 9 / 2 108969.58 WRSH74 6 s 2 6 g 2 G 7 / 2 108969.67 WRSH74 Pb III (1 S 0) Limit 121245.14 RWS76

Energy Levels of Singly Ionized Mercury (Hg II)

Energy Levels of Singly Ionized Mercury (Hg II)

Configuration Term J Level(cm -1) Ref. 5 d 1 0 (1 S)6 s 2 S 1 / 2 0.000 SR01 5 d 9 6 s 2 2 D 5 / 2 35514.624 SR01 5 d 9 6 s 2 2 D 3 / 2 50555.567 SR01 5 d 1 0 (1 S)6 p 2 P° 1 / 2 51486.070 SR01 5 d 1 0 (1 S)6 p 2 P° 3 / 2 60608.362 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 0) (5 / 2 ,0)° 5 / 2 79705.262 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 1) (5 / 2 ,1)° 7 / 2 84212.404 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 1) (5 / 2 ,1)° 5 / 2 84836.143 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 1) (5 / 2 ,1)° 3 / 2 86178.478 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 9 / 2 91139.508 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 3 / 2 94092.834 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 7 / 2 95187.361 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 5 / 2 95304.138 SR01 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 2) (5 / 2 ,2)° 1 / 2 96187.932 SR01 5 d 1 0 (1 S)7 s 2 S 1 / 2 95714.406 SR01 5 d 1 0 (1 S)6 d 2 D 3 / 2 104984.138 SR01 5 d 1 0 (1 S)6 d 2 D 5 / 2 105544.042 SR01 5 d 1 0 (1 S)7 p 2 P° 1 / 2 108298.183 SR01 5 d 1 0 (1 S)7 p 2 P° 3 / 2 111971.464 SR01 5 d 1 0 (1 S)5 f 2 F° 7 / 2 123153.775 SR01 5 d 1 0 (1 S)5 f 2 F° 5 / 2 123411.351 SR01 Hg III (1 S 0) Limit 151284.4 SR01

Energy Levels of Singly Ionized Osmium (Os II)

Energy Levels of Singly Ionized Osmium (Os II)

Configuration Term J Level(cm -1) Ref. 5 d 6 (5 D)6 s 6 D 9 / 2 0.00 KK61 5 d 6 (5 D)6 s 6 D 7 / 2 3593.15 KK61 5 d 6 (5 D)6 s 6 D 5 / 2 3928.94 KK61 5 d 6 (5 D)6 s 6 D 3 / 2 5592.05 KK61 5 d 6 (5 D)6 s 6 D 1 / 2 6636.57 KK61 5 d 5 6 s 2 6 S 5 / 2 7891.93 KK61 5 d 6 (5 D)6 s 4 D 7 / 2 11459.90 KK61 5 d 6 (5 D)6 s 4 D 5 / 2 11654.08 KK61 5 d 6 (5 D)6 s 4 D 3 / 2 13136.61 KK61 5 d 5 6 s (7 S)6 p 8 P° 5 / 2 37321.53 KK61 5 d 5 6 s (7 S)6 p 8 P° 7 / 2 39389.49 KK61 5 d 5 6 s (7 S)6 p 8 P° 9 / 2 41282.95 KK61 5 d 6 (5 D)6 p 6 D° 7 / 2 43802.36 KK61 5 d 6 (5 D)6 p 6 D° 9 / 2 44315.40 KK61 5 d 6 (5 D)6 p 6 D° 3 / 2 46157.19 KK61 5 d 6 (5 D)6 p 6 D° 5 / 2 46373.51 KK61 5 d 6 (5 D)6 p 6 F° 5 / 2 48798.70 KK61 5 d 6 (5 D)6 p 6 F° 9 / 2 51951.61 KK61 5 d 6 (5 D)6 p 6 F° 7 / 2 52206.48 KK61 5 d 5 6 s (7 S)6 p 6 P° 7 / 2 49149.39 KK61 Os III (5 D 4) Limit

Energy Levels of Singly Ionized Platinum (Pt II)

Energy Levels of Singly Ionized Platinum (Pt II)

Configuration Term J Level(cm -1) Ref. 5 d 9 2 D 5 / 2 .000 BW92a 5 d 9 2 D 3 / 2 8419.822 BW92a 5 d 8 (3 F)6 s 4 F 9 / 2 4786.611 BW92a 5 d 8 (3 F)6 s 4 F 7 / 2 9356.274 BW92a 5 d 8 (3 F)6 s 4 F 5 / 2 16820.894 BW92a 5 d 8 (3 F)6 s 4 F 3 / 2 21168.684 BW92a 5 d 8 (3 P)6 s 4 P 5 / 2 13329.227 BW92a 5 d 8 (3 P)6 s 4 P 1 / 2 21717.260 BW92a 5 d 8 (3 P)6 s 4 P 3 / 2 23875.553 BW92a 5 d 8 (1 D)6 s 2 D 3 / 2 15791.276 BW92a 5 d 8 (3 F)6 s 2 F 7 / 2 18097.715 BW92a 5 d 8 (3 F)6 s 2 F 5 / 2 23461.503 BW92a 5 d 7 6 s 2 4 F 9 / 2 24879.480 BW92a 5 d 7 6 s 2 4 F 7 / 2 34647.221 BW92a 5 d 7 6 s 2 4 F 5 / 2 36484.028 BW92a 5 d 7 6 s 2 4 F 3 / 2 37877.792 BW92a 5 d 8 (3 P)6 s 2 P 1 / 2 27255.687 BW92a 5 d 8 (1 G)6 s 2 G 7 / 2 29030.479 BW92a 5 d 8 (1 G)6 s 2 G 9 / 2 29261.967 BW92a 5 d 8 (1 D)6 s 2 D 3 / 2 32237.007 BW92a 5 d 8 (1 D)6 s 2 D 5 / 2 32918.561 BW92a 5 d 8 (3 F 4)6 p 1 / 2 (4, 1 / 2)° 7 / 2 51408.370 BW92a 5 d 8 (3 F 4)6 p 1 / 2 (4, 1 / 2)° 9 / 2 53875.493 BW92a 5 d 8 (3 P 2)6 p 1 / 2 (2, 1 / 2)° 3 / 2 56587.934 BW92a 5 d 8 (3 P 2)6 p 1 / 2 (2, 1 / 2)° 5 / 2 57018.130 BW92a 5 d 8 (3 F 4)6 p 3 / 2 (4, 3 / 2)° 9 / 2 60907.688 BW92a 5 d 8 (3 F 4)6 p 3 / 2 (4, 3 / 2)° 1 1 / 2 61058.490 BW92a 5 d 8 (3 F 4)6 p 3 / 2 (4, 3 / 2)° 5 / 2 61190.026 BW92a 5 d 8 (3 F 4)6 p 3 / 2 (4, 3 / 2)° 7 / 2 61665.485 BW92a 5 d 8 (3 P 2)6 p 3 / 2 (2, 3 / 2)° 1 / 2 62781.658 BW92a 5 d 8 (3 P 2)6 p 3 / 2 (2, 3 / 2)° 5 / 2 65351.069 BW92a 5 d 8 (3 P 2)6 p 3 / 2 (2, 3 / 2)° 3 / 2 66028.014 BW92a 5 d 8 (3 P 2)6 p 3 / 2 (2, 3 / 2)° 7 / 2 66434.315 BW92a 5 d 7 (4 F 9 / 2)6 s 6 p (3 P° 0) (9 / 2 ,0)° 9 / 2 62820.489 BW92a 5 d 7 (4 F 9 / 2)6 s 6 p (3 P° 1) (9 / 2 ,1)° 1 1 / 2 65046.23 BW92a 5 d 8 (3 F 3)6 p 1 / 2 (3, 1 / 2)° 7 / 2 63738.841 BW92a 5 d 8 (3 F 3)6 p 1 / 2 (3, 1 / 2)° 5 / 2 64757.343 BW92a 5 d 8 (3 F 2)6 p 1 / 2 (2, 1 / 2)° 3 / 2 64388.642 BW92a 5 d 8 (3 P 0)6 p 1 / 2 (0, 1 / 2)° 1 / 2 65587.115 BW92a 5 d 8 (1 D)7 s 2 D 5 / 2 101199.085 BW92a 5 d 8 (1 D)7 s 2 D 3 / 2 101517.59 BW92a Pt III (3 F 4) Limit 149723 S38b

Energy Levels of Singly Ionized Polonium (Po II)

Energy Levels of Singly Ionized Polonium (Po II)

Sorry! No data are available.

Energy Levels of Singly Ionized Rhenium (Re II)

Energy Levels of Singly Ionized Rhenium (Re II)

Configuration Term J Level(cm -1) Ref. 5 d 5 (6 S)6 s 7 S 3 0.000 WJLG97 5 d 4 6 s 2 1 0 13777.3 MCS58 5 d 5 (4 D)6 s 2 2 14352.2 MCS58 5 d 5 (4 D)6 s 3 1 14824.0 MCS58 5 d 6 5 D 4 14882.6 MCS58 5 d 5 (4 D)6 s 4 3 14930.5 MCS58 5 d 5 (6 S)6 s 5 S 2 17223.5 MCS58 5 d 5 (4 G)6 s 5 G 2 18845.8 MCS58 5 d 5 (4 G)6 s 5 G 3 19139.7 MCS58 5 d 5 (4 G)6 s 5 G 4 20463.2 MCS58 5 d 5 (4 G)6 s 5 G 6 20781.5 MCS58 5 d 5 (4 G)6 s 5 G 5 20976.4 MCS58 5 d 4 6 s (6 D)6 p 7 P° 2 43937.578 WJLG97 5 d 4 6 s (6 D)6 p 7 P° 3 45147.445 WJLG97 5 d 4 6 s (6 D)6 p 7 P° 4 50680.795 WJLG97 10° 2 52677.0 MCS58 11° 3 53802.1 MCS58 12° 5 60926.8 MCS58 Re III (6 S 5 / 2) Limit

Energy Levels of Singly Ionized Thallium (Tl II)

Energy Levels of Singly Ionized Thallium (Tl II)

Configuration Term J Level(cm -1) Ref. 5 d 1 0 6 s 2 1 S 0 0.00 JKBL96 5 d 1 0 6 s 6 p 3 P° 0 49451.45 JKBL96 5 d 1 0 6 s 6 p 3 P° 1 52393.96 JKBL96 5 d 1 0 6 s 6 p 3 P° 2 61727.68 JKBL96 5 d 1 0 6 s 6 p 1 P° 1 75663.33 JKBL96 5 d 1 0 6 s 7 s 3 S 1 105229.28 JKBL96 5 d 1 0 6 s 7 s 1 S 0 107999.96 JKBL96 5 d 1 0 6 s 6 d 1 D 2 115165.60 JKBL96 5 d 1 0 6 s 6 d 3 D 1 116152.00 JKBL96 5 d 1 0 6 s 6 d 3 D 2 116436.16 JKBL96 5 d 1 0 6 s 6 d 3 D 3 116830.90 JKBL96 5 d 1 0 6 s 7 p 3 P° 0 119361. ES36 5 d 1 0 6 s 7 p 3 P° 1 119576. ES36 5 d 1 0 6 s 7 p 3 P° 2 122029. ES36 5 d 1 0 6 s 5 f 3 F° 3 136115. ES36 5 d 1 0 6 s 5 f 3 F° 2 136216. ES36 5 d 1 0 6 s 5 f 3 F° 4 136230. ES36 Tl III (2 S 1 / 2) Limit 164765 M58

Energy Levels of Singly Ionized Actinium (Ac II)

Energy Levels of Singly Ionized Actinium (Ac II)

Configuration Term J Level(cm -1) Ref. 7 s 2 1 S 0 0.00 MFT57 6 d 7 s 3 D 1 4739.63 MFT57 6 d 7 s 3 D 2 5267.16 MFT57 6 d 7 s 3 D 3 7426.52 MFT57 6 d 7 s 1 D 2 9087.54 MFT57 6 d 2 3 F 2 13236.46 MFT57 6 d 2 3 F 3 14949.21 MFT57 6 d 2 3 F 4 16756.90 MFT57 6 d 2 3 P 0 17737.10 MFT57 6 d 2 3 P 1 19015.32 MFT57 6 d 2 3 P 2 22199.45 MFT57 6 d 2 1 D 2 19203.02 MFT57 6 d 2 1 G 4 20848.23 MFT57 7 s 7 p 3 P° 0 20956.40 MFT57 7 s 7 p 3 P° 1 22180.52 MFT57 7 s 7 p 3 P° 2 26446.96 MFT57 6 d 7 p 3 F° 2 28201.11 MFT57 6 d 7 p ° 1 29250.40 MFT57 5 f 7 s 1 F° 3 29881.09 MFT57 6 d 7 p ° 3 31174.60 MFT57 6 d 7 p 1 D° 2 31878.87 MFT57 5 f 7 s 3 F° 4 32965.55 MFT57 6 d 7 p 3 D° 2 33304.96 MFT57 6 d 7 p 3 D° 1 33388.61 MFT57 6 d 7 p 3 D° 3 36144.35 MFT57 Ac III (7 s 2 S 1 / 2) Limit 94800 MHRS74

Energy Levels of Singly Ionized Americium (Am II)

Energy Levels of Singly Ionized Americium (Am II)

Configuration Term J Level(cm -1) Ref. 5 f 7 (8 S°)7 s 9 S° 4 0.00 BW92b 5 f 7 (8 S°)7 s 7 S° 3 2598.32 BW92b 5 f 7 (8 S°)6 d 9 D° 2,3 14222.21 BW92b 5 f 7 (8 S°)6 d 9 D° 3,4 14479.56 BW92b 5 f 7 (8 S°)6 d 9 D° 4,5 14905.50 BW92b 4 24447.22 BW92b 4 24767.76 BW92b 4 28060.74 BW92b 3 29063.30 BW92b 4 31298.50 BW92b 5 35297.13 BW92b Am III (8 S° 7 / 2) Limit

Energy Levels of Singly Ionized Francium (Fr II)

Energy Levels of Singly Ionized Francium (Fr II)

Sorry! No data are available.

Energy Levels of Singly Ionized Neptunium (Np II)

Energy Levels of Singly Ionized Neptunium (Np II)

Configuration Term J Level(cm -1) Ref. 5 f 4 6 d 7 s 7 L 5 0.000 BW92b 5 f 4 7 s 2 5 I 4 24.270 BW92b 5 f 5 (6 H° 5 / 2)7 s (5 / 2 , 1 / 2)° 2 83.490 BW92b 5 f 5 (6 H° 5 / 2)7 s (5 / 2 , 1 / 2)° 3 1053.100 BW92b 5 f 4 6 d 7 s 7 L 6 1774.150 BW92b 5 f 4 6 d 7 s 7 K 4 2473.180 BW92b 5 f 4 7 s 2 5 I 5 3836.145 BW92b 5 f 4 6 d 7 s 7 K 5 4007.270 BW92b 5 f 4 6 d 7 s 7 I 3 4209.465 BW92b 5 f 4 6 d 7 s 7 L 7 4797.670 BW92b 5 f 4 6 d 7 s 5 L 6 5068.225 BW92b 5 f 4 6 d 7 s 7 I 4 5451.830 BW92b 5 f 4 7 s 7 p ° 4 24030.585 BW92b Np III (5 f 5 6 H° 5 / 2) Limit

Energy Levels of Singly Ionized Plutonium (Pu II)

Energy Levels of Singly Ionized Plutonium (Pu II)

Configuration Term J Level(cm -1) Ref. 5 f 6 7 s 8 F 1 / 2 0.000 BW92b 5 f 6 7 s 8 F 3 / 2 2014.970 BW92b 5 f 6 7 s 8 F 5 / 2 3969.850 BW92b 5 f 6 7 s 8 F 7 / 2 5717.985 BW92b 5 f 6 7 s 8 F 9 / 2 7278.870 BW92b 5 f 6 7 s 8 F 1 1 / 2 8638.250 BW92b 5 f 6 7 s 8 F 1 3 / 2 9707.985 BW92b 5 f 6 7 s 6 F 1 / 2 3235.775 BW92b 5 f 6 7 s 6 F 3 / 2 5502.070 BW92b 5 f 6 7 s 6 F 5 / 2 7498.380 BW92b 5 f 6 7 s 6 F 7 / 2 9242.365 BW92b 5 f 6 7 s 6 F 9 / 2 10726.330 BW92b 5 f 6 7 s 6 F 1 1 / 2 11799.245 BW92b 5 f 5 7 s 2 6 H° 5 / 2 8198.665 BW92b 5 f 5 6 d 7 s 8 K° 7 / 2 8709.640 BW92b 5 f 5 6 d 7 s 8 K° 9 / 2 10436.770 BW92b 5 f 5 7 s 2 6 H° 7 / 2 11504.095 BW92b 5 f 6 7 p 8 G° 1 / 2 22038.970 BW92b ° 3 / 2 29952.07 BW92b 5 f 5 6 d 7 s ° 3 / 2 31000.03 BW92b ° 3 / 2 31255.97 BW92b 5 f 5 7 s 2 6 P° 5 / 2 32398.17 BW92b ° 1 / 2 32558.12 BW92b 5 f 6 7 p ° 5 / 2 32820.810 BW92b ° 1 / 2 33052.83 BW92b ° 3 / 2 33721.06 BW92b ° 3 / 2 33867.55 BW92b 5 f 6 7 p ° 3 / 2 34077.84 BW92b ° 5 / 2 36026.44 BW92b ° 5 / 2 37641.00 BW92b ° 9 / 2 37665.47 BW92b ° 9 / 2 39081.59 BW92b ° 1 1 / 2 39185.84 BW92b ° 1 1 / 2 39886.62 BW92b ° 1 5 / 2 43339.89 BW92b Pu III (7 F 0) Limit [90000] CNWM70

Energy Levels of Singly Ionized Protactinium (Pa II)

Energy Levels of Singly Ionized Protactinium (Pa II)

Configuration Term J Level(cm -1) Ref. 5 f 2 7 s 2 3 H 4 0.000 BW92b 5 f 2 6 d 7 s 5 K 5 823.265 BW92b 5 f 2 6 d 7 s 5 I 4 1744.800 BW92b 5 f 2 6 d 7 s 5 K 6 1764.365 BW92b 5 f 2 6 d 7 s 5 G 2 2232.135 BW92b 5 f 2 6 d 7 s 5 I 5 2555.865 BW92b 5 f 2 6 d 7 s 5 H? 3 3078.285 BW92b 5 f 2 7 s 2 3 F 2 3150.950 BW92b 5 f 2 6 d 7 s 5 H 3 4011.455 BW92b 5 f 2 7 s 2 3 H 5 4447.575 BW92b 5 f 2 6 d 7 s 5 H 4 4555.030 BW92b 5 f 2 6 d 7 s 3 I? 5 4716.445 BW92b 5 f 6 d 2 7 s 5 I° 4 4751.660 BW92b 5 f 2 6 d 7 s 4 4895.130 BW92b 5 f 2 6 d 7 s 3 K 6 4924.960 BW92b 5 f 6 d 2 7 s ° 3 5088.230 BW92b 5 f 2 6 d 7 s 5 K 7 5458.850 BW92b ° 5 23533.415 BW92b ° 5 25469.955 BW92b ° 7 30717.935 BW92b Pa III (5 f 2 (3 H)6 d 4 I° 1 1 / 2) Limit

Energy Levels of Singly Ionized Radium (Ra II)

Energy Levels of Singly Ionized Radium (Ra II)

Configuration Term J Level(cm -1) Ref. 7 s 2 S 1 / 2 0.00 M58 6 d 2 D 3 / 2 12084.38 M58 6 d 2 D 5 / 2 13743.11 M58 7 p 2 P° 1 / 2 21351.20 M58 7 p 2 P° 3 / 2 26208.86 M58 8 s 2 S 1 / 2 43405.01 M58 7 d 2 D 3 / 2 48744.04 M58 7 d 2 D 5 / 2 49240.48 M58 5 f 2 F° 5 / 2 48987.98 M58 5 f 2 F° 7 / 2 49272.31 M58 8 p 2 P° 1 / 2 50606.01 M58 8 p 2 P° 3 / 2 52392.05 M58 9 s 2 S 1 / 2 59165.23 M58 Ra III (1 S 0) Limit 81842.31 M58

Energy Levels of Singly Ionized Radon (Rn II)

Energy Levels of Singly Ionized Radon (Rn II)

Sorry! No data are available.

Energy Levels of Singly Ionized Thorium (Th II)

Energy Levels of Singly Ionized Thorium (Th II)

Configuration Term J Level(cm -1) Ref. 6 d 2 (3 F)7 s 3 / 2 0.000 BW92b 6 d 2 (3 F)7 s 4 F 5 / 2 1521.896 BW92b 6 d 2 (3 F)7 s 4 F 3 / 2 1859.938 BW92b 6 d 2 (3 F)7 s 4 F 7 / 2 4146.576 BW92b 6 d 2 (3 F)7 s 4 F 9 / 2 6213.490 BW92b 6 d (2 D)7 s 2 5 / 2 4113.359 BW92b 5 f (2 F°)7 s 2 2 F° 5 / 2 4490.262 BW92b 5 f (2 F°)7 s 2 2 F° 7 / 2 8378.859 BW92b 5 f 6 d (3 H°)7 s 4 H° 7 / 2 6168.356 BW92b 5 f 6 d (3 H°)7 s 4 H° 1 1 / 2 10189.067 BW92b 5 f 6 d (3 H°)7 s 4 H° 9 / 2 10572.041 BW92b 5 f 6 d (3 H°)7 s 4 H° 1 3 / 2 13406.433 BW92b 6 d 2 (3 P)7 s 4 P 1 / 2 6244.294 BW92b 6 d 2 (3 P)7 s 4 P 3 / 2 8018.192 BW92b 6 d 2 (3 P)7 s 4 P 5 / 2 9061.103 BW92b 5 f 6 d (3 F°)7 s 4 F° 3 / 2 6691.387 BW92b 5 f 6 d (3 F°)7 s 4 F° 5 / 2 7331.485 BW92b 5 f 6 d (3 F°)7 s 4 F° 7 / 2 9720.297 BW92b 5 f 6 d (3 F°)7 s 4 F° 9 / 2 12488.287 BW92b 5 f 6 d (3 H°)7 s ° 9 / 2 6700.186 BW92b 6 d 3 3 / 2 7001.420 BW92b 6 d 2 (1 P)7 s 1 / 2 7828.560 BW92b 5 f (2 F°)7 s 2 2 F° 7 / 2 8378.859 BW92b 6 d 3 4 F 3 / 2 8460.352 BW92b 6 d 3 4 F 5 / 2 9400.964 BW92b 6 d 3 4 F 7 / 2 10855.323 BW92b 6 d 3 4 F 9 / 2 13248.708 BW92b 6 d 2 (1 F)7 s 2 F 5 / 2 8605.841 BW92b 5 f 6 d (1 G°)7 s 2 G° 7 / 2 9202.265 BW92b 5 f 6 d (1 G°)7 s 2 G° 9 / 2 9238.020 BW92b 5 f 6 d (3 G°)7 s 4 G° 5 / 2 9585.404 BW92b 5 f 6 d (3 G°)7 s 4 G° 7 / 2 11116.584 BW92b 5 f 6 d (3 G°)7 s 4 G° 9 / 2 13468.967 BW92b 5 f 6 d (3 G°)7 s 4 G° 1 1 / 2 15349.879 BW92b 6 d 2 (1 G)7 s 2 G 7 / 2 9711.962 BW92b 6 d 7 s (3 D)7 p ° 5 / 2 24873.983 BW92b 5 f 7 s (3 F°)7 p 7 / 2 27257.149 BW92b 6 d 7 s (3 D)7 p ° 5 / 2 28243.812 BW92b 5 f 2 (3 F)7 s 9 / 2 29515.134 BW92b 5 f 6 d (3 H°)7 p 9 / 2 30452.725 BW92b 6 d 2 (3 F)7 p ° 5 / 2 30972.162 BW92b 6 d 7 s (3 D)7 p 4 F° 7 / 2 30994.266 BW92b 6 d 7 s (3 D)7 p ° 3 / 2 31353.125 BW92b 6 d 7 s (3 D)7 p ° 5 / 2 31810.548 BW92b 6 d 2 (3 F)7 p 4 G° 7 / 2 32957.429 BW92b 6 d 2 (3 F)7 p 4 G° 1 1 / 2 41447.959 BW92b Th III (3 H° 4) Limit 96000 MCS75

Energy Levels of Singly Ionized Uranium (U II)

Energy Levels of Singly Ionized Uranium (U II)

Configuration Term J Level(cm -1) Ref. 5 f 3 (4 I°)7 s 2 4 I° 9 / 2 0.000 BW92b 5 f 3 (4 I°)7 s 2 4 I° 1 1 / 2 4420.870 BW92b 5 f 3 (4 I°)7 s 2 4 I° 1 3 / 2 8276.733 BW92b 5 f 3 (4 I°)7 s 2 4 I° 1 5 / 2 11708.483 BW92b 5 f 3 (4 I°)6 d 7 s 6 L° 1 1 / 2 289.041 BW92b 5 f 3 (4 I°)6 d 7 s 6 L° 1 3 / 2 1749.123 BW92b 5 f 3 (4 I°)6 d 7 s 6 L° 1 5 / 2 5259.652 BW92b 5 f 3 (4 I°)6 d 7 s 6 L° 1 7 / 2 8853.748 BW92b 5 f 3 (4 I°)6 d 7 s 6 L° 1 9 / 2 12350.355 BW92b 5 f 3 (4 I°)6 d 7 s 6 L° 2 1 / 2 - 5 f 3 (4 I°)6 d 7 s 6 K° 9 / 2 914.765 BW92b 5 f 3 (4 I°)6 d 7 s ° 1 1 / 2 2294.696 BW92b 5 f 3 (4 I°)6 d 2 (3 F) ° 1 3 / 2 4585.434 BW92b 5 f 4 (5 I)7 s 6 I 7 / 2 4663.803 BW92b 5 f 3 (4 I°)6 d 7 s ° 5 / 2 4706.272 BW92b 5 f 3 6 d 7 s ° 7 / 2 5401.504 BW92b 5 f 3 (4 I°)6 d 7 s 6 K° 1 3 / 2 5526.748 BW92b 5 f 3 (4 I°)6 d 7 s 6 I° 7 / 2 5667.331 BW92b 5 f 4 (5 I)7 s 9 / 2 5716.449 BW92b 5 f 3 (4 I°)6 d 7 s ° 1 1 / 2 5790.641 BW92b 5 f 3 (4 I°)6 d 7 s 4 L° 1 3 / 2 6283.431 BW92b 5 f 3 (4 I°)6 d 7 s ° 9 / 2 6445.035 BW92b 5 f 3 (4 F°)7 s 2 4 F° 3 / 2 7017.172 BW92b 5 f 3 6 d 7 s ° 9 / 2 7166.630 BW92b 5 f 3 (4 I°)6 d 7 s ° 7 / 2 7547.373 BW92b 5 f 3 6 d 7 s ° 1 1 / 2 7598.355 BW92b 5 f 4 (5 I)7 s 6 I 1 1 / 2 8347.689 BW92b 5 f 3 (4 I°)6 d 7 s ° 9 / 2 8379.696 BW92b 5 f 3 (4 I°)6 d 2 6 M° 1 5 / 2 8394.362 BW92b 5 f 3 (4 I°)6 d 7 s ° 3 / 2 8400.125 BW92b 5 f 4 (5 I)7 s 9 / 2 8423.417 BW92b 5 f 3 (4 I°)6 d 7 s ° 5 / 2 8430.185 BW92b 5 f 3 6 d 7 s ° 1 1 / 2 8510.866 BW92b 5 f 3 (4 I°)6 d 7 s 6 K° 1 5 / 2 8521.922 BW92b 5 f 3 6 d 7 s ° 1 3 / 2 8755.640 BW92b 5 f 3 6 d 7 s ° 7 / 2 9075.731 BW92b 5 f 3 6 d 7 s ° 9 / 2 9241.971 BW92b 5 f 3 6 d 7 s ° 5 / 2 9344.624 BW92b 5 f 3 (4 I°)6 d 7 s 6 I° 1 1 / 2 9553.185 BW92b 5 f 3 (4 I°)6 d 7 s ° 1 3 / 2 9626.113 BW92b 5 f 3 (2 H°)7 s 2 ° 9 / 2 9690.665 BW92b 5 f 3 (4 F°)6 d 7 s ° 3 / 2 9881.618 BW92b 5 f 3 (4 I°)6 d 7 s ° 9 / 2 9882.725 BW92b 5 f 3 6 d 7 s ° 7 / 2 9933.224 BW92b 6 L 1 1 / 2 22917.451 BW92b 5 f 3 7 s 7 p 6 K 9 / 2 23315.090 BW92b 5 f 3 7 s 7 p 6 I 9 / 2 24684.132 BW92b 1 3 / 2 25714.049 BW92b 1 3 / 2 25986.312 BW92b 5 f 3 6 d 7 p 6 M 1 3 / 2 26191.309 BW92b 1 3 / 2 26716.697 BW92b 5 f 3 6 d 7 p 6 L 1 1 / 2 28154.450 BW92b 5 f 4 (5 I°)7 p 6 K° 9 / 2 30599.179 BW92b 5 f 4 7 p ° 9 / 2 30756.116 BW92b U III (5 I 4) Limit 85000 SRC71

Energy Levels of Singly Ionized Berkelium (Bk II)

Energy Levels of Singly Ionized Berkelium (Bk II)

Configuration Term J Level(cm -1) Ref. 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 0.00 BW92b 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 1487.51 BW92b 5 f 9 (6 F° 1 1 / 2)7 s (1 1 / 2 , 1 / 2)° 6 5598.10 BW92b 5 f 9 (6 F° 1 1 / 2)7 s (1 1 / 2 , 1 / 2)° 5 6906.07 BW92b 5 f 9 (6 F° 9 / 2)7 s (9 / 2 , 1 / 2)° 5 6051.18 BW92b 5 f 9 (6 F° 9 / 2)7 s (9 / 2 , 1 / 2)° 4 7038.48 BW92b 5 f 9 (6 H° 1 3 / 2)7 s (1 3 / 2 , 1 / 2)° 7 6809.52 BW92b 5 f 9 (6 H° 1 3 / 2)7 s (1 3 / 2 , 1 / 2)° 6 7786.75 BW92b 5 f 8 7 s 2 7 F 6 7040.98 BW92b 5 f 8 7 s 2 7 F 5 10191.14 BW92b 5 f 8 6 d 7 s 9 G 8 12340.96 BW92b 5 f 8 6 d 7 s 9 G 7 12558.97 BW92b 5 f 8 6 d 7 s 9 G 6 12583.03 BW92b 5 f 8 6 d 7 s 9 G 5 13889.43 BW92b 7 23817.32 BW92b 7 23861.38 BW92b 5 f 8 6 d 7 s 9 H 8 25593.755 BW92b 5 f 9 (6 H° 1 5 / 2)7 p 1 / 2 (1 5 / 2 , 1 / 2) 8 27157.155 BW92b 5 f 8 6 d 7 s 7 H 8 28223.10 BW92b 7 30786.30 BW92b 5 f 9 (6 H° 1 5 / 2)7 p 3 / 2 (1 5 / 2 , 3 / 2) 9 34729.28 BW92b 8 35355.68 BW92b Bk III (6 H° 1 5 / 2) Limit

Energy Levels of Singly Ionized Californium (Cf II)

Energy Levels of Singly Ionized Californium (Cf II)

Configuration Term J Level(cm -1) Ref. 5 f 1 0 (5 I 8)7 s (8, 1 / 2) 1 7 / 2 0.00 BW92b 5 f 1 0 (5 I 8)7 s (8, 1 / 2) 1 5 / 2 1180.52 BW92b 5 f 1 0 (5 F 5)7 s (5, 1 / 2) 1 1 / 2 8852.05 BW92b 5 f 1 0 (5 F 5)7 s (5, 1 / 2) 9 / 2 9633.09 BW92b 5 f 1 0 (5 I 7)7 s (7, 1 / 2) 1 5 / 2 9350.19 BW92b 5 f 1 0 (5 I 7)7 s (7, 1 / 2) 1 3 / 2 9922.27 BW92b 5 f 1 0 (5 I 8)6 d 3 / 2 (8, 3 / 2) 1 5 / 2 19359.06 BW92b 5 f 1 0 (5 I 8)6 d 3 / 2 (8, 3 / 2) 1 7 / 2 20091.38 BW92b 5 f 1 0 (5 I 8)6 d 3 / 2 (8, 3 / 2) 1 3 / 2 20445.10 BW92b 5 f 1 0 (5 I 8)6 d 3 / 2 (8, 3 / 2) 1 9 / 2 21599.67 BW92b 5 f 9 6 d 7 s ° 1 9 / 2 24213.34 BW92b 5 f 9 6 d 7 s ° 1 7 / 2 26213.78 BW92b 5 f 1 0 (5 I 8)7 p 1 / 2 (8, 1 / 2)° 1 5 / 2 26858.90 BW92b 5 f 1 0 (5 I 8)7 p 1 / 2 (8, 1 / 2)° 1 7 / 2 27564.94 BW92b 5 f 1 0 (5 I 8)7 p 3 / 2 (8, 3 / 2)° 1 9 / 2 36031.74 BW92b 5 f 1 0 (5 I 8)7 p 3 / 2 (8, 3 / 2)° 1 7 / 2 36233.01 BW92b Cf III (5 I 8) Limit [95000] CNWM70

Energy Levels of Singly Ionized Curium (Cm II)

Energy Levels of Singly Ionized Curium (Cm II)

Configuration Term J Level(cm -1) Ref. 5 f 7 7 s 2 8 S° 7 / 2 0.000 BW92b 5 f 8 7 s 8 F 1 3 / 2 2093.870 BW92b 5 f 8 7 s 8 F 9 / 2 5919.263 BW92b 5 f 8 7 s 8 F 1 1 / 2 6347.900 BW92b 5 f 8 7 s 8 F 7 / 2 7067.133 BW92b 5 f 8 7 s 8 F 5 / 2 8436.099 BW92b 5 f 8 7 s 8 F 3 / 2 9127.846 BW92b 5 f 8 7 s 8 F 1 / 2 9801.305 BW92b 5 f 8 7 s 6 F 1 1 / 2 3941.439 BW92b 5 f 8 7 s 6 F 9 / 2 8144.306 BW92b 5 f 8 7 s 6 F 7 / 2 9073.572 BW92b 5 f 8 7 s 6 F 5 / 2 10433.776 BW92b 5 f 8 7 s 6 F 3 / 2 11250.886 BW92b 5 f 8 7 s 6 F 1 / 2 11978.441 BW92b 5 f 7 6 d 7 s 1 0 D° 5 / 2 4010.645 BW92b 5 f 7 6 d 7 s 1 0 D° 7 / 2 4411.540 BW92b 5 f 7 6 d 7 s 1 0 D° 9 / 2 5067.900 BW92b 5 f 7 6 d 7 s 1 0 D° 1 1 / 2 6202.430 BW92b 5 f 7 6 d 7 s 1 0 D° 1 3 / 2 8425.360 BW92b 5 f 7 6 d 7 s 8 D° 3 / 2 8199.890 BW92b 5 f 7 6 d 7 s 8 D° 5 / 2 8474.775 BW92b 5 f 7 6 d 7 s 8 D° 7 / 2 9012.480 BW92b 5 f 7 6 d 7 s 8 D° 9 / 2 10134.785 BW92b 5 f 7 6 d 7 s 8 D° 1 1 / 2 12913.101 BW92b 5 f 7 (8 S°)7 s 7 p (3 P°) 1 0 P 9 / 2 25579.725 BW92b 5 f 8 (7 F 6)7 p 1 / 2 (6, 1 / 2)° 1 3 / 2 27700.945 BW92b 5 f 7 (8 S°)7 s 7 p (3 P°) 8 P 5 / 2 27980.085 BW92b 5 f 7 6 d 2 ° 1 3 / 2 32923.880 BW92b 5 f 8 (7 F 6)7 p 3 / 2 (6, 3 / 2)° 1 3 / 2 34926.680 BW92b 5 f 7 6 d 7 p 1 0 D 5 / 2 35280.665 BW92b 5 f 7 (8 S°)7 s 7 p (3 P°) 8 P 9 / 2 35397.790 BW92b ° 1 5 / 2 36226.140 BW92b ° 1 3 / 2 36413.100 BW92b 5 f 7 (8 S°)7 s 7 p (1 P°) 8 P 5 / 2 40592.510 BW92b 5 f 7 6 d 7 p 8 D 9 / 2 42332.445 BW92b Cm III (5 f 8 7 F 6 ?) Limit

Energy Levels of Singly Ionized Einsteinium (Es II)

Energy Levels of Singly Ionized Einsteinium (Es II)

Configuration Term J Level(cm -1) Ref. 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 0.00 BW92b 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 938.65 BW92b 5 f 1 1 (4 F° 9 / 2)7 s (9 / 2 , 1 / 2)° 5 7588.09 BW92b 5 f 1 1 (4 F° 9 / 2)7 s (9 / 2 , 1 / 2)° 4 8123.26 BW92b 5 f 1 1 (2 H° 1 1 / 2)7 s (1 1 / 2 , 1 / 2)° 6 9085.30 BW92b 5 f 1 1 (2 H° 1 1 / 2)7 s (1 1 / 2 , 1 / 2)° 5 9580.22 BW92b 5 f 1 1 (4 I° 1 3 / 2)7 s (1 3 / 2 , 1 / 2)° 7 11335.68 BW92b 5 f 1 1 (4 I° 1 3 / 2)7 s (1 3 / 2 , 1 / 2)° 6 11764.95 BW92b 5 f 1 1 7 p (1 5 / 2 , 1 / 2) 7 27751.11 BW92b 5 f 1 1 7 p (1 5 / 2 , 1 / 2) 8 28178.81 BW92b 5 f 1 1 (2 H° 1 1 / 2)7 p (1 1 / 2 , 1 / 2) 6 36450.29 BW92b 5 f 1 1 (2 H° 1 1 / 2)7 p (1 1 / 2 , 1 / 2) 5 36803.23 BW92b 5 f 1 0 6 d 7 s 7 36807.72 BW92b 5 f 1 1 (4 I° 1 5 / 2)7 p (1 5 / 2 , 3 / 2) 9 36907.83 BW92b Es III (4 I° 1 5 / 2) Limit [97000] CNWM70

References and Notes for Beryllium (Be)

References and Notes for Helium (He)

References and Notes for Hydrogen (H)

References and Notes for Lithium (Li)

References and Notes for Aluminum (Al)

References and Notes for Argon (Ar)

References and Notes for Boron (B)

References and Notes for Calcium (Ca)

References and Notes for Carbon (C)

References and Notes for Chlorine (Cl)

References and Notes for Fluorine (F)

References and Notes for Magnesium (Mg)

References and Notes for Neon (Ne)

References and Notes for Nitrogen (N)

References and Notes for Oxygen (O)

References and Notes for Phosphorus (P)

References and Notes for Potassium (K)

References and Notes for Scandium (Sc)

References and Notes for Silicon (Si)

References and Notes for Sodium (Na)

References and Notes for Sulfur (S)

References and Notes for Titanium (Ti)

References and Notes for Arsenic (As)

References and Notes for Bromine (Br)

References and Notes for Chromium (Cr)

References and Notes for Cobalt (Co)

References and Notes for Copper (Cu)

References and Notes for Gallium (Ga)

References and Notes for Germanium (Ge)

References and Notes for Iron (Fe)

References and Notes for Krypton (Kr)

References and Notes for Manganese (Mn)

References and Notes for Nickel (Ni)

References and Notes for Niobium (Nb)

References and Notes for Rubidium (Rb)

References and Notes for Selenium (Se)

References and Notes for Strontium (Sr)

References and Notes for Vanadium (V)

References and Notes for Yttrium (Y)

References and Notes for Zinc (Zn)

References and Notes for Zirconium (Zr)

References and Notes for Antimony (Sb)

References and Notes for Barium (Ba)

References and Notes for Cadmium (Cd)

References and Notes for Cesium (Cs)

References and Notes for Indium (In)

References and Notes for Iodine (I)

References and Notes for Molybdenum (Mo)

References and Notes for Palladium (Pd)

References and Notes for Rhodium (Rh)

References and Notes for Ruthenium (Ru)

References and Notes for Silver (Ag)

References and Notes for Technetium (Tc)

References and Notes for Tellurium (Te)

References and Notes for Tin (Sn)

References and Notes for Xenon (Xe)

References and Notes for Cerium (Ce)

References and Notes for Europium (Eu)

References and Notes for Gadolinium (Gd)

References and Notes for Lanthanum (La)

References and Notes for Neodymium (Nd)

References and Notes for Praseodymium (Pr)

References and Notes for Promethium (Pm)

References and Notes for Samarium (Sm)

References and Notes for Terbium (Tb)

References and Notes for Dysprosium (Dy)

References and Notes for Erbium (Er)

References and Notes for Gold (Au)

References and Notes for Hafnium (Hf)

References and Notes for Holmium (Ho)

References and Notes for Iridium (Ir)

References and Notes for Lead (Pb)

References and Notes for Lutetium (Lu)

References and Notes for Mercury (Hg)

References and Notes for Osmium (Os)

References and Notes for Platinum (Pt)

References and Notes for Rhenium (Re)

References and Notes for Tantalum (Ta)

References and Notes for Thallium (Tl)

References and Notes for Thulium (Tm)

References and Notes for Tungsten (W)

References and Notes for Ytterbium (Yb)

References and Notes for Actinium (Ac)

References and Notes for Americium (Am)

References and Notes for Astatine (At)

References and Notes for Berkelium (Bk)

References and Notes for Bismuth (Bi)

References and Notes for Californium (Cf)

References and Notes for Curium (Cm)

References and Notes for Einsteinium (Es)

References and Notes for Francium (Fr)

References and Notes for Neptunium (Np)

References and Notes for Plutonium (Pu)

References and Notes for Polonium (Po)

References and Notes for Protactinium (Pa)

References and Notes for Radium (Ra)

References and Notes for Radon (Rn)

References and Notes for Thorium (Th)

References and Notes for Uranium (U)

Strong Lines of Hydrogen (H)

Strong Lines of Hydrogen (H)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 15 926.2256 H I MK00a 20 930.7482 H I MK00a 30 937.8034 H I MK00a 50 P 949.7430 H I MK00a 100 P 972.5367 H I MK00a 300 P 1025.7222 H I MK00a 1000 P 1215.66824 H I MK00a 500 P 1215.67364 H I MK00a Air 5 3835.384 H I RCWM80 6 3889.049 H I RCWM80 8 3970.072 H I RCWM80 15 4101.74 H I RCWM80 30 P 4340.462 H I MK00a 30 P 4861.2786 H I MK00a 10 P 4861.2870 H I MK00a 60 P 4861.3615 H I MK00a 90 P 6562.7110 H I MK00a 30 P 6562.7248 H I MK00a 180 P 6562.8518 H I MK00a 5 9545.97 H I RCWM80 7 10049.4 H I RCWM80 12 10938.1 H I RCWM80 20 P 12818.07 H I MK00a 40 P ,c 18751.01 H I MK00a 5 21655.3 H I RCWM80 8 26251.5 H I RCWM80 15 40511.6 H I RCWM80 4 46525.1 H I RCWM80 6 74578 H I RCWM80 3 123685 H I RCWM80

Strong Lines of Beryllium (Be)

Strong Lines of Beryllium (Be)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 200 1143.039 Be II J61a 400 1197.188 Be II J61a 600 P 1512.269 Be II J61a 800 P ,c 1512.412 Be II J61a 100 P 1661.478 Be I KM97 50 c 1964.59 Be I KM97 60 c 1998.01 Be I KM97 Air 50 2056.012 Be I KM97 50 c 2174.986 Be I KM97 60 2175.103 Be I KM97 1000 P 2348.610 Be I KM97 60 2350.703 Be I KM97 300 2350.829 Be I KM97 100 P 2494.728 Be I KM97 100 P 2650.454 Be I KM97 60 P 2650.550 Be I KM97 200* P 2650.613 Be I KM97 200* P 2650.619 Be I KM97 60 P 2650.694 Be I KM97 100 P 2650.760 Be I KM97 1000 P 3130.4219 Be II BWWI85 600 P 3131.0667 Be II BWWI85 100 P 3321.340 Be I KM97 15 3813.454 Be I KM97 60 P 4360.663 Be II J61a 100 P 4360.988 Be II J61a 12 P 4572.664 Be I KM97 140 P 4673.329 Be II J61a 200 P 4673.423 Be II J61a 40 4828.159 Be II J61a 60 5270.28 Be II J61a 100 P 5270.81 Be II J61a 12 6547.89 Be II J61a 12 6558.36 Be II J61a 10 6982.749 Be I KM97 10 7209.134 Be I KM97 4 P 8254.070 Be I KM97 5 8801.370 Be I KM97 12 10119.92 Be II J61a 20 12095.36 Be II J61a 6 14643.92 Be I KM97 6 14644.75 Be I KM97 5 16157.72 Be I HJ69 6 18143.54 Be I KM97 5 31778.70 Be I HJ69

Strong Lines of Boron (B)

Strong Lines of Boron (B)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 180 693.947 B II O70 500 882.543 B II O70 500 882.681 B II O70 500 1081.875 B II O70 500 1082.073 B II O70 500 1230.160 B II O70 1000 P 1362.463 B II LZJK98 700 P 1623.597 B II LZJK98 500 P 1623.790 B II LZJK98 1000 P 1624.023 B II LZJK98 300 1624.175 B II LZJK98 700 P 1624.376 B II LZJK98 300 1666.850 B I BTG74 500 1667.272 B I BTG74 300 1817.843 B I BTG74 500 1818.348 B I BTG74 800 P 1825.894 B I EL01 1000 P 1826.400 B I EL01 500 P 1842.820 B II LZJK98 Air 200 2066.364 B I GV72 , GM62 200 2066.646 B I GV72 , GM62 250 2067.186 B I GV72 , GM62 400 P 2088.889 B I JLKK93 500 P 2089.570 B I JLKK93 200 P 2395.048 B II O70 500 P 2496.769 B I JLKK93 800 P 2497.722 B I JLKK93 700 2918.076 B II O70 500 P 3451.303 B II LZJK98 300 4121.933 B II O70 110 4194.792 B II O70 110 4472.101 B II O70 110 4472.851 B II O70 110 4940.376 B II O70 110 6080.44 B II O70 100 P 11660.028 B I EL01 50 P 11662.452 B I El01

Strong Lines of Carbon (C)

Strong Lines of Carbon (C)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 600 P 687.0526 C II KE74 1000 P 687.346 C II KE74 150 903.6235 C II KE74 300 903.9616 C II KE74 750 P 904.1416 C II KE74 150 904.4801 C II KE74 250 P 1036.3367 C II KE74 500 P 1037.0182 C II KE74 300* 1193.0088 C I J66 300* 1193.0308 C I J66 400 1193.2402 C I KE74 100 1193.2644 C I KE74 200 1261.5520 C I KE74 400 P 1277.2452 C I KE74 800 P 1277.2824 C I KE74 200 P 1277.5131 C I KE74 1000 P 1277.5497 C I KE74 800 P 1280.3330 C I KE74 200 1329.5775 C I KE74 100 1329.6005 C I KE74 80 P 1334.5323 C II KE74 150 P 1335.7077 C II KE74 200 1560.309 C I KE74 500 P 1560.682 C I KE74 200 P 1560.709 C I KE74 600 P 1561.438 C I KE74 500 P 1656.267 C I KE74 400 P 1656.928 C I KE74 1000 P 1657.008 C I KE74 400 P 1657.379 C I KE74 400 P 1657.907 C I KE74 500 P 1658.121 C I KE74 500 P 1751.827 C I KE74 1000 P 1930.906 C I KE74 Air 400 P 2478.561 C I J66 500 P 2836.710 C II MG93 400 P 2837.603 C II MG93 400 h 2992.618 C II MG93 300 P 3918.978 C II MG93 400 P 3920.693 C II MG93 400 P 4267.003 C II MG93 500 P ,c 4267.258 C II MG93 300 5145.16 C II MG93 200 5151.09 C II MG93 150 5380.34 C I J66 300 5889.77 C II MG93 150 6013.22 C I J66 400 P 6578.05 C II MG93 300 6582.88 C II MG93 400 P 7231.32 C II MG93 500 P 7236.42 C II MG93 250 P 8335.15 C I J66 220 9094.83 C I J66 150 9111.80 C I J66 400 P 9405.73 C I J66 150 9658.44 C I J66 150 10691.25 C I J66 90 11748.22 C I JL65 140 P 11753.32 C I JL65 110 P 11754.76 C I JL65 50 16890.38 C I JL65

Strong Lines of Helium (He)

Strong Lines of Helium (He)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 15 c 231.4541 He II GM65 20 c 232.5842 He II GM65 30 c 234.3472 He II GM65 50 c 237.3307 He II GM65 100 c 243.0266 He II GM65 300 P 256.3166 He II MK00b 150 P 256.3177 He II MK00b 1000 P 303.7804 He II MK00b 500 P 303.7858 He II MK00b 10 320.293 He I TW71 2 505.50035 He I M02 3 505.68433 He I M02 4 505.91252 He I M02 5 506.20034 He I M02 7 506.57057 He I M02 10 507.05802 He I M02 15 507.71809 He I M02 20 508.64338 He I M02 25 509.99829 He I M02 35 512.09856 He I M02 50 515.61684 He I M02 100 P 522.21309 He I M02 400 P 537.02992 He I M02 1000 P 584.33436 He I M02 50 591.41207 He I M02 5 c 958.70 He II GM65 6 c 972.11 He II GM65 8 c 992.36 He II GM65 15 c 1025.27 He II GM65 30 c 1084.94 He II GM65 35 1215.09 He II GM65 50 c 1215.17 He II GM65 120 P 1640.3321 He II MK00b 50 P 1640.3447 He II MK00b 7 P 1640.3750 He II MK00b 25 P 1640.3914 He II MK00b 180 P 1640.4742 He II MK00b 25 P 1640.4897 He II MK00b 15 P 1640.5326 He II MK00b Air 7 c 2385.40 He II GM65 9 c 2511.20 He II GM65 1 2723.19 He I M60a 12 c 2733.30 He II GM65 2 2763.80 He I M60a 10 2818.2 He I BDD72 4 2829.08 He I M60a 10 2945.11 He I M60a 40 3013.7 He I BDD72 20 3187.74 He I M60a 15 c 3203.10 He II GM65 1 3354.55 He I M60a 2 3447.59 He I M60a 1 3587.27 He I M60a 3 3613.64 He I M60a 2 3634.23 He I M60a 3 3705.00 He I M60a 1 3732.86 He I M60a 10 3819.607 He I M60a 1 3819.76 He I M60a 60 P 3888.6046 He I M02 200 P 3888.6456 He I M02 300 P 3888.6489 He I M02 20 3964.729 He I M60a 1 4009.27 He I M60a 50 4026.191 He I M60a 5 4026.36 He I M60a 12 4120.82 He I M60a 2 4120.99 He I M60a 3 4143.76 He I M60a 10 4387.929 He I M60a 3 4437.55 He I M60a 200 4471.479 He I M60a 25 4471.68 He I M60a 4 P ,c 4685.3769 He II MK00b 3 P ,c 4685.4072 He II MK00b 15* P ,c 4685.7038 He II MK00b 15* P ,c 4685.7044 He II MK00b 12 P ,c 4685.8041 He II MK00b 30 4713.146 He I M60a 4 4713.38 He I M60a 20 4921.931 He I M60a 100 5015.678 He I M60a 10 5047.74 He I M60a 5 c 5411.52 He II GM65 500 P 5875.6148 He I M02 250 P 5875.6404 He I M02 120 P 5875.9663 He I M02 8 c 6560.10 He II GM65 200 P 6678.1517 He I M02 3 6867.48 He I M60a 100 P 7065.1771 He I M02 60 P 7065.2153 He I M02 20 P 7065.7086 He I M02 50 7281.35 He I M60a 1 7816.15 He I M60a 2 8361.69 He I M60a 2 9063.27 He I M60a 2 9210.34 He I M60a 10 9463.61 He I M60a 4 9516.60 He I M60a 3 9526.17 He I M60a 1 9529.27 He I M60a 1 9603.42 He I M60a 3 9702.60 He I M60a 6 10027.73 He I M60a 2 10031.16 He I M60a 15 c 10123.6 He II GM65 1 10138.50 He I M60a 10 10311.23 He I M60a 2 10311.54 He I M60a 3 10667.65 He I M60a 150 P 10829.0911 He I M02 500 P 10830.2501 He I M02 1000 P 10830.3398 He I M02 9 10913.05 He I L70a 3 10917.10 He I L70a 4 c 11626.4 He II GM65 30 11969.12 He I L70a 20 12527.52 He I L70a 50 12784.99 He I L70a 20 12790.57 He I L70a 7 12845.96 He I L70a 10 12968.45 He I L70a 2 12984.89 He I L70a 12 15083.64 He I L70a 200 17002.47 He I L70a 1 18555.55 He I M60a 6 c 18636.8 He II GM65 500 18685.34 He I L70a 200 18697.23 He I L70a 100 19089.38 He I L70a 20 19543.08 He I L70a 500 P 20581.287 He I M02 80 21120.07 He I L70a 10 21121.43 He I L70a 20 21132.03 He I L70a 3 c 30908.5 He II GM65 4 40478.90 He I L70a

Strong Lines of Lithium (Li)

Strong Lines of Lithium (Li)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 30 171.575 Li II R37 300 P 178.014 Li II R37 1000 P 199.280 Li II R37 10 944.73 Li II SO82 10 1017.88 Li II SO82 30 1131.88 Li II SO82 10 1166.63 Li II SO82 50 1198.092 Li II HM59 20 1237.29 Li II SO82 10 1253.32 Li II SO82 60 1420.900 Li II DM01 15 1492.931 Li II HM59 30 1492.973 Li II HM59 6 1493.036 Li II HM59 15 1653.077 Li II HM59 30 1653.132 Li II HM59 6 1653.213 Li II HM59 40 1681.661 Li II HM59 50 1755.332 Li II HM59 Air 10 2329.836 Li II HM59 10 2381.538 Li II HM59 20 2383.199 Li II HM59 15 2402.331 Li II HM59 10 2410.842 Li II HM59 10 2429.814 Li II HM59 15 2506.940 Li II HM59 30 2508.785 Li II HM59 20 2539.487 Li II HM59 10 2551.70 Li II SO82 15 2605.081 Li II HM59 20 2657.293 Li II HM59 30 2657.303 Li II HM59 20 2674.460 Li II HM59 20 2728.288 Li II HM59 7 2728.315 Li II HM59 50* 2730.473 Li II HM59 50* 2730.551 Li II HM59 40 2766.989 Li II HM59 20 2790.313 Li II HM59 20* 3029.121 Li II HM59 20* 3029.136 Li II HM59 20* 3155.308 Li II HM59 20* 3155.330 Li II HM59 20 3196.330 Li II HM59 10 3196.356 Li II HM59 70* 3199.332 Li II HM59 70* 3199.434 Li II HM59 2* 3232.633 Li I REB95 2* 3232.643 Li I REB95 50 3249.868 Li II HM59 40 3306.284 Li II HM59 30 3684.320 Li II HM59 2* 4132.624 Li I REB95 2* 4132.625 Li I REB95 10 4155.946 Li II DM01 15 4325.419 Li II HM59 15 4325.471 Li II HM59 15 P 4602.831 Li I REB95 30* P 4602.898 Li I REB95 30* 4602.902 Li I REB95 30 4671.651 Li II HM59 10 4671.705 Li II HM59 80 4678.056 Li II HM59 25 4678.290 Li II HM59 80 4788.363 Li II HM59 15 4881.320 Li II HM59 15 4881.386 Li II HM59 5 4881.490 Li II HM59 5 4971.665 Li I REB95 10 4971.748 Li I REB95 15 5037.915 Li II HM59 300 P 5483.56 Li II HM59 500 P 5484.50 Li II HM59 400 P 5485.11 Li II HM59 300 P 6103.542 Li I REB95 400* P 6103.654 Li I REB95 400* 6103.667 Li I REB95 500 P 6707.775 Li I REB95 1000 P 6707.926 Li I REB95 150 P 8126.232 Li I REB95 300 P 8126.453 Li I REB95 100 P 9581.42 Li II SO82 2* 18703.01 Li I REB95 2* 18703.11 Li I REB95 2* 18703.14 Li I REB95 10 P 26877.67 Li I REB95 5 P 26878.36 Li I REB95

Strong Lines of Fluorine (F)

Strong Lines of Fluorine (F)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 900 P 484.602 F II P69 900 P 605.669 F II P69 800 P 606.288 F II P69 1000 P 606.804 F II P69 700 P 606.923 F II P69 800 P 607.472 F II P69 900 P 608.062 F II P69 500 P 951.870 F I L49 1000 P 954.826 F I L49 800 P 955.546 F I L49 500 P 958.525 F I L49 400 973.895 F I L49 100 976.217 F I L49 100 977.743 F I L49 Air 200 3501.388 F II P69 200 3501.451 F II P69 200 3501.569 F II P69 200 3502.840 F II P69 200 3502.964 F II P69 200 3503.106 F II P69 150 3505.369 F II P69 200 3505.515 F II P69 200 3505.628 F II P69 200 3601.393 F II P69 200 3602.838 F II P69 200 3704.526 F II P69 250 P 3847.086 F II P69 250 P 3849.985 F II P69 250 P 3851.668 F II P69 200 3898.825 F II P69 200 3901.933 F II P69 250 P 4024.726 F II P69 200 P 4025.010 F II P69 250 P 4025.491 F II P69 200 4103.074 F II P69 150 4103.216 F II P69 200 4103.508 F II P69 200 4103.710 F II P69 150 4103.870 F II P69 200 4246.227 F II P69 200 4246.385 F II P69 200 4246.590 F II P69 150 4246.774 F II P69 150 4246.844 F II P69 200 4299.170 F II P69 150 4446.527 F II P69 150 4446.722 F II P69 200 4447.188 F II P69 130 P 6239.651 F I L49 100 P 6348.508 F I L49 80 6413.651 F I L49 20 6690.481 F I L49 70 6773.984 F I L49 90 6834.264 F I L49 500 P 6856.030 F I L49 80 6870.215 F I L49 150 P 6902.475 F I L49 60 6909.816 F I L49 40 6966.349 F I L49 500 P 7037.469 F I L49 300 P 7127.890 F I L49 130 7179.90 F II P69 150 P 7202.360 F I L49 130 h 7211.79 F II P69 150 P 7311.019 F I L49 50 7331.957 F I L49 100 P 7398.688 F I L49 40 7425.645 F I L49 20 7482.723 F I L49 25 7489.155 F I L49 50 7552.235 F I L49 50 7573.384 F I L49 70 7607.170 F I L49 200 P 7754.696 F I L49 150 P 7800.212 F I L49 80 8016.01 F II P69 6 8129.26 F I L49 6 8179.339 F I L49 25 8214.726 F I L49 30 8230.773 F I L49 20 8298.581 F I L49

Strong Lines of Nitrogen (N)

Strong Lines of Nitrogen (N)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 200 P 644.635 N II E83 600 P 644.837 N II E83 1000 P 645.179 N II E83 80 692.70 N I M75a 200 P 775.967 N II E83 50 P 915.613 N II E83 50 P 915.963 N II E83 60 P ,d 916.019 N II E83 200 P ,d 916.708 N II E83 25 P 1083.994 N II E83 60 P ,d 1084.580 N II E83 15 P 1085.550 N II E83 100 P 1085.710 N II E83 90 1134.165 N I M75a 90 1134.415 N I M75a 1000 P 1199.550 N I M75a 700 P 1200.223 N I M75a 300 P 1200.710 N I M75a 250 P 1243.179 N I M75a 90 1411.94 N I M75a 250 P 1492.625 N I M75a 120 1492.820 N I M75a 150 1494.675 N I M75a 200 P 1742.729 N I M75a 150 1745.252 N I M75a Air 20 3955.85 N II M75a 50 P 3995.00 N II M75a 30 4041.31 N II M75a 20 4241.78 N II M75a 30 P 4447.03 N II M75a 30 4601.48 N II M75a 20 4607.16 N II M75a 20 4621.39 N II M75a 40 P 4630.54 N II M75a 30 4643.08 N II M75a 20 4803.29 N II M75a 80 4963.98 N I M75a 20 4994.36 N II M75a 30 5001.48 N II M75a 40 P 5005.15 N II M75a 30 5007.32 N II M75a 20 5010.62 N II M75a 30 5045.10 N II M75a 30 5666.63 N II M75a 30 5676.02 N II M75a 40 P 5679.56 N II M75a 20 5686.21 N II M75a 20 5710.77 N II M75a 150 5752.50 N I M75a 30 5931.78 N II M75a 30 P 5941.65 N II M75a 40 P 6482.05 N II M75a 90 6482.70 N I M75a 40 P 6610.56 N II M75a 150 7423.64 N I M75a 200 P 7442.29 N I M75a 200 P 7468.31 N I M75a 90 8184.87 N I M75a 90 8188.02 N I M75a 140 8216.34 N I M75a 90 8223.14 N I M75a 90 8242.39 N I M75a 30 8438.74 N II M75a 120 8567.74 N I M75a 140 8594.00 N I M75a 150 8629.24 N I M75a 120 8655.89 N I M75a 150 P 8680.28 N I M75a 150 P 8683.40 N I M75a 120 8686.15 N I M75a 120 8703.25 N I M75a 140 8711.70 N I M75a 120 8718.83 N I M75a 120 9386.80 N I M75a 140 9392.79 N I M75a 80 10112.48 N I M75a 90 10114.64 N I M75a 90 12186.82 N I M75a 200 P 12469.62 N I M75a 120 13429.61 N I M75a 200 P 13581.33 N I M75a

Strong Lines of Oxygen (O)

Strong Lines of Oxygen (O)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 400 P 429.918 O II MKM93 700 P 430.041 O II MKM93 1000 P 430.177 O II MKM93 800 P 537.8319 O II MKM93 1000 P 538.2636 O II MKM93 600 P 538.318 O II MKM93 800 P 539.0855 O II MKM93 700 P 539.5489 O II MKM93 500 P 539.8544 O II MKM93 800 P 718.5036 O II MKM93 500 P 718.5663 O II MKM93 250 796.664 O II MKM93 250 796.682 O II MKM93 250 P 832.7587 O II MKM93 400 P 833.3302 O II MKM93 500 P 834.4655 O II MKM93 50 988.773 O I M75b 80 1025.762 O I M75b 50 1039.230 O I M75b 1000 P 1302.168 O I M75b 700 P 1304.858 O I M75b 300 P 1306.029 O I M75b Air 250 2445.538 O II MKM93 250 2733.289 O II MKM93 90 2972.29 O I HHMR86 400 P 3134.720 O II MKM93 250 3138.335 O II MKM93 300 3287.472 O II MKM93 250 3390.209 O II MKM93 250 3470.676 O II MKM93 250 3727.320 O II MKM93 300 3749.486 O II MKM93 400 P 3911.957 O II MKM93 60 3947.29 O I M75b 50 3947.48 O I M75b 50 3947.59 O I M75b 400 P 3973.2562 O II MKM93 200 3982.7140 O II MKM93 250 4072.157 O II MKM93 400 P 4075.862 O II MKM93 250 4119.215 O II MKM93 250 4185.449 O II MKM93 400 4189.789 O II MKM93 250 4317.138 O II MKM93 250 4349.426 O II MKM93 400 P 4414.905 O II MKM93 250 4416.974 O II MKM93 300 4590.972 O II MKM93 250 4596.175 O II MKM93 300 P 4641.810 O II MKM93 400 P 4649.135 O II MKM93 300 4661.633 O II MKM93 250 4676.235 O II MKM93 250 4705.352 O II MKM93 130 6155.98 O I M75b 150 6156.77 O I M75b 150 6158.18 O I M75b 130 6455.98 O I M75b 150 7002.23 O I M75b 130 7254.15 O I M75b 150 7254.45 O I M75b 300 P 7771.94 O I M75b 250 P 7774.17 O I M75b 250 P 7775.39 O I M75b 130 8221.82 O I M75b 250 P 8446.25 O I M75b 300 P 8446.36 O I M75b 300 P 8446.76 O I M75b 150 9260.81 O I M75b 150 9260.84 O I M75b 150 9260.94 O I M75b 130 9262.58 O I M75b 200 9262.67 O I M75b 200 9262.77 O I M75b 150 9265.94 O I M75b 200 P 9266.01 O I M75b 200 11286.34 O I M75b 200 11286.91 O I M75b 150 11287.02 O I M75b 150 11287.32 O I M75b 150 11295.10 O I M75b 200 11297.68 O I M75b 200 11302.38 O I M75b 150 12464.02 O I M75b 150 12570.04 O I M75b 250 P 13163.89 O I M75b 250 P 13164.85 O I M75b 200 13165.11 O I M75b 200 18021.21 O I M75b 200 18243.63 O I M75b

Strong Lines of Aluminum (Al)

Strong Lines of Aluminum (Al)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 800 P 1539.830 Al II KM91b 1000 P 1670.7886 Al II GK00 800 P 1719.440 Al II KM91b 500 1721.244 Al II KM91b 900 P 1721.271 Al II KM91b 500 1724.952 Al II KM91b 900 P 1724.984 Al II KM91b 30 1762.899 Al I KM91b 500 1763.869 Al II KM91b 700 P 1763.952 Al II KM91b 50 1765.636 Al I KM91b 300 1765.815 Al II KM91b 50 1766.385 Al I KM91b 400 1767.731 Al II KM91b 50 1769.140 Al I KM91b 600 1828.588 Al II KM91b 700 P 1858.026 Al II KM91b 1000 P 1862.311 Al II KM91b 700 1990.531 Al II KM91b Air 700 2094.264 Al II KM91b 40 P 2269.096 Al I KM91b 50 P 2367.052 Al I KM91b 90 P 2373.124 Al I KM91b 25 2567.984 Al I KM91b 50 P 2575.094 Al I KM91b 600 P 2816.185 Al II KM91b 40 3050.073 Al I KM91b 50 3057.144 Al I KM91b 500 P 3082.153 Al I KM91b 800 P 3092.710 Al I KM91b 200 P 3092.839 Al I KM91b 400 3586.557 Al II KM91b 400 3900.675 Al II KM91b 500 P 3944.006 Al I KM91b 1000 P 3961.520 Al I KM91b 1000 P 4663.056 Al II KM91b 600 4666.800 Al II KM91b 400 5593.302 Al II KM91b 400 6006.410 Al II KM91b 400 6073.198 Al II KM91b 400 h 6183.42 Al II KM91b 400 6201.463 Al II KM91b 400 P 6243.36 Al II KM91b 400 6335.701 Al II KM91b 40 6696.015 Al I KM91b 30 7836.134 Al I KM91b 40 8772.866 Al I KM91b 50 8773.896 Al I KM91b 50 11253.189 Al I KM91b 60 11254.926 Al I KM91b 60 13123.378 Al I KM91b 50 13150.708 Al I KM91b 30 16750.429 Al I KM91b

Strong Lines of Magnesium (Mg)

Strong Lines of Magnesium (Mg)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 14 P 1025.9681 Mg II KM91a 12 P 1026.1134 Mg II KM91a 25 P 1239.9253 Mg II KM91a 20 P 1240.3946 Mg II KM91a 15 1367.257 Mg II KM91a 15 1367.708 Mg II KM91a 20 1369.423 Mg II KM91a 20 1476.000 Mg II KM91a 25 1478.004 Mg II KM91a 20 1480.880 Mg II KM91a 30 1482.890 Mg II KM91a 2 1683.412 Mg I KM91a 2 1707.061 Mg I KM91a 40 1734.852 Mg II KM91a 50 1737.628 Mg II KM91a 3 1747.794 Mg I KM91a 40 1750.663 Mg II KM91a 50 1753.474 Mg II KM91a 5 1827.934 Mg I KM91a Air 2 P 2025.824 Mg I KM91a 2 2736.542 Mg I KM91a 6 2776.690 Mg I KM91a 5 2778.270 Mg I KM91a 15* P 2779.820 Mg I KM91a 15* P 2779.834 Mg I KM91a 5 2781.416 Mg I KM91a 6 2782.972 Mg I KM91a 13 P 2790.776 Mg II KM91a 1000 P 2795.5301 Mg II PTW98 15 2797.998 Mg II KM91a 600 P 2802.7056 Mg II PTW98 2 2846.716 Mg I KM91a 2 2848.342 Mg I KM91a 3 2851.660 Mg I KM91a 1000 P 2852.1251 Mg I PTW98 2 2938.473 Mg I KM91a 3 3091.065 Mg I KM91a 4 3092.984 Mg I KM91a 2 3096.890 Mg I KM91a 3 3329.919 Mg I KM91a 25 P 3829.355 Mg I KM91a 50 P 3832.300 Mg I KM91a 80 P 3838.292 Mg I KM91a 2 4167.271 Mg I KM91a 3 4351.906 Mg I KM91a 10 4390.572 Mg II KM91a 14 P 4481.126 Mg II KM91a 13 P 4481.325 Mg II KM91a 5 4571.096 Mg I KM91a 12 P 5167.322 Mg I KM91a 40 P 5172.684 Mg I KM91a 70 P 5183.604 Mg I KM91a 5 5711.088 Mg I KM91a 10 6346.742 Mg II KM91a 11 d 6545.973 Mg II KM91a 2 7387.685 Mg I KM91a 3 7657.603 Mg I KM91a 3 7659.152 Mg I KM91a 3 7659.902 Mg I KM91a 2 7691.550 Mg I KM91a 12 7877.054 Mg II KM91a 13 7896.366 Mg II KM91a 3 8213.034 Mg I KM91a 10 8213.987 Mg II KM91a 11 8234.636 Mg II KM91a 2 8346.120 Mg I KM91a 2 8712.689 Mg I KM91a 2 8717.825 Mg I KM91a 10 8734.980 Mg II KM91a 3 8736.021 Mg I KM91a 11 8745.663 Mg II KM91a 2 8806.757 Mg I KM91a 10 8824.318 Mg II KM91a 11 8835.080 Mg II KM91a 3 8923.569 Mg I KM91a 14 9218.250 Mg II KM91a 13 9244.265 Mg II KM91a 2 9246.499 Mg I KM91a 5 9255.778 Mg I KM91a 10 d 9327.545 Mg II KM91a 10 9340.542 Mg II KM91a 4 9414.964 Mg I KM91a 3 9429.814 Mg I KM91a 3 9432.764 Mg I KM91a 3 9438.783 Mg I KM91a 12 9631.892 Mg II KM91a 11 9632.431 Mg II KM91a 2 9983.20 Mg I KM91a 3 9986.48 Mg I KM91a 3 9993.21 Mg I KM91a 14 10092.16 Mg II KM91a 6 10811.08 Mg I KM91a 11 10914.23 Mg II KM91a 10 10951.78 Mg II KM91a 4 10953.32 Mg I KM91a 4 10957.30 Mg I KM91a 5 10965.45 Mg I KM91a 2 11032.10 Mg I KM91a 2 11033.66 Mg I KM91a 8 P 11828.17 Mg I KM91a 5 12083.65 Mg I KM91a 5 14877.53 Mg I KM91a 6 P 15025.00 Mg I KM91a 5 15040.25 Mg I KM91a 4 15047.71 Mg I KM91a 5 17108.63 Mg I KM91a

Strong Lines of Neon (Ne)

Strong Lines of Neon (Ne)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 90 P 352.9549 Ne II P71 60 P 354.9620 Ne II P71 90 361.4321 Ne II P71 60 362.4544 Ne II P71 150 405.8538 Ne II P71 120 407.1377 Ne II P71 200 P 445.0393 Ne II P71 300 P 446.2552 Ne II P71 250 P 446.5902 Ne II P71 200 447.8146 Ne II P71 150 454.6540 Ne II P71 200 455.2730 Ne II P71 10 456.2728 Ne II P71 120 456.3485 Ne II P71 90 456.8962 Ne II P71 1000 P 460.7284 Ne II P71 500 P 462.3908 Ne II P71 30 587.2127 Ne I SS04 30 587.1792 Ne I SS04 30 589.9114 Ne I SS04 70 591.8306 Ne I SS04 100 595.9200 Ne I SS04 70 598.7056 Ne I SS04 30 598.8897 Ne I SS04 70 600.0365 Ne I SS04 130 602.7263 Ne I SS04 170 P 615.6283 Ne I SS04 170 P 618.6716 Ne I SS04 130 P 619.1023 Ne I SS04 200 P 626.8232 Ne I SS04 200 P 629.7388 Ne I SS04 1000 P 735.8962 Ne I SS04 400 P 743.7195 Ne I SS04 60 993.8825 Ne II P71 70 1068.6488 Ne II P71 90 1131.7224 Ne II P71 100 1131.8490 Ne II P71 90 1229.8367 Ne II P71 90 1418.3779 Ne II P71 90 1428.5822 Ne II P71 90 1436.0813 Ne II P71 120 1681.6840 Ne II P71 200 1688.3553 Ne II P71 100 1888.1064 Ne II P71 100 1889.7120 Ne II P71 200 1907.4940 Ne II P71 500 P 1916.0818 Ne II P71 300 P 1930.0345 Ne II P71 200 1938.8269 Ne II P71 100 c 1945.4521 Ne II P71 Air 80 2007.009 Ne II P71 80 2025.560 Ne II P71 150 2085.466 Ne II P71 200 2096.106 Ne II P71 120 2096.248 Ne II P71 80 2562.123 Ne II P71 90 w 2567.121 Ne II P71 80 2623.107 Ne II P71 80 2629.885 Ne II P71 90 w 2636.069 Ne II P71 80 2638.289 Ne II P71 80 2644.097 Ne II P71 80 2762.921 Ne II P71 90 2792.019 Ne II P71 80 2794.221 Ne II P71 100 2809.485 Ne II P71 80 2906.592 Ne II P71 80 2906.816 Ne II P71 90 2910.061 Ne II P71 90 2910.408 Ne II P71 80 2911.138 Ne II P71 80 2915.122 Ne II P71 80 2925.618 Ne II P71 80 w 2932.103 Ne II P71 80 2940.653 Ne II P71 90 2946.044 Ne II P71 150 2955.725 Ne II P71 150 2963.236 Ne II P71 150 2967.184 Ne II P71 100 2972.997 Ne II P71 30 2974.7189 Ne I SS04 100 2979.461 Ne II P71 30 2982.6696 Ne I SS04 150 3001.668 Ne II P71 120 3017.311 Ne II P71 300 P 3027.016 Ne II P71 300 P 3028.864 Ne II P71 100 3030.787 Ne II P71 120 3034.461 Ne II P71 100 3035.923 Ne II P71 100 3037.720 Ne II P71 100 3039.586 Ne II P71 100 3044.088 Ne II P71 100 3045.556 Ne II P71 120 3047.556 Ne II P71 100 3054.345 Ne II P71 100 3054.677 Ne II P71 30 3057.3907 Ne I SS04 100 3059.106 Ne II P71 100 3062.491 Ne II P71 100 3063.301 Ne II P71 100 3070.887 Ne II P71 100 3071.529 Ne II P71 100 3075.731 Ne II P71 120 3088.166 Ne II P71 100 3092.092 Ne II P71 120 3092.901 Ne II P71 100 3094.006 Ne II P71 100 3095.103 Ne II P71 100 3097.131 Ne II P71 100 3117.980 Ne II P71 120 3118.160 Ne II P71 300 3141.332 Ne II P71 100 3143.721 Ne II P71 100 3148.681 Ne II P71 100 3164.429 Ne II P71 100 3165.648 Ne II P71 100 3188.743 Ne II P71 120 3194.579 Ne II P71 500 P 3198.586 Ne II P71 60 3208.965 Ne II P71 120 3209.356 Ne II P71 120 3213.735 Ne II P71 150 3214.329 Ne II P71 150 3218.193 Ne II P71 120 3224.818 Ne II P71 120 3229.573 Ne II P71 200 3230.070 Ne II P71 120 3230.419 Ne II P71 120 3232.022 Ne II P71 150 3232.372 Ne II P71 100 3243.396 Ne II P71 100 3244.095 Ne II P71 100 3248.345 Ne II P71 100 3250.355 Ne II P71 150 3297.726 Ne II P71 150 3309.740 Ne II P71 300 3319.722 Ne II P71 1000 P 3323.745 Ne II P71 150 3327.153 Ne II P71 100 3329.158 Ne II P71 200 3334.836 Ne II P71 150 3344.395 Ne II P71 300 3345.453 Ne II P71 150 3345.829 Ne II P71 200 3355.016 Ne II P71 120 3357.820 Ne II P71 200 3360.597 Ne II P71 120 3362.161 Ne II P71 100 3362.707 Ne II P71 120 3367.218 Ne II P71 50 3369.8076 Ne I SS04 70 3369.9072 Ne I SS04 100 3371.799 Ne II P71 500 P 3378.216 Ne II P71 150 3388.417 Ne II P71 120 3388.945 Ne II P71 300 3392.798 Ne II P71 100 3404.822 Ne II P71 120 3406.947 Ne II P71 100 3413.148 Ne II P71 120 3416.914 Ne II P71 120 3417.688 Ne II P71 50 3417.9031 Ne I SS04 5 3418.0055 Ne I SS04 120 3428.687 Ne II P71 20 3447.7024 Ne I SS04 10 3454.1944 Ne I SS04 100 3456.610 Ne II P71 100 3459.321 Ne II P71 10 3460.5237 Ne I SS04 10 3464.3382 Ne I SS04 20 3466.5781 Ne I SS04 50 3472.5706 Ne I SS04 150

Strong Lines of Sodium (Na)

Strong Lines of Sodium (Na)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 90 P 300.15 Na II W71 90 300.20 Na II W71 50 301.32 Na II W71 60 301.44 Na II W71 30 302.45 Na II W71 150 P 372.08 Na II W71 200 376.38 Na II W71 50 1374.69 Na II W71 50 1404.68 Na II W71 40 1506.41 Na II W71 50 1776.57 Na II W71 40 1787.19 Na II W71 40 1798.41 Na II W71 50 1807.09 Na II W71 40 1835.22 Na II W71 40 1853.17 Na II W71 90 1881.91 Na II W71 Air 150 2315.65 Na II W71 150 2420.99 Na II W71 150 2424.73 Na II W71 600 2493.15 Na II W71 300 2515.46 Na II W71 300 2531.54 Na II W71 300 2586.31 Na II W71 300 2594.96 Na II W71 500 2611.81 Na II W71 500 2661.00 Na II W71 600 2671.83 Na II W71 500 2678.09 Na II W71 2 2680.34 Na I R56 1 2680.43 Na I R56 500 2809.52 Na II W71 400 2839.56 Na II W71 600 2841.72 Na II W71 5 P 2852.81 Na I R56 2 P 2853.01 Na I R56 400 2859.49 Na II W71 400 2871.28 Na II W71 500 2881.15 Na II W71 500 2886.26 Na II W71 500 2901.14 Na II W71 400 2904.72 Na II W71 600 2904.92 Na II W71 600 2917.52 Na II W71 600 2919.05 Na II W71 700 2919.85 Na II W71 700 2920.95 Na II W71 600 2923.49 Na II W71 500 2937.74 Na II W71 500 2947.50 Na II W71 700 2951.24 Na II W71 600 2952.40 Na II W71 600 2977.13 Na II W71 600 2979.66 Na II W71 600 2980.63 Na II W71 700 2984.19 Na II W71 300 3004.15 Na II W71 400 3007.44 Na II W71 400 3009.14 Na II W71 300 3015.40 Na II W71 500 3053.67 Na II W71 600 3056.16 Na II W71 400 3060.25 Na II W71 400 3061.35 Na II W71 600 P 3092.73 Na II W71 400 3094.45 Na II W71 400 3095.55 Na II W71 900 3124.42 Na II W71 1000 3135.48 Na II W71 900 3137.86 Na II W71 500 3145.71 Na II W71 1000 3149.28 Na II W71 1000 3163.74 Na II W71 600 3179.06 Na II W71 900 3189.79 Na II W71 900 3212.19 Na II W71 800 3257.96 Na II W71 500 3274.22 Na II W71 1000 P 3285.60 Na II W71 900 3301.35 Na II W71 15 P 3302.37 Na I R56 8 P 3302.98 Na I R56 800 3304.96 Na II W71 600 3318.04 Na II W71 500 3327.69 Na II W71 1 3426.86 Na I R56 800 3533.05 Na II W71 700 3631.27 Na II W71 500 3711.07 Na II W71 150 4113.70 Na II W71 1 4324.62 Na I R56 1 4390.03 Na I R56 600 4392.81 Na II W71 1 4393.34 Na I R56 400 4405.12 Na II W71 500 4455.23 Na II W71 400 4490.87 Na II W71 1 4494.18 Na I R56 1 4497.66 Na I R56 2 4664.811 Na I R56 2 4668.560 Na I R56 2 4978.541 Na I R56 5 4982.813 Na I R56 1 5148.838 Na I R56 1 5153.402 Na I R56 50 5414.55 Na II W71 4 5682.633 Na I R56 1 5688.193 Na I R56 7 5688.205 Na I R56 1000 P 5889.950 Na I R56 500 P 5895.924 Na I R56 2 6154.225 Na I R56 3 6160.747 Na I R56 50 6514.21 Na II W71 70 6530.70 Na II W71 70 6544.04 Na II W71 70 6545.75 Na II W71 1 7809.78 Na I R56 60 P 8183.256 Na I R56 10 P 8194.790 Na I R56 110 P 8194.824 Na I R56 1 8649.92 Na I R56 1 8650.89 Na I R56 1 9153.88 Na I R56 1 9465.94 Na I R56 1 9961.28 Na I R56 1 10572.28 Na I R56 2 10746.44 Na I R56 1 10749.29 Na I R56 2 10834.87 Na I R56 1 11197.21 Na I R56 5 P 11381.45 Na I R56 12 P 11403.78 Na I R56 5 12679.17 Na I R56 1 14767.48 Na I R56 1 14779.73 Na I R56 1 16373.85 Na I R56 1 16388.85 Na I R56 5 P 18465.25 Na I R56 1 22056.44 Na I R56 1 23348.41 Na I R56 1 23379.13 Na I R56

Strong Lines of Silicon (Si)

Strong Lines of Silicon (Si)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 70 892.001 Si II RA65 70 992.684 Si II RA65 300 P 1190.4160 Si II KE74 700 P 1193.2898 Si II KE74 800 P 1194.5004 Si II KE74 70 1228.746 Si II S61b 100 1229.388 Si II S61b 100 1248.426 Si II S61b 70 1250.433 Si II S61b 130 1251.164 Si II S61b 500 P 1260.4223 Si II KE74 1000 P 1264.7379 Si II KE74 100 1309.2766 Si II KE74 70 1350.057 Si II S61b 150 1526.70698 Si II GK00 300 P 1533.4318 Si II KE74 70 1594.5655 Si I RAKL67 70 1594.9493 Si I RAKL67 90 1622.8806 Si I RAKL67 100 1629.441 Si I KRA66 100 1629.9477 Si I RAKL67 200 1675.2052 Si I RAKL67 200 1696.2065 Si I RAKL67 250 1697.9409 Si I RAKL67 300 1770.9223 Si I RAKL67 30 1808.01288 Si II GK00 250 1814.0794 Si I RAKL67 40 1816.9290 Si II KE74 200 1836.5102 Si I RAKL67 400 1841.4490 Si I RAKL67 200 1843.7700 Si I RAKL67 200 1845.5203 Si I RAKL67 200 1846.1118 Si I RAKL67 300 1847.4737 Si I RAKL67 200 1848.1504 Si I RAKL67 250 1848.7480 Si I RAKL67 400 P 1850.6719 Si I RAKL67 250 1852.4717 Si I RAKL67 200 1874.8423 Si I RAKL67 400 P 1901.3377 Si I RAKL67 400 P 1977.5978 Si I RAKL67 400 P 1979.2056 Si I RAKL67 300 P 1980.6185 Si I RAKL67 300 P 1983.2330 Si I RAKL67 500 P 1986.3640 Si I RAKL67 1000 P 1988.9937 Si I RAKL67 Air 600 P 2058.1323 Si I KRA66 20 2072.016 Si II S61b 30 2072.701 Si II S61b 400 P 2207.978 Si I RA65 500 P 2210.894 Si I RA65 300 P 2211.744 Si I RA65 500 P 2216.669 Si I RA65 400 P 2218.057 Si I RA65 300 2435.154 Si I RA65 400 P 2506.897 Si I RA65 400 P 2514.316 Si I RA65 500 P 2516.112 Si I RA65 400 P 2519.202 Si I RA65 400 P 2524.108 Si I RA65 400 P 2528.509 Si I RA65 200 2631.282 Si I RA65 1000 P 2881.5771 Si I BE93 50 2904.283 Si II S61b 80 2905.692 Si II S61b 150 2987.645 Si I RA65 15 h 3053.184 Si II S61b 15 3188.97 Si II S61b 15 3193.09 Si II S61b 7 3199.514 Si II S61b 20 h 3203.872 Si II S61b 30 h 3210.020 Si II RA65 20 3333.139 Si II S61b 30 3339.819 Si II S61b 100 P ,h 3856.017 Si II S61b 40 h 3862.595 Si II S61b 200 3905.523 Si I RA65 50 P ,h 4128.067 Si II S61b 70 P ,h 4130.893 Si II S61b 20 4621.721 Si II S61b 130 P 5041.026 Si II S61b 130 P 5055.981 Si II S61b 25 h 5192.86 Si II S61b 70 h 5202.41 Si II S61b 70 h 5466.432 Si II S61b 70 h 5466.868 Si II S61b 25 h 5496.45 Si II S61b 20 h 5576.66 Si II S61b 25 h 5639.48 Si II S61b 20 h 5660.66 Si II S61b 130 P ,h 5669.562 Si II S61b 60 5684.484 Si I RA65 40 h 5688.81 Si II S61b 25 h 5701.37 Si II S61b 80 5708.397 Si I RA65 25 h 5800.47 Si II S61b 30 5806.74 Si II S61b 50 h 5868.40 Si II S61b 25 5915.22 Si II S61b 50 P 5948.545 Si I RA65 80 5957.561 Si II S61b 80 5978.929 Si II S61b 40 6155.134 Si I RA65 40 6237.320 Si I RA65 30 6243.813 Si I RA65 30 6244.468 Si I RA65 40 6254.188 Si I RA65 130 P 6347.103 Si II S61b 100 P 6371.359 Si II S61b 40 7003.567 Si I RA65 40 7005.883 Si I RA65 60 7034.903 Si I RA65 50 7165.545 Si I RA65 40 7250.625 Si I RA65 40 7275.294 Si I RA65 100 P 7289.1730 Si I MKMD94 90 P 7405.7740 Si I MKMD94 50 7409.082 Si I RA65 60 7415.946 Si I RA65 100 P 7423.497 Si I RA65 50 7848.80 Si II S61b 70 7849.72 Si II S61b 25 7932.349 Si I RA65 30 7944.001 Si I RA65 25 8556.7803 Si I BE93 20 10585.140 Si I BE93 20 10603.427 Si I BE93 20 10660.970 Si I BE93 20 10827.088 Si I BE93 20 10869.539 Si I BE93 50 P 11984.201 Si I BE93 30 11991.562 Si I BE93 60 P 12031.503 Si I BE93 20 12103.535 Si I BE93 15 12270.692 Si I BE93 25 15888.431 Si I BE93

Strong Lines of Chlorine (Cl)

Strong Lines of Chlorine (Cl)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 600 787.580 Cl II RK74 600 788.740 Cl II RK74 600 793.342 Cl II RK74 700 P 839.297 Cl II RK74 900 P 839.599 Cl II RK74 800 P 841.414 Cl II RK74 600 P 851.691 Cl II RK74 700 P 1063.831 Cl II RK74 300 P 1067.945 Cl II RK74 1000 P 1071.036 Cl II RK74 700 P 1071.767 Cl II RK74 600 P 1075.230 Cl II RK74 600 P 1079.080 Cl II RK74 150 1179.293 Cl I RK69 300 P 1335.726 Cl I RK69 1000 P 1347.240 Cl I RK69 500 P 1351.657 Cl I RK69 500 P 1363.447 Cl I RK69 120 1373.116 Cl I RK69 500 P 1379.528 Cl I RK69 500 P 1389.693 Cl I RK69 500 P 1389.957 Cl I RK69 500 P 1396.527 Cl I RK69 Air 25 3833.348 Cl II RK74 15 3845.367 Cl II RK74 20 3845.651 Cl II RK74 60 P 3850.991 Cl II RK74 40 P 3851.373 Cl II RK74 140 P 3860.83 Cl II RK74 25 3860.985 Cl II RK74 60 P ,h 4132.498 Cl II RK74 30 4372.93 Cl II RK74 25 4768.649 Cl II RK74 70 4781.318 Cl II RK74 600 P 4794.55 Cl II RK74 150 P 4810.06 Cl II RK74 90 4819.471 Cl II RK74 400 P 4896.77 Cl II RK74 250 P 4904.776 Cl II RK74 140 P 4917.731 Cl II RK74 60 4995.477 Cl II RK74 140 P 5078.264 Cl II RK74 300 P 5217.94 Cl II RK74 130 P 5221.355 Cl II RK74 80 P 5392.119 Cl II RK74 600 P 5423.23 Cl II RK74 60 5423.507 Cl II RK74 110 P 5443.37 Cl II RK74 60 5444.205 Cl II RK74 30 5457.022 Cl II RK74 40 7256.620 Cl I RK69 25 7414.114 Cl I RK69 60 P 7547.072 Cl I RK69 12 7672.419 Cl I RK69 40 7717.581 Cl I RK69 50 P 7744.970 Cl I RK69 11 7769.163 Cl I RK69 11 7821.363 Cl I RK69 8 7830.746 Cl I RK69 15 7878.215 Cl I RK69 12 7899.310 Cl I RK69 9 7915.084 Cl I RK69 15 7924.645 Cl I RK69 10 7933.894 Cl I RK69 8 7935.012 Cl I RK69 14 7997.854 Cl I RK69 11 8015.611 Cl I RK69 8 8084.508 Cl I RK69 11 8085.562 Cl I RK69 15 8086.672 Cl I RK69 12 8194.420 Cl I RK69 11 8199.128 Cl I RK69 11 8200.21 Cl I RK69 90 P 8212.038 Cl I RK69 15 8220.445 Cl I RK69 100 P 8221.742 Cl I RK69 90 P 8333.307 Cl I RK69 500 P 8375.94 Cl I RK69 80 P 8428.254 Cl I RK69 11 8467.341 Cl I RK69 11 8550.438 Cl I RK69 100 P 8575.24 Cl I RK69 400 P 8585.97 Cl I RK69 20 8686.26 Cl I RK69 11 8912.921 Cl I RK69 15 8948.063 Cl I RK69 10 9038.982 Cl I RK69 12 9045.433 Cl I RK69 10 9073.166 Cl I RK69 40 9121.146 Cl I RK69 15 9191.731 Cl I RK69 20 9288.856 Cl I RK69 20 9452.098 Cl I RK69 20 9592.222 Cl I RK69 8 15730.1 Cl I RK69 14 15869.7 Cl I RK69

Strong Lines of Phosphorus (P)

Strong Lines of Phosphorus (P)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 200 P 1310.700 P II SMZ83 80 P 1532.530 P II SMZ83 130 P 1535.917 P II SMZ83 80 P 1536.410 P II SMZ83 130 P 1542.297 P II SMZ83 800 P 1674.591 P I S80 1000 P 1679.695 P I S80 1000 P 1774.951 P I S80 800 P 1782.838 P I S80 700 P 1787.656 P I S80 600 1858.886 P I S80 400 1859.393 P I S80 Air 200 2032.432 P I S80 300 2033.477 P I S80 200 P 2135.465 P I S80 400 P 2136.182 P I S80 400 P 2149.145 P I S80 150 P 2152.940 P I S80 300 P 2154.080 P I S80 400 P 2533.987 P I M59 500 P 2535.606 P I M59 400 P 2553.253 P I M59 300 2554.904 P I M59 80 4420.71 P II M59 110 P 4588.04 P II M59 110 P 4589.86 P II M59 130 P 4602.08 P II M59 110 4943.53 P II M59 80 5296.13 P II M59 80 5425.91 P II M59 80 5450.74 P II M59 110 P 6024.18 P II M59 80 6034.04 P II M59 110 P 6043.12 P II M59 70 6087.82 P II M59 70 6165.59 P II M59 60 6199.024 P I S80 130 P 6459.99 P II M59 130 P 6503.46 P II M59 130 P 6507.97 P II M59 30 8741.529 P I S80 50 9193.85 P I S80 30 9278.88 P I S80 70 9304.94 P I S80 30 9323.50 P I S80 50 9435.069 P I S80 50 9441.86 P I S80 30 9452.83 P I S80 70 9493.56 P I S80 90 P 9525.73 P I S80 80 P 9545.18 P I S80 90 P 9563.439 P I S80 40 9609.04 P I S80 20 9638.939 P I S80 30 9676.24 P I S80 80 P 9734.750 P I S80 80 P 9750.77 P I S80 30 9790.21 P I S80 90 P 9796.85 P I S80 20 9903.68 P I S80 50 10529.52 P I S80 70 10581.57 P I S80 40 11183.23 P I S80 25 14241.64 P I S80 40 15711.52 P I S80 90 16482.92 P I S80 30 16590.07 P I S80

Strong Lines of Sulfur (S)

Strong Lines of Sulfur (S)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 400 906.885 S II KM93 300 910.484 S II KM93 250 912.735 S II KM93 250 937.421 S II KM93 300 937.684 S II KM93 250 1014.449 S II KM93 400 P 1250.578 S II KM93 900 P 1253.805 S II KM93 1000 P 1259.518 S II KM93 200 1388.435 S I KM93 120 1392.588 S I KM93 250 1396.112 S I KM93 150 1401.514 S I KM93 1000 P 1425.030 S I KM93 600 P 1433.280 S I KM93 200 P 1433.310 S I KM93 250 1436.968 S I KM93 1000 P 1473.995 S I KM93 700 1483.039 S I KM93 900 P 1666.688 S I KM93 800 P 1687.530 S I KM93 1000 P 1807.311 S I KM93 900 P 1820.343 S I KM93 800 P 1826.245 S I KM93 200 1900.286 S I KM93 100 1914.698 S I KM93 Air 200 4153.064 S II KM93 250 4162.665 S II KM93 40 4694.13 S I KM93 140 P 5428.667 S II KM93 250 P 5432.815 S II KM93 400 P 5453.828 S II KM93 150 P 5473.620 S II KM93 150 P 5509.718 S II KM93 150 P 5606.151 S II KM93 150 P 5639.972 S II KM93 120 5659.985 S II KM93 40 6757.16 S I KM93 150 P 7578.909 S II KM93 120 P 7629.740 S II KM93 100 7923.90 S I KM93 80 P 7967.371 S II KM93 120 P 8314.594 S II KM93 40 8694.71 S I KM93 150 P 9212.865 S I KM93 100 P 9228.092 S I KM93 80 P 9237.538 S I KM93 200 P 10455.451 S I KM93 30 P 10456.757 S I KM93 130 P 10459.406 S I KM93

Strong Lines of Argon (Ar)

Strong Lines of Argon (Ar)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 10 487.2272 Ar II M71 15 490.6495 Ar II M71 10 490.7013 Ar II M71 10 519.3270 Ar II M71 10 542.9124 Ar II M71 70 543.2033 Ar II M71 25 547.4606 Ar II M71 25 556.8170 Ar II M71 25 573.3619 Ar II M71 10 576.7364 Ar II M71 25 580.2632 Ar II M71 10 583.4371 Ar II M71 25 597.7001 Ar II M71 10 602.8584 Ar II M71 10 612.3716 Ar II M71 150 P 661.8690 Ar II M71 10 664.5623 Ar II M71 70 666.0109 Ar II M71 300 P 670.9455 Ar II M71 1000 P 671.8513 Ar II M71 25 676.2425 Ar II M71 10 677.9518 Ar II M71 10 679.2184 Ar II M71 70 679.4006 Ar II M71 70 718.0899 Ar II M71 1000 P 723.3606 Ar II M71 150 725.5485 Ar II M71 25 730.9297 Ar II M71 70 740.2692 Ar II M71 70 744.9248 Ar II M71 25 745.3223 Ar II M71 20 802.85896 Ar I M73 100 806.4710 Ar I M73 60 806.86887 Ar I M73 30 807.21842 Ar I M73 40 807.6529 Ar I M73 50 809.92660 Ar I M73 120 816.23193 Ar I M73 70 816.46391 Ar I M73 80 820.12352 Ar I M73 120 825.34592 Ar I M73 120 826.36484 Ar I M73 150 834.3918 Ar I M73 100 835.00210 Ar I M73 100 842.80506 Ar I M73 180 P 866.79997 Ar I M73 150 P 869.75411 Ar I M73 180 P 876.05767 Ar I M73 180 P 879.94656 Ar I M73 150 P 894.31013 Ar I M73 300 P 919.7810 Ar II M71 300 P 932.0537 Ar II M71 1000 P 1048.21987 Ar I VHU99 500 P 1066.65980 Ar I M73 Air 2 2420.456 Ar II N73 3 2516.789 Ar II N73 3 2534.709 Ar II N73 5 2562.087 Ar II N73 8 2891.612 Ar II N73 70 2942.893 Ar II N73 30 2979.050 Ar II N73 15 3033.508 Ar II N73 15 3093.402 Ar II N73 7 3243.689 Ar II N73 8 3293.640 Ar II N73 7 3307.228 Ar II N73 8 3350.924 Ar II N73 8 3376.436 Ar II N73 8 3388.531 Ar II N73 25 3476.747 Ar II N73 7 3478.232 Ar II N73 15 3491.244 Ar II N73 30 3491.536 Ar II N73 25 3509.778 Ar II N73 25 3514.388 Ar II N73 25 3545.596 Ar II N73 25 3545.845 Ar II N73 30 3559.508 Ar II N73 30 3561.030 Ar II N73 25 3576.616 Ar II N73 8 3581.608 Ar II N73 15 3582.355 Ar II N73 25 3588.441 Ar II N73 8 3622.138 Ar II N73 7 3639.833 Ar II N73 12 3718.206 Ar II N73 25 3729.309 Ar II N73 15 3737.889 Ar II N73 50 3765.270 Ar II N73 15 3766.119 Ar II N73 1 3770.369 Ar I N73 7 3770.520 Ar II N73 8 3780.840 Ar II N73 8 3803.172 Ar II N73 15 3809.456 Ar II N73 25 3850.581 Ar II N73 12 3868.528 Ar II N73 12 3925.719 Ar II N73 15 3928.623 Ar II N73 8 3932.547 Ar II N73 25 3946.097 Ar II N73 1 3948.979 Ar I N73 7 3979.356 Ar II N73 12 3994.792 Ar II N73 15 4013.857 Ar II N73 15 4033.809 Ar II N73 7 4035.460 Ar II N73 50 4042.894 Ar II N73 1 4044.418 Ar I N73 30 4052.921 Ar II N73 70 4072.005 Ar II N73 25 4072.385 Ar II N73 8 4076.628 Ar II N73 12 4079.574 Ar II N73 8 4082.387 Ar II N73 50 4103.912 Ar II N73 100 4131.724 Ar II N73 12 4156.086 Ar II N73 11 4158.590 Ar I N73 1 4164.180 Ar I N73 12 4179.297 Ar II N73 1 4181.884 Ar I N73 3 4190.713 Ar I N73 1 4191.029 Ar I N73 6 4198.317 Ar I N73 11 4200.674 Ar I N73 8 4218.665 Ar II N73 8 4222.637 Ar II N73 8 4226.988 Ar II N73 30 4228.158 Ar II N73 30 4237.220 Ar II N73 1 4251.185 Ar I N73 6 4259.362 Ar I N73 3 4266.286 Ar I N73 25 4266.527 Ar II N73 4 4272.169 Ar I N73 200 P 4277.528 Ar II N73 7 4282.898 Ar II N73 3 4300.101 Ar I N73 8 4300.650 Ar II N73 25 4309.239 Ar II N73 70 4331.200 Ar II N73 15 4332.030 Ar II N73 3 4333.561 Ar I N73 1 4335.338 Ar I N73 1 4345.168 Ar I N73 250 P 4348.064 Ar II N73 15 4352.205 Ar II N73 8 4362.066 Ar II N73 15 4367.832 Ar II N73 70 4370.753 Ar II N73 25 4371.329 Ar II N73 15 4375.954 Ar II N73 50 4379.667 Ar II N73 15 4385.057 Ar II N73 25 4400.097 Ar II N73 70 4400.986 Ar II N73 130 4426.001 Ar II N73 50 4430.189 Ar II N73 15 4430.996 Ar II N73 15 4433.838 Ar II N73 7 4439.461 Ar II N73 12 4448.879 Ar II N73 30 4474.759 Ar II N73 70 4481.811 Ar II N73 3 4510.733 Ar I N73 1 4522.323 Ar I N73 7 4530.552 Ar II N73 130 4545.052 Ar II N73 7 4564.405 Ar II N73 130 4579.350 Ar II N73 130 4589.898 Ar II N73 200 P 4609.567 Ar II N73 12 4637.233 Ar II N73 130 4657.901 Ar II N73 7 4721.591 Ar II N73 200 P 4726.868 Ar II N73 15 4732.053 A

Strong Lines of Calcium (Ca)

Strong Lines of Calcium (Ca)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 250 1649.858 Ca II ER56 140 1651.991 Ca II ER56 250 1840.061 Ca II ER56 Air 2197.787 Ca II ER56 2208.611 Ca II ER56 120 2275.462 Ca I R68 140 P 2721.645 Ca I R68 700 P 3158.869 Ca II ER56 800 P 3179.332 Ca II ER56 700 3181.275 Ca II ER56 700 P 3706.026 Ca II ER56 800 P 3736.901 Ca II ER56 1000 P 3933.6614 Ca II L99 1000 P 3968.4673 Ca II L99 1000 P 4226.727 Ca I R68 500 4302.527 Ca I R68 500 4307.741 Ca I R68 500 P 4425.441 Ca I R68 500 P 4434.960 Ca I R68 500 P 4435.688 Ca I R68 600 P 4454.781 Ca I R68 600 P 4455.887 Ca I R68 400 P 4456.605 Ca I R68 500 4878.132 Ca I R68 300 5019.971 Ca II ER56 500 5188.848 Ca I R68 500 5265.557 Ca I R68 500 5270.270 Ca I R68 500 5349.472 Ca I R68 500 5581.971 Ca I R68 500 P 5588.757 Ca I R68 500 5590.120 Ca I R68 500 5594.468 Ca I R68 500 5598.487 Ca I R68 600 5857.452 Ca I R68 500 P 6102.722 Ca I R68 600 P 6122.219 Ca I R68 600 P 6162.172 Ca I R68 500 6169.055 Ca I R68 600 6169.559 Ca I R68 700 P 6439.073 Ca I R68 600 6449.810 Ca I R68 300 6456.874 Ca II ER56 700 P 6462.566 Ca I R68 600 6471.660 Ca I R68 600 P 6493.780 Ca I R68 600 6499.649 Ca I R68 500 P 6572.777 Ca I R68 600 6717.685 Ca I R68 700 7148.147 Ca I R68 600 7202.194 Ca I R68 700 7326.146 Ca I R68 300 7601.304 Ca II R68 400 8201.720 Ca II ER56 500 8248.797 Ca II ER56 600 8498.018 Ca II ER56 700 P 8542.089 Ca II ER56 700 P 8662.140 Ca II ER56 400 8912.07 Ca II ER56 500 8927.36 Ca II ER56 500 9213.900 Ca II R68 400 9311.998 Ca II R68 400 9319.560 Ca II R68 500 9320.650 Ca II R68 500 9416.967 Ca I R68 400 9567.965 Ca II R68 500 9599.235 Ca II R68 300 9601.815 Ca II R68 300 9854.74 Ca II ER56 500 9890.63 Ca II ER56 400 9931.39 Ca II ER56 400 10223.04 Ca II R68 500 12816.04 Ca I R68 500 12909.10 Ca I R68 600 13033.57 Ca I R68 600 19046.14 Ca I R68 1000 19309.20 Ca I R68 1000 19452.99 Ca I R68 900 19505.72 Ca I R68 1000 19776.79 Ca I R68 700 19853.10 Ca I R68 700 19862.22 Ca I R68 500 22624.93 Ca I R68 600 22651.23 Ca I R68

Strong Lines of Potassium (K)

Strong Lines of Potassium (K)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 800 441.81 K II E31 150 465.08 K II E31 469.50 K II E31 300 476.03 K II E31 1000 495.14 K II E31 1000 P 600.77 K II E31 800 P 607.93 K II E31 1000 P 612.62 K II E31 Air 200 2190.00 K II D26 200 2550.02 K II D26 2992.12 K I R56 2992.22 K I R56 3034.76 K I R56 3034.92 K I R56 150 3101.79 K I R56 120 3102.04 K I R56 200 3105.00 K II D26 300 3217.16 K I R56 250 3217.62 K I R56 250 3440.05 K II D26 400 3446.37 K I R56 400 3447.38 K I R56 250 3530.75 K II D26 200 3618.49 K II D26 120 3648.84 K I R56 150 3648.98 K I R56 200 3681.54 K II D26 200 3816.56 K II D26 250 3817.50 K II D26 250 3897.92 K II D26 250 4001.24 K II D26 700 P 4044.14 K I R56 700 P 4047.21 K I R56 250 4134.72 K II D26 250 4149.19 K II D26 250 4186.24 K II D26 250 4222.97 K II D26 250 4225.67 K II D26 250 4263.40 K II D26 250 4305.00 K II D26 250 4309.10 K II D26 250 4388.16 K II D26 250 4608.45 K II D26 400 4641.88 K I R56 400 4642.37 K I R56 150 4740.91 K I R56 250 4744.35 K I R56 200 4753.93 K I R56 300 4757.39 K I R56 200 4786.49 K I R56 300 4791.05 K I R56 250 4799.75 K I R56 300 4804.35 K I R56 300 4829.23 K II D26 300 4849.86 K I R56 300 4856.09 K I R56 300 4863.48 K I R56 400 4869.76 K I R56 300 4942.02 K I R56 400 4950.82 K I R56 400 4956.15 K I R56 400 4965.03 K I R56 250 5005.60 K II D26 250 5056.27 K II D26 400 5084.23 K I R56 400 5097.17 K I R56 400 5099.20 K I R56 500 5112.25 K I R56 500 5323.28 K I R56 500 5339.69 K I R56 500 5342.97 K I R56 600 5359.57 K I R56 600 5782.38 K I R56 700 5801.75 K I R56 600 5812.15 K I R56 700 5831.89 K I R56 250 6120.27 K II D26 250 6307.29 K II D26 800 6911.08 K I R56 500 6936.28 K I R56 800 6938.77 K I R56 300 6964.18 K I R56 500 6964.67 K I R56 1000 P 7664.8991 K I E99 1000 P 7698.9645 K I E99 200 7955.37 K I R56 150 7956.83 K I R56 300 8078.11 K I R56 250 8079.62 K I R56 400 8250.18 K I R56 300 8251.74 K I R56 120 8390.22 K I R56 8391.44 K I R56 80 8417.54 K I R56 40 8420.00 K I R56 400 8503.45 K I R56 400 8505.11 K I R56 150 8763.96 K I R56 120 8767.05 K I R56 500 8902.19 K I R56 500 8904.02 K I R56 200 8923.31 K I R56 150 8925.44 K I R56 300 9347.24 K I R56 120 9349.25 K I R56 250 9351.59 K I R56 600 9595.70 K I R56 600 9597.83 K I R56 250 9949.67 K I R56 200 9954.14 K I R56 400 10479.63 K I R56 200 10482.15 K I R56 300 10487.11 K I R56 700 11019.87 K I R56 600 11022.67 K I R56 700 P 11690.21 K I R56 600 P 11769.62 K I R56 700 P 11772.83 K I R56 12432.24 K I R56 12522.11 K I R56 13377.86 K I R56 13397.09 K I R56 15163.08 K I R56 15168.40 K I R56 40158.37 K I L70b

Strong Lines of Scandium (Sc)

Strong Lines of Scandium (Sc)

Intensity Wavelength (Å) Spectrum Ref. Air 100 2552.350 Sc II JL80 80 2560.232 Sc II JL80 15 2706.738 Sc I AV77 25 2711.341 Sc I AV77 15 2965.879 Sc I AV77 50 2974.010 Sc I AV77 60 2980.755 Sc I AV77 15 2988.965 Sc I AV77 90 3015.367 Sc I AV77 120 3019.349 Sc I AV77 15 3030.759 Sc I AV77 70 3255.676 Sc I AV77 200 P 3269.897 Sc I AV77 250 P 3273.628 Sc I AV77 400 P 3353.724 Sc II JL80 70 3359.668 Sc II JL80 60 3361.257 Sc II JL80 60 3361.926 Sc II JL80 140 3368.936 Sc II JL80 250 P 3372.150 Sc II JL80 12 3431.351 Sc I AV77 25 3435.541 Sc I AV77 12 3457.442 Sc I AV77 100 3535.713 Sc II JL80 250 3558.534 Sc II JL80 200 3567.702 Sc II JL80 500 P 3572.530 Sc II JL80 400 P 3576.340 Sc II JL80 300 P 3580.928 Sc II JL80 140 3589.633 Sc II JL80 140 3590.474 Sc II JL80 1000 P 3613.831 Sc II JL80 700 P 3630.742 Sc II JL80 500 P 3642.782 Sc II JL80 250 3645.308 Sc II JL80 200 3651.798 Sc II JL80 900 P 3907.484 Sc I AV77 1000 P 3911.812 Sc I AV77 200 P 3933.375 Sc I AV77 250 P 3996.601 Sc I AV77 900 P 4020.387 Sc I AV77 900 P 4023.678 Sc I AV77 10 4030.622 Sc I AV77 10 4043.803 Sc I AV77 120 4047.797 Sc I AV77 250 P 4054.544 Sc I AV77 10 4056.593 Sc I AV77 250 P 4082.387 Sc I AV77 15 4087.150 Sc I AV77 20 h 4132.984 Sc I AV77 25 h 4140.272 Sc I AV77 30 4152.341 Sc I AV77 50 h 4165.187 Sc I AV77 15 4238.053 Sc I AV77 500 P 4246.820 Sc II JL80 150 4314.082 Sc II JL80 120 4320.745 Sc II JL80 90 4324.998 Sc II JL80 70 4374.462 Sc II JL80 20 4729.209 Sc I AV77 25 4734.109 Sc I AV77 30 4737.647 Sc I AV77 30 4741.024 Sc I AV77 50 4743.821 Sc I AV77 10 4779.354 Sc I AV77 11 5064.306 Sc I AV77 25 5070.257 Sc I AV77 11 5075.820 Sc I AV77 90 5081.561 Sc I AV77 50 5083.721 Sc I AV77 50 5085.549 Sc I AV77 15 5087.123 Sc I AV77 12 5089.930 Sc I AV77 15 5096.721 Sc I AV77 25 5099.274 Sc I AV77 15 5101.119 Sc I AV77 14 5116.648 Sc I AV77 15 5210.547 Sc I AV77 12 5219.634 Sc I AV77 12 5258.364 Sc I AV77 15 5349.342 Sc I AV77 25 5356.097 Sc I AV77 12 5375.373 Sc I AV77 15 5392.058 Sc I AV77 12 5446.195 Sc I AV77 30 5482.012 Sc I AV77 25 5484.628 Sc I AV77 25 5514.230 Sc I AV77 30 5520.519 Sc I AV77 25 5526.785 Sc II JL80 70 5671.828 Sc I AV77 50 5686.856 Sc I AV77 50 5700.186 Sc I AV77 40 5711.793 Sc I AV77 10 5717.314 Sc I AV77 25 6210.66 Sc I AV77 14 6239.80 Sc I AV77 11 6258.90 Sc I AV77 30 6305.65 Sc I AV77 40 22052.1 Sc I AV77 40 22065.4 Sc I AV77

Strong Lines of Titanium (Ti)

Strong Lines of Titanium (Ti)

Intensity Wavelength (Å) Spectrum Ref. Air 25 2279.967 Ti I F91 25 2305.674 Ti I F91 30 2525.586 Ti II HJLW82 25 2529.871 Ti I F91 25 2541.908 Ti I F91 25 2593.640 Ti I F91 30 2599.904 Ti I F91 40 2605.133 Ti I F91 70 2611.285 Ti I F91 40 2619.933 Ti I F91 80 2641.087 Ti I F91 100 2644.253 Ti I F91 120 2646.625 Ti I F91 30 2802.494 Ti I F91 60 2912.083 Ti I F91 40 2928.327 Ti I F91 150 2948.242 Ti I F91 200 2956.123 Ti I F91 25 2967.225 Ti I F91 110 d 3066.229 Ti II HJLW82 50 3072.117 Ti II HJLW82 90 3072.986 Ti II HJLW82 130 3075.231 Ti II HJLW82 200 P 3078.651 Ti II HJLW82 300 P 3088.042 Ti II HJLW82 90 3119.723 Ti I F91 25 3123.073 Ti I F91 40 3161.231 Ti II HJLW82 60 3161.798 Ti II HJLW82 80 3162.586 Ti II HJLW82 130 3168.550 Ti II HJLW82 300 3186.451 Ti I F91 80 3190.914 Ti II HJLW82 400 3191.993 Ti I F91 500 3199.915 Ti I F91 60 3202.559 Ti II HJLW82 30 3203.825 Ti I F91 30 3214.237 Ti I F91 90 3217.073 Ti II HJLW82 110 3222.839 Ti II HJLW82 40 3228.618 Ti II HJLW82 60 3229.194 Ti II HJLW82 40 3229.430 Ti II HJLW82 600 P 3234.513 Ti II HJLW82 400 P 3236.581 Ti II HJLW82 300 P 3239.038 Ti II HJLW82 200 3241.994 Ti II HJLW82 100 3248.605 Ti II HJLW82 80 3251.909 Ti II HJLW82 100 3252.916 Ti II HJLW82 100 3254.251 Ti II HJLW82 100 3261.585 Ti II HJLW82 40 3287.657 Ti II HJLW82 40 3292.076 Ti I F91 30 3309.497 Ti I F91 110 3314.421 Ti I F91 30 3318.021 Ti II HJLW82 50 3321.697 Ti II HJLW82 250 3322.939 Ti II HJLW82 30 3326.765 Ti II HJLW82 200 3329.458 Ti II HJLW82 50 3332.112 Ti II HJLW82 150 3335.182 Ti II HJLW82 90 3340.341 Ti II HJLW82 700 3341.874 Ti I F91 30 3346.745 Ti II HJLW82 400 P 3349.029 Ti II HJLW82 1000 P 3349.405 Ti II HJLW82 500 3354.633 Ti I F91 40 3358.271 Ti I F91 40 3360.989 Ti I F91 600 P 3361.227 Ti II HJLW82 40 3361.266 Ti I F91 140 3370.434 Ti I F91 600 3371.452 Ti I F91 500 P 3372.798 Ti II HJLW82 150 3377.486 Ti I F91 400 3377.575 Ti I F91 40 3379.211 Ti I F91 120 3380.277 Ti II HJLW82 500 P 3383.769 Ti II HJLW82 20 3385.660 Ti I F91 200 3385.941 Ti I F91 120 3387.840 Ti II HJLW82 90 3394.578 Ti II HJLW82 70 3444.322 Ti II HJLW82 50 3461.507 Ti II HJLW82 50 3477.187 Ti II HJLW82 30 3480.525 Ti I F91 40 3491.072 Ti II HJLW82 70 3504.900 Ti II HJLW82 50 3510.862 Ti II HJLW82 25 3547.028 Ti I F91 25 3598.713 Ti I F91 80 3610.153 Ti I F91 600 P 3635.462 Ti I F91 800 P 3642.674 Ti I F91 25 3646.196 Ti I F91 900 P 3653.495 Ti I F91 40 3654.590 Ti I F91 80 3658.095 Ti I F91 50 3660.629 Ti I F91 50 3668.963 Ti I F91 80 3671.671 Ti I F91 250 P 3685.205 Ti II HJLW82 80 3689.914 Ti I F91 40 3709.957 Ti I F91 60 3717.391 Ti I F91 40 3722.570 Ti I F91 80 3724.569 Ti I F91 400 3729.806 Ti I F91 400 3741.060 Ti I F91 30 3741.644 Ti II HJLW82 700 P 3752.858 Ti I F91 80 3753.633 Ti I F91 300 P 3759.300 Ti II HJLW82 250 P 3761.326 Ti II HJLW82 80 3771.651 Ti I F91 110 3786.042 Ti I F91 30 3866.439 Ti I F91 30 3875.257 Ti I F91 60 3882.891 Ti I F91 40 3900.559 Ti II HJLW82 25 3900.959 Ti I F91 300 3904.784 Ti I F91 40 3913.477 Ti II HJLW82 60 3914.334 Ti I F91 40 3921.422 Ti I F91 140 3924.526 Ti I F91 110 3929.874 Ti I F91 140 3947.769 Ti I F91 600 P 3948.670 Ti I F91 600 P 3956.334 Ti I F91 700 P 3958.201 Ti I F91 120 3962.851 Ti I F91 120 3964.269 Ti I F91 600 P 3981.761 Ti I F91 70 3982.480 Ti I F91 700 P 3989.758 Ti I F91 1000 P 3998.636 Ti I F91 120 4008.927 Ti I F91 25 4009.656 Ti I F91 150 4024.571 Ti I F91 25 h 4030.511 Ti I F91 40 4055.011 Ti I F91 50 4060.262 Ti I F91 25 4064.209 Ti I F91 25 4065.095 Ti I F91 110 4078.470 Ti I F91 40 4082.455 Ti I F91 30 4112.708 Ti I F91 50 4186.117 Ti I F91 40 4263.133 Ti I F91 30 4274.588 Ti I F91 30 4282.698 Ti I F91 110 4286.003 Ti I F91 110 4287.402 Ti I F91 120 4289.070 Ti I F91 110 4290.929 Ti I F91 110 4295.748 Ti I F91 250 4298.665 Ti I F91 25 4299.202 Ti I F91 25 4299.629 Ti I F91 400 4300.554 Ti I F91 500 4301.079 Ti I F91 800 P 4305.907 Ti I F91 150 4314.800 Ti I F91 50 4318.629 Ti I F91 25 4325.126 Ti I F91 20 4393.922 Ti I F91 30 4395.004 Ti II HJLW82 30 4417.273 Ti I F91 110 4427.098 Ti I F91 110 4449.143 Ti I F91 70

Strong Lines of Vanadium (V)

Strong Lines of Vanadium (V)

Intensity Wavelength (Å) Spectrum Ref. Air 20 2507.782 V I DA78 20 2519.622 V I DA78 30 2526.221 V I DA78 20 2530.183 V I DA78 20 2574.018 V I DA78 300 P 2687.954 V II ICL88 200 P 2700.937 V II ICL88 140 2706.174 V II ICL88 150 2715.664 V II ICL88 20 2864.361 V I DA78 20 2868.095 V I DA78 250 2891.644 V II ICL88 140 2892.433 V II ICL88 250 2892.652 V II ICL88 400 P 2893.307 V II ICL88 250 2906.454 V II ICL88 130 2907.462 V II ICL88 600 P 2908.810 V II ICL88 200 2910.016 V II ICL88 140 2910.385 V II ICL88 150 2911.058 V II ICL88 30 2914.926 V I DA78 60 2923.619 V I DA78 600 P 2924.017 V II ICL88 400 P 2924.630 V II ICL88 200 2930.805 V II ICL88 250 2941.372 V II ICL88 120 2941.499 V II ICL88 20 2942.319 V I DA78 20 2942.388 V I DA78 20 2943.189 V I DA78 300 2944.569 V II ICL88 20 2949.629 V I DA78 150 2952.068 V II ICL88 30 2962.781 V I DA78 150 2968.374 V II ICL88 20 2977.540 V I DA78 20 3043.119 V I DA78 20 3043.548 V I DA78 20 3044.933 V I DA78 40 3053.653 V I DA78 100 3056.334 V I DA78 120 3060.456 V I DA78 200 3066.374 V I DA78 1000 P 3093.102 V II ICL88 800 P 3102.292 V II ICL88 700 P 3110.709 V II ICL88 500 P 3118.376 V II ICL88 400 P 3125.282 V II ICL88 140 3130.272 V II ICL88 110 3133.339 V II ICL88 250 P 3183.412 V I D76 400 P 3183.992 V I D76 300 P 3185.385 V I DA78 110 3187.717 V II ICL88 140 3188.522 V II ICL88 200 P 3190.686 V II ICL88 40 3198.012 V I DA78 60 3202.389 V I DA78 40 3205.577 V I DA78 40 3207.408 V I DA78 30 3212.432 V I DA78 300 3267.702 V II ICL88 250 3271.124 V II ICL88 200 P 3276.130 V II ICL88 150 3517.296 V II ICL88 20 3529.733 V I DA78 50 3533.676 V I DA78 150 3545.195 V II ICL88 150 3556.800 V II ICL88 150 3589.763 V II ICL88 130 3592.021 V II ICL88 50 3592.530 V I DA78 20 3663.604 V I DA78 20 3667.741 V I DA78 25 3673.406 V I DA78 25 3675.699 V I DA78 25 3680.119 V I DA78 50 3683.118 V I DA78 40 3687.498 V I DA78 110 3688.069 V I DA78 80 3690.282 V I DA78 120 3692.222 V I DA78 40 3695.342 V I DA78 80 3695.864 V I DA78 300 P 3703.574 V I DA78 150 3704.703 V I DA78 50 3705.038 V I DA78 20 3778.675 V I DA78 40 3790.325 V I DA78 90 3794.962 V I DA78 50 3799.907 V I DA78 50 3803.475 V I DA78 25 3807.502 V I DA78 40 3808.517 V I DA78 20 3809.596 V I DA78 80 3813.485 V I DA78 110 3818.240 V I DA78 20 3819.960 V I DA78 20 3821.483 V I DA78 50 3822.002 V I DA78 40 3822.886 V I DA78 25 3823.209 V I DA78 140 3828.555 V I DA78 25 3834.216 V I DA78 50 3840.429 V I DA78 200 3840.750 V I DA78 30 3844.434 V I DA78 25 3847.326 V I DA78 100 3855.363 V I DA78 250 P 3855.845 V I DA78 110 3864.856 V I DA78 20 3867.601 V I DA78 120 3875.071 V I DA78 40 3875.898 V I DA78 50 3876.082 V I DA78 60 3890.179 V I DA78 40 3892.858 V I DA78 200 P 3902.256 V I DA78 60 3909.888 V I DA78 20 3922.431 V I DA78 20 3924.651 V I DA78 20 3930.022 V I DA78 20 3934.010 V I DA78 40 3990.570 V I DA78 20 3992.802 V I DA78 40 3998.726 V I DA78 30 4050.955 V I DA78 30 4051.347 V I DA78 25 4057.064 V I DA78 20 4063.928 V I DA78 20 4071.536 V I DA78 90 4090.571 V I DA78 150 4092.684 V I DA78 70 4095.477 V I DA78 250 4099.784 V I DA78 50 4102.151 V I DA78 20 4104.382 V I DA78 20 4104.767 V I DA78 250 4105.155 V I DA78 200 4109.778 V I DA78 700 P 4111.780 V I DA78 20 4113.506 V I DA78 400 P 4115.180 V I DA78 150 4116.473 V I DA78 20 4119.446 V I DA78 150 4123.503 V I DA78 250 P 4128.064 V I DA78 250 P 4131.989 V I DA78 200 4134.485 V I DA78 20 4179.408 V I DA78 20 4209.853 V I DA78 30 4232.458 V I DA78 50 4268.638 V I DA78 40 4271.550 V I DA78 40 4276.953 V I DA78 40 4284.047 V I DA78 30 4291.82 V I MCS75 40 4330.026 V I DA78 40 4332.825 V I DA78 60 4341.008 V I DA78 80 4352.871 V I DA78 1000 P 4379.230 V I DA78 600 P 4384.710 V I DA78 400 P 4389.980 V I DA78 300 P 4395.223 V I DA78 120 4400.572 V I DA78 200 4406.638 V I DA78 250 4407.633 V I DA78 300 P 4408.195 V I DA78 400 P 4408.501 V I DA78 50 4416.469 V I DA78 50 4421.566 V I DA78 40 4426.002 V I DA78 25 4428.517 V I DA78 20 4429.800 V I DA78 40 4436.133 V I DA78 50 4437.830 V I DA78 70 4441.68 V I MCS75 50

Strong Lines of Chromium (Cr)

Strong Lines of Chromium (Cr)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 90 1220.165 Cr II SKRR03 150 1247.554 Cr II SKRR03 1000 P 1426.208 Cr II SKRR03 800 P 1431.323 Cr II SKRR03 600 P 1431.865 Cr II SKRR03 600 P 1432.056 Cr II SKRR03 500 P 1433.004 Cr II SKRR03 600 P 1434.808 Cr II SKRR03 400 P 1435.207 Cr II SKRR03 350 P 1435.582 Cr II SKRR03 300 1448.428 Cr II SKRR03 170 1669.876 Cr II SKRR03 150 1672.738 Cr II SKRR03 200 1676.152 Cr II SKRR03 180 1752.585 Cr II SKRR03 180 1760.747 Cr II SKRR03 150 1767.457 Cr II SKRR03 Air 1000 P 2055.59 Cr II K51 700 P 2061.54 Cr II K51 500 P 2065.46 Cr II K51 6 2383.303 Cr I K53 7 2408.60 Cr I K53 8 2496.30 Cr I K53 10 2504.31 Cr I K53 20 2519.51 Cr I K53 8 2549.548 Cr I K53 6 2560.695 Cr I K53 8 2571.74 Cr I K53 20 2591.84 Cr I K53 13 2653.57 Cr II K51 13 2658.59 Cr II K51 15 2663.42 Cr II K51 25 2666.02 Cr II K51 15 2668.71 Cr II K51 20 2671.80 Cr II K51 15 2672.83 Cr II K51 90 P 2677.19 Cr II K51 15 2678.79 Cr II K51 12 2687.09 Cr II K51 15 2691.03 Cr II K51 9 2698.40 Cr II K51 9 2698.68 Cr II K51 9 2722.74 Cr II K51 20 2726.496 Cr I K53 14 2731.895 Cr I K53 8 2736.463 Cr I K53 13 2743.63 Cr II K51 15 2748.98 Cr II K51 20 2750.72 Cr II K51 15 2751.85 Cr II K51 8 2757.086 Cr I K53 20 2757.72 Cr II K51 40 P 2762.58 Cr II K51 40 P 2766.55 Cr II K51 12 2769.902 Cr I K53 30 2780.695 Cr I K53 9 2822.38 Cr II K51 9 2830.46 Cr II K51 130 P 2835.63 Cr II K51 90 P 2843.24 Cr II K51 60 P 2849.83 Cr II K51 50 P 2855.67 Cr II K51 30 2858.91 Cr II K51 25 2860.92 Cr II K51 40 P 2862.57 Cr II K51 40 P 2865.10 Cr II K51 30 2866.72 Cr II K51 25 2867.65 Cr II K51 11 2870.43 Cr II K51 15 2875.97 Cr II K51 12 2876.24 Cr II K51 9 2877.97 Cr II K51 8 2886.995 Cr I K53 40 2889.294 Cr I K53 20 2893.254 Cr I K53 10 2894.168 Cr I K53 10 2896.756 Cr I K53 9 2905.477 Cr I K53 13 2909.049 Cr I K53 13 2910.892 Cr I K53 12 2911.148 Cr I K53 25 2967.64 Cr I K53 25 2971.102 Cr I K53 11 2971.90 Cr II K51 25 2975.478 Cr I K53 10 2979.73 Cr II K51 20 2980.784 Cr I K53 25 2985.849 Cr I K53 80 2986.01 Cr I K53 100 2986.466 Cr I K53 30 2988.638 Cr I K53 25 2991.877 Cr I K53 12 2994.06 Cr I K53 15 2995.094 Cr I K53 40 2996.571 Cr I K53 10 2998.783 Cr I K53 60 3000.88 Cr I K53 40 3005.06 Cr I K53 40 3013.72 Cr I K53 40 3014.756 Cr I K53 70 3014.932 Cr I K53 40 3015.197 Cr I K53 140 3017.591 Cr I K53 20 3018.492 Cr I K53 12 3018.827 Cr I K53 20 3020.671 Cr I K53 140 3021.576 Cr I K53 60 3024.359 Cr I K53 8 3029.165 Cr I K53 40 3030.25 Cr I K53 7 3031.346 Cr I K53 20 3034.191 Cr I K53 30 3037.049 Cr I K53 30 3040.837 Cr I K53 40 3053.87 Cr I K53 13 3118.64 Cr II K51 25 3120.36 Cr II K51 25 3124.94 Cr II K51 30 3132.05 Cr II K51 13 3180.70 Cr II K51 12 3197.08 Cr II K51 9 3209.19 Cr II K51 6 3257.826 Cr I K53 7 3339.81 Cr II K51 9 3358.49 Cr II K51 25 3368.04 Cr II K51 9 3403.30 Cr II K51 20 3408.76 Cr II K51 11 3421.19 Cr II K51 14 3422.73 Cr II K51 14 3433.589 Cr I K53 8 3436.190 Cr I K53 7 3441.449 Cr I K53 8 3445.604 Cr I K53 8 3447.426 Cr I K53 10 3453.328 Cr I K53 6 3455.607 Cr I K53 6 3573.636 Cr I K53 15 3574.796 Cr I K53 1000 P 3578.682 Cr I K53 800 P 3593.481 Cr I K53 20 3601.655 Cr I K53 600 P 3605.320 Cr I K53 6 3632.832 Cr I K53 20 3636.588 Cr I K53 30 3639.80 Cr I K53 11 3641.84 Cr I K53 11 3648.993 Cr I K53 8 3653.916 Cr I K53 11 3656.26 Cr I K53 6 3663.206 Cr I K53 6 3686.82 Cr I K53 6 3687.25 Cr I K53 6 3730.805 Cr I K53 8 3732.03 Cr I K53 25 3743.57 Cr I K53 30 3743.887 Cr I K53 15 3749.00 Cr I K53 12 3757.659 Cr I K53 13 3768.237 Cr I K53 6 3791.384 Cr I K53 6 3792.142 Cr I K53 6 3793.872 Cr I K53 7 3797.138 Cr I K53 10 3797.714 Cr I K53 25 3804.801 Cr I K53 9 3815.438 Cr I K53 9 3819.57 Cr I K53 6 3826.427 Cr I K53 20 3841.28 Cr I K53 10 3848.983 Cr I K53 7 3849.35 Cr I K53 14 3850.029 Cr I K53 7 3852.221 Cr I K53 10 3854.229 Cr I K53 7 3855.58 Cr I K53 13 3857.63 Cr I K53 30 3883.289 Cr I K53 30 3885.24 Cr I K53 2

Strong Lines of Iron (Fe)

Strong Lines of Iron (Fe)

Intensity Wavelength (Å) Spectrum Ref. Air 30 2178.0808 Fe I NJLT94 30 2259.5103 Fe I NJLT94 30 2292.5249 Fe I NJLT94 60 2298.1689 Fe I NJLT94 30 2300.1418 Fe I NJLT94 60 2327.3958 Fe II NLTH91 60 2331.3084 Fe II NLTH91 200 2332.7990 Fe II NLTH91 120 2338.0065 Fe II NLTH91 400 P 2343.4951 Fe II NLTH91 50 2343.9610 Fe II NLTH91 90 2344.2816 Fe II NLTH91 120 2348.1159 Fe II NLTH91 150 2348.3025 Fe II NLTH91 120 2359.1322 Fe II NLTH91 90 2359.9997 Fe II NLTH91 70 2360.2945 Fe II NLTH91 40 2363.8612 Fe II NLTH91 120 2364.8281 Fe II NLTH91 50 2365.7654 Fe II NLTH91 50 2368.5964 Fe II NLTH91 50 2369.9534 Fe II NLTH91 40 2373.6245 Fe I NJLT94 60 2373.7357 Fe II NLTH91 40 2375.1940 Fe II NLTH91 70 2376.4294 Fe II NLTH91 50 2379.2765 Fe II NLTH91 70 2380.7616 Fe II NLTH91 1000 P 2382.0376 Fe II NLTH91 40 2383.2452 Fe II NLTH91 200 2388.6289 Fe II NLTH91 700 P 2395.6254 Fe II NLTH91 200 2399.2413 Fe II NLTH91 500 P 2404.8858 Fe II NLTH91 150 2406.6612 Fe II NLTH91 50 2406.9761 Fe II NLTH91 200 2410.5192 Fe II NLTH91 120 2411.0677 Fe II NLTH91 90 2413.3104 Fe II NLTH91 50 2417.8707 Fe II NLTH91 40 2422.6882 Fe II NLTH91 90 2424.1456 Fe II NLTH91 70 2428.3638 Fe II NLTH91 70 2430.0783 Fe II NLTH91 50 2432.2612 Fe II NLTH91 40 2432.8732 Fe II NLTH91 90 2439.3014 Fe II NLTH91 40 2443.7100 Fe II NLTH91 60 2444.5154 Fe II NLTH91 60 2445.5732 Fe II NLTH91 150 2457.5891 Fe I NJLT94 90 2458.7838 Fe II NLTH91 40 2460.4404 Fe II NLTH91 50 2461.2835 Fe II NLTH91 60 2461.8610 Fe II NLTH91 150 2462.6472 Fe I NJLT94 80 2465.1492 Fe I NJLT94 40 2466.6713 Fe II NLTH91 40 2466.8194 Fe II NLTH91 60 2468.8799 Fe I NJLT94 40 2469.5147 Fe II NLTH91 50 2470.6694 Fe II NLTH91 80 2472.3320 Fe I NJLT94 100 2472.8713 Fe I NJLT94 60 2474.8145 Fe I NJLT94 40 2478.5722 Fe II NLTH91 120 2479.7764 Fe I NJLT94 60 2480.1577 Fe II NLTH91 50 2482.1172 Fe II NLTH91 60 2482.6577 Fe II NLTH91 1000 P 2483.2708 Fe I NJLT94 30 2483.5334 Fe I NJLT94 100 2484.1875 Fe I NJLT94 40 2484.2446 Fe II NLTH91 80 2486.3728 Fe I NJLT94 600 P 2488.1426 Fe I NJLT94 50 2489.4833 Fe II NLTH91 100 2489.7524 Fe I NJLT94 500 P 2490.6443 Fe I NJLT94 40 2490.8584 Fe II NLTH91 200 2491.1550 Fe I NJLT94 60 2491.3965 Fe II NLTH91 60 2493.1846 Fe II NLTH91 300 P 2493.2637 Fe II NLTH91 60 2496.5337 Fe I NJLT94 100 2501.1318 Fe I NJLT94 40 2502.3930 Fe II NLTH91 40 2503.8745 Fe II NLTH91 50 2506.0935 Fe II NLTH91 50 2507.9004 Fe I NJLT94 100 2510.8350 Fe I NJLT94 70 2511.7603 Fe II NLTH91 40 2512.3650 Fe I NJLT94 30 2517.6611 Fe I NJLT94 80 2518.1018 Fe I NJLT94 40 2519.0472 Fe II NLTH91 400 P 2522.8494 Fe I NJLT94 50 2524.2925 Fe I NJLT94 120 2525.3879 Fe II NLTH91 200 2526.2939 Fe II NLTH91 200 2527.4351 Fe I NJLT94 80 2529.1350 Fe I NJLT94 70 2533.6274 Fe II NLTH91 60 2534.4186 Fe II NLTH91 70 2535.4856 Fe II NLTH91 40 2535.6069 Fe I NJLT94 40 2536.6726 Fe II NLTH91 120 2536.80 Fe II C74 60 2538.7987 Fe II NLTH91 60 2538.9094 Fe II NLTH91 90 2538.99 Fe II C74 120 2540.66 Fe II C74 60 2540.9722 Fe I NJLT94 50 2541.1010 Fe II NLTH91 40 2541.8358 Fe II NLTH91 30 2542.1013 Fe I NJLT94 40 2543.3781 Fe II NLTH91 80 2545.9785 Fe I NJLT94 50 2546.6701 Fe II NLTH91 60 2548.7442 Fe II NLTH91 50 2549.0833 Fe II NLTH91 50 2549.3947 Fe II NLTH91 40 2549.4616 Fe II NLTH91 60 2549.6133 Fe I NJLT94 40 2550.0274 Fe II NLTH91 30 2550.6832 Fe II NLTH91 250 2562.5356 Fe II NLTH91 120 2563.4755 Fe II NLTH91 40 2566.9126 Fe II NLTH91 90 2574.3662 Fe II NLTH91 30 2576.6902 Fe I NJLT94 40 2577.9219 Fe II NLTH91 60 2582.5832 Fe II NLTH91 150 2584.5359 Fe I NJLT94 300 P 2585.8758 Fe II NLTH91 60 2591.5428 Fe II NLTH91 400 P 2598.3692 Fe II NLTH91 700 P 2599.3956 Fe II NLTH91 30 2599.5669 Fe I NJLT94 200 2606.5162 Fe II NLTH91 80 2606.8264 Fe I NJLT94 300 P 2607.0871 Fe II NLTH91 400 P 2611.8736 Fe II NLTH91 200 2613.8243 Fe II NLTH91 200 2617.6174 Fe II NLTH91 60 2620.41 Fe II D38 40 2623.5339 Fe I NJLT94 120 2625.6671 Fe II NLTH91 90 2628.2931 Fe II NLTH91 150 2631.0471 Fe II NLTH91 150 2631.3232 Fe II NLTH91 30 2635.8088 Fe I NJLT94 40 2664.6638 Fe II NLTH91 30 2666.8125 Fe I NJLT94 60 2679.0242 Fe I NJLT94 300 2684.7536 Fe II NLTH91 40 2689.2122 Fe I NJLT94 40 2692.6019 Fe II NLTH91 40 2703.9891 Fe II NLTH91 40 2706.5820 Fe I NJLT94 50 2714.4129 Fe II NLTH91 400 P 2719.0273 Fe I NJLT94 150 2720.9023 Fe I NJLT94 40 2723.5774 Fe I NJLT94 50

Strong Lines of Manganese (Mn)

Strong Lines of Manganese (Mn)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 8 1915.10 Mn II IV64 7 1921.250 Mn II IV64 400 P 1996.056 Mn I CMG64 500 P 1999.511 Mn I CMG64 Air 700 P 2003.849 Mn I CMG64 60 2092.159 Mn I CMG64 60 2109.585 Mn I CMG64 11 2208.806 Mn I CMG64 20 2213.855 Mn I CMG64 30 2221.837 Mn I CMG64 7 2534.221 Mn II IV64 8 2535.658 Mn II IV64 8 2537.919 Mn II IV64 8 2548.750 Mn II IV64 8 2558.605 Mn II IV64 12 2563.642 Mn II IV64 20 2572.755 Mn I CMG64 20 2575.509 Mn I CMG64 1000 P 2576.103 Mn II KG00 20 2584.302 Mn I CMG64 9 2592.944 Mn I CMG64 500 P 2593.720 Mn II KG00 9 2595.763 Mn I CMG64 8 2598.905 Mn II IV64 400 P 2605.680 Mn II KG00 15 2610.200 Mn II IV64 40 2618.145 Mn II IV64 15 2625.606 Mn II IV64 15 2632.354 Mn II IV64 11 2638.173 Mn II IV64 7 2639.849 Mn II IV64 9 2672.581 Mn II IV64 9 2688.247 Mn II IV64 7 2701.024 Mn II IV64 13 2701.698 Mn II IV64 8 2703.98 Mn II IV64 11 2705.732 Mn II IV64 7 2707.544 Mn II IV64 9 2708.452 Mn II IV64 7 2710.336 Mn II IV64 9 2711.568 Mn II IV64 250 P 2794.817 Mn I CMG64 200 P 2798.270 Mn I CMG64 140 P 2801.084 Mn I CMG64 7 2879.482 Mn II IV64 13 2889.600 Mn II IV64 7 2900.154 Mn II IV64 90 P 2933.054 Mn II KG00 120 P 2939.308 Mn II KG00 9 h 2940.331 Mn I CMG64 150 P 2949.205 Mn II KG00 12 3044.566 Mn I CMG64 9 3054.362 Mn I CMG64 40 3228.092 Mn I CMG64 11 3230.716 Mn I CMG64 30 3236.778 Mn I CMG64 12 3243.777 Mn I CMG64 25 3248.512 Mn I CMG64 11 3252.949 Mn I CMG64 11 3256.137 Mn I CMG64 15 3330.775 Mn II IV64 8 3336.394 Mn II IV64 60 P 3441.985 Mn II KG00 30 3460.314 Mn II KG00 30 h 3474.038 Mn II KG00 25 3482.904 Mn II KG00 15 3488.675 Mn II KG00 12 3495.833 Mn II KG00 8 3497.525 Mn II KG00 13 3531.836 Mn I CMG64 40 3532.110 Mn I CMG64 50 3547.794 Mn I CMG64 40 3548.022 Mn I CMG64 14 3548.182 Mn I CMG64 80 3569.494 Mn I CMG64 25 3569.804 Mn I CMG64 50 3577.870 Mn I CMG64 25 3586.540 Mn I CMG64 11 3595.110 Mn I CMG64 15 3607.530 Mn I CMG64 15 3608.485 Mn I CMG64 13 3610.298 Mn I CMG64 11 3619.272 Mn I CMG64 10 3693.671 Mn I CMG64 10 3790.214 Mn I CMG64 120 P 3806.715 Mn I CMG64 25 3809.593 Mn I CMG64 80 3823.508 Mn I CMG64 14 3823.891 Mn I CMG64 20 3833.865 Mn I CMG64 50 3834.368 Mn I CMG64 13 3839.779 Mn I CMG64 25 3841.074 Mn I CMG64 13 3843.988 Mn I CMG64 60 4018.106 Mn I CMG64 1000 P 4030.755 Mn I CMG64 700 P 4033.068 Mn I CMG64 400 P 4034.485 Mn I CMG64 60 4035.729 Mn I CMG64 200 P 4041.357 Mn I CMG64 40 4048.747 Mn I CMG64 70 4055.548 Mn I CMG64 40 4058.936 Mn I CMG64 25 4061.737 Mn I CMG64 25 4063.530 Mn I CMG64 11 4070.280 Mn I CMG64 25 4079.241 Mn I CMG64 25 4079.415 Mn I CMG64 40 4082.945 Mn I CMG64 40 4083.634 Mn I CMG64 14 4235.154 Mn I CMG64 20 4235.300 Mn I CMG64 11 4257.669 Mn I CMG64 11 4265.928 Mn I CMG64 10 4281.100 Mn I CMG64 4 4326.633 Mn II IV64 13 4414.887 Mn I CMG64 30 4451.575 Mn I CMG64 10 4458.263 Mn I CMG64 20 4462.033 Mn I CMG64 11 4464.679 Mn I CMG64 9 4498.897 Mn I CMG64 9 4502.223 Mn I CMG64 40 4754.048 Mn I CMG64 30 4762.376 Mn I CMG64 11 4765.856 Mn I CMG64 20 4766.426 Mn I CMG64 30 4783.432 Mn I CMG64 40 4823.528 Mn I CMG64 11 6021.787 Mn I CMG64

Strong Lines of Arsenic (As)

Strong Lines of Arsenic (As)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 800 1211.17 As II LA71 800 1218.10 As II LA71 800 1241.31 As II LA71 1000 P 1243.08 As II LA71 900 1245.67 As II LA71 800 1258.58 As II LA71 1000 P 1263.77 As II LA71 800 1266.34 As II LA71 800 1267.59 As II LA71 700 1280.99 As II LA71 700 1287.54 As II LA71 700 1305.70 As II LA71 800 1333.15 As II LA71 1000 P 1341.55 As II LA71 800 1355.93 As II LA71 1000 P 1369.77 As II LA71 800 1373.65 As II LA71 1000 P 1375.07 As II LA71 800 1375.78 As II LA71 800 1394.64 As II LA71 800 1400.31 As II LA71 700 P ,r 1890.43 As I HA85 400 P ,r 1937.59 As I HA85 200 P ,r 1972.62 As I HA85 Air 200 P ,r 2003.35 As I HA85 50 P ,r 2288.12 As I HA85 100 P ,r 2349.84 As I HA85 70 P ,r 2370.77 As I HA85 400 P ,r 2456.53 As I HA85 900 P ,r 2780.22 As I HA85 1000 P ,r 2860.44 As I HA85 700 4190.082 As II LA71 700 4458.469 As II LA71 700 4466.348 As II LA71 800 4494.230 As II LA71 800 4507.659 As II LA71 700 4543.483 As II LA71 500 6170.27 As II LA71 150 9597.92 As I HA85 150 9626.65 As I HA85 200 9833.78 As I HA85 250 9923.03 As I HA85 200 10024.01 As I HA85

Strong Lines of Cobalt (Co)

Strong Lines of Cobalt (Co)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 140 1970.769 Co I PT96 Air 200 2193.605 Co II PRUJ98 200 2256.745 Co II PRUJ98 200 2283.522 Co II PRUJ98 1000 P 2286.159 Co II PRUJ98 200 2291.991 Co II PRUJ98 300 2293.390 Co II PRUJ98 300 2301.403 Co II PRUJ98 800 P 2307.860 Co II PRUJ98 120 2309.010 Co I PT96 500 P 2311.604 Co II PRUJ98 500 P 2314.056 Co II PRUJ98 300 2314.975 Co II PRUJ98 200 2317.070 Co II PRUJ98 110 2323.145 Co I PT96 300 2324.321 Co II PRUJ98 200 2326.100 Co II PRUJ98 500 2326.473 Co II PRUJ98 200 P 2347.399 Co II PRUJ98 200 P 2353.422 Co II PRUJ98 90 2353.368 Co I PT96 500 P 2363.800 Co II PRUJ98 400 P 2378.626 Co II PRUJ98 200 2381.765 Co II PRUJ98 300 P 2383.459 Co II PRUJ98 200 P 2386.370 Co II PRUJ98 500 P 2388.917 Co II PRUJ98 200 2397.386 Co II PRUJ98 200 2404.172 Co II PRUJ98 250 P 2407.256 Co I PT96 250 P 2411.624 Co I PT96 250 2414.464 Co I PT96 250 2415.290 Co I PT96 300 2417.659 Co II PRUJ98 200 P 2424.935 Co I PT96 150 2432.213 Co I PT96 140 2436.662 Co I PT96 110 2439.040 Co I PT96 200 2442.617 Co II PRUJ98 200 2446.017 Co II PRUJ98 200 2447.711 Co II PRUJ98 200 2450.002 Co II PRUJ98 200 2464.199 Co II PRUJ98 200 2486.441 Co II PRUJ98 200 2498.821 Co II PRUJ98 500 2506.464 Co II PRUJ98 200 2511.160 Co II PRUJ98 500 2519.823 Co II PRUJ98 200 P 2521.365 Co I PT96 200 2524.634 Co II PRUJ98 300 2524.974 Co II PRUJ98 500 2528.616 Co II PRUJ98 140 2528.970 Co I PT96 200 2530.080 Co II PRUJ98 200 2533.801 Co II PRUJ98 140 2535.966 Co I PT96 300 2541.953 Co II PRUJ98 200 2546.739 Co II PRUJ98 300 2559.405 Co II PRUJ98 200 2560.031 Co II PRUJ98 500 2564.034 Co II PRUJ98 800 2580.326 Co II PRUJ98 300 2582.240 Co II PRUJ98 500 2587.220 Co II PRUJ98 500 2587.524 Co II PRUJ98 200 2588.904 Co II PRUJ98 200 2666.740 Co II PRUJ98 200 2706.606 Co II PRUJ98 200 2707.343 Co II PRUJ98 150 3044.005 Co I PT96 100 3395.373 Co I PT96 500 P 3405.118 Co I PT96 200 3409.176 Co I PT96 300 3412.337 Co I PT96 100 3412.633 Co I PT96 130 3417.157 Co I PT96 120 3431.582 Co I PT96 200 3433.040 Co I PT96 400 P 3443.645 Co I PT96 200 3449.170 Co I PT96 100 3449.440 Co I PT96 1000 P 3453.510 Co I PT96 250 3462.805 Co I PT96 250 3465.793 Co I PT96 400 P 3473.974 Co I PT96 400 P 3474.042 Co I PT96 250 3489.400 Co I PT96 110 3495.682 Co I PT96 500 P 3502.280 Co I PT96 300 3506.312 Co I PT96 140 3509.841 Co I PT96 250 3512.640 Co I PT96 200 3513.481 Co I PT96 250 3518.347 Co I PT96 130 3521.566 Co I PT96 200 3523.433 Co I PT96 300 P 3526.850 Co I PT96 130 3529.033 Co I PT96 300 P 3529.808 Co I PT96 400 P 3569.376 Co I PT96 120 3575.360 Co I PT96 300 3587.187 Co I PT96 300 3845.469 Co I PT96 250 3873.114 Co I PT96 130 3873.955 Co I PT96 400 3894.078 Co I PT96 300 3995.308 Co I PT96 130 4118.774 Co I PT96 200 4121.318 Co I PT96

Strong Lines of Copper (Cu)

Strong Lines of Copper (Cu)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 400 886.943 Cu II R69 400 890.567 Cu II R69 500 893.678 Cu II R69 400 896.759 Cu II R69 400 901.073 Cu II R69 500 914.213 Cu II R69 400 922.019 Cu II R69 400 932.939 Cu II R69 400 935.058 Cu II R69 400 935.086 Cu II R69 400 935.898 Cu II R69 400 943.335 Cu II R69 400 945.525 Cu II R69 400 1036.470 Cu II R69 400 1039.348 Cu II R69 400 1039.582 Cu II R69 500 1044.519 Cu II R69 500 1044.744 Cu II R69 400 1054.690 Cu II R69 400 1056.955 Cu II R69 400 1059.096 Cu II R69 400 1060.634 Cu II R69 400 1063.005 Cu II R69 200 P 1358.773 Cu II R69 150 P 1367.951 Cu II R69 500 1488.637 Cu II R69 400 1519.837 Cu II R69 500 1541.703 Cu II R69 400 1593.556 Cu II R69 400 1621.426 Cu II R69 300 P 1979.956 Cu II R69 Air 150 P 1999.698 Cu II R69 200 P 2035.854 Cu II R69 150 P 2037.127 Cu II R69 250 P 2043.802 Cu II R69 600 P 2135.981 Cu II R69 130 P 2165.09 Cu I S48 150 P 2178.94 Cu I S48 500 2179.410 Cu II R69 150 P 2181.72 Cu I S48 500 2189.630 Cu II R69 600 P 2192.268 Cu II R69 150 2199.58 Cu I S48 500 2210.268 Cu II R69 150 2214.58 Cu I S48 500 P 2218.108 Cu II R69 200 P 2225.70 Cu I S48 150 2227.78 Cu I S48 250 P 2230.08 Cu I S48 600 2242.618 Cu II R69 250 P 2244.26 Cu I S48 700 P 2247.002 Cu II R69 200 2263.08 Cu I S48 250 2293.84 Cu I S48 250 2392.63 Cu I S48 150 2406.66 Cu I S48 100 P 2441.64 Cu I S48 200 P 2492.15 Cu I S48 250 2618.37 Cu I S48 500 2689.300 Cu II R69 500 2700.962 Cu II R69 400 2703.184 Cu II R69 500 2713.508 Cu II R69 400 2718.778 Cu II R69 250 2766.37 Cu I S48 500 2769.669 Cu II R69 400 2877.100 Cu II R69 250 2961.16 Cu I S48 250 3036.10 Cu I S48 250 3063.41 Cu I S48 200 3108.60 Cu I S48 150 3194.10 Cu I S48 150 h 3243.16 Cu I S48 1000 P 3247.54 Cu I S48 1000 P 3273.96 Cu I S48 150 h 3290.54 Cu I S48 250 h 3307.95 Cu I S48 150 3337.84 Cu I S48 200 3530.38 Cu I S48 700 3686.555 Cu II R69 200 4062.64 Cu I S48 200 4651.12 Cu I S48 700 4909.734 Cu II R69 600 4931.698 Cu II R69 500 4953.724 Cu II R69 600 5051.793 Cu II R69 150 P 5105.54 Cu I S48 200 P 5153.24 Cu I S48 250 P 5218.20 Cu I S48 150 5292.52 Cu I S48 150 5700.24 Cu I S48 150 5782.13 Cu I S48 400 6000.120 Cu II R69 400 6150.384 Cu II R69 500 6154.222 Cu II R69 500 6216.939 Cu II R69 500 6219.844 Cu II R69 700 6273.349 Cu II R69 600 6301.009 Cu II R69 500 6377.840 Cu II R69 600 6423.884 Cu II R69 500 6448.559 Cu II R69 600 6470.168 Cu II R69 500 6481.437 Cu II R69 500 6624.292 Cu II R69 500 6641.396 Cu II R69 700 7404.354 Cu II R69 500 7652.333 Cu II R69 700 7664.648 Cu II R69 500 7778.738 Cu II R69 500 7805.184 Cu II R69 1000 7807.659 Cu II R69 700 7825.654 Cu II R69 500 7902.553 Cu II R69 150 7933.13 Cu I S48 800 7988.163 Cu II R69 200 8092.63 Cu I S48 500 8283.160 Cu II R69 500 8511.061 Cu II R69 400 9861.280 Cu II R69 400 9864.137 Cu II R69 400 10054.938 Cu II R69

Strong Lines of Gallium (Ga)

Strong Lines of Gallium (Ga)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 140 829.529 Ga II IL85 200 1113.708 Ga II IL85 200 1119.133 Ga II IL85 300 1130.760 Ga II IL85 1000 P 1414.401 Ga II IL85 800 P 1535.309 Ga II IL85 800 P 1813.878 Ga II IL85 900 P 1845.199 Ga II IL85 Air 1000 P 2090.771 Ga II IL85 150 2450.08 Ga I MM52 200 2500.19 Ga I MM52 300 2700.491 Ga II IL85 300 2779.977 Ga II IL85 400 P 2874.235 Ga I JL67 600 P 2943.636 Ga I JL67 200 P 2944.173 Ga I JL67 600 3374.915 Ga II IL85 500 3375.948 Ga II IL85 500 3470.347 Ga II IL85 300 3735.024 Ga II IL85 500 P 4032.984 Ga I ND82 1000 P 4172.042 Ga I JL67 300 4262.019 Ga II IL85 500 5219.65 Ga II IL85 500 5416.36 Ga II IL85 1000 P 6334.05 Ga II IL85 100 6396.56 Ga I JL67 70 6413.45 Ga I JL67 900 P 6419.23 Ga II IL85 800 P 6455.89 Ga II IL85 800 7792.26 Ga II IL85 50 11949.12 Ga I JL67 40 12109.78 Ga I JL67

Strong Lines of Germanium (Ge)

Strong Lines of Germanium (Ge)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 300 1085.51 Ge II S63a 500 P 1106.74 Ge II S63a 500 P 1120.46 Ge II S63a 500 1181.19 Ge II S63a 500 1181.65 Ge II S63a 200 P 1188.73 Ge II S63a 300 1191.26 Ge II S63a 500 P 1237.059 Ge II KE74 500 P 1261.905 Ge II KE74 500 P 1576.855 Ge II KE74 80 r 1716.784 Ge I KE74 80 1750.043 Ge I KE74 80 1774.176 Ge I KE74 80 1785.046 Ge I KE74 80 h 1841.328 Ge I KE74 80 h 1842.410 Ge I KE74 80 1853.134 Ge I KE74 200 r 1860.086 Ge I KE74 120 r 1874.256 Ge I KE74 200 r 1904.702 Ge I KE74 120 r 1917.592 Ge I KE74 200 r 1929.826 Ge I KE74 500 P 1938.008 Ge II KE74 500 P 1938.891 Ge II KE74 80 1944.731 Ge I KE74 80 1955.115 Ge I KE74 200 1962.013 Ge I KE74 80 1970.880 Ge I KE74 120 h 1987.849 Ge I KE74 120 P 1988.267 Ge I KE74 200 r 1998.887 Ge I KE74 Air 80 2011.29 Ge I AM59 700 P 2019.068 Ge I AM59 900 P ,r 2041.712 Ge I AM59 600 P ,r 2043.770 Ge I AM59 150 2054.461 Ge I AM59 80 h 2057.238 Ge I AM59 300 r 2065.215 Ge I AM59 1000 P ,r 2068.656 Ge I AM59 150 2086.021 Ge I AM59 800 P ,r 2094.258 Ge I AM59 90 2105.824 Ge I AM59 130 P ,r 2198.714 Ge I AM59 500 2500.54 Ge II S63a 200 P 2592.534 Ge I AM59 500 P 2651.172 Ge I AM59 200 P 2651.568 Ge I AM59 200 P 2691.341 Ge I AM59 300 P 2709.624 Ge I AM59 400 2729.78 Ge II S63a 250 P 2754.588 Ge I AM59 1000 P 2831.843 Ge II S63a 1000 P 2845.527 Ge II S63a 300 P 3039.067 Ge I AM59 250 3067.021 Ge I AM59 40 P 3269.489 Ge I AM59 300 3499.21 Ge II S63a 1000 P 4741.806 Ge II S63a 1000 P 4814.608 Ge II S63a 1000 P 5893.389 Ge II S63a 500 P 6021.041 Ge II S63a 90 11252.83 Ge I HA64 70 11614.81 Ge I HA64 250 11714.76 Ge I HA64 500 P 12069.20 Ge I HA64 400 P 12391.58 Ge I HA64 90 13107.61 Ge I HA64 200 14822.38 Ge I HA64

Strong Lines of Nickel (Ni)

Strong Lines of Nickel (Ni)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 150 P 1741.547 Ni II S70 Air 150 P 2165.553 Ni II S70 300 2169.096 Ni II S70 300 P 2174.666 Ni II S70 250 2175.147 Ni II S70 130 2180.473 Ni II S70 130 2184.605 Ni II S70 400 P 2185.504 Ni II S70 500 P 2192.090 Ni II S70 100 2201.409 Ni II S70 800 P 2205.548 Ni II S70 700 P 2206.715 Ni II S70 1000 P 2216.482 Ni II S70 130 2220.402 Ni II S70 150 2222.957 Ni II S70 150 2264.461 Ni II S70 300 P 2270.214 Ni II S70 130 2277.282 Ni II S70 130 2278.770 Ni II S70 200 2289.987 Ni I LBT93 80 2300.781 Ni I LBT93 150 2302.996 Ni II S70 250 P 2310.961 Ni I LBT93 200 2312.344 Ni I LBT93 150 2313.656 Ni I LBT93 150 2313.983 Ni I LBT93 150 P 2316.039 Ni II S70 150 2317.165 Ni I LBT93 300 P 2320.034 Ni I LBT93 250 2321.383 Ni I LBT93 150 2325.802 Ni I LBT93 110 2329.970 Ni I LBT93 60 2337.488 Ni I LBT93 150 P 2345.543 Ni I LBT93 50 2347.514 Ni I LBT93 150 2375.418 Ni II S70 150 2394.519 Ni II S70 300 2416.134 Ni II S70 60 2943.912 Ni I LBT93 70 2981.646 Ni I LBT93 60 2992.592 Ni I LBT93 120 2994.453 Ni I LBT93 500 P 3002.485 Ni I LBT93 250 3003.621 Ni I LBT93 500 P 3012.001 Ni I LBT93 40 3019.143 Ni I LBT93 200 3037.932 Ni I LBT93 400 P 3050.816 Ni I LBT93 200 3054.312 Ni I LBT93 250 3057.639 Ni I LBT93 60 3064.618 Ni I LBT93 50 3080.752 Ni I LBT93 300 P 3101.557 Ni I LBT93 150 3101.878 Ni I LBT93 400 P 3134.104 Ni I LBT93 130 3232.933 Ni I LBT93 70 3243.054 Ni I LBT93 80 3297.600 Ni II S70 80 3315.663 Ni I LBT93 40 3320.259 Ni I LBT93 40 3322.309 Ni I LBT93 300 3331.875 Ni II S70 100 3358.676 Ni II S70 40 3361.554 Ni I LBT93 40 3365.765 Ni I LBT93 40 3366.166 Ni I LBT93 400 3369.566 Ni I LBT93 50 3371.987 Ni I LBT93 400 3380.570 Ni I LBT93 150 3391.043 Ni I LBT93 400 3392.986 Ni I LBT93 40 3413.476 Ni I LBT93 40 3413.936 Ni I LBT93 1000 P 3414.764 Ni I LBT93 200 3423.708 Ni I LBT93 300 3433.556 Ni I LBT93 120 3437.278 Ni I LBT93 600 P 3446.259 Ni I LBT93 150 3452.889 Ni I LBT93 600 P 3458.460 Ni I LBT93 600 P 3461.652 Ni I LBT93 200 3472.545 Ni I LBT93 70 3483.777 Ni I LBT93 700 P 3492.956 Ni I LBT93 80 3500.851 Ni I LBT93 300 3510.335 Ni I LBT93 800 P 3515.052 Ni I LBT93 80 3519.765 Ni I LBT93 1000 P 3524.536 Ni I LBT93 40 3548.182 Ni I LBT93 600 P 3566.372 Ni I LBT93 120 3571.864 Ni I LBT93 150 3597.703 Ni I LBT93 150 3610.462 Ni I LBT93 60 3612.740 Ni I LBT93 800 P 3619.391 Ni I LBT93 70 3775.571 Ni I LBT93 90 3783.530 Ni I LBT93 90 3807.144 Ni I LBT93 150 3858.297 Ni I LBT93 80 4992.024 Ni II S70 150 8096.75 Ni II S70 120 8121.48 Ni II S70

Strong Lines of Zinc (Zn)

Strong Lines of Zinc (Zn)

Intensity Wavelength (Å) Spectrum Ref. Air 1000 P 2025.4845 Zn II GL00 1000 P 2062.0011 Zn II GL00 400 P 2064.2266 Zn II GL00 1000 P 2099.9273 Zn II GL00 200 2102.1661 Zn II GL00 1000 P 2138.5735 Zn I GL00 300 P 2501.9945 Zn II GL00 500 P 2557.9460 Zn II GL00 10 2608.5576 Zn I GL00 20 2770.8538 Zn I GL00 8 2770.9740 Zn I GL00 20 P 2800.8635 Zn I GL00 6 P 2801.0500 Zn I GL00 60 P 3075.8971 Zn I GL00 100 3196.31 Zn II CD68 50 P 3282.3256 Zn I GL00 200 P 3302.5829 Zn I GL00 70 P 3302.9395 Zn I GL00 400 P 3345.0134 Zn I GL00 80 P 3345.5694 Zn I GL00 15 P 3345.9353 Zn I GL00 100 P 4680.1359 Zn I GL00 250 P 4722.1569 Zn I GL00 400 P 4810.5321 Zn I GL00 80 P 4911.6269 Zn II GL00 120 P 4924.0132 Zn II GL00 100 5894.3607 Zn II GL00 40 6214.5778 Zn II GL00 30 P 6362.3458 Zn I GL00 50 7478.7691 Zn II GL00 60 7588.4648 Zn II GL00 40 7732.4886 Zn II GL00

Strong Lines of Bromine (Br)

Strong Lines of Bromine (Br)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 1000 P 889.25 Br II MT84 500 896.65 Br II MT84 500 906.01 Br II MT84 500 984.99 Br II MT84 500 1012.13 Br II MT84 1000 P 1015.53 Br II MT84 500 1036.98 Br II MT84 1000 P 1048.94 Br II MT84 400 1064.71 Br II MT84 500 1071.84 Br II MT84 100 1232.43 Br I T63 150 1384.60 Br I T63 700 P 1488.45 Br I T63 400 1531.74 Br I T63 300 P 1540.65 Br I T63 400 P 1574.84 Br I T63 250 1576.39 Br I T63 300 1582.31 Br I T63 1000 P 1633.40 Br I T63 Air 500 h 2317.30 Br II R58 500 2386.70 Br II R58 400 2388.96 Br II R58 500 2389.69 Br II R58 400 2521.70 Br II R58 500 h 2972.26 Br II R58 500 3914.38 Br II RR44 500 3980.38 Br II K40 1000 4223.89 Br II K40 1000 4365.63 Br II K40 130 4441.74 Br I T63 130 4472.61 Br I T63 250 4477.72 Br I T63 200 4525.59 Br I T63 500 4542.89 Br II K40 500 4678.70 Br II K40 500 P 4704.92 Br II K40 500 P 4785.48 Br II K40 500 P 4816.68 Br II K40 400 4930.62 Br II K40 500 5182.36 Br II K40 500 5238.26 Br II K40 500 5332.07 Br II K40 500 5506.72 Br II K40 500 6148.60 Br I T63 800 6350.73 Br I T63 250 6544.57 Br I T63 700 c 6559.80 Br I T63 250 6582.17 Br I T63 700 c 6631.62 Br I T63 250 6682.28 Br I T63 130 6692.13 Br I T63 130 7005.19 Br I T63 130 P 7348.51 Br I T63 500 P 7512.96 Br I T63 400 P 7803.02 Br I T63 400 P ,c 7938.68 Br I T63 130 7978.57 Br I T63 400 7989.94 Br I T63 400 8131.52 Br I T63 130 8153.75 Br I T63 300 8154.00 Br I T63 200 8264.96 Br I T63 1000 P ,c 8272.44 Br I T63 250 8334.70 Br I T63 130 P 8343.70 Br I T63 500 P 8446.55 Br I T63 250 8638.66 Br I T63 130 c 8793.47 Br I T63 200 8819.96 Br I T63 300 8825.22 Br I T63 400 8897.62 Br I T63 400 9166.06 Br I T63 200 9173.63 Br I T63 250 9178.16 Br I T63 500 9265.42 Br I T63 200 9320.86 Br I T63 130 9896.40 Br I T63 400 10457.96 Br I T63

Strong Lines of Krypton (Kr)

Strong Lines of Krypton (Kr)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 20 729.40 Kr II MSP69 70 761.18 Kr II MSP69 30 763.98 Kr II MSP69 20 766.20 Kr II MSP69 70 771.03 Kr II MSP69 20 773.69 Kr II MSP69 70 782.10 Kr II MSP69 30 783.72 Kr II MSP69 20 818.15 Kr II MSP69 20 830.38 Kr II MSP69 30 P 844.06 Kr II MSP69 20 864.82 Kr II MSP69 20 868.87 Kr II MSP69 70 884.14 Kr II MSP69 300 P 886.30 Kr II MSP69 130 891.01 Kr II MSP69 70 911.39 Kr II MSP69 700 P 917.43 Kr II MSP69 100 945.4414 Kr I K93 80 946.5443 Kr I K93 30 951.056 Kr I K93 80 953.4041 Kr I K93 80 963.3745 Kr I K93 700 P 964.97 Kr II MSP69 150 1001.0606 Kr I K93 150 1003.5504 Kr I K93 150 1030.0232 Kr I K93 300 P 1164.8671 Kr I K93 1000 P 1235.8378 Kr I K93 Air 30 h 2464.77 Kr II RCWM80 20 2492.48 Kr II DHM33 25 h 2712.40 Kr II DHM33 30 2833.00 Kr II DHM33 30 h 3607.88 Kr II DHM33 70 3631.889 Kr II HP70a 80 3653.928 Kr II HP70a 13 3665.324 Kr I KH69 50 3669.01 Kr II DHM33 15 d 3679.58 Kr I KH69 25 3686.182 Kr II HP70a 100 h 3718.02 Kr II DHM33 70 3718.595 Kr II HP70a 50 3721.350 Kr II HP70a 70 3741.638 Kr II HP70a 50 3744.80 Kr II DHM33 25 3754.245 Kr II HP70a 150 3778.046 Kr II HP70a 150 3783.095 Kr II HP70a 50 h 3875.44 Kr II DHM33 50 3906.177 Kr II HP70a 70 3920.081 Kr II HP70a 30 3994.840 Kr II HP70a 30 h 3997.793 Kr II HP70a 100 4057.037 Kr II HP70a 100 4065.128 Kr II HP70a 150 4088.337 Kr II HP70a 80 4098.729 Kr II HP70a 30 4109.248 Kr II HP70a 80 4145.122 Kr II HP70a 50 4250.580 Kr II HP70a 150 4273.9694 Kr I K93 15 4282.9674 Kr I K93 200 4292.923 Kr II HP70a 70 4300.49 Kr II DHM33 150 h 4317.81 Kr II DHM33 70 4318.5513 Kr I K93 150 4319.5794 Kr I K93 50 h 4322.98 Kr II DHM33 15 4351.3597 Kr I K93 1000 P 4355.477 Kr II HP70a 80 4362.6416 Kr I K93 70 4369.69 Kr II DHM33 130 4376.1216 Kr I K93 100 h 4386.54 Kr II DHM33 30 4399.9663 Kr I K93 15 4425.1901 Kr I K93 150 4431.685 Kr II HP70a 200 4436.812 Kr II HP70a 100 4453.9175 Kr I K93 130 4463.6900 Kr I K93 250 4475.014 Kr II HP70a 130 h 4489.88 Kr II DHM33 100 4502.3543 Kr I K93 130 h 4523.14 Kr II DHM33 70 h 4556.61 Kr II DHM33 250 4577.209 Kr II HP70a 100 4582.978 Kr II HP70a 50 h 4592.80 Kr II DHM33 150 4615.292 Kr II HP70a 300 P 4619.166 Kr II HP70a 250 4633.885 Kr II HP70a 700 P 4658.876 Kr II HP70a 150 4680.406 Kr II HP70a 30 4691.301 Kr II HP70a 70 4694.360 Kr II HP70a 1000 P 4739.002 Kr II HP70a 100 4762.435 Kr II HP70a 300 P 4765.744 Kr II HP70a 100 4811.76 Kr II DHM33 100 4825.18 Kr II DHM33 250 P 4832.077 Kr II HP70a 250 P 4846.612 Kr II HP70a 50 4857.20 Kr II DHM33 100 4945.59 Kr II DHM33 70 5022.40 Kr II DHM33 80 5086.52 Kr II DHM33 130 h 5125.73 Kr II DHM33 150 5208.32 Kr II DHM33 70 5308.66 Kr II DHM33 150 5333.41 Kr II DHM33 70 5468.17 Kr II DHM33 80 5562.2253 Kr I K93 300 P 5570.2894 Kr I K93 13 5580.3873 Kr I K93 15 5649.5618 Kr I K93 130 5681.89 Kr II DHM33 70 h 5690.35 Kr II DHM33 15 5832.8566 Kr I K93 500 P 5870.9160 Kr I K93 70 5992.22 Kr II DHM33 10 5993.8502 Kr I K93 10 6056.1263 Kr I K93 100 6420.18 Kr II DHM33 15 6421.0270 Kr I K93 30 6456.2889 Kr I K93 50 6570.07 Kr II DHM33 10 6699.2296 Kr I K93 15 6904.6788 Kr I K93 80 7213.13 Kr II DHM33 15 7224.104 Kr I KH69 13 7287.258 Kr I KH69 130 7289.78 Kr II DHM33 130 7407.02 Kr II DHM33 10 7425.541 Kr I KH69 70 7435.78 Kr II DHM33 15 7486.862 Kr I KH69 100 7524.46 Kr II DHM33 150 7587.4136 Kr I K93 300 7601.5457 Kr I K93 50 7641.16 Kr II DHM33 150 7685.2459 Kr I K93 200 7694.5401 Kr I K93 80 7735.69 Kr II DHM33 25 7746.827 Kr I KH69 130 7854.8234 Kr I K93 30 7913.4251 Kr I K93 30 7928.5988 Kr I K93 70 7933.22 Kr II DHM33 40 7973.62 Kr II DHM33 15 7982.401 Kr I KH69 250 8059.5048 Kr I K93 700 P 8104.3655 Kr I K93 1000 P 8112.9012 Kr I K93 10 8132.967 Kr I KH69 500 P 8190.0566 Kr I K93 70 8202.72 Kr II DHM33 13 8218.365 Kr I KH69 500 P 8263.2426 Kr I K93 15 8272.353 Kr I KH69 250 8281.0522 Kr I K93 800 P 8298.1099 Kr I K93 15 8412.430 Kr I KH69 500 P 8508.8728 Kr I K93 25 8764.110 Kr I KH69 1000 P 8776.7505 Kr I K93 300 8928.6934 Kr I K93 150 9238.48 Kr II DHM33 150 h,l 9293.82

Strong Lines of Rubidium (Rb)

Strong Lines of Rubidium (Rb)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 2 513.266 Rb II R75 3 530.173 Rb II R75 30 P 589.419 Rb II R75 15 643.878 Rb II R75 30 P 697.049 Rb II R75 70 P 711.187 Rb II R75 110 P 741.456 Rb II R75 11 1604.12 Rb II R75 60 1760.50 Rb II R75 Air 20 2068.92 Rb II R75 11 2071.50 Rb II R75 110 2075.95 Rb II R75 11 2090.29 Rb II R75 11 2125.25 Rb II R75 300 2143.83 Rb II R75 110 2217.08 Rb II R75 60 2291.71 Rb II R75 20 2333.39 Rb II R75 20 2385.34 Rb II R75 600 2472.20 Rb II R75 20 2496.38 Rb II R75 11 2524.24 Rb II R75 11 2684.10 Rb II R75 11 2711.76 Rb II R75 11 3051.36 Rb II R75 60 c 3148.90 Rb II R75 13 3161.00 Rb II R75 1 3227.98 Rb I RE80 20 3270.99 Rb II R75 15 3321.49 Rb II R75 13 3340.55 Rb II R75 1 3348.72 Rb I RE80 1 3350.82 Rb I RE80 13 3393.03 Rb II R75 11 3434.18 Rb II R75 15 3461.50 Rb II R75 30 3521.39 Rb II R75 30 l 3531.55 Rb II R75 11 3541.15 Rb II R75 1 3587.05 Rb I RE80 60 3600.60 Rb II R75 110 3600.64 Rb II R75 11 c 3662.74 Rb II R75 30 c 3699.58 Rb II R75 40 3796.81 Rb II R75 30 3801.90 Rb II R75 11 3826.66 Rb II R75 30 l 3926.44 Rb II R75 300 P 3940.51 Rb II R75 11 c 3978.15 Rb II R75 20 4029.49 Rb II R75 30 c 4083.88 Rb II R75 20 c 4104.28 Rb II R75 20 c 4136.11 Rb II R75 40 4193.08 Rb II R75 11 P 4201.80 Rb I RE80 6 P 4215.53 Rb I RE80 1000 P 4244.40 Rb II R75 150 4273.14 Rb II R75 30 c 4287.97 Rb II R75 15 4293.97 Rb II R75 11 4346.96 Rb II R75 30 4377.12 Rb II R75 11 4469.47 Rb II R75 30 4530.34 Rb II R75 200 4571.77 Rb II R75 30 c 4622.42 Rb II R75 110 4648.57 Rb II R75 11 4730.45 Rb II R75 11 4755.30 Rb II R75 300 P 4775.95 Rb II R75 60 c 4782.83 Rb II R75 15 c 4885.59 Rb II R75 110 P 5152.08 Rb II R75 1 5431.532 Rb I B59 60 5522.78 Rb II R75 60 c 5635.99 Rb II R75 30 d 5699.15 Rb II R75 1 5724.121 Rb I B59 1 6070.755 Rb I B59 11 c 6199.08 Rb II R75 1 c 6206.309 Rb I B59 1 c 6298.325 Rb I B59 110 P 6458.33 Rb II R75 11 6555.62 Rb II R75 60 6560.81 Rb II R75 30 l 6775.07 Rb II R75 1 l 7279.997 Rb I B59 2 7408.173 Rb I B59 2 l 7618.933 Rb I B59 3 7757.651 Rb I B59 1 7759.436 Rb I B59 1000 c,P 7800.27 Rb I J61b 500 c,P 7947.60 Rb I J61b 20 8603.96 Rb II R75 11 9479.32 Rb II R75 20 c 9689.05 Rb II R75 1 13235.17 Rb I J61b 1 13665.01 Rb I J61b 11 P 14752.41 Rb I J61b 9 P 15288.43 Rb I J61b 2 15289.48 Rb I J61b

Strong Lines of Selenium (Se)

Strong Lines of Selenium (Se)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 800 832.62 Se II G62 800 912.69 Se II G62 800 P 1013.40 Se II G62 800 1013.99 Se II G62 1000 P 1033.56 Se II G62 1000 P 1049.65 Se II G62 800 1057.41 Se II G62 800 1141.97 Se II G62 1000 P 1192.24 Se II G62 300 1795.28 Se I RG34 300 1855.20 Se I RG34 400 1898.55 Se I RG34 400 1913.79 Se I RG34 300 1919.19 Se I RG34 600 P 1960.894 Se I LP77 150 P 1995.111 Se I LP77 Air 600 P 2039.842 Se I LP77 400 P 2062.779 Se I LP77 600 P 2074.784 Se I LP77 600 P 2164.188 Se I LP77 700 P 2413.535 Se I LP77 300 2547.98 Se I RG34 800 4175.28 Se II G62 1000 P 4180.90 Se II G62 600 P 4730.78 Se I RG34 400 4739.03 Se I RG34 300 4742.25 Se I RG34 800 4844.941 Se II G62 1000 P 5227.533 Se II G62 800 5305.347 Se II G62 1000 P 6055.84 Se II G62 800 6444.29 Se II G62 300 7062.065 Se I E72 300 8000.96 Se I RG34 300 8918.86 Se I MV74 400 10307.45 Se I MV74 1000 P 10327.26 Se I MV74 700 P 10386.36 Se I MV74 400 14817.93 Se I MV74 500 14917.47 Se I MV74 600 15151.44 Se I MV74 400 15471.00 Se I MV74 400 15618.40 Se I MV74 400 16659.44 Se I MV74 600 16813.78 Se I MV74 800 P 21442.56 Se I MV74 500 21473.48 Se I MV74 400 24385.99 Se I MV74 600 25127.43 Se I MV74

Strong Lines of Strontium (Sr)

Strong Lines of Strontium (Sr)

Intensity Wavelength (Å) Spectrum Ref. Air 30 P 2152.84 Sr II MCS75 30 P 2165.96 Sr II MCS75 14 P 3380.71 Sr II MCS75 20 P 3464.46 Sr II MCS75 20 4030.38 Sr I MCS75 1000 P 4077.71 Sr II MCS75 4 4161.80 Sr II MCS75 700 P 4215.52 Sr II MCS75 7 P 4305.45 Sr II MCS75 1000 P 4607.33 Sr I MCS75 50 4722.28 Sr I MCS75 30 4741.92 Sr I MCS75 20 4784.32 Sr I MCS75 70 P 4811.88 Sr I MCS75 60 4832.08 Sr I MCS75 50 P 4872.49 Sr I MCS75 30 4876.32 Sr I MCS75 120 P 4962.26 Sr I MCS75 20 P 4967.94 Sr I MCS75 20 5222.20 Sr I MCS75 30 5225.11 Sr I MCS75 30 5229.27 Sr I MCS75 40 5238.55 Sr I MCS75 70 P 5256.90 Sr I MCS75 25 5450.84 Sr I MCS75 110 P 5480.84 Sr I MCS75 50 5504.17 Sr I MCS75 40 5521.83 Sr I MCS75 30 5534.81 Sr I MCS75 30 5540.05 Sr I MCS75 140 P 6408.47 Sr I MCS75 80 P 6504.00 Sr I MCS75 25 6550.26 Sr I MCS75 50 6617.26 Sr I MCS75 30 P 6791.05 Sr I MCS75 70 P 6878.38 Sr I MCS75 20 P 6892.59 Sr I MCS75 80 P 7070.10 Sr I MCS75 40 7309.41 Sr I MCS75 4 8688.91 Sr II NOL73 7 10036.66 Sr II S38a 20 P 10327.31 Sr II S38a 4 10914.88 Sr II S38a

Strong Lines of Yttrium (Y)

Strong Lines of Yttrium (Y)

Intensity Wavelength (Å) Spectrum Ref. Air 25 2243.045 Y II NJK91 40 2422.186 Y II NJK91 40 2948.406 Y I P77 40 2964.964 Y I P77 50 2974.588 Y I P77 80 2984.254 Y I P77 20 3045.363 Y I P77 300 3173.045 Y II NJK91 200 3195.613 Y II NJK91 150 3200.269 Y II NJK91 150 3203.320 Y II NJK91 300 3216.680 Y II NJK91 500 P 3242.272 Y II NJK91 400 3327.876 Y II NJK91 15 3485.722 Y I P77 130 3496.079 Y II NJK91 300 P 3549.002 Y II NJK91 50 3552.690 Y I P77 15 3558.741 Y I P77 20 3571.431 Y I P77 25 3576.052 Y I P77 250 3584.514 Y II NJK91 30 3587.743 Y I P77 300 3592.915 Y I P77 800 P 3600.731 Y II NJK91 500 3601.915 Y II NJK91 600 P 3611.043 Y II NJK91 400 3620.940 Y I P77 150 3628.700 Y II NJK91 600 P 3633.121 Y II NJK91 250 3664.610 Y II NJK91 15 3692.523 Y I P77 1000 P 3710.287 Y II NJK91 90 3747.551 Y II NJK91 800 P 3774.330 Y II NJK91 110 3776.556 Y II NJK91 600 3788.693 Y II NJK91 100 3818.341 Y II NJK91 300 P 3832.889 Y II NJK91 300 3950.349 Y II NJK91 300 P 3982.592 Y II NJK91 90 4039.826 Y I P77 250 4047.628 Y I P77 900 P 4077.359 Y I P77 200 4083.705 Y I P77 1000 P 4102.364 Y I P77 6 4106.384 Y I P77 900 P 4128.299 Y I P77 800 P 4142.841 Y I P77 250 4167.513 Y I P77 200 4174.133 Y I P77 600 P 4177.528 Y II NJK91 15 4217.799 Y I P77 30 4220.629 Y I P77 200 4235.929 Y I P77 100 4251.201 Y I P77 40 h 4302.290 Y I P77 200 4309.620 Y II NJK91 40 h 4348.783 Y I P77 900 P 4374.933 Y II NJK91 200 4398.008 Y II NJK91 15 4475.720 Y I P77 20 4476.952 Y I P77 15 4477.442 Y I P77 30 4487.460 Y I P77 50 4505.948 Y I P77 90 4527.239 Y I P77 40 4527.783 Y I P77 13 4596.528 Y I P77 200 4643.698 Y I P77 20 h 4658.319 Y I P77 200 4674.848 Y I P77 20 4696.800 Y I P77 15 4728.514 Y I P77 15 4752.790 Y I P77 40 4760.978 Y I P77 15 4786.875 Y I P77 20 4799.301 Y I P77 80 4839.866 Y I P77 60 4845.668 Y I P77 40 4852.682 Y I P77 300 4854.861 Y II NJK91 30 4859.841 Y I P77 700 P 4883.682 Y II NJK91 600 P 4900.118 Y II NJK91 700 P 5087.418 Y II NJK91 20 5135.199 Y I P77 300 5200.409 Y II NJK91 500 P 5205.722 Y II NJK91 20 5240.800 Y I P77 20 5438.226 Y I P77 70 5466.466 Y I P77 30 5503.464 Y I P77 70 5527.561 Y I P77 20 5577.416 Y I P77 60 5581.874 Y I P77 60 5630.138 Y I P77 15 5706.714 Y I P77 100 6024.271 Y I P77 120 6191.720 Y I P77 30 6222.579 Y I P77 100 6435.022 Y I P77 15 6687.571 Y I P77 20 6793.704 Y I P77 50 9476.928 Y II NJK91 30 10329.701 Y II NJK91 30 10605.150 Y II NJK91 200 15619.966 Y I P77 400 17123.808 Y I P77 250 17366.720 Y I P77 600 P 17422.838 Y I P77 500 17663.292 Y I P77 1000 P 17903.209 Y I P77 1000 P 18049.810 Y I P77 1000 18115.296 Y I P77 900 18181.765 Y I P77 800 P 21260.444 Y I P77 700 P 22543.828 Y I P77 500 P 23990.450 Y I P77 400 24920.894 Y I P77

Strong Lines of Zirconium (Zr)

Strong Lines of Zirconium (Zr)

Intensity Wavelength (Å) Spectrum Ref. Air 300 P 2568.871 Zr II J98 400 P 2571.457 Zr II J98 300 P 2678.632 Zr II J98 130 2700.129 Zr II J98 250 P 2722.609 Zr II J98 90 2732.721 Zr II J98 250 P 2734.851 Zr II J98 200 2742.553 Zr II J98 120 2745.854 Zr II J98 120 2752.202 Zr II J98 90 2758.806 Zr II J98 200 2814.902 Zr I J98 90 2825.557 Zr II J98 200 2837.226 Zr I J98 120 2844.575 Zr II J98 40 2848.186 Zr II J98 140 2875.980 Zr I J98 90 2960.867 Zr I J98 250 2985.388 Zr I J98 250 3011.743 Zr I J98 90 3028.038 Zr II J98 250 3029.515 Zr I J98 120 3054.833 Zr II J98 120 3106.576 Zr II J98 100 3120.746 Zr I J98 90 3129.173 Zr II J98 90 3129.760 Zr II J98 100 3132.060 Zr I J98 120 3138.678 Zr II J98 90 3164.313 Zr II J98 150 3165.977 Zr II J98 150 3182.860 Zr II J98 150 3191.215 Zr I J98 150 3212.016 Zr I J98 130 3214.189 Zr II J98 110 3231.692 Zr II J98 200 3234.123 Zr I J98 130 3241.044 Zr II J98 90 3250.393 Zr I J98 60 3260.111 Zr I J98 90 3272.222 Zr II J98 200 3273.047 Zr II J98 250 P 3279.264 Zr II J98 90 3282.732 Zr I J98 150 3284.712 Zr II J98 90 3305.152 Zr II J98 150 3306.277 Zr II J98 130 3340.553 Zr II J98 130 3356.087 Zr II J98 90 3357.261 Zr II J98 100 3387.869 Zr II J98 130 3388.295 Zr II J98 1000 P 3391.972 Zr II J98 100 3393.119 Zr II J98 100 3404.827 Zr II J98 130 3410.243 Zr II J98 200 3430.527 Zr II J98 800 P 3438.231 Zr II J98 150 3447.362 Zr I J98 60 3455.902 Zr I J98 70 3457.561 Zr II J98 140 3463.013 Zr II J98 150 3471.185 Zr I J98 60 3478.780 Zr I J98 200 P 3479.387 Zr II J98 250 P 3481.155 Zr II J98 130 3483.532 Zr II J98 700 P 3496.206 Zr II J98 140 3505.666 Zr II J98 300 3509.321 Zr I J98 600 P 3519.604 Zr I J98 80 3525.808 Zr II J98 130 3533.223 Zr I J98 60 3535.159 Zr I J98 110 3542.621 Zr II J98 500 P 3547.683 Zr I J98 60 3549.731 Zr I J98 200 3550.460 Zr I J98 300 P 3551.951 Zr II J98 400 P 3556.594 Zr II J98 300 3566.099 Zr I J98 400 P 3572.468 Zr II J98 300 P 3575.790 Zr I J98 250 P 3576.853 Zr II J98 250 3586.293 Zr I J98 80 3587.974 Zr II J98 1000 P 3601.191 Zr I J98 120 3611.891 Zr II J98 200 3613.097 Zr II J98 200 3614.772 Zr II J98 300 3623.865 Zr I J98 90 3634.148 Zr I J98 70 3661.202 Zr I J98 300 P 3663.648 Zr I J98 140 3674.715 Zr II J98 150 3698.165 Zr II J98 130 3709.269 Zr II J98 100 3745.947 Zr II J98 150 3751.590 Zr II J98 140 3764.389 Zr I J98 140 3766.714 Zr I J98 200 3780.534 Zr I J98 150 3791.397 Zr I J98 150 3822.413 Zr I J98 600 P 3835.962 Zr I J98 250 P 3836.761 Zr II J98 100 3843.018 Zr II J98 150 3847.008 Zr I J98 150 3849.250 Zr I J98 800 P 3863.872 Zr I J98 200 3864.332 Zr I J98 300 3877.595 Zr I J98 60 3879.048 Zr I J98 400 3885.422 Zr I J98 800 P 3890.316 Zr I J98 600 P 3891.380 Zr I J98 110 3900.512 Zr I J98 150 3921.788 Zr I J98 300 3929.529 Zr I J98 150 3958.220 Zr II J98 140 3966.659 Zr I J98 300 3968.256 Zr I J98 200 3973.502 Zr I J98 60 3975.294 Zr I J98 140 3991.127 Zr II J98 140 3998.965 Zr II J98 60 4007.596 Zr I J98 110 4023.977 Zr I J98 200 4024.912 Zr I J98 300 4027.201 Zr I J98 70 4028.947 Zr I J98 70 4029.675 Zr II J98 140 4030.032 Zr I J98 110 4035.887 Zr I J98 70 4042.219 Zr I J98 150 4043.570 Zr I J98 140 4044.560 Zr I J98 70 4045.612 Zr II J98 110 4048.666 Zr II J98 60 4050.476 Zr I J98 200 4055.027 Zr I J98 150 4055.704 Zr I J98 90 4061.523 Zr I J98 400 4064.151 Zr I J98 600 P 4072.698 Zr I J98 90 4074.925 Zr I J98 60 4076.524 Zr I J98 70 4078.305 Zr I J98 600 P 4081.209 Zr I J98 60 4108.394 Zr I J98 200 P 4149.198 Zr II J98 60 4152.640 Zr I J98 70 4161.200 Zr II J98 110 4166.366 Zr I J98 200 4187.559 Zr I J98 110 4194.760 Zr I J98 150 4201.451 Zr I J98 110 4208.980 Zr II J98 110 4213.863 Zr I J98 600 P 4227.750 Zr I J98 60 4236.056 Zr I J98 600 P 4239.309 Zr I J98 200 4240.335 Zr I J98 200 4241.197 Zr I J98 300 4241.683 Zr I J98 90 4268.015 Zr I J98 150 4282.198 Zr I J98 150 4294.787 Zr I J98 90 4302.878 Zr I J98 150 4341.127 Zr I J98 300 4347.888 Zr I J98 90 4360.800 Zr I J98 150 4507.109 Zr I J98 150 4535.742 Zr I J98 60 4553.008 Zr I J98 60 4555.124 Zr I J98 140 4575.513 Zr I J98 200 4633.982 Zr I J9

Strong Lines of Molybdenum (Mo)

Strong Lines of Molybdenum (Mo)

Intensity Wavelength (Å) Spectrum Ref. Air 500 P 2015.109 Mo II SPNL01 1000 P 2020.314 Mo II SPNL01 500 P 2038.452 Mo II SPNL01 400 P 2045.973 Mo II SPNL01 120 P 2081.681 Mo II SPNL01 60 P 2089.52 Mo II MCS75 60 P 2092.50 Mo II MCS75 100 P 2093.11 Mo II MCS75 70 P 2100.84 Mo II MCS75 40 2104.29 Mo II MCS75 40 2108.02 Mo II MCS75 20 2269.69 Mo II MCS75 30 2538.46 Mo II MCS75 25 2542.67 Mo II MCS75 11 2548.225 Mo I WB88 11 2572.345 Mo I WB88 20 2593.710 Mo II SPNL01 20 2602.800 Mo II SPNL01 10 2613.084 Mo I WB88 14 2616.786 Mo I WB88 15 2629.850 Mo I WB88 25 2636.670 Mo II SPNL01 50 2638.761 Mo II SPNL01 14 2640.984 Mo I WB88 40 2644.348 Mo II SPNL01 30 2646.486 Mo II SPNL01 20 2649.458 Mo I WB88 40 2653.347 Mo II SPNL01 20 2655.021 Mo I WB88 10 2658.111 Mo I WB88 50 2660.576 Mo II SPNL01 50 2672.843 Mo II SPNL01 20 2673.27 Mo II MCS75 30 2679.854 Mo I WB88 50 2683.234 Mo II SPNL01 70 2684.140 Mo II SPNL01 40 2687.992 Mo II SPNL01 40 2701.416 Mo II SPNL01 20 2717.35 Mo II MCS75 25 2732.880 Mo II SPNL01 20 2746.30 Mo II MCS75 11 2751.468 Mo I WB88 15 2763.62 Mo II MCS75 20 2769.76 Mo II MCS75 130 P 2775.402 Mo II SPNL01 70 2780.037 Mo II SPNL01 30 2784.99 Mo II MCS75 30 2807.753 Mo II SPNL01 130 P 2816.158 Mo II SPNL01 15 2817.44 Mo II MCS75 130 P 2848.233 Mo II SPNL01 30 2853.23 Mo II MCS75 30 2863.81 Mo II MCS75 15 2866.69 Mo II MCS75 130 P 2871.512 Mo II SPNL01 15 2879.05 Mo II MCS75 100 2890.994 Mo II SPNL01 70 2894.451 Mo II SPNL01 20 2903.07 Mo II MCS75 40 2909.117 Mo II SPNL01 80 2911.917 Mo II SPNL01 100 2923.392 Mo II SPNL01 80 2930.502 Mo II SPNL01 60 2934.298 Mo II SPNL01 20 2956.057 Mo II SPNL01 20 2963.797 Mo II SPNL01 20 2972.611 Mo II SPNL01 10 3041.699 Mo I WB88 30 3064.274 Mo I WB88 20 3065.04 Mo II MCS75 30 3074.369 Mo I WB88 30 3085.616 Mo I WB88 20 3087.62 Mo II MCS75 20 3094.663 Mo I WB88 20 3101.344 Mo I WB88 50 3112.119 Mo I WB88 20 3122.00 Mo II MCS75 500 P 3132.594 Mo I WB88 15 3152.82 Mo II MCS75 200 P 3158.167 Mo I WB88 300 P 3170.344 Mo I WB88 13 3183.033 Mo I WB88 13 3185.104 Mo I WB88 250 P 3193.979 Mo I WB88 10 3195.960 Mo I WB88 11 3205.217 Mo I WB88 30 3205.887 Mo I WB88 100 P 3208.838 Mo I WB88 20 3215.072 Mo I WB88 12 3221.734 Mo I WB88 30 3228.212 Mo I WB88 20 3229.795 Mo I WB88 40 3233.142 Mo I WB88 30 3237.060 Mo I WB88 30 3256.208 Mo I WB88 10 3262.626 Mo I WB88 15 3264.401 Mo I WB88 30 3270.899 Mo I WB88 11 3285.355 Mo I WB88 40 3289.011 Mo I WB88 30 3290.820 Mo I WB88 11 3305.563 Mo I WB88 11 3307.125 Mo I WB88 20 3323.949 Mo I WB88 12 3325.674 Mo I WB88 12 3327.304 Mo I WB88 40 3344.730 Mo I WB88 11 3347.004 Mo I WB88 60 3358.118 Mo I WB88 30 3363.778 Mo I WB88 30 3379.965 Mo I WB88 11 3382.482 Mo I WB88 70 3384.609 Mo I WB88 20 3404.335 Mo I WB88 40 3405.94 Mo I MCS75 13 3434.788 Mo I WB88 11 3435.448 Mo I WB88 20 3437.213 Mo I WB88 110 P 3447.124 Mo I WB88 20 3449.074 Mo I WB88 10 3451.75 Mo I MCS75 30 3456.386 Mo I WB88 20 3460.778 Mo I WB88 11 3466.824 Mo I WB88 11 3469.219 Mo I WB88 30 3504.411 Mo I WB88 20 3508.114 Mo I WB88 15 3521.413 Mo I WB88 20 3537.28 Mo I MCS75 11 3542.166 Mo I WB88 20 3558.095 Mo I WB88 14 3563.136 Mo I WB88 10 3566.052 Mo I WB88 11 3573.878 Mo I WB88 50 3581.885 Mo I WB88 9 3602.938 Mo I WB88 50 3624.462 Mo I WB88 11 3626.180 Mo I WB88 30 3635.43 Mo I MCS75 14 3657.357 Mo I WB88 20 3664.811 Mo I WB88 20 3672.807 Mo I WB88 40 3680.590 Mo I WB88 50 3694.939 Mo I WB88 15 3727.679 Mo I WB88 11 3732.709 Mo I WB88 12 3770.445 Mo I WB88 12 3781.592 Mo I WB88 1000 P 3798.252 Mo I WB88 10 3801.840 Mo I WB88 20 3826.694 Mo I WB88 30 3828.876 Mo I WB88 60 3833.747 Mo I WB88 13 3847.246 Mo I WB88 1000 P 3864.104 Mo I WB88 20 3869.082 Mo I WB88 20 3886.822 Mo I WB88 13 3901.770 Mo I WB88 700 P 3902.953 Mo I WB88 9 4056.012 Mo I WB88 50 4062.077 Mo I WB88 80 P 4069.882 Mo I WB88 40 4081.44 Mo I MCS75 30 4084.373 Mo I WB88 25 4107.462 Mo I WB88 20 4120.093 Mo I WB88 100 4143.55 Mo I MCS75 15 4185.819 Mo I WB88 90 P 4188.324 Mo I WB88 50 4232.589 Mo I WB88 9 4269.279 Mo I WB88 30 4276.906 Mo I WB88 40 4277.239 Mo I WB88 50

Strong Lines of Niobium (Nb)

Strong Lines of Niobium (Nb)

Intensity Wavelength (Å) Spectrum Ref. Air 1000 P 2029.3423 Nb II RCL00 900 P 2033.0102 Nb II RCL00 600 P 2109.4384 Nb II RCL00 500 2125.2164 Nb II RCL00 300 2126.5498 Nb II RCL00 500 2131.1832 Nb II RCL00 110 2295.6800 Nb II RCL00 120 2544.806 Nb II RCL00 120 2583.987 Nb II RCL00 120 2590.943 Nb II RCL00 15 2592.20 Nb I MCS75 100 2646.254 Nb II RCL00 20 2647.50 Nb I MCS75 20 2654.45 Nb I MCS75 300 P 2697.060 Nb II RCL00 100 c 2698.860 Nb II RCL00 100 2702.194 Nb II RCL00 140 P 2716.622 Nb II RCL00 140 P 2721.981 Nb II RCL00 20 2758.61 Nb I MCS75 20 2773.20 Nb I MCS75 150 2868.515 Nb II RCL00 250 P 2875.390 Nb II RCL00 150 2877.038 Nb II RCL00 150 P 2883.174 Nb II RCL00 140 2897.806 Nb II RCL00 140 2908.240 Nb II RCL00 200 2910.587 Nb II RCL00 140 c 2911.743 Nb II RCL00 300 P 2927.814 Nb II RCL00 250 2941.543 Nb II RCL00 300 P 2950.882 Nb II RCL00 120 2972.571 Nb II RCL00 100 2974.094 Nb II RCL00 100 2990.278 Nb II RCL00 140 2994.728 Nb II RCL00 110 3028.440 Nb II RCL00 120 3076.865 Nb II RCL00 500 P 3094.176 Nb II RCL00 500 P 3130.782 Nb II RCL00 120 3145.403 Nb II RCL00 400 P 3163.401 Nb II RCL00 120 3180.285 Nb II RCL00 300 P 3194.975 Nb II RCL00 120 3215.593 Nb II RCL00 250 P 3225.467 Nb II RCL00 120 3236.410 Nb II RCL00 100 3254.066 Nb II RCL00 20 3296.01 Nb I MCS75 25 3312.60 Nb I MCS75 80 P 3341.97 Nb I MCS75 80 P 3343.71 Nb I MCS75 110 P 3349.06 Nb I MCS75 25 3349.52 Nb I MCS75 20 3354.74 Nb I MCS75 110 P 3358.42 Nb I MCS75 20 3366.96 Nb I MCS75 20 3374.92 Nb I MCS75 15 3380.41 Nb I MCS75 20 3392.34 Nb I MCS75 15 3408.38 Nb I MCS75 20 3478.69 Nb I MCS75 30 3498.63 Nb I MCS75 30 3507.96 Nb I MCS75 120 P 3535.30 Nb I MCS75 80 3537.48 Nb I MCS75 30 3544.02 Nb I MCS75 20 3550.45 Nb I MCS75 60 3554.66 Nb I MCS75 40 3563.50 Nb I MCS75 40 3563.62 Nb I MCS75 90 P 3575.85 Nb I MCS75 300 P 3580.27 Nb I MCS75 30 3584.97 Nb I MCS75 50 3589.11 Nb I MCS75 30 3589.36 Nb I MCS75 30 3593.97 Nb I MCS75 30 3602.56 Nb I MCS75 25 3649.85 Nb I MCS75 120 3651.182 Nb II RCL00 40 3660.37 Nb I MCS75 60 3664.70 Nb I MCS75 15 3674.78 Nb I MCS75 90 3697.85 Nb I MCS75 20 3711.34 Nb I MCS75 200 3713.01 Nb I MCS75 30 3716.99 Nb I MCS75 150 3726.24 Nb I MCS75 15 3738.42 Nb I MCS75 150 P 3739.80 Nb I MCS75 200 3740.714 Nb II RCL00 15 3741.78 Nb I MCS75 110 3742.39 Nb I MCS75 30 3763.49 Nb I MCS75 20 3765.08 Nb I MCS75 30 3771.85 Nb I MCS75 50 3781.01 Nb I MCS75 110 3787.06 Nb I MCS75 80 3790.15 Nb I MCS75 200 3791.21 Nb I MCS75 150 3798.12 Nb I MCS75 15 3801.30 Nb I MCS75 150 3802.92 Nb I MCS75 40 3803.88 Nb I MCS75 30 3804.74 Nb I MCS75 40 3810.49 Nb I MCS75 30 3811.03 Nb I MCS75 30 3815.51 Nb I MCS75 40 3824.88 Nb I MCS75 20 3835.18 Nb I MCS75 20 3858.95 Nb I MCS75 20 3863.38 Nb I MCS75 15 3867.92 Nb I MCS75 30 3877.56 Nb I MCS75 50 3878.82 Nb I MCS75 40 3883.14 Nb I MCS75 70 3885.44 Nb I MCS75 40 3885.68 Nb I MCS75 40 3891.30 Nb I MCS75 40 3914.70 Nb I MCS75 30 3920.20 Nb I MCS75 40 3937.44 Nb I MCS75 30 3943.67 Nb I MCS75 60 d 3966.09 Nb I MCS75 70 4032.52 Nb I MCS75 1000 P ,c 4058.94 Nb I MCS75 20 4060.79 Nb I MCS75 800 P 4079.73 Nb I MCS75 15 4084.86 Nb I MCS75 30 4100.40 Nb I MCS75 400 P 4100.92 Nb I MCS75 20 4116.90 Nb I MCS75 300 P 4123.81 Nb I MCS75 40 4129.43 Nb I MCS75 50 4129.93 Nb I MCS75 140 4137.10 Nb I MCS75 30 4139.44 Nb I MCS75 150 4139.71 Nb I MCS75 20 4143.21 Nb I MCS75 50 4150.12 Nb I MCS75 300 P 4152.58 Nb I MCS75 50 4163.47 Nb I MCS75 300 P 4163.66 Nb I MCS75 250 P 4164.66 Nb I MCS75 200 P 4168.13 Nb I MCS75 20 4184.44 Nb I MCS75 80 4190.88 Nb I MCS75 50 4192.07 Nb I MCS75 50 4195.09 Nb I MCS75 80 4195.66 Nb I MCS75 20 4198.51 Nb I MCS75 20 4201.52 Nb I MCS75 50 4205.31 Nb I MCS75 20 4214.73 Nb I MCS75 25 4217.94 Nb I MCS75 25 4229.15 Nb I MCS75 50 4262.05 Nb I MCS75 25 4266.02 Nb I MCS75 20 4270.69 Nb I MCS75 25 4286.99 Nb I MCS75 40 4299.60 Nb I MCS75 40 4300.99 Nb I MCS75 25 4311.27 Nb I MCS75 20 4326.33 Nb I MCS75 25 4331.37 Nb I MCS75 20 4351.57 Nb I MCS75 20 4410.21 Nb I MCS75 20 4447.18 Nb I MCS75 30

Strong Lines of Technetium (Tc)

Strong Lines of Technetium (Tc)

Intensity Wavelength (Å) Spectrum Ref. Air 200 2496.77 Tc II BMC67 1000 P 2543.23 Tc II BMC67 1000 P ,c 2609.99 Tc II BMC67 150 2614.23 Tc I BMC67 100 2615.87 Tc I BMC67 200 2634.91 Tc II BMC67 1000 P ,c 2647.01 Tc II BMC67 100 2652.35 Tc II BMC67 70 2707.90 Tc II BMC67 100 2708.78 Tc I BMC67 100 2726.69 Tc I BMC67 100 2782.05 Tc I BMC67 130 2795.78 Tc II BMC67 100 2802.81 Tc I BMC67 300 2811.61 Tc II BMC67 70 2821.35 Tc II BMC67 200 c 2859.11 Tc I BMC67 100 2887.73 Tc I BMC67 100 2896.34 Tc I BMC67 100 2913.15 Tc I BMC67 100 2928.20 Tc I BMC67 100 3099.10 Tc I BMC67 70 3122.64 Tc I BMC67 150 3131.23 Tc I BMC67 300 P 3173.30 Tc I BMC67 200 P 3182.37 Tc I BMC67 200 P 3183.11 Tc I BMC67 500 P ,c 3195.20 Tc II BMC67 700 P 3212.02 Tc II BMC67 700 P 3237.02 Tc II BMC67 500 P ,c 3466.28 Tc I BMC67 100 3475.59 Tc I BMC67 100 c 3486.23 Tc I BMC67 100 3500.70 Tc I BMC67 80 c 3502.70 Tc I BMC67 80 3525.83 Tc I BMC67 80 3538.68 Tc I BMC67 200 c 3541.77 Tc I BMC67 600 c 3549.72 Tc I BMC67 400 c 3550.64 Tc I BMC67 80 3560.32 Tc I BMC67 80 3568.85 Tc I BMC67 100 3580.06 Tc I BMC67 60 3581.26 Tc I BMC67 80 3582.08 Tc I BMC67 200 3582.63 Tc I BMC67 400 3587.94 Tc I BMC67 100 c 3595.66 Tc I BMC67 100 c 3607.32 Tc I BMC67 200 c 3608.27 Tc I BMC67 100 c 3627.36 Tc I BMC67 300 c 3635.15 Tc I BMC67 1000 P ,c 3636.07 Tc I BMC67 100 3638.22 Tc I BMC67 90 3639.38 Tc I BMC67 100 c 3648.04 Tc I BMC67 60 3651.47 Tc I BMC67 100 c 3658.59 Tc I BMC67 100 3679.15 Tc I BMC67 500 3684.74 Tc I BMC67 70 3703.83 Tc I BMC67 80 3712.26 Tc I BMC67 800 P 3718.86 Tc I BMC67 120 3723.67 Tc I BMC67 150 3724.40 Tc I BMC67 400 3726.35 Tc I BMC67 100 3746.15 Tc I BMC67 500 3746.84 Tc I BMC67 100 3752.13 Tc I BMC67 400 3754.37 Tc I BMC67 100 3758.54 Tc I BMC67 200 3761.81 Tc I BMC67 500 3768.77 Tc I BMC67 300 3771.03 Tc I BMC67 200 3779.37 Tc I BMC67 300 c 3780.68 Tc I BMC67 100 3797.77 Tc I BMC67 60 3832.82 Tc I BMC67 150 3837.56 Tc I BMC67 80 3841.31 Tc I BMC67 80 3845.97 Tc I BMC67 100 3868.24 Tc I BMC67 60 c 3880.72 Tc I BMC67 60 3899.83 Tc I BMC67 400 c 3946.57 Tc I BMC67 200 3947.09 Tc I BMC67 500 P ,c 3984.97 Tc I BMC67 100 3994.51 Tc I BMC67 50 4012.00 Tc I BMC67 30 4017.22 Tc I BMC67 100 4020.76 Tc I BMC67 1000 P ,c 4031.63 Tc I BMC67 50 4039.25 Tc I BMC67 500 c 4049.11 Tc I BMC67 500 4088.71 Tc I BMC67 700 P 4095.67 Tc I BMC67 50 4110.22 Tc I BMC67 500 4115.08 Tc I BMC67 30 4119.27 Tc I BMC67 400 4124.22 Tc I BMC67 50 4128.27 Tc I BMC67 40 4139.85 Tc I BMC67 300 4144.95 Tc I BMC67 150 4145.08 Tc I BMC67 500 4165.61 Tc I BMC67 50 4169.68 Tc I BMC67 200 4170.27 Tc I BMC67 250 4172.53 Tc I BMC67 50 4176.28 Tc I BMC67 40 4186.51 Tc I BMC67 500 P ,c 4238.19 Tc I BMC67 800 P 4262.27 Tc I BMC67 40 4262.69 Tc I BMC67 200 4274.97 Tc II BMC67 30 4278.90 Tc I BMC67 1000 P 4297.06 Tc I BMC67 40 4429.59 Tc I BMC67 40 4481.53 Tc I BMC67 120 4487.06 Tc I BMC67 40 4515.98 Tc I BMC67 400 4522.84 Tc I BMC67 80 4539.53 Tc I BMC67 30 4552.85 Tc I BMC67 40 4557.05 Tc I BMC67 80 4564.54 Tc I BMC67 40 4578.45 Tc I BMC67 40 4593.35 Tc I BMC67 40 4616.86 Tc I BMC67 40 4630.57 Tc I BMC67 120 4637.50 Tc I BMC67 80 4648.33 Tc I BMC67 80 c 4660.21 Tc I BMC67 80 4669.30 Tc I BMC67 40 4706.92 Tc I BMC67 80 4717.77 Tc I BMC67 150 c 4719.28 Tc I BMC67 400 4740.61 Tc I BMC67 40 4752.72 Tc I BMC67 150 4771.54 Tc I BMC67 400 4820.74 Tc I BMC67 40 4834.37 Tc I BMC67 40 4835.39 Tc I BMC67 800 P 4853.59 Tc I BMC67 400 4866.73 Tc I BMC67 300 4891.92 Tc I BMC67 40 4908.51 Tc I BMC67 80 4909.57 Tc I BMC67 250 4976.34 Tc I BMC67 300 5096.28 Tc I BMC67 150 5161.81 Tc I BMC67 150 5174.81 Tc I BMC67 80 5275.51 Tc I BMC67 70 5285.07 Tc I BMC67 50 5320.20 Tc I BMC67 300 c 5589.02 Tc I BMC67 200 c 5620.45 Tc I BMC67 150 5642.13 Tc I BMC67 80 5644.94 Tc I BMC67 70 5725.31 Tc I BMC67 100 c 5924.47 Tc I BMC67 60 c 5931.93 Tc I BMC67 80 6085.23 Tc I BMC67 100 6120.68 Tc I BMC67 100 6130.80 Tc I BMC67 80 6192.66

Strong Lines of Cadmium (Cd)

Strong Lines of Cadmium (Cd)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 200 1514.26 Cd II SP49 200 1571.58 Cd II SP49 300 1922.23 Cd II SP49 200 1995.43 Cd II SP49 Air 1000 P ,r 2144.408 Cd II SP49 1000 2194.557 Cd II SP49 1000 P 2265.018 Cd II SP49 800 P ,r 2288.022 Cd I BA56 1000 P 2312.766 Cd II SP49 200 2321.074 Cd II SP49 500 P 2572.930 Cd II SP49 1000 P 2748.549 Cd II SP49 100 2836.900 Cd I BA56 100 r 2880.767 Cd I BA56 200 2914.672 Cd II SP49 200 2929.271 Cd II SP49 500 r 2980.620 Cd I BA56 100 r 2981.362 Cd I BA56 100 3133.167 Cd I BA56 150 3252.524 Cd I BA56 150 3261.055 Cd I BA56 400 P 3403.652 Cd I BA56 500 P 3466.200 Cd I BA56 400 P 3467.655 Cd I BA56 500 P 3610.508 Cd I BA56 400 P 3612.873 Cd I BA56 200 4134.768 Cd II SP49 1000 4415.63 Cd II SP49 100 P 4678.149 Cd I BA56 150 P 4799.912 Cd I BA56 500 P ,h 5085.822 Cd I BA56 1000 5337.48 Cd II SP49 1000 5378.13 Cd II SP49 200 5381.89 Cd II SP49 150 6099.142 Cd I BA56 400 6354.72 Cd II SP49 500 6359.98 Cd II SP49 1000 P 6438.470 Cd I BA56 400 6464.94 Cd II SP49 500 6725.78 Cd II SP49 500 7345.670 Cd I BA56

Strong Lines of Palladium (Pd)

Strong Lines of Palladium (Pd)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 600 P 1162.1700 Pd II LLTL01 700 P 1183.4003 Pd II LLTL01 1000 P 1196.4051 Pd II LLTL01 800 P 1203.9645 Pd II LLTL01 600 1214.5242 Pd II LLTL01 700 P 1218.6219 Pd II LLTL01 600 1225.2684 Pd II LLTL01 600 1235.1957 Pd II LLTL01 700 P 1237.0677 Pd II LLTL01 800 P 1320.0229 Pd II LLTL01 700 P 1363.6892 Pd II LLTL01 600 1365.5430 Pd II LLTL01 800 P 1367.7039 Pd II LLTL01 900 P 1374.8481 Pd II LLTL01 Air 400 P 2231.5907 Pd II LLJ94 700 P 2296.5164 Pd II LLJ94 400 P 2351.3469 Pd II LLJ94 800 2360.5341 Pd II LLJ94 300 P 2367.9664 Pd II LLJ94 500 P 2446.1888 Pd II LLJ94 300 P 2447.9058 Pd I ELLW98 250 2469.2517 Pd II LLJ94 250 P 2476.4127 Pd I ELLW98 400 P 2486.5260 Pd II LLJ94 700 P 2488.9146 Pd II LLJ94 400 P 2498.7769 Pd II LLJ94 300 2505.7293 Pd II LLJ94 300 2551.8452 Pd II LLJ94 150 2565.5045 Pd II LLJ94 100 2658.7201 Pd II LLJ94 400 P 2763.0899 Pd I ELLW98 40 2776.6595 Pd II LLJ94 40 P 2854.5776 Pd II LLJ94 100 3114.0380 Pd I ELLW98 500 P 3242.6983 Pd I ELLW98 110 3251.6361 Pd I ELLW98 150 3258.7765 Pd I ELLW98 150 3302.1262 Pd I ELLW98 200 3372.9943 Pd I ELLW98 1000 P 3404.5764 Pd I ELLW98 500 P 3421.2214 Pd I ELLW98 500 3433.4278 Pd I ELLW98 250 3441.3896 Pd I ELLW98 300 P 3460.7381 Pd I ELLW98 400 P 3481.1516 Pd I ELLW98 80 3489.7700 Pd I ELLW98 500 P 3516.9438 Pd I ELLW98 500 P 3553.0803 Pd I ELLW98 200 3571.1489 Pd I ELLW98 800 P 3609.5547 Pd I ELLW98 800 P 3634.6884 Pd I ELLW98 200 3690.3368 Pd I ELLW98 90 3894.1988 Pd I ELLW98 100 4212.9537 Pd I ELLW98

Strong Lines of Rhodium (Rh)

Strong Lines of Rhodium (Rh)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 1000 P 1604.45 Rh II S58 400 P 1624.47 Rh II S58 1000 P 1628.94 Rh II S58 400 P 1634.72 Rh II S58 400 P 1637.88 Rh II S58 Air 40 2322.58 Rh I MCS75 800 P 2334.77 Rh II S58 30 2361.92 Rh I MCS75 30 2382.89 Rh I MCS75 25 2383.40 Rh I MCS75 300 P 2415.84 Rh II S58 25 2429.52 Rh I MCS75 40 2440.34 Rh I MCS75 400 P 2461.03 Rh II S58 400 P 2490.79 Rh II S58 40 2509.70 Rh I MCS75 20 2515.75 Rh I MCS75 500 P 2520.52 Rh II S58 40 2545.70 Rh I MCS75 60 2555.36 Rh I MCS75 25 2625.88 Rh I MCS75 40 2652.66 Rh I MCS75 40 2703.73 Rh I MCS75 400 P 2715.27 Rh II S58 20 2718.54 Rh I MCS75 15 2728.94 Rh I MCS75 20 2826.68 Rh I MCS75 30 2862.94 Rh I MCS75 15 2907.21 Rh I MCS75 300 P 2910.15 Rh II S58 20 2924.02 Rh I MCS75 25 2968.66 Rh I MCS75 15 2977.68 Rh I MCS75 50 2986.20 Rh I MCS75 20 3083.96 Rh I MCS75 25 3123.70 Rh I MCS75 50 3191.19 Rh I MCS75 20 3197.13 Rh I MCS75 60 3263.14 Rh I MCS75 60 3271.61 Rh I MCS75 250 3280.55 Rh I MCS75 250 3283.57 Rh I MCS75 30 3289.14 Rh I MCS75 20 3294.28 Rh I MCS75 30 3300.46 Rh I MCS75 400 P 3323.09 Rh I MCS75 40 3338.54 Rh I MCS75 30 3360.80 Rh I MCS75 40 3368.38 Rh I MCS75 120 3372.25 Rh I MCS75 600 P 3396.82 Rh I MCS75 90 3399.70 Rh I MCS75 15 3406.55 Rh I MCS75 90 3412.27 Rh I MCS75 40 3421.22 Rh I MCS75 900 P 3434.89 Rh I MCS75 150 3440.53 Rh I MCS75 40 3455.22 Rh I MCS75 20 3457.07 Rh I MCS75 25 3457.93 Rh I MCS75 600 3462.04 Rh I MCS75 20 3469.62 Rh I MCS75 500 3470.66 Rh I MCS75 500 3474.78 Rh I MCS75 200 3478.91 Rh I MCS75 130 3498.73 Rh I MCS75 600 P 3502.52 Rh I MCS75 300 P 3507.32 Rh I MCS75 900 P 3528.02 Rh I MCS75 90 d 3538.14 Rh I MCS75 30 3541.91 Rh I MCS75 130 3543.95 Rh I MCS75 200 3549.54 Rh I MCS75 25 3564.13 Rh I MCS75 130 3570.18 Rh I MCS75 500 3583.10 Rh I MCS75 500 3596.19 Rh I MCS75 600 3597.15 Rh I MCS75 30 3605.86 Rh I MCS75 300 3612.47 Rh I MCS75 25 3614.78 Rh I MCS75 20 3620.46 Rh I MCS75 200 3626.59 Rh I MCS75 30 3639.51 Rh I MCS75 40 3654.87 Rh I MCS75 900 P 3657.99 Rh I MCS75 30 3661.86 Rh I MCS75 140 3666.22 Rh I MCS75 20 3666.91 Rh I MCS75 60 3681.04 Rh I MCS75 200 3690.70 Rh I MCS75 1000 P 3692.36 Rh I MCS75 100 3695.52 Rh I MCS75 30 3698.26 Rh I MCS75 40 3698.60 Rh I MCS75 800 P 3700.91 Rh I MCS75 100 3713.02 Rh I MCS75 70 3735.28 Rh I MCS75 40 3737.27 Rh I MCS75 40 3744.17 Rh I MCS75 130 3748.22 Rh I MCS75 25 3754.12 Rh I MCS75 40 3754.27 Rh I MCS75 50 3755.58 Rh I MCS75 110 3760.40 Rh I MCS75 250 3765.08 Rh I MCS75 50 3769.97 Rh I MCS75 40 3778.13 Rh I MCS75 110 3788.47 Rh I MCS75 140 3792.18 Rh I MCS75 400 3793.22 Rh I MCS75 500 3799.31 Rh I MCS75 80 3805.92 Rh I MCS75 140 3806.76 Rh I MCS75 50 3815.01 Rh I MCS75 80 3816.47 Rh I MCS75 140 3818.19 Rh I MCS75 400 3822.26 Rh I MCS75 250 3828.48 Rh I MCS75 200 3833.89 Rh I MCS75 600 3856.52 Rh I MCS75 50 3870.01 Rh I MCS75 40 3877.34 Rh I MCS75 25 3922.19 Rh I MCS75 200 3934.23 Rh I MCS75 60 3942.72 Rh I MCS75 400 3958.86 Rh I MCS75 40 3975.31 Rh I MCS75 25 3984.40 Rh I MCS75 25 3995.61 Rh I MCS75 40 3996.15 Rh I MCS75 60 4082.78 Rh I MCS75 120 4121.68 Rh I MCS75 150 4128.87 Rh I MCS75 200 4135.27 Rh I MCS75 25 4154.37 Rh I MCS75 40 4196.50 Rh I MCS75 400 4211.14 Rh I MCS75 90 4288.71 Rh I MCS75 400 P 4374.80 Rh I MCS75 15 4675.03 Rh I MCS75 14 5354.40 Rh I MCS75 15 5599.42 Rh I MCS75 14 5983.60 Rh I MCS75

Strong Lines of Ruthenium (Ru)

Strong Lines of Ruthenium (Ru)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 600 P 1875.564 Ru II CHR88a 600 P 1888.043 Ru II JJLL94 600 P 1903.221 Ru II JJLL94 250 P 1916.816 Ru II JJLL94 250 P 1939.043 Ru II JJLL94 250 P 1939.505 Ru II JJLL94 Air 200 2076.43 Ru I K59 250 2083.78 Ru I K59 200 2090.22 Ru I K59 60 2255.53 Ru I K59 70 2272.091 Ru I K59 70 2279.582 Ru I K59 40 2317.784 Ru I K59 200 P 2357.916 Ru II JJLL94 1000 P 2402.72 Ru II MCS75 250 2455.531 Ru II JJ93 200 P 2456.438 Ru II JJLL94 500 P 2456.57 Ru II MCS75 400 P 2478.93 Ru II MCS75 200 2498.42 Ru II MCS75 200 2498.57 Ru II MCS75 300 P 2507.01 Ru II MCS75 50 2549.56 Ru I K59 30 2609.062 Ru I K59 80 2612.06 Ru I K59 40 2642.946 Ru I K59 40 2659.617 Ru I K59 400 P 2661.61 Ru II MCS75 900 P 2678.76 Ru II MCS75 400 2692.06 Ru II MCS75 250 P 2712.41 Ru II MCS75 60 2719.51 Ru I K59 400 P 2734.35 Ru II MCS75 150 2735.727 Ru I K59 150 2810.551 Ru I K59 40 2829.149 Ru I K59 60 2854.075 Ru I K59 40 2861.408 Ru I K59 50 2866.653 Ru I K59 150 2874.984 Ru I K59 70 2886.528 Ru I K59 30 2908.883 Ru I K59 100 2916.251 Ru I K59 250 2945.67 Ru II MCS75 30 2949.492 Ru I K59 50 2965.166 Ru I K59 200 2965.55 Ru II MCS75 200 P 2976.584 Ru II JJLL94 50 2976.923 Ru I K59 130 2988.945 Ru I K59 40 2994.967 Ru I K59 40 3006.588 Ru I K59 40 3064.834 Ru I K59 30 3096.565 Ru I K59 80 3099.284 Ru I K59 70 3100.836 Ru I K59 40 3294.109 Ru I K59 30 3301.593 Ru I K59 80 3339.555 Ru I K59 30 3368.455 Ru I K59 30 3392.533 Ru I K59 300 3417.332 Ru I K59 400 3428.319 Ru I K59 40 3430.764 Ru I K59 600 P 3436.737 Ru I K59 800 P 3498.944 Ru I K59 60 3514.491 Ru I K59 70 3539.368 Ru I K59 60 3570.606 Ru I K59 40 3587.204 Ru I K59 600 P 3589.220 Ru I K59 600 P 3593.029 Ru I K59 600 P 3596.185 Ru I K59 120 3599.769 Ru I K59 30 3626.740 Ru I K59 300 3634.931 Ru I K59 600 3661.364 Ru I K59 80 3663.378 Ru I K59 60 3669.546 Ru I K59 40 3716.998 Ru I K59 50 3726.096 Ru I K59 800 P 3726.926 Ru I K59 1000 P 3728.026 Ru I K59 600 P 3730.432 Ru I K59 40 3739.470 Ru I K59 300 3742.287 Ru I K59 80 3742.798 Ru I K59 40 3744.396 Ru I K59 250 3745.592 Ru I K59 70 3753.546 Ru I K59 80 3755.937 Ru I K59 110 3759.838 Ru I K59 30 3760.019 Ru I K59 50 3761.511 Ru I K59 50 3767.353 Ru I K59 140 3777.588 Ru I K59 40 3781.171 Ru I K59 50 3782.749 Ru I K59 400 3786.065 Ru I K59 500 3790.521 Ru I K59 70 3798.054 Ru I K59 700 P 3798.899 Ru I K59 700 P 3799.353 Ru I K59 50 3812.739 Ru I K59 70 3817.293 Ru I K59 70 3819.039 Ru I K59 60 3822.091 Ru I K59 50 3824.938 Ru I K59 70 3831.795 Ru I K59 80 3839.699 Ru I K59 40 3846.672 Ru I K59 70 3850.441 Ru I K59 40 3856.458 Ru I K59 120 3857.551 Ru I K59 60 3862.690 Ru I K59 120 3867.844 Ru I K59 60 3892.230 Ru I K59 70 3909.085 Ru I K59 140 3923.486 Ru I K59 300 3925.930 Ru I K59 50 3931.787 Ru I K59 70 3945.586 Ru I K59 40 3950.230 Ru I K59 50 3978.449 Ru I K59 50 3979.420 Ru I K59 80 3984.862 Ru I K59 140 4022.168 Ru I K59 50 4023.832 Ru I K59 130 4051.402 Ru I K59 60 4054.050 Ru I K59 30 4064.456 Ru I K59 70 4068.367 Ru I K59 90 4076.730 Ru I K59 500 4080.599 Ru I K59 80 4097.787 Ru I K59 150 4112.741 Ru I K59 200 4144.160 Ru I K59 60 4145.737 Ru I K59 80 4167.514 Ru I K59 50 4197.572 Ru I K59 50 4198.864 Ru I K59 700 P 4199.892 Ru I K59 140 4206.020 Ru I K59 500 4212.062 Ru I K59 70 4214.445 Ru I K59 80 4217.263 Ru I K59 30 4220.675 Ru I K59 50 4230.309 Ru I K59 70 4241.058 Ru I K59 70 4243.058 Ru I K59 30 4246.736 Ru I K59 70 4284.330 Ru I K59 50 4295.932 Ru I K59 300 4297.714 Ru I K59 80 4307.604 Ru I K59 30 4318.441 Ru I K59 50 4319.871 Ru I K59 50 4342.073 Ru I K59 60 4354.130 Ru I K59 80 4361.204 Ru I K59 200 4372.200 Ru I K59 80 4385.393 Ru I K59 120 4385.650 Ru I K59 150 4390.440 Ru I K59 150 4410.028 Ru I K59 40 4439.745 Ru I K59 40 4449.322 Ru I K59 100 4460.031 Ru I K59 500 4554.514 Ru I K59 150 4584.440 Ru I K59 70 4647.594 Ru I K59 130 4709.482 Ru I K59 50 4757.844 Ru I K59 50 4869.163 Ru I K59 40 4903.066 Ru I K59 40 5057.340 Ru I K59 50 5136.558 Ru I K59 50 5155.140 Ru I K59 80 5171.026

Strong Lines of Silver (Ag)

Strong Lines of Silver (Ag)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 1000 P 1106.9931 Ag II KLLT02 600 P 1112.4006 Ag II KLLT02 700 P 1195.8092 Ag II KLLT02 9 r 1515.63 Ag I S40 300 1644.4958 Ag II KLLT02 400 1665.3513 Ag II KLLT02 5 1651.52 Ag I S40 300 1682.8353 Ag II KLLT02 300 1723.6119 Ag II KLLT02 300 1994.3173 Ag II KLLT02 Air 20 2061.162 Ag I PZ01 9 2069.844 Ag I PZ01 300 P ,r 2113.8250 Ag II KLLT02 300 2243.4485 Ag II KLLT02 700 P ,r 2246.4120 Ag II KLLT02 300 P ,r 2248.7490 Ag II KLLT02 300 P 2279.9812 Ag II KLLT02 200 2317.0342 Ag II KLLT02 400 P ,r 2320.2451 Ag II KLLT02 300 P ,r 2324.6670 Ag II KLLT02 500 P ,r 2331.3665 Ag II KLLT02 1000 P ,r 2413.1883 Ag II KLLT02 1000 P ,r 2437.7832 Ag II KLLT02 200 2477.1279 Ag II KLLT02 200 2711.8732 Ag II KLLT02 5 2721.77 Ag I S40 9 h 2824.39 Ag I S40 60 2934.0209 Ag II KLLT02 1000 P ,r 3280.680 Ag I PZ01 500 P ,r 3382.887 Ag I PZ01 20 3810.941 Ag I PZ01 9 h 3840.750 Ag I PZ01 9 h 3981.580 Ag I PZ01 9 h 4055.476 Ag I PZ01 8 h 4210.960 Ag I PZ01 9 4212.814 Ag I PZ01 50 4620.0361 Ag II KLLT02 5 h 4668.477 Ag I PZ01 100 4788.3968 Ag II KLLT02 9 4874.10 Ag I S40 50 5027.3433 Ag II KLLT02 90 P 5209.078 Ag I PZ01 90 P 5465.497 Ag I PZ01 9 5471.555 Ag I PZ01 9 5667.34 Ag I S40 30 P 7687.772 Ag I PZ01 50 P 8273.509 Ag I PZ01 5 16819.5 Ag I S40

Strong Lines of Antimony (Sb)

Strong Lines of Antimony (Sb)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 800 P 1274.938 Sb II AJK89 800 P 1327.378 Sb II AJK89 800 1354.955 Sb II AJK89 600 1358.009 Sb II AJK89 800 P 1384.656 Sb II AJK89 1000 P 1387.565 Sb II AJK89 600 1407.784 Sb II AJK89 800 P 1436.447 Sb II AJK89 800 1498.549 Sb II AJK89 800 1513.255 Sb II AJK89 800 1524.367 Sb II AJK89 800 1565.501 Sb II AJK89 900 P 1576.099 Sb II AJK89 800 1581.353 Sb II AJK89 1000 P 1606.952 Sb II AJK89 700 1814.964 Sb II AJK89 400 P ,r 1871.154 Sb I SM02 200 1882.568 Sb I SM02 300 r 1950.393 Sb I SM02 Air 30 r 2039.792 Sb I SM02 60 P ,r 2049.577 Sb I SM02 100 2054.734 Sb II AJK89 400 P ,r 2068.344 Sb I SM02 20 r 2098.424 Sb I SM02 40 P ,r 2139.698 Sb I SM02 40 P ,r 2144.841 Sb I SM02 100 2170.855 Sb II AJK89 600 P ,r 2175.818 Sb I SM02 100 P ,r 2179.190 Sb I SM02 120 P ,r 2208.430 Sb I SM02 120 r 2262.483 Sb I SM02 120 r 2306.507 Sb I SM02 1000 P ,r 2311.463 Sb I SM02 150 h 2373.631 Sb I SM02 120 h 2383.616 Sb I SM02 150 r 2445.502 Sb I SM02 150 2478.316 Sb I SM02 800 P ,r 2528.509 Sb I SM02 600 P ,r 2598.048 Sb I SM02 200 r 2598.084 Sb I SM02 120 r 2612.304 Sb I SM02 120 r 2670.630 Sb I SM02 150 r 2769.931 Sb I SM02 400 P ,r 2877.913 Sb I SM02 200 r 3029.809 Sb I SM02 250 P ,r 3232.495 Sb I SM02 300 P ,r 3267.491 Sb I SM02 200 4711.68 Sb II C66b 400 P 5568.12 Sb II C66b 200 5639.77 Sb II C66b 500 P 6005.57 Sb II C66b 200 6079.67 Sb II C66b 300 P 6130.00 Sb II C66b 150 9518.68 Sb I SM02 150 9949.14 Sb I SM02 120 10260.849 Sb I SM02 400 10677.246 Sb I SM02 300 10741.898 Sb I SM02 250 10839.571 Sb I SM02 150 10879.698 Sb I SM02 120 11012.728 Sb I SM02 60 11266.082 Sb I SM02 12 11863.229 Sb I SM02

Strong Lines of Indium (In)

Strong Lines of Indium (In)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 20 P 1586.340 In II SM02 14 P ,w 1711.1 In I G54 14 P ,w 1757.3 In I G54 6 P 1936.217 In II B69 6 P 1966.711 In II B69 11 P 1977.359 In II B69 Air 14 P 2078.608 In II SM02 6 P ,c 2306.046 In II PC38 , B69 1 2306.86 In I P38 2 2389.54 In I P38 3 2460.08 In I P38 2 h 2468.02 In I P38 6 2521.37 In I P38 9 P ,d 2554.434 In II PC38 60 P 2560.150 In I P38 11 2601.76 In I P38 90 P 2710.265 In I P38 15 2713.94 In I P38 40 P 2753.878 In I P38 2 2775.37 In I P38 10 c 2836.92 In I P38 2 c 2858.14 In I P38 7 P ,d 2890.179 In II PC38 60 P 2932.630 In I P38 6 P 2941.050 In II PC38 1 c 2957.01 In I P38 400 P 3039.356 In I P38 700 P 3256.089 In I P38 150 P 3258.565 In I P38 20 w 3716.14 In II PC38 13 c 3799.21 In II PC38 14 c 3834.65 In II PC38 11 c 3842.18 In II PC38 14 w 3962.35 In II PC38 25 w 4056.94 In II PC38 900 P 4101.7504 In I DMZ53 1000 P 4511.2972 In I DMZ53 14 c 4620.14 In II PC38 20 c 4638.16 In II PC38 12 c 4644.58 In II PC38 20 c 4655.62 In II PC38 20 w 4656.74 In II PC38 25 w 4684.8 In II PC38 15 c 5120.80 In II PC38 11 w 5121.75 In II PC38 13 c 5175.42 In II PC38 12 w 5436.70 In II PC38 20 c 5513.00 In II PC38 14 w 5523.28 In II PC38 13 c 5576.90 In II PC38 11 w 5636.70 In II PC38 3 5709.91 In I P38 3 5727.68 In I P38 12 c 5853.15 In II PC38 25 w 5903.4 In II PC38 14 w 5915.4 In II PC38 14 c 6095.95 In II PC38 12 c 6108.66 In II PC38 13 w 6128.7 In II PC38 13 w 6129.4 In II PC38 20 w 6132.1 In II PC38 15 w 6228.3 In II PC38 15 w 6304.8 In II PC38 15 w 6362.3 In II PC38 15 w 6469.0 In II PC38 12 c 6541.20 In II PC38 20 P ,w 6891.56 In II PC38 20 P ,w 7182.89 In II PC38 12 c 7276.5 In II PC38 20 c 7350.6 In II PC38 12 c 7740.7 In II PC38 13 c 8227.0 In II PC38 12 w 9213.0 In II PC38 3 h 9370.27 In I JL67 6 9977.86 In I JL67 11 10257.03 In I JL67 3 h 10717.42 In I JL67 6 h 10744.31 In I JL67 1 P 12912.59 In I JL67 1 P 13429.96 In I JL67

Strong Lines of Tellurium (Te)

Strong Lines of Tellurium (Te)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 40 802.28 Te II HM64 40 1059.51 Te II HM64 40 P 1077.66 Te II HM64 50 P 1174.34 Te II HM64 60 P 1175.79 Te II HM64 40 1208.54 Te II HM64 40 1220.98 Te II HM64 40 1253.62 Te II HM64 40 1270.52 Te II HM64 50 P 1324.92 Te II HM64 40 1363.24 Te II HM64 50 1374.80 Te II HM64 50 1608.41 Te II HM64 50 1613.15 Te II HM64 500 P 1822.155 Te I MV75 500 P 1857.296 Te I MV75 500 P 1994.839 Te I MV75 Air 1000 P 2002.028 Te I MV75 250 P 2081.172 Te I MV75 700 P 2142.822 Te I MV75 120 P 2147.260 Te I MV75 14 2159.864 Te I MV75 15 2215.630 Te I MV75 5 2255.507 Te I MV75 20 P 2259.034 Te I MV75 5 2265.536 Te I MV75 100 2373.06 Te II HM64 50 P 2383.277 Te I MV75 60 P 2385.792 Te I MV75 250 2438.69 Te II HM64 5 2530.738 Te I MV75 100 2567.82 Te II HM64 50 2574.96 Te II HM64 50 2591.12 Te II HM64 50 2592.85 Te II HM64 50 2605.72 Te II HM64 50 2624.86 Te II HM64 500 2649.66 Te II HM64 4 2677.13 Te I MCS75 500 2858.29 Te II HM64 800 2895.41 Te II HM64 400 2967.29 Te II HM64 400 3047.00 Te II HM64 4 3175.147 Te I MV75 800 3406.79 Te II HM64 250 P 3521.11 Te II HM64 500 3611.78 Te II HM64 250 P 4006.52 Te II HM64 500 4169.77 Te II HM64 500 4261.11 Te II HM64 800 4364.00 Te II HM64 800 4478.63 Te II HM64 500 4557.78 Te II HM64 500 4641.12 Te II HM64 900 P 4654.37 Te II HM64 1000 4686.91 Te II HM64 500 4696.38 Te II HM64 500 4706.53 Te II HM64 500 4766.05 Te II HM64 500 4784.87 Te II HM64 500 4827.14 Te II HM64 800 4831.28 Te II HM64 800 4842.90 Te II HM64 600 4865.12 Te II HM64 1000 4866.24 Te II HM64 800 5576.35 Te II HM64 800 P 5649.26 Te II HM64 500 5666.20 Te II HM64 1000 P 5708.12 Te II HM64 800 5755.85 Te II HM64 500 5974.68 Te II HM64 120 8758.183 Te I MV75 200 P 9722.742 Te I MV75 20 9868.92 Te I MV75 25 9956.30 Te I MV75 250 P 10051.41 Te I MV75 150 10091.01 Te I MV75 30 10493.57 Te I MV75 70 10918.34 Te I MV75 400 P 11089.56 Te I MV75 250 P 11487.23 Te I MV75 60 13247.75 Te I MV75 40 14513.51 Te I MV75 60 15452.45 Te I MV75 90 15546.23 Te I MV75 140 16403.90 Te I MV75 80 17303.54 Te I MV75 110 18291.59 Te I MV75 40 21043.73 Te I MV75

Strong Lines of Tin (Sn)

Strong Lines of Tin (Sn)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 600 1223.721 Sn II B64 500 1242.926 Sn II B64 1000 1290.880 Sn II B64 1000 1316.576 Sn II B64 1000 P 1400.440 Sn II B64 1000 P 1474.997 Sn II B64 300 1811.201 Sn II B64 140 1860.330 Sn I B64 300 P 1899.881 Sn II B64 Air 200 P 2091.590 Sn I B64 80 P 2150.844 Sn II B64 200 P 2199.346 Sn I B64 300 P 2209.660 Sn I B64 300 P 2246.057 Sn I B64 80 P 2266.016 Sn II B64 300 P 2268.930 Sn I B64 300 2286.681 Sn I B64 400 2317.230 Sn I B64 400 2334.812 Sn I B64 700 P 2354.850 Sn I B64 80 P 2368.226 Sn II B64 600 P 2421.694 Sn I B64 700 P 2429.495 Sn I B64 25 2448.908 Sn II B64 200 2483.410 Sn I B64 60 2486.967 Sn II B64 140 2495.724 Sn I B64 300 2546.549 Sn I B64 400 2571.594 Sn I B64 140 2594.421 Sn I B64 140 P 2661.244 Sn I B64 500 P 2706.505 Sn I B64 1000 P 2839.976 Sn I B64 700 P 2863.315 Sn I B64 140 2913.559 Sn I B64 500 P 3009.133 Sn I B64 140 3032.778 Sn I B64 600 P 3034.115 Sn I B64 400 P 3175.035 Sn I B64 400 P 3262.331 Sn I B64 50 P 3283.140 Sn II B64 60 P 3351.952 Sn II B64 200 P 3801.011 Sn I B64 110 P 4524.734 Sn I B64 30 P 5332.339 Sn II B64 30 P 5561.910 Sn II B64 30 P 5588.815 Sn II B64 60 5631.676 Sn I B64 30 P 5798.860 Sn II B64 30 6054.674 Sn I B64 40 6069.117 Sn I B64 40 6149.604 Sn I B64 20 6154.446 Sn I B64 50 P 6453.542 Sn II B64 30 P 6844.186 Sn II B64 20 7190.776 Sn II B64 15 7741.425 Sn II B64 20 8114.030 Sn I B64 20 8422.624 Sn I B64 30 8552.531 Sn I B64 20 h 9805.184 Sn I B64 40 9850.381 Sn I B64 11 11454.407 Sn I B64 9 11616.152 Sn I B64 11 11739.591 Sn I B64 9 11932.82 Sn I B64 14 12981.01 Sn I B64 14 13459.2 Sn I B64

Strong Lines of Iodine (I)

Strong Lines of Iodine (I)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 100 879.84 I II MC60 200 1018.58 I II MC60 500 P 1034.66 I II MC60 100 1066.34 I II MC60 150 1075.21 I II MC60 250 1105.00 I II MC60 120 1111.16 I II MC60 200 1125.25 I II MC60 100 1131.50 I II MC60 500 P 1139.80 I II MC60 500 P 1160.56 I II MC60 1000 P 1166.48 I II MC60 250 1175.84 I II MC60 500 P 1178.65 I II MC60 800 P 1187.34 I II MC60 500 P 1190.85 I II MC60 250 1198.88 I II MC60 400 1200.22 I II MC60 1000 P 1220.89 I II MC60 1000 P 1234.06 I II MC60 40 1259.51 I I KC59 40 1289.40 I I KC59 130 1300.34 I I KC59 40 1302.98 I I KC59 40 1313.95 I I KC59 40 1317.54 I I KC59 1000 P 1336.52 I II MC60 70 1355.10 I I KC59 40 1357.97 I I KC59 70 1360.97 I I KC59 40 1361.11 I I KC59 50 1383.23 I I KC59 40 1390.75 I I KC59 110 1425.49 I I KC59 70 1446.26 I I KC59 70 1453.18 I I KC59 70 1457.39 I I KC59 70 1457.47 I I KC59 130 P 1457.98 I I KC59 50 1459.15 I I KC59 70 1492.89 I I KC59 70 1507.04 I I KC59 70 1514.68 I I KC59 200 P 1518.05 I I KC59 70 1593.58 I I KC59 70 1617.60 I I KC59 200 P 1702.07 I I KC59 150 P 1782.76 I I KC59 70 1799.09 I I KC59 1000 P 1830.38 I I KC59 200 P 1844.45 I I KC59 Air 25 P 2061.63 I I KC59 100 2582.79 I II MC60 250 3078.75 I II MC60 130 P 5119.29 I I KC59 150 P ,c 5161.20 I II MC60 150 c 5245.71 I II MC60 500 P 5338.22 I II MC60 250 P ,c 5345.15 I II MC60 150 5435.83 I II MC60 100 P ,c 5464.62 I II MC60 500 P 5625.69 I II MC60 100 c 5690.91 I II MC60 200 c 5710.53 I II MC60 250 5950.25 I II MC60 100 c 6074.98 I II MC60 100 c 6127.49 I II MC60 70 6619.66 I I KC59 200 6812.57 I II MC60 70 7402.06 I I KC59 70 7468.99 I I KC59 130 P 8043.74 I I KC59 50 8240.05 I I KC59 130 c 8393.30 I I KC59 40 8857.50 I I KC59 70 9022.40 I I KC59 200 P 9058.33 I I KC59 150 9113.91 I I KC59 50 9426.71 I I KC59 40 9427.15 I I KC59 40 d 9653.06 I I KC59 70 9731.73 I I KC59 70 10466.54 I I KC59

Strong Lines of Xenon (Xe)

Strong Lines of Xenon (Xe)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 120 740.41 Xe II B36 120 803.07 Xe II B36 200 880.80 Xe II B36 120 885.54 Xe II B36 200 925.87 Xe II B36 80 935.40 Xe II B36 250 P 972.77 Xe II B36 250 976.68 Xe II B36 150 1032.44 Xe II B36 250 1037.68 Xe II B36 400 P 1041.31 Xe II B36 300 P 1048.27 Xe II B36 400 P 1051.92 Xe II B36 700 P 1074.48 Xe II B36 200 1083.86 Xe II B36 400 P 1100.43 Xe II B36 200 1158.47 Xe II B36 80 1169.63 Xe II B36 250 P 1183.05 Xe II B36 25 P 1192.0376 Xe I BVHU01 200 P 1244.76 Xe II B36 25 P 1250.2091 Xe I BVHU01 100 P 1295.5878 Xe I BVHU01 60 P 1469.6123 Xe I BVHU01 Air 70 2864.73 Xe II H39 50 h 2895.22 Xe II H39 130 2979.32 Xe II H39 30 h 3017.43 Xe II H39 100 3121.87 Xe II H39 70 h 3366.72 Xe II H39 30 h 3461.26 Xe II H39 1 3506.74 Xe I HM33 1 3549.86 Xe I HM33 1 3554.04 Xe I HM33 2 3610.32 Xe I HM33 1 3613.06 Xe I HM33 1 3633.06 Xe I HM33 1 3669.91 Xe I HM33 4 3685.90 Xe I HM33 4 3693.49 Xe I HM33 30 l 3907.91 Xe II H39 30 4037.59 Xe II H39 70 l 4057.46 Xe II H39 30 h 4098.89 Xe II H39 70 l 4158.04 Xe II H39 300 h 4180.10 Xe II H39 150 h 4193.15 Xe II H39 100 h 4208.48 Xe II H39 30 h 4209.47 Xe II H39 100 h 4213.72 Xe II H39 30 4215.60 Xe II H39 100 h 4223.00 Xe II H39 130 h 4238.25 Xe II H39 150 h 4245.38 Xe II H39 30 l 4251.57 Xe II H39 150 h 4296.40 Xe II H39 150 h 4310.51 Xe II H39 300 l 4330.52 Xe II H39 70 h 4369.20 Xe II H39 30 l 4373.78 Xe II H39 150 h 4393.20 Xe II H39 150 l 4395.77 Xe II H39 70 l 4406.88 Xe II H39 50 l 4416.07 Xe II H39 150 h 4448.13 Xe II H39 300 h 4462.19 Xe II H39 150 l 4480.86 Xe II H39 30 l 4521.86 Xe II H39 60 4734.152 Xe I HM33 15 4792.619 Xe I HM33 50 4807.02 Xe I HM33 40 4829.71 Xe I HM33 30 4843.29 Xe I HM33 700 P 4844.33 Xe II HP87 50 4916.51 Xe I HM33 50 4923.152 Xe I HM33 70 l 4971.71 Xe II H39 130 4972.71 Xe II H39 100 4988.77 Xe II H39 30 l 4991.17 Xe II H39 20 5028.280 Xe I HM33 70 5044.92 Xe II H39 300 5080.62 Xe II H39 100 5122.42 Xe II H39 30 5125.70 Xe II H39 30 5178.82 Xe II H39 100 5188.04 Xe II H39 130 5191.37 Xe II H39 30 5192.10 Xe II H39 150 5260.44 Xe II H39 150 5261.95 Xe II H39 700 P 5292.22 Xe II H39 100 5309.27 Xe II H39 300 5313.87 Xe II H39 700 5339.33 Xe II H39 70 5363.20 Xe II H39 70 5368.07 Xe II H39 150 5372.39 Xe II H39 10 5392.80 Xe I HM33 1000 P 5419.15 Xe II H39 250 5438.96 Xe II H39 100 5445.45 Xe II H39 70 5450.45 Xe II H39 130 5460.39 Xe II H39 300 5472.61 Xe II H39 30 l 5494.86 Xe II H39 70 5525.53 Xe II H39 200 5531.07 Xe II H39 10 5566.62 Xe I HM33 100 5616.67 Xe II H39 100 5659.38 Xe II H39 200 5667.56 Xe II H39 50 5670.91 Xe II H39 10 5695.75 Xe I HM33 70 5699.61 Xe II H39 70 5716.10 Xe II H39 150 5726.91 Xe II H39 150 5751.03 Xe II H39 100 5758.65 Xe II H39 100 5776.39 Xe II H39 30 5815.96 Xe II H39 30 5823.89 Xe I HM33 15 5824.80 Xe I HM33 10 5875.02 Xe I HM33 100 5893.29 Xe II H39 10 5894.99 Xe I HM33 70 5905.13 Xe II H39 10 5934.17 Xe I HM33 150 5945.53 Xe II H39 100 5971.13 Xe II H39 700 P 5976.46 Xe II H39 70 6008.92 Xe II H39 300 6036.20 Xe II H39 700 P 6051.15 Xe II H39 200 6093.50 Xe II H39 500 P 6097.59 Xe II H39 130 6101.43 Xe II H39 30 6115.08 Xe II H39 30 6146.45 Xe II H39 15 6178.30 Xe I HM33 12 6179.66 Xe I HM33 30 6182.42 Xe I HM33 150 6194.07 Xe II H39 10 6198.26 Xe I HM33 150 6270.82 Xe II H39 130 6277.54 Xe II H39 30 6284.41 Xe II H39 10 6286.01 Xe I HM33 80 6300.86 Xe II H39 50 6318.06 Xe I HM33 130 6343.96 Xe II H39 200 6356.35 Xe II H39 70 6375.28 Xe II H39 30 6397.99 Xe II H39 30 6469.70 Xe I HM33 15 6472.84 Xe I HM33 12 6487.76 Xe I HM33 10 6498.72 Xe I HM33 20 h 6504.18 Xe I HM33 100 6512.83 Xe II H39 70 6528.65 Xe II H39 10 6533.16 Xe I HM33 300 6595.01 Xe II H39 10 6595.56 Xe I HM33 130 6597.25 Xe II H39 30 6598.84 Xe II H39 15 6668.92 Xe I HM33 100 6694.32 Xe II H39 20 6728.01 Xe I HM33 50 6788.71 Xe II H39 30 6790.37 Xe II H39 300 6805.74 Xe II H39 20 6827.32 Xe I HM33 10 6872.11 Xe I HM33 30

Strong Lines of Barium (Ba)

Strong Lines of Barium (Ba)

Intensity Wavelength (Å) Spectrum Ref. Air 20 P 2304.247 Ba II KL99 30 P 2335.267 Ba II KL99 30 P 3071.584 Ba I KL99 80 P 3501.108 Ba I KL99 20 P 3891.779 Ba II KL99 25 P 4130.649 Ba II KL99 9 4132.427 Ba I KL99 3 4166.001 Ba II KL99 30 4283.097 Ba I KL99 2 4524.926 Ba II KL99 1000 P 4554.033 Ba II KL99 6 4899.927 Ba II KL99 300 P 4934.077 Ba II KL99 1000 P 5535.481 Ba I KL99 80 5777.619 Ba I KL99 40 5853.675 Ba II KL99 80 5997.087 Ba I KL99 250 6110.783 Ba I KL99 300 P 6141.713 Ba II KL99 200 P 6496.898 Ba II KL99 250 P 6498.760 Ba I KL99 110 P 6527.312 Ba I KL99 100 P 6595.325 Ba I KL99 50 6675.270 Ba I KL99 50 P 6693.842 Ba I KL99 9 6865.686 Ba I KL99 200 P 7059.943 Ba I KL99 30 7120.331 Ba I KL99 9 7195.230 Ba I KL99 150 P 7280.296 Ba I KL99 15 7392.405 Ba I KL99 25 7488.075 Ba I KL99 80 P 7672.085 Ba I KL99 50 7780.478 Ba I KL99 25 7905.747 Ba I KL99 12 7911.329 Ba I KL99 9 8210.239 Ba I KL99 60 P 8559.998 Ba I KL99 8 8915.013 Ba I KL99 50 9370.119 Ba I KL99 15 9608.894 Ba I KL99 40 10032.139 Ba I KL99 60 P 14999.852 Ba I KL99 50 P 23253.56 Ba I KL99 60 P 25514.88 Ba I KL99

Strong Lines of Cerium (Ce)

Strong Lines of Cerium (Ce)

Intensity Wavelength (Å) Spectrum Ref. Air 200 3063.008 Ce II C73 200 3194.821 Ce II C73 300 3201.712 Ce II C73 200 3218.944 Ce II C73 250 3221.171 Ce II C73 200 3227.114 Ce II C73 200 3234.161 Ce II C73 300 3272.253 Ce II C73 200 3485.046 Ce II C73 200 3539.076 Ce II C73 300 3560.798 Ce II C73 300 3577.450 Ce II C73 200 3653.664 Ce II C73 500 P 3655.843 Ce II C73 250 3660.639 Ce II C73 250 3667.976 Ce II C73 300 3709.285 Ce II C73 300 3709.926 Ce II C73 400 3716.364 Ce II C73 250 3728.414 Ce II C73 200 3764.115 Ce II C73 200 3781.616 Ce II C73 250 3786.628 Ce II C73 700 P 3801.520 Ce II C73 250 3803.086 Ce II C73 300 3808.110 Ce II C73 300 3838.535 Ce II C73 250 3848.595 Ce II C73 250 3853.148 Ce II C73 300 3854.187 Ce II C73 300 3854.320 Ce II C73 200 3855.301 Ce II C73 200 3876.971 Ce II C73 300 3878.358 Ce II C73 400 3882.447 Ce II C73 300 3889.984 Ce II C73 200 3895.113 Ce II C73 200 3907.286 Ce II C73 300 3912.426 Ce II C73 200 3918.269 Ce II C73 200 3931.082 Ce II C73 200 3940.326 Ce II C73 600 P 3942.157 Ce II C73 800 P 3942.746 Ce II C73 200 3943.881 Ce II C73 900 P 3952.545 Ce II C73 300 3956.275 Ce II C73 200 3960.913 Ce II C73 200 3967.044 Ce II C73 200 3984.671 Ce II C73 200 3992.381 Ce II C73 250 3993.818 Ce II C73 800 P 3999.237 Ce II C73 250 4003.769 Ce II C73 250 4005.232 Ce I M75c 800 P 4012.387 Ce II C73 250 4014.897 Ce II C73 250 4024.487 Ce II C73 250 4028.404 Ce II C73 250 4031.332 Ce II C73 600 P 4040.752 Ce II C73 250 4042.578 Ce II C73 200 4046.337 Ce II C73 200 4053.500 Ce II C73 300 4055.836 Ce I M75c 300 4071.773 Ce II C73 500 4073.475 Ce II C73 400 4075.698 Ce II C73 400 4075.844 Ce II C73 200 4081.219 Ce II C73 250 4083.219 Ce II C73 200 4118.141 Ce II C73 300 4123.873 Ce II C73 300 4127.371 Ce II C73 800 P 4133.802 Ce II C73 600 P 4137.649 Ce II C73 200 4142.397 Ce II C73 200 4144.996 Ce II C73 300 4149.895 Ce II C73 400 4151.969 Ce II C73 400 4165.600 Ce II C73 200 4166.881 Ce II C73 1000 P 4186.596 Ce II C73 200 4196.330 Ce II C73 250 4198.715 Ce II C73 250* 4202.926 Ce II C73 250* 4202.956 Ce II C73 400 4222.598 Ce II C73 200 4227.747 Ce II C73 300 4239.909 Ce II C73 300 4248.668 Ce II C73 200 4255.779 Ce II C73 200 4270.186 Ce II C73 600 P 4289.935 Ce II C73 400 4296.680 Ce II C73 200 4300.327 Ce II C73 200 4306.722 Ce II C73 300 4337.773 Ce II C73 200 4349.788 Ce II C73 250 4364.650 Ce II C73 250 4382.164 Ce II C73 200 4386.826 Ce II C73 500 4391.660 Ce II C73 300 4418.778 Ce II C73 200 4429.265 Ce II C73 200 4449.322 Ce II C73 200 4450.727 Ce II C73 700 P 4460.204 Ce II C73 400 4471.237 Ce II C73 200 4479.358 Ce II C73 200 4483.891 Ce II C73 250 4486.905 Ce II C73 250 4506.413 Ce I M75c 200 4523.077 Ce II C73 250 4527.349 Ce II C73 250 4528.472 Ce II C73 250 4539.745 Ce II C73 200 4560.283 Ce II C73 600 P 4562.358 Ce II C73 300 4572.281 Ce II C73 250 4593.924 Ce II C73 500 4628.157 Ce II C73 500 P 4632.320 Ce I BWCC91 300 4650.509 Ce I M75c 300 4822.547 Ce I M75c 400 4847.774 Ce I M75c 300 4943.44 Ce I MCS75 400 4994.627 Ce I BWCC91 600 P 5009.098 Ce I M75c 300 5040.846 Ce I M75c 300 5071.775 Ce I M75c 400 5112.703 Ce I M75c 500 5129.569 Ce I M75c 250 5149.993 Ce I BWCC91 800 P 5159.686 Ce I M75c 800 P 5161.484 Ce I M75c 500 5174.554 Ce I M75c 110 5187.459 Ce II C73 500 5211.877 Ce I BWCC91 700 P 5223.461 Ce I M75c 500 5229.745 Ce I M75c 700 P 5245.916 Ce I M75c 100 5274.230 Ce II C73 400 5296.563 Ce I M75c 400 5328.082 Ce I M75c 400 5397.638 Ce I M75c 300 5420.380 Ce I BWCC91 400 5449.239 Ce I BWCC91 70 5512.049 Ce II C73 300 5556.252 Ce I BWCC91 500 5564.966 Ce I M75c 400 5565.965 Ce I M75c 250 5595.875 Ce I BWCC91 600 P 5601.280 Ce I M75c 500 5655.140 Ce I M75c 600 P 5669.959 Ce I M75c 300 5677.752 Ce I BWCC91 300 5692.943 Ce I BWCC91 800 P 5696.993 Ce I M75c 1000 P 5699.226 Ce I M75c 600 P 5719.031 Ce I M75c 400 5773.122 Ce I BWCC91 300 5788.143 Ce I BWCC91 300 5812.919 Ce I M75c 250 5862.491 Ce I BWCC91 150 5926.301 Ce I BWCC91 200 5928.342 Ce I BWCC91 250 5937.720 Ce I BWCC91 600 P 5940.857 Ce I M75c 150 6001.901 Ce I M75c 150 6005.861 Ce I BWCC91 150 6006.817 Ce I BWCC91 200 6013.419 Ce

Strong Lines of Cesium (Cs)

Strong Lines of Cesium (Cs)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 20 639.36 Cs II RE75 150 718.14 Cs II RE75 150 P 808.76 Cs II RE75 150 P 813.84 Cs II RE75 400 P 901.27 Cs II RE75 400 P 926.66 Cs II RE75 1 1840.50 Cs II S81 1 1859.16 Cs II S81 1 1883.93 Cs II S81 1 1935.19 Cs II S81 Air 15 2267.65 Cs II S81 8 2273.84 Cs II S81 14 2332.46 Cs II S81 10 2392.86 Cs II S81 15 2931.08 Cs II S81 11 w 3785.44 Cs II S81 25 3805.12 Cs II S81 30 c 3876.15 Cs I S81 10 c 3888.61 Cs I S81 30 3896.99 Cs II S81 40 3959.51 Cs II S81 25 3965.20 Cs II S81 20 3974.25 Cs II S81 80 4039.85 Cs II S81 20 4068.78 Cs II S81 20 4213.14 Cs II S81 20 4232.20 Cs II S81 10 4234.41 Cs II S81 140 4264.70 Cs II S81 200 w 4277.13 Cs II S81 50 4288.38 Cs II S81 80 4363.30 Cs II S81 40 4373.04 Cs II S81 40 w 4405.26 Cs II S81 120 4501.55 Cs II S81 200 P 4526.74 Cs II S81 40 4538.97 Cs II S81 15 P ,c 4555.28 Cs I K62b 8 P ,c 4593.17 Cs I K62b 1000 P 4603.79 Cs II S81 40 c 4616.17 Cs II S81 70 4763.64 Cs II S81 250 4830.19 Cs II S81 200 4870.04 Cs II S81 50 c 4880.05 Cs II S81 400 4952.85 Cs II S81 80 4972.60 Cs II S81 250 5043.80 Cs II S81 70 c 5209.58 Cs II S81 800 P 5227.04 Cs II S81 300 5249.38 Cs II S81 110 5274.05 Cs II S81 100 c 5349.13 Cs II S81 200 5370.99 Cs II S81 1 c 5465.94 Cs I K62b 1 5502.88 Cs I K62b 400 5563.02 Cs II S81 2 5635.21 Cs I K62b 3 c 5664.02 Cs I K62b 50 5814.16 Cs II S81 250 5831.14 Cs II S81 1 c 5838.83 Cs I K62b 5 5845.14 Cs I K62b 500 5925.63 Cs II S81 10 c 6010.49 Cs I K62b 1 6034.09 Cs I K62b 100 6128.61 Cs II S81 15 6213.10 Cs I K62b 3 6217.60 Cs I K62b 5 c 6354.55 Cs I K62b 80 6495.53 Cs II S81 100 w 6536.44 Cs II S81 8 6586.51 Cs I K62b 2 6628.66 Cs I EW70 90 6646.57 Cs II S81 50 c 6723.28 Cs I S81 100 6724.47 Cs II S81 3 6824.65 Cs I EW70 5 6870.45 Cs I EW70 400 6955.50 Cs II S81 80 6973.30 Cs I K62b 150 6979.67 Cs II S81 15 6983.49 Cs I K62b 130 w 7149.54 Cs II S81 13 7228.53 Cs I EW70 2 7279.90 Cs I EW70 20 7279.96 Cs I EW70 40 c 7608.90 Cs I K62b 25 7852.52 Cs II S81 50 7943.88 Cs I K62b 200 7997.44 Cs II S81 20 8012.98 Cs II S81 60 8015.73 Cs I EW70 80 c 8047.13 Cs II S81 8 8078.94 Cs I EW70 70 8079.04 Cs I EW70 1000 P ,c 8521.13 Cs I EJN64 15 8608.31 Cs II S81 250 P ,c 8761.41 Cs I EJN64 1000 P ,c 8943.47 Cs I EJN64 300 P 9172.32 Cs I EJN64 90 9208.53 Cs I EJN64 30 c 9220.75 Cs II S81 14 9994.79 Cs II S81 300 10024.36 Cs I EW70 80 10123.41 Cs I EW70 400 10123.60 Cs I EW70 30 c 10176.02 Cs II S81 25 10379.66 Cs II S81 13 10480.93 Cs II S81 50 10504.51 Cs II S81 20 w 10807.88 Cs II S81 11 12604.29 Cs II S81 20 c 12735.52 Cs II S81 50 13424.31 Cs I S81 600 P ,c 13588.29 Cs I S81 140 13602.56 Cs I S81 40 c 13692.91 Cs II S81 90 13758.81 Cs I S81 14 c 13868.82 Cs II S81 900 P ,c 14694.91 Cs I S81 20 c 15293.80 Cs II S81 15 c 15356.61 Cs II S81 11 c 16426.14 Cs II S81 13 16535.63 Cs I S81 25 17012.32 Cs I S81 12 20138.47 Cs I S81 14 22811.86 Cs I S81 20 23037.98 Cs I S81 60 23344.47 Cs I S81 70 24251.21 Cs I S81 14 24374.96 Cs I S81 9 25220.37 Cs II S81 15 d 25763.51 Cs I SAV81 8 25764.73 Cs I SAV81 11 c 29310.06 Cs I S81 50 P 30103.27 Cs I S81 10 c 30953.06 Cs I S81 20 P 34900.13 Cs I S81 3 36131.00 Cs I S81

Strong Lines of Lanthanum (La)

Strong Lines of Lanthanum (La)

Intensity Wavelength (Å) Spectrum Ref. Air 90 2256.76 La II MCS75 60 3245.13 La II MCS75 60 3265.67 La II MCS75 90 3303.11 La II MCS75 150 3337.49 La II MCS75 100 3344.56 La II MCS75 150 3380.91 La II MCS75 300 P 3574.43 La I MCS75 250 d 3641.53 La I MCS75 110 3645.42 La II MCS75 250 P 3759.08 La II MCS75 400 P 3790.83 La II MCS75 400 P 3794.78 La II MCS75 200 3849.02 La II MCS75 400 P 3871.64 La II MCS75 200 3886.37 La II MCS75 140 3916.05 La II MCS75 120 3921.54 La II MCS75 200 3927.56 La I MCS75 250 3929.22 La II MCS75 1000 P 3949.10 La II MCS75 500 P 3988.52 La II MCS75 400 P 3995.75 La II MCS75 250 4015.39 La I MCS75 300 P 4031.69 La II MCS75 300 P 4042.91 La II MCS75 300 P 4060.33 La I MCS75 300 P 4077.35 La II MCS75 600 P 4086.72 La II MCS75 250 4089.61 La I MCS75 500 P 4123.23 La II MCS75 120 4151.97 La II MCS75 400 P 4187.32 La I MCS75 150 4196.55 La II MCS75 200 4238.38 La II MCS75 400 P 4280.27 La I MCS75 500 P 4333.74 La II MCS75 200 4423.90 La I MCS75 200 4429.90 La II MCS75 90 4522.37 La II MCS75 200 4567.91 La I MCS75 300 4570.02 La I MCS75 90 4899.92 La II MCS75 110 4920.98 La II MCS75 110 4921.79 La II MCS75 500 P 4949.77 La I MCS75 80 4999.47 La II MCS75 300 5050.57 La I MCS75 250 5056.46 La I MCS75 300 5106.23 La I MCS75 600 P 5145.42 La I MCS75 400 5158.69 La I MCS75 800 P 5177.31 La I MCS75 90 5183.42 La II MCS75 1000 P 5211.86 La I MCS75 700 P 5234.27 La I MCS75 500 5253.46 La I MCS75 500 5271.19 La I MCS75 700 P 5455.15 La I MCS75 700 P 5501.34 La I MCS75 300 5648.25 La I MCS75 250 5740.66 La I MCS75 500 5769.34 La I MCS75 400 5789.24 La I MCS75 600 P 5791.34 La I MCS75 400 5930.62 La I MCS75 1000 P 6249.93 La I MCS75 600 P 6394.23 La I MCS75 300 6410.99 La I MCS75 300 6455.99 La I MCS75 200 6543.16 La I MCS75 200 6578.51 La I MCS75 150 c,w 7334.18 La I MCS75 120 7539.23 La I MCS75 100 8086.05 La I MCS75 120 8324.69 La I MCS75 130 8346.53 La I MCS75 90 8545.44 La I MCS75

Strong Lines of Neodymium (Nd)

Strong Lines of Neodymium (Nd)

Intensity Wavelength (Å) Spectrum Ref. Air 250 h 3484.88 Nd I MCS75 100 3665.18 Nd II MCS75 100 3672.36 Nd II MCS75 110 3673.54 Nd II MCS75 200 3685.80 Nd II MCS75 120 d 3714.73 Nd II MCS75 140 3723.50 Nd II MCS75 130 3728.13 Nd II MCS75 200 d 3735.54 Nd II MCS75 200 3738.06 Nd II MCS75 110 3752.49 Nd II MCS75 90 3757.82 Nd II MCS75 150 3758.95 Nd II MCS75 150 3763.47 Nd II MCS75 90 3769.65 Nd II MCS75 250 3775.50 Nd II MCS75 130 3779.47 Nd II MCS75 110 3780.40 Nd II MCS75 90 3781.32 Nd II MCS75 400 P 3784.25 Nd II MCS75 200 3803.47 Nd II MCS75 500 P 3805.36 Nd II MCS75 100 3808.77 Nd II MCS75 110 3810.49 Nd II MCS75 130 3814.73 Nd II MCS75 200 3826.42 Nd II MCS75 100 3828.85 Nd II MCS75 90 3830.47 Nd II MCS75 140 3836.54 Nd II MCS75 300 3838.98 Nd II MCS75 300* d 3848.24 Nd II MCS75 300* d 3848.31 Nd II MCS75 300 3848.52 Nd II MCS75 400* P ,d 3851.66 Nd II MCS75 400* P ,d 3851.74 Nd II MCS75 700* P ,d 3863.33 Nd II MCS75 700* P ,d 3863.40 Nd II MCS75 150 3869.07 Nd II MCS75 200 3878.58 Nd II MCS75 200 3879.55 Nd II MCS75 140 3880.38 Nd II MCS75 200 3880.78 Nd II MCS75 100 3887.87 Nd II MCS75 250 3889.93 Nd II MCS75 250 3890.58 Nd II MCS75 250 3890.94 Nd II MCS75 110 3891.51 Nd II MCS75 150 3894.63 Nd II MCS75 400 P 3900.21 Nd II MCS75 250 3901.84 Nd II MCS75 300 3905.89 Nd II MCS75 90 3907.84 Nd II MCS75 400 P 3911.16 Nd II MCS75 150 3912.23 Nd II MCS75 110 3915.95 Nd II MCS75 200 3920.96 Nd II MCS75 90 3927.10 Nd II MCS75 110 3934.82 Nd II MCS75 90 3938.86 Nd II MCS75 400 P 3941.51 Nd II MCS75 400 P 3951.16 Nd II MCS75 150 3952.20 Nd II MCS75 110 3958.00 Nd II MCS75 90 3962.21 Nd II MCS75 250 3963.12 Nd II MCS75 200 3973.30 Nd II MCS75 140 3973.69 Nd II MCS75 140 3976.85 Nd II MCS75 140 3979.49 Nd II MCS75 250 3990.10 Nd II MCS75 200 3991.74 Nd II MCS75 200 3994.68 Nd II MCS75 100 4004.02 Nd II MCS75 700 P 4012.25 Nd II MCS75 100 4012.70 Nd II MCS75 200 4020.87 Nd II MCS75 200 4021.34 Nd II MCS75 200 4021.78 Nd II MCS75 200 4023.00 Nd II MCS75 200 4031.82 Nd II MCS75 600 P 4040.80 Nd II MCS75 150 4051.15 Nd II MCS75 150 4059.96 Nd II MCS75 900 P 4061.09 Nd II MCS75 200 4069.28 Nd II MCS75 130 4075.12 Nd II MCS75 250 4109.08 Nd II MCS75 500 P 4109.46 Nd II MCS75 90 4110.48 Nd II MCS75 90 4135.33 Nd II MCS75 600 P 4156.08 Nd II MCS75 90 4156.26 Nd II MCS75 150 4175.61 Nd II MCS75 400 P 4177.32 Nd II MCS75 120 4179.59 Nd II MCS75 250 4232.38 Nd II MCS75 400 P 4247.38 Nd II MCS75 150 4252.44 Nd II MCS75 130 4284.52 Nd II MCS75 1000 P 4303.58 Nd II MCS75 200 4325.76 Nd II MCS75 90 4327.93 Nd II MCS75 100 4338.70 Nd II MCS75 130 4351.29 Nd II MCS75 150 4358.17 Nd II MCS75 130 4385.66 Nd II MCS75 100 4400.83 Nd II MCS75 90 4411.06 Nd II MCS75 110 4446.39 Nd II MCS75 250 4451.57 Nd II MCS75 140 4462.99 Nd II MCS75 250 4527.25 Nd I MCS75 300 4559.67 Nd I MCS75 200 4586.62 Nd I MCS75 200 4603.82 Nd I MCS75 200 4609.87 Nd I MCS75 600 P 4621.94 Nd I MCS75 200 4627.98 Nd I MCS75 1000 P 4634.24 Nd I MCS75 700 P 4641.10 Nd I MCS75 400 4646.40 Nd I MCS75 600 P 4649.67 Nd I MCS75 400 4654.73 Nd I MCS75 600 P 4683.45 Nd I MCS75 200 4684.04 Nd I MCS75 200 4690.35 Nd I MCS75 400 4696.44 Nd I MCS75 250 4706.96 Nd I MCS75 500 P 4719.02 Nd I MCS75 250 4731.77 Nd I MCS75 250 4779.46 Nd I MCS75 400 4866.74 Nd I MCS75 700 P 4883.81 Nd I MCS75 500 4891.07 Nd I MCS75 500 P 4896.93 Nd I MCS75 250 4901.53 Nd I MCS75 400 4901.84 Nd I MCS75 400 4913.41 Nd I MCS75 900 P 4924.53 Nd I MCS75 500 P 4944.83 Nd I MCS75 600 P 4954.78 Nd I MCS75 130 5130.60 Nd II MCS75 90 5191.45 Nd II MCS75 120 5192.62 Nd II MCS75 300 5213.23 Nd I MCS75 130 5249.59 Nd II MCS75 110 5273.43 Nd II MCS75 200 5291.67 Nd I MCS75 130 5293.17 Nd II MCS75 90 5319.82 Nd II MCS75 400 5620.54 Nd I MCS75 250 d 5675.97 Nd I MCS75 200 5729.29 Nd I MCS75

Strong Lines of Praseodymium (Pr)

Strong Lines of Praseodymium (Pr)

Intensity Wavelength (Å) Spectrum Ref. Air 80 2579.31 Pr I MCS75 130 2881.60 Pr I MCS75 70 3668.83 Pr II MCS75 60 3714.05 Pr II MCS75 80 3739.18 Pr II MCS75 130 3761.87 Pr II MCS75 130 3800.30 Pr II MCS75 60 3804.84 Pr II MCS75 80 3811.84 Pr II MCS75 250 h 3816.02 Pr II MCS75 130 3818.28 Pr II MCS75 60 3821.80 Pr II MCS75 200 3830.72 Pr II MCS75 90 3840.99 Pr II MCS75 110 3846.59 Pr II MCS75 250 3850.79 Pr II MCS75 140 c 3851.55 Pr II MCS75 200 3852.80 Pr II MCS75 90 c 3865.45 Pr II MCS75 90 3876.19 Pr II MCS75 300 c 3877.18 Pr II MCS75 130 3880.47 Pr II MCS75 80 c 3885.19 Pr II MCS75 80 c 3889.34 Pr II MCS75 150 c 3908.05 Pr II MCS75 120 3912.90 Pr II MCS75 60 3913.55 Pr II MCS75 250 c 3918.85 Pr II MCS75 80 3919.63 Pr II MCS75 200 3925.47 Pr II MCS75 90 3927.46 Pr II MCS75 70 3929.29 Pr II MCS75 70 3935.82 Pr II MCS75 140 c 3947.63 Pr II MCS75 150 c 3949.43 Pr II MCS75 150 c 3953.51 Pr II MCS75 70 3956.75 Pr II MCS75 500 P 3959.44 Pr I MCS75 90 3962.45 Pr II MCS75 110 3964.26 Pr II MCS75 300 c 3964.81 Pr II MCS75 110 c 3966.57 Pr II MCS75 100 3971.16 Pr II MCS75 60 3971.67 Pr II MCS75 120 c 3972.14 Pr II MCS75 60 3974.85 Pr II MCS75 250 c 3989.68 Pr II MCS75 70 3992.16 Pr II MCS75 300 3994.79 Pr II MCS75 110 c 3997.04 Pr II MCS75 60 3999.12 Pr II MCS75 120 c 4000.173 Pr II G90 140 4004.702 Pr II G90 400 4008.691 Pr II G90 120 4010.601 Pr II G90 140 4015.391 Pr II G90 120 4020.96 Pr II MCS75 90 4022.712 Pr II G90 70 4025.54 Pr II MCS75 70 c 4029.72 Pr II MCS75 140 c 4031.753 Pr II MCS75 200 4033.827 Pr II G90 140 4038.455 Pr II G90 90 4039.341 Pr II G90 250 4044.813 Pr II G90 70 4047.082 Pr II G90 90 4051.13 Pr II MCS75 400 4054.860 Pr II G90 400 4056.537 Pr II G90 90 4058.800 Pr II G90 700* P 4062.804 Pr II G90 700* P 4062.806 Pr II G90 100 c 4079.77 Pr II MCS75 100 c 4080.980 Pr II G90 150 4081.85 Pr II MCS75 100 4083.341 Pr II G90 110 4096.820 Pr II G90 70 4098.400 Pr II G90 600 P ,c 4100.717 Pr II G90 300 c 4118.457 Pr II G90 70 4130.771 Pr II G90 300 c 4141.224 Pr II G90 500 P 4143.112 Pr II G90 300 c 4164.156 Pr II G90 120 4171.822 Pr II G90 140 4172.246 Pr II G90 1000 P 4179.391 Pr II G90 500 P 4189.479 Pr II G90 110 c 4191.605 Pr II G90 60 4201.17 Pr II MCS75 500 P ,c 4206.719 Pr II G90 100 4208.315 Pr II G90 60 4211.862 Pr II G90 60 4217.810 Pr II G90 700 P 4222.931 Pr II G90 700 P 4225.346 Pr II G90 60 4233.114 Pr II G90 60 c 4236.153 Pr II G90 200 4241.010 Pr II G90 70 4243.507 Pr II G90 150 c 4247.631 Pr II G90 100 4254.402 Pr II G90 60 4269.093 Pr II G90 150 c 4272.273 Pr II G90 90 c 4280.07 Pr II MCS75 150 c 4282.456 Pr II G90 90 c 4298.965 Pr II G90 60 4303.61 Pr II MCS75 300 4305.764 Pr II G90 250 4333.973 Pr II G90 70 4338.702 Pr II G90 120 c,w 4344.30 Pr II MCS75 90 c 4347.491 Pr II G90 70 4350.399 Pr II G90 90 4354.91 Pr II MCS75 80 c 4359.788 Pr II G90 250 4368.334 Pr II G90 60 4371.62 Pr II MCS75 80 4405.825 Pr II G90 300 4408.820 Pr II G90 80 4413.770 Pr II G90 250 c 4429.128 Pr II G90 140 4449.826 Pr II G90 200 4468.663 Pr II G90 200 4496.456 Pr II G90 150 4510.153 Pr II G90 70 c 4534.154 Pr II G90 70 4535.923 Pr II G90 400 4632.28 Pr I MCS75 400 4635.68 Pr I MCS75 500 P 4639.55 Pr I MCS75 500 P 4687.80 Pr I MCS75 800 P 4695.77 Pr I MCS75 400 4709.52 Pr I MCS75 500 P 4730.67 Pr I MCS75 700 P 4736.69 Pr I MCS75 250 4744.16 Pr I MCS75 300 4906.99 Pr I MCS75 400 4914.02 Pr I MCS75 500 P 4924.60 Pr I MCS75 400 4936.00 Pr I MCS75 800 P 4939.74 Pr I MCS75 400 4940.30 Pr I MCS75 1000 P 4951.37 Pr I MCS75 300 4975.75 Pr I MCS75 300 5018.59 Pr I MCS75 500 P 5019.76 Pr I MCS75 500 P 5026.96 Pr I MCS75 250 5033.38 Pr I MCS75 300 5043.83 Pr I MCS75 800 P 5045.52 Pr I MCS75 400 5053.40 Pr I MCS75 500 P 5087.12 Pr I MCS75 70 5110.384 Pr II G90 110 5110.763 Pr II G90 80 5129.536 Pr II G90 700 P 5133.44 Pr I MCS75 250 5139.81 Pr I MCS75 120 5173.905 Pr II G90 300 5194.43 Pr I MCS75 70 5206.561 Pr II G90 70 5219.048 Pr II G90 110 5220.108 Pr II G90 300 5227.97 Pr I MCS75 130 5259.737 Pr II G90 70 c 5292.024 Pr II G90 70 5292.620 Pr II G

Strong Lines of Promethium (Pm)

Strong Lines of Promethium (Pm)

Intensity Wavelength (Å) Spectrum Ref. Air 300 3072.41 Pm II RCWM80 500 3427.40 Pm II RCWM80 400 3449.80 Pm II RCWM80 300 3634.20 Pm II RCWM80 300 3659.39 Pm II RCWM80 400 3689.79 Pm II RCWM80 300 3692.50 Pm II RCWM80 300 3697.50 Pm II RCWM80 400 3702.63 Pm II RCWM80 800 3711.72 Pm II RCWM80 150 3726.01 Pm I RD67 300 3742.52 Pm II RCWM80 500 3745.86 Pm II RCWM80 300 3747.09 Pm II RCWM80 500 3750.09 Pm II RCWM80 400 3795.66 Pm II RCWM80 300 3820.53 Pm II RCWM80 300 3842.98 Pm II RCWM80 800 3877.62 Pm II RCWM80 1000 P 3892.15 Pm II RCWM80 400 3899.78 Pm II RCWM80 1000 P 3910.26 Pm II RCWM80 1000 P 3919.10 Pm II RCWM80 800 P 3936.48 Pm II RCWM80 300 3944.21 Pm II RCWM80 1000 P 3957.74 Pm II RCWM80 500 3980.74 Pm II RCWM80 300 3995.05 Pm II RCWM80 1000 P ,r 3998.96 Pm II RCWM80 500 4009.96 Pm II RCWM80 300 4051.54 Pm II RCWM80 600 r 4055.20 Pm II RCWM80 600 P 4075.84 Pm II RCWM80 500 P 4086.10 Pm II RCWM80 300 4192.92 Pm II RCWM80 600 P 4297.78 Pm II RCWM80 300 4336.54 Pm II RCWM80 300 4342.12 Pm II RCWM80 150 r 4369.64 Pm I RD67 150 r 4388.49 Pm I RD67 100 r 4412.47 Pm I RD67 1000 P 4417.96 Pm II RCWM80 400 4432.51 Pm II RCWM80 500 4445.41 Pm II RCWM80 600 4446.90 Pm II RCWM80 800 P 4453.95 Pm II RCWM80 300 4473.23 Pm II RCWM80 150 r 4481.60 Pm I RD67 600 4500.15 Pm II RCWM80 600 4525.20 Pm II RCWM80 150 r 4527.70 Pm I RD67 800 P 4529.21 Pm II RCWM80 150 r 4575.27 Pm I RD67 100 4597.55 Pm I RD67 100 r 4600.25 Pm I RD67 200 r 4605.66 Pm I RD67 100 r 4609.85 Pm I RD67 150 r 4617.02 Pm I RD67 100 r 4619.75 Pm I RD67 100 4621.57 Pm I RD67 200 r 4623.68 Pm I RD67 100 4624.41 Pm I RD67 200 r 4625.29 Pm I RD67 150 r 4633.45 Pm I RD67 150 r 4643.36 Pm I RD67 100 r 4643.76 Pm I RD67 100 r 4647.03 Pm I RD67 150 r 4653.41 Pm I RD67 100 r 4660.79 Pm I RD67 150 r 4663.46 Pm I RD67 300 r 4665.19 Pm I RD67 150 r 4671.23 Pm I RD67 100 r 4677.92 Pm I RD67 150 r 4678.09 Pm I RD67 200 r 4682.92 Pm I RD67 100 r 4696.80 Pm I RD67 300 r 4728.36 Pm I RD67 150 r 4728.68 Pm I RD67 400 P ,r 4734.27 Pm I RD67 150 r 4745.13 Pm I RD67 150 r 4757.73 Pm I RD67 700 P ,r 4759.00 Pm I RD67 1000 P ,r 4762.57 Pm I RD67 400 P ,r 4773.46 Pm I RD67 200 r 4781.29 Pm I RD67 600 P ,r 4798.98 Pm I RD67 500 P ,r 4801.36 Pm I RD67 200 r 4809.54 Pm I RD67 350 P ,r 4811.85 Pm I RD67 350 P ,r 4837.66 Pm I RD67 700 P ,r 4860.74 Pm I RD67 300 r 4865.72 Pm I RD67 150 r 4872.42 Pm I RD67 100 r 4887.02 Pm I RD67 350 P ,r 4892.52 Pm I RD67 350 P ,r 4932.99 Pm I RD67 500 P ,r 4959.46 Pm I RD67 1000 P ,r 4997.10 Pm I RD67 1000 P ,r 5058.31 Pm I RD67 400 r 5094.83 Pm I RD67 300 r 5100.77 Pm I RD67 1000 P ,r 5127.34 Pm I RD67 700 P ,r 5146.30 Pm I RD67 400 5153.86 Pm II RCWM80 300 5169.71 Pm II RCWM80 500 5171.58 Pm II RCWM80 300 5194.05 Pm II RCWM80 500 5208.09 Pm II RCWM80 500 5236.26 Pm II RCWM80 300 5236.66 Pm II RCWM80 400 5246.33 Pm II RCWM80 500 5270.64 Pm II RCWM80 800 P 5546.08 Pm II RCWM80 800 P 5576.02 Pm II RCWM80 500 5823.93 Pm II RCWM80 300 c 5868.79 Pm II RCWM80 400 c 5946.49 Pm II RCWM80 150 5956.42 Pm I RCWM80 100 6043.39 Pm I RCWM80 50 6069.06 Pm I RCWM80 300 P 6100.21 Pm I RCWM80 200 h 6151.76 Pm I RCWM80 50 6229.64 Pm I RCWM80 100 6286.06 Pm I RCWM80 50 6308.29 Pm I RCWM80 100 6323.84 Pm I RCWM80 50 6390.31 Pm I RCWM80 500 h 6431.93 Pm I RCWM80 50 6517.25 Pm I RCWM80 300 P ,d 6520.45 Pm I RCWM80 50 6542.20 Pm I RCWM80 400 P 6598.15 Pm I RCWM80 80 6598.66 Pm I RCWM80 70 6606.37 Pm I RCWM80 80 w 6625.23 Pm I RCWM80 70 6649.81 Pm I RCWM80 400 6659.05 Pm II RCWM80 50 6661.68 Pm I RCWM80 80 c 6667.51 Pm I RCWM80 70 h 6677.47 Pm I RCWM80 50 6685.55 Pm I RCWM80 50 6685.68 Pm I RCWM80 60 6700.33 Pm I RCWM80 70 6714.67 Pm I RCWM80 50 6717.26 Pm I RCWM80 50 6720.71 Pm I RCWM80 70 6727.50 Pm I RCWM80 60 6743.71 Pm I RCWM80 90 6749.91 Pm I RCWM80 90 6750.48 Pm I RCWM80 300 6772.29 Pm II RCWM80 80 6833.30 Pm I RCWM80

Strong Lines of Europium (Eu)

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Intensity Wavelength (Å) Spectrum Ref. Air 4 2577.14 Eu II MCS75 15 2638.77 Eu II MCS75 6 2641.27 Eu II MCS75 11 2668.34 Eu II MCS75 4 2678.29 Eu II MCS75 4 2685.66 Eu II MCS75 9 2692.03 Eu II MCS75 12 2701.14 Eu II MCS75 13 2701.90 Eu II MCS75 4 2705.28 Eu II MCS75 15 2709.981 Eu I ST76 12 2716.98 Eu II MCS75 70 P 2727.78 Eu II MCS75 6 2729.44 Eu II MCS75 8 2781.89 Eu II MCS75 30 2802.84 Eu II MCS75 4 2811.75 Eu II MCS75 60 P 2813.94 Eu II MCS75 9 2816.18 Eu II MCS75 30 2820.78 Eu II MCS75 7 c,w 2828.72 Eu II MCS75 4 2859.67 Eu II MCS75 5 2862.57 Eu II MCS75 20 2892.502 Eu I ST76 13 2893.013 Eu I ST76 30 2893.838 Eu I ST76 50 P 2906.68 Eu II MCS75 15 2908.993 Eu I ST76 14 2925.04 Eu II MCS75 3 c,w 2952.68 Eu II MCS75 4 2960.21 Eu II MCS75 5 2991.33 Eu II MCS75 5 c,w 3054.94 Eu II MCS75 11 3058.975 Eu I ST76 4 3077.36 Eu II MCS75 30 3106.162 Eu I ST76 90 P 3111.427 Eu I ST76 40 3210.566 Eu I ST76 90 P 3212.804 Eu I ST76 40 3213.745 Eu I ST76 4 3277.78 Eu II MCS75 90 P 3334.313 Eu I ST76 10 3350.397 Eu I ST76 5 3396.58 Eu II MCS75 8 c,w 3521.09 Eu II MCS75 110 P 3688.42 Eu II MCS75 300 P ,c,w 3724.94 Eu II MCS75 6 3741.31 Eu II MCS75 4 3761.12 Eu II MCS75 11 3811.33 Eu I MCS75 600 P ,c,w 3819.67 Eu II MCS75 15 3865.57 Eu I MCS75 14 3884.75 Eu I MCS75 500 P ,c,w 3907.10 Eu II MCS75 20 3917.29 Eu I MCS75 500 P ,c,w 3930.48 Eu II MCS75 500 P ,c,w 3971.96 Eu II MCS75 11 4039.19 Eu I MCS75 600 P ,c,w 4129.70 Eu II MCS75 10 4182.22 Eu I MCS75 1000 P ,c,w 4205.05 Eu II MCS75 14 4298.73 Eu I MCS75 4 4355.09 Eu II MCS75 250 P ,c,w 4435.56 Eu II MCS75 50 P 4522.57 Eu II MCS75 1000 P 4594.03 Eu I MCS75 900 P 4627.22 Eu I MCS75 800 P 4661.88 Eu I MCS75 10 4867.62 Eu I MCS75 14 4907.18 Eu I MCS75 15 4911.40 Eu I MCS75 15 5013.17 Eu I MCS75 15 5022.91 Eu I MCS75 10 5029.54 Eu I MCS75 15 5114.37 Eu I MCS75 15 5129.10 Eu I MCS75 20 5133.52 Eu I MCS75 25 5160.07 Eu I MCS75 20 5166.70 Eu I MCS75 20 5199.85 Eu I MCS75 10 5200.96 Eu I MCS75 11 5206.44 Eu I MCS75 70 P 5215.10 Eu I MCS75 25 5223.49 Eu I MCS75 11 5239.24 Eu I MCS75 20 5266.40 Eu I MCS75 40 5271.96 Eu I MCS75 10 5272.48 Eu I MCS75 14 5282.82 Eu I MCS75 11 5291.26 Eu I MCS75 11 5294.64 Eu I MCS75 50 P 5357.61 Eu I MCS75 11 5361.61 Eu I MCS75 10 5376.94 Eu I MCS75 11 5392.94 Eu I MCS75 40 5402.77 Eu I MCS75 30 5451.51 Eu I MCS75 25 5452.94 Eu I MCS75 11 5488.65 Eu I MCS75 11 5510.52 Eu I MCS75 20 5547.44 Eu I MCS75 14 5570.33 Eu I MCS75 20 5577.14 Eu I MCS75 11 5580.03 Eu I MCS75 20 5645.80 Eu I MCS75 30 5765.20 Eu I MCS75 15 5783.69 Eu I MCS75 50 P ,c,w 5830.98 Eu I MCS75 6 5966.07 Eu II MCS75 40 c,w 5967.10 Eu I MCS75 15 5972.75 Eu I MCS75 20 5992.83 Eu I MCS75 10 6012.56 Eu I MCS75 40 6018.15 Eu I MCS75 15 6029.00 Eu I MCS75 7 6049.51 Eu II MCS75 13 6057.36 Eu I MCS75 20 6083.84 Eu I MCS75 20 6099.35 Eu I MCS75 11 6118.78 Eu I MCS75 6 6173.05 Eu II MCS75 10 6178.76 Eu I MCS75 25 c,w 6188.13 Eu I MCS75 13 6195.07 Eu I MCS75 20 6262.25 Eu I MCS75 15 6299.77 Eu I MCS75 4 6303.41 Eu II MCS75 11 c,w 6350.04 Eu I MCS75 11 c,w 6400.93 Eu I MCS75 15 6410.04 Eu I MCS75 13 6411.32 Eu I MCS75 14 6437.64 Eu II MCS75 11 6457.96 Eu I MCS75 25 6645.11 Eu II MCS75 13 6802.72 Eu I MCS75 30 6864.54 Eu I MCS75 11 7040.20 Eu I MCS75 6 7077.10 Eu II MCS75 10 7194.81 Eu II MCS75 10 7217.55 Eu II MCS75 9 7301.17 Eu II MCS75 12 7370.22 Eu II MCS75 5 7426.57 Eu II MCS75 15 7583.91 Eu I MCS75

Strong Lines of Samarium (Sm)

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Intensity Wavelength (Å) Spectrum Ref. Air 200 3254.377 Sm II K35 400 3306.388 Sm II K35 200 3307.017 Sm II K35 200 3310.661 Sm II K35 300 3321.179 Sm II K35 200 3340.579 Sm II K35 300 3365.863 Sm II K35 300 3382.399 Sm II K35 200 3408.676 Sm II K35 1000 P 3568.271 Sm II K35 1000 P 3592.603 Sm II K35 400 3604.285 Sm II K35 800 P 3609.491 Sm II K35 400 3621.229 Sm II K35 200 3627.014 Sm II K35 200 3631.126 Sm II K35 800 P 3634.290 Sm II K35 500 3661.365 Sm II K35 500 3670.840 Sm II K35 250 P 3693.989 Sm II K35 200 3708.654 Sm II K35 200 3718.877 Sm II K35 200 3721.847 Sm II K35 400 3728.469 Sm II K35 500 3731.258 Sm II K35 400 3735.980 Sm II K35 200 3737.141 Sm II K35 700* P 3739.117 Sm II K35 700* P 3739.197 Sm II K35 200 3741.288 Sm II K35 300 3743.868 Sm II K35 600* P 3745.465 Sm I K35 600* P 3745.605 Sm II K35 200 3755.276 Sm II K35 500 3756.411 Sm I K35 300 3757.529 Sm II K35 500 3760.694 Sm II K35 250 3764.370 Sm II K35 250* d 3773.331 Sm I K35 250* d 3773.422 Sm II K35 250 3778.135 Sm II K35 400 3788.125 Sm II K35 400 3793.971 Sm II K35 400 3797.730 Sm II K35 200 3800.887 Sm II K35 400 3826.202 Sm II K35 250 3831.501 Sm II K35 400 3834.476 Sm I K35 400 3843.500 Sm II K35 300 3853.295 Sm I K35 600 3854.209 Sm II K35 300 3854.556 Sm I K35 200 3855.901 Sm II K35 250 3858.737 Sm I K35 200 3871.778 Sm II K35 200 3880.766 Sm II K35 900 P 3885.286 Sm II K35 400 3896.977 Sm II K35 300 3903.417 Sm II K35 600 P 3922.397 Sm II K35 500 3928.279 Sm II K35 300 3941.874 Sm II K35 200 3948.113 Sm II K35 300 3951.887 Sm I K35 400* 3962.98 Sm II RAVS90 400* 3963.03 Sm II RAVS90 200 3970.528 Sm II K35 400 3971.397 Sm II K35 400 3974.665 Sm I K35 250 3976.270 Sm II K35 250 3976.430 Sm II K35 250 3979.200 Sm II K35 200 3983.138 Sm II K35 200 3986.682 Sm II K35 400* 3990.002 Sm II K35 400* P 3990.025 Sm I K35 200 3993.308 Sm II K35 200 4023.231 Sm II K35 200 4035.110 Sm II K35 200 4042.723 Sm II K35 200 4042.905 Sm II K35 200 4047.160 Sm II K35 300* 4064.55 Sm II RAVS90 300* 4064.57 Sm II RAVS90 200 4066.737 Sm II K35 200 4075.845 Sm II K35 250 4092.266 Sm II K35 200* 4107.277 Sm II K35 200* 4107.387 Sm II K35 500 4118.551 Sm II K35 200 4149.831 Sm II K35 300 4152.209 Sm II K35 200 4169.478 Sm II K35 250 4188.128 Sm II K35 250 4203.051 Sm II K35 200 4220.659 Sm II K35 250 4225.328 Sm II K35 200 4229.704 Sm II K35 300 4236.745 Sm II K35 500 P 4256.393 Sm II K35 300 4262.677 Sm II K35 300* 4279.678 Sm II K35 300* 4279.747 Sm II K35 500 P 4280.789 Sm II K35 400 4282.208 Sm I K35 300 4282.833 Sm I K35 1000 P 4296.743 Sm I K35 200 4309.012 Sm II K35 500 4318.936 Sm II K35 300 4319.530 Sm I K35 400 4329.016 Sm II K35 300 4330.016 Sm I K35 300 4334.153 Sm II K35 600 P 4336.137 Sm I K35 250 4347.801 Sm II K35 200 4362.040 Sm II K35 300 P 4362.912 Sm I K35 200 4378.236 Sm II K35 300 4380.423 Sm I K35 400 4390.858 Sm II K35 200 4397.341 Sm I K35 250 4401.174 Sm I K35 200* d 4403.06 Sm II K35 200* d 4403.13 Sm I K35 200 4411.585 Sm I K35 300 4419.332 Sm I K35 400 4420.526 Sm II K35 250 4421.138 Sm II K35 700 P 4424.339 Sm II K35 300 4429.664 Sm I K35 400 4433.885 Sm II K35 400 4434.323 Sm II K35 300 4441.812 Sm I K35 300 4442.276 Sm I K35 400 4445.153 Sm I K35 300 4452.727 Sm II K35 300 4454.629 Sm II K35 250 4458.517 Sm II K35 500 P 4467.342 Sm II K35 500 P 4470.886 Sm I K35 200 4478.657 Sm II K35 250 4499.108 Sm I K35 200 4519.633 Sm II K35 200 4533.799 Sm I K35 200 4543.948 Sm II K35 200 4581.581 Sm I K35 300 4581.729 Sm I K35 200 4642.235 Sm II K35 200 4645.405 Sm I K35 250 4649.491 Sm I K35 200 4663.556 Sm I K35 200 4669.396 Sm II K35 300 4670.747 Sm I K35 250 4674.599 Sm II K35 250 4688.733 Sm I K35 500 P 4716.097 Sm I K35 500 P 4728.423 Sm I K35 500 P 4760.27 Sm I K35 400 4783.103 Sm I K35 200 4785.864 Sm I K35 600 P 4841.701 Sm I K35 500 P 4883.971 Sm I K35 400 4910.400 Sm I K35 250 4918.986 Sm I K35 250 5044.279 Sm I K35 300 5071.200 Sm I K35 300 5117.162 Sm I K35 200 5122.136 Sm I K35 300 5175.419 Sm I K35 250 5271.403 Sm I K35

Strong Lines of Dysprosium (Dy)

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Intensity Wavelength (Å) Spectrum Ref. Air 25 2623.688 Dy I NG00 20 2634.803 Dy II NG00 30 3038.288 Dy II NG00 40 3135.384 Dy II NG00 50 3156.521 Dy II NG00 30 3162.833 Dy II NG00 50 3169.992 Dy II NG00 40 3216.627 Dy II NG00 50 3251.268 Dy II NG00 40 3280.091 Dy II NG00 50 3308.883 Dy II NG00 40 3316.316 Dy II NG00 50 3319.878 Dy II NG00 40 3340.993 Dy II NG00 250 P 3385.014 Dy II NG00 30 3388.850 Dy II NG00 150 3393.567 Dy II NG00 60 3396.156 Dy II NG00 250 P 3407.792 Dy II NG00 60 3413.783 Dy II NG00 40 3419.631 Dy II NG00 90 3434.367 Dy II NG00 60 3441.446 Dy II NG00 150 3445.572 Dy II NG00 40 3446.992 Dy II NG00 120 3454.315 Dy II NG00 60 3456.557 Dy II NG00 200 P 3460.966 Dy II NG00 30 3468.429 Dy II NG00 60 3477.067 Dy II NG00 200 P 3494.489 Dy II NG00 40 3498.707 Dy II NG00 40 3504.528 Dy II NG00 40 3505.452 Dy II NG00 60 3506.812 Dy II NG00 200 3523.979 Dy II NG00 1000 P 3531.703 Dy II NG00 200 3534.958 Dy II NG00 250 P 3536.018 Dy II NG00 200 3538.516 Dy II NG00 80 3542.327 Dy II NG00 60 3546.832 Dy II NG00 200 3550.217 Dy II NG00 100 3551.615 Dy II NG00 100 3563.146 Dy II NG00 40 3573.830 Dy II NG00 60 3574.152 Dy II NG00 200 3576.242 Dy II NG00 80 3576.865 Dy II NG00 40 3577.983 Dy II NG00 150 3585.058 Dy II NG00 60 3585.778 Dy II NG00 50 3591.416 Dy II NG00 80 3595.037 Dy II NG00 25 3600.374 Dy II NG00 80 3606.121 Dy II NG00 50 3629.419 Dy II NG00 200 P 3630.239 Dy II NG00 50 3640.249 Dy II NG00 500 P 3645.396 Dy II NG00 50 3648.786 Dy II NG00 30 3664.614 Dy II NG00 25 3666.838 Dy I NG00 40 3672.296 Dy II NG00 60 3674.086 Dy II NG00 100 3676.586 Dy II NG00 40 3678.504 Dy I NG00 50 3684.850 Dy I NG00 80 3685.777 Dy I NG00 200 P 3694.811 Dy II NG00 40 3698.206 Dy II NG00 70 3724.445 Dy II NG00 20 3727.996 Dy I NG00 60 3739.340 Dy I NG00 50 3747.813 Dy II NG00 60 3753.504 Dy II NG00 60 3753.747 Dy II NG00 80 3757.049 Dy I NG00 200 P 3757.367 Dy II NG00 40 3767.625 Dy I NG00 20 3771.106 Dy I NG00 40 3773.051 Dy I NG00 25 3774.714 Dy I NG00 25 3781.467 Dy I NG00 150 3786.176 Dy II NG00 70 3788.438 Dy II NG00 30 3791.870 Dy II NG00 25 3806.269 Dy II NG00 30 3812.272 Dy I NG00 60 3816.762 Dy II NG00 30 3825.682 Dy II NG00 100 3836.504 Dy II NG00 25 3840.890 Dy I NG00 60 3841.307 Dy II NG00 20 3844.361 Dy I NG00 25 3847.019 Dy I NG00 50 3853.026 Dy II NG00 25 3858.402 Dy I NG00 100 3868.803 Dy I NG00 40 3869.861 Dy II NG00 300 P 3872.103 Dy II NG00 50 3873.986 Dy II NG00 250 P 3898.528 Dy II NG00 30 3917.286 Dy I NG00 25 3927.860 Dy I NG00 30 3930.147 Dy I NG00 90 3931.526 Dy II NG00 25 3936.701 Dy I NG00 500 P 3944.679 Dy II NG00 40 3957.791 Dy II NG00 25 3962.590 Dy I NG00 600 P 3968.384 Dy II NG00 120 3978.564 Dy II NG00 60 3981.926 Dy II NG00 70 3983.651 Dy II NG00 40 3984.210 Dy II NG00 70 3996.688 Dy II NG00 400 P 4000.449 Dy II NG00 25 4005.837 Dy I NG00 30 4013.822 Dy I NG00 25 4023.715 Dy I NG00 800 P 4045.970 Dy I NG00 70 4050.566 Dy II NG00 110 4073.119 Dy II NG00 300 P 4077.965 Dy II NG00 25 4085.336 Dy I NG00 25 4096.100 Dy I NG00 200 P 4103.305 Dy II NG00 50 4103.874 Dy I NG00 70 4111.340 Dy II NG00 40 4129.423 Dy II NG00 20 4130.352 Dy I NG00 25 4133.850 Dy I NG00 50 4143.100 Dy II NG00 60 4146.060 Dy I NG00 400 P 4167.974 Dy I NG00 25 4171.931 Dy I NG00 60 4183.721 Dy I NG00 800 P 4186.821 Dy I NG00 140 P 4191.640 Dy I NG00 400 P 4194.846 Dy I NG00 50 4198.015 Dy I NG00 40 4201.301 Dy I NG00 40 4202.240 Dy I NG00 30 4211.238 Dy I NG00 1000 P 4211.714 Dy I NG00 110 4213.180 Dy I NG00 250 P 4215.159 Dy I NG00 300 P 4218.092 Dy I NG00 300 P 4221.110 Dy I NG00 30 4222.212 Dy I NG00 150 P 4225.154 Dy I NG00 40 4232.024 Dy I NG00 40 4239.856 Dy I NG00 30 4245.912 Dy I NG00 50 4308.630 Dy II NG00 20 4325.868 Dy I NG00 30 4449.705 Dy II NG00 25 4577.775 Dy I NG00 130 P 4589.364 Dy I NG00 60 4612.258 Dy I NG00 20 4957.347 Dy II NG00 15 6259.087 Dy I NG00

Strong Lines of Gadolinium (Gd)

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Intensity Wavelength (Å) Spectrum Ref. Air 110 2796.93 Gd II MCS75 90 2809.72 Gd II MCS75 140 2999.04 Gd II MCS75 250 3010.13 Gd II MCS75 200 3027.60 Gd II MCS75 250 3032.84 Gd II MCS75 200 3034.05 Gd II MCS75 110 3068.64 Gd II MCS75 70 3076.92 Gd II MCS75 250 3081.99 Gd II MCS75 400 3100.50 Gd II MCS75 70 3102.55 Gd II MCS75 110 3145.00 Gd II MCS75 110 3156.53 Gd II MCS75 110 3161.37 Gd II MCS75 80* 3223.74 Gd II MCS75 110 3266.73 Gd I MCS75 90 3291.48 Gd I MCS75 90 3294.08 Gd I MCS75 150 3331.38 Gd II MCS75 90 3332.13 Gd II MCS75 130 3336.18 Gd II MCS75 70 3345.98 Gd II MCS75 600 P 3350.47 Gd II MCS75 500 P 3358.62 Gd II MCS75 90 3360.71 Gd II MCS75 600 P 3362.23 Gd II MCS75 130 3392.53 Gd II MCS75 130* 3407.56 Gd II MCS75 130* 3407.61 Gd II MCS75 150 3416.95 Gd II MCS75 150 3418.73 Gd II MCS75 800 P 3422.47 Gd II MCS75 250* 3423.90 Gd I MCS75 250* 3423.92 Gd II MCS75 90 3424.59 Gd II MCS75 80 3432.99 Gd II MCS75 200 3439.21 Gd II MCS75 90 3439.78 Gd II MCS75 300 3439.99 Gd II MCS75 150 3450.38 Gd II MCS75 130 3451.23 Gd II MCS75 100 3454.90 Gd II MCS75 300 3463.98 Gd II MCS75 200 3467.27 Gd II MCS75 200 3468.99 Gd II MCS75 150 3473.22 Gd II MCS75 250 3481.28 Gd II MCS75 200 3481.80 Gd II MCS75 110 3491.95 Gd II MCS75 200 3494.40 Gd II MCS75 150 3505.51 Gd II MCS75 90 3512.22 Gd II MCS75 130 3512.50 Gd II MCS75 150 3513.65 Gd I MCS75 110 3524.20 Gd II MCS75 500 P 3545.80 Gd II MCS75 400 3549.36 Gd II MCS75 150 3557.05 Gd II MCS75 80 3571.93 Gd II MCS75 110 3581.91 Gd II MCS75 600 P 3584.96 Gd II MCS75 130 3592.71 Gd II MCS75 250 3604.87 Gd I MCS75 90 3608.75 Gd II MCS75 90 3610.76 Gd II MCS75 100 3645.62 Gd II MCS75 700 P 3646.19 Gd II MCS75 70 3652.54 Gd II MCS75 400 3654.62 Gd II MCS75 400 3656.15 Gd II MCS75 150 3662.26 Gd II MCS75 300 3664.60 Gd II MCS75 250 3671.20 Gd II MCS75 200 3674.05 Gd I MCS75 70 3679.21 Gd I MCS75 400 P 3684.13 Gd I MCS75 80 3686.33 Gd II MCS75 400 3687.74 Gd II MCS75 250 3697.73 Gd II MCS75 150 3699.73 Gd II MCS75 300 3712.70 Gd II MCS75 400 P 3713.57 Gd I MCS75 150 3716.36 Gd II MCS75 400 P 3717.48 Gd I MCS75 200* 3719.45 Gd II MCS75 200* 3719.53 Gd II MCS75 150 3730.84 Gd II MCS75 100 3739.76 Gd I MCS75 500 P 3743.47 Gd II MCS75 130 3744.83 Gd I MCS75 200 3757.94 Gd I MCS75 150 3758.31 Gd II MCS75 90 3759.00 Gd II MCS75 70 3760.71 Gd II MCS75 200 3762.20 Gd I MCS75 100 3767.04 Gd II MCS75 1000 P 3768.39 Gd II MCS75 70 3769.45 Gd II MCS75 150 3770.69 Gd II MCS75 110 3782.34 Gd II MCS75 600 P 3783.05 Gd I MCS75 130 3787.56 Gd II MCS75 90 3791.17 Gd II MCS75 600 P 3796.37 Gd II MCS75 80 3801.29 Gd II MCS75 400 3813.97 Gd II MCS75 90 3816.64 Gd II MCS75 110 3836.91 Gd II MCS75 110 3839.64 Gd II MCS75 140 3842.20 Gd II MCS75 300 3843.28 Gd I MCS75 150 3844.58 Gd II MCS75 400 3850.69 Gd II MCS75 600 P 3850.97 Gd II MCS75 500 P 3852.45 Gd II MCS75 300 3866.99 Gd I MCS75 150 3894.70 Gd II MCS75 90 3902.40 Gd II MCS75 90 3905.65 Gd I MCS75 250 P 3916.51 Gd II MCS75 250* 3934.79 Gd I MCS75 250* 3934.82 Gd II MCS75 90 3941.80 Gd I MCS75 120 3942.63 Gd I MCS75 300 3945.54 Gd I MCS75 120 3953.37 Gd I MCS75 140 3957.67 Gd II MCS75 90* 3959.44 Gd II MCS75 90* 3959.52 Gd II MCS75 120 3966.28 Gd I MCS75 70 3968.26 Gd II MCS75 150 3969.00 Gd I MCS75 80 3972.71 Gd I MCS75 70 3973.98 Gd II MCS75 150 3979.33 Gd I MCS75 100 3987.84 Gd I MCS75 70 3992.69 Gd I MCS75 70 3994.16 Gd II MCS75 80 3996.32 Gd II MCS75 70 4008.33 Gd I MCS75 90 4017.71 Gd I MCS75 250 4023.14 Gd I MCS75 150 4023.35 Gd I MCS75 250 4028.15 Gd I MCS75 200 4030.88 Gd I MCS75 150 4033.49 Gd I MCS75 70 4035.40 Gd I MCS75 150 4037.33 Gd II MCS75 80 4037.90 Gd II MCS75 90 4043.71 Gd I MCS75 300 4045.01 Gd I MCS75 150 4049.43 Gd II MCS75 250 P 4049.86 Gd II MCS75 90 4053.29 Gd II MCS75 500 P 4053.64 Gd I MCS75 150 4054.72 Gd I MCS75 500 P 4058.22 Gd I MCS75 140 4059.88 Gd I MCS75 70 4062.59 Gd II MCS75 200 4063.39 Gd II MCS75 110 4068.35 Gd I MCS75 90* 4070.29 Gd II MCS75 90* 4070.39 Gd II MCS75 70 4073.20 Gd II MCS75 150 4078.44 Gd II MCS75 600 P 4078.70 Gd I MCS7

Strong Lines of Holmium (Ho)

Strong Lines of Holmium (Ho)

Intensity Wavelength (Å) Spectrum Ref. Air 30 2880.98 Ho II MCS75 40 c 2909.41 Ho II MCS75 25 2973.00 Ho II MCS75 25 c 2979.63 Ho II MCS75 25 2987.64 Ho II MCS75 30 c 3049.38 Ho II MCS75 25 c 3054.00 Ho II MCS75 30 c 3057.45 Ho II MCS75 30 c 3082.34 Ho II MCS75 60 3084.36 Ho II MCS75 25 c 3086.54 Ho II MCS75 50 3118.50 Ho II MCS75 40 c 3166.62 Ho II MCS75 25 d,l 3171.72 Ho II MCS75 50 3173.78 Ho II MCS75 25 3174.84 Ho II MCS75 50 c 3181.50 Ho II MCS75 25 3183.84 Ho II MCS75 25 c 3197.83 Ho II MCS75 25 3201.76 Ho II MCS75 25 c 3278.15 Ho II MCS75 60 c 3281.97 Ho II MCS75 25 3288.46 Ho II MCS75 40 c 3337.23 Ho II MCS75 25 c 3338.86 Ho II MCS75 60 c 3343.58 Ho II MCS75 500 P ,c 3398.95 Ho II MZH78 50 c 3410.26 Ho II MCS75 25 c 3410.65 Ho II MCS75 90 c 3414.90 Ho II MCS75 300 P 3416.44 Ho II MZH78 80 3421.63 Ho II MCS75 120 c 3425.34 Ho II MCS75 120 c 3428.13 Ho II MCS75 40 c 3429.18 Ho II MCS75 40 3449.35 Ho I MCS75 200 P 3453.11 Ho II MZH78 50 c 3455.70 Ho II MCS75 1000 P ,c 3456.02 Ho II MZH78 100 3461.97 Ho II MCS75 50 c 3473.91 Ho II MCS75 300 P ,c 3474.25 Ho II MZH78 400 P 3484.80 Ho II MZH78 30 3489.58 Ho II MCS75 40 c 3493.09 Ho II MCS75 150 c 3494.76 Ho II MCS75 50 c 3498.88 Ho II MCS75 25 c 3506.95 Ho II MCS75 90 3510.73 Ho I MCS75 250 P ,c 3515.56 Ho II MZH78 25 c 3519.94 Ho II MCS75 40 3540.76 Ho II MCS75 100 3546.05 Ho II MCS75 70 c 3556.78 Ho II MCS75 25 3560.15 Ho II MCS75 25 c 3573.24 Ho II MCS75 40 c 3574.80 Ho II MCS75 90 3579.12 Ho I MCS75 25 3580.75 Ho II MCS75 25 3581.83 Ho II MCS75 40 c 3592.23 Ho II MCS75 70 c,w 3598.77 Ho II MCS75 40 3599.48 Ho I MCS75 30 c 3600.95 Ho II MCS75 20 3613.31 Ho II MCS75 50 3618.43 Ho I MCS75 25 c 3626.69 Ho II MCS75 30 3627.25 Ho II MCS75 25 c 3631.76 Ho II MCS75 25 c 3638.30 Ho II MCS75 200 c 3662.29 Ho I MCS75 50 3662.99 Ho I MCS75 80 3666.65 Ho I MCS75 150 3667.97 Ho I MCS75 50 3669.52 Ho I MCS75 30 c 3674.77 Ho II MCS75 80 3679.19 Ho I MCS75 80 3679.70 Ho I MCS75 80 3682.65 Ho I MCS75 25 3685.16 Ho II MCS75 70 3690.65 Ho I MCS75 40 3691.95 Ho I MCS75 50 3700.04 Ho I MCS75 30 c 3702.35 Ho II MCS75 40 3709.76 Ho I MCS75 50 3712.88 Ho I MCS75 50 3720.72 Ho I MCS75 120 3731.40 Ho I MCS75 40 3732.09 Ho I MCS75 90 3736.35 Ho I MCS75 200 P ,c,w 3748.17 Ho II MCS75 40 3769.09 Ho I MCS75 600 P ,c 3796.75 Ho II MZH78 600 P ,c 3810.74 Ho II MZH78 60 3811.86 Ho I MCS75 60 c 3813.25 Ho II MCS75 40 3829.27 Ho I MCS75 25 c 3835.35 Ho II MCS75 80 c,w 3837.51 Ho II MCS75 25 c 3842.05 Ho II MCS75 70 3843.86 Ho II MCS75 30 c 3846.73 Ho II MCS75 30 3849.88 Ho I MCS75 110 c 3854.07 Ho II MCS75 25 c,w 3856.94 Ho II MCS75 40 3857.72 Ho II MCS75 150 c 3861.68 Ho II MCS75 60 3862.62 Ho I MCS75 40 3874.68 Ho II MCS75 30 3881.61 Ho II MCS75 200 P ,c 3888.96 Ho II MZH78 60 3890.42 Ho I MCS75 800 P ,c 3890.94 Ho II MZH78 30 3896.76 Ho II MCS75 40 3904.44 Ho I MCS75 80 c,w 3905.68 Ho II MCS75 40 3911.80 Ho I MCS75 40 3919.45 Ho I MCS75 25 3938.85 Ho I MCS75 25 3950.56 Ho I MCS75 70 3955.73 Ho I MCS75 60 3959.68 Ho I MCS75 25 3975.88 Ho I MCS75 40 c 3976.93 Ho I MCS75 40 3999.58 Ho I MCS75 25 4003.39 Ho I MCS75 40 4027.21 Ho I MCS75 30 4028.86 Ho I MCS75 25 4037.62 Ho I MCS75 300 P 4040.81 Ho I MZH78 300 P ,c 4045.47 Ho II MZH78 25 c 4047.52 Ho I MCS75 900 P 4053.87 Ho I MZH78 30 4054.48 Ho II MCS75 30 4057.55 Ho I MCS75 25 4060.31 Ho I MCS75 110 4065.09 Ho II MCS75 80 4068.05 Ho I MCS75 30 4071.83 Ho I MCS75 30 4073.13 Ho I MCS75 30 4073.51 Ho I MCS75 25 4083.67 Ho I MCS75 25 4100.22 Ho I MCS75 1000 P 4103.80 Ho I MZH78 30 4106.50 Ho I MCS75 300 P 4108.62 Ho I MZH78 30 4112.00 Ho I MCS75 30 4116.73 Ho I MCS75 150 4120.20 Ho I MCS75 150 4125.65 Ho I MCS75 500 P 4127.16 Ho I MZH78 30 4134.54 Ho I MCS75 150 4136.22 Ho I MCS75 25 4142.19 Ho I MCS75 30 4148.97 Ho I MCS75 60 c,w 4152.61 Ho II MCS75 900 P 4163.03 Ho I MZH78 300 P 4173.20

Strong Lines of Terbium (Tb)

Strong Lines of Terbium (Tb)

Intensity Wavelength (Å) Spectrum Ref. Air 120 3078.905 Tb II B01 200 3218.925 Tb II B01 200 3219.982 Tb II B01 200 3285.030 Tb II B01 250 3293.065 Tb II B01 700 P 3324.413 Tb II B01 1000 P 3509.146 Tb II B01 250 3523.679 Tb II B01 200 3540.270 Tb II B01 600 P 3561.708 Tb II B01 700 P 3568.513 Tb II B01 300 3568.970 Tb II B01 200 3579.227 Tb II B01 300 3600.410 Tb II B01 400 P 3650.421 Tb II B01 400 P 3658.891 Tb II B01 700 P 3676.363 Tb II B01 800 P 3702.856 Tb II B01 400 P 3703.930 Tb II B01 200 d 3711.768 Tb II B01 200 3755.251 Tb II B01 300 P 3765.136 Tb II B01 400 P 3776.489 Tb II B01 500 P 3830.261 Tb I B01 150 d 3842.471 Tb II B01 600 P 3848.740 Tb II B01 600 P ,w 3874.172 Tb II B01 400 P 3899.197 Tb II B01 500 P 3901.325 Tb I B01 400 P ,d 3976.845 Tb II B01 300 3981.875 Tb II B01 300 4005.474 Tb II B01 300 P 4032.284 Tb I B01 400 P 4033.027 Tb II B01 400 P 4061.558 Tb I B01 200 4144.412 Tb II B01 200 4203.749 Tb I B01 200 4266.340 Tb I B01 700 P 4318.847 Tb I B01 200 4322.224 Tb I B01 1000 P 4326.472 Tb I B01 200 4332.117 Tb I B01 300 P 4336.455 Tb I B01 200 4337.646 Tb I B01 600 P 4338.435 Tb I B01 250 4340.609 Tb I B01 300 P 4356.837 Tb I B01 140 4493.077 Tb I B01 40 4578.69 Tb II MCS75 40 4641.98 Tb II MCS75 50 P 4645.31 Tb II MCS75 40 4702.41 Tb II MCS75 70 P 4752.53 Tb II MCS75 60 4786.78 Tb I MCS75 40 5228.12 Tb I MCS75 50 P 5354.88 Tb I MCS75 25 6794.58 Tb II MCS75 30 8212.57 Tb I MCS75

Strong Lines of Erbium (Er)

Strong Lines of Erbium (Er)

Intensity Wavelength (Å) Spectrum Ref. Air 40 2670.260 Er II M64b 60 2755.630 Er II M64b 50 2770.016 Er II M64b 90 2904.469 Er II M64b 140 2910.359 Er II M64b 140 2964.520 Er II M64b 110 3002.407 Er II M64b 50 3072.53 Er II M64b 60 3073.344 Er II M64b 70 3082.083 Er II M64b 60 3084.020 Er II M64b 70 3122.722 Er II M64b 80 3181.919 Er II M64b 80 3220.729 Er II M64b 60 3223.306 Er II M64b 200 P 3230.582 Er II M64b 50 3259.050 Er II M64b 250 P 3264.782 Er II M64b 70 3279.326 Er II M64b 70 3280.218 Er II M64b 200 P 3312.424 Er II M64b 50 3316.390 Er II M64b 70 3323.195 Er II M64b 70 3332.702 Er II M64b 120 3346.036 Er II M64b 130 3364.078 Er II M64b 130 d 3368.022 Er II M64b 700 P 3372.71 Er II M64b 90 3374.173 Er II M64b 150 3385.083 Er II M64b 200 P 3391.998 Er II M64b 40 3428.388 Er II M64b 70 3441.128 Er II M64b 30 3442.684 Er I M64b 40 3469.509 Er I M64b 90 3471.709 Er II M64b 60 3479.413 Er II M64b 90 3485.854 Er II M64b 600 P 3499.104 Er II M64b 40 3502.780 Er I M64b 40 3514.889 Er II M64b 60 3524.912 Er II M64b 30 3539.590 Er I M64b 70 3549.844 Er II M64b 110 3558.016 Er I M64b 40 3558.713 Er I M64b 90 3559.896 Er II M64b 20 3565.172 Er I M64b 70 3570.753 Er I M64b 20 3578.244 Er I M64b 90 3580.519 Er II M64b 25 3586.601 Er I M64b 40 3590.764 Er I M64b 30 3595.835 Er I M64b 60 3599.501 Er II M64b 90 3599.826 Er II M64b 50 3604.898 Er II M64b 30 3607.424 Er I M64b 300 P 3616.565 Er II M64b 50 3617.850 Er II M64b 50 3618.916 Er II M64b 50 3628.037 Er I M64b 20 3629.368 Er I M64b 90 3633.536 Er II M64b 40 3634.674 Er I M64b 110 3638.676 Er I M64b 80 3645.936 Er II M64b 50 3650.408 Er II M64b 50 3652.874 Er II M64b 25 3664.445 Er I M64b 50 3682.701 Er II M64b 25 3684.012 Er I M64b 700 P 3692.650 Er II M64b 25 3697.679 Er I M64b 50 3700.719 Er II M64b 50 3707.637 Er II M64b 50 3712.391 Er II M64b 25 3719.351 Er I M64b 120 3729.524 Er II M64b 50 3738.162 Er II M64b 80 3742.640 Er II M64b 60 3747.430 Er I M64b 40 3756.050 Er I M64b 150 3786.836 Er II M64b 50 3787.858 Er II M64b 50 3791.829 Er II M64b 40 3792.794 Er I M64b 50 3797.058 Er II M64b 110 3810.330 Er I M64b 300 P 3830.482 Er II M64b 40 3849.914 Er I M64b 50 3855.898 Er I M64b 50 3858.392 Er II M64b 500 P 3862.851 Er I M64b 140 3880.611 Er II M64b 110 3882.886 Er II M64b 300 P 3892.684 Er I M64b 500 P 3896.234 Er II M64b 70 3902.756 Er II M64b 90 3905.404 Er I M64b 1000 P 3906.311 Er II M64b 70 3932.254 Er II M64b 250 P 3937.014 Er I M64b 200 P 3938.626 Er II M64b 250 P 3944.420 Er I M64b 40 3948.062 Er I M64b 25 3956.416 Er I M64b 200 P 3973.036 Er I M64b 250 P 3973.575 Er I M64b 130 3974.719 Er II M64b 60 3977.019 Er I M64b 80 3982.331 Er I M64b 60 3987.655 Er I M64b 1000 P 4007.965 Er I M64b 80 4012.533 Er I M64b 200 P 4020.512 Er I M64b 30 4021.548 Er I M64b 70 4046.955 Er I M64b 90 4055.465 Er II M64b 40 4059.515 Er I M64b 60 4059.779 Er II M64b 30 4077.880 Er I M64b 50 4081.243 Er II M64b 250 P 4087.632 Er I M64b 80 4098.099 Er I M64b 25 4116.361 Er I M64b 25 4118.546 Er I M64b 40 4131.504 Er I M64b 50 4142.914 Er II M64b 500 P 4151.108 Er I M64b 70 4190.697 Er I M64b 100 4218.425 Er I M64b 50 4286.556 Er I M64b 25 4298.905 Er I M64b 20 4386.397 Er I M64b 60 4409.340 Er I M64b 50 4419.608 Er II M64b 25 4424.571 Er I M64b 25 4426.769 Er I M64b 70 P 4606.606 Er I M64b 20 4673.161 Er I M64b 50 4675.619 Er II M64b 20 4900.080 Er II M64b 20 4934.115 Er II M64b 20 5007.234 Er I M64b 20 5042.049 Er II M64b 15 5164.767 Er II M64b 15 5188.898 Er II M64b 20 5762.801 Er I M64b 30 P 5826.786 Er I M64b 25 P 6221.019 Er I M64b 9 7469.51 Er I MCS75

Strong Lines of Lutetium (Lu)

Strong Lines of Lutetium (Lu)

Intensity Wavelength (Å) Spectrum Ref. Air 90 P ,h 2195.54 Lu II MCS75 90 2578.79 Lu II MCS75 100 2613.40 Lu II MCS75 1000 P 2615.42 Lu II MCS75 100 2619.26 Lu II MCS75 150 2657.80 Lu II MCS75 80 h 2685.08 Lu I MCS75 250 P 2701.71 Lu II MCS75 60 h 2728.95 Lu I MCS75 200 P 2754.17 Lu II MCS75 100 h 2765.74 Lu I MCS75 150 2796.63 Lu II MCS75 150 2847.51 Lu II MCS75 80 h 2885.14 Lu I MCS75 400 P 2894.84 Lu II MCS75 250 P 2900.30 Lu II MCS75 500 P 2911.39 Lu II MCS75 250 P 2963.32 Lu II MCS75 130 2969.82 Lu II MCS75 250 2989.27 Lu I MCS75 150 P 3020.54 Lu II MCS75 120 3056.72 Lu II MCS75 400 P 3077.60 Lu II MCS75 700 P ,h 3081.47 Lu I MCS75 400 P 3118.43 Lu I MCS75 300 3171.36 Lu I MCS75 250 P 3254.31 Lu II MCS75 500 P 3278.97 Lu I MCS75 1000 P 3281.74 Lu I MCS75 800 P 3312.11 Lu I MCS75 1000 P 3359.56 Lu I MCS75 800 P 3376.50 Lu I MCS75 120 3385.50 Lu I MCS75 200 3396.82 Lu I MCS75 250 P 3397.07 Lu II MCS75 250 P 3472.48 Lu II MCS75 500 P ,c 3507.39 Lu II MCS75 200 3508.42 Lu I MCS75 250 P 3554.43 Lu II MCS75 600 P 3567.84 Lu I MCS75 90 3636.25 Lu I MCS75 300 P 3647.77 Lu I MCS75 400 P 3841.18 Lu I MCS75 60 3968.46 Lu I MCS75 90 4054.45 Lu I MCS75 400 P 4124.73 Lu I MCS75 60 4154.08 Lu I MCS75 90 4184.25 Lu II MCS75 400 P 4518.57 Lu I MCS75 130 4658.02 Lu I MCS75 60 4904.88 Lu I MCS75 110 5001.14 Lu I MCS75 400 P 5135.09 Lu I MCS75 70 5402.57 Lu I MCS75 120 P 5476.69 Lu II MCS75 70 5736.55 Lu I MCS75 200 P 6004.52 Lu I MCS75 60 6055.03 Lu I MCS75 120 P 6221.87 Lu II MCS75 60 6463.12 Lu II MCS75

Strong Lines of Thulium (Tm)

Strong Lines of Thulium (Tm)

Intensity Wavelength (Å) Spectrum Ref. Air 90 2480.13 Tm II MCS75 150 2509.08 Tm II MCS75 40 2552.764 Tm I SMC73 60 2561.65 Tm II MCS75 15 2596.489 Tm I SMC73 90 2607.06 Tm II MCS75 80 2624.33 Tm II MCS75 60 2721.19 Tm II MCS75 80 2794.60 Tm II MCS75 80 2797.27 Tm II MCS75 70 2827.92 Tm II MCS75 20 2854.166 Tm I SMC73 200 2869.23 Tm II MCS75 70 2890.94 Tm II MCS75 80 2926.74 Tm II MCS75 70 2935.99 Tm II MCS75 50 2973.218 Tm I SMC73 60 2981.48 Tm II MCS75 70 2990.54 Tm II MCS75 150 3015.30 Tm II MCS75 70 3073.08 Tm II MCS75 40 3081.121 Tm I SMC73 80 3098.60 Tm II MCS75 800 P 3131.26 Tm II MCS75 250 3133.89 Tm II MCS75 200 3151.04 Tm II MCS75 150 3157.34 Tm II MCS75 40 3172.654 Tm I SMC73 250 3172.83 Tm II MCS75 130 3236.81 Tm II MCS75 200 3240.23 Tm II MCS75 250 3241.54 Tm II MCS75 30 3246.963 Tm I SMC73 200 3258.05 Tm II MCS75 200 3266.64 Tm II MCS75 130 3267.40 Tm II MCS75 90 3268.99 Tm II MCS75 120 3276.81 Tm II MCS75 130 3283.40 Tm II MCS75 130 3285.61 Tm II MCS75 250 3291.00 Tm II MCS75 200 3302.46 Tm II MCS75 130 3309.80 Tm II MCS75 25 3349.987 Tm I SMC73 400 P 3362.61 Tm II MCS75 200 3397.50 Tm II MCS75 80 3410.048 Tm I SMC73 30 3412.590 Tm I SMC73 30 3416.588 Tm I SMC73 700 P 3425.08 Tm II MCS75 110 3425.63 Tm II MCS75 30 3429.332 Tm I SMC73 90 3429.96 Tm II MCS75 600 P 3441.50 Tm II MCS75 600 P 3453.66 Tm II MCS75 1000 P 3462.20 Tm II MCS75 20 3467.513 Tm I SMC73 30 3476.692 Tm I SMC73 30 3480.975 Tm I SMC73 40 3487.379 Tm I SMC73 30 3499.948 Tm I SMC73 25 3517.598 Tm I SMC73 200 3535.52 Tm II MCS75 90 3536.58 Tm II MCS75 40 3537.910 Tm I SMC73 20 3555.818 Tm I SMC73 30 3560.916 Tm I SMC73 40 3563.876 Tm I SMC73 150 3566.47 Tm II MCS75 40 3567.356 Tm I SMC73 30 3586.067 Tm I SMC73 250 3608.77 Tm II MCS75 40 3638.408 Tm I SMC73 110 3643.65 Tm II MCS75 120 3668.09 Tm II MCS75 500 P 3700.26 Tm II MCS75 400 P 3701.36 Tm II MCS75 800 P 3717.914 Tm I SMC73 100 3725.06 Tm II MCS75 250 3734.12 Tm II MCS75 500 P 3744.064 Tm I SMC73 150 3751.806 Tm I SMC73 700 P 3761.33 Tm II MCS75 500 P 3761.91 Tm II MCS75 800 P 3795.75 Tm II MCS75 80 3798.541 Tm I SMC73 60 3807.719 Tm I SMC73 60 3817.39 Tm II MCS75 30 3826.386 Tm I SMC73 150 3838.20 Tm II MCS75 30 3840.869 Tm I SMC73 1000 P 3848.02 Tm II MCS75 700 P 3883.132 Tm I SMC73 200 3883.44 Tm II MCS75 500 P 3887.348 Tm I SMC73 40 3896.617 Tm I SMC73 80 3900.79 Tm II MCS75 400 P 3916.477 Tm I SMC73 60 3929.58 Tm II MCS75 150 3949.270 Tm I SMC73 150 3958.10 Tm II MCS75 200 3996.52 Tm II MCS75 20 4024.230 Tm I SMC73 40 4044.474 Tm I SMC73 1000 P 4094.187 Tm I SMC73 1000 P 4105.841 Tm I SMC73 110 4138.334 Tm I SMC73 900 P 4187.615 Tm I SMC73 60 4199.92 Tm II MCS75 600 P 4203.727 Tm I SMC73 40 4222.671 Tm I SMC73 300 P 4242.15 Tm II MCS75 25 4271.716 Tm I SMC73 15 4298.365 Tm I SMC73 250 P 4359.928 Tm I SMC73 140 P 4386.434 Tm I SMC73 20 4394.420 Tm I SMC73 14 4396.495 Tm I SMC73 60 4481.26 Tm II MCS75 15 4519.595 Tm I SMC73 30 4522.57 Tm II MCS75 25 4599.017 Tm I SMC73 30 4615.94 Tm II MCS75 15 4681.920 Tm I SMC73 70 P 4733.335 Tm I SMC73 14 4957.175 Tm I SMC73 20 5009.77 Tm II MCS75 20 5034.22 Tm II MCS75 15 5060.895 Tm I SMC73 60 P 5307.116 Tm I SMC73 25 5631.406 Tm I SMC73 50 P 5675.835 Tm I SMC73 20 5764.287 Tm I SMC73 14 5971.264 Tm I SMC73 20 6460.261 Tm I SMC73 14 7558.33 Tm I SMC73

Strong Lines of Ytterbium (Yb)

Strong Lines of Ytterbium (Yb)

Intensity Wavelength (Å) Spectrum Ref. Air 140 P 2116.67 Yb II M67 150 P 2126.74 Yb II M67 20 2161.60 Yb II M67 50 P 2185.71 Yb II M67 40 P 2224.46 Yb II M67 8 2320.81 Yb II M67 9 2390.74 Yb II M67 25 P 2464.50 Yb I MT78 8 2512.061 Yb II M67 15 2538.67 Yb II M67 6 2617.01 Yb II M67 6 2644.306 Yb II M67 60 P 2653.75 Yb II M67 11 2665.038 Yb II M67 20 P 2671.958 Yb I MT78 20 2672.656 Yb II M67 9 2718.349 Yb II M67 6 2732.742 Yb II M67 13 2748.664 Yb II M67 70 P 2750.477 Yb II M67 9 2776.280 Yb II M67 6 2784.656 Yb II M67 6 2798.211 Yb II M67 8 2821.152 Yb II M67 6 2824.974 Yb II M67 11 2830.989 Yb II M67 13 h 2847.175 Yb II M67 6 2848.445 Yb II M67 20 2851.126 Yb II M67 6 2859.392 Yb II M67 25 2859.805 Yb II M67 8 2861.212 Yb II M67 6 2861.34 Yb II M67 11 2867.06 Yb II M67 11 2888.04 Yb II M67 200 P 2891.384 Yb II M67 9 2914.210 Yb II M67 8 2915.275 Yb II M67 15 2919.346 Yb II M67 8 2945.907 Yb II M67 7 2964.755 Yb II M67 110 P 2970.564 Yb II M67 11 2983.990 Yb II M67 9 2994.805 Yb II M67 15 3005.766 Yb II M67 6 3009.392 Yb II M67 9 3017.560 Yb II M67 9 3026.669 Yb II M67 50 3031.110 Yb II M67 6 3065.040 Yb II M67 6 3089.102 Yb II M67 9 3107.902 Yb II M67 11 3117.806 Yb II M67 13 3140.936 Yb II M67 7 3169.056 Yb II M67 7 3180.919 Yb II M67 20 3192.885 Yb II M67 13 3201.160 Yb II M67 7 3261.508 Yb II M67 1000 P 3289.370 Yb II M67 7 3305.252 Yb I MT78 8 3305.733 Yb II M67 4 3319.412 Yb I MT78 13 3337.171 Yb II M67 15 d 3342.93 Yb II M67 4 3343.071 Yb II M67 6 3352.491 Yb II M67 6 3362.438 Yb II M67 13 3375.483 Yb II M67 8 3387.505 Yb I MT78 8 3418.390 Yb I MT78 20 3426.044 Yb I MT78 13 3431.107 Yb I MT78 6 3438.848 Yb II M67 5 3452.398 Yb I MT78 30 3454.080 Yb II M67 11 d 3458.286 Yb II M67 7 3458.391 Yb I MT78 20 3460.269 Yb I MT78 130 P 3464.37 Yb I MT78 30 3476.303 Yb II M67 30 3478.835 Yb II M67 6 h,w 3495.90 Yb II M67 13 3520.293 Yb II M67 6 3549.822 Yb II M67 11 3560.327 Yb II M67 9 3560.704 Yb II M67 20 3585.466 Yb II M67 7 3606.478 Yb II M67 11 3619.803 Yb II M67 6 3634.525 Yb I MT78 13 3637.757 Yb II M67 4 3648.150 Yb I MT78 5 3655.729 Yb I MT78 13 3669.69 Yb II M67 8 3675.085 Yb II M67 1000 P 3694.190 Yb II M67 4 3700.580 Yb I MT78 10 3734.694 Yb I MT78 30 3770.095 Yb I MT78 4 3774.323 Yb I MT78 9 3839.907 Yb I MT78 20 3872.852 Yb I MT78 20 3900.85 Yb I MT78 8 3911.272 Yb I MT78 1000 P 3987.99 Yb I MT78 50 P 3990.885 Yb I MT78 4 4052.283 Yb I MT78 25 4089.68 Yb I MT78 7 h 4119.464 Yb II M67 25 4149.066 Yb I MT78 7 4174.56 Yb I MT78 20 4180.809 Yb II M67 8 d 4218.565 Yb II M67 7 4231.972 Yb I MT78 4 4277.738 Yb I MT78 7 4305.966 Yb I MT78 25 4439.19 Yb I MT78 5 h 4482.422 Yb I MT78 5 h 4563.95 Yb I MT78 40 P 4576.209 Yb I MT78 11 4582.355 Yb I MT78 4 4589.211 Yb I MT78 8 4590.834 Yb I MT78 11 4726.08 Yb II M67 9 h 4781.867 Yb I MT78 9 4786.61 Yb II M67 40 P 4935.500 Yb I MT78 8 4966.902 Yb I MT78 4 5069.144 Yb I MT78 12 5074.34 Yb I MT78 5 5211.604 Yb I MT78 6 5244.11 Yb I MT78 8 h 5277.04 Yb I MT78 9 5335.15 Yb II M67 8 5352.95 Yb II M67 5 h 5539.053 Yb I MT78 130 P 5556.466 Yb I MT78 12 5719.99 Yb I MT78 20 6489.06 Yb I MT78 10 6667.82 Yb I MT78 40 P 6799.60 Yb I MT78 40 P 7699.49 Yb I MT78 4 h 8922.56 Yb II M67

Strong Lines of Hafnium (Hf)

Strong Lines of Hafnium (Hf)

Intensity Wavelength (Å) Spectrum Ref. Air 700 P 2012.78 Hf II MCS75 1000 P 2028.18 Hf II MCS75 140 2096.18 Hf II MCS75 60 2210.82 Hf II MCS75 40 2254.01 Hf II MCS75 70 2277.16 Hf II MCS75 70 2322.47 Hf II MCS75 40 2323.25 Hf II MCS75 40 2324.89 Hf II MCS75 40 2347.44 Hf II MCS75 60 2351.22 Hf II MCS75 50 2393.36 Hf II MCS75 80 2393.83 Hf II MCS75 60 2405.42 Hf II MCS75 40 2410.14 Hf II MCS75 40 2417.69 Hf II MCS75 50 2447.25 Hf II MCS75 50 2460.49 Hf II MCS75 50 2464.19 Hf II MCS75 70 2512.69 Hf II MCS75 70 2513.03 Hf II MCS75 100 P 2516.88 Hf II MCS75 40 2531.19 Hf II MCS75 40 2551.40 Hf II MCS75 100 2571.67 Hf II MCS75 40 2573.90 Hf II MCS75 40 2576.82 Hf II MCS75 40 2578.14 Hf II MCS75 40 2582.54 Hf II MCS75 50 2606.37 Hf II MCS75 50 2607.03 Hf II MCS75 50 2622.74 Hf II MCS75 130 2638.71 Hf II MCS75 130 P 2641.41 Hf II MCS75 80 2647.29 Hf II MCS75 300 2705.61 Hf I MCS75 110 2718.59 Hf I MCS75 80 2738.76 Hf II MCS75 40 2751.81 Hf II MCS75 200 2761.63 Hf I MCS75 120 P 2773.36 Hf II MCS75 200 2779.37 Hf I MCS75 100 2817.68 Hf I MCS75 140 P 2820.22 Hf II MCS75 60 2822.68 Hf II MCS75 200 2845.83 Hf I MCS75 120 2850.96 Hf I MCS75 90 2861.01 Hf II MCS75 90 2861.70 Hf II MCS75 1000 P 2866.37 Hf I MCS75 400 2889.62 Hf I MCS75 800 P 2898.26 Hf I MCS75 500 P 2904.41 Hf I MCS75 400 2904.75 Hf I MCS75 900 P 2916.48 Hf I MCS75 250 2918.58 Hf I MCS75 40 2919.59 Hf II MCS75 60 2929.63 Hf II MCS75 200 2929.90 Hf I MCS75 80 2937.80 Hf II MCS75 900 P 2940.77 Hf I MCS75 500 2950.68 Hf I MCS75 500 2954.20 Hf I MCS75 250 2958.02 Hf I MCS75 600 2964.88 Hf I MCS75 300 2966.93 Hf I MCS75 80 2968.81 Hf II MCS75 100 2975.88 Hf II MCS75 500 2980.81 Hf I MCS75 400 3005.56 Hf I MCS75 130 3012.90 Hf II MCS75 250 3016.78 Hf I MCS75 130 3016.94 Hf II MCS75 400 3018.31 Hf I MCS75 500 3020.53 Hf I MCS75 50 3031.16 Hf II MCS75 300 3050.76 Hf I MCS75 500 3057.02 Hf I MCS75 400 3067.41 Hf I MCS75 1000 P 3072.88 Hf I MCS75 110 3074.79 Hf I MCS75 200 3080.84 Hf I MCS75 40 3101.40 Hf II MCS75 80 3109.12 Hf II MCS75 300 3131.81 Hf I MCS75 100 P 3134.72 Hf II MCS75 200 3156.63 Hf I MCS75 120 3159.82 Hf I MCS75 80 3162.61 Hf II MCS75 200 3168.39 Hf I MCS75 400 3172.94 Hf I MCS75 50 3176.86 Hf II MCS75 40 3193.53 Hf II MCS75 80 3194.19 Hf II MCS75 140 3206.11 Hf I MCS75 150 3247.66 Hf I MCS75 100 3249.53 Hf I MCS75 100 P 3253.70 Hf II MCS75 150 3310.27 Hf I MCS75 300 3312.86 Hf I MCS75 400 3332.73 Hf I MCS75 40 3352.06 Hf II MCS75 100 3358.91 Hf I MCS75 90 3389.83 Hf II MCS75 100 3392.81 Hf I MCS75 100 3397.26 Hf I MCS75 100 3397.60 Hf I MCS75 250 P 3399.80 Hf II MCS75 100 3417.34 Hf I MCS75 200 3419.18 Hf I MCS75 300 3472.40 Hf I MCS75 60 3479.28 Hf II MCS75 110 3497.16 Hf I MCS75 400 3497.49 Hf I MCS75 140 3505.23 Hf II MCS75 400 3523.02 Hf I MCS75 120 3535.54 Hf II MCS75 300 3536.62 Hf I MCS75 60 3552.70 Hf II MCS75 150 3561.66 Hf II MCS75 120 3567.36 Hf I MCS75 130 3569.04 Hf II MCS75 250 3599.87 Hf I MCS75 400 3616.89 Hf I MCS75 40 3630.87 Hf II MCS75 90 3644.36 Hf II MCS75 150 3649.10 Hf I MCS75 200 3675.74 Hf I MCS75 1000 P 3682.24 Hf I MCS75 130 3696.51 Hf I MCS75 40 3701.15 Hf II MCS75 500 3717.80 Hf I MCS75 80 3719.28 Hf II MCS75 200 3733.79 Hf I MCS75 200 3746.80 Hf I MCS75 600 3777.64 Hf I MCS75 600 3785.46 Hf I MCS75 80 3793.37 Hf II MCS75 400 d 3800.38 Hf I MCS75 150 3811.78 Hf I MCS75 600 3820.73 Hf I MCS75 130 3830.02 Hf I MCS75 400 3849.18 Hf I MCS75 250 3858.31 Hf I MCS75 100 3860.91 Hf I MCS75 40 3880.82 Hf II MCS75 300 3899.94 Hf I MCS75 70 3918.09 Hf II MCS75 150 3931.38 Hf I MCS75 200 3951.83 Hf I MCS75 100 4062.84 Hf I MCS75 60 P 4093.16 Hf II MCS75 500 P 4174.34 Hf I MCS75 150 4294.79 Hf I MCS75 110 4356.33 Hf I MCS75 110 4565.94 Hf I MCS75 250 d 4598.80 Hf I MCS75 100 4620.86 Hf I MCS75 140 4800.50 Hf I MCS75 100 5181.86 Hf I MCS75 100 5550.60 Hf I MCS75 100 5552.12 Hf I MCS75 250 7131.81 Hf I MCS75 300 P 7237.10 Hf I MCS75 200 7240.87 Hf I MCS75 150 7624.40 Hf I MCS75 140 7845.35 Hf I MCS75 110 7994.73 Hf I M

Strong Lines of Tantalum (Ta)

Strong Lines of Tantalum (Ta)

Intensity Wavelength (Å) Spectrum Ref. Air 500 2140.13 Ta II MCS75 600 P 2146.87 Ta II MCS75 300 2150.62 Ta II MCS75 250 2165.01 Ta II MCS75 300 2178.03 Ta II MCS75 500 2182.71 Ta II MCS75 200 2193.20 Ta II MCS75 500 2193.88 Ta II MCS75 600 P 2196.03 Ta II MCS75 600 P 2199.67 Ta II MCS75 200 2207.14 Ta II MCS75 600* P ,d 2210.03 Ta II MCS75 600* P 2210.19 Ta II MCS75 600 P 2239.48 Ta II MCS75 200 2249.79 Ta II MCS75 500 2250.76 Ta II MCS75 200 2258.71 Ta II MCS75 400 2261.42 Ta II MCS75 400 2262.30 Ta II MCS75 300 2271.85 Ta II MCS75 400 2272.59 Ta II MCS75 80 2279.85 Ta I MCS75 300 2285.25 Ta II MCS75 250 2286.59 Ta II MCS75 400 2289.16 Ta II MCS75 300 2331.98 Ta II MCS75 250 2332.19 Ta II MCS75 100 2357.30 Ta I MCS75 100 2361.09 Ta I MCS75 250 2364.24 Ta II MCS75 120 2371.58 Ta I MCS75 600 P 2387.06 Ta II MCS75 1000 P 2400.63 Ta II MCS75 140 2427.64 Ta I MCS75 200 2432.70 Ta II MCS75 250 2474.62 Ta I MCS75 200 2484.95 Ta I MCS75 250 2488.70 Ta II MCS75 200 2490.46 Ta I MCS75 250 2504.45 Ta I MCS75 250 2507.45 Ta I MCS75 90 2512.65 Ta I MCS75 500 d 2526.35 Ta I MCS75 250 2532.12 Ta II MCS75 90 2546.80 Ta I MCS75 200 d 2551.07 Ta I MCS75 200 2554.62 Ta II MCS75 90 2555.05 Ta I MCS75 500 P 2559.43 Ta I MCS75 200 2562.10 Ta I MCS75 150 2573.54 Ta I MCS75 150 2573.79 Ta I MCS75 250 2577.37 Ta II MCS75 130 2577.78 Ta I MCS75 150 2593.08 Ta I MCS75 200 2595.26 Ta I MCS75 250 2603.49 Ta II MCS75 500 P 2608.63 Ta I MCS75 120 d 2611.34 Ta I MCS75 130 2615.46 Ta I MCS75 120 2615.66 Ta I MCS75 500 P 2635.58 Ta II MCS75 200 2636.67 Ta I MCS75 300 2636.90 Ta I MCS75 200 2646.22 Ta I MCS75 250 2646.37 Ta I MCS75 900 P 2647.47 Ta I MCS75 110 2651.22 Ta II MCS75 1000 P 2653.27 Ta I MCS75 700 P 2656.61 Ta I MCS75 600 P 2661.34 Ta I MCS75 250 2668.62 Ta I MCS75 300 2675.90 Ta II MCS75 250 2684.28 Ta I MCS75 600 P 2685.17 Ta II MCS75 130 2691.31 Ta I MCS75 100 2692.40 Ta I MCS75 200 2694.52 Ta II MCS75 90 2696.81 Ta I MCS75 400 P 2698.30 Ta I MCS75 200 2706.69 Ta I MCS75 500 2710.13 Ta I MCS75 1000 P 2714.67 Ta I MCS75 90 2717.18 Ta I MCS75 200 2720.76 Ta I MCS75 200 2727.44 Ta II MCS75 150 2727.78 Ta I MCS75 200 2746.68 Ta I MCS75 500 2748.78 Ta I MCS75 300 2749.83 Ta I MCS75 400 P 2758.31 Ta I MCS75 200 2761.68 Ta II MCS75 300 2775.88 Ta I MCS75 150 2787.69 Ta I MCS75 250 2796.34 Ta I MCS75 300 2797.76 Ta II MCS75 150 2802.07 Ta I MCS75 150 2806.30 Ta I MCS75 200 2806.58 Ta I MCS75 100 2842.82 Ta I MCS75 250 2844.25 Ta I MCS75 110 c 2845.35 Ta I MCS75 200 2848.52 Ta I MCS75 600 P 2850.49 Ta I MCS75 700 P 2850.98 Ta I MCS75 140 2861.98 Ta I MCS75 120 2868.65 Ta I MCS75 200 2871.42 Ta I MCS75 100 2873.36 Ta I MCS75 100 2873.56 Ta I MCS75 150 2880.02 Ta I MCS75 300 2891.84 Ta I MCS75 100 2899.04 Ta I MCS75 200 2902.05 Ta I MCS75 120 2915.49 Ta I MCS75 150 2925.19 Ta I MCS75 120 2932.70 Ta I MCS75 700 P 2933.55 Ta I MCS75 200 2940.06 Ta I MCS75 500 2940.22 Ta I MCS75 90 2942.14 Ta I MCS75 200 2951.92 Ta I MCS75 130 2953.56 Ta I MCS75 600 P 2963.32 Ta I MCS75 300 2965.13 Ta II MCS75 300 2965.54 Ta I MCS75 130 2969.47 Ta I MCS75 150 2975.56 Ta I MCS75 800 P 3012.54 Ta II MCS75 110 d 3027.48 Ta I MCS75 200 3049.56 Ta I MCS75 200 3069.24 Ta I MCS75 140 3077.24 Ta I MCS75 200 3103.25 Ta I MCS75 150 3124.97 Ta I MCS75 150 3130.58 Ta I MCS75 100 3132.64 Ta I MCS75 120 3170.29 Ta I MCS75 100 3173.59 Ta I MCS75 250 3180.95 Ta I MCS75 90 3184.55 Ta I MCS75 400 P 3311.16 Ta I MCS75 250 3318.84 Ta I MCS75 140 d 3330.99 Ta II MCS75 250 3371.54 Ta I MCS75 140 3385.05 Ta I MCS75 150 3406.94 Ta I MCS75 200 3480.52 Ta I MCS75 150 3497.85 Ta I MCS75 90 3503.87 Ta I MCS75 200 3511.04 Ta I MCS75 300 3607.41 Ta I MCS75 400 3626.62 Ta I MCS75 200 3642.06 Ta I MCS75 90 3833.74 Ta II MCS75 150 4061.40 Ta I MCS75 120 4067.91 Ta I MCS75 120 4205.88 Ta I MCS75 140 d 4510.98 Ta I MCS75 130 4574.31 Ta I MCS75 100 4619.51 Ta I MCS75 150 P 4681.88 Ta I MCS75 130 P 5156.56 Ta I MCS75 90 5877.36 Ta I MCS75 90 5944.02 Ta I MCS75 100 6

Strong Lines of Iridium (Ir)

Strong Lines of Iridium (Ir)

Intensity Wavelength (Å) Spectrum Ref. Air 600 2010.65 Ir I MCS75 500 2022.35 Ir I MCS75 900 P 2033.57 Ir I MCS75 400 2052.22 Ir I MCS75 300 2060.64 Ir I MCS75 200 2083.22 Ir I MCS75 200 2085.74 Ir I MCS75 1000 P 2088.82 Ir I MCS75 800 2092.63 Ir I MCS75 150 2112.68 Ir I MCS75 800 P 2126.81 Ir II KM78 250 2127.94 Ir I MCS75 200 2148.22 Ir I MCS75 150 2150.54 Ir I MCS75 600 P 2152.68 Ir II KM78 150 2155.81 Ir I MCS75 500 P 2158.05 Ir I MCS75 120 2162.88 Ir I MCS75 1000 P 2169.42 Ir II MCS75 250 2175.24 Ir I MCS75 150 2178.17 Ir I MCS75 300 2187.43 Ir II MCS75 200 2190.38 Ir II MCS75 500 P 2204.96 Ir II KM78 150 2208.09 Ir II MCS75 80 2220.37 Ir I MCS75 400 P 2242.69 Ir II KM78 120 2253.38 Ir I MCS75 120 2255.10 Ir I MCS75 80 2255.81 Ir I MCS75 80 2258.86 Ir I MCS75 50 2264.61 Ir I MCS75 60 2266.33 Ir I MCS75 60 2268.90 Ir I MCS75 150 P 2281.02 Ir II MCS75 50 2298.05 Ir I MCS75 50 2300.50 Ir I MCS75 150 2304.22 Ir I MCS75 50 2308.93 Ir I MCS75 30 2333.30 Ir I MCS75 40 2333.84 Ir I MCS75 30 2334.50 Ir I MCS75 90 2343.18 Ir I MCS75 40 2343.61 Ir I MCS75 30 2355.00 Ir I MCS75 150 2363.04 Ir I MCS75 60 P 2368.04 Ir II KM78 200 P 2372.77 Ir I MCS75 50 2375.09 Ir II MCS75 30 2381.62 Ir I MCS75 80 2386.89 Ir I MCS75 150 2390.62 Ir I MCS75 150 2391.18 Ir I MCS75 30 2413.31 Ir I MCS75 40 2418.11 Ir I MCS75 30 2426.53 Ir II MCS75 30 2427.61 Ir I MCS75 30 2431.24 Ir I MCS75 80 2431.94 Ir I MCS75 50 2452.81 Ir I MCS75 80 2455.61 Ir I MCS75 50 2467.30 Ir I MCS75 200 P 2475.12 Ir I MCS75 120 2481.18 Ir I MCS75 40 2493.08 Ir I MCS75 250 P 2502.98 Ir I MCS75 30 2512.58 Ir II MCS75 60 2533.13 Ir I MCS75 60 2534.46 Ir I MCS75 30 2537.22 Ir I MCS75 30 2542.02 Ir I MCS75 500 P 2543.97 Ir I MCS75 50 2546.03 Ir I MCS75 50 2564.18 Ir I MCS75 40 2577.26 Ir I MCS75 40 2592.06 Ir I MCS75 40 2599.04 Ir I MCS75 40 2608.25 Ir I MCS75 110 2611.30 Ir I MCS75 40 2634.17 Ir I MCS75 200 P 2639.71 Ir I MCS75 110 2661.98 Ir I MCS75 150 P 2664.79 Ir I MCS75 30 2669.91 Ir I MCS75 30 2671.84 Ir I MCS75 200 P 2694.23 Ir I MCS75 30 2781.29 Ir I MCS75 30 2797.35 Ir I MCS75 90 2797.70 Ir I MCS75 40 2823.18 Ir I MCS75 70 2824.45 Ir I MCS75 50 2836.40 Ir I MCS75 60 2839.16 Ir I MCS75 50 2840.22 Ir I MCS75 200 P 2849.72 Ir I MCS75 50 2882.64 Ir I MCS75 40 2897.15 Ir I MCS75 250 P 2924.79 Ir I MCS75 70 2934.64 Ir I MCS75 50 2936.68 Ir I MCS75 150 2943.15 Ir I MCS75 70 2951.22 Ir I MCS75 40 3003.63 Ir I MCS75 90 3068.89 Ir I MCS75 30 3100.29 Ir I MCS75 30 3100.45 Ir I MCS75 200 3133.32 Ir I MCS75 40 3212.12 Ir I MCS75 300 P 3220.78 Ir I MCS75 30 3368.48 Ir I MCS75 40 3437.02 Ir I MCS75 200 P 3513.64 Ir I MCS75 70 3573.72 Ir I MCS75 40 3628.67 Ir I MCS75 30 P 3731.36 Ir II MCS75 30 3747.20 Ir I MCS75 200 3800.12 Ir I MCS75 30 3976.31 Ir I MCS75 15 4268.10 Ir I MCS75 13 4311.50 Ir I MCS75

Strong Lines of Osmium (Os)

Strong Lines of Osmium (Os)

Intensity Wavelength (Å) Spectrum Ref. Air 300 2001.45 Os I MCS75 400 2003.73 Os I MCS75 300 2004.81 Os I MCS75 600 2010.15 Os I MCS75 1000 P 2018.14 Os I MCS75 1000 2020.26 Os MCS75 500 2022.76 Os I MCS75 500 2028.23 Os I MCS75 600 P 2034.44 Os I MCS75 900 P 2045.36 Os I MCS75 300* 2058.69 Os I MCS75 300* 2058.78 Os I MCS75 400 2061.69 Os I MCS75 1000 P 2067.21 Os II MCS75 500 P 2070.67 Os II MCS75 250 2076.95 Os I MCS75 250 2078.09 Os MCS75 500 P 2079.97 Os I MCS75 100 2082.54 Os I MCS75 100 2089.03 Os I MCS75 100 2089.21 Os I MCS75 200 2097.60 Os I MCS75 200 2100.63 Os I MCS75 70 2117.66 Os I MCS75 150 2117.96 Os I MCS75 250 2119.79 Os MCS75 70 2123.84 Os I MCS75 200 2137.11 Os I MCS75 80 2149.97 Os MCS75 90 2154.59 Os I MCS75 40 2157.84 Os I MCS75 40 2158.53 Os I MCS75 80 2161.00 Os MCS75 110 2166.90 Os I MCS75 40 2167.75 Os I MCS75 70 2171.65 Os I MCS75 30 2184.68 Os I MCS75 110 P 2194.39 Os II MCS75 40 2234.61 Os I MCS75 40 2252.15 Os I MCS75 250 P 2255.85 Os II MCS75 50 2264.60 Os I MCS75 30 2270.17 Os I MCS75 200 P 2282.26 Os II MCS75 30 2283.67 Os I MCS75 25 2308.31 Os I MCS75 25 2313.75 Os II MCS75 90 P 2336.80 Os II MCS75 30 2350.23 Os II MCS75 15 2355.28 Os II MCS75 30 2362.77 Os I MCS75 60 P 2367.35 Os II MCS75 12 2375.06 Os II MCS75 90 2377.03 Os I MCS75 30 2379.39 Os I MCS75 60 2387.29 Os I MCS75 40 2395.88 Os I MCS75 30 2401.13 Os I MCS75 12 2405.08 Os II MCS75 12 2420.02 Os II MCS75 25 2423.07 Os II MCS75 50 2424.97 Os I MCS75 30 2450.74 Os I MCS75 14 2454.91 Os II MCS75 60 2461.42 Os I MCS75 14 2468.90 Os II MCS75 30 2476.84 Os I MCS75 70 P 2486.24 Os II MCS75 90 2498.41 Os I MCS75 25 2512.87 Os I MCS75 80 2513.25 Os I MCS75 25 2515.04 Os I MCS75 25 2518.44 Os I MCS75 100 P 2538.00 Os II MCS75 30 2542.51 Os I MCS75 25 2563.16 Os II MCS75 20 2566.49 Os I MCS75 20 2578.32 Os II MCS75 15 2580.03 Os II MCS75 25 2581.96 Os I MCS75 30 2590.76 Os I MCS75 20 2596.00 Os II MCS75 60 2613.06 Os I MCS75 30 2619.94 Os I MCS75 20 2621.82 Os I MCS75 130 P 2637.13 Os I MCS75 70 2644.11 Os I MCS75 70 2658.60 Os I MCS75 20 2659.83 Os I MCS75 20 2674.57 Os I MCS75 70 2689.82 Os I MCS75 20 2699.59 Os I MCS75 20 2706.70 Os I MCS75 100 P 2714.64 Os I MCS75 20 2715.36 Os I MCS75 40 2720.04 Os I MCS75 30 2721.86 Os I MCS75 20 2730.61 Os I MCS75 20 2732.80 Os I MCS75 25 2761.42 Os I MCS75 30 2770.71 Os I MCS75 25 2782.55 Os I MCS75 20 2786.31 Os I MCS75 20 2796.73 Os I MCS75 100 P 2806.91 Os I MCS75 25 2814.20 Os I MCS75 200 P 2838.63 Os I MCS75 25 2841.60 Os I MCS75 80 2844.40 Os I MCS75 50 2850.76 Os I MCS75 50 2860.96 Os I MCS75 300 P 2909.06 Os I MCS75 70 2912.33 Os I MCS75 20 2917.26 Os I MCS75 70 2919.79 Os I MCS75 20 2931.28 Os I MCS75 40 h 2948.23 Os I MCS75 50 2949.53 Os I MCS75 20 2962.15 Os I MCS75 25 2970.97 Os I MCS75 20 2982.90 Os I MCS75 20 3017.25 Os I MCS75 150 P 3018.04 Os I MCS75 40 3030.70 Os I MCS75 100 3040.90 Os I MCS75 15 3042.74 Os II MCS75 300 P 3058.66 Os I MCS75 20 3062.19 Os I MCS75 40 3077.72 Os I MCS75 20 3109.38 Os I MCS75 110 3156.25 Os I MCS75 25 3173.93 Os II MCS75 20 3213.31 Os II MCS75 70 3232.06 Os I MCS75 110 P 3262.29 Os I MCS75 110 P 3267.94 Os I MCS75 20 3269.21 Os I MCS75 20 3275.20 Os I MCS75 40 3290.26 Os I MCS75 250 P 3301.56 Os I MCS75 20 3310.91 Os I MCS75 30 3336.15 Os I MCS75 30 3370.59 Os I MCS75 20 3387.84 Os I MCS75 20 3401.86 Os I MCS75 20 3504.66 Os I MCS75 40 3528.60 Os I MCS75 30 3559.79 Os I MCS75 40 3560.86 Os I MCS75 20 3598.11 Os I MCS75 12 3604.48 Os II MCS75 130 3752.52 Os I MCS75 70 P 3782.20 Os I MCS75 20 3790.14 Os I MCS75 25 3876.77 Os I MCS75 30 3963.63 Os I MCS75 25 3977.23 Os I MCS75 30 4066.69 Os I MCS75 40 4112.02 Os I MCS75 90 4135.78 Os I MCS75 40 4173.23 Os I MCS75 20 4175.63 Os I MCS75 40 4211.86 Os I MCS75 150 P 4260.85 Os I MCS75 20 4293.95 Os I MCS75 20 4311.40 Os I MCS75 20 4394.86 Os I MCS75 150 P 4420.47 Os I MCS75 20 4550.41 Os I MCS75 25 4793.99 Os I MCS75 9 5202.63 Os I MCS75 9 5523.53 Os I MCS75 6

Strong Lines of Rhenium (Re)

Strong Lines of Rhenium (Re)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 800 P ,c 1973.1340 Re II WJLG97 Air 500 P 2003.53 Re I MCS75 300 P 2017.87 Re I MCS75 500 P 2049.08 Re I MCS75 80 P 2074.70 Re I MCS75 200 P 2085.59 Re I MCS75 200 P 2097.12 Re I MCS75 50 2109.22 Re I MCS75 600 P 2139.04 Re II MCS75 250 P 2142.74 Re II MCS75 70 2156.67 Re I MCS75 90 P 2167.94 Re I MCS75 60 2176.21 Re I MCS75 1000 P ,c 2214.2749 Re II WJLG97 40 2214.58 Re I MCS75 30 2226.42 Re I MCS75 15 2235.44 Re I MCS75 8 2255.73 Re I MCS75 15 2256.19 Re I MCS75 40 2264.39 Re I MCS75 40 2274.62 Re I MCS75 900 P ,c 2275.2532 Re II WJLG97 30 2281.62 Re I MCS75 50 2287.51 Re I MCS75 50 2294.49 Re I MCS75 60 2298.09 Re II MCS75 7 2299.77 Re I MCS75 11 2302.99 Re I MCS75 12 2306.54 Re I MCS75 15 2322.49 Re I MCS75 15 2344.78 Re I MCS75 12 2352.07 Re I MCS75 20 2365.90 Re I MCS75 10 2367.68 Re I MCS75 9 2369.27 Re I MCS75 40 2370.76 Re II MCS75 25 2405.06 Re I MCS75 13 2405.60 Re I MCS75 20 2419.81 Re I MCS75 50 2428.58 Re I MCS75 9 2431.54 Re I MCS75 8 2432.18 Re I MCS75 11 2446.98 Re I MCS75 11 2449.71 Re I MCS75 30 2455.83 Re II MCS75 7 2461.20 Re I MCS75 130 c 2461.84 Re II MCS75 30 2467.57 Re II MCS75 20 2483.92 Re I MCS75 7 2485.81 Re I MCS75 20 2487.33 Re I MCS75 90 P 2502.35 Re II MCS75 40 2504.60 Re II MCS75 30 c 2508.99 Re I MCS75 10 2520.01 Re I MCS75 10 2521.50 Re I MCS75 10 2540.51 Re I MCS75 13 d 2544.74 Re I MCS75 60 2554.63 Re II MCS75 20 2556.51 Re I MCS75 90 P 2568.64 Re II MCS75 60 2571.81 Re II MCS75 7 2586.79 Re I MCS75 110 P 2608.50 Re II MCS75 11 d 2611.54 Re I MCS75 50 2635.83 Re II MCS75 10 2636.64 Re I MCS75 12 2651.90 Re I MCS75 7 2654.12 Re I MCS75 15 2674.34 Re I MCS75 25 2715.47 Re I MCS75 30 2731.56 Re II MCS75 100 P 2733.04 Re II MCS75 10 2783.57 Re I MCS75 15 2819.95 Re I MCS75 50 2887.68 Re I MCS75 15 c 2902.48 Re I MCS75 10 2909.82 Re I MCS75 15 c 2927.42 Re I MCS75 8 2943.14 Re I MCS75 13 2965.11 Re I MCS75 25 2965.76 Re I MCS75 30 2992.36 Re I MCS75 100 P 2999.60 Re I MCS75 9 3016.02 Re I MCS75 7 3030.45 Re I MCS75 30 3067.40 Re I MCS75 6 3069.94 Re I MCS75 10 3082.43 Re I MCS75 13 3100.67 Re I MCS75 13 3108.81 Re I MCS75 8 3128.94 Re I MCS75 8 3151.64 Re I MCS75 13 3168.37 Re I MCS75 11 3182.87 Re I MCS75 20 3184.76 Re I MCS75 20 3185.57 Re I MCS75 20 c 3204.25 Re I MCS75 7 3235.94 Re I MCS75 11 3258.85 Re I MCS75 11 3259.55 Re I MCS75 50 3303.21 Re II MCS75 11 3322.48 Re I MCS75 40 3338.18 Re I MCS75 30 3342.24 Re I MCS75 15 3344.32 Re I MCS75 50 3379.06 Re II MCS75 70 P 3399.30 Re I MCS75 12 3404.72 Re I MCS75 12 3405.89 Re I MCS75 15 3419.41 Re I MCS75 150 P 3424.62 Re I MCS75 7 3426.19 Re I MCS75 300 P ,c 3451.88 Re I MCS75 1000 P ,c 3460.46 Re I MCS75 700 P ,c 3464.73 Re I MCS75 7 3467.96 Re I MCS75 7 3480.38 Re I MCS75 10 3503.06 Re I MCS75 140 P ,c 3580.15 Re II MCS75 12 3580.97 Re I MCS75 15 3583.02 Re I MCS75 15 3637.84 Re I MCS75 8 3651.97 Re I MCS75 15 c 3689.50 Re I MCS75 25 c 3691.48 Re I MCS75 9 3703.24 Re I MCS75 70 P 3725.76 Re I MCS75 15 3735.31 Re I MCS75 15 3740.10 Re I MCS75 13 3787.52 Re I MCS75 10 3929.85 Re I MCS75 30 4136.45 Re I MCS75 13 4144.36 Re I MCS75 12 4221.08 Re I MCS75 70 c 4227.46 Re I MCS75 7 4358.69 Re I MCS75 50 4513.31 Re I MCS75 9 4522.73 Re I MCS75 40 c,w 4889.14 Re I MCS75 25 5270.95 Re I MCS75 30 c,w 5275.56 Re I MCS75 10 5834.31 Re I MCS75

Strong Lines of Tungsten (W)

Strong Lines of Tungsten (W)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 1000 P 1951.051 W II EKM00 900 P 1962.140 W II EKM00 600 1977.524 W II EKM00 600 1982.907 W II EKM00 900 P 1989.394 W II EKM00 500 1990.863 W II EKM00 Air 400 P 2001.712 W II EKM00 800 P 2008.095 W II EKM00 300 P 2009.982 W II EKM00 250 2010.236 W II EKM00 250 2014.238 W II EKM00 500 P 2026.088 W II EKM00 900 P 2029.995 W II EKM00 150 2035.043 W II EKM00 300 2049.636 W II EKM00 140 2065.573 W II EKM00 200 2071.208 W II EKM00 140 2075.590 W II EKM00 600 P 2079.118 W II EKM00 600 P 2079.120 W II EKM00 200 2088.204 W II EKM00 140 2089.156 W II EKM00 200 2090.48 W I MCS75 400 P 2094.751 W II EKM00 150 2098.602 W II EKM00 140 2100.675 W II EKM00 150 2101.54 W I MCS75 90 2106.187 W II EKM00 80 2110.323 W II EKM00 130 2118.874 W II EKM00 150 2121.576 W II EKM00 50 2153.558 W II EKM00 50 2157.796 W II EKM00 90 2166.316 W II EKM00 60 2182.90 W I MCS75 30 2194.528 W II EKM00 80 P 2204.483 W II EKM00 30 P 2248.758 W II EKM00 50 2249.80 W I MCS75 60 2277.58 W I MCS75 60 d 2294.49 W I MCS75 50 2313.17 W I MCS75 50 2321.63 W I MCS75 70 2360.44 W I MCS75 100 2363.07 W I MCS75 60 2374.47 W I MCS75 80 2384.82 W I MCS75 50 2397.107 W II EKM00 70 2397.73 W I MCS75 70 2397.98 W I MCS75 200 d 2405.58 W I MCS75 70 2415.68 W I MCS75 100 2424.21 W I MCS75 70 2431.08 W I MCS75 70 2433.98 W I MCS75 200 2435.96 W I MCS75 70 2444.06 W I MCS75 50 2451.476 W II EKM00 100 2452.00 W I MCS75 50 2454.72 W I MCS75 70 2454.98 W I MCS75 90 2455.51 W I MCS75 90 2456.53 W I MCS75 130 2459.30 W I MCS75 60 2462.79 W I MCS75 150 2466.85 W I MCS75 60 2472.51 W I MCS75 140 2474.15 W I MCS75 100 2480.13 W I MCS75 50 2480.96 W I MCS75 150 2481.44 W I MCS75 60 d 2482.10 W I MCS75 70 2484.74 W I MCS75 50 2487.50 W I MCS75 25 2489.231 W II EKM00 70 2495.26 W I MCS75 80 2504.70 W I MCS75 90 2521.32 W I MCS75 90 2523.41 W I MCS75 50 2527.76 W I MCS75 90 2533.64 W I MCS75 70 2545.34 W I MCS75 140 2547.14 W I MCS75 90 2550.38 W I MCS75 300 P 2551.35 W I MCS75 50 2553.82 W I MCS75 25 P 2554.853 W II EKM00 40 P 2555.095 W II EKM00 80 2561.97 W I MCS75 30 2571.444 W II EKM00 100 2580.49 W I MCS75 25 2589.160 W II EKM00 80 2606.39 W I MCS75 110 2613.08 W I MCS75 60 2613.82 W I MCS75 50 2620.25 W I MCS75 50 2622.21 W I MCS75 50 2625.22 W I MCS75 50 2632.48 W I MCS75 50 2632.70 W I MCS75 90 2633.13 W I MCS75 50 d 2638.62 W I MCS75 80 2646.18 W I MCS75 50 2646.73 W I MCS75 200 2656.54 W I MCS75 50 2657.38 W I MCS75 25 d 2658.032 W II EKM00 90 2662.84 W I MCS75 90 2671.47 W I MCS75 80 2677.28 W I MCS75 50 2678.88 W I MCS75 250 P 2681.42 W I MCS75 80 2695.67 W I MCS75 13 2697.710 W II EKM00 80 2699.59 W I MCS75 50 2700.01 W I MCS75 50 2706.58 W I MCS75 50 2708.59 W I MCS75 50 d 2708.80 W I MCS75 50 2715.50 W I MCS75 250 2718.91 W I MCS75 300 P 2724.35 W I MCS75 50 2725.03 W I MCS75 80 2748.84 W I MCS75 50 2762.34 W I MCS75 25 P 2764.261 W II EKM00 50 2769.74 W I MCS75 90 2770.88 W I MCS75 90 2774.00 W I MCS75 90 2774.48 W I MCS75 90 2792.70 W I MCS75 50 2799.93 W I MCS75 90 2818.06 W I MCS75 200 P 2831.38 W I MCS75 90 2833.63 W I MCS75 50 2841.57 W I MCS75 90 2848.02 W I MCS75 80 2856.03 W I MCS75 80 2866.06 W I MCS75 70 2879.11 W I MCS75 70 2879.40 W I MCS75 50 2896.01 W I MCS75 150 P 2896.44 W I MCS75 80 2935.00 W I MCS75 300 P 2944.40 W I MCS75 300 P 2946.99 W I MCS75 60 2947.39 W I MCS75 13 2952.268 W II EKM00 50 2964.52 W I MCS75 60 2977.11 W I MCS75 80 d 2979.71 W I MCS75 50 2993.61 W I MCS75 60 3016.47 W I MCS75 90 3017.44 W I MCS75 50 d 3041.73 W I MCS75 50 3046.44 W I MCS75 90 3049.69 W I MCS75 60 3207.25 W I MCS75 120 P 3215.56 W I MCS75 80 3300.82 W I MCS75 50 3311.38 W I MCS75 50 3326.20 W I MCS75 50 3331.69 W I MCS75 50 3373.75 W I MCS75 50 3495.24 W I MCS75 80 3545.22 W I MCS75 200 P 3617.52 W I MCS75 15 3641.408 W II EKM00 80 3682.08 W I MCS75 50 3683.30 W I MCS75 70 3688.06 W I MCS75 90 3707.92 W I MCS75 60 3757.92 W I MCS75 80 3760.13 W I MCS75 120 3768.45 W I MCS75 12

Strong Lines of Gold (Au)

Strong Lines of Gold (Au)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 600 P 1224.592 Au II RW97 600 1229.901 Au II RW97 9 h 1328.374 Au I BG78 400 1355.616 Au II RW97 400 P 1362.326 Au II RW97 9 1408.451 Au I BG78 9 1481.764 Au I BG78 500 1486.547 Au II RW97 20 1587.158 Au I BG78 9 1624.335 Au I BG78 14 P 1646.674 Au I BG78 9 1665.755 Au I BG78 20 P 1699.339 Au I BG78 600 1740.475 Au II RW97 600 1783.200 Au II RW97 9 1879.829 Au I BG78 Air 150 2000.792 Au II RW97 1000 P 2012.00 Au I MCS75 250 P 2021.38 Au I MCS75 150 2044.587 Au II RW97 400 P 2082.077 Au II RW97 500 P 2110.685 Au II RW97 200 2228.915 Au II RW97 400 2248.562 Au II RW97 700 P 2263.627 Au II RW97 250 2304.684 Au II RW97 15 2352.65 Au I MCS75 11 2387.75 Au I MCS75 250 P 2427.95 Au I MCS75 400 2533.518 Au II RW97 100 2552.658 Au II RW97 400 2616.393 Au II RW97 25 2641.480 Au I ED71 300 P 2675.954 Au I ED71 100 P 2748.253 Au I ED71 9 2780.822 Au I ED71 600 P 2802.036 Au II RW97 200 2819.793 Au II RW97 1000 P 2822.546 Au II RW97 400 h 2825.437 Au II RW97 120 2837.848 Au II RW97 400 2846.920 Au II RW97 25 2883.446 Au I ED71 25 2891.961 Au I ED71 400 P 2893.247 Au II RW97 20 2907.042 Au II RW97 40 2913.517 Au II RW97 400 P 2918.235 Au II RW97 200 2954.222 Au II RW97 200 h 2990.268 Au II RW97 400 P 2994.800 Au II RW97 30 P 3029.204 Au I ED71 25 3065.424 Au I ED71 150 P 3122.784 Au I ED71 9 3194.720 Au I ED71 25 3230.632 Au I ED71 25 3308.305 Au I ED71 25 3309.638 Au I ED71 25 3557.365 Au I ED71 25 3586.731 Au I ED71 9 3611.568 Au I ED71 9 h 3631.311 Au I ED71 25 3637.905 Au I ED71 9 h 3645.016 Au I ED71 9 3650.739 Au I ED71 9 3709.622 Au I ED71 9 3796.007 Au I ED71 40 3897.865 Au I ED71 25 3909.383 Au I ED71 40 4040.931 Au I ED71 60 4065.068 Au I ED71 20 4315.110 Au I ED71 11 h 4437.269 Au I ED71 25 4488.253 Au I ED71 80 h 4607.512 Au I ED71 50 4792.583 Au I ED71 25 5230.259 Au I ED71 25 5837.374 Au I ED71 25 h 5956.965 Au I ED71 50 P 6278.170 Au I ED71 9 6562.680 Au I ED71 50 7510.728 Au I ED71

Strong Lines of Mercury (Hg)

Strong Lines of Mercury (Hg)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 20 893.0847 Hg II SR01 12 915.819 Hg II SR01 20 942.630 Hg II SR01 25 962.711 Hg II SR01 25 969.142 Hg II SR01 20 1039.6315 Hg II SR01 20 1062.7802 Hg II SR01 1000 P 1649.9373 Hg II SR01 1000 P 1849.499 Hg I WA63 1000 P 1942.273 Hg II SR01 15 1973.794 Hg II SR01 10 1987.841 Hg II SR01 Air 20 2026.860 Hg II SR01 400 P 2052.828 Hg II SR01 20 2224.711 Hg II SR01 10 2252.786 Hg II SR01 60 2260.294 Hg II SR01 400 P 2262.223 Hg II SR01 10 2263.634 Hg II SR01 1000 P ,c 2536.517 Hg I BAL50 25 2652.039 Hg I BAL50 40 2653.679 Hg I BAL50 400 P 2847.675 Hg II SR01 30 2916.250 Hg II SR01 25 2947.074 Hg II SR01 250 P 2967.280 Hg I BAL50 70 3021.498 Hg I BAL50 90 3125.668 Hg I BAL50 80 3131.548 Hg I BAL50 80 3131.839 Hg I BAL50 12 3208.169 Hg II SR01 10 3532.594 Hg II SR01 10 3605.762 Hg II SR01 600 P 3650.153 Hg I BAL50 70 3654.836 Hg I BAL50 50 3663.279 Hg I BAL50 1000 P ,c 3983.931 Hg II SR01 400 P 4046.563 Hg I BAL50 60 4339.223 Hg I BAL50 100 4347.494 Hg I BAL50 1000 P 4358.328 Hg I BAL50 12 c 5128.442 Hg II SR01 15 5204.768 Hg II SR01 80 P 5425.253 Hg II SR01 500 P 5460.735 Hg I BAL50 200 P 5677.105 Hg II SR01 50 5769.598 Hg I BAL50 60 5790.663 Hg I BAL50 12 5871.279 Hg II SR01 20 c 5888.939 Hg II SR01 15 6146.435 Hg II SR01 250 P ,c 6149.475 Hg II SR01 25 7081.90 Hg I F54 6 7346.508 Hg II SR01 250 P 7944.555 Hg II SR01 6 h 9520.198 Hg II SR01 200 P 10139.76 Hg I BAL50 50 13570.21 Hg I H53 40 13673.51 Hg I H53 50 15295.82 Hg I H53 50 17072.79 Hg I H53 25 23253.07 Hg I PBT55

Strong Lines of Platinum (Pt)

Strong Lines of Platinum (Pt)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 30 1164.4184 Pt II SRSA92 30 1166.8635 Pt II SRSA92 90 1169.7477 Pt II SRSA92 80 1178.9614 Pt II SRSA92 30 1182.3552 Pt II SRSA92 60 1186.2203 Pt II SRSA92 60 1193.4484 Pt II SRSA92 70 1198.7745 Pt II SRSA92 110 1219.4931 Pt II SRSA92 40 1229.0134 Pt II SRSA92 40 1232.8739 Pt II SRSA92 90 1238.8499 Pt II SRSA92 200 1248.6069 Pt II SRSA92 40 1264.5677 Pt II SRSA92 40 1271.7939 Pt II SRSA92 30 1283.6978 Pt II SRSA92 70 1289.9515 Pt II SRSA92 30 1290.0131 Pt II SRSA92 30 1290.0131 Pt II SRSA92 30 1292.7998 Pt II SRSA92 50 1302.4578 Pt II SRSA92 40 1303.1187 Pt II SRSA92 40 1327.4314 Pt II SRSA92 40 1348.8300 Pt II SRSA92 30 1352.9768 Pt II SRSA92 30 1363.3059 Pt II SRSA92 30 1364.1171 Pt II SRSA92 30 1373.1724 Pt II SRSA92 120 1378.9572 Pt II SRSA92 100 1382.0460 Pt II SRSA92 200 1403.9006 Pt II SRSA92 80 1429.5248 Pt II SRSA92 40 1447.8030 Pt II SRSA92 30 1454.2866 Pt II SRSA92 30 1454.2866 Pt II SRSA92 40 1461.0786 Pt II SRSA92 40 1462.6591 Pt II SRSA92 60 1475.6306 Pt II SRSA92 150 1482.8256 Pt II SRSA92 25 1491.9735 Pt II SRSA92 200 1494.7256 Pt II SRSA92 100 1498.1132 Pt II SRSA92 200 1499.3707 Pt II SRSA92 140 1505.2462 Pt II SRSA92 110 1506.2923 Pt II SRSA92 30 1507.6288 Pt II SRSA92 600 1509.2920 Pt II SRSA92 30 1520.7414 Pt II SRSA92 150 1524.5715 Pt II SRSA92 900 1524.7295 Pt II SRSA92 900 1524.7295 Pt II SRSA92 80 1528.2831 Pt II SRSA92 60 1530.1969 Pt II SRSA92 100 1534.9063 Pt II SRSA92 50 1540.5040 Pt II SRSA92 60 l 1541.8337 Pt II SRSA92 30 1542.7098 Pt II SRSA92 40 1546.8248 Pt II SRSA92 110 1552.3268 Pt II SRSA92 200 1554.9285 Pt II SRSA92 30 1558.3479 Pt II SRSA92 40 1559.3893 Pt II SRSA92 40 1561.5450 Pt II SRSA92 40 1561.5450 Pt II SRSA92 30 1568.9021 Pt II SRSA92 30 1573.1802 Pt II SRSA92 40 1573.8180 Pt II SRSA92 200 1574.3059 Pt II SRSA92 80 1579.4357 Pt II SRSA92 90 1581.3980 Pt II SRSA92 40 1587.7205 Pt II SRSA92 40 1589.3735 Pt II SRSA92 40 1594.0344 Pt II SRSA92 40 1594.2611 Pt II SRSA92 9 1604.0102 Pt I SRSA92 80 l 1621.6590 Pt II SRSA92 80 1631.0903 Pt II SRSA92 120 1634.2337 Pt II SRSA92 25 1636.1647 Pt I SRSA92 8 1644.4634 Pt I SRSA92 50 1659.4860 Pt II SRSA92 200 1669.2312 Pt II SRSA92 20 1677.8443 Pt I SRSA92 50 1684.5867 Pt II SRSA92 50 1684.5867 Pt II SRSA92 7 1690.7825 Pt I SRSA92 30 1698.4958 Pt II SRSA92 80 1707.0710 Pt II SRSA92 40 1713.8364 Pt II SRSA92 7 1714.4801 Pt I SRSA92 150 1723.1314 Pt II SRSA92 50 1727.6799 Pt II SRSA92 90 1735.8642 Pt II SRSA92 14 1737.1732 Pt I SRSA92 10 1744.4305 Pt I SRSA92 120 1753.8286 Pt II SRSA92 120 1753.8286 Pt II SRSA92 14 1764.5948 Pt I SRSA92 25 1766.0328 Pt II SRSA92 120 1767.1612 Pt II SRSA92 200 1775.0160 Pt II SRSA92 40 1776.5571 Pt I SRSA92 600 P 1777.0866 Pt II SRSA92 20 1777.2783 Pt I SRSA92 250 1781.8617 Pt II SRSA92 30 1785.8803 Pt II SRSA92 25 1786.6480 Pt I SRSA92 20 1802.9398 Pt I SRSA92 20 1812.8819 Pt I SRSA92 15 1817.8736 Pt I SRSA92 8 1825.3262 Pt I SRSA92 13 1826.1377 Pt I SRSA92 25 1833.3875 Pt II SRSA92 40 1835.0745 Pt II SRSA92 80 1836.5075 Pt II SRSA92 30 1838.8246 Pt II SRSA92 80 1839.5258 Pt II SRSA92 25 1845.7517 Pt I SRSA92 13 1849.6831 Pt I SRSA92 9 1853.4523 Pt I SRSA92 40 1853.4523 Pt II SRSA92 80 1867.1302 Pt II SRSA92 90 1870.4100 Pt II SRSA92 30 1871.1038 Pt II SRSA92 70 1879.1031 Pt II SRSA92 600 P 1883.0587 Pt II SRSA92 30 1885.8171 Pt II SRSA92 140 1889.5226 Pt II SRSA92 30 1895.0088 Pt II SRSA92 30 1897.5769 Pt II SRSA92 40 1898.1722 Pt II SRSA92 30 1899.0445 Pt II SRSA92 15 1903.2186 Pt I SRSA92 400 P 1911.7092 Pt II SRSA92 40 1928.4320 Pt II SRSA92 250 P 1929.2449 Pt II SRSA92 40 1929.6829 Pt II SRSA92 50 1934.3690 Pt I SRSA92 100 1937.4245 Pt I SRSA92 130 l 1939.8110 Pt II SRSA92 20 1940.0319 Pt I SRSA92 150 1944.4617 Pt II SRSA92 40 1949.9102 Pt II SRSA92 30 1954.7436 Pt II SRSA92 11 1963.1429 Pt I SRSA92 13 1969.6807 Pt I SRSA92 30 1971.5374 Pt I SRSA92 50 1978.8444 Pt II SRSA92 25 1979.7647 Pt I SRSA92 40 1983.7486 Pt II SRSA92 9 1987.7868 Pt I SRSA92 15 1989.1056 Pt I SRSA92 80 1990.5751 Pt II SRSA92 8 1991.5830 Pt I SRSA92 11 1995.8991 Pt I SRSA92 Air 140 2007.7572 Pt II SRSA92 200 2014.9330 Pt II SRSA92 9 2020.5434 Pt I SRSA92 20

Strong Lines of Thallium (Tl)

Strong Lines of Thallium (Tl)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 500 r 696.30 Tl II ES36 300 r 817.18 Tl II ES36 500 r 1162.55 Tl II ES36 500 r 1307.50 Tl II ES36 800 P ,r 1321.644 Tl II JKBL96 500 r 1561.58 Tl II ES36 300 P ,r 1792.827 Tl II JKBL96 400 P ,r 1814.776 Tl II JKBL96 700 1881.121 Tl II JKBL96 800 P ,r 1908.617 Tl II JKBL96 Air 5 r 2007.56 Tl I C52 5 r 2210.71 Tl I C52 1000 P 2298.058 Tl II JKBL96 7 2315.98 Tl I MCS75 40 P ,h 2379.69 Tl I MCS75 700 P 2530.740 Tl II JKBL96 40 P 2580.14 Tl I MCS75 20 2709.23 Tl I MCS75 200 P ,d 2767.87 Tl I MCS75 14 2826.16 Tl I MCS75 140 P 2918.32 Tl I MCS75 20 2921.52 Tl I MCS75 700 P 3091.570 Tl II JKBL96 500 3185.51 Tl II ES36 500 3186.56 Tl II ES36 500 3187.74 Tl II ES36 60 P 3229.75 Tl I MCS75 500 3291.01 Tl II ES36 500 3369.15 Tl II ES36 1000 P 3519.24 Tl I MCS75 250 P 3529.43 Tl I MCS75 600 P ,c,w 3775.72 Tl I MCS75 700 4274.98 Tl II ES36 1000 4306.80 Tl II ES36 700 4737.05 Tl II ES36 500 4981.35 Tl II ES36 800 P 5078.54 Tl II ES36 800 P 5152.14 Tl II ES36 900 P 5350.46 Tl I MCS75 500 d 5384.85 Tl II ES36 800 P 5949.48 Tl II ES36 700 9130. Tl II ES36 1 9130.5 Tl I MM52 50 P 11512.82 Tl I MM52 40 P 13013.2 Tl I MM52

Strong Lines of Actinium (Ac)

Strong Lines of Actinium (Ac)

Intensity Wavelength (Å) Spectrum Ref. Air 100 h 2847.16 Ac II MFT57 130 2994.17 Ac II MFT57 300 3043.30 Ac II MFT57 130 3069.36 Ac II MFT57 130 3112.83 Ac II MFT57 300 s 3153.09 Ac II MFT57 300 s 3154.41 Ac II MFT57 150 s 3164.81 Ac II MFT57 130 s 3230.59 Ac II MFT57 300 3260.91 Ac II MFT57 130 s 3383.53 Ac II MFT57 130 3413.84 Ac II MFT57 200 3417.77 Ac II MFT57 300 s 3481.16 Ac II MFT57 130 3489.53 Ac II MFT57 130 s 3554.99 Ac II MFT57 700 P ,s 3565.59 Ac II MFT57 150 s 3756.67 Ac II MFT57 70 3799.82 Ac II MFT57 700 P ,s 3863.12 Ac II MFT57 400 P 3885.56 Ac I MFT57 200 4034.63 Ac I MFT57 150 s 4061.60 Ac II MFT57 200 4063.10 Ac I MFT57 1000 P ,s 4088.44 Ac II MFT57 700 P ,s 4168.40 Ac II MFT57 1000 P 4179.98 Ac I MFT57 500 P 4183.12 Ac I MFT57 400 P 4194.40 Ac I MFT57 100 s 4209.69 Ac II MFT57 130 4359.13 Ac II MFT57 300 P ,l 4384.53 Ac I MFT57 500 P ,l 4386.41 Ac II MFT57 400 P 4396.71 Ac I MFT57 400 P 4462.73 Ac I MFT57 700 P ,l 4507.20 Ac II MFT57 300 4605.45 Ac II MFT57 300 P 4613.93 Ac I MFT57 200 4705.78 Ac I MFT57 500 P 4716.58 Ac I MFT57 300 s 4720.16 Ac II MFT57 200 4812.22 Ac II MFT57 300 P 5258.24 Ac I MFT57 200 5569.26 Ac I MFT57 70 l 5732.05 Ac II MFT57 130 5758.97 Ac II MFT57 300 P 5910.85 Ac II MFT57 200 l 6164.75 Ac II MFT57 30 l 6167.83 Ac II MFT57 100 6242.83 Ac II MFT57 300 P 6359.86 Ac I MFT57 200 P ,l 6691.27 Ac I MFT57 300 P 7290.40 Ac I MFT57 200 l 7866.10 Ac I MFT57

Strong Lines of Astatine (At)

Strong Lines of Astatine (At)

Intensity Wavelength (Å) Spectrum Ref. Air 800 P 2162.25 At I M64a 1000 P 2244.01 At I M64a

Strong Lines of Bismuth (Bi)

Strong Lines of Bismuth (Bi)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 400 P 1241.045 Bi II WBBF01 300 P 1283.715 Bi II WBBF01 400 P 1436.810 Bi II WBBF01 500 1455.091 Bi II WBBF01 400 1486.954 Bi II WBBF01 400 1520.549 Bi II WBBF01 400 1533.139 Bi II WBBF01 300 1536.745 Bi II WBBF01 400 1538.037 Bi II WBBF01 400 1573.69 Bi II WBBF01 600 P 1591.76 Bi II WBBF01 400 1609.69 Bi II WBBF01 400 1611.358 Bi II WBBF01 800 P 1777.05 Bi II WBBF01 600 1787.406 Bi II WBBF01 700 P 1791.842 Bi II WBBF01 700 P 1823.728 Bi II WBBF01 1000 P 1902.341 Bi II WBBF01 300 P 1954.706 Bi I WBBF01 250 P 1960.049 Bi I WBBF01 Air 250 P 2021.149 Bi I WBBF01 300 P 2061.634 Bi I WBBF01 400 h 2068.937 Bi II WBBF01 200 P 2110.217 Bi I WBBF01 120 2133.600 Bi I WBBF01 600 P 2186.930 Bi II DLW02 400 h 2214.031 Bi II DLW02 120 P 2228.203 Bi I WBBF01 600 P 2230.602 Bi I WBBF01 600 P 2368.384 Bi II DLW02 80 2627.904 Bi I WBBF01 50 2780.476 Bi I WBBF01 500 P 2897.965 Bi I WBBF01 400 P 2938.297 Bi I WBBF01 300 P 2989.019 Bi I GMV85 80 P 2993.336 Bi I GMV85 300 P 3024.621 Bi I GMV85 1000 P ,c 3067.700 Bi I WBBF01 70 c 3397.198 Bi I GMV85 400 c 3430.605 Bi II DLW02 60 c 3510.864 Bi I GMV85 50 c 3596.097 Bi I GMV85 700 P 3792.564 Bi II DLW02 300 3864.025 Bi II DLW02 400 h 4079.072 Bi II DLW02 800 P ,h 4259.413 Bi II DLW02 700 P ,h 4301.697 Bi II DLW02 600 P ,h 4705.285 Bi II DLW02 70 P ,c 4722.527 Bi I GMV85 300 4730.267 Bi II DLW02 500 P ,h 5124.356 Bi II DLW02 600 P ,h 5144.492 Bi II DLW02 800 P ,h 5209.325 Bi II DLW02 400 h 5270.512 Bi II DLW02 400 h 5719.138 Bi II DLW02 400 h 6600.339 Bi II DLW02 500 h 6809.196 Bi II DLW02 300 8532. Bi II CM34 70 P ,d 9657.04 Bi I GMV85 50 P ,d 11710.83 Bi I GMV85

Strong Lines of Francium (Fr)

Strong Lines of Francium (Fr)

Intensity Wavelength (Å) Spectrum Ref. Air 4225.655 Fr I ABDJ90 4325.361 Fr I ABDJ90 7179.866 Fr I ABDJ90 8169.418 Fr I ABDJ90

Strong Lines of Lead (Pb)

Strong Lines of Lead (Pb)

Intensity Wavelength (Å) Spectrum Ref. Vacuum 200 1060.619 Pb II WRSH74 200 1121.325 Pb II WRSH74 1000 P 1433.906 Pb II KT96 1000 P 1512.298 Pb II KT96 500 1671.553 Pb II KT96 500 1682.127 Pb II KT96 600 P 1726.802 Pb II KT96 400 1796.669 Pb II KT96 1000 P 1822.052 Pb II KT96 Air 200 P 2022.016 Pb I WA68 200 P 2053.284 Pb I WA68 150 P ,r 2170.005 Pb I WA68 500 P 2203.534 Pb II WRSH74 50 P ,r 2393.792 Pb I WA68 20 r 2401.940 Pb I WA68 4 r 2411.734 Pb I WA68 15 r 2613.655 Pb I WA68 200 P ,r 2614.175 Pb I WA68 90 2663.154 Pb I WA68 300 P ,r 2801.995 Pb I WA68 120 r 2823.189 Pb I WA68 300 P ,r 2833.053 Pb I WA68 120 r 2873.311 Pb I WA68 100 c 3016.387 Pb II WRSH74 2 3220.528 Pb I WA68 2 3240.186 Pb I WA68 1 3262.355 Pb I WA68 30 3572.729 Pb I WA68 150 P ,r 3639.568 Pb I WA68 10 3671.491 Pb I WA68 400 P ,r 3683.462 Pb I WA68 50 3713.982 Pb II WRSH74 80 P 3739.935 Pb I WA68 12 4019.632 Pb I WA68 1000 P 4057.807 Pb I WA68 15 P 4062.136 Pb I WA68 50 4152.82 Pb II WRSH74 4 4168.033 Pb I WA68 100 P ,c 4244.92 Pb II WRSH74 50 4352.74 Pb II WRSH74 100 P ,c 4386.46 Pb II WRSH74 50 4579.051 Pb II WRSH74 50 4582.27 Pb II WRSH74 3 5005.416 Pb I WA68 250 P 5042.58 Pb II WRSH74 50 5070.58 Pb II WRSH74 50 5074.53 Pb II WRSH74 50 5111.64 Pb II WRSH74 1 5201.437 Pb I WA68 50 5367.64 Pb II WRSH74 50 5372.099 Pb II WRSH74 50 c 5544.25 Pb II WRSH74 100 P ,c 5608.85 Pb II WRSH74 6 5895.624 Pb I WA68 5 6001.862 Pb I WA68 200 P 6075.74 Pb II WRSH74 200 P 6081.409 Pb II WRSH74 50 6159.89 Pb II S75 250 P ,c 6660.20 Pb II WRSH74 100 7193.60 Pb II S75 4 7228.965 Pb I WA68 50 7558.97 Pb II S75 50 7632.56 Pb II S75 50 8395.68 Pb II WRSH74 50 9050.82 Pb II WRSH74 50 9063.43 Pb II WRSH74 2 10290.458 Pb I WA68 1 10498.965 Pb I WA68

Strong Lines of Polonium (Po)

Strong Lines of Polonium (Po)

Intensity Wavelength (Å) Spectrum Ref. Air 600 P ,w 2450.08 Po I C66a 300 2483.94 Po I C66a 300 2490.53 Po I C66a 600 P ,w 2558.01 Po I C66a 300 h 2663.33 Po CHPT55 250 2761.92 Po I C66a 250 2958.92 Po I C66a 1000 P ,w 3003.21 Po I C66a 250 3328.60 Po I C66a 500 P 4170.52 Po I C66a 300 4493.21 Po I C66a 250 7962.62 Po I C66a

Strong Lines of Radium (Ra)

Strong Lines of Radium (Ra)

Intensity Wavelength (Å) Spectrum Ref. Air 100 2708.96 Ra II R34a 150 P 2813.76 Ra II R34a 500 P 3649.55 Ra II R34a 1000 P 3814.42 Ra II R34a 500 P 4340.64 Ra II R34a 100 4436.27 Ra II R34a 150 P 4533.11 Ra II R34a 500 P 4682.28 Ra II R34a 1000 P 4825.91 Ra I R34b 200 5400.23 Ra I R34b 200 5406.81 Ra I R34b 200 5555.85 Ra I R34b 500 P 5660.81 Ra I R34b 100 5813.63 Ra II R34a 300 P 6200.30 Ra I R34b 200 6446.20 Ra I R34b 200 6487.32 Ra I R34b 200 6980.22 Ra I R34b 200 7118.50 Ra I R34b 500 P 7141.21 Ra I R34b 200 7225.16 Ra I R34b 200 7838.12 Ra I R34b 250 P 8019.70 Ra II R34a

Strong Lines of Radon (Rn)

Strong Lines of Radon (Rn)

Intensity Wavelength (Å) Spectrum Ref. Vacuum P 1451.56 Rn I R30 P 1786.07 Rn I R30 Air 70 3753.65 Rn I R33 250 4307.76 Rn I R33 300 P 4349.60 Rn I R33 150 4459.25 Rn I R33 150 4508.48 Rn I R33 150 4577.72 Rn I R33 150 4609.38 Rn I R33 100 4721.76 Rn I R33 50 6627.23 Rn I R33 70 6751.81 Rn I R33 700 P 7055.42 Rn I R33 300 P 7268.11 Rn I R33 70 7291.00 Rn I R33 1000 P 7450.00 Rn I R33 70 7746.64 Rn I R33 300 P 7809.82 Rn I R33 70 8049.00 Rn I R33 300 P 8099.51 Rn I R33 300 P 8270.96 Rn I R33 70 8520.95 Rn I R33 300 P 8600.07 Rn I R33 50 8675.83 Rn I R33 150 9327.02 Rn I R33

Strong Lines of Neptunium (Np)

Strong Lines of Neptunium (Np)

Intensity Wavelength (Å) Spectrum Ref. Air 300 P 3481.93 Np I FTBC76 300 P ,h 3501.50 Np I FTBC76 300 P ,l 3986.89 Np I FTBC76 300 P ,s 5044.66 Np I FTBC76 1000 P 5380.98 Np II FTBC76 300 P ,l 5878.04 Np I FTBC76 300 P ,s 6930.31 Np I FTBC76 1000 P ,s 6972.09 Np I FTBC76 300 P ,l 7735.14 Np I FTBC76 300 P ,l 7765.75 Np I FTBC76 300 P ,l 7791.38 Np I FTBC76 300 P ,l 8339.12 Np I FTBC76 1000 P 8372.88 Np I FTBC76 1000 P 8529.96 Np I FTBC76 300 s 8696.23 Np I FTBC76 300 s 8906.02 Np I FTBC76 300 8942.70 Np I FTBC76 300 s 9004.75 Np I FTBC76 300 l 9006.31 Np I FTBC76 1000 P ,l 9016.18 Np I FTBC76 300 l 9141.30 Np I FTBC76 300 P ,s 9379.33 Np I FTBC76 300 P ,l 9468.66 Np I FTBC76 300 s 9679.13 Np I FTBC76 300 l 9930.55 Np I FTBC76 300 P ,l 10091.99 Np I FTBC76 300 P ,s 10817.45 Np I FTBC76 300 l 11695.15 Np I FTBC76 300 P ,l 11776.64 Np I FTBC76 300 s 12148.18 Np I FTBC76 300 P ,s 12377.42 Np I FTBC76 300 l 12407.99 Np I FTBC76 300 l 13834.33 Np I FTBC76

Strong Lines of Protactinium (Pa)

Strong Lines of Protactinium (Pa)

Intensity Wavelength (Å) Spectrum Ref. Air 300 h 2492.85 Pa II BW92b 300 2599.16 Pa II BW92b 300 2699.22 Pa II BW92b 300 2822.792 Pa II G67 300 l 2832.14 Pa II BW92b 300 2870.005 Pa II G67 300 h 2871.413 Pa II G67 300 h 2891.139 Pa II G67 300 h 2906.93 Pa II BW92b 300 l 3011.10 Pa II BW92b 300 s 3033.59 Pa II BW92b 300 l 3071.24 Pa II BW92b 300 l 3093.23 Pa II BW92b 300 l 3126.23 Pa II BW92b 300 l 3146.28 Pa II BW92b 300 l 3170.89 Pa II BW92b 300 l 3171.54 Pa II BW92b 300 l 3240.58 Pa II BW92b 300 3274.46 Pa II BW92b 300 l 3332.69 Pa II BW92b 300 s 3346.661 Pa II G67 300 l 3394.49 Pa II BW92b 300 l 3452.82 Pa II BW92b 300 3504.97 Pa I BW92b 300 s 3530.65 Pa II BW92b 300 3570.56 Pa I BW92b 300 3571.82 Pa I BW92b 300 3618.07 Pa I BW92b 1000 P 3636.52 Pa I BW92b 300 3702.74 Pa I BW92b 300 3752.67 Pa I BW92b 300 3873.35 Pa I BW92b 300 3931.83 Pa I BW92b 300 s 3952.62 Pa II BW92b 1000 P ,l 3957.85 Pa II BW92b 300 s 3970.07 Pa II BW92b 300 3981.82 Pa I BW92b 1000 P 3982.23 Pa I BW92b 300 l 4012.96 Pa II BW92b 300 s 4018.21 Pa II BW92b 300 4030.16 Pa II BW92b 300 s 4046.93 Pa II BW92b 1000 P ,s 4056.20 Pa II BW92b 1000 P ,s 4070.40 Pa II BW92b 300 4117.62 Pa I BW92b 300 l 4176.18 Pa II BW92b 1000 P ,l 4217.23 Pa II BW92b 1000 P ,s 4248.083 Pa II G67 300 s 4291.345 Pa II G67 300 4400.77 Pa I BW92b 300 4436.13 Pa I BW92b 300 s 4601.43 Pa II BW92b 300 4628.19 Pa I BW92b 300 4820.34 Pa I BW92b 300 s 4861.49 Pa I BW92b 300 l 6035.78 Pa I BW92b 300 6162.56 Pa I BW92b 300 6216.35 Pa I BW92b 300 l 6358.61 Pa I BW92b 300 6379.25 Pa I BW92b 300 l 6438.97 Pa I BW92b 300 h 6792.75 Pa I BW92b 1000 P 6945.72 Pa I BW92b 300 6960.09 Pa I BW92b 300 h 6961.78 Pa I BW92b 300 s 6992.73 Pa I BW92b 300 7076.27 Pa I BW92b 300 h 7100.94 Pa I BW92b 1000 P ,s 7114.89 Pa I BW92b 300 h 7171.55 Pa I BW92b 300 7227.13 Pa I BW92b 300 7318.79 Pa I BW92b 1000 P ,l 7368.25 Pa I BW92b 300 h 7471.89 Pa I BW92b 1000 P ,h 7493.15 Pa I BW92b 300 h 7558.26 Pa I BW92b 1000 P ,h 7608.20 Pa I BW92b 1000 P 7626.79 Pa I BW92b 1000 P ,s 7635.18 Pa I BW92b 1000 P 7669.34 Pa I BW92b 300 7679.20 Pa I BW92b 1000 P ,h 7749.19 Pa I BW92b 300 7872.95 Pa I BW92b 300 l 7945.56 Pa I BW92b 1000 P 8039.34 Pa I BW92b 1000 P ,h 8099.84 Pa I BW92b 1000 P 8199.04 Pa I BW92b 1000 P 8271.87 Pa I BW92b 300 s 8358.98 Pa I BW92b 300 s 8369.60 Pa I BW92b 300 h 8441.04 Pa I BW92b 1000 P ,h 8532.66 Pa I BW92b 1000 P ,s 8572.96 Pa I BW92b 300 h 8639.91 Pa I BW92b 300 h 8653.51 Pa I BW92b 1000 P 8735.27 Pa I BW92b 300 10594.38 Pa I BW92b 300 10923.32 Pa I BW92b 300 11646.78 Pa I BW92b 1000 P 11791.73 Pa I BW92b 300 12279.01 Pa I BW92b 300 13234.09 Pa I BW92b 1000 P 13522.40 Pa I BW92b 1000 P 14344.76 Pa I BW92b 300 18478.61 Pa I BW92b

Strong Lines of Thorium (Th)

Strong Lines of Thorium (Th)

Intensity Wavelength (Å) Spectrum Ref. Air 120 2565.593 Th II GSZ70 90 2684.288 Th II GSZ70 110 2692.415 Th II Z79 120 2747.156 Th II Z79 100 2752.166 Th II GSZ70 200 2832.3154 Th II PE83 300 P 2837.2954 Th II PE83 80 2842.8127 Th II PE83 150 2848.0839 Th I PE83 130 2870.4066 Th II PE83 80 2884.2897 Th II PE83 90 2885.0491 Th II PE83 90 2887.8176 Th II PE83 150 2936.0846 Th I PE83 80 2942.8600 Th II PE83 150 2943.7288 Th I PE83 90 2988.2318 Th II PE83 90 3034.0654 Th II PE83 100 3049.0924 Th II PE83 110 3067.7294 Th II PE83 90 3072.1150 Th II PE83 150 3078.8280 Th II PE83 110 3080.2170 Th II PE83 120 3108.2968 Th II PE83 150 3116.2630 Th I PE83 120 3119.5262 Th II PE83 120 3122.9634 Th II PE83 90 3124.3874 Th II PE83 110 3125.5071 Th II PE83 150 3136.2161 Th I PE83 100 3139.3066 Th II PE83 100 3142.8356 Th II PE83 70 3146.0434 Th II PE83 70 3154.3009 Th II PE83 100 3175.7257 Th II PE83 250 P 3180.1937 Th II PE83 70 3184.9492 Th II PE83 200 3188.2329 Th II PE83 90 3192.5856 Th I PE83 90 3195.6891 Th I PE83 90 3214.3801 Th I PE83 130 3221.2912 Th II PE83 130 3229.0096 Th II PE83 110 3235.8400 Th II PE83 140 3238.1157 Th II PE83 200 3244.4488 Th I PE83 70 3251.9159 Th II PE83 200 3256.2738 Th II PE83 300 3257.3667 Th I PE83 200 3262.6684 Th II PE83 200 3272.0268 Th I PE83 200 3285.7525 Th I PE83 150 3287.7893 Th II PE83 200 3291.7394 Th II PE83 150 3292.5209 Th II PE83 400 3301.6511 Th I PE83 800 P 3304.2383 Th I PE83 200 3309.3654 Th I PE83 120 3321.4508 Th II PE83 90 3324.7527 Th II PE83 200 3325.1207 Th II PE83 400 3330.4770 Th I PE83 150 3334.6041 Th II PE83 150 3337.8703 Th II PE83 500 P 3348.7684 Th I PE83 250 P 3351.2286 Th II PE83 70 3354.1796 Th II PE83 150 3358.6020 Th II PE83 90 3367.8189 Th II PE83 400 3374.9749 Th I PE83 90 3378.5734 Th II PE83 200 3380.8595 Th I PE83 70 3385.5316 Th II PE83 70 3386.5006 Th II PE83 200 3387.9205 Th I PE83 300 P 3392.0349 Th II PE83 300 3396.7278 Th I PE83 400 3398.5448 Th I PE83 300 3405.5584 Th I PE83 400 3413.0130 Th I PE83 700 P 3421.2100 Th I PE83 500 3423.9897 Th I PE83 250 P 3433.9988 Th II PE83 200 3435.9771 Th II PE83 80 3438.9503 Th II PE83 200 3442.5790 Th I PE83 200 3451.7023 Th I PE83 80 3462.8505 Th II PE83 90 3468.2198 Th II PE83 300 P 3469.9208 Th II PE83 300 3471.2186 Th I PE83 120 3480.0525 Th I PE83 300 3486.5512 Th I PE83 150 3489.1841 Th I PE83 120 3496.8107 Th I PE83 200 3498.6210 Th I PE83 120 3503.7859 Th I PE83 200 3511.1574 Th I PE83 250 3518.4040 Th I PE83 120 3521.0595 Th I PE83 120 3526.6342 Th I PE83 250 3531.4505 Th I PE83 150 3539.5872 Th II PE83 300 3544.0179 Th I PE83 300 3549.5959 Th I PE83 250 3551.4019 Th I PE83 300 3555.0135 Th I PE83 130 3559.4500 Th II PE83 200 3563.3756 Th I PE83 120 3569.8204 Th I PE83 300 3576.5574 Th I PE83 150 3583.1022 Th I PE83 300 3589.7495 Th I PE83 500 3592.7794 Th I PE83 500 3598.1199 Th I PE83 90 3601.0344 Th II PE83 300 3608.3779 Th I PE83 250 P 3609.4452 Th II PE83 300 3612.4275 Th I PE83 110 3615.1327 Th II PE83 90 3617.1173 Th II PE83 90 3625.6280 Th II PE83 250 3632.8303 Th I PE83 500 3635.9433 Th I PE83 120 3638.6444 Th I PE83 400 3642.2490 Th I PE83 300 3649.7349 Th I PE83 150 3659.6294 Th I PE83 400 3663.2025 Th I PE83 250 3668.1398 Th I PE83 500 3669.9684 Th I PE83 150 3675.5675 Th II PE83 250 3682.4863 Th I PE83 150 3690.6238 Th I PE83 300 3692.5664 Th I PE83 300 3698.1061 Th I PE83 600 P 3706.7672 Th I PE83 70 3711.3041 Th II PE83 1000 P 3719.4347 Th I PE83 200 3721.8254 Th II PE83 200 3727.9027 Th I PE83 300 P 3741.1830 Th II PE83 70 3747.5390 Th II PE83 150 3752.5689 Th II PE83 250 3757.6941 Th I PE83 200 3765.2401 Th I PE83 300 3770.0560 Th I PE83 140 3776.2711 Th I PE83 80 3785.6002 Th II PE83 150 3789.1679 Th I PE83 140 3795.3858 Th I PE83 1000 P 3803.0750 Th I PE83 80 3813.0676 Th II PE83 130 3825.1331 Th I PE83 800 P 3828.3846 Th I PE83 120 3836.5851 Th I PE83 200 3839.7475 Th II PE83 70 3841.9601 Th II PE83 150 3846.8876 Th I PE83 140 3852.1353 Th I PE83 90 3854.5108 Th II PE83 110 3863.4059 Th II PE83 150 3869.6633 Th I PE83 400 3875.3731 Th I PE83 250 3879.6441 Th I PE83 150 3886.9159 Th I PE83 600 P 3895.4192 Th I PE83 200 3903.1024 Th I PE83 140 3911.9091 Th I PE83 200 3919.0234 Th I PE83 250 3925.0934 Th

Strong Lines of Uranium (U)

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Intensity Wavelength (Å) Spectrum Ref. Air 120 2635.529 U II BW92b 150 2793.934 U II BW92b 200 2802.560 U II BW92b 130 2807.119 U II BW92b 130 2817.958 U II BW92b 200 2821.121 U II BW92b 140 2828.935 U II BW92b 200 2832.061 U II BW92b 200 2865.681 U II BW92b 250 2889.624 U II BW92b 150 2906.794 U II BW92b 150 2908.272 U II BW92b 120 2931.414 U II BW92b 250 2941.916 U II BW92b 150 2943.896 U II BW92b 120 2956.060 U II BW92b 120 2967.936 U II BW92b 120 2971.066 U II BW92b 130 3022.210 U II BW92b 130 3031.987 U II BW92b 120 3050.197 U II BW92b 130 3057.939 U II BW92b 130 3062.537 U II BW92b 120 3072.783 U II BW92b 120 3093.005 U II BW92b 120 3102.422 U II BW92b 200 3111.618 U II BW92b 140 3124.952 U II BW92b 140 3149.240 U II BW92b 150 3229.499 U II BW92b 140 3232.156 U II BW92b 150 3291.332 U II BW92b 200 3305.8912 U II SPMR72 120 3357.8437 U I SPMR72 250 3390.3775 U I SPMR72 120 3424.5566 U II SPMR72 200 3435.4913 U I SPMR72 110 3459.9191 U I SPMR72 100 3462.2200 U I SPMR72 140 3463.5479 U I SPMR72 200 3466.3010 U I SPMR72 100 3473.4269 U I SPMR72 110 3480.3634 U I SPMR72 140 3482.4900 U II SPMR72 500 P 3489.3672 U I SPMR72 110 3493.9963 U I SPMR72 200 3500.0760 U I SPMR72 100 3504.0089 U I SPMR72 250 3507.3442 U I SPMR72 100 3513.6742 U I SPMR72 500 P 3514.6107 U I SPMR72 130 3533.5659 U II SPMR72 100 3534.3346 U I SPMR72 100 3542.5704 U I SPMR72 100 3549.2018 U I SPMR72 250 3550.8223 U II SPMR72 200 3555.3188 U I SPMR72 100 3561.4110 U I SPMR72 400 P 3561.8038 U I SPMR72 120 3563.6559 U I SPMR72 700 P 3566.5909 U I SPMR72 150 3569.0781 U I SPMR72 100 3574.7602 U I SPMR72 110 3577.9162 U I SPMR72 130 3578.7211 U II SPMR72 1000 P 3584.8774 U I SPMR72 120 3591.7443 U I SPMR72 140 3605.2742 U I SPMR72 100 3616.3305 U I SPMR72 100 3620.0838 U I SPMR72 100 3622.6987 U I SPMR72 250 3638.1986 U I SPMR72 130 3644.2422 U I SPMR72 200 3651.5366 U I SPMR72 150 3652.0641 U I SPMR72 300 P 3659.1548 U I SPMR72 600 P 3670.0701 U II SPMR72 200 3701.5161 U II SPMR72 110 3713.5546 U I SPMR72 120 3738.0405 U II SPMR72 140 3746.4190 U II SPMR72 200 3748.6758 U II SPMR72 200 3751.1746 U I SPMR72 150 3758.3480 U I SPMR72 100 3763.2643 U I SPMR72 130 3766.8864 U I SPMR72 150 3773.4339 U I SPMR72 400 P 3782.8407 U II SPMR72 120 3793.1002 U II SPMR72 120 3793.2638 U I SPMR72 120 3808.9207 U I SPMR72 600 P 3811.9911 U I SPMR72 150 3826.5084 U II SPMR72 400 P 3831.4593 U II SPMR72 400 P 3839.6255 U I SPMR72 200 3854.2202 U I PKE80 500 P 3854.6448 U II PKE80 1000 P 3859.5716 U II PKE80 400 P 3865.9176 U II PKE80 500 P 3871.0353 U I PKE80 130 3874.0387 U II PKE80 130 3878.0847 U II PKE80 200 3881.4546 U II PKE80 400 P 3890.3615 U II PKE80 130 3892.6810 U II PKE80 150 3894.1206 U I PKE80 130 3899.7775 U II PKE80 120 3906.4530 U I PKE80 100 3926.2078 U I PKE80 100 3926.7153 U I PKE80 400 P 3932.0221 U II PKE80 400 P 3943.8161 U I PKE80 110 3964.2064 U I PKE80 120 3966.5211 U II SPMR72 250 3985.7924 U II PKE80 130 4005.2094 U I PKE80 120 4017.7163 U II PKE80 300 P 4042.7496 U I PKE80 130 4047.6117 U I PKE80 300 P 4050.0412 U II PKE80 200 4062.5440 U II PKE80 400 P 4090.1319 U II PKE80 150 4116.0974 U II PKE80 300 P 4153.9710 U I PKE80 120 P 4156.6483 U I PKE80 300 P 4171.5886 U II PKE80 110 4222.3677 U I PKE80 200 P 4241.6646 U II PKE80 140 P 4341.6865 U II PKE80 130 P ,h 4355.7400 U I PKE80 130 P 4362.0510 U I PKE80 100 4393.5858 U I PKE80 120 4472.3297 U II PKE80 130 P 4543.6255 U II PKE80 50 4756.8059 U I PKE80 50 5027.3841 U I PKE80 70 P 5915.385 U I PKE80 30 6826.913 U I PKE80 25 8607.950 U I PKE80 7 8691.282 U I PKE80 9 8757.760 U I PKE80 15 10157.91 U I BW92b 13 10259.55 U I BW92b 30 10554.93 U I BW92b 10 11167.84 U I BW92b 15 11384.13 U I BW92b 15 11859.42 U I BW92b 30 11908.83 U I BW92b 25 13185.16 U I BW92b 10 13961.58 U I BW92b

Strong Lines of Americium (Am)

Strong Lines of Americium (Am)

Intensity Wavelength (Å) Spectrum Ref. Air 40 s 2756.550 Am II FT57 40 s 2812.920 Am II FT57 200 l 2815.282 Am II FT57 1000 P ,s 2832.258 Am II FT57 200 l 2888.505 Am II FT57 40 l 2899.562 Am II FT57 40 l 2911.130 Am II FT57 200 s 2920.593 Am II FT57 40 l 2927.534 Am II FT57 40 l 2936.992 Am II FT57 100 l 2950.393 Am II FT57 200 l 2966.712 Am II FT57 200 l 2969.292 Am II FT57 200 s 2987.238 Am II FT57 100 l 2993.508 Am II FT57 200 s 3004.250 Am II FT57 100 s 3027.990 Am II FT57 100 l 3038.363 Am II FT57 40 s 3053.688 Am II FT57 400 s 3120.486 Am II FT57 40 s 3161.826 Am II FT57 100 s 3282.320 Am II FT57 40 l 3286.666 Am II FT57 10 l 3343.867 Am I FT57 100 s 3362.546 Am II FT57 20 l 3395.010 Am I FT57 40 s 3419.662 Am II FT57 20 3446.186 Am I FT57 200 l 3452.098 Am II FT57 1000 P ,l 3483.308 Am II FT57 500 P 3510.127 Am I FT57 100 l 3530.948 Am I FT57 40 s 3562.680 Am II FT57 500 P 3569.163 Am I FT57 50 3603.410 Am I FT57 500 P 3673.121 Am I FT57 200 s 3696.420 Am II FT57 1000 P ,l 3777.504 Am II FT57 1000 P ,l 3926.248 Am II FT57 200 l 3952.576 Am II FT57 10 s 4020.252 Am I FT57 10 s 4035.808 Am I FT57 100 s 4036.365 Am II FT57 1000 P ,s 4089.291 Am II FT57 10 s 4140.959 Am I FT57 200 s 4188.121 Am II FT57 100 4265.550 Am I FT57 500 P 4289.258 Am I FT57 40 s 4309.652 Am II FT57 400 s 4324.570 Am II FT57 400 s 4441.357 Am II FT57 1000 P ,l 4509.450 Am II FT57 1000 P ,l 4575.590 Am II FT57 200 s 4593.307 Am II FT57 10 l 4649.119 Am I FT57 10 l 4653.448 Am I FT57 500 P ,l 4662.790 Am I FT57 200 l 4681.651 Am I FT57 400 l 4699.700 Am II FT57 100 l 4706.802 Am I FT57 400 l 4872.220 Am II FT57 20 l 4990.786 Am I FT57 10 s 5000.21 Am I FT57 200 l 5020.96 Am II FT57 40 l 5215.99 Am II FT57 100 s 5402.62 Am I FT57 100 s 5424.70 Am I FT57 200 l 5584.21 Am II FT57 100 s 5598.13 Am I FT57 1000 P ,l 6054.64 Am I FT57 100 l 6405.11 Am I FT57 50 l 6544.16 Am I FT57 50 s 6955.58 Am I FT57

Strong Lines of Berkelium (Bk)

Strong Lines of Berkelium (Bk)

Intensity Wavelength (Å) Spectrum Ref. Air 1000 s 2748.019 Bk II WC78 1000 s 2827.567 Bk II WC78 1000 l 2872.114 Bk II WC78 1000 P ,s 2878.572 Bk II WC78 1000 l 2884.772 Bk II WC78 1000 s 2889.803 Bk II WC78 1000 s 2893.660 Bk II WC78 1000 l 2910.645 Bk II WC78 1000 s 2926.489 Bk II WC78 1000 s 2927.907 Bk II WC78 1000 l 2941.713 Bk II WC78 1000 P ,l 2951.761 Bk II WC78 1000 l 2969.125 Bk II WC78 1000 l 2987.755 Bk II WC78 1000 l 3178.466 Bk II WC78 1000 P ,s 3247.262 Bk II WC78 1000 3252.191 Bk I WC78 1000 s 3263.473 Bk II WC78 1000 P ,l 3288.750 Bk I WC78 1000 P 3289.347 Bk I WC78 1000 3335.261 Bk I WC78 1000 s 3387.446 Bk II WC78 1000 3408.281 Bk I WC78 1000 P ,l 3412.131 Bk II WC78 1000 P 3426.951 Bk I WC78 1000 P 3442.664 Bk I WC78 1000 l 3453.897 Bk I WC78 1000 s 3461.244 Bk II WC78 1000 s 3464.133 Bk II WC78 1000 s 3472.016 Bk II WC78 1000 s 3477.620 Bk II WC78 1000 3528.721 Bk I WC78 1000 l 3531.397 Bk I WC78 1000 l 3535.731 Bk I WC78 1000 P ,s 3542.187 Bk II WC78 1000 3553.596 Bk I WC78 1000 3556.515 Bk I WC78 1000 l 3567.254 Bk II WC78 1000 3590.320 Bk I WC78 1000 3595.880 Bk I WC78 1000 3601.115 Bk I WC78 1000 s 3603.201 Bk II WC78 1000 3604.781 Bk I WC78 1000 P 3609.614 Bk I WC78 1000 3616.620 Bk I WC78 1000 s 3621.805 Bk II WC78 1000 3627.607 Bk I WC78 1000 l 3637.054 Bk I WC78 1000 3640.255 Bk I WC78 1000 s 3640.928 Bk II WC78 1000 l 3675.585 Bk I WC78 1000 s 3681.221 Bk II WC78 1000 l 3684.427 Bk I WC78 1000 l 3686.737 Bk I WC78 1000 3695.368 Bk I WC78 1000 3703.279 Bk I WC78 1000 s 3704.015 Bk I WC78 1000 s 3711.135 Bk II WC78 1000 3712.929 Bk I WC78 1000 3725.385 Bk I WC78 1000 3739.916 Bk I WC78 1000 3743.047 Bk I WC78 1000 3745.403 Bk I WC78 1000 3750.075 Bk I WC78 1000 3751.905 Bk I WC78 1000 3757.851 Bk I WC78 1000 s 3771.060 Bk II WC78 1000 3788.205 Bk I WC78 1000 3791.419 Bk I WC78 1000 3796.206 Bk I WC78 1000 3798.629 Bk I WC78 1000 s 3802.345 Bk I WC78 1000 3802.470 Bk I WC78 1000 s 3823.098 Bk II WC78 1000 s 3824.083 Bk II WC78 1000 3825.190 Bk I WC78 1000 s 3825.844 Bk II WC78 1000 l 3831.565 Bk II WC78 1000 s 3833.480 Bk I WC78 1000 s 3835.967 Bk II WC78 1000 3842.185 Bk I WC78 1000 l 3846.618 Bk I WC78 1000 3847.626 Bk I WC78 1000 3855.030 Bk I WC78 1000 l 3859.888 Bk II WC78 1000 l 3877.937 Bk II WC78 1000 3880.106 Bk I WC78 1000 l 3882.602 Bk I WC78 1000 P ,l 3894.547 Bk II WC78 1000 P ,s 3906.094 Bk II WC78 1000 l 3916.365 Bk II WC78 1000 3921.415 Bk I WC78 1000 l 3928.045 Bk II WC78 1000 l 4147.134 Bk II WC78 1000 P ,s 4189.692 Bk II WC78 1000 P ,s 4197.441 Bk II WC78 1000 l 4329.580 Bk I WC78 1000 4351.504 Bk I WC78 1000 P 4363.636 Bk I WC78 1000 4423.011 Bk I WC78 1000 P 4466.457 Bk I WC78 1000 l 4765.40 Bk I WC78 1000 l 5118.24 Bk I WC78 1000 s 5135.53 Bk II WC78 1000 5170.61 Bk I WC78 1000 5197.55 Bk I WC78 1000 P 5212.53 Bk I WC78 1000 P 5271.95 Bk I WC78 1000 5392.03 Bk I WC78 1000 5394.24 Bk I WC78 1000 5449.63 Bk I WC78 1000 l 5467.47 Bk I WC78 1000 s 5484.58 Bk I WC78 1000 5512.22 Bk II WC78 1000 l 5537.93 Bk I WC78 1000 l 5556.80 Bk I WC78 1000 s 5557.09 Bk I WC78 1000 5581.21 Bk I WC78 1000 l 5656.54 Bk I WC78 1000 P 5659.03 Bk I WC78 1000 5702.24 Bk I WC78 1000 P 5910.71 Bk I WC78 1000 l 7040.85 Bk I WC78 1000 7107.85 Bk I WC78 1000 7252.50 Bk I WC78 1000 7306.94 Bk I WC78 1000 7394.26 Bk I WC78 1000 s 7903.90 Bk I WC78 1000 s 9429.13 Bk I CWBC77 1000 l 9862.39 Bk II CWBC77 1000 10126.20 Bk I CWBC77 1000 10292.44 Bk I CWBC77 1000 l 10570.53 Bk I CWBC77 1000 P ,l 11293.14 Bk I CWBC77 1000 P ,l 11500.30 Bk I CWBC77 1000 s 11575.34 Bk I CWBC77 1000 P ,s 11793.09 Bk I CWBC77 1000 s 12159.05 Bk I CWBC77 1000 13498.36 Bk I CWBC77 1000 s 14196.93 Bk I CWBC77

Strong Lines of Curium (Cm)

Strong Lines of Curium (Cm)

Intensity Wavelength (Å) Spectrum Ref. Air 1000 P 2462.764 Cm II WHGC76 1000 2617.169 Cm II WHGC76 1000 P 2636.281 Cm II WHGC76 1000 2651.171 Cm II WHGC76 1000 2653.804 Cm II WHGC76 1000 2725.682 Cm II WHGC76 1000 2736.892 Cm II WHGC76 1000 2748.039 Cm II WHGC76 1000 2784.826 Cm II WHGC76 1000 2811.618 Cm II WHGC76 1000 P 2824.204 Cm II WHGC76 1000 P 2833.580 Cm II WHGC76 1000 2899.904 Cm II WHGC76 1000 P 2912.965 Cm II WHGC76 1000 P 2928.922 Cm II WHGC76 1000 2996.180 Cm II WHGC76 1000 2999.385 Cm I WHGC76 1000 b 3014.867 Cm II WHGC76 1000 P 3044.848 Cm II WHGC76 1000 P 3109.690 Cm I WHGC76 1000 P 3116.411 Cm I WHGC76 1000 3135.099 Cm I WHGC76 1000 3137.160 Cm I WHGC76 1000 3147.325 Cm I WHGC76 1000 3158.599 Cm I WHGC76 1000 3169.983 Cm II WHGC76 1000 3177.554 Cm I WHGC76 1000 3179.098 Cm I WHGC76 1000 3186.412 Cm I WHGC76 1000 3188.109 Cm I WHGC76 1000 3207.121 Cm II WHGC76 1000 3207.708 Cm I WHGC76 1000 3209.892 Cm II WHGC76 1000 3209.943 Cm I WHGC76 1000 3210.050 Cm II WHGC76 1000 3220.759 Cm II WHGC76 1000 P 3224.226 Cm I WHGC76 1000 P 3225.108 Cm I WHGC76 1000 3226.412 Cm II WHGC76 1000 3230.278 Cm I WHGC76 1000 3230.349 Cm II WHGC76 1000 3236.737 Cm I WHGC76 1000 3238.548 Cm II WHGC76 1000 P 3242.657 Cm II WHGC76 1000 3246.247 Cm I WHGC76 1000 b 3252.675 Cm I WHGC76 1000 3265.806 Cm I WHGC76 1000 3280.450 Cm I WHGC76 1000 3296.708 Cm II WHGC76 1000 P 3304.849 Cm I WHGC76 1000 3317.143 Cm I WHGC76 1000 3374.696 Cm I WHGC76 1000 P 3452.922 Cm I WHGC76 1000 P 3458.338 Cm I WHGC76 1000 3510.279 Cm I WHGC76 1000 3522.355 Cm I WHGC76 1000 3524.938 Cm I WHGC76 1000 3542.059 Cm I WHGC76 1000 3547.018 Cm I WHGC76 1000 3547.922 Cm I WHGC76 1000 3561.437 Cm I WHGC76 1000 P 3572.949 Cm II WHGC76 1000 3600.615 Cm I WHGC76 1000 3639.944 Cm I WHGC76 1000 3664.340 Cm I WHGC76 1000 3709.426 Cm I WHGC76 1000 3729.004 Cm I WHGC76 1000 3732.351 Cm I WHGC76 1000 3747.863 Cm I WHGC76 1000 3763.045 Cm I WHGC76 1000 3775.751 Cm I WHGC76 1000 P 3816.304 Cm I WHGC76 1000 3825.138 Cm I WHGC76 1000 3833.315 Cm I WHGC76 1000 3837.593 Cm I WHGC76 1000 3842.000 Cm I WHGC76 1000 3849.924 Cm I WHGC76 1000 3854.106 Cm I WHGC76 1000 3900.253 Cm I WHGC76 1000 P 3904.064 Cm II WHGC76 1000 P 3908.238 Cm II WHGC76 1000 P 3936.666 Cm I WHGC76 1000 3942.025 Cm I WHGC76 1000 3944.146 Cm I WHGC76 1000 3948.683 Cm I WHGC76 1000 3953.362 Cm I WHGC76 1000 3964.827 Cm I WHGC76 1000 P 3995.100 Cm I WHGC76 1000 4016.17 Cm I WHGC76 1000 4031.76 Cm I WHGC76 1000 4048.29 Cm I WHGC76 1000 4049.65 Cm I WHGC76 1000 4113.29 Cm I WHGC76 1000 4129.71 Cm I WHGC76 1000 P 4207.66 Cm II WHGC76 1000 P 4211.62 Cm I WHGC76 1000 4266.45 Cm I WHGC76 1000 4293.00 Cm I WHGC76 1000 P 4330.82 Cm I WHGC76 1000 4345.69 Cm I WHGC76 1000 4447.77 Cm I WHGC76 1000 P 4459.16 Cm I WHGC76 1000 P 4608.40 Cm I WHGC76 1000 5846.07 Cm I WHGC76 1000 P 5952.41 Cm I WHGC76 1000 6058.90 Cm I WHGC76 1000 6243.35 Cm I WHGC76 1000 P 6376.71 Cm I WHGC76 1000 6554.41 Cm I WHGC76 1000 6640.17 Cm I WHGC76 1000 6686.87 Cm I WHGC76 1000 P 6706.85 Cm I WHGC76 1000 6726.68 Cm I WHGC76 1000 6793.15 Cm I WHGC76 1000 P 7162.69 Cm I WHGC76 1000 P 7720.47 Cm I WHGC76 1000 P 8392.37 Cm I WHGC76 1000 P 10542.98 Cm I WHGC76 1000 P 10792.25 Cm I WHGC76 1000 11834.28 Cm I CBV76 1000 12464.99 Cm I CBV76 1000 13004.56 Cm I CBV76 1000 13258.18 Cm I CBV76 1000 13289.84 Cm I CBV76 1000 13480.54 Cm I CBV76 1000 13590.01 Cm I CBV76 1000 13644.77 Cm I CBV76 1000 13789.52 Cm I CBV76 1000 13908.46 Cm I CBV76 1000 14235.27 Cm I CBV76 1000 14334.52 Cm I CBV76 1000 14563.41 Cm I CBV76 1000 14580.23 Cm I CBV76 1000 15018.13 Cm I CBV76

Strong Lines of Plutonium (Pu)

Strong Lines of Plutonium (Pu)

Intensity Wavelength (Å) Spectrum Ref. Air 500 2933.298 Pu II BFG84 700 P 2933.602 Pu II BFG84 700 P 2951.820 Pu II BFG84 700 P 2964.644 Pu II BFG84 700 2966.843 Pu II BFG84 700 P 2969.035 Pu II BFG84 700 P 2972.500 Pu II BFG84 700 2980.227 Pu II BFG84 700 2994.046 Pu II BFG84 700 2996.406 Pu II BFG84 700 3000.572 Pu II BW92b 700 3029.924 Pu II BFG84 700 3159.201 Pu II BFG84 700 3174.488 Pu II BFG84 700 3175.152 Pu II BFG84 700 P 3198.467 Pu II BFG84 700 P 3220.942 Pu II BFG84 700 P 3224.873 Pu II BFG84 500 d 3232.224 Pu I BFG84 500 3244.162 Pu I BFG84 700 P 3245.206 Pu II BFG84 500 3252.070 Pu I BFG84 700 d 3260.539 Pu II BFG84 500 3265.177 Pu I BFG84 700 P 3273.111 Pu II BFG84 700 P 3275.125 Pu II BFG84 500 3275.236 Pu I BFG84 700 P 3279.326 Pu II BFG84 700 P 3289.977 Pu II BFG84 700 P 3290.345 Pu II BFG84 500 3292.560 Pu I BFG84 500 3301.754 Pu I BFG84 700 P 3312.647 Pu II BFG84 500 3320.607 Pu I BFG84 500 3320.834 Pu I BFG84 700 P 3337.708 Pu II BFG84 500 3338.942 Pu I BFG84 700 P 3350.330 Pu II BFG84 700 P 3391.405 Pu II BFG84 700 d 3401.09 Pu II BFG84 700 3632.210 Pu II BFG84 500 3632.210 Pu I BFG84 800 3720.243 Pu I BFG84 1000 3720.243 Pu II BFG84 500 P 3753.628 Pu I BFG84 500 P 3755.940 Pu I BFG84 500 P 3758.338 Pu I BFG84 500 P 3774.384 Pu I BFG84 500 3792.220 Pu I BFG84 500 3799.368 Pu I BFG84 500 3805.923 Pu I BFG84 500 3811.396 Pu I BFG84 500 3835.520 Pu I BFG84 500 P 3851.007 Pu I BFG84 400 3851.849 Pu I BFG84 500 P 3878.540 Pu I BFG84 400 3895.888 Pu I BFG84 500 4133.005 Pu I BFG84 500 4140.041 Pu I BFG84 500 4151.091 Pu I BFG84 500 4151.443 Pu I BFG84 1000 P 4206.481 Pu I BFG84 500 4208.234 Pu I BFG84 500 4261.886 Pu I BFG84 500 4404.894 Pu I BFG84 1000 P 4536.146 Pu II BFG84 500 5712.382 Pu I BFG84 500 6192.798 Pu I BFG84 800 P 6304.661 Pu I BFG84 500 6449.744 Pu I BFG84 800 P 6486.707 Pu I BFG84 1000 P 6488.853 Pu I BFG84 500 6535.271 Pu I BFG84 500 6544.207 Pu I BFG84 500 6608.947 Pu I BFG84 800 P 6887.710 Pu I BFG84 500 7258.049 Pu I BFG84 500 7572.923 Pu I BFG84 500 8309.602 Pu I BFG84 1000 P 8630.189 Pu I BFG84 150 9533.071 Pu I BFG84 150 12231.212 Pu I BFG84 150 16897.369 Pu I BFG84

Strong Lines of Californium (Cf)

Strong Lines of Californium (Cf)

Intensity Wavelength (Å) Spectrum Ref. Air 1000 2739.31 Cf II RCWM80 1000 P ,s 2759.10 Cf II RCWM80 1000 P 2774.52 Cf II RCWM80 1000 l 2852.03 Cf II RCWM80 1000 s 2855.24 Cf II RCWM80 1000 P 3298.14 Cf I RCWM80 1000 P 3352.71 Cf I RCWM80 1000 l 3367.79 Cf II RCWM80 1000 3392.22 Cf I RCWM80 1000 3481.07 Cf I RCWM80 1000 l 3513.47 Cf II RCWM80 1000 3531.49 Cf I RCWM80 1000 3540.98 Cf I RCWM80 1000 P 3598.77 Cf I RCWM80 1000 3605.32 Cf I RCWM80 1000 3612.11 Cf I RCWM80 1000 3617.49 Cf I RCWM80 1000 P ,s 3626.76 Cf II RCWM80 1000 3659.46 Cf I RCWM80 1000 3662.70 Cf I RCWM80 1000 s 3699.49 Cf II RCWM80 1000 P ,l 3722.11 Cf II RCWM80 1000 3739.35 Cf I RCWM80 1000 3785.61 Cf I RCWM80 1000 l 3789.04 Cf II RCWM80 1000 s 3893.23 Cf II RCWM80 1000 P ,l 3993.57 Cf II RCWM80 1000 4035.45 Cf I RCWM80 1000 4099.12 Cf I RCWM80 1000 4242.38 Cf I RCWM80 1000 P 4329.03 Cf I RCWM80 1000 4335.22 Cf I RCWM80 1000 5173.96 Cf I RCWM80 1000 5179.08 Cf I RCWM80 1000 5219.24 Cf I RCWM80 1000 b,s 5279.01 Cf I RCWM80 1000 s 5320.09 Cf I RCWM80 1000 s 5339.13 Cf I RCWM80 1000 P 5408.88 Cf I RCWM80 1000 5726.05 Cf I RCWM80 1000 6622.83 Cf I RCWM80 1000 6631.26 Cf I RCWM80 1000 6677.90 Cf I RCWM80 1000 6894.59 Cf I RCWM80 1000 P 6927.10 Cf II RCWM80 1000 l 7074.52 Cf I RCWM80 1000 s 7307.90 Cf I RCWM80 1000 P 8141.29 Cf I RCWM80 1000 8241.77 Cf II RCWM80 1000 8333.85 Cf II RCWM80 1000 8423.49 Cf II RCWM80 1000 8568.83 Cf II RCWM80 1000 l 9228.52 Cf I RCWM80 1000 9337.70 Cf I RCWM80 1000 9649.51 Cf I RCWM80 1000 s 10308.41 Cf I CWBV77 1000 l 10568.83 Cf I CWBV77 1000 s 10614.84 Cf I CWBV77 1000 11300.19 Cf I CWBV77 1000 11681.85 Cf I CWBV77 1000 P 11941.33 Cf I CWBV77 1000 P ,l 12183.05 Cf II CWBV77 1000 s 12352.72 Cf I CWBV77 1000 s 12437.48 Cf I CWBV77 1000 P ,l 12787.41 Cf I CWBV77 1000 l 13329.98 Cf II CWBV77 1000 s 13362.98 Cf I CWBV77 1000 P ,l 13376.89 Cf II CWBV77 1000 l 13474.44 Cf I CWBV77 1000 l 14772.49 Cf II CWBV77 1000 s 15281.32 Cf I CWBV77 1000 15587.12 Cf II CWBV77 1000 15675.92 Cf I CWBV77 1000 P 16759.06 Cf II CWBV77 1000 s 17626.25 Cf I CWBV77 1000 l 18718.69 Cf I CWBV77 1000 h 19068.71 Cf I CWBV77 1000 l 19336.96 Cf I CWBV77 1000 l 19576.84 Cf I CWBV77 1000 l 20393.38 Cf I CWBV77 1000 s 20869.98 Cf I CWBV77

Strong Lines of Einsteinium (Es)

Strong Lines of Einsteinium (Es)

Intensity Wavelength (Å) Spectrum Ref. Air 1000 P ,s 2708.66 Es II WLGC74 100 s 2724.57 Es II WLGC74 100 l 2765.76 Es II WLGC74 300 P ,l 2787.10 Es II WLGC74 100 l 2796.11 Es II WLGC74 300* l 2815.15 Es I WLGC74 300* P ,l 2815.15 Es II WLGC74 300 2907.03 Es WLGC74 100 l 3065.40 Es WLGC74 300 3135.25 Es I WLGC74 100 l 3154.27 Es II WLGC74 1000 3413.17 Es WLGC74 1000 P ,s 3428.48 Es I WLGC74 300 s 3445.25 Es WLGC74 300 3452.36 Es WLGC74 300 s 3484.59 Es I WLGC74 1000 P ,s 3498.11 Es I WLGC74 1000 P ,l 3514.33 Es I WLGC74 1000 P ,s 3521.38 Es I WLGC74 1000 P ,s 3523.49 Es I WLGC74 1000 s 3536.01 Es WLGC74 1000 P ,s 3547.75 Es II WLGC74 1000 P ,l 3555.34 Es I WLGC74 300 s 3556.65 Es WLGC74 300 s 3560.92 Es WLGC74 100 s 3575.68 Es WLGC74 100 s 3582.95 Es II WLGC74 300 3590.28 Es WLGC74 100 3595.47 Es WLGC74 1000 P ,s 3602.43 Es II WLGC74 100 s 3606.75 Es II WLGC74 300 l 3631.09 Es WLGC74 1000 s 3632.87 Es WLGC74 100 l 3651.94 Es WLGC74 1000 P ,l 3670.01 Es II WLGC74 100 l 3720.56 Es II WLGC74 1000 P ,l 3728.55 Es II WLGC74 1000 l 3792.99 Es WLGC74 1000 P ,l 3801.49 Es I WLGC74 300 3930.77 Es I WLGC74 1000 s 4082.24 Es WLGC74 300 l 4107.59 Es WLGC74 100 l 4176.94 Es I WLGC74 100 4789.93 Es WLGC74 100 h 4802.21 Es WLGC74 300 h 4958.29 Es WLGC74 1000 s 5052.08 Es WLGC74 100 s 5102.93 Es WLGC74 1000 P ,s 5161.74 Es I WLGC74 1000 P ,l 5204.40 Es I WLGC74 300 P ,l 5615.51 Es I WLGC74

Persistent Lines of Neutral Helium (He I)

Persistent Lines of Neutral Helium (He I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 100 522.21309 2.4356 0.000 -191492.7120 M02 D96 400 537.02992 5.6634 0.000 -186209.3651 M02 D96 1000 584.33436 17.989 0.000 -171134.8970 M02 D96 60 3888.6046 0.0947 159855.9745-185564.8547 M02 D96 200 3888.6456 0.0947 159855.9745-185564.5840 M02 D96 300 3888.6489 0.0947 159855.9745-185564.5620 M02 D96 500 5875.6148 0.7070 169086.7666-186101.5463 M02 D96 250 5875.6404 0.5303 169086.8430-186101.5488 M02 D96 120 5875.9663 0.3927 169087.8309-186101.5930 M02 D96 200 6678.1517 0.6369 171134.8970-186104.9668 M02 D96 100 7065.1771 0.1547 169086.7666-183236.7918 M02 D96 60 7065.2153 0.0928 169086.8430-183236.7918 M02 D96 20 7065.7086 0.0309 169087.8309-183236.7918 M02 D96 50 7281.3507 0.1830 171134.8970-184864.8294 M02 D96 150 10829.0911 0.1022 159855.9745-169087.8309 M02 D96 500 10830.2501 0.1021 159855.9745-169086.8430 M02 D96 1000 10830.3398 0.1021 159855.9745-169086.7666 M02 D96 500 20581.287 0.0197 166277.4403-171134.8970 M02 D96

Persistent Lines of Neutral Hydrogen (H I)

Persistent Lines of Neutral Hydrogen (H I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 50 949.7430 0.34375 0.0000-105291.6443 MK00a BM00 100 972.5367 0.6819 0.0000-102823.8791 MK00a BM00 300 1025.7222 1.6725 0.0000- 97492.2835 MK00a BM00 1000 1215.66824 6.2648 0.0000- 82259.2850 MK00a BM00 500 1215.67364 6.2649 0.0000- 82258.9191 MK00a BM00 30 4340.462 0.0253 82259.1109-105291.6587 MK00a WSG66 30 4861.2786 0.1719 82258.9191-102823.8942 MK00a BM00 10 4861.2870 0.0967 82258.9544-102823.8943 MK00a BM00 60 4861.3615 0.2063 82259.2850-102823.9095 MK00a BM00 90 6562.7110 0.5388 82258.9191- 97492.3195 MK00a BM00 30 6562.7248 0.2245 82258.9544- 97492.3196 MK00a BM00 180 6562.8518 0.6465 82259.2850- 97492.3556 MK00a BM00 20 12818.07 0.0220 97492.3087-105291.6587 MK00a WSG66 40 18751.01 0.0899 97492.3087-102823.9002 MK00a WSG66

Persistent Lines of Neutral Lithium (Li I)

Persistent Lines of Neutral Lithium (Li I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 15 4602.831 0.223 14903.622- 36623.297 REB95 FW96 30 4602.898 0.223 14903.957- 36623.312 REB95 FW96 300 6103.542 0.686 14903.622- 31283.018 REB95 FW96 400 6103.654 0.686 14903.957- 31283.053 REB95 FW96 500 6707.775 0.369 0.000- 14903.957 REB95 FW96 1000 6707.926 0.369 0.000- 14903.622 REB95 FW96 150 8126.232 0.349 14903.622- 27206.066 REB95 WSG66 300 8126.453 0.349 14903.957- 27206.066 REB95 WSG66 10 26877.67 0.038 27206.066- 30925.613 REB95 WSG66 5 26878.36 0.038 27206.066- 30925.517 REB95 WSG66

Persistent Lines of Neutral Aluminum (Al I)

Persistent Lines of Neutral Aluminum (Al I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 40 2269.096 0.691 112.061- 44168.847 KM91b M03 50 2367.052 0.628 0.000- 42233.742 KM91b M03 90 2373.124 0.748 112.061- 42237.783 KM91b M03 50 2575.094 0.226 112.061- 38933.968 KM91b M03 500 3082.153 0.622 0.000- 32435.453 KM91b M03 800 3092.710 0.738 112.061- 32436.796 KM91b M03 200 3092.839 0.123 112.061- 32435.453 KM91b M03 500 3944.006 0.498 0.000- 25347.756 KM91b M03 1000 3961.520 0.982 112.061- 25347.756 KM91b M03

Persistent Lines of Neutral Beryllium (Be I)

Persistent Lines of Neutral Beryllium (Be I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 100 1661.478 0.0726 0.000- 60187.34 KM97 M03 1000 2348.610 5.53 0.000- 42565.35 KM97 M03 100 2494.728 1.6 21981.27 - 62053.72 KM97 FW96 100 2650.454 4.24* 21978.925- 59697.08 KM97 FW96 60 2650.550 4.24* 21978.28 - 59695.07 KM97 FW96 200* 2650.613 4.24* 21978.925- 59695.07 KM97 FW96 200* 2650.619 4.24* 21981.27 - 59697.08 KM97 FW96 60 2650.694 4.24* 21978.925- 59693.65 KM97 FW96 100 2650.760 4.24* 21981.27 - 59695.07 KM97 FW96 100 3321.340 21981.27 - 52080.94 KM97 12 4572.664 0.79 42565.35 - 64428.31 KM97 FW96 4 8254.070 42565.35 - 54677.26 KM97

Persistent Lines of Neutral Boron (B I)

Persistent Lines of Neutral Boron (B I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 1825.894 1.70 0.000- 54767.698 EL01 M03 1000 1826.400 2.04 15.287- 54767.844 EL01 M03 400 2088.889 0.361 0.000- 47857.127 JLKK93 M03 500 2089.570 0.432 15.287- 47856.807 JLKK93 M03 500 2496.769 0.837 0.000- 40039.695 JLKK93 M03 800 2497.722 1.67 15.287- 40039.695 JLKK93 OL92 100 11660.028 40039.695- 48613.655 EL01 50 11662.452 40039.695- 48611.872 EL01

Persistent Lines of Neutral Carbon (C I)

Persistent Lines of Neutral Carbon (C I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 1277.2452 1.27 0.00000- 78293.50 KE74 WFD96 800 1277.2824 1.73 16.41671- 78307.62 KE74 WFD96 200 1277.5131 0.912 16.41671- 78293.50 KE74 WFD96 1000 1277.5497 2.31 43.41350- 78318.23 KE74 WFD96 800 1280.3330 0.577 43.41350- 78148.09 KE74 WFD96 500 1560.682 0.908 16.41671- 64090.97 KE74 M03 200 1560.709 0.505 16.41671- 64089.86 KE74 M03 600 1561.438 1.21 43.41350- 64086.95 KE74 M03 500 1656.267 0.858 16.41671- 60393.15 KE74 WFD96 400 1656.928 1.13 0.00000- 60352.64 KE74 WFD96 1000 1657.008 2.52 43.41350- 60393.15 KE74 WFD96 400 1657.379 0.864 16.41671- 60352.64 KE74 WFD96 400 1657.907 3.43 16.41671- 60333.43 KE74 WFD96 500 1658.121 1.44 43.41350- 60352.64 KE74 WFD96 500 1751.827 0.907 21648.02 - 78731.28 KE74 WFD96 1000 1930.906 3.51 10192.66 - 61981.82 KE74 WFD96 400 2478.561 0.340 21648.02 - 61981.82 J66 WFD96 250 8335.15 0.351 61981.82 - 73975.91 J66 WFD96 400 9405.73 0.291 61981.82 - 72610.73 J66 WFD96 140 11753.32 0.263 69744.03 - 78249.93 JL65 WFD96 101 11754.76 0.240 69710.67 - 78215.50 JL65 WFD96

Persistent Lines of Neutral Fluorine (F I)

Persistent Lines of Neutral Fluorine (F I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 951.870 2.55 0.000-105056.283 L49 M03 1000 954.826 6.32 0.000-104731.048 L49 M03 800 955.546 5.05 404.141-105056.283 L49 M03 500 958.525 1.25 404.141-104731.048 L49 M03 130 6239.651 0.25 102405.714-118427.814 L49 FW96 100 6348.508 0.18 102680.439-118427.814 L49 FW96 500 6856.030 0.494 102405.714-116987.391 L49 FW96 150 6902.475 0.32 102680.439-117164.002 L49 FW96 500 7037.469 0.30 104731.048-118936.791 L49 FW96 300 7127.890 0.38 105056.283-119081.814 L49 FW96 150 7202.360 0.072 105056.283-118936.791 L49 WSG66 150 7311.019 0.39 104731.048-118405.256 L49 FW96 100 7398.688 0.285 102405.714-115917.904 L49 FW96 200 7754.696 0.382 104731.048-117622.917 L49 FW96 150 7800.212 0.21 105056.283-117872.917 L49 FW96

Persistent Lines of Neutral Magnesium (Mg I)

Persistent Lines of Neutral Magnesium (Mg I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 2 2025.824 0.612 0.000- 49346.729 KM91a M03 15* 2779.820 1.31 21870.464- 57833.40 KM91a WSM69 15* 2779.834 3.92 21911.178- 57873.94 KM91a WSM69 1000 2852.1251 5.00 0.000- 35051.264 PTW98 FW96 25 3829.355 0.940 21850.405- 47957.058 KM91a WSM69 50 3832.300 1.27 21870.464- 47957.027 KM91a WSM69 " 0.703 21870.464- 47957.058 WSM69 80 3838.292 1.68 21911.178- 47957.045 KM91a WSM69 12 5167.322 0.116 21850.405- 41197.403 KM91a FW96 40 5172.684 0.346 21870.464- 41197.403 KM91a FW96 70 5183.604 0.575 21911.178- 41197.403 KM91a FW96 8 11828.17 0.26 35051.264- 43503.333 KM91a WSM69 6 15025.00 0.139 41197.403- 47851.162 KM91a WSM69

Persistent Lines of Neutral Neon (Ne I)

Persistent Lines of Neutral Neon (Ne I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 170 615.6283 0.380 0.00 -162435.6780 SS04 VVF96 170 618.6716 0.929 0.00 -161636.6175 SS04 VVF96 130 619.1023 0.330 0.00 -161524.1739 SS04 VVF96 200 626.8232 0.741 0.00 -159534.6196 SS04 VVF96 200 629.7388 0.480 0.00 -158795.9924 SS04 VVF96 1000 735.8962 3.16 0.00 -135888.7173 SS04 VVF96 400 743.7195 0.486 0.00 -134459.2871 SS04 VVF96 100 3520.4711 0.093 135888.7173-164285.8872 SS04 FW96 200 5400.5618 0.0090 134459.2871-152970.7328 SS04 FW96 200 5852.4879 0.682 135888.7173-152970.7328 SS04 FW96 100 6029.9969 0.0561 134459.2871-151038.4524 SS04 FW96 100 6074.3377 0.603 134459.2871-150917.4307 SS04 FW96 100 6143.0626 0.282 134041.8400-150315.8612 SS04 FW96 100 6163.5939 0.146 134818.6405-151038.4524 SS04 FW96 100 6217.2812 0.0637 134041.8400-150121.5922 SS04 FW96 100 6266.4950 0.249 134818.6405-150772.1118 SS04 FW96 100 6382.9917 0.321 134459.2871-150121.5922 SS04 FW96 200 6402.248 0.514 134041.8400-149657.0393 SS04 FW96 150 6506.5281 0.300 134459.2871-149824.2215 SS04 FW96 100 6598.9529 0.232 135888.7173-151038.4524 SS04 FW96 1000 6929.4673 0.174 135888.7173-150315.8612 SS04 FW96 800 7032.4131 0.253 134041.8400-148257.7898 SS04 FW96 800 7173.9381 0.0287 135888.7173-149824.2215 SS04 FW96 800 7245.1666 0.0935 134459.2871-148257.7898 SS04 FW96 800 8377.6080 0.51 149657.0393-161590.3412 SS04 WSG66 600 8654.3831 0.445 150858.5079-162410.1736 SS04 WSG66 600 8780.6226 150315.8612-161701.4486 SS04 400 8783.7533 0.313 151038.4524-162419.9818 SS04 FW96 300 11143.0200 149824.2215-158795.9924 SS04 500 11177.5240 149657.0393-158601.1152 SS04 300 11522.7459 150858.5079-159534.6196 SS04

Persistent Lines of Neutral Nitrogen (N I)

Persistent Lines of Neutral Nitrogen (N I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1199.550 4.07 0.000- 83364.620 M75a M03 700 1200.223 4.02 0.000- 83317.830 M75a M03 300 1200.710 4.00 0.000- 83284.070 M75a M03 250 1243.179 3.21 19224.464- 99663.427 M75a WFD96 250 1492.625 3.13 19224.464- 86220.510 M75a WFD96 200 1742.729 1.16 28839.306- 86220.510 M75a WFD96 200 7442.29 0.124 83317.830- 96750.840 M75a WFD96 200 7468.31 0.193 83364.620- 96750.840 M75a WFD96 150 8680.28 0.246 83364.620- 94881.820 M75a WFD96 150 8683.40 0.180 83317.830- 94830.890 M75a WFD96 200 12469.62 0.228 96864.050-104881.350 M75a WFD96 200 13581.33 0.0639 86220.510- 93581.550 M75a WFD96

Persistent Lines of Neutral Oxygen (O I)

Persistent Lines of Neutral Oxygen (O I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1302.168 3.15 0.000- 76794.978 M75b M03 700 1304.858 1.87 158.265- 76794.978 M75b M03 300 1306.029 0.623 226.977- 76794.978 M75b M03 300 7771.94 0.369 73768.200- 86631.454 M75b WFD96 250 7774.17 0.369 73768.200- 86627.778 M75b WFD96 250 7775.39 0.369 73768.200- 86625.757 M75b WFD96 250 8446.25 0.322 76794.978- 88631.303 M75b WFD96 300 8446.36 0.322 76794.978- 88631.146 M75b WFD96 300 8446.76 0.322 76794.978- 88630.587 M75b WFD96 200 9266.01 0.445 86631.454- 97420.630 M75b WFD96 250 13163.89 0.0714 88630.587- 96225.049 M75b WFD96 250 13164.85 0.119 88631.146- 96225.049 M75b WFD96

Persistent Lines of Neutral Phosphorus (P I)

Persistent Lines of Neutral Phosphorus (P I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 1674.591 0.773 0.00 - 59715.921 S80 M03 1000 1679.695 0.845 0.00 - 59534.549 S80 M03 1000 1774.951 2.38 0.00 - 56339.656 S80 M03 800 1782.838 2.38 0.00 - 56090.626 S80 M03 700 1787.656 2.52 0.00 - 55939.421 S80 M03 200 2135.465 0.211 11361.02 - 58174.366 S80 FW96 400 2136.182 2.83 11376.63 - 58174.366 S80 FW96 400 2149.145 3.18 11361.02 - 57876.574 S80 FW96 150 2152.940 0.485 18722.71 - 65156.242 S80 FW96 300 2154.080 0.58 18748.01 - 65157.126 S80 FW96 " 0.173 18748.01 - 65156.242 FW96 400 2533.987 0.200 18722.71 - 58174.366 M59 FW96 500 2535.606 0.95 18748.01 - 58174.366 M59 FW96 400 2553.253 0.71 18722.71 - 57876.574 M59 FW96 90 9525.73 0.18 56339.656- 66834.648 S80 BMQZ94 80 9545.18 56339.656- 66813.271 S80 90 9563.439 56090.626- 66544.243 S80 80 9734.750 56090.626- 66360.282 S80 80 9750.77 0.24 56090.626- 66343.438 S80 BMQZ94 90 9796.85 0.21 56339.656- 66544.243 S80 BMQZ94

Persistent Lines of Neutral Silicon (Si I)

Persistent Lines of Neutral Silicon (Si I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 1850.6719 3.14 223.157- 54257.574 RAKL67 M03 400 1901.3377 6298.847- 58893.362 RAKL67 400 1977.5978 0.279 0.000- 50566.414 RAKL67 M03 400 1979.2056 0.870 77.112- 50602.435 RAKL67 M03 300 1980.6185 0.207 77.112- 50566.414 RAKL67 M03 300 1983.2330 0.218 77.112- 50499.843 RAKL67 M03 500 1986.3640 0.365 223.157- 50566.414 RAKL67 M03 1000 1988.9937 0.657 223.157- 50499.843 RAKL67 M03 600 2058.1323 6298.847- 54871.027 KRA66 400 2207.978 0.262 0.000- 45276.187 RA65 M03 500 2210.894 0.345 77.112- 45293.623 RA65 M03 300 2211.744 0.181 77.112- 45276.187 RA65 M03 500 2216.669 0.454 223.157- 45321.848 RA65 M03 400 2218.057 0.109 223.157- 45293.623 RA65 M03 400 2506.897 0.547 77.112- 39955.051 RA65 M03 400 2514.316 0.740 0.000- 39760.285 RA65 M03 500 2516.112 1.68 223.157- 39955.051 RA65 M03 400 2519.202 0.549 77.112- 39760.285 RA65 M03 400 2524.108 2.22 77.112- 39683.158 RA65 M03 400 2528.509 0.904 223.157- 39760.285 RA65 M03 1000 2881.5771 1.89 6298.847- 40991.888 BE93 FW96 50 5948.545 0.022 40991.888- 57798.080 RA65 FW96 100 7289.1730 45321.848- 59037.043 MKMD94 80 7405.7740 0.037 45276.187- 58775.442 MKMD94 FW96 100 7423.497 45321.848- 58788.878 RA65 50 11984.201 39760.285- 48102.321 BE93 60 12031.503 39955.051- 48264.290 BE93

Persistent Lines of Neutral Sodium (Na I)

Persistent Lines of Neutral Sodium (Na I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 5 2852.81 0.00554 0.000- 35042.85 R56 M03 2 2853.01 0.00554 0.000- 35040.38 R56 M03 15 3302.37 0.0281 0.000- 30272.58 R56 M03 8 3302.98 0.0281 0.000- 30266.99 R56 M03 1000 5889.950 0.616 0.000- 16973.368 R56 M03 500 5895.924 0.614 0.000- 16956.172 R56 M03 60 8183.256 0.453 16956.172- 29172.889 R56 FW96 10 8194.790 0.090 16973.368- 29172.889 R56 FW96 110 8194.824 0.54 16973.368- 29172.839 R56 FW96 5 11381.45 0.090 16956.172- 25739.991 R56 FW96 12 11403.78 0.176 16973.368- 25739.991 R56 FW96 5 18465.25 0.140 29172.839- 34586.92 R56 WSM69 " 0.00933 29172.839- 34586.92 WSM69

Persistent Lines of Neutral Sulfur (S I)

Persistent Lines of Neutral Sulfur (S I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1425.030 2.92 0.000- 70173.968 KM93 M03 600 1433.280 2.16 396.055- 70166.195 KM93 M03 200 1433.310 1.20 396.055- 70164.650 KM93 M03 1000 1473.995 1.82 0.000- 67842.867 KM93 M03 900 1666.688 6.3 9238.609- 69237.886 KM93 FW96 800 1687.530 0.94 22179.954- 81438.30 KM93 FW96 1000 1807.311 3.08 0.000- 55330.811 KM93 M03 900 1820.343 1.70 396.055- 55330.811 KM93 M03 800 1826.245 0.549 573.640- 55330.811 KM93 M03 150 9212.865 0.30 52623.640- 63475.051 KM93 WSM69 100 9228.092 0.28 52623.640- 63457.142 KM93 WSM69 80 9237.538 0.28 52623.640- 63446.065 KM93 WSM69 200 10455.451 0.22 55330.811- 64892.582 KM93 WSM69 30 10456.757 0.22 55330.811- 64891.386 KM93 WSM69 130 10459.406 0.22 55330.811- 64888.964 KM93 WSM69

Persistent Lines of Neutral Argon (Ar I)

Persistent Lines of Neutral Argon (Ar I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 180 866.79997 3.14 0.000 -115366.871 M73 VVF96 150 869.75411 0.35 0.000 -114975.024 M73 VVF96 180 876.05767 2.69 0.000 -114147.737 M73 VVF96 180 879.94656 0.77 0.000 -113643.265 M73 VVF96 150 894.31013 0.000 -111818.033 M73 1000 1048.21987 5.32 0.000 - 95399.8329 VHU99 M03 500 1066.65980 1.32 0.000 - 93750.6031 M73 M03 300 6965.431 0.067 93143.7653-107496.4219 N73 RCWM80 300 7067.218 0.0395 93143.7653-107289.7054 N73 RCWM80 600 7503.869 0.472 95399.8329-108722.6247 N73 RCWM80 700 7635.106 0.274 93143.7653-106237.5571 N73 RCWM80 600 7948.176 0.196 94553.6705-107131.7139 N73 RCWM80 600 8006.157 0.0490 93750.6031-106237.5571 N73 FW96 700 8014.786 0.0928 93143.7653-105617.2753 N73 FW96 600 8103.693 0.25 93750.6031-106087.2651 N73 FW96 1000 8115.311 0.331 93143.7653-105462.7649 N73 FW96 1000 9122.967 0.189 93143.7653-104102.1043 N73 FW96 700 9657.786 0.0543 93750.6031-104102.1043 N73 FW96

Persistent Lines of Neutral Calcium (Ca I)

Persistent Lines of Neutral Calcium (Ca I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 140 2721.645 0.0027 0.000- 36731.615 R68 M03 1000 4226.727 2.20 0.000- 23652.304 R68 M03 500 4425.441 0.498 15157.901- 37748.197 R68 FW96 500 4434.960 0.67 15210.063- 37751.867 R68 FW96 500 4435.688 0.342 15210.063- 37748.197 R68 FW96 600 4454.781 0.87 15315.943- 37757.449 R68 FW96 600 4455.887 0.20 15315.943- 37751.867 R68 FW96 400 4456.605 15315.943- 37748.197 R68 500 5588.757 0.49 20371.000- 38259.124 R68 FW96 500 6102.722 0.096 15157.901- 31539.495 R68 FW96 600 6122.219 0.287 15210.063- 31539.495 R68 FW96 600 6162.172 0.354 15315.943- 31539.495 R68 FW96 700 6439.073 0.53 20371.000- 35896.889 R68 FW96 700 6462.566 0.47 20349.260- 35818.713 R68 FW96 600 6493.780 0.44 20335.360- 35730.454 R68 FW96 500 6572.777 0.000- 15210.063 R68

Persistent Lines of Neutral Chlorine (Cl I)

Persistent Lines of Neutral Chlorine (Cl I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 1335.726 2.24 0.00 - 74865.667 RK69 M03 1000 1347.240 5.62 0.00 - 74225.846 RK69 M03 500 1351.657 4.24 882.35 - 74865.667 RK69 M03 500 1363.447 0.99 882.35 - 74225.846 RK69 M03 500 1379.528 0.096 0.00 - 72488.568 RK69 M03 500 1389.693 0.0030 0.00 - 71958.363 RK69 M03 500 1389.957 0.023 882.35 - 72827.038 RK69 M03 500 1396.527 0.011 882.35 - 72488.568 RK69 M03 60 7547.072 0.12 72488.568- 85735.091 RK69 FW96 50 7744.970 0.063 72827.038- 85735.091 RK69 FW96 90 8212.038 71958.363- 84132.262 RK69 100 8221.742 72488.568- 84648.100 RK69 90 8333.307 72488.568- 84485.309 RK69 500 8375.94 71958.363- 83894.037 RK69 80 8428.254 72827.038- 84688.637 RK69 100 8575.24 72827.038- 84485.309 RK69 400 8585.97 72488.568- 84132.262 RK69

Persistent Lines of Neutral Chromium (Cr I)

Persistent Lines of Neutral Chromium (Cr I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3578.682 1.48 0.00- 27935.26 K53 FW96 800 3593.481 1.50 0.00- 27820.23 K53 FW96 600 3605.320 1.62 0.00- 27728.87 K53 FW96 1000 4254.331 0.315 0.00- 23498.84 K53 FW96 800 4274.806 0.307 0.00- 23386.35 K53 FW96 500 4289.733 0.316 0.00- 23305.01 K53 FW96 250 5204.505 0.509 7593.16- 26801.93 K53 FW96 400 5206.021 0.514 7593.16- 26796.28 K53 FW96 600 5208.415 0.506 7593.16- 26787.50 K53 FW96

Persistent Lines of Neutral Cobalt (Co I)

Persistent Lines of Neutral Cobalt (Co I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 250 2407.256 3.6 0.000- 41528.455 PT96 FW96 250 2411.624 816.000- 42269.229 PT96 200 2424.935 3.2 0.000- 41225.710 PT96 FW96 200 2521.365 3.0 0.000- 39649.124 PT96 FW96 500 3405.118 1.0 3482.780- 32841.916 PT96 FW96 400 3443.645 0.69 4142.631- 33173.313 PT96 FW96 1000 3453.510 1.1 3482.780- 32430.535 PT96 FW96 400* 3473.974 0.0299 0.000- 28777.236 PT96 M03 400* 3474.042 0.56 4690.141- 33466.823 PT96 FW96 500 3502.280 0.80 3482.780- 32027.440 PT96 FW96 300 3526.850 0.137 0.000- 28345.814 PT96 M03 300 3529.808 0.46 4142.631- 32464.688 PT96 FW96 400 3569.376 1.6 7442.399- 35450.505 PT96 FW96

Persistent Lines of Neutral Copper (Cu I)

Persistent Lines of Neutral Copper (Cu I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 130 2165.09 0.547 0.000- 46172.842 S48 M03 150 2178.94 0.913 0.000- 45879.311 S48 M03 150 2181.72 0.994 0.000- 45821.00 S48 M03 200 2225.70 0.444 0.000- 44915.61 S48 M03 250 2230.08 11202.565- 56029.95 S48 250 2244.26 0.0185 0.000- 44544.153 S48 M03 100 2441.64 0.0201 0.000- 40943.73 S48 M03 200 2492.15 0.0279 0.000- 40113.99 S48 M03 1000 3247.54 1.37 0.000- 30783.686 S48 M03 1000 3273.96 1.36 0.000- 30535.302 S48 M03 150 5105.54 0.020 11202.565- 30783.686 S48 FW96 200 5153.24 0.60 30535.302- 49935.200 S48 FW96 250 5218.20 0.75 30783.686- 49942.057 S48 FW96

Persistent Lines of Neutral Iron (Fe I)

Persistent Lines of Neutral Iron (Fe I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2483.2708 4.81 0.000- 40257.311 NJLT94 OWLW91 600 2488.1426 4.20 415.933- 40594.429 NJLT94 OWLW91 500 2490.6443 3.45 704.007- 40842.151 NJLT94 OWLW91 400 2522.8494 2.13 0.000- 39625.801 NJLT94 OWLW91 400 2719.0273 1.42 0.000- 36766.964 NJLT94 OWLW91 300 2788.1047 0.59 6928.268- 42784.349 NJLT94 OWLW91 400 3440.6060 0.171 0.000- 29056.322 NJLT94 M03 600 3581.1931 1.02 6928.268- 34843.955 NJLT94 FW96 600 3719.9348 0.162 0.000- 26874.548 NJLT94 FW96 700 3734.8638 0.902 6928.268- 33695.395 NJLT94 FW96 600 3737.1316 0.141 415.933- 27166.818 NJLT94 M03 600 3745.5613 0.115 704.007- 27394.689 NJLT94 FW96 300 3748.2622 0.0914 888.132- 27559.581 NJLT94 M03 400 3749.4854 0.764 7376.764- 34039.514 NJLT94 FW96 300 3758.2329 0.634 7728.059- 34328.750 NJLT94 FW96 500 3820.4253 0.668 6928.268- 33095.939 NJLT94 FW96 500 3859.9114 0.0969 0.000- 25899.987 NJLT94 M03 300 3886.2822 0.0530 415.933- 26140.177 NJLT94 M03 300 4045.8125 0.863 11976.238- 36686.174 NJLT94 FW96 200 4383.5449 0.500 11976.238- 34782.419 NJLT94 FW96

Persistent Lines of Neutral Manganese (Mn I)

Persistent Lines of Neutral Manganese (Mn I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 1996.056 0.77 0.00- 50099.03 CMG64 M91 500 1999.511 0.76 0.00- 50012.50 CMG64 M91 700 2003.849 0.76 0.00- 49888.01 CMG64 M91 250 2794.817 3.7 0.00- 35769.97 CMG64 FW96 200 2798.270 3.6 0.00- 35725.85 CMG64 FW96 140 2801.084 3.7 0.00- 35689.98 CMG64 FW96 120 3806.715 0.59 17052.29- 43314.23 CMG64 FW96 1000 4030.755 0.17 0.00- 24802.25 CMG64 FW96 700 4033.068 0.165 0.00- 24788.05 CMG64 FW96 400 4034.485 0.158 0.00- 24779.32 CMG64 FW96 200 4041.357 0.787 17052.29- 41789.48 CMG64 FW96

Persistent Lines of Neutral Nickel (Ni I)

Persistent Lines of Neutral Nickel (Ni I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 250 2310.961 0.000- 43258.726 LBT93 300 2320.034 6.94 0.000- 43089.578 LBT93 M03 150 2345.543 2.23 0.000- 42620.994 LBT93 M03 500 3002.485 0.903 204.787- 33500.822 LBT93 M03 500 3012.001 1.3 3409.937- 36600.791 LBT93 FW96 400 3050.816 0.604 204.787- 32973.376 LBT93 M03 300 3101.557 0.699 879.816- 33112.334 LBT93 M03 400 3134.104 0.749 1713.087- 33610.890 LBT93 M03 1000 3414.764 0.615 204.787- 29480.989 LBT93 M03 600 3446.259 0.455 879.816- 29888.477 LBT93 M03 600 3458.460 0.667 1713.087- 30619.414 LBT93 M03 600 3461.652 0.278 204.787- 29084.456 LBT93 M03 700 3492.956 1.02 879.816- 29500.674 LBT93 M03 800 3515.052 0.474 879.816- 29320.762 LBT93 M03 1000 3524.536 1.09 204.787- 28569.203 LBT93 M03 600 3566.372 0.56 3409.937- 31441.635 LBT93 FW96 800 3619.391 0.66 3409.937- 31031.020 LBT93 FW96

Persistent Lines of Neutral Potassium (K I)

Persistent Lines of Neutral Potassium (K I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 4044.14 0.0116 0.000- 24720.139 R56 M03 700 4047.21 0.0107 0.000- 24701.382 R56 M03 1000 7664.8991 0.379 0.000- 13042.876 E99 M03 1000 7698.9645 0.374 0.000- 12985.170 E99 M03 700 11690.21 0.220 12985.170- 21536.988 R56 WSM69 600 11769.62 0.0434 13042.876- 21536.988 R56 WSM69 700 11772.83 0.259 13042.876- 21534.680 R56 WSM69

Persistent Lines of Neutral Scandium (Sc I)

Persistent Lines of Neutral Scandium (Sc I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 3269.897 3.13 0.00- 30573.17 AV77 FW96 250 3273.628 2.81 168.34- 30706.66 AV77 FW96 900 3907.484 1.66 0.00- 25584.64 AV77 FW96 1000 3911.812 1.79 168.34- 25724.68 AV77 FW96 200 3933.375 0.162 168.34- 25584.64 AV77 FW96 250 3996.601 0.165 0.00- 25014.21 AV77 FW96 900 4020.387 1.63 0.00- 24866.17 AV77 FW96 900 4023.678 1.65 168.34- 25014.21 AV77 FW96 250 4054.544 0.441 0.00- 24656.72 AV77 M03 250 4082.387 0.410 168.34- 24656.88 AV77 M03

Persistent Lines of Neutral Titanium (Ti I)

Persistent Lines of Neutral Titanium (Ti I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 3635.462 0.909 0.000- 27498.983 F91 M03 800 3642.674 0.895 170.134- 27614.678 F91 M03 900 3653.495 0.869 386.875- 27750.136 F91 M03 700 3752.858 0.581 386.875- 27025.658 F91 M03 600 3948.670 0.560 0.000- 25317.815 F91 M03 600 3956.334 0.346 170.134- 25438.906 F91 M03 700 3958.201 0.488 386.875- 25643.699 F91 M03 600 3981.761 0.442 0.000- 25107.410 F91 M03 700 3989.758 0.448 170.134- 25227.220 F91 M03 1000 3998.636 0.481 386.875- 25388.331 F91 M03 800 4305.907 6842.965- 30060.338 F91 700 4981.730 0.660 6842.965- 26910.712 F91 FW96 600 4991.066 0.584 6742.755- 26772.969 F91 FW96 400 5007.206 0.492 6598.764- 26564.398 F91 FW96 400 5014.186 0.0611 0.000- 19937.852 F91 M03 200 5064.651 0.0437 386.875- 20126.060 F91 M03 200 5210.384 0.0411 386.875- 19573.973 F91 M03

Persistent Lines of Neutral Vanadium (V I)

Persistent Lines of Neutral Vanadium (V I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 250 3183.412 2.4 137.382- 31541.147 D76 FW96 400 3183.992 2.5 323.457- 31721.708 D76 FW96 300 3185.385 2.8 552.961- 31937.266 DA78 M03 300 3703.574 0.92 2424.783- 29418.073 DA78 FW96 250 3855.845 0.578 552.961- 26480.291 DA78 FW96 200 3902.256 0.268 552.961- 26171.916 DA78 FW96 700 4111.780 1.01 2424.783- 26738.318 DA78 FW96 400 4115.180 0.58 2311.355- 26604.796 DA78 FW96 250 4128.064 0.77 2220.106- 26437.640 DA78 FW96 250 4131.989 0.55 2311.355- 26505.932 DA78 FW96 1000 4379.230 1.1 2424.783- 25253.432 DA78 FW96 600 4384.710 1.1 2311.355- 25111.467 DA78 FW96 400 4389.980 0.69 2220.106- 24992.884 DA78 FW96 300 4395.223 0.55 2153.207- 24898.771 DA78 FW96 300 4408.195 0.60 2220.106- 24898.771 DA78 FW96 400 4408.501 2153.207- 24830.228 DA78 " 2112.282- 24789.385 110 6090.208 0.26 8715.761- 25131.005 DA78 FW96

Persistent Lines of Neutral Arsenic (As I)

Persistent Lines of Neutral Arsenic (As I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 1890.43 2.7 0.000- 52898.056 HA85 M00 400 1937.59 2.2 0.000- 51610.393 HA85 M00 200 1972.62 2.0 0.000- 50693.897 HA85 M00 200 2003.35 10914.866- 60815.218 HA85 50 2288.12 2.8 10914.866- 54605.491 HA85 FW96 100 2349.84 3.1 10592.666- 53135.750 HA85 FW96 70 2370.77 0.42 18647.663- 60815.218 HA85 FW96 400 2456.53 0.072 10914.866- 51610.393 HA85 FW96 900 2780.22 0.78 18647.663- 54605.491 HA85 FW96 1000 2860.44 0.55 18186.328- 53135.750 HA85 FW96

Persistent Lines of Neutral Bromine (Br I)

Persistent Lines of Neutral Bromine (Br I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 1488.45 2.0 0.00- 67183.58 T63 M00 300 1540.65 2.2 0.00- 64907.19 T63 M00 400 1574.84 0.20 3685.24- 67183.58 T63 M00 1000 1633.40 0.23 3685.24- 64907.19 T63 M00 130 7348.51 0.12 64907.19- 78511.60 T63 FW96 500 7512.96 0.12 63436.45- 76743.08 T63 FW96 400 7803.02 0.053 66883.87- 79695.89 T63 FW96 400 7938.68 0.19 75890.33- 88483.42 T63 FW96 1000 8272.44 63436.45- 75521.50 T63 130 8343.70 0.22 66883.87- 78865.72 T63 FW96 500 8446.55 0.12 64907.19- 76743.08 T63 FW96

Persistent Lines of Neutral Gallium (Ga I)

Persistent Lines of Neutral Gallium (Ga I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 2874.235 1.17 0.000- 34781.66 JL67 M03 600 2943.636 1.34 826.19 - 34787.85 JL67 M03 200 2944.173 0.261 826.19 - 34781.66 JL67 M03 500 4032.984 0.485 0.000- 24788.530 ND82 M03 1000 4172.042 0.945 826.19 - 24788.530 JL67 M03

Persistent Lines of Neutral Germanium (Ge I)

Persistent Lines of Neutral Germanium (Ge I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 120 1988.267 0.41 1409.9609- 51705.020 KE74 M00 200 1998.887 1.24 1409.9609- 51437.802 KE74 M00 700 2019.068 0.49 557.1341- 50068.954 AM59 M00 900 2041.712 1.51 0.0000- 48962.783 AM59 M00 600 2043.770 0.86 1409.9609- 50323.465 AM59 M00 1000 2068.656 1.2 557.1341- 48882.263 AM59 M00 800 2094.258 1.70 1409.9609- 49144.397 AM59 M00 130 2198.714 7125.2989- 52592.224 AM59 200 2592.534 0.60 557.1341- 39117.9021 AM59 BDGL98 500 2651.172 1.60 1409.9609- 39117.9021 AM59 BDGL98 200 2651.568 0.69 0.0000- 37702.3054 AM59 BDGL98 200 2691.341 0.47 557.1341- 37702.3054 AM59 BDGL98 300 2709.624 2.08 557.1341- 37451.6893 AM59 BDGL98 250 2754.588 0.79 1409.9609- 37702.3054 AM59 BDGL98 300 3039.067 2.04 7125.2989- 40020.5604 AM59 BDGL98 40 3269.489 0.17 7125.2989- 37702.3054 AM59 BDGL98 500 12069.20 37702.3054- 45985.592 HA64 400 12391.58 40020.5604- 48088.3504 HA64

Persistent Lines of Neutral Krypton (Kr I)

Persistent Lines of Neutral Krypton (Kr I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 1164.8671 3.16 0.000 - 85846.7051 K93 FW96 1000 1235.8378 3.12 0.000 - 80916.7685 K93 FW96 300 5570.2894 0.021 79971.7422- 97919.1473 K93 FW96 500 5870.9160 0.018 80916.7685- 97945.1669 K93 FW96 700 8104.3655 0.13 79971.7422- 92307.3791 K93 FW96 1000 8112.9012 0.36 79971.7422- 92294.4017 K93 FW96 500 8190.0566 0.11 80916.7685- 93123.3414 K93 FW96 500 8263.2426 0.35 85846.7051- 97945.1669 K93 FW96 800 8298.1099 0.32 80916.7685- 92964.3948 K93 FW96 500 8508.8728 0.24 85846.7051- 97595.9158 K93 FW96 1000 8776.7505 0.27 80916.7685- 92307.3791 K93 FW96 400 13634.220 92294.4017- 99626.883 KH69 300 14426.793 92964.3948- 99894.048 KH69 400 16890.441 92307.3791- 98226.268 KH69 400 18167.315 92294.4017- 97797.287 KH69

Persistent Lines of Neutral Molybdenum (Mo I)

Persistent Lines of Neutral Molybdenum (Mo I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3132.594 1.79 0.000- 31913.171 WB88 FW96 200 3158.167 0.463 0.000- 31654.786 WB88 FW96 300 3170.344 1.37 0.000- 31533.206 WB88 FW96 250 3193.979 1.53 0.000- 31299.876 WB88 FW96 100 3208.838 0.277 0.000- 31154.935 WB88 FW96 110 3447.124 0.875 12346.280- 41347.664 WB88 FW96 1000 3798.252 0.690 0.000- 26320.420 WB88 FW96 1000 3864.104 0.624 0.000- 25871.887 WB88 FW96 700 3902.953 0.617 0.000- 25614.367 WB88 FW96 80 4069.882 0.325 16783.856- 41347.664 WB88 FW96 90 4188.324 0.332 16784.522- 40653.701 WB88 FW96 90 4411.695 0.263 16784.522- 39445.182 WB88 FW96 250 5506.494 0.361 10768.332- 28923.668 WB88 FW96 200 5533.031 0.372 10768.332- 28836.592 WB88 FW96 90 5570.444 0.330 10768.332- 28715.242 WB88 FW96

Persistent Lines of Neutral Niobium (Nb I)

Persistent Lines of Neutral Niobium (Nb I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 80 3341.97 1142.79- 31056.60 MCS75 80 3343.71 1586.90- 31485.20 MCS75 110 3349.06 2154.11- 32004.63 MCS75 110 3358.42 2805.36- 32572.72 MCS75 120 3535.30 695.25- 28973.12 MCS75 " 0.00- 28278.25 90 3575.85 695.25- 28652.66 MCS75 300 3580.27 1050.26- 28973.12 MCS75 150 3739.80 0.59 695.25- 27427.07 MCS75 DHL86 1000 4058.94 1.28 1050.26- 25680.36 MCS75 DHL86 " 10237.51- 34867.68 800 4079.73 0.99 695.25- 25199.81 MCS75 DHL86 400 4100.92 0.76 391.99- 24769.91 MCS75 DHL86 " 13145.71- 37523.53 300 4123.81 0.58 154.19- 24396.80 MCS75 DHL86 300 4152.58 0.38 695.25- 24769.91 MCS75 DHL86 300 4163.66 0.65 154.19- 24164.79 MCS75 DHL86 250 4164.66 0.50 391.99- 24396.80 MCS75 DHL86 200 4168.13 0.91 0.00- 23984.87 MCS75 DHL86

Persistent Lines of Neutral Rubidium (Rb I)

Persistent Lines of Neutral Rubidium (Rb I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 11 4201.80 0.018 0.000- 23792.591 RE80 FW96 6 4215.53 0.015 0.000- 23715.081 RE80 FW96 1000 7800.27 0.370 0.000- 12816.545 J61b FW96 500 7947.60 0.340 0.000- 12578.950 J61b FW96 11 14752.41 12578.950- 19355.649 J61b 9 15288.43 12816.545- 19355.649 J61b

Persistent Lines of Neutral Ruthenium (Ru I)

Persistent Lines of Neutral Ruthenium (Ru I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 3436.737 0.728 1190.64- 30279.68 K59 WSL94 800 3498.944 0.861 0.00- 28571.89 K59 WSL94 600 3589.220 0.911 3105.49- 30958.80 K59 WSL94 600 3593.029 0.817 2713.24- 30537.06 K59 WSL94 600 3596.185 0.420 2091.54- 29890.91 K59 WSL94 800 3726.926 0.753 1190.64- 28014.79 K59 WSL94 1000 3728.026 0.820 0.00- 26816.23 K59 WSL94 600 3730.432 0.706 2091.54- 28890.47 K59 WSL94 700 3798.899 0.598 1190.64- 27506.59 K59 WSL94 700 3799.353 0.533 0.00- 26312.83 K59 WSL94 700 4199.892 0.399 6545.03- 30348.45 K59 WSL94

Persistent Lines of Neutral Selenium (Se I)

Persistent Lines of Neutral Selenium (Se I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 1960.894 2.13 0.00 - 50997.161 LP77 M00 150 1995.111 22446.202- 72568.72 LP77 600 2039.842 0.98 1989.497- 50997.161 LP77 M00 400 2062.779 0.33 2534.36 - 50997.161 LP77 M00 600 2074.784 0.017 0.00 - 48182.420 LP77 M00 600 2164.188 0.0032 1989.497- 48182.420 LP77 M00 700 2413.535 9576.149- 50997.161 LP77 600 4730.78 48182.420- 69314.635 RG34 1000 10327.26 50997.161- 60677.618 MV74 700 10386.36 50997.161- 60622.532 MV74 800 21442.56 60677.618- 65339.968 MV74

Persistent Lines of Neutral Strontium (Sr I)

Persistent Lines of Neutral Strontium (Sr I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 4607.33 2.01 0.000- 21698.482 MCS75 FW96 70 4811.88 14898.563- 35674.668 MCS75 50 4872.49 14504.351- 35022.015 MCS75 120 4962.26 14898.563- 35045.055 MCS75 20 4967.94 14898.563- 35022.015 MCS75 70 5256.90 18319.267- 37336.616 MCS75 110 5480.84 18319.267- 36559.514 MCS75 140 6408.47 18319.267- 33919.330 MCS75 80 6504.00 18218.795- 33589.724 MCS75 30 6791.05 14317.520- 29038.795 MCS75 70 6878.38 14504.351- 29038.795 MCS75 20 6892.59 0.00048 0.000- 14504.351 MCS75 M00 80 7070.10 14898.563- 29038.795 MCS75

Persistent Lines of Neutral Technetium (Tc I)

Persistent Lines of Neutral Technetium (Tc I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 3173.30 0.86 0.00- 31503.93 BMC67 PW99 200 3182.37 0.39 0.00- 31414.05 BMC67 PW99 200 3183.11 0.56 0.00- 31406.74 BMC67 PW99 500 3466.28 1.22 2572.89- 31414.05 BMC67 PW99 1000 3636.07 1.57 2572.89- 30067.29 BMC67 PW99 800 3718.86 1.05 3250.91- 30133.26 BMC67 PW99 500 3984.97 0.42 2572.89- 27660.10 BMC67 PW99 1000 4031.63 1.01 2572.89- 27369.79 BMC67 PW99 700 4095.67 0.49 3250.91- 27660.10 BMC67 PW99 500 4238.19 0.38 0.00- 23588.40 BMC67 PW99 800 4262.27 0.40 0.00- 23455.21 BMC67 PW99 1000 4297.06 0.42 0.00- 23265.32 BMC67 PW99 800 4853.59 0.49 10516.53- 31114.08 BMC67 PW99

Persistent Lines of Neutral Yttrium (Y I)

Persistent Lines of Neutral Yttrium (Y I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 900 4077.359 1.1 0.000- 24518.751 P77 FW96 1000 4102.364 1.3 530.351- 24899.632 P77 FW96 900 4128.299 1.6 530.351- 24746.573 P77 FW96 800 4142.841 1.6 0.000- 24131.250 P77 FW96 600 17422.838 11078.614- 16816.641 P77 1000 17903.209 11532.096- 17116.156 P77 1000 18049.810 11277.928- 16816.641 P77 800 21260.444 11532.096- 16234.382 P77 700 22543.828 11277.928- 15712.522 P77 500 23990.450 11078.614- 15245.803 P77

Persistent Lines of Neutral Zinc (Zn I)

Persistent Lines of Neutral Zinc (Zn I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2138.5735 7.14 0.000- 46745.404 GL00 M03 20 2800.8635 32890.327- 68583.083 GL00 25 2801.0500 32890.327- 68580.705 GL00 60 3075.8971 0.000375 0.000- 32501.399 GL00 M03 50 3282.3256 0.90 32311.319- 62768.747 GL00 FW96 200 3302.5829 1.2 32501.399- 62772.014 GL00 FW96 70 3302.9395 0.67 32501.399- 62768.747 GL00 FW96 400 3345.0134 1.7 32890.327- 62776.981 GL00 FW96 80 3345.5694 0.40 32890.327- 62772.014 GL00 FW96 15 3345.9353 0.045 32890.327- 62768.747 GL00 FW96 100 4680.1359 32311.319- 53672.240 GL00 250 4722.1569 32501.399- 53672.240 GL00 400 4810.5321 32890.327- 53672.240 GL00 30 6362.3458 0.474 46745.404- 62458.533 GL00 FW96

Persistent Lines of Neutral Zirconium (Zr I)

Persistent Lines of Neutral Zirconium (Zr I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 3519.604 0.00- 28404.26 J98 500 3547.683 570.41- 28749.80 J98 300 3575.790 0.53 570.41- 28528.36 J98 BGHL81 1000 3601.191 1.33 1240.84- 29001.65 J98 D95 300 3663.648 0.57 1240.84- 28528.36 J98 BGHL81 600 3835.962 0.00- 26061.70 J98 800 3863.872 570.41- 26443.88 J98 800 3890.316 1240.84- 26938.42 J98 600 3891.380 0.39 1240.84- 26931.35 J98 BGHL81 600 4072.698 1.19 5540.54- 30087.33 J98 BGHL81 600 4081.209 5888.93- 30384.50 J98 600 4227.750 5888.93- 29535.48 J98 600 4239.309 5540.54- 29122.71 J98 700 4687.799 0.85 5888.93- 27214.89 J98 BGHL81 500 4710.074 0.64 5540.54- 26765.66 J98 BGHL81 200 6127.457 0.017 1240.84- 17556.26 J98 BGHL81 150 7097.727 0.051 5540.54- 19625.58 J98 BGHL81 150 7169.092 5888.93- 19833.78 J98 250 8070.099 5888.93- 18276.92 J98

Persistent Lines of Neutral Antimony (Sb I)

Persistent Lines of Neutral Antimony (Sb I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 1871.154 0.000- 53442.967 SM02 60 2049.577 8512.125- 57287.052 SM02 400 2068.344 1.81 0.000- 48332.424 SM02 GL80 40 2139.698 1.74 8512.125- 55232.963 SM02 GL80 40 2144.841 8512.125- 55120.943 SM02 600 2175.818 1.75 0.000- 45945.340 SM02 GL80 100 2179.190 2.39 9854.018- 55728.264 SM02 GL80 120 2208.430 9854.018- 55120.943 SM02 1000 2311.463 1.69 0.000- 43249.337 SM02 GL80 800 2528.509 1.77 9854.018- 49391.133 SM02 GL80 600 2598.048 0.210 8512.125- 46991.058 SM02 GL80 400 2877.913 0.424 8512.125- 43249.337 SM02 GL80 250 3232.495 0.307 18464.202- 49391.133 SM02 GL80 300 3267.491 0.495 16395.359- 46991.058 SM02 GL80

Persistent Lines of Neutral Barium (Ba I)

Persistent Lines of Neutral Barium (Ba I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 30 3071.584 0.41 0.000- 32547.033 KL99 KFW02 80 3501.108 0.35 0.000- 28554.221 KL99 KFW02 1000 5535.481 1.19 0.000- 18060.261 KL99 KFW02 250 6498.760 0.54 9596.533- 24979.834 KL99 KFW02 110 6527.312 0.33 9215.501- 24531.513 KL99 KFW02 100 6595.325 0.38 9033.966- 24192.033 KL99 KFW02 50 6693.842 0.146 9596.533- 24531.513 KL99 KFW02 200 7059.943 0.50 9596.533- 23757.049 KL99 KFW02 150 7280.296 0.32 9215.501- 22947.423 KL99 KFW02 80 7672.085 0.15 9033.966- 22064.645 KL99 KFW02 60 8559.998 0.20 11395.350- 23074.387 KL99 KFW02 60 14999.852 0.0025 11395.350- 18060.261 KL99 KFW02 50 23253.56 9215.501- 13514.745 KL99 60 25514.88 9596.533- 13514.745 KL99

Persistent Lines of Neutral Cadmium (Cd I)

Persistent Lines of Neutral Cadmium (Cd I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 2288.022 5.3 0.000- 43692.384 BA56 FW96 400 3403.652 0.77 30113.990- 59485.768 BA56 FW96 500 3466.200 1.2 30656.087- 59497.868 BA56 FW96 400 3467.655 0.67 30656.087- 59485.768 BA56 FW96 500 3610.508 1.3 31826.952- 59515.980 BA56 FW96 400 3612.873 0.35 31826.952- 59497.868 BA56 FW96 100 4678.149 0.13 30113.990- 51483.980 BA56 FW96 150 4799.912 0.41 30656.087- 51483.980 BA56 FW96 500 5085.822 0.56 31826.952- 51483.980 BA56 FW96 1000 6438.470 0.59 43692.384- 59219.734 BA56 FW96

Persistent Lines of Neutral Cesium (Cs I)

Persistent Lines of Neutral Cesium (Cs I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 15 4555.28 0.0188 0.0000- 21946.396 K62b FW96 8 4593.17 0.0080 0.0000- 21765.35 K62b FW96 1000 8521.13 0.3276 0.0000- 11732.3079 EJN64 FW96 250 8761.41 11178.2686- 22588.8210 EJN64 1000 8943.47 0.287 0.0000- 11178.2686 EJN64 FW96 300 9172.32 11732.3079- 22631.6863 EJN64 600 13588.29 11178.2686- 18535.529 S81 900 14694.91 11732.3079- 18535.529 S81 50 30103.27 11178.2686- 14499.2584 S81 20 34900.13 11732.3079- 14596.8423 S81

Persistent Lines of Neutral Indium (In I)

Persistent Lines of Neutral Indium (In I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 14 1711.1 2212.598- 60654 G54 14 1757.3 0.000- 56905 G54 60 2560.150 0.20 0.000- 39048.53 P38 M00 90 2710.265 0.27 2212.598- 39098.38 P38 M00 40 2753.878 0.13 0.000- 36301.84 P38 M00 60 2932.630 0.23 2212.598- 36301.84 P38 M00 400 3039.356 1.11 0.000- 32892.21 P38 M00 700 3256.089 1.30 2212.598- 32915.54 P38 M00 150 3258.565 0.30 2212.598- 32892.21 P38 M00 900 4101.7504 0.50 0.000- 24372.956 DMZ53 M00 1000 4511.2972 0.89 2212.598- 24372.956 DMZ53 M00 1 12912.59 24372.956- 32115.22 JL67 1 13429.96 24372.956- 31816.96 JL67

Persistent Lines of Neutral Iodine (I I)

Persistent Lines of Neutral Iodine (I I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 130 1457.98 0.00- 68587.87 KC59 200 1518.05 7603.15- 73477.24 KC59 200 1702.07 2.05 7603.15- 66355.10 KC59 M00 150 1782.76 2.71 0.00- 56092.88 KC59 FW96 1000 1830.38 0.16 0.00- 54633.46 KC59 FW96 200 1844.45 0.070 7603.15- 61819.76 KC59 M00 25 2061.63 0.030 7603.15- 56092.88 KC59 M00 130 5119.29 56092.88- 75621.41 KC59 130 8043.74 54633.46- 67062.09 KC59 200 9058.33 54633.46- 65669.99 KC59

Persistent Lines of Neutral Palladium (Pd I)

Persistent Lines of Neutral Palladium (Pd I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 2447.9058 0.111 0.000- 40838.874 ELLW98 M00 250 2476.4127 0.188 0.000- 40368.796 ELLW98 M00 400 2763.0899 0.169 0.000- 36180.677 ELLW98 M00 500 3242.6983 0.77 6564.148- 37393.762 ELLW98 BGKZ82 1000 3404.5764 1.34 6564.148- 35927.948 ELLW98 BGKZ82 500 3421.2214 7755.025- 36975.973 ELLW98 300 3460.7381 0.30 6564.148- 35451.443 ELLW98 BGKZ82 400 3481.1516 10093.992- 38811.896 ELLW98 500 3516.9438 1.03 7755.025- 36180.677 ELLW98 BGKZ82 500 3553.0803 11721.809- 39858.361 ELLW98 800 3609.5547 0.82 7755.025- 35451.443 ELLW98 BGKZ82 800 3634.6884 6564.148- 34068.977 ELLW98

Persistent Lines of Neutral Rhodium (Rh I)

Persistent Lines of Neutral Rhodium (Rh I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 3323.09 0.63 1529.97- 31613.78 MCS75 FW96 600 3396.82 0.65 0.00- 29430.86 MCS75 FW96 900 3434.89 0.00- 29104.71 MCS75 600 3502.52 0.43 0.00- 28542.69 MCS75 FW96 300 3507.32 0.34 2598.03- 31101.75 MCS75 FW96 900 3528.02 0.85 1529.97- 29866.34 MCS75 FW96 900 3657.99 0.88 1529.97- 28859.64 MCS75 FW96 1000 3692.36 0.91 0.00- 27075.26 MCS75 FW96 800 3700.91 0.39 1529.97- 28542.69 MCS75 FW96 400 4374.80 0.164 5690.97- 28542.69 MCS75 FW96

Persistent Lines of Neutral Silver (Ag I)

Persistent Lines of Neutral Silver (Ag I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3280.680 1.47 0.000- 30472.703 PZ01 M00 500 3382.887 1.35 0.000- 29552.061 PZ01 M00 90 5209.078 0.75 29552.061- 48743.969 PZ01 FW96 90 5465.497 0.86 30472.703- 48764.219 PZ01 FW96 30 7687.772 29552.061- 42556.152 PZ01 50 8273.509 30472.703- 42556.152 PZ01

Persistent Lines of Neutral Tellurium (Te I)

Persistent Lines of Neutral Tellurium (Te I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 1822.155 0.000- 54880.070 MV75 500 1857.296 4750.712- 58592.434 MV75 500 1994.839 4750.712- 54880.070 MV75 1000 2002.028 4750.712- 54683.886 MV75 250 2081.172 10557.877- 58592.434 MV75 700 2142.822 3.11 0.000- 46652.738 MV75 M00 120 2147.260 10557.877- 57114.206 MV75 20 2259.034 0.13 0.000- 44253.000 MV75 M00 50 2383.277 0.40 4706.500- 46652.738 MV75 M00 60 2385.792 0.81 4750.712- 46652.738 MV75 M00 200 9722.742 44253.000- 54535.345 MV75 250 10051.41 44253.000- 54199.122 MV75 400 11089.56 46652.738- 55667.758 MV75 250 11487.23 46652.738- 55355.672 MV75

Persistent Lines of Neutral Tin (Sn I)

Persistent Lines of Neutral Tin (Sn I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 2091.590 1691.806- 49487.127 B64 200 2199.346 0.29 1691.806- 47145.684 B64 FW96 300 2209.660 0.56 3427.673- 48669.409 B64 FW96 300 2246.057 1.48 0.000- 44508.677 B64 M00 300 2268.930 1.14 3427.673- 47487.696 B64 M00 700 2354.850 1.85 1691.806- 44144.368 B64 M00 600 2421.694 2.5 8612.955- 49893.823 B64 FW96 700 2429.495 1.5 3427.673- 44576.006 B64 FW96 140 2661.244 0.153 1691.806- 39257.053 B64 M00 500 2706.505 0.539 1691.806- 38628.876 B64 M00 1000 2839.976 1.57 3427.673- 38628.876 B64 M00 700 2863.315 0.544 0.000- 34914.282 B64 M00 500 3009.133 0.355 1691.806- 34914.282 B64 M00 600 3034.115 1.89 1691.806- 34640.758 B64 M00 400 3175.035 0.893 3427.673- 34914.282 B64 M00 400 3262.331 2.7 8612.955- 39257.053 B64 FW96 200 3801.011 0.28 8612.955- 34914.282 B64 FW96 110 4524.734 0.26 17162.499- 39257.053 B64 FW96

Persistent Lines of Neutral Xenon (Xe I)

Persistent Lines of Neutral Xenon (Xe I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 25 1192.0376 5.93 0.000- 83889.971 BVHU01 M00 25 1250.2091 0.149 0.000- 79986.619 BVHU01 M00 100 1295.5878 2.53 0.000- 77185.040 BVHU01 M00 60 1469.6123 2.73 0.000- 68045.156 BVHU01 M00 1000 8231.635 67067.547- 79212.464 HP70b 700 8280.117 68045.156- 80118.962 HP70b 500 8819.411 67067.547- 78403.060 HP70b 300 9923.190 68045.156- 78119.798 HP70b 250 12623.399 77269.144- 85188.774 HP70b 300 14732.816 78403.060- 85188.774 HP70b 600 31069.23 79212.464- 82430.205 HP70b 500 35070.26 78119.798- 80970.439 HP70b

Persistent Lines of Neutral Cerium (Ce I)

Persistent Lines of Neutral Cerium (Ce I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 4632.320 0.000 - 21581.408 BWCC91 600 5009.098 3196.607 - 23154.693 M75c 800 5159.686 5315.803 - 24691.432 M75c 800 5161.484 7780.202 - 27149.080? M75c 700 5223.461 4762.718 - 23901.786 M75c 700 5245.916 4762.718 - 23819.871 M75c 600 5601.280 6809.128 - 24657.245 M75c 600 5669.959 3210.583 - 20842.504 M75c 800 5696.993 5315.803 - 22864.055 M75c 1000 5699.226 6809.128 - 24350.503 M75c 600 5719.031 5802.108 - 23282.722 M75c 600 5940.857 3764.008 - 20591.937 M75c

Persistent Lines of Neutral Dysprosium (Dy I)

Persistent Lines of Neutral Dysprosium (Dy I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 4045.970 1.92 0.000- 24708.971 NG00 WLN00 400 4167.974 1.92 4134.222- 28119.931 NG00 WLN00 800 4186.821 1.26 0.000- 23877.739 NG00 WLN00 140 4191.640 0.71 4134.222- 27984.513 NG00 WLN00 400 4194.846 0.88 0.000- 23832.060 NG00 WLN00 1000 4211.714 2.08 0.000- 23736.610 NG00 WLN00 250 4215.159 0.81 4134.222- 27851.435 NG00 WLN00 300 4218.092 1.20 4134.222- 27834.933 NG00 WLN00 300 4221.110 1.28 4134.222- 27818.000 NG00 WLN00 150 4225.154 1.95 7050.603- 30711.717 NG00 WLN00 130 4589.364 0.137 0.000- 21783.407 NG00 WLN00

Persistent Lines of Neutral Erbium (Er I)

Persistent Lines of Neutral Erbium (Er I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3862.851 1.16 0.000- 25880.274 M64b M00 300 3892.684 0.728 0.000- 25681.933 M64b M00 250 3937.014 0.292 0.000- 25392.779 M64b M00 250 3944.420 5035.193- 30380.282 M64b 200 3973.036 0.479 0.000- 25162.553 M64b M00 250 3973.575 0.366 0.000- 25159.143 M64b M00 1000 4007.965 1.73 0.000- 24943.272 M64b M00 200 4020.512 6958.329- 31823.748 M64b 250 4087.632 0.303 0.000- 24457.139 M64b M00 500 4151.108 0.960 0.000- 24083.166 M64b M00 70 4606.606 0.0754 0.000-21701.885 M64b M00 30 5826.786 0.0104 0.000- 17157.307 M64b M00 25 6221.019 0.0084 0.000-16070.095 M64b M00

Persistent Lines of Neutral Europium (Eu I)

Persistent Lines of Neutral Europium (Eu I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 90 3111.427 0.34 0.00- 32130.25 ST76 M00 90 3212.804 0.33 0.00- 31116.38 ST76 M00 90 3334.313 0.39 0.00- 29982.50 ST76 M00 1000 4594.03 1.60 0.00- 21761.26 MCS75 M00 900 4627.22 1.53 0.00- 21605.17 MCS75 M00 800 4661.88 1.45 0.00- 21444.58 MCS75 M00 70 5215.10 0.40 13778.68- 32948.41 MCS75 HWL02 50 5357.61 0.23 13457.21- 32117.10 MCS75 HWL02 50 5830.98 0.51 13778.68- 30923.71 MCS75 HWL02

Persistent Lines of Neutral Gadolinium (Gd I)

Persistent Lines of Neutral Gadolinium (Gd I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 3684.13 0.91 0.000- 27135.695 MCS75 M00 400 3713.57 0.92 215.124- 27135.695 MCS75 M00 400 3717.48 0.68 532.977- 27425.245 MCS75 M00 600 3783.05 0.94 999.121- 27425.245 MCS75 M00 500 4053.64 0.62 999.121- 25661.340 MCS75 M00 500 4058.22 0.57 215.124- 24849.514 MCS75 M00 600 4078.70 0.59 532.977- 25043.649 MCS75 M00 500 4175.54 0.42 1719.087- 25661.340 MCS75 M00 500 4190.78 0.30 999.121- 24854.297 MCS75 M00 1000 4225.85 0.89 1719.087- 25376.313 MCS75 M00 400 4313.84 0.43 215.124- 23389.782 MCS75 M00 400 4327.12 0.52 0.000- 23103.660 MCS75 M00 500 4346.46 999.121- 23999.912 MCS75 300 4401.86 0.38 1719.087- 24430.425 MCS75 M00 300 4422.41 0.28 215.124- 22820.895 MCS75 M00 250 4430.63 0.30 0.000- 22563.824 MCS75 M00 250 4519.66 0.38 215.124- 22334.508 MCS75 M00 200 5103.45 7947.294- 27536.397 MCS75 200 5155.84 7480.348- 26870.393 MCS75

Persistent Lines of Neutral Holmium (Ho I)

Persistent Lines of Neutral Holmium (Ho I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 4040.81 0.373 0.00-24740.52 MZH78 M00 900 4053.87 1.62 0.00-24660.80 MZH78 M00 1000 4103.80 1.55 0.00-24360.81 MZH78 M00 300 4108.62 2.0 5419.70-29751.91 MZH78 HWL99 500 4127.16 2.1 5419.70-29642.60 MZH78 HWL99 900 4163.03 0.897 0.00-24014.22 MZH78 M00 300 4173.20 0.258 0.00-23955.69 MZH78 M00 200 4227.13 1.1 5419.70-29069.78 MZH78 HWL99 150 4254.38 0.115 0.00-23498.57 MZH78 M00 150 4350.73 0.089 0.00-22978.19 MZH78 M00 30 4939.01 0.026 0.00-20241.31 MZH78 M00 25 5982.85 0.0093 0.00-16709.82 MZH78 M00 30 6604.91 0.00-15136.06 MZH78

Persistent Lines of Neutral Lanthanum (La I)

Persistent Lines of Neutral Lanthanum (La I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 3574.43 0.000- 27968.54 MCS75 300 4060.33 4121.572- 28743.24 MCS75 400 4187.32 0.000- 23874.95 MCS75 400 4280.27 1053.164- 24409.68 MCS75 500 4949.77 0.87 0.000- 20197.34 MCS75 M00 600 5145.42 3010.002- 22439.36 MCS75 800 5177.31 3494.526- 22804.25 MCS75 1000 5211.86 4121.572- 23303.26 MCS75 700 5234.27 4121.572- 23221.10 MCS75 700 5455.15 1053.164- 19379.40 MCS75 700 5501.34 0.529 0.000- 18172.35 MCS75 M00 600 5791.34 4121.572- 21384.00 MCS75 1000 6249.93 4121.572- 20117.38 MCS75 600 6394.23 3494.526- 19129.31 MCS75

Persistent Lines of Neutral Neodymium (Nd I)

Persistent Lines of Neutral Neodymium (Nd I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 4621.94 0.56 2366.597- 23996.513 MCS75 M00 1000 4634.24 0.84 0.000- 21572.610 MCS75 M00 700 4641.10 - MCS75 600 4649.67 - MCS75 600 4683.45 0.52 0.000- 21345.837 MCS75 M00 500 4719.02 0.33 0.000- 21184.881 MCS75 M00 700 4883.81 0.88 5048.602- 25518.700 MCS75 K91 500 4896.93 0.59 1128.056- 21543.326 MCS75 K91 900 4924.53 0.90 0.000- 20300.875 MCS75 M00 500 4944.83 0.67 1128.056- 21345.572 MCS75 M00 600 4954.78 0.29 0.000- 20176.912 MCS75 M00

Persistent Lines of Neutral Praseodymium (Pr I)

Persistent Lines of Neutral Praseodymium (Pr I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3959.44 - MCS75 500 4639.55 1376.60- 22924.39 MCS75 500 4687.80 - MCS75 800 4695.77 - MCS75 500 4730.67 0.34 1376.60- 22509.40 MCS75 M00 700 4736.69 0.53 0.00- 21105.88 MCS75 M00 500 4924.60 0.59 1376.60- 21677.15 MCS75 M00 800 4939.74 2846.75- 23085.08 MCS75 1000 4951.37 0.83 0.00- 20190.85 MCS75 M00 500 5019.76 2846.75- 22762.55 MCS75 500 5026.96 0.40 1376.60- 21263.71 MCS75 M00 800 5045.52 0.71 4381.10- 24195.13 MCS75 M00 500 5087.12 0.44 2846.75- 22498.81 MCS75 M00 700 5133.44 0.38 0.00- 19474.75 MCS75 M00

Persistent Lines of Neutral Promethium (Pm I)

Persistent Lines of Neutral Promethium (Pm I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 4734.27 803.82- 21920.49 RD67 700 4759.00 5089.79- 26096.75 RD67 1000 4762.57 5089.79- 26080.99 RD67 400 4773.46 2797.10- 23740.42 RD67 600 4798.98 2797.10- 23629.06 RD67 500 4801.36 803.82- 21625.45 RD67 350 4811.85 7497.99- 28274.21 RD67 350 4837.66 1748.78- 22414.17 RD67 700 4860.74 803.82- 21371.05 RD67 350 4892.52 803.82- 21237.49 RD67 350 4932.99 0.00- 20265.98 RD67 500 4959.46 0.00- 20157.85 RD67 1000 4997.10 0.00- 20006.04 RD67 1000 5058.31 803.82- 20567.76 RD67 1000 5127.34 2797.10- 22294.96 RD67 700 5146.30 3919.03- 23345.07 RD67 300 6100.21 - RCWM80 300 6520.45 - RCWM80 400 6598.15 - RCWM80

Persistent Lines of Neutral Samarium (Sm I)

Persistent Lines of Neutral Samarium (Sm I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600* 3745.465 0.27 1489.55- 28180.95 K35 M00 400* 3990.025 0.43 3125.46- 28180.95 K35 M00 1000 4296.743 1.00 4020.66- 27287.58 K35 M00 600 4336.137 3125.46- 26180.92 K35 300 4362.912 0.49 0.00- 22914.07 K35 M00 500 4470.886 2273.09- 24633.75 K35 500 4716.097 3125.46- 24323.51 K35 500 4728.423 0.49 1489.55- 22632.30 K35 M00 500 4760.27 0.13 811.92- 21813.22 K35 M00 600 4841.701 0.87 4020.66- 24668.79 K35 M00 500 4883.971 3125.46- 23594.84 K35

Persistent Lines of Neutral Terbium (Tb I)

Persistent Lines of Neutral Terbium (Tb I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3830.261 285.530- 26386.005 B01 500 3901.325 462.120- 26087.175 B01 300 4032.284 2310.120- 27102.955 B01 400 4061.558 462.120- 25076.265 B01 700 4318.847 0.000- 23147.820 B01 1000 4326.472 0.000- 23107.025 B01 300 4336.455 2771.675- 25825.505 B01 600 4338.435 0.000- 23043.310 B01 300 4356.837 2771.675- 25717.655 B01 50 5354.88 462.120- 19131.480 MCS75

Persistent Lines of Neutral Thulium (Tm I)

Persistent Lines of Neutral Thulium (Tm I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 3717.914 1.44 0.000- 26889.125 SMC73 WL97 500 3744.064 0.990 0.000- 26701.325 SMC73 WL97 700 3883.132 1.06 0.000- 25745.117 SMC73 WL97 500 3887.348 0.372 0.000- 25717.197 SMC73 WL97 400 3916.477 1.98 8771.243- 34297.17 SMC73 WL97 1000 4094.187 0.979 0.000- 24418.018 SMC73 WL97 1000 4105.841 0.636 0.000- 24348.692 SMC73 WL97 900 4187.615 0.640 0.000- 23873.207 SMC73 WL97 600 4203.727 0.243 0.000- 23781.698 SMC73 WL97 250 4359.928 0.120 0.000- 22929.717 SMC73 WL97 140 4386.434 0.037 0.000- 22791.176 SMC73 WL97 70 4733.335 0.020 0.000- 21120.836 SMC73 WL97 60 5307.116 0.022 0.000- 18837.385 SMC73 WL97 50 5675.835 0.013 0.000- 17613.659 SMC73 M00

Persistent Lines of Neutral Gold (Au I)

Persistent Lines of Neutral Gold (Au I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 14 1646.674 0.000- 60728.49 BG78 20 1699.339 0.000- 58845.414 BG78 1000 2012.00 9161.177- 58845.414 ED71 250 2021.38 9161.177- 58616.764 ED71 250 2427.95 1.98 0.000- 41174.613 ED71 M00 300 2675.954 1.63 0.000- 37358.991 ED71 M00 100 2748.253 9161.177- 45537.195 ED71 30 3029.204 9161.177- 42163.530 ED71 150 3122.784 0.190 9161.177- 41174.613 ED71 FW96 50 6278.170 0.034 21435.191- 37358.991 ED71 FW96

Persistent Lines of Neutral Hafnium (Hf I)

Persistent Lines of Neutral Hafnium (Hf I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2866.37 0.00- 34877.04 MCS75 800 2898.26 2356.68- 36850.04 MCS75 500 2904.41 4567.64- 38987.85 MCS75 900 2916.48 4567.64- 38845.45 MCS75 900 2940.77 0.00- 33994.86 MCS75 1000 3072.88 0.00- 32533.32 MCS75 1000 3682.24 0.26 0.00- 27149.64 MCS75 M00 500 4174.34 0.046 2356.68- 26305.78 MCS75 M00 300 7237.10 4567.64- 18381.50 MCS75

Persistent Lines of Neutral Iridium (Ir I)

Persistent Lines of Neutral Iridium (Ir I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 900 2033.57 0.00- 49158.63 MCS75 1000 2088.82 0.00- 47858.45 MCS75 500 2158.05 2834.99- 49158.63 MCS75 200 2372.77 0.00- 42131.84 MCS75 200 2475.12 0.21 0.00- 40389.83 MCS75 FW96 250 2502.98 0.32 0.00- 39940.37 MCS75 FW96 500 2543.97 2834.99- 42131.84 MCS75 200 2639.71 0.47 0.00- 37871.69 MCS75 FW96 150 2664.79 0.40 0.00- 37515.32 MCS75 FW96 200 2694.23 0.48 2834.99- 39940.37 MCS75 FW96 200 2849.72 0.22 0.00- 35080.70 MCS75 FW96 250 2924.79 0.142 0.00- 34180.46 MCS75 FW96 300 3220.78 0.24 2834.99- 33874.44 MCS75 FW96 200 3513.64 0.00- 28452.31 MCS75

Persistent Lines of Neutral Lead (Pb I)

Persistent Lines of Neutral Lead (Pb I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 2022.016 0.059 0.000- 49439.616 WA68 M00 200 2053.284 0.102 0.000- 48686.934 WA68 M00 150 2170.005 1.5 0.000- 46068.438 WA68 FW96 50 2393.792 10650.327- 52412.325 WA68 200 2614.175 1.9 7819.263- 46060.836 WA68 FW96 300 2801.995 1.6 10650.327- 46328.667 WA68 FW96 300 2833.053 0.58 0.000- 35287.224 WA68 FW96 150 3639.568 0.34 7819.263- 35287.224 WA68 FW96 400 3683.462 1.5 7819.263- 34959.908 WA68 FW96 80 3739.935 0.73 21457.798- 48188.630 WA68 FW96 1000 4057.807 0.89 10650.327- 35287.224 WA68 FW96 15 4062.136 0.92 21457.798- 46068.438 WA68 FW96

Persistent Lines of Neutral Lutetium (Lu I)

Persistent Lines of Neutral Lutetium (Lu I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 3081.47 2.62 1993.92- 34436.49 MCS75 FHLP00 400 3118.43 2.03 0.00- 32058.1 MCS75 FHLP00 500 3278.97 1.00 0.00- 30488.62 MCS75 FHLP00 1000 3281.74 3.05 1993.92- 32456.87 MCS75 FHLP00 800 3312.11 1.85 0.00- 30183.55 MCS75 FHLP00 1000 3359.56 2.44 1993.92- 31751.17 MCS75 FHLP00 800 3376.50 1.68 0.00- 29607.98 MCS75 FHLP00 600 3567.84 0.69 0.00- 28020.18 MCS75 FHLP00 300 3647.77 0.92 4136.00- 31542.24 MCS75 FHLP00 400 3841.18 0.265 1993.92- 28020.18 MCS75 FHLP00 400 4124.73 0.89 7476.35- 31713.60 MCS75 FHLP00 400 4518.57 0.226 0.00- 22124.70 MCS75 FHLP00 400 5135.09 0.091 1993.92- 21462.35 MCS75 FHLP00 200 6004.52 0.49 7476.35- 24125.86 MCS75 FHLP00

Persistent Lines of Neutral Mercury (Hg I)

Persistent Lines of Neutral Mercury (Hg I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1849.499 7.46 0.000- 54068.781 WA63 M00 1000 2536.517 0.080 0.000- 39412.300 BAL50 FW96 250 2967.280 0.45 37645.080- 71336.164 BAL50 FW96 600 3650.153 1.3 44042.977- 71431.311 BAL50 FW96 400 4046.563 0.21 37645.080- 62350.456 BAL50 FW96 1000 4358.328 0.557 39412.300- 62350.456 BAL50 FW96 500 5460.735 0.487 44042.977- 62350.456 BAL50 FW96 200 10139.76 0.271 54068.781- 63928.243 BAL50 FW96

Persistent Lines of Neutral Osmium (Os I)

Persistent Lines of Neutral Osmium (Os I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2018.14 0.00- 49534.28 MCS75 600 2034.44 0.00- 49138.11 MCS75 900 2045.36 0.00- 48874.93 MCS75 500 2079.97 0.00- 48062.22 MCS75 130 2637.13 0.00- 37908.77 MCS75 100 2714.64 0.00- 36826.39 MCS75 100 2806.91 0.00- 35615.92 MCS75 200 2838.63 5143.92- 40361.92 MCS75 300 2909.06 0.00- 34365.33 MCS75 150 3018.04 0.00- 33124.48 MCS75 300 3058.66 0.29 0.00- 32684.61 MCS75 M00 " 14091.37- 46776.29 110 3262.29 4159.32- 34803.82 MCS75 110 3267.94 0.058 0.00- 30591.45 MCS75 M00 250 3301.56 0.099 0.00- 30279.95 MCS75 M00 70 3782.20 4159.32- 30591.45 MCS75 150 4260.85 0.00- 23462.90 MCS75 150 4420.47 0.00- 22615.69 MCS75

Persistent Lines of Neutral Platinum (Pt I)

Persistent Lines of Neutral Platinum (Pt I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 2487.1685 775.892- 40970.165 SRSA92 " 0.000- 40194.228 SRSA92 200 2628.0269 0.482 775.892- 38815.908 SRSA92 M00 300 2650.8524 0.0962 823.678- 38536.160 SRSA92 M00 500 2659.4503 0.890 0.000- 37590.569 SRSA92 M00 200 2702.3995 0.523 775.892- 37769.073 SRSA92 M00 150 2705.8951 0.380 823.678- 37769.073 SRSA92 M00 300 2733.9567 0.672 775.892- 37342.101 SRSA92 M00 300 2830.2919 0.168 0.000- 35321.653 SRSA92 M00 130 2893.8630 0.0647 775.892- 35321.653 SRSA92 M00 400 2929.7894 0.185 0.000- 34122.165 SRSA92 M00 600 2997.9622 0.288 775.892- 34122.165 SRSA92 M00 800 3042.6318 0.0769 823.678- 33680.402 SRSA92 M00 1000 3064.7110 0.644 0.000- 32620.018 SRSA92 M00 250 3301.8596 0.343 6567.461- 36844.710 SRSA92 M00 150 3315.0419 0.00176 0.000- 30156.854 SRSA92 M00 900 3408.1308 0.0129 823.678- 30156.854 SRSA92 M00 250 3818.6874 10116.729- 36296.310 SRSA92

Persistent Lines of Neutral Rhenium (Re I)

Persistent Lines of Neutral Rhenium (Re I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 2003.53 0.00- 49895.57 MCS75 300 2017.87 0.00- 49540.96 MCS75 500 2049.08 0.00- 48786.35 MCS75 80 2074.70 0.00- 48184.20 MCS75 200 2085.59 0.00- 47932.55 MCS75 200 2097.12 0.00- 47669.01 MCS75 90 2167.94 0.00- 46112.24 MCS75 100 2999.60 11754.52- 45082.63 MCS75 70 3399.30 11754.52- 41163.91 MCS75 150 3424.62 11754.52- 40946.53 MCS75 300 3451.88 0.174 0.00- 28961.55 MCS75 FMW88 1000 3460.46 0.313 0.00- 28889.72 MCS75 FMW88 700 3464.73 0.249 0.00- 28854.18 MCS75 FMW88 70 3725.76 23631.82- 50464.34 MCS75

Persistent Lines of Neutral Tantalum (Ta I)

Persistent Lines of Neutral Tantalum (Ta I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 2559.43 0.00- 39059.52 MCS75 500 2608.63 2010.10- 40333.03 MCS75 900 2647.47 0.00- 37760.67 MCS75 1000 2653.27 2010.10- 39688.20 MCS75 700 2656.61 0.00- 37630.09 MCS75 600 2661.34 5621.04- 43185.09 MCS75 400 2698.30 2010.10- 39059.52 MCS75 1000 2714.67 0.00- 36825.97 MCS75 400 2758.31 2010.10- 38253.39 MCS75 600 2850.49 - MCS75 700 2850.98 5621.04- 40686.42 MCS75 700 2933.55 0.00- 34078.42 MCS75 600 2963.32 2010.10- 35746.18 MCS75 400 3311.16 5621.04- 35813.47 MCS75 150 4681.88 0.015 2010.10- 23363.09 MCS75 FW96 130 5156.56 5621.04- 25008.83 MCS75

Persistent Lines of Neutral Thallium (Tl I)

Persistent Lines of Neutral Thallium (Tl I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 40 2379.69 0.44 0.0- 42011.4 MCS75 FW96 40 2580.14 0.18 0.0- 38745.9 MCS75 FW96 200 2767.87 1.26 0.0- 36117.9 MCS75 FW96 140 2918.32 0.42 7792.7- 42049.0 MCS75 FW96 60 3229.75 0.173 7792.7- 38745.9 MCS75 FW96 1000 3519.24 1.24 7792.7- 36199.9 MCS75 FW96 250 3529.43 0.220 7792.7- 36117.9 MCS75 FW96 600 3775.72 0.625 0.0- 26477.5 MCS75 FW96 900 5350.46 0.795 7792.7- 26477.5 MCS75 FW96 50 11512.82 26477.5- 35161.1 MM52 40 13013.2 26477.5- 34159.9 MM52

Persistent Lines of Neutral Tungsten (W I)

Persistent Lines of Neutral Tungsten (W I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 2551.35 1.78 0.00- 39183.20 MCS75 M00 250 2681.42 2951.29- 40233.97 MCS75 300 2724.35 2951.29- 39646.41 MCS75 200 2831.38 2951.29- 38259.40 MCS75 150 2896.44 2951.29- 37466.30 MCS75 300 2944.40 2951.29- 36904.16 MCS75 300 2946.99 2951.29- 36874.36 MCS75 120 3215.56 0.21 6219.33- 37309.16 MCS75 FW96 200 3617.52 0.11 2951.29- 30586.64 MCS75 FW96 1000 4008.75 0.163 2951.29- 27889.68 MCS75 FW96 600 4074.36 0.10 2951.29- 27488.11 MCS75 FW96 500 4294.61 0.12 2951.29- 26229.77 MCS75 FW96 250 4302.11 0.036 2951.29- 26189.20 MCS75 FW96

Persistent Lines of Neutral Ytterbium (Yb I)

Persistent Lines of Neutral Ytterbium (Yb I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 25 2464.50 1.00 0.000- 40563.97 MT78 M00 20 2671.958 0.143 0.000- 37414.59 MT78 M00 130 3464.37 0.683 0.000- 28857.014 MT78 M00 1000 3987.99 1.92 0.000- 25068.222 MT78 M00 50 3990.885 19710.388- 44760.37 MT78 40 4576.209 17992.007- 39838.04 MT78 40 4935.500 19710.388- 39966.09 MT78 130 5556.466 0.0115 0.000- 17992.007 MT78 M00 40 6799.60 17992.007- 32694.692 MT78 40 7699.49 19710.388- 32694.692 MT78

Persistent Lines of Neutral Actinium (Ac I)

Persistent Lines of Neutral Actinium (Ac I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 3885.56 0.00- 25729.03 MFT57 1000 4179.98 0.00- 23916.84 MFT57 500 4183.12 0.00- 23898.86 MFT57 400 4194.40 2231.43- 26066.04 MFT57 300 4384.53 0.00- 22801.10 MFT57 400 4396.71 2231.43- 24969.30 MFT57 400 4462.73 0.00- 22401.52 MFT57 300 4613.93 2231.43- 23898.86 MFT57 500 4716.58 0.00- 21195.87 MFT57 300 5258.24 0.00- 19012.46 MFT57 300 6359.86 2231.43- 17950.71 MFT57 200 6691.27 0.00- 14940.72 MFT57 300 7290.40 0.00- 13712.90 MFT57

Persistent Lines of Neutral Americium (Am I)

Persistent Lines of Neutral Americium (Am I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3510.127 0.00- 28480.87 FT57 500 3569.163 0.00- 28009.81 FT57 500 3673.121 0.00- 27217.14 FT57 500 4289.258 0.00- 23307.41 FT57 500 4662.790 0.00- 21440.37 FT57 1000 6054.64 0.00- 16511.82 FT57

Persistent Lines of Neutral Astatine (At I)

Persistent Lines of Neutral Astatine (At I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 2162.25 0.0 - 46233.6 ? M64a 1000 2244.01 0.0 - 44549.3 ? M64a

Persistent Lines of Neutral Bismuth (Bi I)

Persistent Lines of Neutral Bismuth (Bi I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 1954.706 0.586 0.000- 51158.494 WBBF01 CBZS95 250 1960.049 0.154 0.000- 51019.090 WBBF01 CBZS95 250 2021.149 0.060 0.000- 49460.910 WBBF01 FW96 300 2061.634 0.96 0.000- 48489.869 WBBF01 CBZS95 200 2110.217 0.53 0.000- 47373.477 WBBF01 CBZS95 120 2228.203 0.88 0.000- 44865.076 WBBF01 CBZS95 600 2230.602 2.34 0.000- 44816.841 WBBF01 CBZS95 500 2897.965 1.53 11419.039- 45915.883 WBBF01 FW96 400 2938.297 1.23 15437.501- 49460.910 WBBF01 FW96 300 2989.019 0.54 11419.039- 44865.076 GMV85 CBZS95 80 2993.336 0.145 11419.039- 44816.841 GMV85 CBZS95 300 3024.621 0.86 15437.501- 48489.869 GMV85 CBZS95 1000 3067.700 1.67 0.000- 32588.221 WBBF01 CBZS95 70 4722.527 0.094 11419.039- 32588.221 GMV85 CBZS95 70 9657.04 32588.221- 42940.519 GMV85 50 11710.83 32588.221- 41124.985 GMV85

Persistent Lines of Neutral Curium (Cm I)

Persistent Lines of Neutral Curium (Cm I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3109.690 1214.203- 33362.424 WHGC76 1000 3116.411 0.000- 32078.886 WHGC76 1000 3224.226 1764.268- 32770.516 WHGC76 1000 3225.108 1764.268- 32762.036 WHGC76 1000 3304.849 1214.203- 31464.053 WHGC76 1000 3452.922 3809.355- 32762.036 WHGC76 1000 3458.338 1214.203- 30121.545 WHGC76 1000 3816.304 1214.203- 27410.123 WHGC76 1000 3936.666 1214.203- 26609.213 WHGC76 1000 3995.100 0.000- 25023.578 WHGC76 1000 4211.62 1214.203- 24951.328 WHGC76 1000 4330.82 0.000- 23083.822 WHGC76 1000 4459.16 1214.203- 23633.638 WHGC76 1000 4608.40 1214.203- 22907.611 WHGC76 1000 5952.41 1214.203- 18009.483 WHGC76 1000 6376.71 0.000- 15677.750 WHGC76 1000 6706.85 815.655- 15721.679 WHGC76 1000 7162.69 1764.268- 15721.679 WHGC76 1000 7720.47 9064.880- 22013.913 WHGC76 1000 8392.37 3809.355- 15721.679 WHGC76 1000 10542.98 302.153- 9784.543 WHGC76 1000 10792.25 0.000- 9263.374 WHGC76

Persistent Lines of Neutral Francium (Fr I)

Persistent Lines of Neutral Francium (Fr I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 4225.655 0.000- 23658.306 ABDJ90 4325.361 0.000- 23112.960 ABDJ90 7179.866 0.000- 13923.998 ABDJ90 8169.418 0.000- 12237.409 ABDJ90

Persistent Lines of Neutral Neptunium (Np I)

Persistent Lines of Neutral Neptunium (Np I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 3481.93 0.000- 28711.465 FTBC76 300 3501.50 0.000- 28551.035 FTBC76 300 3986.89 0.000- 25075.145 FTBC76 300 5044.66 2033.965- 21851.300 FTBC76 300 5878.04 0.000- 17007.700 FTBC76 300 6930.31 2033.965- 16459.340 FTBC76 1000 6972.09 0.000- 14338.880 FTBC76 300 7735.14 6903.440- 19827.885 FTBC76 300 7765.75 7112.430- 19985.980 FTBC76 300 7791.38 3502.855- 16334.010 FTBC76 300 8339.12 7112.430- 19100.810 FTBC76 1000 8372.88 0.000- 11940.075 FTBC76 1000 8529.96 6474.180- 18194.400 FTBC76 1000 9016.18 7112.430- 18200.530 FTBC76 300 9379.33 2033.965- 12692.765 FTBC76 300 9468.66 5185.015- 15743.235 FTBC76 300 10091.99 2033.965- 11940.075 FTBC76 300 10817.45 3450.995- 12692.765 FTBC76 300 11776.64 3450.995- 11940.075 FTBC76 300 12377.42 4615.670- 12692.765 FTBC76

Persistent Lines of Neutral Plutonium (Pu I)

Persistent Lines of Neutral Plutonium (Pu I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3753.628 0.000- 26633.288 BFG84 500 3755.940 2203.606- 28820.548 BFG84 500 3758.338 10238.473- 36838.42 BFG84 500 3774.384 2203.606- 28690.480 BFG84 500 3851.007 0.000- 25959.849 BFG84 500 3878.540 2203.606- 27979.161 BFG84 1000 4206.481 0.000- 23766.139 BFG84 800 6304.661 0.000- 15856.888 BFG84 800 6486.707 2203.606- 17615.482 BFG84 1000 6488.853 0.000- 15406.760 BFG84 800 6887.710 6313.866- 20828.477 BFG84 1000 8630.189 6313.866- 17897.919 BFG84

Persistent Lines of Neutral Polonium (Po I)

Persistent Lines of Neutral Polonium (Po I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 2450.08 0.00- 40802.70 C66a 600 2558.01 0.00- 39081.19 C66a 1000 3003.21 7514.69- 40802.70 C66a 500 4170.52 16831.61- 40802.70 C66a

Persistent Lines of Neutral Protactinium (Pa I)

Persistent Lines of Neutral Protactinium (Pa I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3636.52 825.415 - 28316.365 BW92b 1000 3982.23 0.000 - 25104.455 BW92b 1000 6945.72 0.000 - 14393.410 BW92b 1000 7114.89 825.415 - 14876.545 BW92b 1000 7368.25 825.415 - 14393.410 BW92b 1000 7493.15 3323.860 - 16665.690 BW92b 1000 7608.20 3323.860 - 16463.970 BW92b 1000 7626.79 3711.625 - 16819.670 BW92b 1000 7635.18 7512.695 - 20606.365 BW92b 1000 7669.34 4121.450 - 17156.785 BW92b 1000 7749.19 1618.325 - 14519.355 BW92b 1000 8039.34 3711.625 - 16147.025 BW92b 1000 8099.84 4121.450 - 16463.970 BW92b 1000 8199.04 825.415 - 13018.610 BW92b 1000 8271.87 825.415 - 12911.260 BW92b 1000 8532.66 2966.530 - 14683.005 BW92b 1000 8572.96 7000.290 - 18661.700 BW92b 1000 8735.27 0.000 - 11444.705 BW92b 1000 11791.73 2966.530 - 11444.705 BW92b 1000 13522.40 7000.290 - 14393.410 BW92b 1000 14344.76 5149.465 - 12118.750 BW92b

Persistent Lines of Neutral Radium (Ra I)

Persistent Lines of Neutral Radium (Ra I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 4825.91 0.00- 20715.71 R34b 500 5660.81 14707.35- 32367.78 R34b 300 6200.30 13993.97- 30117.78 R34b 500 7141.21 0.00- 13999.38 R34b

Persistent Lines of Neutral Radon (Rn I)

Persistent Lines of Neutral Radon (Rn I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1451.56 0.0 - 68891.34 R30 1786.07 0.0 - 55989.03 R30 300 4349.60 54620.35- 77604.53 R33 700 7055.42 54620.35- 68789.93 R33 300 7268.11 55989.03- 69743.98 R33 1000 7450.00 54620.35- 68039.48 R33 300 7809.82 55989.03- 68789.93 R33 300 8099.51 55989.03- 68332.10 R33 300 8270.96 54620.35- 66707.53 R33 300 8600.07 54620.35- 66244.97 R33

Persistent Lines of Neutral Thorium (Th I)

Persistent Lines of Neutral Thorium (Th I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 3304.2383 0.000- 30255.452 PE83 500 3348.7684 0.000- 29853.143 PE83 700 3421.2100 4961.659- 34182.708 PE83 600 3706.7672 8111.005- 35081.017 PE83 1000 3719.4347 0.000- 26878.162 PE83 1000 3803.0750 0.000- 26287.049 PE83 800 3828.3846 0.000- 26113.270 PE83 600 3895.4192 7795.275- 33459.180 PE83 700 3967.3921 4961.659- 30160.003 PE83 500 4012.4952 2869.259- 27784.366 PE83 400 4112.7545 0.000- 24307.749 PE83 500 4115.7589 5563.142- 29853.143 PE83 200 5067.9737 7795.275- 27521.527 PE83 200 5231.1597 2558.057- 21668.956 PE83 120 5760.5508 0.000- 17354.639 PE83 100 6169.8221 4961.659- 21165.096 PE83 100 6457.2824 7795.275- 23277.387 PE83 90 6989.6553 7795.275- 22098.187 PE83 70 8967.6403 8800.251- 19948.395 PE83

Persistent Lines of Neutral Uranium (U I)

Persistent Lines of Neutral Uranium (U I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3489.3672 0.13 0.000- 28650.294 SPMR72 M00 500 3514.6107 0.12 0.000- 28444.517 SPMR72 M00 400 3561.8038 0.057 0.000- 28067.646 SPMR72 M00 700 3566.5909 0.24 620.323- 28650.294 SPMR72 M00 1000 3584.8774 0.19 0.000- 27886.995 SPMR72 M00 300 3659.1548 620.323- 27941.253 SPMR72 600 3811.9911 0.16 0.000- 26225.569 SPMR72 M00 400 3839.6255 3800.829- 29837.643 SPMR72 500 3871.0353 0.19 0.000- 25825.565 PKE80 M00 400 3943.8161 0.21 0.000- 25348.977 PKE80 M00 300 4042.7496 620.323- 25348.977 PKE80 300 4153.9710 0.12 0.000- 24066.566 PKE80 M00 120 4156.6483 620.323- 24671.388 PKE80 130 4355.7400 620.323- 23572.086 PKE80 130 4362.0510 0.11 0.000- 22918.553 PKE80 M00 70 5915.385 0.045 0.000- 16900.386 PKE80 M00

Persistent Lines of Neutral Berkelium (Bk I)

Persistent Lines of Neutral Berkelium (Bk I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3288.750 5416.690- 35814.60 WC78 1000 3289.347 - 1000 3426.951 0.000- 29172.103 WC78 1000 3442.664 0.000- 29038.930 WC78 1000 3609.614 0.000- 27695.870 WC78 1000 4363.636 0.000- 22910.225 WC78 1000 4466.457 0.000- 22382.830 WC78 1000 5212.53 0.000- 19179.210 WC78 1000 5271.95 6530.720- 25493.793 WC78 1000 5659.03 0.000- 17665.980 WC78 1000 5910.71 0.000- 16913.770 WC78 1000 11293.14 9141.115- 17993.628 CWBC77 1000 11500.30 9300.585- 17993.628 CWBC77 1000 11793.09 9300.585- 17777.808 CWBC77

Persistent Lines of Neutral Californium (Cf I)

Persistent Lines of Neutral Californium (Cf I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3298.14 0.000- 30311.400 RCWM80 1000 3352.71 0.000- 29818.055 RCWM80 1000 3598.77 0.000- 27779.345 RCWM80 1000 4329.03 0.000- 23093.355 RCWM80 1000 5408.88 0.000- 18483.060 RCWM80 1000 8141.29 19907.460- 32187.145 RCWM80 1000 11941.33 16909.535- 25281.530 CWBV77 1000 12787.41 16909.535- 24727.600 CWBV77

Persistent Lines of Neutral Einsteinium (Es I)

Persistent Lines of Neutral Einsteinium (Es I)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3428.48 0.00- 29159.28 WLGC74 1000 3498.11 0.00- 28578.60 WLGC74 1000 3514.33 0.00- 28447.02 WLGC74 1000 3521.38 10244.29- 38634.04 WLGC74 1000 3523.49 0.00- 28372.78 WLGC74 1000 3555.34 0.00- 28118.65 WLGC74 1000 3801.49 7894.54- 34192.6 WLGC74 1000 5161.74 0.00- 19367.85 WLGC74 1000 5204.40 0.00- 19209.15 WLGC74 300 5615.51 0.00- 17803.09 WLGC74

Persistent Lines of Singly Ionized Beryllium (Be II)

Persistent Lines of Singly Ionized Beryllium (Be II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 1512.269 9.2 31928.744- 98054.55 J61a FW96 800 1512.412 11. 31935.320- 98055.10 J61a FW96 " 31935.320- 98054.55 1000 3130.4219 1.13 0.000- 31935.320 BWWI85 M03 600 3131.0667 1.13 0.000- 31928.744 BWWI85 M03 60 4360.663 0.92 96495.34 -119421.18 J61a FW96 100 4360.988 1.1 96497.26 -119421.42 J61a FW96 140 4673.329 98054.55 -119446.59 J61a 200 4673.423 98055.10 -119446.71 J61a 100 5270.811 0.66 96497.26 -115464.38 J61a FW96

Persistent Lines of Singly Ionized Boron (B II)

Persistent Lines of Singly Ionized Boron (B II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1362.463 11.9 0.00- 73396.51 LZJK98 M03 700 1623.597 37342.15- 98933.76 LZJK98 500 1623.790 37336.04- 98920.37 LZJK98 1000 1624.023 15.6 37358.30- 98933.76 LZJK98 LZJK98 700 1624.376 37358.30- 98920.37 LZJK98 500 1842.820 13.3 73396.51-127661.19 LZJK98 LZJK98 200 2395.048 102362.77-144103.17 O70 500 3451.303 0.54 73396.51-102362.77 LZJK98 LZJK98

Persistent Lines of Singly Ionized Carbon (C II)

Persistent Lines of Singly Ionized Carbon (C II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 687.0526 23.7 0.00-145549.27 KE74 WFD96 1000 687.346 28.4 63.42-145550.70 KE74 WFD96 750 904.1416 34.2 63.42-110665.56 KE74 WFD96 250 1036.3367 7.34 0.00- 96493.74 KE74 M03 500 1037.0182 14.7 63.42- 96493.74 KE74 M03 80 1334.5323 2.40 0.00- 74932.62 KE74 M03 150 1335.7077 2.88 63.42-74930.10 KE74 M03 500 2836.710 0.398 96493.74-131735.52 MG93 WFD96 400 2837.603 0.397 96493.74-131724.37 MG93 WFD96 300 3918.978 0.636 131724.37-157234.07 MG93 WFD96 400 3920.693 1.27 131735.52-157234.07 MG93 WFD96 400 4267.003 2.23 145549.27-168978.34 MG93 WFD96 500 4267.258 2.38 145550.70-168978.34 MG93 WFD96 " 0.159 145550.70-168978.34 WFD96 400 6578.05 0.363 116537.65-131735.52 MG93 WFD96 400 7231.32 0.352 131724.37-145549.27 MG93 WFD96 500 7236.42 0.422 131735.52-145550.70 MG93 WFD96

Persistent Lines of Singly Ionized Fluorine (F II)

Persistent Lines of Singly Ionized Fluorine (F II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 900 484.602 20873.4 -227228.42 P69 900 605.669 43 0.00 -165106.66 P69 WSG66 800 606.288 100 341.1400-165279.19 P69 WSG66 1000 606.804 78 0.00 -164797.88 P69 WSG66 700 606.923 26 341.1400-165106.66 P69 WSG66 800 607.472 33 489.6845-165106.66 P69 WSG66 900 608.062 25 341.1400-164797.88 P69 WSG66 250 3847.086 1.3 176493.93 -202480.26 P69 WSG66 250 3849.985 1.3 176493.93 -202460.69 P69 WSG66 250 3851.668 1.3 176493.93 -202449.35 P69 WSG66 250 4024.726 1.2 182864.40 -207703.79 P69 WSG66 200 4025.010 1.2 182864.40 -207702.04 P69 WSG66 250 4025.491 1.2 182864.40 -207699.07 P69 WSG66

Persistent Lines of Singly Ionized Helium (He II)

Persistent Lines of Singly Ionized Helium (He II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 256.3166 26.77 0.0000-390142.5605 MK00b BM00 150 256.3177 26.77 0.0000-390140.8250 MK00b BM00 1000 303.7804 100.27 0.0000-329185.1511 MK00b BM00 500 303.7858 100.28 0.0000-329179.2940 MK00b BM00 120 1640.3321 8.624 329179.2940-390142.5576 MK00b BM00 50 1640.3447 3.593 329179.7623-390142.5605 MK00b BM00 7 1640.3750 0.337 329179.2940-390140.9646 MK00b BM00 25 1640.3914 3.594 329179.7623-390140.8250 MK00b BM00 180 1640.4742 10.35 329185.1511-390143.1361 MK00b BM00 25 1640.4897 1.725 329185.1511-390142.5576 MK00b BM00 15 1640.5326 0.674 329185.1511-390140.9646 MK00b BM00 4 4685.3769 0.939 390140.8250-411477.8537 MK00b BM00 3 4685.4072 0.491 390140.9646-411477.8550 MK00b BM00 15* 4685.7038 2.060 390142.5576-411478.0973 MK00b BM00 15* 4685.7044 1.126 390142.5605-411478.0978 MK00b BM00 12 4685.8041 2.207 390143.1361-411478.2193 MK00b BM00

Persistent Lines of Singly Ionized Hydrogen (H II)

Persistent Lines of Singly Ionized Hydrogen (H II)

Sorry! No data are available.

Persistent Lines of Singly Ionized Lithium (Li II)

Persistent Lines of Singly Ionized Lithium (Li II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 178.014 77.9 0. -561751.50 R37 WSG66 1000 199.280 256 0. -501807.59 R37 WSG66 300 5483.56 0.228 476034.24-494265.57 HM59 WSG66 500 5484.50 0.228 476034.24-494262.48 HM59 WSG66 400 5485.11 0.228 476034.24-494260.32 HM59 WSG66 100 9581.42 0.0518 491373.58-501807.59 TE62 WSG66

Persistent Lines of Singly Ionized Magnesium (Mg II)

Persistent Lines of Singly Ionized Magnesium (Mg II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 14 1025.9681 0.032 0.00- 97468.92 KM91a M03 12 1026.1134 0.032 0.00- 97455.12 KM91a M03 25 1239.9253 0.014 0.00- 80650.02 KM91a M03 20 1240.3946 0.015 0.00- 80619.50 KM91a M03 13 2790.7767 4.0 35669.31- 71491.06 KM91a FW96 1000 2795.5301 2.6 0.00- 35760.88 PTW98 FW96 15 2797.998 4.8 35760.88- 71490.19 KM91a FW96 600 2802.7056 2.6 0.00- 35669.31 PTW98 FW96 14 4481.126 2.23 71490.19- 93799.75 KM91a FW96 13 4481.325 2.08 71491.06- 93799.63 KM91a FW96

Persistent Lines of Singly Ionized Neon (Ne II)

Persistent Lines of Singly Ionized Neon (Ne II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 90 352.9549 6.69 0.00-283322.35 P71 VVF96 60 354.9620 17.3 0.00-281720.28 P71 VVF96 200 445.0393 13.1 0.00-224699.27 P71 VVF96 300 446.2552 32.6 0.00-224087.02 P71 VVF96 250 446.5902 26.0 780.34-224699.27 P71 VVF96 1000 460.7284 53.9 0.00-217047.61 P71 VVF96 500 462.3908 26.6 780.34-217047.61 P71 VVF96 500 1916.0818 0.69 224087.02-276276.85 P71 FW96 300 1930.0345 0.57 224699.27-276511.82 P71 FW96 300 3027.016 1.4 246192.45-279218.66 P71 FW96 300 3028.864 0.47 219947.46-252953.54 P71 FW96 500 3198.586 1.7 249445.99-280700.77 P71 FW96 1000 3323.745 1.6 224087.02-254165.01 P71 FW96 500 3378.216 1.7 224699.27-254292.19 P71 FW96 800 3766.259 0.29 219648.44-246192.45 P71 FW96 1000 3777.133 0.42 219947.46-246415.04 P71 FW96

Persistent Lines of Singly Ionized Nitrogen (N II)

Persistent Lines of Singly Ionized Nitrogen (N II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 644.635 12.1 0.00-155126.73 E83 WFD96 600 644.837 36.4 48.67-155126.73 E83 WFD96 1000 645.179 60.7 130.80-155126.73 E83 WFD96 400 775.967 30.8 15316.17-144187.94 E83 WFD96 50 915.613 4.38 0.00-109216.44 E83 WFD96 50 915.963 13.2 48.67-109223.34 E83 WFD96 60 916.019 3.26 48.67-109216.93 E83 WFD96 " 3.33 48.67-109216.44 E83 WFD96 200 916.708 9.90 130.80-109216.93 E83 WFD96 " 5.46 130.80-109216.44 E83 WFD96 25 1083.994 2.18 0.00- 92251.46 E83 WFD96 60 1084.580 1.61 48.67- 92251.46 E83 WFD96 " 2.93 48.67- 92249.91 E83 WFD96 15 1085.550 130.80- 92251.46 E83 WFD96 " 0.947 130.80- 92249.91 E83 WFD96 100 1085.710 3.87 130.80- 92236.46 E83 WFD96 50 3995.00 1.35 149187.80-174212.03 M75a WFD96 30 4447.03 1.14 164610.76-187091.37 M75a WFD96 40 4630.54 0.772 149076.52-170666.23 M75a WFD96 40 5005.15 1.16 166678.64-186652.49 M75a WFD96 40 5679.56 0.525 149076.52-166678.64 M75a WFD96 30 5941.65 0.554 170666.23-187491.90 M75a WFD96 40 6482.05 0.301 149187.80-164610.76 M75a WFD96 40 6610.56 0.634 174212.03-189335.16 M75a WFD96

Persistent Lines of Singly Ionized Oxygen (O II)

Persistent Lines of Singly Ionized Oxygen (O II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 429.918 42.5 0.00 -232602.492 MKM93 WFD96 700 430.041 41.3 0.00 -232535.949 MKM93 WFD96 1000 430.177 43.6 0.00 -232462.724 MKM93 WFD96 800 537.8319 57.3 26830.57 -212762.25 MKM93 WFD96 1000 538.2636 51.8 26810.55 -212593.82 MKM93 WFD96 600 538.318 5.87 26830.57 -212593.82 MKM93 WFD96 800 539.0855 9.83 0.00 -185499.124 MKM93 WFD96 700 539.5489 9.81 0.00 -185340.577 MKM93 WFD96 500 539.8544 9.81 0.00 -185235.281 MKM93 WFD96 800 718.5036 19.0 26810.55 -165988.46 MKM93 WFD96 500 718.5663 18.5 26830.57 -165996.50 MKM93 WFD96 250 832.7587 8.67 0.00 -120082.86 MKM93 WFD96 400 833.3302 8.65 0.00 -120000.43 MKM93 WFD96 500 834.4655 8.61 0.00 -119837.21 MKM93 WFD96 400 3134.720 1.23 207002.482-238893.96 MKM93 WFD96 400 3911.957 1.09 206971.68 -232527.09 MKM93 WFD96 400 3973.2562 1.02 189068.514-214229.671 MKM93 WFD96 400 4075.862 1.98 207002.482-231530.246 MKM93 WFD96 400 4414.905 0.847 189068.514-211712.732 MKM93 WFD96 300 4641.810 0.585 185340.577-206877.865 MKM93 WFD96 400 4649.135 0.784 185499.124-207002.482 MKM93 WFD96

Persistent Lines of Singly Ionized Sodium (Na II)

Persistent Lines of Singly Ionized Sodium (Na II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 90 300.15 30. 0.00-333162.94 W71 FW96 150 372.08 34. 0.00-268762.96 W71 FW96 600 3092.73 264924.32-297248.82 W71 1000 3285.60 268762.96-299189.96 W71

Persistent Lines of Singly Ionized Aluminum (Al II)

Persistent Lines of Singly Ionized Aluminum (Al II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 1539.830 8.8 59852.02-124794.13 KM91b FW96 1000 1670.7886 14.6 0.00- 59852.02 GK00 FW96 800 1719.440 6.79 37393.03- 95551.44 KM91b FW96 900 1721.271 9.14 37453.91- 95550.51 KM91b WSM69 900 1724.984 12.1 37577.79- 95549.42 KM91b WSM69 700 1763.952 9.8 37577.79- 94268.68 KM91b FW96 700 1858.026 2.48 37453.91- 91274.50 KM91b FW96 1000 1862.311 4.12 37577.79- 91274.50 KM91b FW96 600 2816.185 3.83 59852.02- 95350.60 KM91b FW96 1000 4663.056 0.53 85481.35-106920.56 KM91b FW96 400 6243.36 1.1 105470.93-121483.50 KM91b FW96

Persistent Lines of Singly Ionized Argon (Ar II)

Persistent Lines of Singly Ionized Argon (Ar II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 150 661.8690 8.05 0.0000-151087.3128 M71 VVF96 300 670.9455 6.43 1431.5831-150474.9900 M71 VVF96 1000 671.8513 7.90 0.0000-148842.4674 M71 VVF96 1000 723.3606 23.1 0.0000-138243.6442 M71 VVF96 300 919.7810 1.43 0.0000-108721.53 M71 M03 300 932.0537 0.700 1431.5831-108721.53 M71 M03 200 4277.528 0.80 148842.4674-172213.8800 N73 FW96 250 4348.064 1.17 134241.7392-157234.0200 N73 FW96 200 4609.567 0.789 148842.4674-170530.4041 N73 FW96 200 4726.868 0.588 138243.6442-159393.3850 N73 FW96 250 4764.865 0.64 139258.3384-160239.4280 N73 FW96 200 4806.020 0.780 134241.7392-155043.1622 N73 FW96 250 4879.864 0.823 138243.6442-158730.2997 N73 FW96

Persistent Lines of Singly Ionized Calcium (Ca II)

Persistent Lines of Singly Ionized Calcium (Ca II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 3158.869 3.1 25191.51- 56839.25 ER56 FW96 800 3179.332 3.6 25414.40- 56858.46 ER56 FW96 700 3706.026 0.88 25191.51- 52166.93 ER56 FW96 800 3736.901 1.7 25414.40- 52166.93 ER56 FW96 1000 3933.6614 1.35 0.00- 25414.40 L99 M03 1000 3968.4673 1.32 0.00- 25191.51 L99 M03 700 8542.089 13710.88- 25414.40 ER56 700 8662.140 13650.19- 25191.51 ER56

Persistent Lines of Singly Ionized Chlorine (Cl II)

Persistent Lines of Singly Ionized Chlorine (Cl II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 839.297 696.00-119843.31 RK74 900 839.599 696.00-119800.32 RK74 800 841.414 996.47-119843.31 RK74 600 851.691 11653.58-129066.96 RK74 700 1063.831 0.49 0.00- 93999.88 RK74 M03 300 1067.945 1.17 696.00- 94333.84 RK74 M03 1000 1071.036 0.87 0.00- 93367.56 RK74 M03 700 1071.767 0.29 696.00- 93999.88 RK74 M03 600 1075.230 0.38 996.47- 93999.88 RK74 M03 600 1079.080 0.28 696.00- 93367.56 RK74 M03 60 3850.991 1.8 128663.57-154623.57 RK74 FW96 40 3851.373 1.6 128663.57-154620.97 RK74 FW96 140 3860.83 128730.82-154624.66 RK74 60 4132.498 1.6 129066.96-153258.61 RK74 FW96 600 4794.55 1.04 107879.66-128730.82 RK74 FW96 150 4810.06 0.99 107879.66-128663.57 RK74 FW96 400 4896.77 126784.37-147200.24 RK74 250 4904.776 0.81 126744.97-147127.57 RK74 FW96 140 4917.731 0.75 126726.70-147055.61 RK74 FW96 140 5078.264 0.77 126784.37-146470.64 RK74 FW96 300 5217.94 112609.36-131768.66 RK74 130 5221.355 112609.36-131756.12 RK74 80 5392.119 1.0 129066.96-147607.37 RK74 FW96 600 5423.23 110296.84-128730.82 RK74 110 5443.37 110297.72-128663.57 RK74

Persistent Lines of Singly Ionized Chromium (Cr II)

Persistent Lines of Singly Ionized Chromium (Cr II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1426.208 12496.44- 82612.69 SKRR03 800 1431.323 12496.44- 82362.19 SKRR03 600 1431.865 12303.86- 82143.15 SKRR03 600 1432.056 12147.82- 81978.08 SKRR03 500 1433.004 12032.58- 81816.29 SKRR03 600 1434.808 12496.44- 82192.59 SKRR03 400 1435.207 12147.82- 81824.40 SKRR03 350 1435.582 12303.86- 81962.29 SKRR03 1000 2055.59 1.2 0.00- 48632.12 K51 M03 700 2061.54 1.2 0.00- 48491.10 K51 M03 500 2065.46 1.2 0.00- 48398.95 K51 M03 90 2677.19 12496.44- 49838.38 K51 40 2762.58 12303.86- 48491.10 K51 40 2766.55 12496.44- 48632.12 K51 130 2835.63 2.0 12496.44- 47751.62 K51 FW96 90 2843.24 0.64 12303.86- 47464.55 K51 FW96 60 2849.83 0.92 12147.82- 47227.24 K51 FW96 50 2855.67 12032.58- 47040.35 K51 40 2862.57 0.63 12303.86- 47227.24 K51 FW96 40 2865.10 12147.82- 47040.35 K51

Persistent Lines of Singly Ionized Iron (Fe II)

Persistent Lines of Singly Ionized Iron (Fe II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 2343.4951 1.73 0.000- 42658.224 NLTH91 M03 1000 2382.0376 3.13 0.000- 41968.046 NLTH91 M03 700 2395.6254 2.67 384.790- 42114.818 NLTH91 M03 500 2404.8858 2.05 667.683- 42237.033 NLTH91 M03 300 2493.2637 3.4 21251.608- 61347.614 NLTH91 FW96 300 2585.8758 0.861 0.000- 38660.043 NLTH91 M03 400 2598.3692 1.42 384.790- 38858.958 NLTH91 M03 800 2599.3956 2.36 0.000- 38458.981 NLTH91 M03 300 2607.0871 1.74 667.683- 39013.206 NLTH91 M03 400 2611.8736 1.23 384.790- 38660.043 NLTH91 M03 400 2739.5474 1.9 7955.299- 44446.878 NLTH91 FW96 400 2749.3216 2.1 8391.938- 44753.799 NLTH91 FW96 500 2755.7365 2.1 7955.299- 44232.512 NLTH91 FW96

Persistent Lines of Singly Ionized Manganese (Mn II)

Persistent Lines of Singly Ionized Manganese (Mn II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2576.103 2.82 0.00- 38806.67 KG00 KG00 500 2593.720 2.77 0.00- 38543.08 KG00 KG00 400 2605.680 2.72 0.00- 38366.18 KG00 KG00 90 2933.054 1.94 9472.97- 43557.14 KG00 KG00 120 2939.308 1.95 9472.97- 43484.64 KG00 KG00 150 2949.205 1.94 9472.97- 43370.51 KG00 KG00 60 3441.985 0.36 14325.86- 43370.51 KG00 KG00

Persistent Lines of Singly Ionized Phosphorus (P II)

Persistent Lines of Singly Ionized Phosphorus (P II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 1310.700 0.328 469.12- 76764.06 SMZ83 M03 80 1532.530 0.029 0.00- 65251.45 SMZ83 M03 130 1535.917 0.0385 164.90- 65272.35 SMZ83 M03 80 1536.410 0.018 164.90- 65251.45 SMZ83 M03 130 1542.297 0.048 469.12- 65307.17 SMZ83 M03 110 4588.04 1.7 103339.14-125128.87 M59 FW96 110 4589.86 1.6 103165.61-124946.73 M59 FW96 130 4602.08 1.9 103667.86-125391.13 M59 FW96 110 6024.18 0.51 86743.96-103339.14 M59 FW96 110 6043.12 0.68 87124.60-103667.86 M59 FW96 130 6459.99 88192.13-103667.86 M59 130 6503.46 87966.81-103339.14 M59 130 6507.97 87804.10-103165.61 M59

Persistent Lines of Singly Ionized Potassium (K II)

Persistent Lines of Singly Ionized Potassium (K II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 600.77 0.0-166461.5 E31 800 607.93 0.013 0.0-164496.1 E31 FW96 1000 612.62 0.0-163237.0 E31

Persistent Lines of Singly Ionized Scandium (Sc II)

Persistent Lines of Singly Ionized Scandium (Sc II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 3353.724 1.51 2540.95- 32349.98 JL80 FW96 250 3372.150 0.99 177.76- 29823.93 JL80 FW96 500 3572.530 1.38 177.76- 28161.17 JL80 FW96 400 3576.340 1.06 67.72- 28021.29 JL80 FW96 300 3580.928 1.23 0.00- 27917.78 JL80 FW96 1000 3613.831 1.48 177.76- 27841.35 JL80 FW96 700 3630.742 1.20 67.72- 27602.45 JL80 FW96 500 3642.782 1.13 0.00- 27443.71 JL80 FW96 500 4246.820 1.29 2540.95- 26081.34 JL80 FW96

Persistent Lines of Singly Ionized Silicon (Si II)

Persistent Lines of Singly Ionized Silicon (Si II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 1190.4160 6.86 0.00- 84004.26 KE74 M03 700 1193.2898 27.3 0.00- 83801.95 KE74 M03 800 1194.5004 34.0 287.24- 84004.26 KE74 M03 500 1260.4223 24.7 0.00- 79338.50 KE74 M03 1000 1264.7379 29.3 287.24- 79355.02 KE74 M03 300 1533.4318 7.50 287.24- 65500.47 KE74 M03 100 3856.017 55325.18- 81251.32 S61b 50 4128.067 79338.50-103556.16 S61b 70 4130.893 79355.02-103556.03 S61b 130 5041.026 0.98 81191.34-101023.05 S61b FW96 130 5055.981 1.26 81251.32-101024.35 S61b BBC95 130 5669.562 0.50 114529.14-132162.29 S61b BBC95 130 6347.103 0.66 65500.47- 81251.32 S61b BBC95 100 6371.359 0.77 65500.47- 81191.34 S61b BBC95

Persistent Lines of Singly Ionized Sulfur (S II)

Persistent Lines of Singly Ionized Sulfur (S II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 1250.578 0.463 0.00- 79962.61 KM93 M03 900 1253.805 0.462 0.00- 79756.83 KM93 M03 1000 1259.518 0.465 0.00- 79395.39 KM93 M03 140 5428.667 0.42 109560.69-127976.34 KM93 FW96 250 5432.815 0.68 109831.59-128233.20 KM93 FW96 400 5453.828 0.85 110268.60-128599.16 KM93 FW96 150 5473.620 0.73 109560.69-127825.08 KM93 FW96 150 5509.718 0.40 109831.59-127976.34 KM93 FW96 150 5606.151 0.54 110766.56-128599.16 KM93 FW96 150 5639.972 0.66 113461.54-131187.19 KM93 FW96 150 7578.909 127128.35-140319.23 KM93 120 7629.740 127127.10-140230.10 KM93 80 7967.371 0.080 112937.57-125485.29 KM93 WSM69 120 8314.594 0.16 113461.54-125485.29 KM93 WSM69

Persistent Lines of Singly Ionized Titanium (Ti II)

Persistent Lines of Singly Ionized Titanium (Ti II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 3078.651 1.34 225.73- 32697.99 SC85 M03 300 3088.042 1.50 393.44- 32767.07 SC85 M03 600 3234.513 1.71 393.44- 31301.01 SC85 M03 400 3236.581 1.37 225.73- 31113.65 SC85 M03 300 3239.038 1.26 94.10- 30958.50 SC85 M03 400 3349.029 4897.65- 34748.40 SC85 1000 3349.405 1.68 393.44- 30240.88 SC85 M03 600 3361.227 1.58 225.73- 29968.30 SC85 M03 500 3372.798 1.41 94.10- 29734.54 SC85 M03 500 3383.769 1.39 0.00- 29544.37 SC85 M03 250 3685.205 4628.58- 31756.51 SC85 " 4897.65- 32025.47 300 3759.300 0.94 4897.65- 31490.82 SC85 FW96 250 3761.326 0.99 4628.58- 31207.42 SC85 FW96

Persistent Lines of Singly Ionized Vanadium (V II)

Persistent Lines of Singly Ionized Vanadium (V II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 2687.954 0.767 339.21- 37531.08 ICL88 M03 200 2700.937 0.345 339.21- 37352.45 ICL88 M03 400 2893.307 1.1 2968.27- 37520.57 ICL88 BGFM89 600 2908.810 1.54 3162.80- 37531.08 ICL88 BGFM89 600 2924.017 1.73 3162.80- 37352.45 ICL88 BGFM89 400 2924.630 1.21 2968.27- 37150.51 ICL88 BGFM89 1000 3093.102 2.1 3162.80- 35483.39 ICL88 BGFM89 800 3102.292 1.77 2968.27- 35193.13 ICL88 BGFM89 700 3110.709 1.68 2808.82- 34946.55 ICL88 BGFM89 500 3118.376 1.54 2687.11- 34745.72 ICL88 BGFM89 400 3125.282 1.51 2604.88- 34592.75 ICL88 BGFM89 200 3190.686 0.33 9097.83- 40430.04 ICL88 BGFM89 200 3276.130 0.52 9097.83- 39612.96 ICL88 BGFM89

Persistent Lines of Singly Ionized Arsenic (As II)

Persistent Lines of Singly Ionized Arsenic (As II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1243.08 2.9 1063.49 - 81508.925 LA71 M00 1000 1263.77 3.6 0.0 - 79128.33 LA71 M00 1000 1341.55 10095.82 - 84636.186 LA71 1000 1369.77 10095.82 - 83100.804 LA71 1000 1375.07 10095.82 - 82819.214 LA71

Persistent Lines of Singly Ionized Bromine (Br II)

Persistent Lines of Singly Ionized Bromine (Br II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 889.25 0.00-112454.52 MT84 1000 1015.53 0.00- 98470.12 MT84 1000 1048.94 3136.50- 98470.12 MT84 500 4704.92 1.1 93921.36-115170.02 K40 FW96 500 4785.48 0.94 93921.36-114812.00 K40 FW96 500 4816.68 1.1 93921.36-114676.79 K40 FW96

Persistent Lines of Singly Ionized Cobalt (Co II)

Persistent Lines of Singly Ionized Cobalt (Co II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2286.159 3.3 3350.494- 47078.491 PRUJ98 FW96 800 2307.860 2.6 4028.988- 47345.842 PRUJ98 FW96 500 2311.604 2.8 4560.789- 47807.490 PRUJ98 FW96 500 2314.056 2.8 4950.062- 48150.937 PRUJ98 FW96 200 2347.399 4950.062- 47537.362 PRUJ98 200 2353.422 1.8 4560.789- 47039.102 PRUJ98 FW96 500 2363.800 2.1 4028.988- 46320.829 PRUJ98 FW96 400 2378.626 1.9 3350.494- 45378.751 PRUJ98 FW96 300 2383.459 1.8 4028.988- 45972.033 PRUJ98 FW96 200 2386.370 4560.789- 46452.697 PRUJ98 500 2388.917 1.5 3350.494- 45197.708 PRUJ98 FW96

Persistent Lines of Singly Ionized Copper (Cu II)

Persistent Lines of Singly Ionized Copper (Cu II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 1358.773 3.17 0.000- 73595.813 R69 M03 150 1367.951 2.13 0.000- 73102.038 R69 M03 300 1979.956 22847.131- 73353.292 R69 150 1999.698 2.21 21928.754- 71920.102 R69 CKNJ94 200 2035.854 23998.381- 73102.038 R69 150 2037.127 1.41 22847.131- 71920.102 R69 CKNJ94 250 2043.802 21928.754- 70841.470 R69 600 2135.981 3.33 21928.754- 68730.893 R69 CKNJ94 600 2192.268 2.54 22847.131- 68447.741 R69 CKNJ94 500 2218.108 22847.131- 67916.555 R69 700 2247.002 3.27 21928.754- 66418.687 R69 CKNJ94

Persistent Lines of Singly Ionized Gallium (Ga II)

Persistent Lines of Singly Ionized Gallium (Ga II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1414.401 19.7 0.00- 70701.27 IL85 M03 800 1535.309 14.5 48749.74-113883.19 IL85 C00 800 1813.878 47814.05-102944.55 IL85 900 1845.199 48749.74-102944.55 IL85 1000 2090.771 0.00409 0.00- 47814.05 IL85 M03 1000 6334.05 102944.55-118727.89 IL85 900 6419.23 102944.55-118518.47 IL85 800 6455.89 102944.55-118430.02 IL85

Persistent Lines of Singly Ionized Germanium (Ge II)

Persistent Lines of Singly Ionized Germanium (Ge II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 1106.74 48. 1767.357- 92122.7 S63a M00 500 1120.46 24. 1767.357- 91016.2 S63a M00 200 1188.73 7.7 1767.357- 85890.55 S63a M00 500 1237.059 27. 0.000- 80836.880 KE74 M00 500 1261.905 29. 1767.357- 81012.598 KE74 M00 500 1576.855 1767.357- 65184.738 KE74 500 1938.008 0.0028 1767.357- 53366.738 KE74 M00 500 1938.891 0.0047 0.000- 51575.885 KE74 M00 1000 2831.843 65015.672-100317.976 S63a 1000 2845.527 65184.738-100317.283 S63a 1000 4741.806 0.46 79006.985-100090.088 S63a FW96 1000 4814.608 0.51 79366.627-100130.936 S63a FW96 1000 5893.389 0.92 62403.15 - 79366.627 S63a FW96 500 6021.041 62403.15 - 79006.985 S63a

Persistent Lines of Singly Ionized Krypton (Kr II)

Persistent Lines of Singly Ionized Krypton (Kr II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 30 844.06 0.00-118474.36 MSP69 300 886.30 0.00-112828.27 MSP69 700 917.43 0.23 0.00-109000.36 MSP69 M00 700 964.97 0.098 5370.10-109000.36 MSP69 M00 1000 4355.477 1.0 112828.27-135781.42 HP70a FW96 300 4619.166 0.81 118474.36-140117.23 HP70a FW96 700 4658.876 0.65 112828.27-134286.67 HP70a FW96 1000 4739.002 0.76 112828.27-133923.86 HP70a FW96 300 4765.744 0.67 115092.01-136069.23 HP70a FW96 250 4832.077 0.73 115092.01-135781.26 HP70a FW96 250 4846.612 118474.36-139101.57 HP70a 150 9577.52 129697.19-140135.40 DHM33 300 10221.46 126000.82-135781.42 DHM33

Persistent Lines of Singly Ionized Nickel (Ni II)

Persistent Lines of Singly Ionized Nickel (Ni II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 150 1741.547 0.939 0.00- 57420.16 S70 M03 150 2165.553 2.36 8393.90- 54557.05 S70 FL99 300 2174.666 1.56 9330.04- 55299.65 S70 FL99 400 2185.504 25036.38- 70778.12 S70 500 2192.090 53365.17- 98969.44 S70 800 2205.548 53496.49- 98822.55 S70 700 2206.715 1.52 10115.66- 55417.83 S70 FL99 1000 2216.482 3.57 8393.90- 53496.49 S70 FL99 300 2270.214 1.61 9330.04- 53365.17 S70 FL99 150 2316.039 2.90 8393.90- 51557.85 S70 FL99

Persistent Lines of Singly Ionized Rubidium (Rb II)

Persistent Lines of Singly Ionized Rubidium (Rb II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 30 589.419 0.00 -169658.536 R75 30 697.049 0.00 -143461.977 R75 70 711.187 0.00 -140610.047 R75 110 741.456 0.00 -134869.751 R75 300 3940.51 133341.607-158711.854 R75 1000 4244.40 133341.607-156895.486 R75 300 4775.95 133341.607-154273.980 R75 110 5152.08 134869.751-154273.980 R75 110 6458.33 138794.380-154273.980 R75

Persistent Lines of Singly Ionized Selenium (Se II)

Persistent Lines of Singly Ionized Selenium (Se II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 1013.40 11.4 0.0- 98674.4 G62 M00 1000 1033.56 10.3 0.0- 96753.3 G62 M00 1000 1049.65 9.96 0.0- 95270.0 G62 M00 1000 1192.24 0.0- 83876.7 G62 1000 4180.90 117798.7-141710.1 G62 1000 5227.533 98674.4-117798.7 G62 1000 6055.84 104873.7-121381.9 G62

Persistent Lines of Singly Ionized Strontium (Sr II)

Persistent Lines of Singly Ionized Strontium (Sr II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 30 2152.84 14555.90- 60991.7 MCS75 30 2165.96 14836.24- 60991.7 MCS75 14 3380.71 23715.19- 53286.31 MCS75 20 3464.46 3.1 24516.65- 53372.97 MCS75 FW96 1000 4077.71 1.42 0.00- 24516.65 MCS75 FW96 700 4215.52 1.27 0.00- 23715.19 MCS75 FW96 7 4305.45 1.4 24516.65- 47736.53 MCS75 FW96 20 10327.31 14836.24- 24516.65 S38a

Persistent Lines of Singly Ionized Yttrium (Y II)

Persistent Lines of Singly Ionized Yttrium (Y II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3242.272 2.0 1449.752- 32283.420 NJK91 FW96 300 3549.002 0.397 1045.076- 29213.958 NJK91 FW96 800 3600.731 1.4 1449.752- 29213.958 NJK91 FW96 600 3611.043 1.04 1045.076- 28730.010 NJK91 FW96 600 3633.121 0.000- 27516.699 NJK91 1000 3710.287 1.5 1449.752- 28394.177 NJK91 FW96 800 3774.330 1.1 1045.076- 27532.321 NJK91 FW96 300 3832.889 0.30 1449.752- 27532.321 NJK91 FW96 300 3982.592 0.27 1045.076- 26147.252 NJK91 FW96 600 4177.528 0.527 3296.180- 27227.027 NJK91 FW96 900 4374.933 0.997 3296.180- 26147.252 NJK91 FW96 700 4883.682 0.47 8743.322- 29213.958 NJK91 FW96 600 4900.118 0.451 8328.039- 28730.010 NJK91 FW96 700 5087.418 0.20 8743.322- 28394.177 NJK91 FW96 500 5205.722 0.16 8328.039- 27532.321 NJK91 FW96

Persistent Lines of Singly Ionized Zinc (Zn II)

Persistent Lines of Singly Ionized Zinc (Zn II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2025.4845 4.07 0.000- 49355.003 GL00 M03 1000 2062.0011 3.86 0.000- 48481.077 GL00 M03 400 2064.2266 4.6 48481.077- 96909.893 GL00 FW96 1000 2099.9273 5.6 49355.003- 96960.588 GL00 FW96 300 2501.9945 48481.077- 88437.149 GL00 500 2557.9460 49355.003- 88437.149 GL00 80 4911.6269 1.6 96909.893-117264.063 GL00 FW96 120 4924.0132 96960.588-117263.558 GL00

Persistent Lines of Singly Ionized Zirconium (Zr II)

Persistent Lines of Singly Ionized Zirconium (Zr II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 2568.871 1322.730- 40238.668 J98 400 2571.457 763.428- 39640.238 J98 300 2678.632 1322.730- 38644.130 J98 250 2722.609 1322.730- 38041.326 J98 250 2734.851 314.673- 36868.921 J98 250 3279.264 763.428- 31249.288 J98 1000 3391.972 1322.730- 30795.649 J98 800 3438.231 763.428- 29839.821 J98 200 3479.387 1.03 5752.868- 34485.338 J98 BGHL81 250 3481.155 6467.509- 35185.385 J98 700 3496.206 314.673- 28908.930 J98 300 3551.951 0.32 763.428- 28908.930 J98 BGHL81 400 3556.594 3757.732- 31866.493 J98 400 3572.468 0.000- 27983.864 J98 250 3576.853 3299.732- 31249.288 J98 250 3836.761 0.51 4505.496- 30561.756 J98 BGHL81 200 4149.198 0.45 6467.509- 30561.756 J98 BGHL81

Persistent Lines of Singly Ionized Molybdenum (Mo II)

Persistent Lines of Singly Ionized Molybdenum (Mo II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 2015.109 0.88 0.00- 49608.74 SPNL01 SPNL01 1000 2020.314 2.15 0.00- 49481.04 SPNL01 SPNL01 500 2038.452 1.84 0.00- 49040.82 SPNL01 SPNL01 400 2045.973 1.18 0.00- 48860.57 SPNL01 SPNL01 120 2081.681 0.200 0.00- 48022.45 SPNL01 SPNL01 60 2089.52 15199.25- 63041.47 MCS75 60 2092.50 15330.56- 63104.63 MCS75 100 2093.11 15446.97- 63207.43 MCS75 70 2100.84 15427.73- 63012.24 MCS75 130 2775.402 2.26 13460.70- 49481.04 SPNL01 SPNL01 130 2816.158 2.33 13460.70- 48959.68 SPNL01 SPNL01 130 2848.233 1.66 12900.33- 47999.47 SPNL01 SPNL01 130 2871.512 1.15 12417.28- 47231.98 SPNL01 SPNL01

Persistent Lines of Singly Ionized Niobium (Nb II)

Persistent Lines of Singly Ionized Niobium (Nb II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2029.3423 4146.036- 53407.279 RCL00 900 2033.0102 3542.561- 52714.892 RCL00 600 2109.4384 4146.036- 51537.014 RCL00 300 2697.060 1.0 1224.823- 38291.252 RCL00 M00 140 2716.622 0.43 1224.823- 38024.336 RCL00 M00 140 2721.981 0.43 801.326- 37528.382 RCL00 M00 250 2875.390 3029.629- 37797.316 RCL00 150 2883.174 3542.561- 38216.387 RCL00 300 2927.814 4146.036- 38291.252 RCL00 300 2950.882 4146.036- 38024.336 RCL00 500 3094.176 4146.036- 36455.457 RCL00 500 3130.782 3542.561- 35474.197 RCL00 400 3163.401 3029.629- 34632.033 RCL00 300 3194.975 2629.132- 33919.244 RCL00 250 3225.467 2356.816- 33351.090 RCL00

Persistent Lines of Singly Ionized Palladium (Pd II)

Persistent Lines of Singly Ionized Palladium (Pd II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 1162.1700 3.36 0.000- 86046.027 LLTL01 Q96 700 1183.4003 13.9 3539.242- 88041.479 LLTL01 Q96 1000 1196.4051 6.62 3539.242- 87122.977 LLTL01 Q96 800 1203.9645 4.54 0.000- 83058.993 LLTL01 Q96 700 1218.6219 2.63 0.000- 82059.859 LLTL01 Q96 700 1237.0677 3.97 3539.242- 84375.505 LLTL01 Q96 800 1320.0229 4.68 0.000- 75756.251 LLTL01 Q96 700 1363.6892 0.578 0.000- 73330.436 LLTL01 Q96 800 1367.7039 2.54 0.000- 73115.191 LLTL01 Q96 900 1374.8481 1.27 0.000- 72735.273 LLTL01 Q96 400 2231.5907 25084.270- 69881.432 LLJ94 700 2296.5164 25084.270- 68615.072 LLJ94 400 2351.3469 27097.084- 69612.887 LLJ94 300 2367.9664 25084.270- 67301.702 LLJ94 500 2446.1888 27097.084- 67964.621 LLJ94 400 2486.5260 27097.084- 67301.702 LLJ94 700 2488.9146 25084.270- 65250.309 LLJ94 400 2498.7769 32280.538- 72288.057 LLJ94 40 2854.5776 32280.538- 67301.702 LLJ94

Persistent Lines of Singly Ionized Rhodium (Rh II)

Persistent Lines of Singly Ionized Rhodium (Rh II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1604.45 0.0- 62326.1 S58 400 1624.47 2401.3- 63959.5 S58 1000 1628.94 3580.7- 64970.4 S58 400 1634.72 0.0- 61173.1 S58 400 1637.88 2401.3- 63454.9 S58 800 2334.77 16884.8- 59702.4 S58 300 2415.84 19792.4- 61173.1 S58 400 2461.03 18540.4- 59161.5 S58 400 2490.79 16884.8- 57020.8 S58 500 2520.52 16884.8- 56547.3 S58 400 2715.27 25376.9- 62194.4 S58 300 2910.15 25376.9- 59729.4 S58

Persistent Lines of Singly Ionized Ruthenium (Ru II)

Persistent Lines of Singly Ionized Ruthenium (Ru II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 1875.564 0.0- 53317.1 SM58 600 1888.043 0.548 0.0- 52964.4 JJLL94 JJLL94 600 1903.221 1.00 1523.1- 54065.4 JJLL94 JJLL94 250 1916.816 1.14 2493.9- 54663.4 JJLL94 JJLL94 250 1939.043 0.497 2493.9- 54065.4 JJLL94 JJLL94 250 1939.505 0.665 3104.2- 54663.4 JJLL94 JJLL94 200 2357.916 0.84 9151.4- 51548.8 JJLL94 JJLL94 1000 2402.72 9151.4- 50758.3 MCS75 200 2456.438 1.59 10851.7- 51548.8 JJLL94 JJLL94 500 2456.57 10150.4- 50845.3 MCS75 400 2478.93 10851.7- 51179.7 MCS75 300 2507.01 11303.8- 51179.7 MCS75 400 2661.61 9151.4- 46711.5 MCS75 900 2678.76 9151.4- 46471.0 MCS75 250 2712.41 10851.7- 47708.6 MCS75 400 2734.35 10150.4- 46711.5 MCS75 200 2976.584 1.08 19378.7- 52964.4 JJLL94 JJLL94

Persistent Lines of Singly Ionized Silver (Ag II)

Persistent Lines of Singly Ionized Silver (Ag II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1106.9931 6.93 0.000- 90334.836 KLLT02 BPKR97 600 1112.4006 7.71 0.000- 89895.502 KLLT02 BPKR97 700 1195.8092 0.57 0.000- 83625.479 KLLT02 BPKR97 300 2113.8250 3.26 39168.032- 86460.650 KLLT02 BPKR97 700 2246.4120 3.91 39167.986- 83669.614 KLLT02 BPKR97 300 2248.7490 2.95 40745.335- 85200.721 KLLT02 BPKR97 300 2279.9812 1.39 46049.029- 89895.502 KLLT02 BPKR97 400 2320.2451 2.74 46049.029- 89134.688 KLLT02 BPKR97 300 2324.6670 0.72 39167.986- 82171.697 KLLT02 BPKR97 500 2331.3665 2.54 40745.335- 83625.479 KLLT02 BPKR97 1000 2413.1883 2.21 40745.335- 82171.697 KLLT02 BPKR97 1000 2437.7832 2.88 39167.986- 80176.425 KLLT02 BPKR97

Persistent Lines of Singly Ionized Technetium (Tc II)

Persistent Lines of Singly Ionized Technetium (Tc II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2543.23 4.1 0.00- 39308.38 BMC67 B88 1000 2609.99 3.8 0.00- 38302.80 BMC67 B88 1000 2647.01 3.7 0.00- 37767.21 BMC67 B88 500 3195.20 2.0 12617.20- 43905.00 BMC67 B88 700 3212.02 1.9 12617.20- 43741.33 BMC67 B88 700 3237.02 1.9 12617.20- 43500.96 BMC67 B88

Persistent Lines of Singly Ionized Antimony (Sb II)

Persistent Lines of Singly Ionized Antimony (Sb II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 1274.938 12789.8- 91225.0 AJK89 800 1327.378 3054.6- 78390.9 AJK89 800 1384.656 1.1 3054.6- 75274.5 AJK89 M00 1000 1387.565 5658.2- 77726.9 AJK89 800 1436.447 5.2 5658.2- 75274.5 AJK89 M00 800 1576.099 3054.6- 66502.3 AJK89 1000 1606.952 5658.2- 67887.5 AJK89 400 5568.12 75898.9- 93853.2 C66b 500 6005.57 69535.7- 86183.6 C66b 300 6130.00 75274.5- 91583.2 C66b

Persistent Lines of Singly Ionized Barium (Ba II)

Persistent Lines of Singly Ionized Barium (Ba II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 20 2304.247 4873.852- 48258.617 KL99 30 2335.267 5674.824- 48483.332 KL99 20 3891.779 2.17 20261.561- 45949.472 KL99 KFW02 25 4130.649 2.18 21952.404- 46154.847 KL99 KFW02 1000 4554.033 1.11 0.000- 21952.404 KL99 KFW02 300 4934.077 0.953 0.000- 20261.561 KL99 KFW02 300 6141.713 0.412 5674.824- 21952.404 KL99 KFW02 200 6496.898 0.310 4873.852- 20261.561 KL99 KFW02

Persistent Lines of Singly Ionized Cadmium (Cd II)

Persistent Lines of Singly Ionized Cadmium (Cd II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2144.408 2.8 0.00- 46618.55 SP49 FW96 1000 2265.018 3.0 0.00- 44136.08 SP49 FW96 1000 2312.766 46618.55- 89843.78 SP49 500 2572.930 1.7 44136.08- 82990.66 SP49 FW96 1000 2748.549 2.8 46618.55- 82990.66 SP49 FW96

Persistent Lines of Singly Ionized Cerium (Ce II)

Persistent Lines of Singly Ionized Cerium (Ce II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3655.843 0.47 2563.233- 29908.904 C73 BPQ01 700 3801.520 1.7 7233.627- 33531.388 C73 BPQ01 600 3942.157 0.43 0.000- 25359.686 C73 BPQ01 800 3942.746 1.4 6913.392- 32269.252 C73 BPQ01 900 3952.545 0.38 2641.559- 27934.638 C73 BPQ01 800 3999.237 0.061 2382.246- 27379.949 C73 BPQ01 800 4012.387 0.80 4523.033- 29438.817 C73 BPQ01 600 4040.752 0.81 3593.882- 28334.756 C73 BPQ01 800 4133.802 0.076 6967.547- 31151.534 C73 BPQ01 600 4137.649 0.89 4165.550- 28327.071 C73 BPQ01 1000 4186.596 1.3 6967.547- 30846.582 C73 BPQ01 600 4289.935 0.63 2641.559- 25945.396 C73 BPQ01 700 4460.204 0.87 3854.012- 26268.203 C73 BPQ01 600 4562.358 0.55 3854.012- 25766.355 C73 BPQ01

Persistent Lines of Singly Ionized Cesium (Cs II)

Persistent Lines of Singly Ionized Cesium (Cs II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 150 808.76 0.0 -123645.5813 RE75 150 813.84 0.0 -122875.4487 RE75 400 901.27 0.0 -110954.3607 RE75 400 926.66 0.0 -107914.1587 RE75 200 4526.74 107914.1587-129998.9106 S81 1000 4603.79 107401.5602-129116.7070 S81 800 5227.04 107401.5602-126527.5324 S81

Persistent Lines of Singly Ionized Indium (In II)

Persistent Lines of Singly Ionized Indium (In II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1586.340 12.2 0.0 - 63038.18 SM02 C00 250 1936.217 42276.4 - 93923.40 B69 250 1966.711 12.9 63038.18-113884.44 B69 C00 500 1977.359 43350.9 - 93923.40 B69 600 2078.608 45829.6 - 93923.40 SM02 250 2306.046 0.023 0.0 - 43350.9 PC38 C00 400 2554.434 0.01 63038.18-102174.00 PC38 C00 300 2890.179 63038.18- 97627.98 PC38 250 2941.050 1.4 63038.18- 97029.73 PC38 FW96 800 6891.56 93923.40-108429.89 PC38 1000 7182.89 93923.40-107841.54 PC38

Persistent Lines of Singly Ionized Iodine (I II)

Persistent Lines of Singly Ionized Iodine (I II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 1034.66 0.0 - 96650.55 MC60 500 1139.80 0.0 - 87734.06 MC60 500 1160.56 0.0 - 86164.86 MC60 1000 1166.48 0.0 - 85727.98 MC60 500 1178.65 0.0 - 84842.87 MC60 800 1187.34 0.0 - 84222.19 MC60 500 1190.85 13727.2 - 97700.81 MC60 1000 1220.89 0.0 - 81907.83 MC60 1000 1234.06 0.0 - 81032.70 MC60 1000 1336.52 7087.0 - 81907.83 MC60 150 5161.20 81032.70-100402.68 MC60 500 5338.22 93691.35-112419.04 MC60 250 5345.15 96650.55-115353.94 MC60 100 5464.62 81032.70- 99327.14 MC60 500 5625.69 84842.87-102613.52 MC60

Persistent Lines of Singly Ionized Lanthanum (La II)

Persistent Lines of Singly Ionized Lanthanum (La II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 250 3759.08 0.34 1970.70- 28565.40 MCS75 M00 400 3790.83 1016.10- 27388.11 MCS75 400 3794.78 1970.70- 28315.25 MCS75 400 3871.64 1016.10- 26837.66 MCS75 1000 3949.10 3250.35- 28565.40 MCS75 500 3988.52 3250.35- 28315.25 MCS75 400 3995.75 1394.46- 26414.01 MCS75 300 4031.69 2591.60- 27388.11 MCS75 300 4042.91 7473.32- 32201.05 MCS75 300 4077.35 1895.15- 26414.01 MCS75 600 4086.72 0.552 0.00- 24462.66 MCS75 M00 500 4123.23 2591.60- 26837.66 MCS75 500 4333.74 1394.46- 24462.66 MCS75

Persistent Lines of Singly Ionized Tellurium (Te II)

Persistent Lines of Singly Ionized Tellurium (Te II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 40 1077.66 0.000- 92793.22 HM64 50 1174.34 0.000- 85159.66 HM64 60 1175.79 0.000- 85049.41 HM64 50 1324.92 12421.854-87899.86 HM64 250 3521.11 71192.53 - 99584.59 HM64 250 4006.52 71192.53 - 96144.74 HM64 900 4654.37 76300.87 - 97780.09 HM64 800 5649.26 78448.22 - 96144.74 HM64 1000 5708.12 85591.83 -103105.86 HM64

Persistent Lines of Singly Ionized Tin (Sn II)

Persistent Lines of Singly Ionized Tin (Sn II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1400.440 17.5 0.000- 71406.139 B64 M00 1000 1474.997 19.5 4251.494- 72048.257 B64 M00 300 1899.881 5.90 4251.494- 56886.365 B64 M00 80 2150.844 4251.494- 50730.255 B64 80 2266.016 4251.494- 48368.188 B64 80 2368.226 0.0044 4251.494- 46464.291 B64 FW96 50 3283.140 1.0 58844.182- 89294.052 B64 FW96 60 3351.952 1.0 59463.482- 89288.248 B64 FW96 30 5332.339 0.86 71493.275- 90241.555 B64 FW96 30 5561.910 1.2 72377.450- 90351.894 B64 FW96 30 5588.815 0.85 71406.139- 89294.052 B64 FW96 30 5798.860 0.81 72048.257- 89288.248 B64 FW96 50 6453.542 1.2 56886.365- 72377.450 B64 FW96 30 6844.186 0.66 56886.365- 71493.275 B64 FW96

Persistent Lines of Singly Ionized Xenon (Xe II)

Persistent Lines of Singly Ionized Xenon (Xe II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 250 972.77 0.00-102799.07 B36 400 1041.31 0.00- 96033.48 B36 300 1048.27 0.00- 95396.74 B36 400 1051.92 0.00- 95064.38 B36 700 1074.48 0.00- 93068.44 B36 400 1100.43 0.21 0.00- 90873.83 B36 M00 250 1183.05 10537.01- 95064.38 B36 200 1244.76 0.072 10537.01- 90873.83 B36 M00 700 4844.33 1.1 93068.44-113705.40 HP87 FW96 700 5292.22 0.89 93068.44-111958.89 H39 FW96 1000 5419.15 0.62 95064.38-113512.36 H39 FW96 700 5976.46 0.28 95064.38-111792.17 H39 FW96 700 6051.15 0.17 95437.67-111958.89 H39 FW96 500 6097.59 0.26 95396.74-111792.17 H39 FW96

Persistent Lines of Singly Ionized Dysprosium (Dy II)

Persistent Lines of Singly Ionized Dysprosium (Dy II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 250 3385.014 0.539 828.314- 30361.810 NG00 WLN00 250 3407.792 0.488 0.000- 29336.093 NG00 WLN00 200 3460.966 0.297 0.000- 28885.393 NG00 WLN00 200 3494.489 0.315 828.314- 29436.610 NG00 WLN00 1000 3531.703 1.56 0.000- 28306.843 NG00 WLN00 250 3536.018 1.01 4341.104- 32613.423 NG00 WLN00 200 3630.239 0.305 4341.104- 31879.655 NG00 WLN00 500 3645.396 0.620 828.314- 28252.357 NG00 WLN00 200 3694.811 0.237 828.314- 27885.593 NG00 WLN00 200 3757.367 0.201 828.314- 27435.132 NG00 WLN00 300 3872.103 0.254 0.000- 25818.435 NG00 WLN00 250 3898.528 0.469 4755.673- 30399.107 NG00 WLN00 500 3944.679 0.307 0.000- 25343.427 NG00 WLN00 600 3968.384 0.455 0.000- 25192.039 NG00 WLN00 400 4000.449 0.254 828.314- 25818.435 NG00 WLN00 300 4077.965 0.202 828.314- 25343.427 NG00 WLN00 200 4103.305 0.104 828.314- 25192.039 NG00 WLN00

Persistent Lines of Singly Ionized Erbium (Er II)

Persistent Lines of Singly Ionized Erbium (Er II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 200 3230.582 1.5 440.434- 31385.667 M64b K91 250 3264.782 0.58 0.000- 30621.102 M64b K91 200 3312.424 0.37 440.434- 30621.102 M64b K91 700 3372.71 1.3 0.000- 29640.863 M64b K91 200 3391.998 0.235 0.000- 29472.789 M64b K91 600 3499.104 0.75 440.434- 29011.015 M64b K91 300 3616.565 0.20 0.000- 27642.658 M64b K91 700 3692.650 0.48 440.434- 27513.555 M64b K91 300 3830.482 0.14 0.000- 26098.972 M64b K91 500 3896.234 0.18 440.434- 26098.972 M64b K91 1000 3906.311 0.323 0.000- 25592.343 M64b K91 200 3938.626 0.000- 25382.379 M64b

Persistent Lines of Singly Ionized Europium (Eu II)

Persistent Lines of Singly Ionized Europium (Eu II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 70 2727.78 0.65 0.00- 36648.95 MCS75 ZLLZ00 60 2813.94 0.55 0.00- 35527.02 MCS75 ZLLZ00 50 2906.68 0.41 0.00- 34393.57 MCS75 ZLLZ00 110 3688.42 0.13 0.00- 27104.07 MCS75 ZLLZ00 300 3724.94 0.45 0.00- 26838.50 MCS75 K91 600 3819.67 1.27 0.00- 26172.83 MCS75 K91 500 3907.10 1.37 1669.21- 27256.35 MCS75 K91 500 3930.48 1.07 1669.21- 27104.07 MCS75 ZLLZ00 500 3971.96 0.89 1669.21- 26838.50 MCS75 K91 600 4129.70 0.68 0.00- 24207.86 MCS75 K91 1000 4205.05 0.71 0.00- 23774.28 MCS75 K91 250 4435.56 0.31 1669.21- 24207.86 MCS75 K91 50 4522.57 0.099 1669.21- 23774.28 MCS75 K91

Persistent Lines of Singly Ionized Gadolinium (Gd II)

Persistent Lines of Singly Ionized Gadolinium (Gd II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 3350.47 1158.943- 30996.851 MCS75 500 3358.62 261.841- 30027.378 MCS75 600 3362.23 633.273- 30366.818 MCS75 800 3422.47 1935.310- 31145.651 MCS75 500 3545.80 1158.943- 29353.344 MCS75 600 3584.96 1158.943- 29045.291 MCS75 700 3646.19 1935.310- 29353.344 MCS75 500 3743.47 1158.943- 27864.534 MCS75 1000 3768.39 633.273- 27162.224 MCS75 600 3796.37 261.841- 26595.222 MCS75 600 3850.97 0.000- 25960.073 MCS75 500 3852.45 261.841- 26211.912 MCS75 250 3916.51 4841.106- 30366.818 MCS75 250 4049.86 7992.268- 32677.540 MCS75 300 4098.61 6605.154- 30996.851 MCS75 250 4130.37 5897.264- 30101.366 MCS75 300 4184.25 3972.167- 27864.534 MCS75

Persistent Lines of Singly Ionized Holmium (Ho II)

Persistent Lines of Singly Ionized Holmium (Ho II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 500 3398.95 0.635 0.00-29412.38 MZH78 M00 300 3416.44 637.40-29899.21 MZH78 200 3453.11 637.40-29588.49 MZH78 1000 3456.02 0.00-28926.70 MZH78 300 3474.25 0.487 637.40-29412.38 MZH78 M00 400 3484.80 637.40-29325.2 MZH78 250 3515.56 637.40-29074.26 MZH78 200 3748.17 - MCS75 600 3796.75 0.430 0.00-26330.85 MZH78 M00 600 3810.74 0.00-26234.19 MZH78 200 3888.96 5849.74-31556.3 MZH78 800 3890.94 0.699 637.40-26330.85 MZH78 M00 300 4045.47 0.00-24712.0 MZH78

Persistent Lines of Singly Ionized Lutetium (Lu II)

Persistent Lines of Singly Ionized Lutetium (Lu II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 90 2195.54 0.714 0.00- 45532.33 MCS75 M00 1000 2615.42 4.53 0.00- 38223.49 MCS75 M00 250 2701.71 14199.08- 51201.66 MCS75 200 2754.17 0.92 12435.32- 48733.19 MCS75 QPBM99 400 2894.84 1.66 14199.08- 48733.19 MCS75 QPBM99 250 2900.30 12435.32- 46904.38 MCS75 500 2911.39 2.42 14199.08- 48536.83 MCS75 QPBM99 250 2963.32 11796.24- 45532.33 MCS75 150 3020.54 12435.32- 45532.33 MCS75 400 3077.60 1.24 12435.32- 44918.68 MCS75 QPBM99 250 3254.31 0.60 14199.08- 44918.68 MCS75 QPBM99 250 3397.07 11796.24- 41224.96 MCS75 250 3472.48 12435.32- 41224.96 MCS75 500 3507.39 0.125 0.00- 28503.16 MCS75 M00 250 3554.43 17332.58- 45458.56 MCS75 120 5476.69 14199.08- 32453.26 MCS75 120 6221.87 0.099 12435.32- 28503.16 MCS75 QPBM99

Persistent Lines of Singly Ionized Neodymium (Nd II)

Persistent Lines of Singly Ionized Neodymium (Nd II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 3784.25 3066.755- 29484.605 MCS75 500 3805.36 0.31 2585.460- 28856.895 MCS75 M00 400* 3851.66 2585.460- 28540.945 MCS75 400* 3851.74 1470.105- 27425.000 MCS75 700* 3863.33 0.11 0.000- 25877.160 MCS75 M00 700* 3863.40 0.000- 25876.545 MCS75 400 3900.21 3801.930- 29434.255 MCS75 400 3911.16 3801.930- 29362.520 MCS75 400 3941.51 0.45 513.330- 25877.160 MCS75 M00 400 3951.16 0.40 1470.105- 26772.080 MCS75 M00 700 4012.25 1.25 5085.640- 30002.310 MCS75 M00 600 4040.80 1470.105- 26210.740 MCS75 900 4061.09 0.72 3801.930- 28418.970 MCS75 M00 500 4109.46 0.51 2585.460- 26912.765 MCS75 M00 600 4156.08 0.42 1470.105- 25524.470 MCS75 M00 400 4177.32 513.330- 24445.380 MCS75 400 4247.38 0.000- 23537.380 MCS75 1000 4303.58 0.44 0.000- 23229.980 MCS75 M00

Persistent Lines of Singly Ionized Praseodymium (Pr II)

Persistent Lines of Singly Ionized Praseodymium (Pr II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700* 4062.804 0.34 3403.21- 28009.80 G90 GKQW91 700* 4062.806 2998.36- 27604.94 G90 600 4100.717 0.71 4437.14- 28816.25 G90 GKQW91 500 4143.112 0.54 2998.36- 27128.00 G90 GKQW91 1000 4179.391 0.54 1649.01- 25569.19 G90 GKQW91 500 4189.479 0.30 2998.36- 26860.95 G90 GKQW91 500 4206.719 0.45 4437.14- 28201.95 G90 GKQW91 700 4222.931 0.34 441.95- 24115.48 G90 GKQW91 700 4225.346 0.55 0.00- 23660.08 G90 GKQW91

Persistent Lines of Singly Ionized Promethium (Pm II)

Persistent Lines of Singly Ionized Promethium (Pm II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3892.15 - RCWM80 1000 3910.26 2950.31- 28516.85 RCWM80 1000 3919.10 - RCWM80 800 3936.48 1983.52- 27379.79 RCWM80 1000 3957.74 - RCWM80 1000 3998.96 1133.45- 26132.87 RCWM80 600 4075.84 0.00- 24527.89 RCWM80 500 4086.10 0.00- 24466.32 RCWM80 600 4297.78 0.00- 23261.30 RCWM80 1000 4417.96 1133.45- 23761.98 RCWM80 800 4453.95 - RCWM80 800 4529.21 - RCWM80 800 5546.08 6131.47- 24157.20 RCWM80 800 5576.02 5332.36- 23261.30 RCWM80

Persistent Lines of Singly Ionized Samarium (Sm II)

Persistent Lines of Singly Ionized Samarium (Sm II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3568.271 0.64 3909.62- 31926.40 K35 M00 1000 3592.603 0.66 3052.65- 30879.74 K35 M00 800 3609.491 0.58 2237.97- 29934.80 K35 M00 800 3634.290 0.56 1489.16- 28997.14 K35 M00 250 3693.989 0.091 0.00- 27063.30 K35 M00 700* 3739.117 0.17 326.64- 27063.30 K35 M00 700* 3739.197 4386.03- 31122.17 K35 600* 3745.605 0.066 0.00- 26690.30 K35 M00 900 3885.286 3909.62- 29640.51 K35 600 3922.397 3052.65- 28540.12 K35 500 4256.393 3052.65- 26540.12 K35 500 4280.789 3909.62- 27263.25 K35 700 4424.339 3909.62- 26505.53 K35 500 4467.342 5317.56- 27695.96 K35

Persistent Lines of Singly Ionized Terbium (Tb II)

Persistent Lines of Singly Ionized Terbium (Tb II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 3324.413 3423.295- 33495.130 B01 1000 3509.146 0.537 0.000- 28488.810 B01 M00 600 3561.708 3010.050- 31078.460 B01 700 3568.513 1.13 0.000- 28014.875 B01 M00 400 3650.421 3423.295- 30809.590 B01 400 3658.891 1.71 1016.380- 28339.285 B01 M00 700 3676.363 1.19 1016.380- 28209.430 B01 M00 800 3702.856 0.619 1016.380- 28014.875 B01 M00 400 3703.930 3235.190- 30225.865 B01 300 3765.136 3440.825- 29992.75 B01 400 3776.489 3440.825- 29912.930 B01 600 3848.740 0.543 0.000- 25975.160 B01 M00 600 3874.172 1.00 0.000- 25804.650 B01 M00 400 3899.197 3010.050- 28649.095 B01 400 3976.845 0.000- 25138.450 B01 400 4033.027 0.374 1016.380- 25804.650 B01 M00 50 4645.31 0.000- 21521.040 MCS75 70 4752.53 0.000- 21035.530 MCS75

Persistent Lines of Singly Ionized Thulium (Tm II)

Persistent Lines of Singly Ionized Thulium (Tm II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 3131.26 1.06 0.00- 31926.82 MCS75 WL97 400 3362.61 0.934 236.95- 29967.17 MCS75 WL97 700 3425.08 0.652 236.95- 29424.98 MCS75 WL97 600 3441.50 0.560 236.95- 29285.72 MCS75 WL97 600 3453.66 0.266 236.95- 29183.39 MCS75 WL97 1000 3462.20 0.540 0.00- 28875.12 MCS75 WL97 500 3700.26 0.223 236.95- 27254.42 MCS75 WL97 400 3701.36 0.157 0.00- 27009.39 MCS75 WL97 700 3761.33 0.351 0.00- 26578.77 MCS75 WL97 500 3761.91 0.194 0.00- 26574.66 MCS75 WL97 800 3795.75 0.300 236.95- 26574.66 MCS75 WL97 1000 3848.02 0.466 0.00- 25980.02 MCS75 WL97 300 4242.15 0.0465 236.95- 23803.28 MCS75 WL97

Persistent Lines of Singly Ionized Ytterbium (Yb II)

Persistent Lines of Singly Ionized Ytterbium (Yb II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 140 2116.67 0.341 0.00- 47228.96 M67 M00 150 2126.74 0.495 0.00- 47005.46 M67 M00 50 2185.71 0.316 0.00- 45737.29 M67 M00 40 2224.46 0.479 0.00- 44940.61 M67 M00 60 2653.75 3.90 21418.75- 59090.13 M67 BDMQ98 70 2750.477 3.20 21418.75- 57765.32 M67 BDMQ98 200 2891.384 0.342 0.00- 34575.37 M67 M00 110 2970.564 0.261 0.00- 33653.86 M67 M00 1000 3289.370 1.62 0.00- 30392.23 M67 M00 1000 3694.190 1.23 0.00- 27061.82 M67 M00

Persistent Lines of Singly Ionized Gold (Au II)

Persistent Lines of Singly Ionized Gold (Au II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 1224.592 0.00 - 81659.828 RW97 400 1362.326 0.00 - 73403.839 RW97 400 2082.077 15039.572- 63053.318 RW97 500 2110.685 17640.616- 65003.594 RW97 700 2263.627 76659.700-120822.927 RW97 600 2802.036 72495.129-108172.952 RW97 1000 2822.546 85700.201-121118.779 RW97 400 2893.247 86565.667-121118.779 RW97 400 2918.235 86565.667-120822.927 RW97 400 2994.800 74791.477-108172.952 RW97

Persistent Lines of Singly Ionized Hafnium (Hf II)

Persistent Lines of Singly Ionized Hafnium (Hf II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 2012.78 3050.88- 52717.46 MCS75 1000 2028.18 13485.56- 62774.9 MCS75 100 2516.88 3050.88- 42770.6 MCS75 130 2641.41 8361.76- 46209.05 MCS75 120 2773.36 6344.34- 42391.09 MCS75 140 2820.22 3050.88- 38498.53 MCS75 100 3134.72 3050.88- 34942.36 MCS75 100 3253.70 0.21 3050.88- 33776.24 MCS75 M00 250 3399.80 0.31 0.00- 29405.12 MCS75 M00 60 4093.16 3644.65- 28068.79 MCS75

Persistent Lines of Singly Ionized Iridium (Ir II)

Persistent Lines of Singly Ionized Iridium (Ir II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 2126.81 0.00- 47003.98 KM78 600 2152.68 4787.93- 51226.62 KM78 1000 2169.42 - MCS75 500 2204.96 8186.96- 53525.25 KM78 400 2242.69 0.00- 44575.66 KM78 150 2281.02 - MCS75 60 2368.04 4787.93- 47003.98 KM78 30 3731.36 - MCS75

Persistent Lines of Singly Ionized Osmium (Os II)

Persistent Lines of Singly Ionized Osmium (Os II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2067.21 3593.15- 51951.61 MCS75 500 2070.67 3928.94- 52206.48 MCS75 110 2194.39 3593.15- 49149.39 MCS75 250 2255.85 0.00- 44315.40 MCS75 200 2282.26 0.00- 43802.36 MCS75 90 2336.80 3593.15- 46373.51 MCS75 60 2367.35 3928.94- 46157.19 MCS75 70 2486.24 3593.15- 43802.36 MCS75 100 2538.00 0.00- 39389.49 MCS75

Persistent Lines of Singly Ionized Platinum (Pt II)

Persistent Lines of Singly Ionized Platinum (Pt II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 1777.0866 8.77 4786.611- 61058.490 SRSA92 WBJ95 600 1883.0587 2.98 13329.227- 66434.315 SRSA92 WBJ95 400 1911.7092 5.12 9356.274- 61665.485 SRSA92 WBJ95 250 1929.2449 3.72 9356.274- 61190.026 SRSA92 WBJ95 250 2036.4666 2.40 4786.611- 53875.493 SRSA92 WBJ95 900 2144.2458 3.93 4786.611- 51408.370 SRSA92 WBJ95 600 2240.8965 56587.934-101199.085 SRSA92 400 2245.5244 2.14 9356.274- 53875.493 SRSA92 WBJ95 300 2246.5216 57018.130-101517.59 SRSA92 600 2262.7185 57018.130-101199.085 SRSA92 400 2288.2050 1.45 13329.227- 57018.130 SRSA92 WBJ95 500 2310.9626 2.01 13329.227- 56587.934 SRSA92 WBJ95 300 2719.5239 64757.343-101517.59 SRSA92 300 2743.2944 64757.343-101199.085 SRSA92 1000 2875.6314 66434.315-101199.085 SRSA92

Persistent Lines of Singly Ionized Rhenium (Re II)

Persistent Lines of Singly Ionized Rhenium (Re II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 c 1973.1340 0.000- 50680.795 WJLG97 600 2139.04 - MCS75 250 2142.74 - MCS75 1000 c 2214.2749 0.000- 45147.445 WJLG97 900 c 2275.2532 1.34 0.000- 43937.578 WJLG97 WJLG97 90 2502.35 20976.4 - 60926.8 MCS75 90 2568.64 14882.6 - 53802.1 MCS75 110 2608.50 14352.2 - 52677.0 MCS75 100 2733.04 17223.5 - 53802.1 MCS75 140 3580.15 17223.5 - 45147.5 MCS75

Persistent Lines of Singly Ionized Tantalum (Ta II)

Persistent Lines of Singly Ionized Tantalum (Ta II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 2146.87 1031.36- 47595.98 MCS75 600 2196.03 4415.79- 49937.74 MCS75 600 2199.67 0.00- 45446.85 MCS75 600* 2210.03 0.00- 45233.91 MCS75 600* 2210.19 4415.79- 49646.62 MCS75 600 2239.48 4415.79- 49055.18 MCS75 " 2642.26- 47280.89 600 2387.06 4415.79- 46295.03 MCS75 1000 2400.63 6186.81- 47829.75 MCS75 500 2635.58 1031.36- 38962.32 MCS75 600 2685.17 4124.85- 41355.11 MCS75 " 0.00- 37230.75 800 3012.54 5330.77- 38515.55 MCS75

Persistent Lines of Singly Ionized Tungsten (W II)

Persistent Lines of Singly Ionized Tungsten (W II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1951.051 2.16 0.000- 51254.429 EKM00 EKM00 900 1962.140 3.38 3172.473- 54137.225 EKM00 EKM00 900 1989.394 1.97 6147.085- 56413.649 EKM00 EKM00 400 2001.712 0.50 3172.473- 53113.533 EKM00 EKM00 800 2008.095 1.68 4716.278- 54498.608 EKM00 EKM00 300 2009.982 0.65 1518.829- 51254.429 EKM00 EKM00 500 2026.088 1.18 4716.278- 54056.594 EKM00 EKM00 900 2029.995 2.38 6147.085- 55392.446 EKM00 EKM00 600* 2079.118 3.80 6147.085- 54229.082 EKM00 EKM00 600* 2079.120 0.63 3172.473- 51254.429 EKM00 EKM00 400 2094.751 2.03 1518.829- 49242.042 EKM00 EKM00 80 2204.483 1.66 6147.085- 51495.054 EKM00 EKM00 30 2248.758 2.84 0.000- 44455.212 EKM00 EKM00 25 2554.853 0.22 0.000- 39129.460 EKM00 EKM00 40 2555.095 0.50 3172.473- 42298.223 EKM00 EKM00 25 2764.261 0.54 0.000- 36165.356 EKM00 EKM00

Persistent Lines of Singly Ionized Actinium (Ac II)

Persistent Lines of Singly Ionized Actinium (Ac II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 3565.59 5267.16- 33304.96 MFT57 700 3863.12 7426.52- 33304.96 MFT57 1000 4088.44 7426.52- 31878.87 MFT57 700 4168.40 5267.16- 29250.40 MFT57 500 4386.41 9087.54- 31878.87 MFT57 700 4507.20 0.00- 22180.52 MFT57 300 5910.85 5267.16- 22180.52 MFT57

Persistent Lines of Singly Ionized Astatine (At II)

Persistent Lines of Singly Ionized Astatine (At II)

Sorry! No data are available.

Persistent Lines of Singly Ionized Bismuth (Bi II)

Persistent Lines of Singly Ionized Bismuth (Bi II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 400 1241.045 0.000- 80577.071 WBBF01 300 1283.715 17031.698- 94930.640 WBBF01 400 1436.810 3.47 0.000- 69598.475 WBBF01 M00 600 1591.76 13325.401- 76148.712 WBBF01 800 1777.05 0.970 13325.401- 69598.475 WBBF01 M00 700 1791.842 6.41 13325.401- 69133.891 WBBF01 M00 700 1823.728 33938.718- 88771.443 WBBF01 1000 1902.341 3.55 17031.698- 69598.475 WBBF01 M00 600 2186.930 44173.768- 89885.675 DLW02 600 2368.384 33938.718- 76148.712 DLW02 700 3792.564 79091.141-105451.045 DLW02 800 4259.413 82257.251-105728.060 DLW02 700 4301.697 82049.632-105289.732 DLW02 600 4705.285 84280.446-105527.197 DLW02 500 5124.356 88771.443-108280.656 DLW02 600 5144.492 69133.891- 88566.685 DLW02 800 5209.325 69598.475- 88789.478 DLW02

Persistent Lines of Singly Ionized Francium (Fr II)

Persistent Lines of Singly Ionized Francium (Fr II)

Sorry! No data are available.

Persistent Lines of Singly Ionized Lead (Pb II)

Persistent Lines of Singly Ionized Lead (Pb II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1433.906 14.1 0.000- 69739.603 KT96 M00 1000 1512.298 0.000- 66124.53 KT96 600 1726.802 0.000- 57910.48 KT96 1000 1822.052 11.8 14081.074- 68964.310 KT96 M00 500 2203.534 4.94 14081.074- 59448.56 WRSH74 M00 100 4244.92 68964.310- 92515.24 WRSH74 100 4386.46 69739.603- 92530.66 WRSH74 250 5042.58 74458.99 - 94284.58 WRSH74 100 5608.85 59448.56 - 77272.57 WRSH74 200 6075.74 92515.24 -108969.58 WRSH74 200 6081.409 92530.66 -108969.67 WRSH74 250 6660.20 59448.56 - 74458.99 WRSH74

Persistent Lines of Singly Ionized Mercury (Hg II)

Persistent Lines of Singly Ionized Mercury (Hg II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 1649.9373 5.56 0.000- 60608.362 SR01 M00 1000 1942.273 3.44 0.000- 51486.070 SR01 M00 400 2052.828 35514.624- 84212.404 SR01 400 2262.223 35514.624- 79705.262 SR01 400 2847.675 60608.362- 95714.406 SR01 1000 3983.931 35514.624- 60608.362 SR01 80 5425.253 104984.138-123411.351 SR01 200 5677.105 105544.042-123153.775 SR01 250 6149.475 95714.406-111971.464 SR01 250 7944.555 95714.406-108298.183 SR01

Persistent Lines of Singly Ionized Neptunium (Np II)

Persistent Lines of Singly Ionized Neptunium (Np II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 5380.98 5451.830- 24030.585 FTBC76

Persistent Lines of Singly Ionized Plutonium (Pu II)

Persistent Lines of Singly Ionized Plutonium (Pu II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 700 2933.602 0.000- 34077.84 BFG84 700 2951.820 0.000- 33867.55 BFG84 700 2964.644 0.000- 33721.06 BFG84 700 2969.035 3969.850- 37641.00 BFG84 700 2972.500 9707.985- 43339.89 BFG84 700 3198.467 0.000- 31255.97 BFG84 700 3220.942 2014.970- 33052.83 BFG84 700 3224.873 0.000- 31000.03 BFG84 700 3245.206 2014.970- 32820.810 BFG84 700 3273.111 2014.970- 32558.12 BFG84 700 3275.125 5502.070- 36026.44 BFG84 700 3279.326 3235.775- 33721.06 BFG84 700 3289.977 7278.870- 37665.47 BFG84 700 3290.345 2014.970- 32398.17 BFG84 700 3312.647 9707.985- 39886.62 BFG84 700 3337.708 0.000- 29952.07 BFG84 700 3350.330 9242.365- 39081.59 BFG84 700 3391.405 9707.985- 39185.84 BFG84 1000 4536.146 0.000- 22038.970 BFG84

Persistent Lines of Singly Ionized Polonium (Po II)

Persistent Lines of Singly Ionized Polonium (Po II)

Sorry! No data are available.

Persistent Lines of Singly Ionized Protactinium (Pa II)

Persistent Lines of Singly Ionized Protactinium (Pa II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 3957.85 5458.850- 30717.935 BW92b 1000 4056.20 823.265- 25469.955 BW92b 1000 4070.40 - BW92b 1000 4217.23 1764.365- 25469.955 BW92b 1000 4248.083 0.000- 23533.415 G67

Persistent Lines of Singly Ionized Radium (Ra II)

Persistent Lines of Singly Ionized Radium (Ra II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 150 2813.76 13743.11- 49272.31 R34a 500 3649.55 21351.20- 48744.04 R34a 1000 3814.42 0.00- 26208.86 R34a 500 4340.64 26208.86- 49240.48 R34a 150 4533.11 21351.20- 43405.01 R34a 500 4682.28 0.00- 21351.20 R34a 250 8019.70 13743.11- 26208.86 R34a

Persistent Lines of Singly Ionized Radon (Rn II)

Persistent Lines of Singly Ionized Radon (Rn II)

Sorry! No data are available.

Persistent Lines of Singly Ionized Thallium (Tl II)

Persistent Lines of Singly Ionized Thallium (Tl II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 800 1321.644 16.9 0.00- 75663.33 JKBL96 C00 300 1792.827 49451.45-105229.28 JKBL96 400 1814.776 61727.68-116830.90 JKBL96 800 1908.617 0.26 0.00- 52393.96 JKBL96 C00 1000 2298.058 61727.68-105229.28 JKBL96 700 2530.740 1.18 75663.33-115165.60 JKBL96 C00 700 3091.570 75663.33-107999.96 JKBL96 800 5078.54 116436.16-136115. ES36 800 5152.14 116830.90-136230. ES36 800 5949.48 105229.28-122029. ES36

Persistent Lines of Singly Ionized Thorium (Th II)

Persistent Lines of Singly Ionized Thorium (Th II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 300 2837.2954 6213.490- 41447.959 PE83 250 3180.1937 0.88 1521.896- 32957.429 PE83 NZLJ02 250 3351.2286 0.37 1521.896- 31353.125 PE83 NZLJ02 300 3392.0349 1521.896- 30994.266 PE83 250 3433.9988 0.27 1859.938- 30972.162 PE83 NZLJ02 300 3469.9208 0.51 4146.576- 32957.429 PE83 NZLJ02 250 3609.4452 4113.359- 31810.548 PE83 300 3741.1830 0.54 1521.896- 28243.812 PE83 NZLJ02 1000 4019.1289 0.41 0.000- 24873.983 PE83 NZLJ02 250 4116.7137 6168.356- 30452.725 PE83 300 4381.8616 6700.186- 29515.134 PE83 250 4391.1105 4490.262- 27257.149 PE83

Persistent Lines of Singly Ionized Uranium (U II)

Persistent Lines of Singly Ionized Uranium (U II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 600 3670.0701 0.26 914.765- 28154.450 SPMR72 NIJL02 400 3782.8407 289.041- 26716.697 SPMR72 400 3831.4593 4663.803- 30756.116 SPMR72 500 3854.6448 4663.803- 30599.179 PKE80 1000 3859.5716 0.27 289.041- 26191.309 PKE80 NIJL02 400 3865.9176 0.14 2294.696- 28154.450 PKE80 NIJL02 400 3890.3615 289.041- 25986.312 PKE80 400 3932.0221 289.041- 25714.049 PKE80 300 4050.0412 0.080 0.000- 24684.132 PKE80 NIJL02 400 4090.1319 0.19 1749.123- 26191.309 PKE80 NIJL02 300 4171.5886 0.092 1749.123- 25714.049 PKE80 NIJL02 200 4241.6646 0.24 4585.434- 28154.450 PKE80 NIJL02 140 4341.6865 0.070 289.041- 23315.090 PKE80 NIJL02 130 4543.6255 914.765- 22917.451 PKE80

Persistent Lines of Singly Ionized Americium (Am II)

Persistent Lines of Singly Ionized Americium (Am II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2832.258 0.00- 35297.13 FT57 1000 3483.308 2598.32- 31298.50 FT57 1000 3777.504 2598.32- 29063.30 FT57 1000 3926.248 2598.32- 28060.74 FT57 1000 4089.291 0.00- 24447.22 FT57 1000 4509.450 2598.32- 24767.76 FT57 1000 4575.590 2598.32- 24447.22 FT57

Persistent Lines of Singly Ionized Berkelium (Bk II)

Persistent Lines of Singly Ionized Berkelium (Bk II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2878.572 0.00 - 34729.28 WC78 1000 2951.761 1487.51 - 35355.68 WC78 1000 3247.262 0.00 - 30786.30 WC78 1000 3412.131 1487.51 - 30786.30 WC78 1000 3542.187 0.00 - 28223.10 WC78 1000 3894.547 1487.51 - 27157.155 WC78 1000 3906.094 0.00 - 25593.755 WC78 1000 4189.692 0.00 - 23861.38 WC78 1000 4197.441 0.00 - 23817.32 WC78

Persistent Lines of Singly Ionized Californium (Cf II)

Persistent Lines of Singly Ionized Californium (Cf II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2759.10 0.00- 36233.01 RCWM80 1000 2774.52 0.00- 36031.74 RCWM80 1000 3626.76 0.00- 27564.94 RCWM80 1000 3722.11 0.00- 26858.90 RCWM80 1000 3993.57 1180.52- 26213.78 RCWM80 1000 6927.10 21599.67- 36031.74 RCWM80 1000 12183.05 19359.06- 27564.94 CWBV77 1000 13376.89 20091.38- 27564.94 CWBV77 1000 16759.06 21599.67- 27564.94 CWBV77

Persistent Lines of Singly Ionized Curium (Cm II)

Persistent Lines of Singly Ionized Curium (Cm II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2462.764 0.000- 40592.510 WHGC76 1000 2636.281 4411.540- 42332.445 WHGC76 1000 2824.204 0.000- 35397.790 WHGC76 1000 2833.580 0.000- 35280.665 WHGC76 1000 2912.965 2093.870- 36413.100 WHGC76 1000 2928.922 2093.870- 36226.140 WHGC76 1000 3044.848 2093.870- 34926.680 WHGC76 1000 3242.657 2093.870- 32923.880 WHGC76 1000 3572.949 0.000- 27980.085 WHGC76 1000 3904.064 2093.870- 27700.945 WHGC76 1000 3908.238 0.000- 25579.725 WHGC76 1000 4207.66 3941.439- 27700.945 WHGC76

Persistent Lines of Singly Ionized Einsteinium (Es II)

Persistent Lines of Singly Ionized Einsteinium (Es II)

Int Wavelength A ki Energy Line A ki (Å) (10 8 s -1) Levels (cm -1) Ref. Ref. 1000 2708.66 0.00- 36907.83 WLGC74 300 2787.10 938.65- 36807.72 WLGC74 300* 2815.15 938.65- 36450.29 WLGC74 1000 3547.75 0.00- 28178.81 WLGC74 1000 3602.43 0.00- 27751.11 WLGC74 1000 3670.01 938.65- 28178.81 WLGC74 1000 3728.55 938.65- 27751.11 WLGC74

Atomic Data for Hydrogen (H)

Atomic Data for Hydrogen (H)

Atomic Number = 1

Atomic Weight = 1.00794

Reference = E95

Isotope Mass Abundance Spin Mag Moment 1 H 1.007825 99.985% 1/2 +2.79284 2 H 2.0140 0.015% 1 +0.85743

H I Ground State 1 s 2 S 1 / 2 Ionization energy 109678.7717 cm -1 (13.598433 eV) Ref. MK00a

Atomic Data for Aluminum (Al)

Atomic Data for Aluminum (Al)

Atomic Number = 13

Atomic Weight = 26.98154

Reference = E95

Isotope Mass Abundance Spin Mag Moment 27 Al 26.981540 100% 5/2 +3.6415

Al I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 2 P 1 / 2 Ionization energy 48278.48 cm -1 (5.985768 eV) Ref. KM91b Al II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 1 S 0 Ionization energy 151862.5 cm -1 (18.82855 eV) Ref. KM91b

Atomic Data for Argon (Ar)

Atomic Data for Argon (Ar)

Atomic Number = 18

Atomic Weight = 39.948

Reference = E95

Isotope Mass Abundance Spin Mag Moment 36 Ar 35.967545 0.337% 0 38 Ar 37.962732 0.063% 0 40 Ar 39.962384 99.600% 0

Ar I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 1 S 0 Ionization energy 127109.842 cm -1 (15.759610 eV) Ref. VHU99 Ar II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 5 2 P° 3 / 2 Ionization energy 222848.3 cm -1 (27.62966 eV) Ref. M60b

Atomic Data for Beryllium (Be)

Atomic Data for Beryllium (Be)

Atomic Number = 4

Atomic Weight = 9.01218

Reference = E95

Isotope Mass Abundance Spin Mag Moment 9 Be 9.012182 100% 3/2 -1.1776 10 Be 10.013534 Trace 0

Be I Ground State 1 s 2 2 s 2 1 S 0 Ionization energy 75192.64 cm -1 (9.32270 eV) Ref. KM97 Be II Ground State 1 s 2 2 s 2 S 1 / 2 Ionization energy 146882.8 cm -1 (18.21114 eV) Ref. KM00

Atomic Data for Boron (B)

Atomic Data for Boron (B)

Atomic Number = 5

Atomic Weight = 10.81

Reference = E95

Isotope Mass Abundance Spin Mag Moment 10 B 10.012937 19.9% 3 +1.8007 11 B 11.009305 80.1% 3/2 +2.6886

B I Ground State 1 s 2 2 s 2 2 p 2 P° 1 / 2 Ionization energy 66928.04 cm -1 (8.29802 eV) Ref. R02 B II Ground State 1 s 2 2 s 2 1 S 0 Ionization energy 202887.0 cm -1 (25.1548 eV) Ref. R98

Atomic Data for Carbon (C)

Atomic Data for Carbon (C)

Atomic Number = 6

Atomic Weight = 12.011

Reference = E95

Isotope Mass Abundance Spin Mag Moment 12 C 12.000000 98.90% 0 13 C 13.003355 1.10% 1/2 +0.70241

C I Ground State 1 s 2 2 s 2 2 p 2 3 P 0 Ionization energy 90820.45 cm -1 (11.26030 eV) Ref. J66 C II Ground State 1 s 2 2 s 2 2 p 2 P° 1 / 2 Ionization energy 196664.7 cm -1 (24.3833 eV) Ref. MG93

Atomic Data for Chlorine (Cl)

Atomic Data for Chlorine (Cl)

Atomic Number = 17

Atomic Weight = 35.4527

Reference = E95

Isotope Mass Abundance Spin Mag Moment 35 Cl 34.968852 75.77% 3/2 +0.82187 37 Cl 36.965903 24.23% 3/2 +0.68412

Cl I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 5 2 P° 3 / 2 Ionization energy 104591.0 cm -1 (12.96763 eV) Ref. RK69 Cl II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 4 3 P 2 Ionization energy 192070 cm -1 (23.8136 eV) Ref. RK74

Atomic Data for Fluorine (F)

Atomic Data for Fluorine (F)

Atomic Number = 9

Atomic Weight = 18.9984032

Reference = E95

Isotope Mass Abundance Spin Mag Moment 19 F 18.9984032 100% 1/2 +2.6887

F I Ground State 1 s 2 2 s 2 2 p 5 2 P° 3 / 2 Ionization energy 140524.5 cm -1 (17.4228 eV) Ref. L49 F II Ground State 1 s 2 2 s 2 2 p 4 3 P 2 Ionization energy 282058.6 cm -1 (34.9708 eV) Ref. P69

Atomic Data for Helium (He)

Atomic Data for Helium (He)

Atomic Number = 2

Atomic Weight = 4.002602

Reference = E95

Isotope Mass Abundance Spin Mag Moment 3 He 3.01603 0.000138% 1/2 -2.12762 4 He 4.00260 99.999862 0

He I Ground State 1 s 2 1 S 0 Ionization energy 198310.669 cm -1 (24.587387 eV) Ref. M02 He II Ground State 1 s 2 S 1 / 2 Ionization energy 438908.8789 cm -1 (54.417760 eV) Ref. MK00b

Atomic Data for Lithium (Li)

Atomic Data for Lithium (Li)

Atomic Number = 3

Atomic Weight = 6.941

Reference = E95

Isotope Mass Abundance Spin Mag Moment 6 Li 6.015121 7.5% 1 +0.822056 7 Li 7.016003 92.5% 3/2 +3.25644

Li I Ground State 1 s 2 2 s 2 S 1 / 2 Ionization energy 43487.150 cm -1 (5.391719 eV) Ref. K87 Li II Ground State 1 s 2 1 S 0 Ionization energy 610078 cm -1 (75.6400 eV) Ref. DM01

Atomic Data for Magnesium (Mg)

Atomic Data for Magnesium (Mg)

Atomic Number = 12

Atomic Weight = 24.3050

Reference = E95

Isotope Mass Abundance Spin Mag Moment 24 Mg 23.985042 78.99% 0 25 Mg 24.985837 10.00% 5/2 -0.85545 26 Mg 25.982593 11.01% 0

Mg I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 1 S 0 Ionization energy 61671.05 cm -1 (7.646235 eV) Ref. KM91a Mg II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 S 1 / 2 Ionization energy 121267.64 cm -1 (15.03527 eV) Ref. KM91a

Atomic Data for Neon (Ne)

Atomic Data for Neon (Ne)

Atomic Number = 10

Atomic Weight = 20.1797

Reference = E95

Isotope Mass Abundance Spin Mag Moment 20 Ne 19.992435 90.48% 0 21 Ne 20.993843 0.27% 3/2 -0.66179 22 Ne 21.991383 9.25% 0

Ne I Ground State 1 s 2 2 s 2 2 p 6 1 S 0 Ionization energy 173929.75 cm -1 (21.56454 eV) Ref. KM72 Ne II Ground State 1 s 2 2 s 2 2 p 5 2 P° 3 / 2 Ionization energy 330388.6 cm -1 (40.96296 eV) Ref. P71

Atomic Data for Nitrogen (N)

Atomic Data for Nitrogen (N)

Atomic Number = 7

Atomic Weight = 14.00674

Reference = E95

Isotope Mass Abundance Spin Mag Moment 14 N 14.003074 99.63% 1 +0.40376 15 N 15.000108 0.37% 1/2 -0.28319

N I Ground State 1 s 2 2 s 2 2 p 3 4 S° 3 / 2 Ionization energy 117225.7 cm -1 (14.5341 eV) Ref. M75a N II Ground State 1 s 2 2 s 2 2 p 2 3 P 0 Ionization energy 238750.3 cm -1 (29.6013 eV) Ref. E83

Atomic Data for Oxygen (O)

Atomic Data for Oxygen (O)

Atomic Number = 8

Atomic Weight = 15.9994

Reference = E95

Isotope Mass Abundance Spin Mag Moment 16 O 15.994915 99.76% 0 17 O 16.999311 0.048% 5/2 -1.89379 18 O 17.999160 0.20% 0

O I Ground State 1 s 2 2 s 2 2 p 4 3 P 2 Ionization energy 109837.02 cm -1 (13.61805 eV) Ref. MG93 O II Ground State 1 s 2 2 s 2 2 p 3 4 S° 3 / 2 Ionization energy 283270.9 cm -1 (35.1211 eV) Ref. MKM93

Atomic Data for Phosphorus (P)

Atomic Data for Phosphorus (P)

Atomic Number = 15

Atomic Weight = 30.973762

Reference = E95

Isotope Mass Abundance Spin Mag Moment 31 P 30.973762 100% 1/2 +1.13160

P I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 3 4 S° 3 / 2 Ionization energy 84580.83 cm -1 (10.48669 eV) Ref. MZM85 P II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 2 3 P 0 Ionization energy 159451.5 cm -1 (19.7695 eV) Ref. MZM85

Atomic Data for Potassium (K)

Atomic Data for Potassium (K)

Atomic Number = 19

Atomic Weight = 39.0983

Reference = E95

Isotope Mass Abundance Spin Mag Moment 39 K 38.963707 93.2581% 3/2 +0.39146 40 K 39.963999 0.012% 4 -1.298 41 K 40.961825 6.7302% 3/2 +0.21487

K I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 4 s 2 S 1 / 2 Ionization energy 35009.8140 cm -1 (4.3406633 eV) Ref. SC85 K II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 1 S 0 Ionization energy 255100 cm -1 (31.63 eV) Ref. K87

Atomic Data for Silicon (Si)

Atomic Data for Silicon (Si)

Atomic Number = 14

Atomic Weight = 28.0855

Reference = E95

Isotope Mass Abundance Spin Mag Moment 28 Si 27.976927 92.23% 0 29 Si 28.976495 4.67% 1/2 -0.5553 30 Si 29.973770 3.10% 0

Si I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 2 3 P 0 Ionization energy 65747.76 cm -1 (8.15168 eV) Ref. MKMD94 Si II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 2 P° 1 / 2 Ionization energy 131838.14 cm -1 (16.34584 eV) Ref. MZ83

Atomic Data for Sodium (Na)

Atomic Data for Sodium (Na)

Atomic Number = 11

Atomic Weight = 22.989768

Reference = E95

Isotope Mass Abundance Spin Mag Moment 23 Na 22.989767 100% 3/2 2.21752

Na I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 S 1 / 2 Ionization energy 41449.451 cm -1 (5.139076 eV) Ref. BBLB98 Na II Ground State 1 s 2 2 s 2 2 p 6 1 S 0 Ionization energy 381390.2 cm -1 (47.2864 eV) Ref. MZ81

Atomic Data for Sulfur (S)

Atomic Data for Sulfur (S)

Atomic Number = 16

Atomic Weight = 32.066

Reference = E95

Isotope Mass Abundance Spin Mag Moment 32 S 31.972070 95.02% 0 33 S 32.971456 0.75% 3/2 +0.64382 34 S 33.967866 4.21% 0 36 S 35.967080 0.02% 0

S I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 4 3 P 2 Ionization energy 83559.1 cm -1 (10.36001 eV) Ref. MZM90 S II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 3 4 S° 3 / 2 Ionization energy 188232.7 cm -1 (23.33788 eV) Ref. MZM90

Atomic Data for Arsenic (As)

Atomic Data for Arsenic (As)

Atomic Number = 33

Atomic Weight = 74.9216

Reference = E95

Isotope Mass Abundance Spin Mag Moment 75 As 74.921594 100% 3/2 +1.43947

As I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 3 4 S° 3 / 2 Ionization energy 78950 cm -1 (9.7886 eV) Ref. BJ71 As II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 2 3 P 0 Ionization energy 149932 cm -1 (18.5892 eV) Ref. LA71

Atomic Data for Bromine (Br)

Atomic Data for Bromine (Br)

Atomic Number = 35

Atomic Weight = 79.904

Reference = E95

Isotope Mass Abundance Spin Mag Moment 79 Br 78.918336 50.69% 3/2 +2.1064 81 Br 80.916289 49.31% 3/2 +2.2706

Br I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 5 2 P° 3 / 2 Ionization energy 95284.8 cm -1 (11.8138 eV) Ref. T63 Br II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 4 3 P 2 Ionization energy 174140 cm -1 (21.591 eV) Ref. M98

Atomic Data for Calcium (Ca)

Atomic Data for Calcium (Ca)

Atomic Number = 20

Atomic Weight = 40.078

Reference = E95

Isotope Mass Abundance Spin Mag Moment 40 Ca 39.962591 96.941% 0 42 Ca 41.958618 0.647% 0 43 Ca 42.958766 0.135% 7/2 +1.3173 44 Ca 43.955480 2.086% 0 46 Ca 45.953689 0.004% 0 48 Ca 47.952553 0.187% 0

Ca I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 4 s 2 1 S 0 Ionization energy 49305.95 cm -1 (6.11316 eV) Ref. SC85 Ca II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 4 s 2 S 1 / 2 Ionization energy 95751.87 cm -1 (11.87172 eV) Ref. SC85

Atomic Data for Chromium (Cr)

Atomic Data for Chromium (Cr)

Atomic Number = 24

Atomic Weight = 51.9961

Reference = E95

Isotope Mass Abundance Spin Mag Moment 50 Cr 49.946046 4.35% 0 52 Cr 51.940509 83.79% 0 53 Cr 52.940651 9.50% 3/2 -0.47454 54 Cr 53.938882 2.36% 0

Cr I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 5 4 s 7 S 3 Ionization energy 54575.6 cm -1 (6.76651 eV) Ref. SC85 Cr II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 5 6 S 5 / 2 Ionization energy 132966 cm -1 (16.4857 eV) Ref. SC85

Atomic Data for Cobalt (Co)

Atomic Data for Cobalt (Co)

Atomic Number = 27

Atomic Weight = 58.93320

Reference = E95

Isotope Mass Abundance Spin Mag Moment 59 Co 58.933198 100% 7/2 +4.627

Co I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 7 4 s 2 4 F 9 / 2 Ionization energy 63564.6 cm -1 (7.88101 eV) Ref. PG90 Co II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 8 3 F 4 Ionization energy 137795 cm -1 (17.084 eV) Ref. SC85

Atomic Data for Copper (Cu)

Atomic Data for Copper (Cu)

Atomic Number = 29

Atomic Weight = 63.546

Reference = E95

Isotope Mass Abundance Spin Mag Moment 63 Cu 62.939598 69.17% 3/2 +2.2233 65 Cu 64.927793 30.83% 3/2 +2.3817

Cu I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 S 1 / 2 Ionization energy 62317.44 cm -1 (7.72638 eV) Ref. SM90 Cu II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 1 S 0 Ionization energy 163669.2 cm -1 (20.2924 eV) Ref. SM90

Atomic Data for Gallium (Ga)

Atomic Data for Gallium (Ga)

Atomic Number = 31

Atomic Weight = 69.723

Reference = E95

Isotope Mass Abundance Spin Mag Moment 69 Ga 68.925580 60.11% 3/2 +2.01659 71 Ga 70.924700 39.89% 3/2 +2.56227

Ga I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 2 P° 1 / 2 Ionization energy 48387.634 cm -1 (5.999301 eV) Ref. ND82 Ga II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 1 S 0 Ionization energy 165465.8 cm -1 (20.51514 eV) Ref. IL85

Atomic Data for Germanium (Ge)

Atomic Data for Germanium (Ge)

Atomic Number = 32

Atomic Weight = 72.61

Reference = E95

Isotope Mass Abundance Spin Mag Moment 70 Ge 69.924250 20.5% 0 72 Ge 71.922079 27.4% 0 73 Ge 72.923463 7.8% 9/2 -0.87946 74 Ge 73.921177 36.5% 0 76 Ge 75.921401 7.8% 0

Ge I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 2 3 P 0 Ionization energy 63713.24 cm -1 (7.89943 eV) Ref. SM93b Ge II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 2 P° 1 / 2 Ionization energy 128521.3 cm -1 (15.93461 eV) Ref. SM93b

Atomic Data for Iron (Fe)

Atomic Data for Iron (Fe)

Atomic Number = 26

Atomic Weight = 55.847

Reference = E95

Isotope Mass Abundance Spin Mag Moment 54 Fe 53.939612 5.82% 0 56 Fe 55.934939 91.18% 0 57 Fe 56.935396 2.1 % 1/2 +0.09044 58 Fe 57.933277 0.28% 0

Fe I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 6 4 s 2 5 D 4 Ionization energy 63737 cm -1 (7.9024 eV) Ref. SC85 Fe II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 6 4 s 6 D 9 / 2 Ionization energy 130563 cm -1 (16.1877 eV) Ref. SC85

Atomic Data for Krypton (Kr)

Atomic Data for Krypton (Kr)

Atomic Number = 36

Atomic Weight = 83.80

Reference = E95

Isotope Mass Abundance Spin Mag Moment 78 Kr 77.920400 0.35% 0 80 Kr 79.916380 2.25% 0 82 Kr 81.913482 11.6% 0 83 Kr 82.914135 11.5% 9/2 -0.970 84 Kr 83.911507 57.0% 0 86 Kr 85.910616 17.3% 0

Kr I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 1 S 0 Ionization energy 112914.50 cm -1 (13.99961 eV) Ref. YG94 , BHU02 Kr II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 5 2 P° 3 / 2 Ionization energy 196475.4 cm -1 (24.35984 eV) Ref. SM91

Atomic Data for Manganese (Mn)

Atomic Data for Manganese (Mn)

Atomic Number = 25

Atomic Weight = 54.93805

Reference = E95

Isotope Mass Abundance Spin Mag Moment 55 Mn 54.938047 100% 5/2 +3.4687

Mn I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 5 4 s 2 6 S 5 / 2 Ionization energy 59959.4 cm -1 (7.43402 eV) Ref. SC85 Mn II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 5 4 s 7 S 3 Ionization energy 126145.0 cm -1 (15.6400 eV) Ref. SC85

Atomic Data for Nickel (Ni)

Atomic Data for Nickel (Ni)

Atomic Number = 28

Atomic Weight = 58.69

Reference = E95

Isotope Mass Abundance Spin Mag Moment 58 Ni 57.935346 68.27% 0 60 Ni 59.930788 26.10% 0 61 Ni 60.931058 1.13% 3/2 -0.75002 62 Ni 61.928346 3.59% 0 64 Ni 63.927968 0.91% 0

Ni I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 8 4 s 2 3 F 4 Ionization energy 61619 cm -1 (7.6398 eV) Ref. PG90 Ni II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 9 2 D 5 / 2 Ionization energy 146541.56 cm -1 (18.16884 eV) Ref. S70

Atomic Data for Rubidium (Rb)

Atomic Data for Rubidium (Rb)

Atomic Number = 37

Atomic Weight = 85.4678

Reference = E95

Isotope Mass Abundance Spin Mag Moment 85 Rb 84.911794 72.17% 5/2 +1.35302 87 Rb 86.909187 27.83% 3/2 +2.7512

Rb I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 5 s 2 S 1 / 2 Ionization energy 33690.81 cm -1 (4.177128 eV) Ref. J61b Rb II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 1 S 0 Ionization energy 220105.0 cm -1 (27.2895 eV) Ref. R75

Atomic Data for Scandium (Sc)

Atomic Data for Scandium (Sc)

Atomic Number = 21

Atomic Weight = 44.955910

Reference = E95

Isotope Mass Abundance Spin Mag Moment 45 Sc 44.955910 100% 7/2 +4.756

Sc I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 4 s 2 2 D 3 / 2 Ionization energy 52922.0 cm -1 (6.56149 eV) Ref. SC85 Sc II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 4 s 3 D 1 Ionization energy 103237.1 cm -1 (12.79977 eV) Ref. SC85

Atomic Data for Selenium (Se)

Atomic Data for Selenium (Se)

Atomic Number = 34

Atomic Weight = 78.96

Reference = E95

Isotope Mass Abundance Spin Mag Moment 74 Se 73.922475 0.9% 0 76 Se 75.919212 9.2% 0 77 Se 76.919212 7.6% 1/2 +0.535506 78 Se 77.9173 23.7% 0 80 Se 79.916520 49.8% 0 82 Se 81.916698 8.8% 0

Se I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 4 3 P 2 Ionization energy 78658.35 cm -1 (9.75239 eV) Ref. MV74 , LP77 Se II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 3 4 S° 3 / 2 Ionization energy 170900 cm -1 (21.19 eV) Ref. CR58

Atomic Data for Titanium (Ti)

Atomic Data for Titanium (Ti)

Atomic Number = 22

Atomic Weight = 47.88

Reference = E95

Isotope Mass Abundance Spin Mag Moment 46 Ti 45.952629 8.0% 0 47 Ti 46.951764 7.43% 5/2 -0.7885 48 Ti 47.947947 73.8% 0 49 Ti 48.947871 5.5% 7/2 -1.0417 50 Ti 49.944792 5.4% 0

Ti I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 2 4 s 2 3 F 2 Ionization energy 55072.5 cm -1 (6.82812 eV) Ref. SZK90 Ti II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 2 4 s 4 F 3 / 2 Ionization energy 109494 cm -1 (13.5755 eV) Ref. SC85

Atomic Data for Vanadium (V)

Atomic Data for Vanadium (V)

Atomic Number = 23

Atomic Weight = 50.9415

Reference = E95

Isotope Mass Abundance Spin Mag Moment 50 V 49.947161 0.25% 6 +3.34745 51 V 50.943962 99.75% 7/2 +5.1574

V I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 3 4 s 2 4 F 3 / 2 Ionization energy 54411.7 cm -1 (6.74619 eV) Ref. JKLC94 V II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 4 5 D 0 Ionization energy 117900 cm -1 (14.618 eV) Ref. ICL88

Atomic Data for Zinc (Zn)

Atomic Data for Zinc (Zn)

Atomic Number = 30

Atomic Weight = 65.39

Reference = E95

Isotope Mass Abundance Spin Mag Moment 64 Zn 63.929145 48.6% 0 66 Zn 65.926034 27.9% 0 67 Zn 66.927129 4.1% 5/2 +0.87515 68 Zn 67.924846 18.8% 0 70 Zn 69.925325 0.6% 0

Zn I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 1 S 0 Ionization energy 75769.33 cm -1 (9.394199 eV) Ref. SM95 Zn II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 S 1 / 2 Ionization energy 144892.6 cm -1 (17.96439 eV) Ref. SM95

Atomic Data for Antimony (Sb)

Atomic Data for Antimony (Sb)

Atomic Number = 51

Atomic Weight = 121.75

Reference = E95

Isotope Mass Abundance Spin Mag Moment 121 Sb 120.903821 57.3% 5/2 +3.3592 123 Sb 122.904216 42.7% 7/2 +2.5466

Sb I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 3 4 S° 3 / 2 Ionization energy 69431.34 cm -1 (8.60839 eV) Ref. BW86 Sb II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 2 3 P 0 Ionization energy 134100 cm -1 (16.63 eV) Ref. C66b

Atomic Data for Cadmium (Cd)

Atomic Data for Cadmium (Cd)

Atomic Number = 48

Atomic Weight = 112.411

Reference = E95

Isotope Mass Abundance Spin Mag Moment 106 Cd 105.906461 1.25% 0 108 Cd 107.904176 0.89% 0 110 Cd 109.903005 12.51% 0 111 Cd 110.904182 12.81% 1/2 -0.5943 112 Cd 111.902758 24.13% 0 113 Cd 112.904400 12.22% 1/2 -0.6217 114 Cd 113.903357 28.72% 0 116 Cd 115.904754 7.47% 0

Cd I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 1 S 0 Ionization energy 72540.07 cm -1 (8.99382 eV) Ref. BTG75 Cd II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 S 1 / 2 Ionization energy 136374.74 cm -1 (16.90831 eV) Ref. SP49

Atomic Data for Indium (In)

Atomic Data for Indium (In)

Atomic Number = 49

Atomic Weight = 114.82

Reference = E95

Isotope Mass Abundance Spin Mag Moment 113 In 112.904061 4.3% 9/2 +5.5229 115 In 114.903800 95.7% 9/2 +5.534

In I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 2 P° 1 / 2 Ionization energy 46670.11 cm -1 (5.78636 eV) Ref. ND81 , JL67 In II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 1 S 0 Ionization energy 152199 cm -1 (18.8703 eV) Ref. SM02

Atomic Data for Iodine (I)

Atomic Data for Iodine (I)

Atomic Number = 53

Atomic Weight = 126.90447

Reference = E95

Isotope Mass Abundance Spin Mag Moment 127 I 126.904473 100% 5/2 +2.808

I I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 5 2 P 3 / 2 Ionization energy 84295.14 cm -1 (10.45126 eV) Ref. M62 I II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 4 3 P 2 Ionization energy 154304 cm -1 (19.1313 eV) Ref. MC60

Atomic Data for Molybdenum (Mo)

Atomic Data for Molybdenum (Mo)

Atomic Number = 42

Atomic Weight = 95.94

Reference = E95

Isotope Mass Abundance Spin Mag Moment 92 Mo 91.906808 14.84% 0 94 Mo 93.905085 9.25% 0 95 Mo 94.905840 15.92% 5/2 -0.9133 96 Mo 95.904678 16.68% 0 97 Mo 96.906020 9.55% 5/2 -0.9133 100 Mo 98.907477 9.63% 0

Mo I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 5 5 s 7 S 3 Ionization energy 57204.3 cm -1 (7.09243 eV) Ref. RMBH87 Mo II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 5 6 S 5 / 2 Ionization energy 130300 cm -1 (16.16 eV) Ref. SM88

Atomic Data for Niobium (Nb)

Atomic Data for Niobium (Nb)

Atomic Number = 41

Atomic Weight = 92.90638

Reference = E95

Isotope Mass Abundance Spin Mag Moment 93 Nb 92.906377 100% 9/2 +6.1705

Nb I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 4 5 s 6 D 1 / 2 Ionization energy 54513.8 cm -1 (6.75885 eV) Ref. RMBH87 Nb II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 4 5 D 0 Ionization energy 113000 cm -1 (14.0 eV) Ref. M52

Atomic Data for Palladium (Pd)

Atomic Data for Palladium (Pd)

Atomic Number = 46

Atomic Weight = 106.42

Reference = E95

Isotope Mass Abundance Spin Mag Moment 102 Pd 101.905634 1.02% 0 104 Pd 103.904029 11.14% 0 105 Pd 104.905079 22.33% 5/2 -0.642 106 Pd 105.903478 27.33% 0 108 Pd 107.903895 26.46% 0 110 Pd 109.905167 11.72% 0

Pd I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 1 S 0 Ionization energy 67242 cm -1 (8.3369 eV) Ref. CHR88a Pd II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 9 2 D 5 / 2 Ionization energy 156700 cm -1 (19.43 eV) Ref. M58

Atomic Data for Rhodium (Rh)

Atomic Data for Rhodium (Rh)

Atomic Number = 45

Atomic Weight = 102.90550

Reference = E95

Isotope Mass Abundance Spin Mag Moment 103 Rh 102.905500 100% 1/2 -0.0884

Rh I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 8 5 s 4 F 9 / 2 Ionization energy 60160.1 cm -1 (7.45890 eV) Ref. CHR88a Rh II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 8 3 F 4 Ionization energy 145800 cm -1 (18.08 eV) Ref. M58

Atomic Data for Ruthenium (Ru)

Atomic Data for Ruthenium (Ru)

Atomic Number = 44

Atomic Weight = 101.07

Reference = E95

Isotope Mass Abundance Spin Mag Moment 96 Ru 95.907599 5.53% 0 98 Ru 97.905287 1.87% 0 99 Ru 98.905939 12.7% 5/2 -6.413 100 Ru 99.904219 12.6% 0 101 Ru 100.905582 17.1% 5/2 -0.7188 102 Ru 101.904348 31.6% 0 104 Ru 103.905424 18.6% 0

Ru I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 7 5 s 5 F 5 Ionization energy 59366.4 cm -1 (7.36050 eV) Ref. CHR88a Ru II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 7 4 F 9 / 2 Ionization energy 135200 cm -1 (16.76 eV) Ref. SM58

Atomic Data for Silver (Ag)

Atomic Data for Silver (Ag)

Atomic Number = 47

Atomic Weight = 107.8682

Reference = E95

Isotope Mass Abundance Spin Mag Moment 107 Ag 106.905092 51.84% 1/2 -0.1135 109 Ag 108.904757 48.16% 1/2 -0.1305

Ag I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 S 1 / 2 Ionization energy 61106.45 cm -1 (7.57623 eV) Ref. LBS99 Ag II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 1 S 0 Ionization energy 173227.4 cm -1 (21.47746 eV) Ref. BJK75

Atomic Data for Strontium (Sr)

Atomic Data for Strontium (Sr)

Atomic Number = 38

Atomic Weight = 87.62

Reference = E95

Isotope Mass Abundance Spin Mag Moment 84 Sr 83.913430 0.56% 0 86 Sr 85.909267 9.86% 0 87 Sr 86.908884 7.00% 9/2 -1.093 88 Sr 87.905619 82.58% 0

Sr I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 5 s 2 1 S 0 Ionization energy 45932.09 cm -1 (5.69485 eV) Ref. RB78 Sr II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 5 s 2 S 1 / 2 Ionization energy 88964.0 cm -1 (11.0301 eV) Ref. M52

Atomic Data for Technetium (Tc)

Atomic Data for Technetium (Tc)

Atomic Number = 43

Atomic Weight = 98.9062

Reference = E95

Isotope Mass Abundance Spin Mag Moment 97 Tc 96.906364 0 9/2 98 Tc 97.907215 0 6 99 Tc 98.906254 0 9/2 +5.6847

Tc I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 5 5 s 2 6 S 5 / 2 Ionization energy 58700 cm -1 (7.28 eV) Ref. M58 Tc II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 5 5 s 7 S 3 Ionization energy 123100 cm -1 (15.26 eV) Ref. M58

Atomic Data for Tellurium (Te)

Atomic Data for Tellurium (Te)

Atomic Number = 52

Atomic Weight = 127.60

Reference = E95

Isotope Mass Abundance Spin Mag Moment 122 Te 121.903054 2.57% 0 123 Te 122.904271 0.89% 1/2 -0.7359 124 Te 123.902823 4.76% 0 125 Te 124.904433 7.10% 1/2 -0.8871 126 Te 125.903314 18.89% 0 128 Te 127.904463 31.73% 0 130 Te 129.906229 33.97% 0

Te I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 4 3 P 2 Ionization energy 72667 cm -1 (9.0096 eV) Ref. M58 Te II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 3 4 S° 3 / 2 Ionization energy 150000 cm -1 (18.6 eV) Ref. M58

Atomic Data for Tin (Sn)

Atomic Data for Tin (Sn)

Atomic Number = 50

Atomic Weight = 118.710

Reference = E95

Isotope Mass Abundance Spin Mag Moment 112 Sn 111.904826 0.97% 0 114 Sn 113.902784 0.65% 0 115 Sn 114.903348 0.36% 1/2 -0.918 116 Sn 115.901747 14.53% 0 117 Sn 116.902956 7.68% 1/2 -1.000 118 Sn 117.901609 24.22% 0 119 Sn 118.903310 8.58% 1/2 -1.046 120 Sn 119.902220 32.59% 0 122 Sn 121.903440 4.63% 0 124 Sn 123.905724 5.79% 0

Sn I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 2 3 P 0 Ionization energy 59232.7 cm -1 (7.34392 eV) Ref. BTG77 Sn II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 2 P° 1 / 2 Ionization energy 118017.0 cm -1 (14.6322 eV) Ref. M58

Atomic Data for Xenon (Xe)

Atomic Data for Xenon (Xe)

Atomic Number = 54

Atomic Weight = 131.29

Reference = E95

Isotope Mass Abundance Spin Mag Moment 128 Xe 127.903531 1.91% 0 129 Xe 128.904780 26.4% 1/2 -0.7768 130 Xe 129.903509 4.1% 0 131 Xe 130.905072 21.2% 3/2 132 Xe 131.904144 26.9% 0 134 Xe 133.905395 10.4% 0 136 Xe 135.907214 8.9% 0

Xe I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6 1 S 0 Ionization energy 97833.79 cm -1 (12.12984 eV) Ref. BVHU01 , KW85 Xe II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 5 2 P° 3 / 2 Ionization energy 169175 cm -1 (20.9750 eV) Ref. HP87

Atomic Data for Yttrium (Y)

Atomic Data for Yttrium (Y)

Atomic Number = 39

Atomic Weight = 88.90585

Reference = E95

Isotope Mass Abundance Spin Mag Moment 89 Y 88.905849 100% 1/2 -0.1373

Y I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 5 s 2 2 D 3 / 2 Ionization energy 50145.6 cm -1 (6.2173 eV) Ref. GRTE73 , JS00 Y II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 5 s 2 1 S 0 Ionization energy 98590 cm -1 (12.224 eV) Ref. NJK91

Atomic Data for Zirconium (Zr)

Atomic Data for Zirconium (Zr)

Atomic Number = 40

Atomic Weight = 91.224

Reference = E95

Isotope Mass Abundance Spin Mag Moment 90 Zr 89.904703 51.45% 0 91 Zr 90.905644 11.22% 5/2 -1.303 92 Zr 91.905039 17.15% 0 94 Zr 93.906314 17.38% 0 96 Zr 95.908275 2.80% 0

Zr I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 2 5 s 2 3 F 2 Ionization energy 53506.0 cm -1 (6.63390 eV) Ref. HHMR86 Zr II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 2 5 s 4 F 3 / 2 Ionization energy 106000 cm -1 (13.1 eV) Ref. J98

Atomic Data for Barium (Ba)

Atomic Data for Barium (Ba)

Atomic Number = 56

Atomic Weight = 137.327

Reference = E95

Isotope Mass Abundance Spin Mag Moment 130 Ba 129.906282 0.11% 0 132 Ba 131.905042 0.10% 0 134 Ba 133.904486 2.42% 0 135 Ba 134.905665 6.59% 3/2 +0.8365 136 Ba 135.904553 7.85% 0 137 Ba 136.905812 11.23% 3/2 +0.9357 138 Ba 137.905232 71.70% 0

Ba I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6 6 s 2 1 S 0 Ionization energy 42034.91 cm -1 (5.211664 eV) Ref. PVHA85 Ba II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6 6 s 2 S 1 / 2 Ionization energy 80686.30 cm -1 (10.00383 eV) Ref. KL99

Atomic Data for Cerium (Ce)

Atomic Data for Cerium (Ce)

Atomic Number = 58

Atomic Weight = 140.115

Reference = E95

Isotope Mass Abundance Spin Mag Moment 136 Ce 135.907140 0.19% 0 138 Ce 137.905985 0.25% 0 140 Ce 139.905433 88.48% 0 142 Ce 141.909241 11.08% 0

Ce I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 5 d 6 s 2 1 G° 4 Ionization energy 44672 cm -1 (5.5387 eV) Ref. WSPC78 Ce II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 5 d 2 4 H° 7 / 2 Ionization energy 87500 cm -1 (10.85 eV) Ref. SR65

Atomic Data for Cesium (Cs)

Atomic Data for Cesium (Cs)

Atomic Number = 55

Atomic Weight = 132.9054

Reference = E95

Isotope Mass Abundance Spin Mag Moment 133 Cs 132.905429 100% 7/2 +2.579

Cs I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6 6 s 2 S 1 / 2 Ionization energy 31406.46769 cm -1 (3.893905 eV) Ref. WS87 Cs II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6 1 S 0 Ionization energy 186777.4 cm -1 (23.15744 eV) Ref. S81

Atomic Data for Dysprosium (Dy)

Atomic Data for Dysprosium (Dy)

Atomic Number = 66

Atomic Weight = 162.50

Reference = E95

Isotope Mass Abundance Spin Mag Moment 160 Dy 159.925193 2.34% 0 161 Dy 160.926930 18.9% 5/2 -0.48 162 Dy 161.926795 25.5% 0 163 Dy 162.928728 24.9% 5/2 +0.673 164 Dy 163.929171 28.2% 0

Dy I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 1 0 6 s 2 5 I 8 Ionization energy 47900 cm -1 (5.9389 eV) Ref. WSPC78 Dy II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 9 (5 I8)6 s (8, 1 / 2) 1 7 / 2 Ionization energy 94100 cm -1 (11.67 eV) Ref. MZH78

Atomic Data for Erbium (Er)

Atomic Data for Erbium (Er)

Atomic Number = 68

Atomic Weight = 167.26

Reference = E95

Isotope Mass Abundance Spin Mag Moment 162 Er 161.928775 0.14% 0 164 Er 163.929198 1.61% 0 166 Er 165.930290 33.6% 0 167 Er 166.932046 22.95% 7/2 -0.5665 168 Er 167.932368 26.8% 0 170 Er 169.935461 14.9% 0

Er I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6 4 f 1 2 6 s 2 3 H 6 Ionization energy 49262 cm -1 (6.1077 eV) Ref. WSPC78 Er II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6 4 f 1 2 (3 H 6)6 s (6, 1 / 2) 1 3 / 2 Ionization energy 96200 cm -1 (11.93 eV) Ref. SR65

Atomic Data for Europium (Eu)

Atomic Data for Europium (Eu)

Atomic Number = 63

Atomic Weight = 151.965

Reference = E95

Isotope Mass Abundance Spin Mag Moment 151 Eu 150.919847 47.8% 5/2 +3.464 153 Eu 152.921225 52.2% 5/2 +1.530

Eu I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 7 6 s 2 8 S° 7 / 2 Ionization energy 45734.74 cm -1 (5.67038 eV) Ref. NRCA00 Eu II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 7 6 s 9 S° 4 Ionization energy 90700 cm -1 (11.25 eV) Ref. SR65

Atomic Data for Gadolinium (Gd)

Atomic Data for Gadolinium (Gd)

Atomic Number = 64

Atomic Weight = 157.25

Reference = E95

Isotope Mass Abundance Spin Mag Moment 152 Gd 151.919786 0.20% 0 154 Gd 153.920861 2.18% 0 155 Gd 154.922618 14.80% 3/2 -0.27 156 Gd 155.922118 20.47% 0 157 Gd 156.923956 15.65% 3/2 -0.36 158 Gd 157.924099 24.84% 0 160 Gd 159.927049 21.86% 0

Gd I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 7 5 d 6 s 2 9 D° 2 Ionization energy 49601.45 cm -1 (6.14980 eV) Ref. MOW98 Gd II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 7 5 d 6 s 1 0 D° 5 / 2 Ionization energy 97500 cm -1 (12.09 eV) Ref. SR73

Atomic Data for Hafnium (Hf)

Atomic Data for Hafnium (Hf)

Atomic Number = 72

Atomic Weight = 178.49

Reference = E95

Isotope Mass Abundance Spin Mag Moment 176 Hf 175.941406 5.21% 0 177 Hf 176.943217 18.6% 7/2 +0.7935 178 Hf 177.943696 27.30% 0 179 Hf 178.945812 13.63% 9/2 -0.6409 180 Hf 179.946545 35.10% 0

Hf I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 2 6 s 2 3 F 2 Ionization energy 55047.9 cm -1 (6.82507 eV) Ref. CHR88b Hf II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 6 s 2 2 P° 3 / 2 Ionization energy 120000 cm -1 (15 eV) Ref. M58

Atomic Data for Holmium (Ho)

Atomic Data for Holmium (Ho)

Atomic Number = 67

Atomic Weight = 164.93032

Reference = E95

Isotope Mass Abundance Spin Mag Moment 165 Ho 164.93032 100% 7/2

Ho I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 1 1 6 s 2 4 I° 1 5 / 2 Ionization energy 48567 cm -1 (6.0215 eV) Ref. WSPC78 Ho II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 1 1 (4 I° 1 5 / 2)6 s (1 5 / 2 , 1 / 2)° 8 Ionization energy 95200 cm -1 (11.80 eV) Ref. MZH78

Atomic Data for Lanthanum (La)

Atomic Data for Lanthanum (La)

Atomic Number = 57

Atomic Weight = 138.9055

Reference = E95

Isotope Mass Abundance Spin Mag Moment 138 La 137.907105 0.09% 5 +3.707 139 La 138.906346 99.10% 7/2 +2.778

La I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)5 d 6 s 2 2 D 3 / 2 Ionization energy 44981 cm -1 (5.5769 eV) Ref. MZH78 La II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6) 5 d 2 3 F 2 Ionization energy 89200 cm -1 (11.059 eV) Ref. SR65

Atomic Data for Lutetium (Lu)

Atomic Data for Lutetium (Lu)

Atomic Number = 71

Atomic Weight = 174.967

Reference = E95

Isotope Mass Abundance Spin Mag Moment 175 Lu 174.940770 97.41% 7/2 +2.2327 176 Lu 175.942679 2.59% 7 +3.19

Lu I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6)5 d 6 s 2 2 D 3 / 2 Ionization energy 43762.50 cm -1 (5.42586 eV) Ref. CT72 , MMMS89 Lu II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6)6 s 2 1 S 0 Ionization energy 112000 cm -1 (13.9 eV) Ref. MZH78

Atomic Data for Neodymium (Nd)

Atomic Data for Neodymium (Nd)

Atomic Number = 60

Atomic Weight = 144.24

Reference = E95

Isotope Mass Abundance Spin Mag Moment 142 Nd 141.907719 27.13% 0 143 Nd 142.909810 12.18% 7/2 -1.08 144 Nd 143.910083 23.80% 0 145 Nd 144.912570 8.30% 7/2 -0.66 146 Nd 145.913113 17.19% 0 148 Nd 147.916889 5.76% 0 150 Nd 149.920889 5.64% 0

Nd I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 4 6 s 2 5 I 4 Ionization energy 44562 cm -1 (5.5250 eV) Ref. WSPC78 Nd II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 4 6 s 6 I 7 / 2 Ionization energy 86500 cm -1 (10.72 eV) Ref. SR65

Atomic Data for Praseodymium (Pr)

Atomic Data for Praseodymium (Pr)

Atomic Number = 59

Atomic Weight = 140.90765

Reference = E95

Isotope Mass Abundance Spin Mag Moment 141 Pr 140.907647 100% 5/2 +4.3

Pr I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 3 6 s 2 4 I° 9 / 2 Ionization energy 44140 cm -1 (5.473 eV) Ref. WSPC78 Pr II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 3 (4 I° 9 / 2)6 s (9 / 2 , 1 / 2)° 4 Ionization energy 85100 cm -1 (10.55 eV) Ref. SR65

Atomic Data for Promethium (Pm)

Atomic Data for Promethium (Pm)

Atomic Number = 61

Atomic Weight = 145

Reference = E95

Isotope Mass Abundance Spin Mag Moment 145 Pm 144.912743 0 5/2 146 Pm 145.914708 0 3 147 Pm 146.915135 0 7/2 +2.7 149 Pm 148.918332 0 7/2 +-3.3 151 Pm 150.921203 0 5/2 +-1.8

Pm I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 5 6 s 2 6 H° 5 / 2 Ionization energy 45020 cm -1 (5.582 eV) Ref. WSPC78 Pm II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 5 6 s 7 H° 2 Ionization energy 87900 cm -1 (10.90 eV) Ref. SR65

Atomic Data for Samarium (Sm)

Atomic Data for Samarium (Sm)

Atomic Number = 62

Atomic Weight = 150.36

Reference = E95

Isotope Mass Abundance Spin Mag Moment 144 Sm 143.911998 3.1% 0 147 Sm 146.914895 15.0% 7/2 -0.813 148 Sm 147.914820 11.3% 0 149 Sm 148.917181 13.8% 7/2 -0.670 150 Sm 149.917273 7.4% 0 152 Sm 151.919729 26.6% 0 154 Sm 153.922206 22.6% 0

Sm I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 6 6 s 2 7 F 0 Ionization energy 45519.6 cm -1 (5.6437 eV) Ref. JRB00 Sm II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 6 6 s 8 F 1 / 2 Ionization energy 89300 cm -1 (11.07 eV) Ref. SR65

Atomic Data for Terbium (Tb)

Atomic Data for Terbium (Tb)

Atomic Number = 65

Atomic Weight = 158.92534

Reference = E95

Isotope Mass Abundance Spin Mag Moment 159 Tb 158.925342 100% 3/2 +1.95

Tb I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 9 6 s 2 6 H° 1 5 / 2 Ionization energy 47294 cm -1 (5.8638 eV) Ref. WSPC78 Tb II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 9 (6 H° 1 5 / 2)6 s (1 5 / 2 , 1 / 2)° 8 Ionization energy 92900 cm -1 (11.52 eV) Ref. SR65

Atomic Data for Thulium (Tm)

Atomic Data for Thulium (Tm)

Atomic Number = 69

Atomic Weight = 168.93421

Reference = E95

Isotope Mass Abundance Spin Mag Moment 169 Tm 168.93421 100% 1/2 -0.2316

Tm I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 1 3 6 s 2 2 F° 7 / 2 Ionization energy 49879.8 cm -1 (6.18431 eV) Ref. C71 Tm II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 1 3 (2 F° 7 / 2)6 s (7 / 2 , 1 / 2)° 4 Ionization energy 97200 cm -1 (12.05 eV) Ref. SR65

Atomic Data for Ytterbium (Yb)

Atomic Data for Ytterbium (Yb)

Atomic Number = 70

Atomic Weight = 173.04

Reference = E95

Isotope Mass Abundance Spin Mag Moment 168 Yb 167.933894 0.13% 0 170 Yb 169.934759 3.05% 0 171 Yb 170.936323 14.3% 1/2 +0.4919 172 Yb 171.936378 21.9% 0 173 Yb 172.938208 16.12% 5/2 -0.6776 174 Yb 173.938859 31.8% 0 176 Yb 175.942564 12.7% 0

Yb I Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 1 4 6 s 2 1 S 0 Ionization energy 50443.2 cm -1 (6.25416 eV) Ref. A80 Yb II Ground State (1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 5 s 2 5 p 6)4 f 1 4 6 s 2 S 1 / 2 Ionization energy 98207 cm -1 (12.176 eV) Ref. SK79

Atomic Data for Actinium (Ac)

Atomic Data for Actinium (Ac)

Atomic Number = 89

Atomic Weight = (227)

Reference = E95

Isotope Mass Abundance Spin Mag Moment 227 Ac 227.027750 Trace 3/2 -1.1 228 Ac 228.031015 Trace 3

Ac I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 6 d 7 s 2 2 D 3 / 2 Ionization energy 41700 cm -1 (5.17 eV) Ref. S74 Ac II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 7 s 2 1 S 0 Ionization energy 94800 cm -1 (11.75 eV) Ref. MHRS74

Atomic Data for Astatine (At)

Atomic Data for Astatine (At)

Atomic Number = 85

Atomic Weight = 210

Reference = E95

Isotope Mass Abundance Spin Mag Moment 210 At 209.987126 0 5 221 At 210.987469 0 9/2

At I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 5 2 P° 3 / 2

Atomic Data for Bismuth (Bi)

Atomic Data for Bismuth (Bi)

Atomic Number = 83

Atomic Weight = 208.9804

Reference = E95

Isotope Mass Abundance Spin Mag Moment 209 Bi 208.980347 100% 9/2 +4.110 210 Bi 209.984095 Trace 1 -0.044

Bi I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 3 4 S 3 / 2 Ionization energy 58762.0 cm -1 (7.2855 eV) Ref. MGGB89 Bi II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 2 3 P 0 Ionization energy 134720 cm -1 (16.703 eV) Ref. JM86

Atomic Data for Francium (Fr)

Atomic Data for Francium (Fr)

Atomic Number = 87

Atomic Weight = 223

Reference = E95

Isotope Mass Abundance Spin Mag Moment 212 Fr 211.996130 0* 5 223 Fr 223.019733 some 3/2

Fr I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 7 s 2 S 1 / 2 Ionization energy 32848.872 cm -1 (4.072741 eV) Ref. ABDJ90 Fr II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 1 S 0

Atomic Data for Gold (Au)

Atomic Data for Gold (Au)

Atomic Number = 79

Atomic Weight = 196.966543

Reference = E95

Isotope Mass Abundance Spin Mag Moment 197 Au 196.966543 100% 3/2 +0.1457

Au I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 S 1 / 2 Ionization energy 74408.88 cm -1 (9.22553 eV) Ref. BG78 Au II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 1 S 0 Ionization energy 162950 cm -1 (20.20 eV) Ref. RW97

Atomic Data for Iridium (Ir)

Atomic Data for Iridium (Ir)

Atomic Number = 77

Atomic Weight = 192.22

Reference = E95

Isotope Mass Abundance Spin Mag Moment 191 Ir 190.960584 37.3% 3/2 +0.1461 193 Ir 192.962917 62.7% 3/2 +0.1591

Ir I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 7 6 s 2 4 F 9 / 2 Ionization energy 72323.9 cm -1 (8.96702 eV) Ref. CLS97 Ir II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 7 6 s 5 F 5

Atomic Data for Lead (Pb)

Atomic Data for Lead (Pb)

Atomic Number = 82

Atomic Weight = 207.2

Reference = E95

Isotope Mass Abundance Spin Mag Moment 204 Pb 203.973020 1.4% 0 206 Pb 205.974440 24.1% 0 207 Pb 206.975872 22.1% 1/2 +0.5926 208 Pb 207.976627 52.4% 0

Pb I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 2 1 / 2 (1 / 2 , 1 / 2) 0 Ionization energy 59819.2 cm -1 (7.41663 eV) Ref. WA68 Pb II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 2 P° 1 / 2 Ionization energy 121245.14 cm -1 (15.03248 eV) Ref. RWS76

Atomic Data for Mercury (Hg)

Atomic Data for Mercury (Hg)

Atomic Number = 80

Atomic Weight = 200.59

Reference = E95

Isotope Mass Abundance Spin Mag Moment 196 Hg 195.965807 0.15% 0 198 Hg 197.966743 10.1% 0 199 Hg 198.968254 17.0% 1/2 +0.5059 200 Hg 199.968300 23.1% 0 201 Hg 200.970277 13.2% 3/2 -0.5602 202 Hg 201.970617 29.65% 0 204 Hg 203.973467 6.85% 0

Hg I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 1 S 0 Ionization energy 84184.1 cm -1 (10.4375 eV) Ref. B83 Hg II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 S 1 / 2 Ionization energy 151284.4 cm -1 (18.7568 eV) Ref. SR01

Atomic Data for Osmium (Os)

Atomic Data for Osmium (Os)

Atomic Number = 76

Atomic Weight = 190.2

Reference = E95

Isotope Mass Abundance Spin Mag Moment 184 Os 183.952488 0.02% 0 186 Os 185.953830 1.58% 0 187 Os 186.955741 1.6% 1/2 +0.0646 188 Os 187.955860 13.3% 0 189 Os 188.958137 16.1% 3/2 +0.6599 190 Os 189.958436 26.4% 0 192 Os 191.961476 41.0% 0

Os I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 6 6 s 2 5 D 4 Ionization energy 68058.9 cm -1 (8.43823 eV) Ref. CLS97 Os II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 6 6 s 6 D 9 / 2

Atomic Data for Platinum (Pt)

Atomic Data for Platinum (Pt)

Atomic Number = 78

Atomic Weight = 195.08

Reference = E95

Isotope Mass Abundance Spin Mag Moment 190 Pt 189.959917 0.01% 0 192 Pt 191.961019 0.79% 0 194 Pt 193.962655 32.9% 0 195 Pt 194.964766 33.8% 1/2 +0.6095 196 Pt 195.967315 25.3% 0 198 Pt 197.967869 7.2% 0

Pt I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 9 6 s 3 D 3 Ionization energy 72257.3 cm -1 (8.9588 eV) Ref. MMHS95 , JS00 Pt II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 9 2 D 5 / 2 Ionization energy 149723 cm -1 (18.563 eV) Ref. S38b

Atomic Data for Polonium (Po)

Atomic Data for Polonium (Po)

Atomic Number = 84

Atomic Weight = 209

Reference = E95

Isotope Mass Abundance Spin Mag Moment 210 Po 209.982848 Trace 0 211 Po 210.986627 Trace 9/2 216 Po 216.001889 Trace 0 218 Po 218.0089 Trace 0

Po I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 4 3 P 2 Ionization energy 67860 cm -1 (8.414 eV) Ref. C66a Po II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 3 4 S° 3 / 2

Atomic Data for Protactinium (Pa)

Atomic Data for Protactinium (Pa)

Atomic Number = 91

Atomic Weight = 231.03588

Reference = E95

Isotope Mass Abundance Spin Mag Moment 231 Pa 231.035880 Trace 3/2 +2.01 234 Pa 234.043303 Trace 4

Pa I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 2 6 d 7 s 2 4 K 1 1 / 2 Ionization energy 47500 cm -1 (5.89 eV) Ref. S74 Pa II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 2 7 s 2 3 H 4

Atomic Data for Radium (Ra)

Atomic Data for Radium (Ra)

Atomic Number = 88

Atomic Weight = 226.0254

Reference = E95

Isotope Mass Abundance Spin Mag Moment 223 Ra 223.018501 Some 1/2 224 Ra 224.020186 Some 0 226 Ra 226.025402 Some 0 228 Ra 228.031064 Some 0

Ra I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 7 s 2 1 S 0 Ionization energy 42573.36 cm -1 (5.278423 eV) Ref. AWT80 Ra II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 7 s 2 S 1 / 2 Ionization energy 81842.31 cm -1 (10.14715 eV) Ref. M58

Atomic Data for Radon (Rn)

Atomic Data for Radon (Rn)

Atomic Number = 86

Atomic Weight = (222)

Reference = E95

Isotope Mass Abundance Spin Mag Moment 219 Rn 219.009479 Trace 5/2 220 Rn 220.011368 Trace 0 222 Rn 222.017570 Trace 0

Rn I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 1 S 0 Ionization energy 86692.5 cm -1 (10.7485 eV) Ref. R33 Rn II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 5 2 P° 3 / 2

Atomic Data for Rhenium (Re)

Atomic Data for Rhenium (Re)

Atomic Number = 75

Atomic Weight = 186.207

Reference = E95

Isotope Mass Abundance Spin Mag Moment 185 Re 184.952951 37.40% 5/2 +3.172 187 Re 186.955744 62.60% 5/2 +3.2197

Re I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 5 6 s 2 6 S 5 / 2 Ionization energy 63181.6 cm -1 (7.83352 eV) Ref. CS96 Re II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 5 6 s 7 S 3

Atomic Data for Tantalum (Ta)

Atomic Data for Tantalum (Ta)

Atomic Number = 73

Atomic Weight = 180.9479

Reference = E95

Isotope Mass Abundance Spin Mag Moment 180 Ta 179.947462 0.012% 9 181 Ta 220.011368 99.998% 7/2 +2.370

Ta I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 3 6 s 2 4 F 3 / 2 Ionization energy 60891.4 cm -1 (7.54957 eV) Ref. SKJ94 Ta II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 3 6 s 5 F 1

Atomic Data for Thallium (Tl)

Atomic Data for Thallium (Tl)

Atomic Number = 81

Atomic Weight = 204.3833

Reference = E95

Isotope Mass Abundance Spin Mag Moment 203 Tl 202.972320 29.52% 1/2 +1.6223 205 Tl 204.974401 70.48% 1/2 +1.6382

Tl I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 2 P 1 / 2 Ionization energy 49265.91 cm -1 (6.108194 eV) Ref. BC85 Tl II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 1 S 0 Ionization energy 164765 cm -1 (20.4283 eV) Ref. M58

Atomic Data for Thorium (Th)

Atomic Data for Thorium (Th)

Atomic Number = 90

Atomic Weight = 232.0381

Reference = E95

Isotope Mass Abundance Spin Mag Moment 232 Th 232.038054 100% 0

Th I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 6 d 2 7 s 2 3 F 2 Ionization energy 50867 cm -1 (6.3067 eV) Ref. KDEE97 Th II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 6 d 2 7 s 3 / 2 Ionization energy 96000 cm -1 (11.9 eV) Ref. MCS75

Atomic Data for Tungsten (W)

Atomic Data for Tungsten (W)

Atomic Number = 74

Atomic Weight = 183.85

Reference = E95

Isotope Mass Abundance Spin Mag Moment 180 W 79.946701 0.12% 0 182 W 81.948202 26.3% 0 183 W 82.950220 14.28% 1/2 +0.11778 184 W 83.950928 30.7% 0 186 W 85.954357 28.6% 0

W I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 4 6 s 2 5 D 0 Ionization energy 63427.7 cm -1 (7.86403 eV) Ref. CS96 W II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 4 6 s 6 D 1 / 2 Ionization energy 130000 cm -1 (16.1 eV) Ref. MH84

Atomic Data for Americium (Am)

Atomic Data for Americium (Am)

Atomic Number = 95

Atomic Weight = (243)

Reference = E95

Isotope Mass Abundance Spin Mag Moment 241 Am 241.056823 0 5/2 +1.61 243 Am 243.061375 0 5/2 +1.61

Am I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 7 7 s 2 8 S° 7 / 2 Ionization energy 48182 cm -1 (5.9738 eV) Ref. KDEE97 Am II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 7 7 s 9 S° 4

Atomic Data for Berkelium (Bk)

Atomic Data for Berkelium (Bk)

Atomic Number = 97

Atomic Weight = (247)

Reference = E95

Isotope Mass Abundance Spin Mag Moment 247 Bk 247.070300 0 3/2 249 Bk 249.074980 0 7/2 2.0

Bk I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 9 7 s 2 6 H° 1 5 / 2 Ionization energy 49989 cm -1 (6.1979 eV) Ref. KDEE97 Bk II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 9 7 s (1 5 / 2 , 1 / 2)° 8

Atomic Data for Californium (Cf)

Atomic Data for Californium (Cf)

Atomic Number = 98

Atomic Weight = (251)

Reference = E95

Isotope Mass Abundance Spin Mag Moment 249 Cf 249.074844 0 9/2 251 Cf 251.079580 0 1/2 252 Cf 252.081621 0 0

Cf I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 1 0 7 s 2 5 I 8 Ionization energy 50665 cm -1 (6.2817 eV) Ref. KDEE97 Cf II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 1 0 7 s (8, 1 / 2) 1 7 / 2 Ionization energy [95000] cm -1 (11.8 eV) Ref. CNWM70

Atomic Data for Curium (Cm)

Atomic Data for Curium (Cm)

Atomic Number = 96

Atomic Weight = (247)

Reference = E95

Isotope Mass Abundance Spin Mag Moment 245 Cm 245.058830 0 7/2 0.5 246 Cm 246.067218 0 0 247 Cm 247.070347 0 9/2 +0.37 248 Cm 248.072343 0 0

Cm I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 7 6 d 7 s 2 9 D° 2 Ionization energy 48324 cm -1 (5.9914 eV) Ref. KDEE97 Cm II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 7 7 s 2 8 S° 7 / 2

Atomic Data for Einsteinium (Es)

Atomic Data for Einsteinium (Es)

Atomic Number = 99

Atomic Weight = (254)

Reference = E95

Isotope Mass Abundance Spin Mag Moment 252 Es 252.082944 0 5 253 Es 253.084818 0 7/2 4.10 254 Es 254.088019 0 7 255 Es 255.090270 0 7/2

Es I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 1 1 7 s 2 4 I° 1 5 / 2 Ionization energy 51800 cm -1 (6.42 eV) Ref. S74 Es II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 1 1 (4 I 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 Ionization energy [97000] cm -1 (12.0 eV) Ref. CNWM70

Atomic Data for Neptunium (Np)

Atomic Data for Neptunium (Np)

Atomic Number = 93

Atomic Weight = 237.0482

Reference = E95

Isotope Mass Abundance Spin Mag Moment 237 Np 237.048167 0 5/2 +3.14

Np I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 4 6 d 7 s 2 6 L 1 1 / 2 Ionization energy 50536 cm -1 (6.2657 eV) Ref. KDEE97 Np II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 4 6 d 7 s 7 L 5

Atomic Data for Plutonium (Pu)

Atomic Data for Plutonium (Pu)

Atomic Number = 94

Atomic Weight = (244)

Reference = E95

Isotope Mass Abundance Spin Mag Moment 239 Pu 239.052157 0 1/2 +0.203 242 Pu 242.058737 0 0 244 Pu 244.064199 0 0

Pu I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 6 7 s 2 7 F 0 Ionization energy 48603 cm -1 (6.0260 eV) Ref. WCJP93 , KDEE97 Pu II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 6 7 s 8 F 1 / 2 Ionization energy [90000] cm -1 (11.2 eV) Ref. CNWM70

Atomic Data for Uranium (U)

Atomic Data for Uranium (U)

Atomic Number = 92

Atomic Weight = 238.0289

Reference = E95

Isotope Mass Abundance Spin Mag Moment 234 U 34.040946 0.005% 0 235 U 35.043924 0.720% 7/2 -0.35 238 U 38.050784 99.275% 0

U I Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 3 6 d 7 s 2 5 L° 6 Ionization energy 49958.4 cm -1 (6.1941 eV) Ref. CABC82 U II Ground State 1 s 2 2 s 2 2 p 6 3 s 2 3 p 6 3 d 1 0 4 s 2 4 p 6 4 d 1 0 4 f 1 4 5 s 2 5 p 6 5 d 1 0 6 s 2 6 p 6 5 f 3 7 s 2 4 l° 9 / 2 Ionization energy 85000 cm -1 (10.6 eV) Ref. SRC71

NIST: Finding List of Basic Atomic Spectroscopic Data

Finding List

0 - 2000 Å 2000 - 2500 Å 2500 - 2750 Å 2750 - 3000 Å 3000 - 3250 Å 3250 - 3500 Å 3500 - 3750 Å 3750 - 4000 Å 4000 - 4250 Å 4250 - 4500 Å 4500 - 5000 Å 5000 - 6000 Å 6000 - 7000 Å 7000 - 8000 Å > 8000 Å

NIST: Finding List of Basic Atomic Spectroscopic Data

Finding List

0 - 2000 Å 2000 - 2500 Å 2500 - 2750 Å 2750 - 3000 Å 3000 - 3250 Å 3250 - 3500 Å 3500 - 3750 Å 3750 - 4000 Å 4000 - 4250 Å 4250 - 4500 Å 4500 - 5000 Å 5000 - 6000 Å 6000 - 7000 Å 7000 - 8000 Å > 8000 Å Intensity Wavelength(Å) Spectrum Reference 30 171.575 Li II R37 300 P 178.014 Li II R37 1000 P 199.280 Li II R37 15 c 231.4541 He II GM65 20 c 232.5842 He II GM65 30 c 234.3472 He II GM65 50 c 237.3307 He II GM65 100 c 243.0266 He II GM65 300 P 256.3166 He II MK00b 150 P 256.3177 He II MK00b 90 P 300.15 Na II W71 90 300.20 Na II W71 50 301.32 Na II W71 60 301.44 Na II W71 30 302.45 Na II W71 1000 P 303.7804 He II MK00b 500 P 303.7858 He II MK00b 10 320.293 He I TW71 90 P 352.9549 Ne II P71 60 P 354.9620 Ne II P71 90 361.4321 Ne II P71 60 362.4544 Ne II P71 150 P 372.08 Na II W71 200 376.38 Na II W71 150 405.8538 Ne II P71 120 407.1377 Ne II P71 400 P 429.918 O II MKM93 700 P 430.041 O II MKM93 1000 P 430.177 O II MKM93 800 441.81 K II E31 200 P 445.0393 Ne II P71 300 P 446.2552 Ne II P71 250 P 446.5902 Ne II P71 200 447.8146 Ne II P71 150 454.6540 Ne II P71 200 455.2730 Ne II P71 10 456.2728 Ne II P71 120 456.3485 Ne II P71 90 456.8962 Ne II P71 1000 P 460.7284 Ne II P71 500 P 462.3908 Ne II P71 150 465.08 K II E31 469.50 K II E31 300 476.03 K II E31 900 P 484.602 F II P69 10 487.2272 Ar II M71 15 490.6495 Ar II M71 10 490.7013 Ar II M71 1000 495.14 K II E31 2 505.50035 He I M02 3 505.68433 He I M02 4 505.91252 He I M02 5 506.20034 He I M02 7 506.57057 He I M02 10 507.05802 He I M02 15 507.71809 He I M02 20 508.64338 He I M02 25 509.99829 He I M02 35 512.09856 He I M02 2 513.266 Rb II R75 50 515.61684 He I M02 10 519.3270 Ar II M71 100 P 522.21309 He I M02 3 530.173 Rb II R75 400 P 537.02992 He I M02 800 P 537.8319 O II MKM93 1000 P 538.2636 O II MKM93 600 P 538.318 O II MKM93 800 P 539.0855 O II MKM93 700 P 539.5489 O II MKM93 500 P 539.8544 O II MKM93 10 542.9124 Ar II M71 70 543.2033 Ar II M71 25 547.4606 Ar II M71 25 556.8170 Ar II M71 25 573.3619 Ar II M71 10 576.7364 Ar II M71 25 580.2632 Ar II M71 10 583.4371 Ar II M71 1000 P 584.33436 He I M02 30 587.1792 Ne I SS04 30 587.2127 Ne I SS04 30 P 589.419 Rb II R75 30 589.9114 Ne I SS04 50 591.41207 He I M02 70 591.8306 Ne I SS04 100 595.9200 Ne I SS04 25 597.7001 Ar II M71 70 598.7056 Ne I SS04 30 598.8897 Ne I SS04 70 600.0365 Ne I SS04 1000 P 600.77 K II E31 130 602.7263 Ne I SS04 10 602.8584 Ar II M71 900 P 605.669 F II P69 800 P 606.288 F II P69 1000 P 606.804 F II P69 700 P 606.923 F II P69 800 P 607.472 F II P69 800 P 607.93 K II E31 900 P 608.062 F II P69 10 612.3716 Ar II M71 1000 P 612.62 K II E31 170 P 615.6283 Ne I SS04 170 P 618.6716 Ne I SS04 130 P 619.1023 Ne I SS04 200 P 626.8232 Ne I SS04 200 P 629.7388 Ne I SS04 20 639.36 Cs II RE75 15 643.878 Rb II R75 200 P 644.635 N II E83 600 P 644.837 N II E83 1000 P 645.179 N II E83 150 P 661.8690 Ar II M71 10 664.5623 Ar II M71 70 666.0109 Ar II M71 300 P 670.9455 Ar II M71 1000 P 671.8513 Ar II M71 25 676.2425 Ar II M71 10 677.9518 Ar II M71 10 679.2184 Ar II M71 70 679.4006 Ar II M71 600 P 687.0526 C II KE74 1000 P 687.346 C II KE74 80 692.70 N I M75a 180 693.947 B II O70 500 r 696.30 Tl II ES36 30 P 697.049 Rb II R75 70 P 711.187 Rb II R75

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0 - 2000 Å 2000 - 2500 Å 2500 - 2750 Å 2750 - 3000 Å 3000 - 3250 Å 3250 - 3500 Å 3500 - 3750 Å 3750 - 4000 Å 4000 - 4250 Å 4250 - 4500 Å 4500 - 5000 Å 5000 - 6000 Å 6000 - 7000 Å 7000 - 8000 Å > 8000 Å Intensity Wavelength(Å) Spectrum Reference 10 s 5000.21 Am I FT57 30 5000.988 Ti I F91 110 5001.14 Lu I MCS75 30 5001.48 N II M75a 40 P 5005.15 N II M75a 50 5005.1587 Ne I SS04 3 5005.416 Pb I WA68 250 5005.60 K II D26 500 P 5007.206 Ti I F91 20 5007.234 Er I M64b 30 5007.32 N II M75a 600 P 5009.098 Ce I M75c 15 5009.334 Ar II N73 20 5009.77 Tm II MCS75 20 5010.62 N II M75a 15 5013.17 Eu I MCS75 30 5013.281 Ti I F91 400 P 5014.186 Ti I F91 300 5014.275 Ti I F91 150 5015.04 Gd I MCS75 100 5015.678 He I M60a 70 5016.160 Ti I F91 25 5017.163 Ar II N73 60 5017.2540 Th II PE83 300 5018.59 Pr I MCS75 500 P 5019.76 Pr I MCS75 300 5019.971 Ca II ER56 110 5020.024 Ti I F91 200 l 5020.96 Am II FT57 70 5022.40 Kr II DHM33 110 5022.866 Ti I F91 15 5022.91 Eu I MCS75 70 5024.843 Ti I F91 40 5025.569 Ti I F91 500 P 5026.96 Pr I MCS75 50 5027.3433 Ag II KLLT02 50 5027.3841 U I PKE80 20 5028.280 Xe I HM33 10 5029.54 Eu I MCS75 250 5033.38 Pr I MCS75 20 5034.22 Tm II MCS75 150 5035.902 Ti I F91 110 5036.463 Ti I F91 50 5037.7512 Ne I SS04 15 5037.915 Li II HM59 90 5038.396 Ti I F91 150 5039.955 Ti I F91 300 5040.846 Ce I M75c 130 P 5041.026 Si II S61b 20 5042.049 Er II M64b 250 P 5042.58 Pb II WRSH74 250 5043.80 Cs II S81 300 5043.83 Pr I MCS75 9 5044.04 Pt I MCS75 250 5044.279 Sm I K35 300 P,s 5044.66 Np I FTBC76 70 5044.92 Xe II H39 30 5045.10 N II M75a 800 P 5045.52 Pr I MCS75 70 5046.583 Zr I J98 10 5047.74 He I M60a 60 5049.7960 Th II PE83 300 5050.57 La I MCS75 600 5051.793 Cu II R69 1000 s 5052.08 Es WLGC74 90 5053.28 W I MCS75 400 5053.40 Pr I MCS75 130 P 5055.981 Si II S61b 250 5056.27 K II D26 250 5056.46 La I MCS75 40 5057.340 Ru I K59 1000 P,r 5058.31 Pm I RD67 20 5059.48 Pt I MCS75 15 5060.895 Tm I SMC73 25 5062.037 Ar II N73 11 5064.306 Sc I AV77 200 P 5064.651 Ti I F91 100 5064.904 Zr I J98 200 P 5067.9737 Th I PE83 4 5069.144 Yb I MT78 25 5070.257 Sc I AV77 50 5070.58 Pb II WRSH74 300 5071.200 Sm I K35 300 5071.775 Ce I M75c 12 5074.34 Yb I MT78 50 5074.53 Pb II WRSH74 11 5075.820 Sc I AV77 130 5078.252 Zr I J98 140 P 5078.264 Cl II RK74 800 P 5078.54 Tl II ES36 50 5078.96 Nb I MCS75 300 5080.62 Xe II H39 90 5081.561 Sc I AV77 50 5083.721 Sc I AV77 400 5084.23 K I R56 50 5085.549 Sc I AV77 500 P,h 5085.822 Cd I BA56 80 5086.52 Kr II DHM33 500 P 5087.12 Pr I MCS75 15 5087.123 Sc I AV77 700 P 5087.418 Y II NJK91 12 5089.930 Sc I AV77 7 5090.495 Ar II N73 400 r 5094.83 Pm I RD67 25 5095.30 Nb I MCS75 300 5096.28 Tc I BMC67 15 5096.721 Sc I AV77 400 5097.17 K I R56 400 5099.20 K I R56 25 5099.274 Sc I AV77 300 r 5100.77 Pm I RD67 15 5101.119 Sc I AV77 100 s 5102.93 Es WLGC74 200 P 5103.45 Gd I MCS75 150 P 5105.54 Cu I S48 300 5106.23 La I MCS75 70 5110.384 Pr II G90 110 5110.763 Pr II G90 50 5111.64 Pb II WRSH74 500 5112.25 K I R56 400 5112.703 Ce I M75c 25 5113.439 Ti I F91 15 5114.37 Eu I MCS75 14 5116.648 Sc I AV77 300 5117.162 Sm I K35 1000 l 5118.24 Bk I WC78 130 P 5119.29 I I KC59 30 5120.415 Ti I F91 15 c 5120.80 In II PC38 11 w 5121.75 In II PC38 200 5122.136 Sm I K35 100 5122.42 Xe II H39 500 P,h 5124.356 Bi II DLW02

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Persistent Lines of Neutral Beryllium (Be I)

Persistent Lines of Neutral Beryllium (Be I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1661.478 0.000 2 s 2 1 S 0 60187.34 2 s 3 p 1 P° 1 return 2348.610 0.000 2 s 2 1 S 0 42565.35 2 s 2 p 1 P° 1 return 2494.728 21981.27 2 s 2 p 3 P° 2 62053.72 2 s 3 d 3 D 1,2,3 return 2650.454 21978.925 2 s 2 p 3 P° 1 59697.08 2 p 2 3 P 2 return 2650.550 21978.28 2 s 2 p 3 P° 0 59695.07 2 p 2 3 P 1 return 2650.613 21978.925 2 s 2 p 3 P° 1 59695.07 2 p 2 3 P 1 return 2650.619 21981.27 2 s 2 p 3 P° 2 59697.08 2 p 2 3 P 2 return 2650.694 21978.925 2 s 2 p 3 P° 1 59693.65 2 p 2 3 P 0 return 2650.760 21981.27 2 s 2 p 3 P° 2 59695.07 2 p 2 3 P 1 return 3321.340 21981.27 2 s 2 p 3 P° 2 52080.94 2 s 3 s 3 S 1 return 4572.664 42565.35 2 s 2 p 1 P° 1 64428.31 2 s 3 d 1 D 2 return 8254.070 42565.35 2 s 2 p 1 P° 1 54677.26 2 s 3 s 1 S 0 return

Persistent Lines of Neutral Helium (He I)

Persistent Lines of Neutral Helium (He I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 522.21309 0.000 1 s 2 1 S 0 191492.7120 1 s 4 p 1 P° 1 return 537.02992 0.000 1 s 2 1 S 0 186209.3651 1 s 3 p 1 P° 1 return 584.33436 0.000 1 s 2 1 S 0 171134.8970 1 s 2 p 1 P° 1 return 3888.6046 159855.9745 1 s 2 s 3 S 1 185564.8547 1 s 3 p 3 P° 0 return 3888.6456 159855.9745 1 s 2 s 3 S 1 185564.5840 1 s 3 p 3 P° 1 return 3888.6489 159855.9745 1 s 2 s 3 S 1 185564.5620 1 s 3 p 3 P° 2 return 5875.6148 169086.7666 1 s 2 p 3 P° 2 186101.5463 1 s 3 d 3 D 3 return 5875.6404 169086.8430 1 s 2 p 3 P° 1 186101.5488 1 s 3 d 3 D 2 return 5875.9663 169087.8309 1 s 2 p 3 P° 0 186101.5930 1 s 3 d 3 D 1 return 6678.1517 171134.8970 1 s 2 p 1 P° 1 186104.9668 1 s 3 d 1 D 2 return 7065.1771 169086.7666 1 s 2 p 3 P° 2 183236.7918 1 s 3 s 3 S 1 return 7065.2153 169086.8430 1 s 2 p 3 P° 1 183236.7918 1 s 3 s 3 S 1 return 7065.7086 169087.8309 1 s 2 p 3 P° 0 183236.7918 1 s 3 s 3 S 1 return 7281.3507 171134.8970 1 s 2 p 1 P° 1 184864.8294 1 s 3 s 1 S 0 return 10829.0911 159855.9745 1 s 2 s 3 S 1 169087.8309 1 s 2 p 3 P° 0 return 10830.2501 159855.9745 1 s 2 s 3 S 1 169086.8430 1 s 2 p 3 P° 1 return 10830.3398 159855.9745 1 s 2 s 3 S 1 169086.7666 1 s 2 p 3 P° 2 return 20581.287 166277.4403 1 s 2 s 1 S 0 171134.8970 1 s 2 p 1 P° 1 return

Persistent Lines of Neutral Hydrogen (H I)

Persistent Lines of Neutral Hydrogen (H I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 949.7430 0.0000 1 s 2 S 1 / 2 105291.6443 5 p 2 P° 1 / 2 , 3 / 2 return 972.5367 0.0000 1 s 2 S 1 / 2 102823.8791 4 p 2 P° 1 / 2 , 3 / 2 return 1025.7222 0.0000 1 s 2 S 1 / 2 97492.2835 3 p 2 P° 1 / 2 , 3 / 2 return 1215.66824 0.0000 1 s 2 S 1 / 2 82259.2850 2 p 2 P° 3 / 2 return 1215.67364 0.0000 1 s 2 S 1 / 2 82258.9191 2 p 2 P° 1 / 2 return 4340.462 82259.1109 2 s , p 105291.6587 5 s , p , d , f , g return 4861.2786 82258.9191 2 p 2 P° 1 / 2 102823.8942 4 d 2 D 3 / 2 return 4861.2870 82258.9544 2 s 2 S 1 / 2 102823.8943 4 p 2 P° 3 / 2 return 4861.3615 82259.2850 2 p 2 P° 3 / 2 102823.9095 4 d 2 D 5 / 2 return 6562.7110 82258.9191 2 p 2 P° 1 / 2 97492.3195 3 d 2 D 3 / 2 return 6562.7248 82258.9544 2 s 2 S 1 / 2 97492.3196 3 p 2 P° 3 / 2 return 6562.8518 82259.2850 2 p 2 P° 3 / 2 97492.3556 3 d 2 D 5 / 2 return 12818.07 97492.3087 3 s , p , d 105291.6587 5 s , p , d , f , g return 18751.01 97492.3087 3 s , p , d 102823.9002 4 s , p , d , f return

Persistent Lines of Neutral Lithium (Li I)

Persistent Lines of Neutral Lithium (Li I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4602.831 14903.622 2 p 2 P° 1 / 2 36623.297 4 d 2 D 3 / 2 return 4602.898 14903.957 2 p 2 P° 3 / 2 36623.312 4 d 2 D 5 / 2 return 6103.542 14903.622 2 p 2 P° 1 / 2 31283.018 3 d 2 D 3 / 2 return 6103.654 14903.957 2 p 2 P° 3 / 2 31283.053 3 d 2 D 5 / 2 return 6707.775 0.000 2 s 2 S 1 / 2 14903.957 2 p 2 P° 3 / 2 return 6707.926 0.000 2 s 2 S 1 / 2 14903.622 2 p 2 P° 1 / 2 return 8126.232 14903.622 2 p 2 P° 1 / 2 27206.066 3 s 2 S 1 / 2 return 8126.453 14903.957 2 p 2 P° 3 / 2 27206.066 3 s 2 S 1 / 2 return 26877.67 27206.066 3 s 2 S 1 / 2 30925.613 3 p 2 P° 3 / 2 return 26878.36 27206.066 3 s 2 S 1 / 2 30925.517 3 p 2 P° 1 / 2 return

Persistent Lines of Neutral Boron (B I)

Persistent Lines of Neutral Boron (B I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1825.894 0.000 2 s 2 2 p 2 P° 1 / 2 54767.698 2 s 2 3 d 2 D 3 / 2 return 1826.400 15.287 2 s 2 2 p 2 P° 3 / 2 54767.844 2 s 2 3 d 2 D 5 / 2 return 2088.889 0.000 2 s 2 2 p 2 P° 1 / 2 47857.127 2 s 2 p 2 2 D 3 / 2 return 2089.570 15.287 2 s 2 2 p 2 P° 3 / 2 47856.807 2 s 2 p 2 2 D 5 / 2 return 2496.769 0.000 2 s 2 2 p 2 P° 1 / 2 40039.695 2 s 2 3 s 2 S 1 / 2 return 2497.722 15.287 2 s 2 2 p 2 P° 3 / 2 40039.695 2 s 2 3 s 2 S 1 / 2 return 11660.028 40039.695 2 s 2 3 s 2 S 1 / 2 48613.655 2 s 2 3 p 2 P° 3 / 2 return 11662.452 40039.695 2 s 2 3 s 2 S 1 / 2 48611.872 2 s 2 3 p 2 P° 1 / 2 return

Persistent Lines of Neutral Carbon (C I)

Persistent Lines of Neutral Carbon (C I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1277.2452 0.00000 2 s 2 2 p 2 3 P 0 78293.50 2 s 2 2 p (2 P°)3 d 3 D° 1 return 1277.2824 16.41671 2 s 2 2 p 2 3 P 1 78307.62 2 s 2 2 p (2 P°)3 d 3 D° 2 return 1277.5131 16.41671 2 s 2 2 p 2 3 P 1 78293.50 2 s 2 2 p (2 P°)3 d 3 D° 1 return 1277.5497 43.41350 2 s 2 2 p 2 3 P 2 78318.23 2 s 2 2 p (2 P°)3 d 3 D° 3 return 1280.3330 43.41350 2 s 2 2 p 2 3 P 2 78148.09 2 s 2 2 p (2 P°)4 s 3 P° 2 return 1560.682 16.41671 2 s 2 2 p 2 3 P 1 64090.97 2 s 2 p 3 3 D° 2 return 1560.709 16.41671 2 s 2 2 p 2 3 P 1 64089.86 2 s 2 p 3 3 D° 1 return 1561.438 43.41350 2 s 2 2 p 2 3 P 2 64086.95 2 s 2 p 3 3 D° 3 return 1656.267 16.41671 2 s 2 2 p 2 3 P 1 60393.15 2 s 2 2 p (2 P°)3 s 3 P° 2 return 1656.928 0.00000 2 s 2 2 p 2 3 P 0 60352.64 2 s 2 2 p (2 P°)3 s 3 P° 1 return 1657.008 43.41350 2 s 2 2 p 2 3 P 2 60393.15 2 s 2 2 p (2 P°)3 s 3 P° 2 return 1657.379 16.41671 2 s 2 2 p 2 3 P 1 60352.64 2 s 2 2 p (2 P°)3 s 3 P° 1 return 1657.907 16.41671 2 s 2 2 p 2 3 P 1 60333.43 2 s 2 2 p (2 P°)3 s 3 P° 0 return 1658.121 43.41350 2 s 2 2 p 2 3 P 2 60352.64 2 s 2 2 p (2 P°)3 s 3 P° 1 return 1751.827 21648.02 2 s 2 2 p 2 1 S 0 78731.28 2 s 2 2 p (2 P°)3 d 1 P° 1 return 1930.906 10192.66 2 s 2 2 p 2 1 D 2 61981.82 2 s 2 2 p (2 P°)3 s 1 P° 1 return 2478.561 21648.02 2 s 2 2 p 2 1 S 0 61981.82 2 s 2 2 p (2 P°)3 s 1 P° 1 return 8335.15 61981.82 2 s 2 2 p (2 P°)3 s 1 P° 1 73975.91 2 s 2 2 p (2 P°)3 p 1 S 0 return 9405.73 61981.82 2 s 2 2 p (2 P°)3 s 1 P° 1 72610.73 2 s 2 2 p (2 P°)3 p 1 D 2 return 11753.32 69744.03 2 s 2 2 p (2 P°)3 p 3 D 3 78249.93 2 s 2 2 p (2 P°)3 d 3 F° 4 return 11754.76 69710.67 2 s 2 2 p (2 P°)3 p 3 D 2 78215.50 2 s 2 2 p (2 P°)3 d 3 F° 3 return

Persistent Lines of Neutral Fluorine (F I)

Persistent Lines of Neutral Fluorine (F I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 951.870 0.000 2 s 2 2 p 5 2 P° 3 / 2 105056.283 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 return 954.826 0.000 2 s 2 2 p 5 2 P° 3 / 2 104731.048 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 return 955.546 404.141 2 s 2 2 p 5 2 P° 1 / 2 105056.283 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 return 958.525 404.141 2 s 2 2 p 5 2 P° 1 / 2 104731.048 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 return 6239.651 102405.714 2 s 2 2 p 4 (3 P)3 s 4 P 5 / 2 118427.814 2 s 2 2 p 4 (3 P)3 p 4 S° 3 / 2 return 6348.508 102680.439 2 s 2 2 p 4 (3 P)3 s 4 P 3 / 2 118427.814 2 s 2 2 p 4 (3 P)3 p 4 S° 3 / 2 return 6856.030 102405.714 2 s 2 2 p 4 (3 P)3 s 4 P 5 / 2 116987.391 2 s 2 2 p 4 (3 P)3 p 4 D° 7 / 2 return 6902.475 102680.439 2 s 2 2 p 4 (3 P)3 s 4 P 3 / 2 117164.002 2 s 2 2 p 4 (3 P)3 p 4 D° 5 / 2 return 7037.469 104731.048 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 118936.791 2 s 2 2 p 4 (3 P)3 p 2 P° 3 / 2 return 7127.890 105056.283 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 119081.814 2 s 2 2 p 4 (3 P)3 p 2 P° 1 / 2 return 7202.360 105056.283 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 118936.791 2 s 2 2 p 4 (3 P)3 p 2 P° 3 / 2 return 7311.019 104731.048 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 118405.256 2 s 2 2 p 4 (3 P)3 p 2 S° 1 / 2 return 7398.688 102405.714 2 s 2 2 p 4 (3 P)3 s 4 P 5 / 2 115917.904 2 s 2 2 p 4 (3 P)3 p 4 P° 5 / 2 return 7754.696 104731.048 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 117622.917 2 s 2 2 p 4 (3 P)3 p 2 D° 5 / 2 return 7800.212 105056.283 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 117872.917 2 s 2 2 p 4 (3 P)3 p 2 D° 3 / 2 return

Persistent Lines of Neutral Neon (Ne I)

Persistent Lines of Neutral Neon (Ne I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 615.6283 0.00 2 p 6 1 S 0 162435.6780 2 p 5 (2 P° 1 / 2)3 d 2 [3 / 2]° 1 return 618.6716 0.00 2 p 6 1 S 0 161636.6175 2 p 5 (2 P° 3 / 2)3 d 2 [3 / 2]° 1 return 619.1023 0.00 2 p 6 1 S 0 161524.1739 2 p 5 (2 P° 3 / 2)3 d 2 [1 / 2]° 1 return 626.8232 0.00 2 p 6 1 S 0 159534.6196 2 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 1 return 629.7388 0.00 2 p 6 1 S 0 158795.9924 2 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 1 return 735.8962 0.00 2 p 6 1 S 0 135888.7173 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 1 return 743.7195 0.00 2 p 6 1 S 0 134459.2871 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 1 return 3520.4711 135888.7173 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 1 164285.8872 2 p 5 (2 P° 1 / 2)4 p 2 [1 / 2] 0 return 5400.5618 134459.2871 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 1 152970.7328 2 p 5 (2 P° 1 / 2)3 p 2 [1 / 2] 0 return 5852.4879 135888.7173 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 1 152970.7328 2 p 5 (2 P° 1 / 2)3 p 2 [1 / 2] 0 return 6029.9969 134459.2871 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 1 151038.4524 2 p 5 (2 P° 1 / 2)3 p 2 [1 / 2] 1 return 6074.3377 134459.2871 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 1 150917.4307 2 p 5 (2 P° 3 / 2)3 p 2 [1 / 2] 0 return 6143.0626 134041.8400 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 2 150315.8612 2 p 5 (2 P° 3 / 2)3 p 2 [3 / 2] 2 return 6163.5939 134818.6405 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 0 151038.4524 2 p 5 (2 P° 1 / 2)3 p 2 [1 / 2] 1 return 6217.2812 134041.8400 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 2 150121.5922 2 p 5 (2 P° 3 / 2)3 p 2 [3 / 2] 1 return 6266.4950 134818.6405 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 0 150772.1118 2 p 5 (2 P° 1 / 2)3 p 2 [3 / 2] 1 return 6382.9917 134459.2871 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 1 150121.5922 2 p 5 (2 P° 3 / 2)3 p 2 [3 / 2] 1 return 6402.248 134041.8400 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 2 149657.0393 2 p 5 (2 P° 3 / 2)3 p 2 [5 / 2] 3 return 6506.5281 134459.2871 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 1 149824.2215 2 p 5 (2 P° 3 / 2)3 p 2 [5 / 2] 2 return 6598.9529 135888.7173 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 1 151038.4524 2 p 5 (2 P° 1 / 2)3 p 2 [1 / 2] 1 return 6929.4673 135888.7173 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 1 150315.8612 2 p 5 (2 P° 3 / 2)3 p 2 [3 / 2] 2 return 7032.4131 134041.8400 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 2 148257.7898 2 p 5 (2 P° 3 / 2)3 p 2 [1 / 2] 1 return 7173.9381 135888.7173 2 p 5 (2 P° 1 / 2)3 s 2 [1 / 2]° 1 149824.2215 2 p 5 (2 P° 3 / 2)3 p 2 [5 / 2] 2 return 7245.1666 134459.2871 2 p 5 (2 P° 3 / 2)3 s 2 [3 / 2]° 1 148257.7898 2 p 5 (2 P° 3 / 2)3 p 2 [1 / 2] 1 return 8377.6080 149657.0393 2 p 5 (2 P° 3 / 2)3 p 2 [5 / 2] 3 161590.3412 2 p 5 (2 P° 3 / 2)3 d 2 [7 / 2]° 4 return 8654.3831 150858.5079 2 p 5 (2 P° 1 / 2)3 p 2 [3 / 2] 2 162410.1736 2 p 5 (2 P° 1 / 2)3 d 2 [5 / 2]° 3 return 8780.6226 150315.8612 2 p 5 (2 P° 3 / 2)3 p 2 [3 / 2] 2 161701.4486 2 p 5 (2 P° 3 / 2)3 d 2 [5 / 2]° 3 return 8783.7533 151038.4524 2 p 5 (2 P° 1 / 2)3 p 2 [1 / 2] 1 162419.9818 2 p 5 (2 P° 1 / 2)3 d 2 [3 / 2]° 2 return 11143.0200 149824.2215 2 p 5 (2 P° 3 / 2)3 p 2 [5 / 2] 2 158795.9924 2 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 1 return 11177.5240 149657.0393 2 p 5 (2 P° 3 / 2)3 p 2 [5 / 2] 3 158601.1152 2 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 return 11522.7459 150858.5079 2 p 5 (2 P° 1 / 2)3 p 2 [3 / 2] 2 159534.6196 2 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 1 return

Persistent Lines of Neutral Nitrogen (N I)

Persistent Lines of Neutral Nitrogen (N I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1199.550 0.000 2 s 2 2 p 3 4 S° 3 / 2 83364.620 2 s 2 2 p 2 (3 P)3 s 4 P 5 / 2 return 1200.223 0.000 2 s 2 2 p 3 4 S° 3 / 2 83317.830 2 s 2 2 p 2 (3 P)3 s 4 P 3 / 2 return 1200.710 0.000 2 s 2 2 p 3 4 S° 3 / 2 83284.070 2 s 2 2 p 2 (3 P)3 s 4 P 1 / 2 return 1243.179 19224.464 2 s 2 2 p 3 2 D° 5 / 2 99663.427 2 s 2 2 p 2 (1 D)3 s 2 D 5 / 2 return 1492.625 19224.464 2 s 2 2 p 3 2 D° 5 / 2 86220.510 2 s 2 2 p 2 (3 P)3 s 2 P 3 / 2 return 1742.729 28839.306 2 s 2 2 p 3 2 P° 3 / 2 86220.510 2 s 2 2 p 2 (3 P)3 s 2 P 3 / 2 return 7442.29 83317.830 2 s 2 2 p 2 (3 P)3 s 4 P 3 / 2 96750.840 2 s 2 2 p 2 (3 P)3 p 4 S° 3 / 2 return 7468.31 83364.620 2 s 2 2 p 2 (3 P)3 s 4 P 5 / 2 96750.840 2 s 2 2 p 2 (3 P)3 p 4 S° 3 / 2 return 8680.28 83364.620 2 s 2 2 p 2 (3 P)3 s 4 P 5 / 2 94881.820 2 s 2 2 p 2 (3 P)3 p 4 D° 7 / 2 return 8683.40 83317.830 2 s 2 2 p 2 (3 P)3 s 4 P 3 / 2 94830.890 2 s 2 2 p 2 (3 P)3 p 4 D° 5 / 2 return 12469.62 96864.050 2 s 2 2 p 2 (3 P)3 p 2 D° 5 / 2 104881.350 2 s 2 2 p 2 (3 P)3 d 2 F 7 / 2 return 13581.33 86220.510 2 s 2 2 p 2 (3 P)3 s 2 P 3 / 2 93581.550 2 s 2 2 p 2 (3 P)3 p 2 S° 1 / 2 return

Persistent Lines of Neutral Oxygen (O I)

Persistent Lines of Neutral Oxygen (O I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1302.168 0.000 2 s 2 2 p 4 3 P 2 76794.978 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 return 1304.858 158.265 2 s 2 2 p 4 3 P 1 76794.978 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 return 1306.029 226.977 2 s 2 2 p 4 3 P 0 76794.978 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 return 7771.94 73768.200 2 s 2 2 p 3 (4 S°)3 s 5 S° 2 86631.454 2 s 2 2 p 3 (4 S°)3 p 5 P 3 return 7774.17 73768.200 2 s 2 2 p 3 (4 S°)3 s 5 S° 2 86627.778 2 s 2 2 p 3 (4 S°)3 p 5 P 2 return 7775.39 73768.200 2 s 2 2 p 3 (4 S°)3 s 5 S° 2 86625.757 2 s 2 2 p 3 (4 S°)3 p 5 P 1 return 8446.25 76794.978 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 88631.303 2 s 2 2 p 3 (4 S°)3 p 3 P 0 return 8446.36 76794.978 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 88631.146 2 s 2 2 p 3 (4 S°)3 p 3 P 2 return 8446.76 76794.978 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 88630.587 2 s 2 2 p 3 (4 S°)3 p 3 P 1 return 9266.01 86631.454 2 s 2 2 p 3 (4 S°)3 p 5 P 3 97420.630 2 s 2 2 p 3 (4 S°)3 d 5 D° 4 return 13163.89 88630.587 2 s 2 2 p 3 (4 S°)3 p 3 P 1 96225.049 2 s 2 2 p 3 (4 S°)4 s 3 S° 1 return 13164.85 88631.146 2 s 2 2 p 3 (4 S°)3 p 3 P 2 96225.049 2 s 2 2 p 3 (4 S°)4 s 3 S° 1 return

Persistent Lines of Neutral Sodium (Na I)

Persistent Lines of Neutral Sodium (Na I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2852.81 0.000 3 s 2 S 1 / 2 35042.85 5 p 2 P° 3 / 2 return 2853.01 0.000 3 s 2 S 1 / 2 35040.38 5 p 2 P° 1 / 2 return 3302.37 0.000 3 s 2 S 1 / 2 30272.58 4 p 2 P° 3 / 2 return 3302.98 0.000 3 s 2 S 1 / 2 30266.99 4 p 2 P° 1 / 2 return 5889.950 0.000 3 s 2 S 1 / 2 16973.368 3 p 2 P° 3 / 2 return 5895.924 0.000 3 s 2 S 1 / 2 16956.172 3 p 2 P° 1 / 2 return 8183.256 16956.172 3 p 2 P° 1 / 2 29172.889 3 d 2 D 3 / 2 return 8194.790 16973.368 3 p 2 P° 3 / 2 29172.889 3 d 2 D 3 / 2 return 8194.824 16973.368 3 p 2 P° 3 / 2 29172.839 3 d 2 D 5 / 2 return 11381.45 16956.172 3 p 2 P° 1 / 2 25739.991 4 s 2 S 1 / 2 return 11403.78 16973.368 3 p 2 P° 3 / 2 25739.991 4 s 2 S 1 / 2 return 18465.25 29172.839 3 d 2 D 5 / 2 34586.92 4 f 2 F° 7 / 2 return 18465.25 29172.839 3 d 2 D 5 / 2 34586.92 4 f 2 F° 5 / 2 return

Persistent Lines of Neutral Aluminum (Al I)

Persistent Lines of Neutral Aluminum (Al I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2269.096 112.061 3 s 2 (1 S)3 p 2 P° 3 / 2 44168.847 3 s 2 (1 S)5 d 2 D 5 / 2 return 2367.052 0.000 3 s 2 (1 S)3 p 2 P° 1 / 2 42233.742 3 s 2 (1 S)4 d 2 D 3 / 2 return 2373.124 112.061 3 s 2 (1 S)3 p 2 P° 3 / 2 42237.783 3 s 2 (1 S)4 d 2 D 5 / 2 return 2575.094 112.061 3 s 2 (1 S)3 p 2 P° 3 / 2 38933.968 3 s 2 (1 S)4 d y 2 D 5 / 2 return 3082.153 0.000 3 s 2 (1 S)3 p 2 P° 1 / 2 32435.453 3 s 2 (1 S)3 d 2 D 3 / 2 return 3092.710 112.061 3 s 2 (1 S)3 p 2 P° 3 / 2 32436.796 3 s 2 (1 S)3 d 2 D 5 / 2 return 3092.839 112.061 3 s 2 (1 S)3 p 2 P° 3 / 2 32435.453 3 s 2 (1 S)3 d 2 D 3 / 2 return 3944.006 0.000 3 s 2 (1 S)3 p 2 P° 1 / 2 25347.756 3 s 2 (1 S)4 s 2 S 1 / 2 return 3961.520 112.061 3 s 2 (1 S)3 p 2 P° 3 / 2 25347.756 3 s 2 (1 S)4 s 2 S 1 / 2 return

Persistent Lines of Neutral Argon (Ar I)

Persistent Lines of Neutral Argon (Ar I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 866.79997 0.000 3 p 6 1 S 0 115366.871 3 p 5 (2 P° 1 / 2)3 d 2 [3 / 2]° 1 return 869.75411 0.000 3 p 6 1 S 0 114975.024 3 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 1 return 876.05767 0.000 3 p 6 1 S 0 114147.737 3 p 5 (2 P° 1 / 2)3 d 2 [3 / 2]° 1 return 879.94656 0.000 3 p 6 1 S 0 113643.265 3 p 5 (2 P° 1 / 2)5 s 2 [3 / 2]° 1 return 894.31013 0.000 3 p 6 1 S 0 111818.033 3 p 5 (2 P° 3 / 2)3 d 2 [1 / 2]° 1 return 1048.21987 0.000 3 p 6 1 S 0 95399.8329 3 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 1 return 1066.65980 0.000 3 p 6 1 S 0 93750.6031 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 1 return 6965.431 93143.7653 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 107496.4219 3 p 5 (2 P° 1 / 2)4 p 2 [1 / 2] 1 return 7067.218 93143.7653 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 107289.7054 3 p 5 (2 P° 1 / 2)4 p 2 [3 / 2] 2 return 7503.869 95399.8329 3 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 1 108722.6247 3 p 5 (2 P° 1 / 2)4 p 2 [1 / 2] 0 return 7635.106 93143.7653 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 106237.5571 3 p 5 (2 P° 3 / 2)4 p 2 [3 / 2] 2 return 7948.176 94553.6705 3 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 0 107131.7139 3 p 5 (2 P° 1 / 2)4 p 2 [3 / 2] 1 return 8006.157 93750.6031 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 1 106237.5571 3 p 5 (2 P° 3 / 2)4 p 2 [3 / 2] 2 return 8014.786 93143.7653 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 105617.2753 3 p 5 (2 P° 3 / 2)4 p 2 [5 / 2] 2 return 8103.693 93750.6031 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 1 106087.2651 3 p 5 (2 P° 3 / 2)4 p 2 [3 / 2] 1 return 8115.311 93143.7653 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 105462.7649 3 p 5 (2 P° 3 / 2)4 p 2 [5 / 2] 3 return 9122.967 93143.7653 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 2 104102.1043 3 p 5 (2 P° 3 / 2)4 p 2 [1 / 2] 1 return 9657.786 93750.6031 3 p 5 (2 P° 3 / 2)4 s 2 [3 / 2]° 1 104102.1043 3 p 5 (2 P° 3 / 2)4 p 2 [1 / 2] 1 return

Persistent Lines of Neutral Chlorine (Cl I)

Persistent Lines of Neutral Chlorine (Cl I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1335.726 0.00 3 s 2 3 p 5 2 P° 3 / 2 74865.667 3 s 2 3 p 4 (3 P)4 s 2 P 1 / 2 return 1347.240 0.00 3 s 2 3 p 5 2 P° 3 / 2 74225.846 3 s 2 3 p 4 (3 P)4 s 2 P 3 / 2 return 1351.657 882.35 3 s 2 3 p 5 2 P° 1 / 2 74865.667 3 s 2 3 p 4 (3 P)4 s 2 P 1 / 2 return 1363.447 882.35 3 s 2 3 p 5 2 P° 1 / 2 74225.846 3 s 2 3 p 4 (3 P)4 s 2 P 3 / 2 return 1379.528 0.00 3 s 2 3 p 5 2 P° 3 / 2 72488.568 3 s 2 3 p 4 (3 P)4 s 4 P 3 / 2 return 1389.693 0.00 3 s 2 3 p 5 2 P° 3 / 2 71958.363 3 s 2 3 p 4 (3 P)4 s 4 P 5 / 2 return 1389.957 882.35 3 s 2 3 p 5 2 P° 1 / 2 72827.038 3 s 2 3 p 4 (3 P)4 s 4 P 1 / 2 return 1396.527 882.35 3 s 2 3 p 5 2 P° 1 / 2 72488.568 3 s 2 3 p 4 (3 P)4 s 4 P 3 / 2 return 7547.072 72488.568 3 s 2 3 p 4 (3 P)4 s 4 P 3 / 2 85735.091 3 s 2 3 p 4 (3 P)4 p 4 S° 3 / 2 return 7744.970 72827.038 3 s 2 3 p 4 (3 P)4 s 4 P 1 / 2 85735.091 3 s 2 3 p 4 (3 P)4 p 4 S° 3 / 2 return 8212.038 71958.363 3 s 2 3 p 4 (3 P)4 s 4 P 5 / 2 84132.262 3 s 2 3 p 4 (3 P)4 p 4 D° 5 / 2 return 8221.742 72488.568 3 s 2 3 p 4 (3 P)4 s 4 P 3 / 2 84648.100 3 s 2 3 p 4 (3 P)4 p 2 D° 5 / 2 return 8333.307 72488.568 3 s 2 3 p 4 (3 P)4 s 4 P 3 / 2 84485.309 3 s 2 3 p 4 (3 P)4 p 4 D° 3 / 2 return 8375.94 71958.363 3 s 2 3 p 4 (3 P)4 s 4 P 5 / 2 83894.037 3 s 2 3 p 4 (3 P)4 p 4 D° 7 / 2 return 8428.254 72827.038 3 s 2 3 p 4 (3 P)4 s 4 P 1 / 2 84688.637 3 s 2 3 p 4 (3 P)4 p 4 D° 1 / 2 return 8575.24 72827.038 3 s 2 3 p 4 (3 P)4 s 4 P 1 / 2 84485.309 3 s 2 3 p 4 (3 P)4 p 4 D° 3 / 2 return 8585.97 72488.568 3 s 2 3 p 4 (3 P)4 s 4 P 3 / 2 84132.262 3 s 2 3 p 4 (3 P)4 p 4 D° 5 / 2 return

Persistent Lines of Neutral Magnesium (Mg I)

Persistent Lines of Neutral Magnesium (Mg I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2025.824 0.000 3 s 2 1 S 0 49346.729 3 s 4 p 1 P° 1 return 2779.820 21870.464 3 s 3 p 3 P° 1 57833.40 3 p 2 3 P 1 return 2779.834 21911.178 3 s 3 p 3 P° 2 57873.94 3 p 2 3 P 2 return 2852.1251 0.000 3 s 2 1 S 0 35051.264 3 s 3 p 1 P° 1 return 3829.355 21850.405 3 s 3 p 3 P° 0 47957.058 3 s 3 d 3 D 1 return 3832.300 21870.464 3 s 3 p 3 P° 1 47957.027 3 s 3 d 3 D 2 return 3832.300 21870.464 3 s 3 p 3 P° 1 47957.058 3 s 3 d 3 D 1 return 3838.292 21911.178 3 s 3 p 3 P° 2 47957.045 3 s 3 d 3 D 3 return 5167.322 21850.405 3 s 3 p 3 P° 0 41197.403 3 s 4 s 3 S 1 return 5172.684 21870.464 3 s 3 p 3 P° 1 41197.403 3 s 4 s 3 S 1 return 5183.604 21911.178 3 s 3 p 3 P° 2 41197.403 3 s 4 s 3 S 1 return 11828.17 35051.264 3 s 3 p 1 P° 1 43503.333 3 s 4 s 1 S 0 return 15025.00 41197.403 3 s 4 s 3 S 1 47851.162 3 s 4 p 3 P° 2 return

Persistent Lines of Neutral Phosphorus (P I)

Persistent Lines of Neutral Phosphorus (P I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1674.591 0.00 3 s 2 3 p 3 4 S° 3 / 2 59715.921 3 s 3 p 4 4 P 3 / 2 return 1679.695 0.00 3 s 2 3 p 3 4 S° 3 / 2 59534.549 3 s 3 p 4 4 P 5 / 2 return 1774.951 0.00 3 s 2 3 p 3 4 S° 3 / 2 56339.656 3 s 2 3 p 2 (3 P)4 s 4 P 5 / 2 return 1782.838 0.00 3 s 2 3 p 3 4 S° 3 / 2 56090.626 3 s 2 3 p 2 (3 P)4 s 4 P 3 / 2 return 1787.656 0.00 3 s 2 3 p 3 4 S° 3 / 2 55939.421 3 s 2 3 p 2 (3 P)4 s 4 P 1 / 2 return 2135.465 11361.02 3 s 2 3 p 3 2 D° 3 / 2 58174.366 3 s 2 3 p 2 (3 P)4 s 2 P 3 / 2 return 2136.182 11376.63 3 s 2 3 p 3 2 D° 5 / 2 58174.366 3 s 2 3 p 2 (3 P)4 s 2 P 3 / 2 return 2149.145 11361.02 3 s 2 3 p 3 2 D° 3 / 2 57876.574 3 s 2 3 p 2 (3 P)4 s 2 P 1 / 2 return 2152.940 18722.71 3 s 2 3 p 3 2 P° 1 / 2 65156.242 3 s 2 3 p 2 (1 D)4 s 2 D 3 / 2 return 2154.080 18748.01 3 s 2 3 p 3 2 P° 3 / 2 65157.126 3 s 2 3 p 2 (1 D)4 s 2 D 5 / 2 return 2154.080 18748.01 3 s 2 3 p 3 2 P° 3 / 2 65156.242 3 s 2 3 p 2 (1 D)4 s 2 D 3 / 2 return 2533.987 18722.71 3 s 2 3 p 3 2 P° 1 / 2 58174.366 3 s 2 3 p 2 (3 P)4 s 2 P 3 / 2 return 2535.606 18748.01 3 s 2 3 p 3 2 P° 3 / 2 58174.366 3 s 2 3 p 2 (3 P)4 s 2 P 3 / 2 return 2553.253 18722.71 3 s 2 3 p 3 2 P° 1 / 2 57876.574 3 s 2 3 p 2 (3 P)4 s 2 P 1 / 2 return 9525.73 56339.656 3 s 2 3 p 2 (3 P)4 s 4 P 5 / 2 66834.648 3 s 2 3 p 2 (3 P)4 p 4 S° 3 / 2 return 9545.18 56339.656 3 s 2 3 p 2 (3 P)4 s 4 P 5 / 2 66813.271 3 s 2 3 p 2 (3 P)4 p 2 D° 3 / 2 return 9563.439 56090.626 3 s 2 3 p 2 (3 P)4 s 4 P 3 / 2 66544.243 3 s 2 3 p 2 (3 P)4 p 4 P° 5 / 2 return 9734.750 56090.626 3 s 2 3 p 2 (3 P)4 s 4 P 3 / 2 66360.282 3 s 2 3 p 2 (3 P)4 p 4 P° 3 / 2 return 9750.77 56090.626 3 s 2 3 p 2 (3 P)4 s 4 P 3 / 2 66343.438 3 s 2 3 p 2 (3 P)4 p 4 P° 1 / 2 return 9796.85 56339.656 3 s 2 3 p 2 (3 P)4 s 4 P 5 / 2 66544.243 3 s 2 3 p 2 (3 P)4 p 4 P° 5 / 2 return

Persistent Lines of Neutral Potassium (K I)

Persistent Lines of Neutral Potassium (K I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4044.14 0.000 4 s 2 S 1 / 2 24720.139 5 p 2 P° 3 / 2 return 4047.21 0.000 4 s 2 S 1 / 2 24701.382 5 p 2 P° 1 / 2 return 7664.8991 0.000 4 s 2 S 1 / 2 13042.876 4 p 2 P° 3 / 2 return 7698.9645 0.000 4 s 2 S 1 / 2 12985.170 4 p 2 P° 1 / 2 return 11690.21 12985.170 4 p 2 P° 1 / 2 21536.988 3 d 2 D 3 / 2 return 11769.62 13042.876 4 p 2 P° 3 / 2 21536.988 3 d 2 D 3 / 2 return 11772.83 13042.876 4 p 2 P° 3 / 2 21534.680 3 d 2 D 5 / 2 return

Persistent Lines of Neutral Silicon (Si I)

Persistent Lines of Neutral Silicon (Si I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1850.6719 223.157 3 s 2 3 p 2 3 P 2 54257.574 3 s 2 3 p 3 d 3 D° 3 return 1901.3377 6298.847 3 s 2 3 p 2 1 D 2 58893.362 3 s 2 3 p 4 d 1 F° 3 return 1977.5978 0.000 3 s 2 3 p 2 3 P 0 50566.414 3 s 2 3 p 3 d 3 P° 1 return 1979.2056 77.112 3 s 2 3 p 2 3 P 1 50602.435 3 s 2 3 p 3 d 3 P° 0 return 1980.6185 77.112 3 s 2 3 p 2 3 P 1 50566.414 3 s 2 3 p 3 d 3 P° 1 return 1983.2330 77.112 3 s 2 3 p 2 3 P 1 50499.843 3 s 2 3 p 3 d 3 P° 2 return 1986.3640 223.157 3 s 2 3 p 2 3 P 2 50566.414 3 s 2 3 p 3 d 3 P° 1 return 1988.9937 223.157 3 s 2 3 p 2 3 P 2 50499.843 3 s 2 3 p 3 d 3 P° 2 return 2058.1323 6298.847 3 s 2 3 p 2 1 D 2 54871.027 3 s 2 3 p 5 s 1 P° 1 return 2207.978 0.000 3 s 2 3 p 2 3 P 0 45276.187 3 s 3 p 3 3 D° 1 return 2210.894 77.112 3 s 2 3 p 2 3 P 1 45293.623 3 s 3 p 3 3 D° 2 return 2211.744 77.112 3 s 2 3 p 2 3 P 1 45276.187 3 s 3 p 3 3 D° 1 return 2216.669 223.157 3 s 2 3 p 2 3 P 2 45321.848 3 s 3 p 3 3 D° 3 return 2218.057 223.157 3 s 2 3 p 2 3 P 2 45293.623 3 s 3 p 3 3 D° 2 return 2506.897 77.112 3 s 2 3 p 2 3 P 1 39955.051 3 s 2 3 p 4 s 3 P° 2 return 2514.316 0.000 3 s 2 3 p 2 3 P 0 39760.285 3 s 2 3 p 4 s 3 P° 1 return 2516.112 223.157 3 s 2 3 p 2 3 P 2 39955.051 3 s 2 3 p 4 s 3 P° 2 return 2519.202 77.112 3 s 2 3 p 2 3 P 1 39760.285 3 s 2 3 p 4 s 3 P° 1 return 2524.108 77.112 3 s 2 3 p 2 3 P 1 39683.158 3 s 2 3 p 4 s 3 P° 0 return 2528.509 223.157 3 s 2 3 p 2 3 P 2 39760.285 3 s 2 3 p 4 s 3 P° 1 return 2881.5771 6298.847 3 s 2 3 p 2 1 D 2 40991.888 3 s 2 3 p 4 s 1 P° 1 return 5948.545 40991.888 3 s 2 3 p 4 s 1 P° 1 57798.080 3 s 2 3 p 5 p 1 D 2 return 7289.1730 45321.848 3 s 3 p 3 3 D° 3 59037.043 3 s 2 3 p (2 P° 3 / 2)4 f 2 [7 / 2] 4 return 7405.7740 45276.187 3 s 3 p 3 3 D° 1 58775.442 3 s 2 3 p (2 P° 1 / 2)4 f 2 [5 / 2] 2 return 7423.497 45321.848 3 s 3 p 3 3 D° 3 58788.878 3 s 2 3 p (2 P° 1 / 2)4 f 2 [7 / 2] 4 return 11984.201 39760.285 3 s 2 3 p 4 s 3 P° 1 48102.321 3 s 2 3 p 4 p 3 D 2 return 12031.503 39955.051 3 s 2 3 p 4 s 3 P° 2 48264.290 3 s 2 3 p 4 p 3 D 3 return

Persistent Lines of Neutral Sulfur (S I)

Persistent Lines of Neutral Sulfur (S I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1425.030 0.000 3 s 2 3 p 4 3 P 2 70173.968 3 s 2 3 p 3 (4 S°)3 d 3 D° 3 return 1433.280 396.055 3 s 2 3 p 4 3 P 1 70166.195 3 s 2 3 p 3 (4 S°)3 d 3 D° 2 return 1433.310 396.055 3 s 2 3 p 4 3 P 1 70164.650 3 s 2 3 p 3 (4 S°)3 d 3 D° 1 return 1473.995 0.000 3 s 2 3 p 4 3 P 2 67842.867 3 s 2 3 p 3 (2 D°)4 s 3 D° 3 return 1666.688 9238.609 3 s 2 3 p 4 1 D 2 69237.886 3 s 2 3 p 3 (2 D°)4 s 1 D° 2 return 1687.530 22179.954 3 s 2 3 p 4 1 S 0 81438.30 3 s 2 3 p 3 (2 D°)3 d 1 P° 1 return 1807.311 0.000 3 s 2 3 p 4 3 P 2 55330.811 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 return 1820.343 396.055 3 s 2 3 p 4 3 P 1 55330.811 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 return 1826.245 573.640 3 s 2 3 p 4 3 P 0 55330.811 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 return 9212.865 52623.640 3 s 2 3 p 3 (4 S°)4 s 5 S° 2 63475.051 3 s 2 3 p 3 (4 S°)4 p 5 P 3 return 9228.092 52623.640 3 s 2 3 p 3 (4 S°)4 s 5 S° 2 63457.142 3 s 2 3 p 3 (4 S°)4 p 5 P 2 return 9237.538 52623.640 3 s 2 3 p 3 (4 S°)4 s 5 S° 2 63446.065 3 s 2 3 p 3 (4 S°)4 p 5 P 1 return 10455.451 55330.811 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 64892.582 3 s 2 3 p 3 (4 S°)4 p 3 P 2 return 10456.757 55330.811 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 64891.386 3 s 2 3 p 3 (4 S°)4 p 3 P 0 return 10459.406 55330.811 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 64888.964 3 s 2 3 p 3 (4 S°)4 p 3 P 1 return

Persistent Lines of Neutral Calcium (Ca I)

Persistent Lines of Neutral Calcium (Ca I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2721.645 0.000 4 s 2 1 S 0 36731.615 4 s 5 p 1 P° 1 return 4226.727 0.000 4 s 2 1 S 0 23652.304 4 s 4 p 1 P° 1 return 4425.441 15157.901 4 s 4 p 3 P° 0 37748.197 4 s 4 d 3 D 1 return 4434.960 15210.063 4 s 4 p 3 P° 1 37751.867 4 s 4 d 3 D 2 return 4435.688 15210.063 4 s 4 p 3 P° 1 37748.197 4 s 4 d 3 D 1 return 4454.781 15315.943 4 s 4 p 3 P° 2 37757.449 4 s 4 d 3 D 3 return 4455.887 15315.943 4 s 4 p 3 P° 2 37751.867 4 s 4 d 3 D 2 return 4456.605 15315.943 4 s 4 p 3 P° 2 37748.197 4 s 4 d 3 D 1 return 5588.757 20371.000 3 d 4 s 3 D 3 38259.124 3 d 4 p 3 D° 3 return 6102.722 15157.901 4 s 4 p 3 P° 0 31539.495 4 s 5 s 3 S 1 return 6122.219 15210.063 4 s 4 p 3 P° 1 31539.495 4 s 5 s 3 S 1 return 6162.172 15315.943 4 s 4 p 3 P° 2 31539.495 4 s 5 s 3 S 1 return 6439.073 20371.000 3 d 4 s 3 D 3 35896.889 3 d 4 p 3 F° 4 return 6462.566 20349.260 3 d 4 s 3 D 2 35818.713 3 d 4 p 3 F° 3 return 6493.780 20335.360 3 d 4 s 3 D 1 35730.454 3 d 4 p 3 F° 2 return 6572.777 0.000 4 s 2 1 S 0 15210.063 4 s 4 p 3 P° 1 return

Persistent Lines of Neutral Chromium (Cr I)

Persistent Lines of Neutral Chromium (Cr I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3578.682 0.00 3 d 5 (6 S)4 s a 7 S 3 27935.26 3 d 4 (5 D)4 s 4 p (3 P°) y 7 P° 4 return 3593.481 0.00 3 d 5 (6 S)4 s a 7 S 3 27820.23 3 d 4 (5 D)4 s 4 p (3 P°) y 7 P° 3 return 3605.320 0.00 3 d 5 (6 S)4 s a 7 S 3 27728.87 3 d 4 (5 D)4 s 4 p (3 P°) y 7 P° 2 return 4254.331 0.00 3 d 5 (6 S)4 s a 7 S 3 23498.84 3 d 5 (6 S)4 p z 7 P° 4 return 4274.806 0.00 3 d 5 (6 S)4 s a 7 S 3 23386.35 3 d 5 (6 S)4 p z 7 P° 3 return 4289.733 0.00 3 d 5 (6 S)4 s a 7 S 3 23305.01 3 d 5 (6 S)4 p z 7 P° 2 return 5204.505 7593.16 3 d 5 (6 S)4 s a 5 S 2 26801.93 3 d 5 (6 S)4 p z 5 P° 1 return 5206.021 7593.16 3 d 5 (6 S)4 s a 5 S 2 26796.28 3 d 5 (6 S)4 p z 5 P° 2 return 5208.415 7593.16 3 d 5 (6 S)4 s a 5 S 2 26787.50 3 d 5 (6 S)4 p z 5 P° 3 return

Persistent Lines of Neutral Iron (Fe I)

Persistent Lines of Neutral Iron (Fe I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2483.2708 0.000 3 d 6 4 s 2 a 5 D 4 40257.311 3 d 6 (5 D)4 s 4 p (1 P) x 5 F° 5 return 2488.1426 415.933 3 d 6 4 s 2 a 5 D 3 40594.429 3 d 6 (5 D)4 s 4 p (1 P) x 5 F° 4 return 2490.6443 704.007 3 d 6 4 s 2 a 5 D 2 40842.151 3 d 6 (5 D)4 s 4 p (1 P) x 5 F° 3 return 2522.8494 0.000 3 d 6 4 s 2 a 5 D 4 39625.801 3 d 6 (5 D)4 s 4 p (1 P) x 5 D° 4 return 2719.0273 0.000 3 d 6 4 s 2 a 5 D 4 36766.964 3 d 6 (5 D)4 s 4 p (1 P) y 5 P° 3 return 2788.1047 6928.268 3 d 7 (4 F)4 s a 5 F 5 42784.349 3 d 6 (3 H)4 s 4 p (3 P) y 5 G° 6 return 3440.6060 0.000 3 d 6 4 s 2 a 5 D 4 29056.322 3 d 6 (5 D)4 s 4 p (3 P) z 5 P° 3 return 3581.1931 6928.268 3 d 7 (4 F)4 s a 5 F 5 34843.955 3 d 7 (4 F)4 p z 5 G° 6 return 3719.9348 0.000 3 d 6 4 s 2 a 5 D 4 26874.548 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 5 return 3734.8638 6928.268 3 d 7 (4 F)4 s a 5 F 5 33695.395 3 d 7 (4 F)4 p y 5 F° 5 return 3737.1316 415.933 3 d 6 4 s 2 a 5 D 3 27166.818 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 4 return 3745.5613 704.007 3 d 6 4 s 2 a 5 D 2 27394.689 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 3 return 3748.2622 888.132 3 d 6 4 s 2 a 5 D 1 27559.581 3 d 6 (5 D)4 s 4 p (3 P) z 5 F° 2 return 3749.4854 7376.764 3 d 7 (4 F)4 s a 5 F 4 34039.514 3 d 7 (4 F)4 p y 5 F° 4 return 3758.2329 7728.059 3 d 7 (4 F)4 s a 5 F 3 34328.750 3 d 7 (4 F)4 p y 5 F° 3 return 3820.4253 6928.268 3 d 7 (4 F)4 s a 5 F 5 33095.939 3 d 7 (4 F)4 p y 5 D° 4 return 3859.9114 0.000 3 d 6 4 s 2 a 5 D 4 25899.987 3 d 6 (5 D)4 s 4 p (3 P) z 5 D° 4 return 3886.2822 415.933 3 d 6 4 s 2 a 5 D 3 26140.177 3 d 6 (5 D)4 s 4 p (3 P) z 5 D° 3 return 4045.8125 11976.238 3 d 7 (4 F)4 s a 3 F 4 36686.174 3 d 7 (4 F)4 p y 3 F° 4 return 4383.5449 11976.238 3 d 7 (4 F)4 s a 3 F 4 34782.419 3 d 7 (4 F)4 p z 5 G° 5 return

Persistent Lines of Neutral Manganese (Mn I)

Persistent Lines of Neutral Manganese (Mn I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1996.056 0.00 3 d 5 4 s 2 a 6 S 5 / 2 50099.03 3 d 5 (4 P)4 s 4 p (3 P°) v 6 P° 3 / 2 return 1999.511 0.00 3 d 5 4 s 2 a 6 S 5 / 2 50012.50 3 d 5 (4 P)4 s 4 p (3 P°) v 6 P° 5 / 2 return 2003.849 0.00 3 d 5 4 s 2 a 6 S 5 / 2 49888.01 3 d 5 (4 P)4 s 4 p (3 P°) v 6 P° 7 / 2 return 2794.817 0.00 3 d 5 4 s 2 a 6 S 5 / 2 35769.97 3 d 5 (6 S)4 s 4 p (1 P°) y 6 P° 7 / 2 return 2798.270 0.00 3 d 5 4 s 2 a 6 S 5 / 2 35725.85 3 d 5 (6 S)4 s 4 p (1 P°) y 6 P° 5 / 2 return 2801.084 0.00 3 d 5 4 s 2 a 6 S 5 / 2 35689.98 3 d 5 (6 S)4 s 4 p (1 P°) y 6 P° 3 / 2 return 3806.715 17052.29 3 d 6 (5 D)4 s a 6 D 9 / 2 43314.23 3 d 6 (5 D)4 p z 6 F° 1 1 / 2 return 4030.755 0.00 3 d 5 4 s 2 a 6 S 5 / 2 24802.25 3 d 5 (6 S)4 s 4 p (3 P°) z 6 P° 7 / 2 return 4033.068 0.00 3 d 5 4 s 2 a 6 S 5 / 2 24788.05 3 d 5 (6 S)4 s 4 p (3 P°) z 6 P° 5 / 2 return 4034.485 0.00 3 d 5 4 s 2 a 6 S 5 / 2 24779.32 3 d 5 (6 S)4 s 4 p (3 P°) z 6 P° 3 / 2 return 4041.357 17052.29 3 d 6 (5 D)4 s a 6 D 9 / 2 41789.48 3 d 6 (5 D)4 p z 6 D° 9 / 2 return

Persistent Lines of Neutral Scandium (Sc I)

Persistent Lines of Neutral Scandium (Sc I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3269.897 0.00 3 d 4 s 2 2 D 3 / 2 30573.17 3 d 4 s (3 D)4 p 2 P° 1 / 2 return 3273.628 168.34 3 d 4 s 2 2 D 5 / 2 30706.66 3 d 4 s (3 D)4 p 2 P° 3 / 2 return 3907.484 0.00 3 d 4 s 2 2 D 3 / 2 25584.64 3 d 4 s (3 D)4 p 2 F° 5 / 2 return 3911.812 168.34 3 d 4 s 2 2 D 5 / 2 25724.68 3 d 4 s (3 D)4 p 2 F° 7 / 2 return 3933.375 168.34 3 d 4 s 2 2 D 5 / 2 25584.64 3 d 4 s (3 D)4 p 2 F° 5 / 2 return 3996.601 0.00 3 d 4 s 2 2 D 3 / 2 25014.21 3 d 4 s (3 D)4 p 2 D° 5 / 2 return 4020.387 0.00 3 d 4 s 2 2 D 3 / 2 24866.17 3 d 4 s (3 D)4 p 2 D° 3 / 2 return 4023.678 168.34 3 d 4 s 2 2 D 5 / 2 25014.21 3 d 4 s (3 D)4 p 2 D° 5 / 2 return 4054.544 0.00 3 d 4 s 2 2 D 3 / 2 24656.72 3 d 4 s (1 D)4 p 2 P° 1 / 2 return 4082.387 168.34 3 d 4 s 2 2 D 5 / 2 24656.88 3 d 4 s (1 D)4 p 2 P° 3 / 2 return

Persistent Lines of Neutral Titanium (Ti I)

Persistent Lines of Neutral Titanium (Ti I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3635.462 0.000 3 d 2 4 s 2 a 3 F 2 27498.983 3 d 2 (3 F)4 s 4 p (1 P°) y 3 G° 3 return 3642.674 170.134 3 d 2 4 s 2 a 3 F 3 27614.678 3 d 2 (3 F)4 s 4 p (1 P°) y 3 G° 4 return 3653.495 386.875 3 d 2 4 s 2 a 3 F 4 27750.136 3 d 2 (3 F)4 s 4 p (1 P°) y 3 G° 5 return 3752.858 386.875 3 d 2 4 s 2 a 3 F 4 27025.658 3 d 2 (1 D)4 s 4 p (3 P°) x 3 F° 4 return 3948.670 0.000 3 d 2 4 s 2 a 3 F 2 25317.815 3 d 3 (4 F)4 p y 3 D° 1 return 3956.334 170.134 3 d 2 4 s 2 a 3 F 3 25438.906 3 d 3 (4 F)4 p y 3 D° 2 return 3958.201 386.875 3 d 2 4 s 2 a 3 F 4 25643.699 3 d 3 (4 F)4 p y 3 D° 3 return 3981.761 0.000 3 d 2 4 s 2 a 3 F 2 25107.410 3 d 2 (3 F)4 s 4 p (1 P°) y 3 F° 2 return 3989.758 170.134 3 d 2 4 s 2 a 3 F 3 25227.220 3 d 2 (3 F)4 s 4 p (1 P°) y 3 F° 3 return 3998.636 386.875 3 d 2 4 s 2 a 3 F 4 25388.331 3 d 2 (3 F)4 s 4 p (1 P°) y 3 F° 4 return 4305.907 6842.965 3 d 3 (4 F)4 s a 5 F 5 30060.338 3 d 3 (4 F)4 p x 5 D° 4 return 4981.730 6842.965 3 d 3 (4 F)4 s a 5 F 5 26910.712 3 d 3 (4 F)4 p y 5 G° 6 return 4991.066 6742.755 3 d 3 (4 F)4 s a 5 F 4 26772.969 3 d 3 (4 F)4 p y 5 G° 5 return 5007.206 6598.764 3 d 3 (4 F)4 s a 5 F 2 26564.398 3 d 3 (4 F)4 p y 5 G° 3 return 5014.186 0.000 3 d 2 4 s 2 a 3 F 2 19937.852 3 d 2 (3 F)4 s 4 p (3 P°) z 3 D° 1 return 5064.651 386.875 3 d 2 4 s 2 a 3 F 4 20126.060 3 d 2 (3 F)4 s 4 p (3 P°) z 3 D° 3 return 5210.384 386.875 3 d 2 4 s 2 a 3 F 4 19573.973 3 d 2 (3 F)4 s 4 p (3 P°) z 3 F° 4 return

Persistent Lines of Neutral Vanadium (V I)

Persistent Lines of Neutral Vanadium (V I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3183.412 137.382 3 d 3 4 s 2 a 4 F 5 / 2 31541.147 3 d 3 (4 F)4 s 4 p (1 P°) x 4 G° 7 / 2 return 3183.992 323.457 3 d 3 4 s 2 a 4 F 7 / 2 31721.708 3 d 3 (4 F)4 s 4 p (1 P°) x 4 G° 9 / 2 return 3185.385 552.961 3 d 3 4 s 2 a 4 F 9 / 2 31937.266 3 d 3 (4 F)4 s 4 p (1 P°) x 4 G° 1 1 / 2 return 3703.574 2424.783 3 d 4 (5 D)4 s a 6 D 9 / 2 29418.073 3 d 3 (4 P)4 s 4 p (3 P°) y 6 P° 7 / 2 return 3855.845 552.961 3 d 3 4 s 2 a 4 F 9 / 2 26480.291 3 d 4 (5 D)4 p y 4 D° 7 / 2 return 3902.256 552.961 3 d 3 4 s 2 a 4 F 9 / 2 26171.916 3 d 4 (5 D)4 p y 4 F° 9 / 2 return 4111.780 2424.783 3 d 4 (5 D)4 s a 6 D 9 / 2 26738.318 3 d 4 (5 D)4 p y 6 D° 9 / 2 return 4115.180 2311.355 3 d 4 (5 D)4 s a 6 D 7 / 2 26604.796 3 d 4 (5 D)4 p y 6 D° 7 / 2 return 4128.064 2220.106 3 d 4 (5 D)4 s a 6 D 5 / 2 26437.640 3 d 4 (5 D)4 p y 6 D° 3 / 2 return 4131.989 2311.355 3 d 4 (5 D)4 s a 6 D 7 / 2 26505.932 3 d 4 (5 D)4 p y 6 D° 5 / 2 return 4379.230 2424.783 3 d 4 (5 D)4 s a 6 D 9 / 2 25253.432 3 d 4 (5 D)4 p y 6 F° 1 1 / 2 return 4384.710 2311.355 3 d 4 (5 D)4 s a 6 D 7 / 2 25111.467 3 d 4 (5 D)4 p y 6 F° 9 / 2 return 4389.980 2220.106 3 d 4 (5 D)4 s a 6 D 5 / 2 24992.884 3 d 4 (5 D)4 p y 6 F° 7 / 2 return 4395.223 2153.207 3 d 4 (5 D)4 s a 6 D 3 / 2 24898.771 3 d 4 (5 D)4 p y 6 F° 5 / 2 return 4408.195 2220.106 3 d 4 (5 D)4 s a 6 D 5 / 2 24898.771 3 d 4 (5 D)4 p y 6 F° 5 / 2 return 4408.501 2153.207 3 d 4 (5 D)4 s a 6 D 3 / 2 24830.228 3 d 4 (5 D)4 p y 6 F° 3 / 2 return 4408.501 2112.282 3 d 4 (5 D)4 s a 6 D 1 / 2 24789.385 3 d 4 (5 D)4 p y 6 F° 1 / 2 return 6090.208 8715.761 3 d 4 (5 D)4 s a 4 D 7 / 2 25131.005 3 d 4 (5 D)4 p z 4 P° 5 / 2 return

Persistent Lines of Neutral Arsenic (As I)

Persistent Lines of Neutral Arsenic (As I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1890.43 0.000 4 p 3 4 S° 3 / 2 52898.056 4 p 2 (3 P)5 s 4 P 5 / 2 return 1937.59 0.000 4 p 3 4 S° 3 / 2 51610.393 4 p 2 (3 P)5 s 4 P 3 / 2 return 1972.62 0.000 4 p 3 4 S° 3 / 2 50693.897 4 p 2 (3 P)5 s 4 P 1 / 2 return 2003.35 10914.866 4 p 3 2 D° 5 / 2 60815.218 4 p 2 (1 D)5 s 2 D 5 / 2 return 2288.12 10914.866 4 p 3 2 D° 5 / 2 54605.491 4 p 2 (3 P)5 s 2 P 3 / 2 return 2349.84 10592.666 4 p 3 2 D° 3 / 2 53135.750 4 p 2 (3 P)5 s 2 P 1 / 2 return 2370.77 18647.663 4 p 3 2 P° 3 / 2 60815.218 4 p 2 (1 D)5 s 2 D 5 / 2 return 2456.53 10914.866 4 p 3 2 D° 5 / 2 51610.393 4 p 2 (3 P)5 s 4 P 3 / 2 return 2780.22 18647.663 4 p 3 2 P° 3 / 2 54605.491 4 p 2 (3 P)5 s 2 P 3 / 2 return 2860.44 18186.328 4 p 3 2 P° 1 / 2 53135.750 4 p 2 (3 P)5 s 2 P 1 / 2 return

Persistent Lines of Neutral Bromine (Br I)

Persistent Lines of Neutral Bromine (Br I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1488.45 0.00 4 p 5 2 P° 3 / 2 67183.58 4 p 4 (3 P)5 s 2 P 3 / 2 return 1540.65 0.00 4 p 5 2 P° 3 / 2 64907.19 4 p 4 (3 P)5 s 4 P 3 / 2 return 1574.84 3685.24 4 p 5 2 P° 1 / 2 67183.58 4 p 4 (3 P)5 s 2 P 3 / 2 return 1633.40 3685.24 4 p 5 2 P° 1 / 2 64907.19 4 p 4 (3 P)5 s 4 P 3 / 2 return 7348.51 64907.19 4 p 4 (3 P)5 s 4 P 3 / 2 78511.60 4 p 4 (3 P)5 p 2 D° 5 / 2 return 7512.96 63436.45 4 p 4 (3 P)5 s 4 P 5 / 2 76743.08 4 p 4 (3 P)5 p 4 D° 3 / 2 return 7803.02 66883.87 4 p 4 (3 P)5 s 4 P 1 / 2 79695.89 4 p 4 (3 P)5 p 2 P° 3 / 2 return 7938.68 75890.33 4 p 4 (1 D)5 s 2 D° 5 / 2 88483.42 4 p 4 (1 D)5 p 2 D° 5 / 2 return 8272.44 63436.45 4 p 4 (3 P)5 s 4 P 5 / 2 75521.50 4 p 4 (3 P)5 p 4 D° 7 / 2 return 8343.70 66883.87 4 p 4 (3 P)5 s 4 P 1 / 2 78865.72 4 p 4 (3 P)5 p 4 D° 1 / 2 return 8446.55 64907.19 4 p 4 (3 P)5 s 4 P 3 / 2 76743.08 4 p 4 (3 P)5 p 4 D° 3 / 2 return

Persistent Lines of Neutral Cobalt (Co I)

Persistent Lines of Neutral Cobalt (Co I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2407.256 0.000 3 d 7 4 s 2 a 4 F 9 / 2 41528.455 3 d 7 (4 F)4 s 4 p (1 P°) x 4 G° 1 1 / 2 return 2411.624 816.000 3 d 7 4 s 2 a 4 F 7 / 2 42269.229 3 d 7 (4 F)4 s 4 p (1 P°) x 4 G° 9 / 2 return 2424.935 0.000 3 d 7 4 s 2 a 4 F 9 / 2 41225.710 3 d 7 (4 F)4 s 4 p (1 P°) x 4 F° 9 / 2 return 2521.365 0.000 3 d 7 4 s 2 a 4 F 9 / 2 39649.124 3 d 7 (4 F)4 s 4 p (1 P°) x 4 D° 7 / 2 return 3405.118 3482.780 3 d 8 (3 F)4 s b 4 F 9 / 2 32841.916 3 d 8 (3 F)4 p y 4 F° 9 / 2 return 3443.645 4142.631 3 d 8 (3 F)4 s b 4 F 7 / 2 33173.313 3 d 8 (3 F)4 p y 4 F° 7 / 2 return 3453.510 3482.780 3 d 8 (3 F)4 s b 4 F 9 / 2 32430.535 3 d 8 (3 F)4 p y 4 G° 1 1 / 2 return 3473.974 0.000 3 d 7 4 s 2 a 4 F 9 / 2 28777.236 3 d 7 (4 F)4 s 4 p (3 P°) z 4 F° 7 / 2 return 3474.042 4690.141 3 d 8 (3 F)4 s b 4 F 5 / 2 33466.823 3 d 8 (3 F)4 p y 4 G° 7 / 2 return 3502.280 3482.780 3 d 8 (3 F)4 s b 4 F 9 / 2 32027.440 3 d 8 (3 F)4 p y 4 D° 7 / 2 return 3526.850 0.000 3 d 7 4 s 2 a 4 F 9 / 2 28345.814 3 d 7 (4 F)4 s 4 p (3 P°) z 4 F° 9 / 2 return 3529.808 4142.631 3 d 8 (3 F)4 s b 4 F 7 / 2 32464.688 3 d 8 (3 F)4 p y 4 G° 9 / 2 return 3569.376 7442.399 3 d 8 (3 F)4 s a 2 F 7 / 2 35450.505 3 d 8 (3 F)4 p y 2 F° 7 / 2 return

Persistent Lines of Neutral Copper (Cu I)

Persistent Lines of Neutral Copper (Cu I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2165.09 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 46172.842 3 d 9 (2 D)4 s 4 p (3 P°) 3 / 2 return 2178.94 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 45879.311 3 d 9 (2 D)4 s 4 p (3 P°) 2 P° 3 / 2 return 2181.72 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 45821.00 3 d 9 (2 D)4 s 4 p (3 P°) 2 P° 1 / 2 return 2225.70 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 44915.61 3 d 9 (2 D)4 s 4 p (3 P°) 4 D° 1 / 2 return 2230.08 11202.565 3 d 9 4 s 2 2 D 5 / 2 56029.95 3 d 9 (2 D)4 s 4 p (1 P°) 2 F° 7 / 2 return 2244.26 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 44544.153 3 d 9 (2 D)4 s 4 p (3 P°) 4 D° 3 / 2 return 2441.64 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 40943.73 3 d 9 (2 D)4 s 4 p (3 P°) 4 P° 1 / 2 return 2492.15 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 40113.99 3 d 9 (2 D)4 s 4 p (3 P°) 4 P° 3 / 2 return 3247.54 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 30783.686 3 d 1 0 (1 S)4 p 2 P° 3 / 2 return 3273.96 0.000 3 d 1 0 (1 S)4 s 2 S 1 / 2 30535.302 3 d 1 0 (1 S)4 p 2 P° 1 / 2 return 5105.54 11202.565 3 d 9 4 s 2 2 D 5 / 2 30783.686 3 d 1 0 (1 S)4 p 2 P° 3 / 2 return 5153.24 30535.302 3 d 1 0 (1 S)4 p 2 P° 1 / 2 49935.200 3 d 1 0 (1 S)4 d 2 D 3 / 2 return 5218.20 30783.686 3 d 1 0 (1 S)4 p 2 P° 3 / 2 49942.057 3 d 1 0 (1 S)4 d 2 D 5 / 2 return

Persistent Lines of Neutral Gallium (Ga I)

Persistent Lines of Neutral Gallium (Ga I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2874.235 0.000 4 s 2 4 p 2 P° 1 / 2 34781.66 4 s 2 4 d 2 D 3 / 2 return 2943.636 826.19 4 s 2 4 p 2 P° 3 / 2 34787.85 4 s 2 4 d 2 D 5 / 2 return 2944.173 826.19 4 s 2 4 p 2 P° 3 / 2 34781.66 4 s 2 4 d 2 D 3 / 2 return 4032.984 0.000 4 s 2 4 p 2 P° 1 / 2 24788.530 4 s 2 5 s 2 S 1 / 2 return 4172.042 826.19 4 s 2 4 p 2 P° 3 / 2 24788.530 4 s 2 5 s 2 S 1 / 2 return

Persistent Lines of Neutral Germanium (Ge I)

Persistent Lines of Neutral Germanium (Ge I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1988.267 1409.9609 4 s 2 4 p 2 3 P 2 51705.020 4 s 2 4 p 4 d 3 P° 1 return 1998.887 1409.9609 4 s 2 4 p 2 3 P 2 51437.802 4 s 2 4 p 4 d 3 P° 2 return 2019.068 557.1341 4 s 2 4 p 2 3 P 1 50068.954 4 s 2 4 p 4 d 3 F° 2 return 2041.712 0.0000 4 s 2 4 p 2 3 P 0 48962.783 4 s 2 4 p 4 d 3 D° 1 return 2043.770 1409.9609 4 s 2 4 p 2 3 P 2 50323.465 4 s 2 4 p 4 d 3 F° 3 return 2068.656 557.1341 4 s 2 4 p 2 3 P 1 48882.263 4 s 2 4 p 4 d 3 D° 2 return 2094.258 1409.9609 4 s 2 4 p 2 3 P 2 49144.397 4 s 2 4 p 4 d 3 D° 3 return 2198.714 7125.2989 4 s 2 4 p 2 1 D 2 52592.224 4 s 2 4 p 4 d 1 F° 3 return 2592.534 557.1341 4 s 2 4 p 2 3 P 1 39117.9021 4 s 2 4 p 5 s 3 P° 2 return 2651.172 1409.9609 4 s 2 4 p 2 3 P 2 39117.9021 4 s 2 4 p 5 s 3 P° 2 return 2651.568 0.0000 4 s 2 4 p 2 3 P 0 37702.3054 4 s 2 4 p 5 s 3 P° 1 return 2691.341 557.1341 4 s 2 4 p 2 3 P 1 37702.3054 4 s 2 4 p 5 s 3 P° 1 return 2709.624 557.1341 4 s 2 4 p 2 3 P 1 37451.6893 4 s 2 4 p 5 s 3 P° 0 return 2754.588 1409.9609 4 s 2 4 p 2 3 P 2 37702.3054 4 s 2 4 p 5 s 3 P° 1 return 3039.067 7125.2989 4 s 2 4 p 2 1 D 2 40020.5604 4 s 2 4 p 5 s 1 P° 1 return 3269.489 7125.2989 4 s 2 4 p 2 1 D 2 37702.3054 4 s 2 4 p 5 s 3 P° 1 return 12069.20 37702.3054 4 s 2 4 p 5 s 3 P° 1 45985.592 4 s 2 4 p 5 p 3 D 1 return 12391.58 40020.5604 4 s 2 4 p 5 s 1 P° 1 48088.3504 4 s 2 4 p 5 p 3 P 1 return

Persistent Lines of Neutral Nickel (Ni I)

Persistent Lines of Neutral Nickel (Ni I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2310.961 0.000 3 d 8 (3 F)4 s 2 3 F 4 43258.726 3 d 8 (3 F)4 s 4 p (1 P°) 3 F° 4 return 2320.034 0.000 3 d 8 (3 F)4 s 2 3 F 4 43089.578 3 d 8 (3 F)4 s 4 p (1 P°) 3 G° 5 return 2345.543 0.000 3 d 8 (3 F)4 s 2 3 F 4 42620.994 3 d 8 (1 D)4 s 4 p (3 P°) 3 D° 3 return 3002.485 204.787 3 d 9 (2 D)4 s 3 D 3 33500.822 3 d 8 (3 F)4 s 4 p (3 P°) 3 D° 3 return 3012.001 3409.937 3 d 9 (2 D)4 s 1 D 2 36600.791 3 d 8 (3 F)4 s 4 p (3 P°) 1 D° 2 return 3050.816 204.787 3 d 9 (2 D)4 s 3 D 3 32973.376 3 d 8 (3 F)4 s 4 p (3 P°) 3 F° 4 return 3101.557 879.816 3 d 9 (2 D)4 s 3 D 2 33112.334 3 d 8 (3 F)4 s 4 p (3 P°) 3 F° 3 return 3134.104 1713.087 3 d 9 (2 D)4 s 3 D 1 33610.890 3 d 8 (3 F)4 s 4 p (3 P°) 3 D° 2 return 3414.764 204.787 3 d 9 (2 D)4 s 3 D 3 29480.989 3 d 9 (2 D)4 p 3 F° 4 return 3446.259 879.816 3 d 9 (2 D)4 s 3 D 2 29888.477 3 d 9 (2 D)4 p 3 D° 2 return 3458.460 1713.087 3 d 9 (2 D)4 s 3 D 1 30619.414 3 d 9 (2 D)4 p 3 F° 2 return 3461.652 204.787 3 d 9 (2 D)4 s 3 D 3 29084.456 3 d 8 (3 F)4 s 4 p (3 P°) 5 F° 4 return 3492.956 879.816 3 d 9 (2 D)4 s 3 D 2 29500.674 3 d 9 (2 D)4 p 3 P° 1 return 3515.052 879.816 3 d 9 (2 D)4 s 3 D 2 29320.762 3 d 9 (2 D)4 p 3 F° 3 return 3524.536 204.787 3 d 9 (2 D)4 s 3 D 3 28569.203 3 d 9 (2 D)4 p 3 P° 2 return 3566.372 3409.937 3 d 9 (2 D)4 s 1 D 2 31441.635 3 d 9 (2 D)4 p 1 D° 2 return 3619.391 3409.937 3 d 9 (2 D)4 s 1 D 2 31031.020 3 d 9 (2 D)4 p 1 F° 3 return

Persistent Lines of Neutral Selenium (Se I)

Persistent Lines of Neutral Selenium (Se I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1960.894 0.00 4 p 4 3 P 2 50997.161 4 p 3 (4 S°)5 s 3 S° 1 return 1995.111 22446.202 4 p 4 1 S 0 72568.72 4 p 3 (2 P°)5 s 1 P° 1 return 2039.842 1989.497 4 p 4 3 P 1 50997.161 4 p 3 (4 S°)5 s 3 S° 1 return 2062.779 2534.36 4 p 4 3 P 0 50997.161 4 p 3 (4 S°)5 s 3 S° 1 return 2074.784 0.00 4 p 4 3 P 2 48182.420 4 p 3 (4 S°)5 s 5 S° 2 return 2164.188 1989.497 4 p 4 3 P 1 48182.420 4 p 3 (4 S°)5 s 5 S° 2 return 2413.535 9576.149 4 p 4 1 D 2 50997.161 4 p 3 (4 S°)5 s 3 S° 1 return 4730.78 48182.420 4 p 3 (4 S°)5 s 5 S° 2 69314.635 4 p 3 (4 S°)6 p 5 P 3 return 10327.26 50997.161 4 p 3 (4 S°)5 s 3 S° 1 60677.618 4 p 3 (4 S°)5 p 3 P 2 return 10386.36 50997.161 4 p 3 (4 S°)5 s 3 S° 1 60622.532 4 p 3 (4 S°)5 p 3 P 1 return 21442.56 60677.618 4 p 3 (4 S°)5 p 3 P 2 65339.968 4 p 3 (4 S°)4 d 3 D° 3 return

Persistent Lines of Neutral Zinc (Zn I)

Persistent Lines of Neutral Zinc (Zn I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2138.5735 0.000 4 s 2 1 S 0 46745.404 4 s 4 p 1 P° 1 return 2800.8635 32890.327 4 s 4 p 3 P° 2 68583.083 4 s 5 d 3 D 3 return 2801.0500 32890.327 4 s 4 p 3 P° 2 68580.705 4 s 5 d 3 D 2 return 3075.8971 0.000 4 s 2 1 S 0 32501.399 4 s 4 p 3 P° 1 return 3282.3256 32311.319 4 s 4 p 3 P° 0 62768.747 4 s 4 d 3 D 1 return 3302.5829 32501.399 4 s 4 p 3 P° 1 62772.014 4 s 4 d 3 D 2 return 3302.9395 32501.399 4 s 4 p 3 P° 1 62768.747 4 s 4 d 3 D 1 return 3345.0134 32890.327 4 s 4 p 3 P° 2 62776.981 4 s 4 d 3 D 3 return 3345.5694 32890.327 4 s 4 p 3 P° 2 62772.014 4 s 4 d 3 D 2 return 3345.9353 32890.327 4 s 4 p 3 P° 2 62768.747 4 s 4 d 3 D 1 return 4680.1359 32311.319 4 s 4 p 3 P° 0 53672.240 4 s 5 s 3 S 1 return 4722.1569 32501.399 4 s 4 p 3 P° 1 53672.240 4 s 5 s 3 S 1 return 4810.5321 32890.327 4 s 4 p 3 P° 2 53672.240 4 s 5 s 3 S 1 return 6362.3458 46745.404 4 s 4 p 1 P° 1 62458.533 4 s 4 d 1 D 2 return

Persistent Lines of Neutral Krypton (Kr I)

Persistent Lines of Neutral Krypton (Kr I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1164.8671 0.000 4 p 6 1 S 0 85846.7051 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 1 return 1235.8378 0.000 4 p 6 1 S 0 80916.7685 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 return 5570.2894 79971.7422 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 97919.1473 4 p 5 (2 P° 1 / 2)5 p 2 [1 / 2] 1 return 5870.9160 80916.7685 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 97945.1669 4 p 5 (2 P° 1 / 2)5 p 2 [3 / 2] 2 return 8104.3655 79971.7422 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 92307.3791 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 2 return 8112.9012 79971.7422 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 92294.4017 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 3 return 8190.0566 80916.7685 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 93123.3414 4 p 5 (2 P° 3 / 2)5 p 2 [3 / 2] 2 return 8263.2426 85846.7051 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 1 97945.1669 4 p 5 (2 P° 1 / 2)5 p 2 [3 / 2] 2 return 8298.1099 80916.7685 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 92964.3948 4 p 5 (2 P° 3 / 2)5 p 2 [3 / 2] 1 return 8508.8728 85846.7051 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 1 97595.9158 4 p 5 (2 P° 1 / 2)5 p 2 [3 / 2] 1 return 8776.7505 80916.7685 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 92307.3791 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 2 return 13634.220 92294.4017 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 3 99626.883 4 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 return 14426.793 92964.3948 4 p 5 (2 P° 3 / 2)5 p 2 [3 / 2] 1 99894.048 4 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 return 16890.441 92307.3791 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 2 98226.268 4 p 5 (2 P° 3 / 2)4 d 2 [7 / 2]° 3 return 18167.315 92294.4017 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 3 97797.287 4 p 5 (2 P° 3 / 2)4 d 2 [7 / 2]° 4 return

Persistent Lines of Neutral Molybdenum (Mo I)

Persistent Lines of Neutral Molybdenum (Mo I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3132.594 0.000 4 d 5 (6 S)5 s a 7 S 3 31913.171 4 d 4 5 s (6 D)5 p y 7 P° 4 return 3158.167 0.000 4 d 5 (6 S)5 s a 7 S 3 31654.786 4 d 4 5 s (6 D)5 p z 7 D° 3 return 3170.344 0.000 4 d 5 (6 S)5 s a 7 S 3 31533.206 4 d 4 5 s (6 D)5 p y 7 P° 3 return 3193.979 0.000 4 d 5 (6 S)5 s a 7 S 3 31299.876 4 d 4 5 s (6 D)5 p y 7 P° 2 return 3208.838 0.000 4 d 5 (6 S)5 s a 7 S 3 31154.935 4 d 4 5 s (6 D)5 p z 7 D° 2 return 3447.124 12346.280 4 d 4 5 s 2 a 5 D 4 41347.664 4 d 5 (4 G)5 p y 5 F° 5 return 3798.252 0.000 4 d 5 (6 S)5 s a 7 S 3 26320.420 4 d 5 (6 S)5 p z 7 P° 4 return 3864.104 0.000 4 d 5 (6 S)5 s a 7 S 3 25871.887 4 d 5 (6 S)5 p z 7 P° 3 return 3902.953 0.000 4 d 5 (6 S)5 s a 7 S 3 25614.367 4 d 5 (6 S)5 p z 7 P° 2 return 4069.882 16783.856 4 d 5 (4 G)5 s a 5 G 6 41347.664 4 d 5 (4 G)5 p y 5 F° 5 return 4188.324 16784.522 4 d 5 (4 G)5 s a 5 G 5 40653.701 4 d 5 (4 G)5 p z 5 H° 6 return 4411.695 16784.522 4 d 5 (4 G)5 s a 5 G 5 39445.182 4 d 5 (4 G)5 p z 5 G° 5 return 5506.494 10768.332 4 d 5 (6 S)5 s a 5 S 2 28923.668 4 d 5 (6 S)5 p z 5 P° 3 return 5533.031 10768.332 4 d 5 (6 S)5 s a 5 S 2 28836.592 4 d 5 (6 S)5 p z 5 P° 2 return 5570.444 10768.332 4 d 5 (6 S)5 s a 5 S 2 28715.242 4 d 5 (6 S)5 p z 5 P° 1 return

Persistent Lines of Neutral Niobium (Nb I)

Persistent Lines of Neutral Niobium (Nb I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3341.97 1142.79 4 d 3 5 s 2 a 4 F 3 / 2 31056.60 4 d 3 5 s (a 5 F)5 p x 4 G° 5 / 2 return 3343.71 1586.90 4 d 3 5 s 2 a 4 F 5 / 2 31485.20 4 d 3 5 s (a 5 F)5 p x 4 G° 7 / 2 return 3349.06 2154.11 4 d 3 5 s 2 a 4 F 7 / 2 32004.63 4 d 3 5 s (a 5 F)5 p x 4 G° 9 / 2 return 3358.42 2805.36 4 d 3 5 s 2 a 4 F 9 / 2 32572.72 4 d 3 5 s (a 5 F)5 p x 4 G° 1 1 / 2 return 3535.30 695.25 4 d 4 (a 5 D)5 s a 6 D 7 / 2 28973.12 4 d 3 5 s (a 5 P)5 p y 6 P° 7 / 2 return 3535.30 0.00 4 d 4 (a 5 D)5 s a 6 D 1 / 2 28278.25 4 d 3 5 s (a 5 P)5 p y 6 P° 3 / 2 return 3575.85 695.25 4 d 4 (a 5 D)5 s a 6 D 7 / 2 28652.66 4 d 3 5 s (a 5 P)5 p y 6 P° 5 / 2 return 3580.27 1050.26 4 d 4 (a 5 D)5 s a 6 D 9 / 2 28973.12 4 d 3 5 s (a 5 P)5 p y 6 P° 7 / 2 return 3739.80 695.25 4 d 4 (a 5 D)5 s a 6 D 7 / 2 27427.07 4 d 4 (a 5 D)5 p x 6 D° 7 / 2 return 4058.94 1050.26 4 d 4 (a 5 D)5 s a 6 D 9 / 2 25680.36 4 d 4 (a 5 D)5 p y 6 F° 1 1 / 2 return 4058.94 10237.51 4 d 3 5 s 2 a 2 D 5 / 2 34867.68 4 d 3 5 s (a 5 P)5 p x 4 P° 3 / 2 return 4079.73 695.25 4 d 4 (a 5 D)5 s a 6 D 7 / 2 25199.81 4 d 4 (a 5 D)5 p y 6 F° 9 / 2 return 4100.92 391.99 4 d 4 (a 5 D)5 s a 6 D 5 / 2 24769.91 4 d 4 (a 5 D)5 p y 6 F° 7 / 2 return 4100.92 13145.71 4 d 4 (b 3 F)5 s b 4 F 9 / 2 37523.53 4 d 4 (c 3 F)5 p u 4 G° 9 / 2 return 4123.81 154.19 4 d 4 (a 5 D)5 s a 6 D 3 / 2 24396.80 4 d 4 (a 5 D)5 p y 6 F° 5 / 2 return 4152.58 695.25 4 d 4 (a 5 D)5 s a 6 D 7 / 2 24769.91 4 d 4 (a 5 D)5 p y 6 F° 7 / 2 return 4163.66 154.19 4 d 4 (a 5 D)5 s a 6 D 3 / 2 24164.79 4 d 4 (a 5 D)5 p y 6 F° 3 / 2 return 4164.66 391.99 4 d 4 (a 5 D)5 s a 6 D 5 / 2 24396.80 4 d 4 (a 5 D)5 p y 6 F° 5 / 2 return 4168.13 0.00 4 d 4 (a 5 D)5 s a 6 D 1 / 2 23984.87 4 d 4 (a 5 D)5 p y 6 F° 1 / 2 return

Persistent Lines of Neutral Rubidium (Rb I)

Persistent Lines of Neutral Rubidium (Rb I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4201.80 0.000 5 s 2 S 1 / 2 23792.591 6 p 2 P° 3 / 2 return 4215.53 0.000 5 s 2 S 1 / 2 23715.081 6 p 2 P° 1 / 2 return 7800.27 0.000 5 s 2 S 1 / 2 12816.545 5 p 2 P° 3 / 2 return 7947.60 0.000 5 s 2 S 1 / 2 12578.950 5 p 2 P° 1 / 2 return 14752.41 12578.950 5 p 2 P° 1 / 2 19355.649 4 d 2 D 3 / 2 return 15288.43 12816.545 5 p 2 P° 3 / 2 19355.649 4 d 2 D 3 / 2 return

Persistent Lines of Neutral Strontium (Sr I)

Persistent Lines of Neutral Strontium (Sr I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4607.33 0.000 5 s 2 1 S 0 21698.482 5 s 5 p 1 P° 1 return 4811.88 14898.563 5 s 5 p 3 P° 2 35674.668 5 p 2 3 P 2 return 4872.49 14504.351 5 s 5 p 3 P° 1 35022.015 5 s 5 d 3 D 2 return 4962.26 14898.563 5 s 5 p 3 P° 2 35045.055 5 s 5 d 3 D 3 return 4967.94 14898.563 5 s 5 p 3 P° 2 35022.015 5 s 5 d 3 D 2 return 5256.90 18319.267 5 s 4 d 3 D 3 37336.616 4 d 5 p 3 P° 2 return 5480.84 18319.267 5 s 4 d 3 D 3 36559.514 4 d 5 p 3 D° 3 return 6408.47 18319.267 5 s 4 d 3 D 3 33919.330 4 d 5 p 3 F° 4 return 6504.00 18218.795 5 s 4 d 3 D 2 33589.724 4 d 5 p 3 F° 3 return 6791.05 14317.520 5 s 5 p 3 P° 0 29038.795 5 s 6 s 3 S 1 return 6878.38 14504.351 5 s 5 p 3 P° 1 29038.795 5 s 6 s 3 S 1 return 6892.59 0.000 5 s 2 1 S 0 14504.351 5 s 5 p 3 P° 1 return 7070.10 14898.563 5 s 5 p 3 P° 2 29038.795 5 s 6 s 3 S 1 return

Persistent Lines of Neutral Yttrium (Y I)

Persistent Lines of Neutral Yttrium (Y I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4077.359 0.000 4 d 5 s 2 2 D 3 / 2 24518.751 4 d (3 D)5 s 5 p 2 F° 5 / 2 return 4102.364 530.351 4 d 5 s 2 2 D 5 / 2 24899.632 4 d (3 D)5 s 5 p 2 F° 7 / 2 return 4128.299 530.351 4 d 5 s 2 2 D 5 / 2 24746.573 4 d (1 D)5 s 5 p 2 D° 5 / 2 return 4142.841 0.000 4 d 5 s 2 2 D 3 / 2 24131.250 4 d (1 D)5 s 5 p 2 D° 3 / 2 return 17422.838 11078.614 4 d 2 (3 F)5 s 4 F 5 / 2 16816.641 4 d (3 D)5 s 5 p 4 D° 5 / 2 return 17903.209 11532.096 4 d 2 (3 F)5 s 4 F 9 / 2 17116.156 4 d (3 D)5 s 5 p 4 D° 7 / 2 return 18049.810 11277.928 4 d 2 (3 F)5 s 4 F 7 / 2 16816.641 4 d (3 D)5 s 5 p 4 D° 5 / 2 return 21260.444 11532.096 4 d 2 (3 F)5 s 4 F 9 / 2 16234.382 4 d (3 D)5 s 5 p 4 F° 9 / 2 return 22543.828 11277.928 4 d 2 (3 F)5 s 4 F 7 / 2 15712.522 4 d (3 D)5 s 5 p 4 F° 7 / 2 return 23990.450 11078.614 4 d 2 (3 F)5 s 4 F 5 / 2 15245.803 4 d (3 D)5 s 5 p 4 F° 5 / 2 return

Persistent Lines of Neutral Zirconium (Zr I)

Persistent Lines of Neutral Zirconium (Zr I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3519.604 0.00 4 d 2 5 s 2 a 3 F 2 28404.26 4 d 2 5 s (a 2 F)5 p x 3 G° 3 return 3547.683 570.41 4 d 2 5 s 2 a 3 F 3 28749.80 4 d 2 5 s (a 2 F)5 p x 3 G° 4 return 3575.790 570.41 4 d 2 5 s 2 a 3 F 3 28528.36 4 d 2 5 s (a 2 F)5 p w 3 F° 4 return 3601.191 1240.84 4 d 2 5 s 2 a 3 F 4 29001.65 4 d 2 5 s (a 2 F)5 p x 3 G° 5 return 3663.648 1240.84 4 d 2 5 s 2 a 3 F 4 28528.36 4 d 2 5 s (a 2 F)5 p w 3 F° 4 return 3835.962 0.00 4 d 2 5 s 2 a 3 F 2 26061.70 4 d 2 5 s (a 2 D)5 p x 3 F° 2 return 3863.872 570.41 4 d 2 5 s 2 a 3 F 3 26443.88 4 d 2 5 s (a 2 D)5 p x 3 F° 3 return 3890.316 1240.84 4 d 2 5 s 2 a 3 F 4 26938.42 4 d 2 5 s (a 2 D)5 p x 3 F° 4 return 3891.380 1240.84 4 d 2 5 s 2 a 3 F 4 26931.35 4 d 2 5 s (a 2 F)5 p z 5 G° 4 return 4072.698 5540.54 4 d 3 (b 4 F)5 s a 5 F 4 30087.33 4 d 3 (b 4 F)5 p x 5 D° 3 return 4081.209 5888.93 4 d 3 (b 4 F)5 s a 5 F 5 30384.50 4 d 3 (b 4 F)5 p x 5 D° 4 return 4227.750 5888.93 4 d 3 (b 4 F)5 s a 5 F 5 29535.48 4 d 3 (b 4 F)5 p y 5 F° 5 return 4239.309 5540.54 4 d 3 (b 4 F)5 s a 5 F 4 29122.71 4 d 3 (b 4 F)5 p y 5 F° 4 return 4687.799 5888.93 4 d 3 (b 4 F)5 s a 5 F 5 27214.89 4 d 3 (b 4 F)5 p y 5 G° 6 return 4710.074 5540.54 4 d 3 (b 4 F)5 s a 5 F 4 26765.66 4 d 3 (b 4 F)5 p y 5 G° 5 return 6127.457 1240.84 4 d 2 5 s 2 a 3 F 4 17556.26 4 d 2 5 s (a 4 F)5 p z 3 F° 4 return 7097.727 5540.54 4 d 3 (b 4 F)5 s a 5 F 4 19625.58 4 d 2 5 s (a 4 F)5 p z 5 D° 3 return 7169.092 5888.93 4 d 3 (b 4 F)5 s a 5 F 5 19833.78 4 d 2 5 s (a 4 F)5 p z 5 D° 4 return 8070.099 5888.93 4 d 3 (b 4 F)5 s a 5 F 5 18276.92 4 d 2 5 s (a 4 F)5 p z 5 F° 5 return

Persistent Lines of Neutral Antimony (Sb I)

Persistent Lines of Neutral Antimony (Sb I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1871.154 0.000 5 s 2 5 p 3 4 S° 3 / 2 53442.967 5 s 2 5 p 2 (3 P)5 d 4 P 5 / 2 return 2049.577 8512.125 5 s 2 5 p 3 2 D° 3 / 2 57287.052 5 s 2 5 p 2 (3 P)5 d 2 F 5 / 2 return 2068.344 0.000 5 s 2 5 p 3 4 S° 3 / 2 48332.424 5 s 2 5 p 2 (3 P)6 s 4 P 5 / 2 return 2139.698 8512.125 5 s 2 5 p 3 2 D° 3 / 2 55232.963 5 s 2 5 p 2 (1 D)6 s 2 D 3 / 2 return 2144.841 8512.125 5 s 2 5 p 3 2 D° 3 / 2 55120.943 5 s 2 5 p 2 (3 P)5 d 4 F 5 / 2 return 2175.818 0.000 5 s 2 5 p 3 4 S° 3 / 2 45945.340 5 s 2 5 p 2 (3 P)6 s 4 P 3 / 2 return 2179.190 9854.018 5 s 2 5 p 3 2 D° 5 / 2 55728.264 5 s 2 5 p 2 (1 D)6 s 2 D 5 / 2 return 2208.430 9854.018 5 s 2 5 p 3 2 D° 5 / 2 55120.943 5 s 2 5 p 2 (3 P)5 d 4 F 5 / 2 return 2311.463 0.000 5 s 2 5 p 3 4 S° 3 / 2 43249.337 5 s 2 5 p 2 (3 P)6 s 4 P 1 / 2 return 2528.509 9854.018 5 s 2 5 p 3 2 D° 5 / 2 49391.133 5 s 2 5 p 2 (3 P)6 s 2 P 3 / 2 return 2598.048 8512.125 5 s 2 5 p 3 2 D° 3 / 2 46991.058 5 s 2 5 p 2 (3 P)6 s 2 P 1 / 2 return 2877.913 8512.125 5 s 2 5 p 3 2 D° 3 / 2 43249.337 5 s 2 5 p 2 (3 P)6 s 4 P 1 / 2 return 3232.495 18464.202 5 s 2 5 p 3 2 P° 3 / 2 49391.133 5 s 2 5 p 2 (3 P)6 s 2 P 3 / 2 return 3267.491 16395.359 5 s 2 5 p 3 2 P° 1 / 2 46991.058 5 s 2 5 p 2 (3 P)6 s 2 P 1 / 2 return

Persistent Lines of Neutral Cadmium (Cd I)

Persistent Lines of Neutral Cadmium (Cd I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2288.022 0.000 5 s 2 1 S 0 43692.384 5 s 5 p 1 P° 1 return 3403.652 30113.990 5 s 5 p 3 P° 0 59485.768 5 s 5 d 3 D 1 return 3466.200 30656.087 5 s 5 p 3 P° 1 59497.868 5 s 5 d 3 D 2 return 3467.655 30656.087 5 s 5 p 3 P° 1 59485.768 5 s 5 d 3 D 1 return 3610.508 31826.952 5 s 5 p 3 P° 2 59515.980 5 s 5 d 3 D 3 return 3612.873 31826.952 5 s 5 p 3 P° 2 59497.868 5 s 5 d 3 D 2 return 4678.149 30113.990 5 s 5 p 3 P° 0 51483.980 5 s 6 s 3 S 1 return 4799.912 30656.087 5 s 5 p 3 P° 1 51483.980 5 s 6 s 3 S 1 return 5085.822 31826.952 5 s 5 p 3 P° 2 51483.980 5 s 6 s 3 S 1 return 6438.470 43692.384 5 s 5 p 1 P° 1 59219.734 5 s 5 d 1 D 2 return

Persistent Lines of Neutral Indium (In I)

Persistent Lines of Neutral Indium (In I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1711.1 2212.598 5 p 2 P° 3 / 2 60654 5 s 5 p 2 2 P 3 / 2 return 1757.3 0.000 5 p 2 P° 1 / 2 56905 5 s 5 p 2 2 S 1 / 2 return 2560.150 0.000 5 p 2 P° 1 / 2 39048.53 6 d 2 D 3 / 2 return 2710.265 2212.598 5 p 2 P° 3 / 2 39098.38 6 d 2 D 5 / 2 return 2753.878 0.000 5 p 2 P° 1 / 2 36301.84 7 s 2 S 1 / 2 return 2932.630 2212.598 5 p 2 P° 3 / 2 36301.84 7 s 2 S 1 / 2 return 3039.356 0.000 5 p 2 P° 1 / 2 32892.21 5 d 2 D 3 / 2 return 3256.089 2212.598 5 p 2 P° 3 / 2 32915.54 5 d 2 D 5 / 2 return 3258.565 2212.598 5 p 2 P° 3 / 2 32892.21 5 d 2 D 3 / 2 return 4101.7504 0.000 5 p 2 P° 1 / 2 24372.956 6 s 2 S 1 / 2 return 4511.2972 2212.598 5 p 2 P° 3 / 2 24372.956 6 s 2 S 1 / 2 return 12912.59 24372.956 6 s 2 S 1 / 2 32115.22 6 p 2 P° 3 / 2 return 13429.96 24372.956 6 s 2 S 1 / 2 31816.96 6 p 2 P° 1 / 2 return

Persistent Lines of Neutral Palladium (Pd I)

Persistent Lines of Neutral Palladium (Pd I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2447.9058 0.000 4 d 1 0 1 S 0 40838.874 4 d 9 (2 D 5 / 2)5 p 2 [1 / 2]° 1 return 2476.4127 0.000 4 d 1 0 1 S 0 40368.796 4 d 9 (2 D 5 / 2)5 p 2 [3 / 2]° 1 return 2763.0899 0.000 4 d 1 0 1 S 0 36180.677 4 d 9 (2 D 5 / 2)5 p 2 [3 / 2]° 1 return 3242.6983 6564.148 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 3 37393.762 4 d 9 (2 D 5 / 2)5 p 2 [5 / 2]° 3 return 3404.5764 6564.148 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 3 35927.948 4 d 9 (2 D 5 / 2)5 p 2 [7 / 2]° 4 return 3421.2214 7755.025 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 2 36975.973 4 d 9 (2 D 5 / 2)5 p 2 [5 / 2]° 2 return 3460.7381 6564.148 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 3 35451.443 4 d 9 (2 D 5 / 2)5 p 2 [7 / 2]° 3 return 3481.1516 10093.992 4 d 9 (2 D 5 / 2)5 s 2 [3 / 2] 1 38811.896 4 d 9 (2 D 5 / 2)5 p 2 [5 / 2]° 2 return 3516.9438 7755.025 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 2 36180.677 4 d 9 (2 D 5 / 2)5 p 2 [3 / 2]° 1 return 3553.0803 11721.809 4 d 9 (2 D 5 / 2)5 s 2 [3 / 2] 2 39858.361 4 d 9 (2 D 5 / 2)5 p 2 [5 / 2]° 3 return 3609.5547 7755.025 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 2 35451.443 4 d 9 (2 D 5 / 2)5 p 2 [7 / 2]° 3 return 3634.6884 6564.148 4 d 9 (2 D 5 / 2)5 s 2 [5 / 2] 3 34068.977 4 d 9 (2 D 5 / 2)5 p 2 [3 / 2]° 2 return

Persistent Lines of Neutral Rhodium (Rh I)

Persistent Lines of Neutral Rhodium (Rh I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3323.09 1529.97 4 d 8 (3 F)5 s a 4 F 7 / 2 31613.78 4 d 8 (3 F)5 p z 2 G° 9 / 2 return 3396.82 0.00 4 d 8 (3 F)5 s a 4 F 9 / 2 29430.86 4 d 8 (3 F)5 p z 4 F° 9 / 2 return 3434.89 0.00 4 d 8 (3 F)5 s a 4 F 9 / 2 29104.71 4 d 8 (3 F)5 p z 4 G° 1 1 / 2 return 3502.52 0.00 4 d 8 (3 F)5 s a 4 F 9 / 2 28542.69 4 d 8 (3 F)5 p z 4 G° 9 / 2 return 3507.32 2598.03 4 d 8 (3 F)5 s a 4 F 5 / 2 31101.75 4 d 8 (3 F)5 p z 4 G° 7 / 2 return 3528.02 1529.97 4 d 8 (3 F)5 s a 4 F 7 / 2 29866.34 4 d 8 (3 F)5 p z 4 F° 7 / 2 return 3657.99 1529.97 4 d 8 (3 F)5 s a 4 F 7 / 2 28859.64 4 d 8 (3 F)5 p z 4 D° 5 / 2 return 3692.36 0.00 4 d 8 (3 F)5 s a 4 F 9 / 2 27075.26 4 d 8 (3 F)5 p z 4 D° 7 / 2 return 3700.91 1529.97 4 d 8 (3 F)5 s a 4 F 7 / 2 28542.69 4 d 8 (3 F)5 p z 4 G° 9 / 2 return 4374.80 5690.97 4 d 8 (3 F)5 s a 2 F 7 / 2 28542.69 4 d 8 (3 F)5 p z 4 G° 9 / 2 return

Persistent Lines of Neutral Ruthenium (Ru I)

Persistent Lines of Neutral Ruthenium (Ru I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3436.737 1190.64 4 d 7 (a 4 F)5 s a 5 F 4 30279.68 4 d 7 (a 4 F)5 p z 5 G° 5 return 3498.944 0.00 4 d 7 (a 4 F)5 s a 5 F 5 28571.89 4 d 7 (a 4 F)5 p z 5 G° 6 return 3589.220 3105.49 4 d 7 (a 4 F)5 s a 5 F 1 30958.80 4 d 7 (a 4 F)5 p z 5 G° 2 return 3593.029 2713.24 4 d 7 (a 4 F)5 s a 5 F 2 30537.06 4 d 7 (a 4 F)5 p z 5 G° 3 return 3596.185 2091.54 4 d 7 (a 4 F)5 s a 5 F 3 29890.91 4 d 7 (a 4 F)5 p z 3 G° 4 return 3726.926 1190.64 4 d 7 (a 4 F)5 s a 5 F 4 28014.79 4 d 7 (a 4 F)5 p z 5 F° 4 return 3728.026 0.00 4 d 7 (a 4 F)5 s a 5 F 5 26816.23 4 d 7 (a 4 F)5 p z 5 F° 5 return 3730.432 2091.54 4 d 7 (a 4 F)5 s a 5 F 3 28890.47 4 d 7 (a 4 F)5 p z 5 F° 3 return 3798.899 1190.64 4 d 7 (a 4 F)5 s a 5 F 4 27506.59 4 d 7 (a 4 F)5 p z 5 D° 3 return 3799.353 0.00 4 d 7 (a 4 F)5 s a 5 F 5 26312.83 4 d 7 (a 4 F)5 p z 5 D° 4 return 4199.892 6545.03 4 d 7 (a 4 F)5 s a 3 F 4 30348.45 4 d 7 (a 4 F)5 p z 3 F° 4 return

Persistent Lines of Neutral Silver (Ag I)

Persistent Lines of Neutral Silver (Ag I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3280.680 0.000 4 d 1 0 (1 S)5 s 2 S 1 / 2 30472.703 4 d 1 0 (1 S)5 p 2 P° 3 / 2 return 3382.887 0.000 4 d 1 0 (1 S)5 s 2 S 1 / 2 29552.061 4 d 1 0 (1 S)5 p 2 P° 1 / 2 return 5209.078 29552.061 4 d 1 0 (1 S)5 p 2 P° 1 / 2 48743.969 4 d 1 0 (1 S)5 d 2 D 3 / 2 return 5465.497 30472.703 4 d 1 0 (1 S)5 p 2 P° 3 / 2 48764.219 4 d 1 0 (1 S)5 d 2 D 5 / 2 return 7687.772 29552.061 4 d 1 0 (1 S)5 p 2 P° 1 / 2 42556.152 4 d 1 0 (1 S)6 s 2 S 1 / 2 return 8273.509 30472.703 4 d 1 0 (1 S)5 p 2 P° 3 / 2 42556.152 4 d 1 0 (1 S)6 s 2 S 1 / 2 return

Persistent Lines of Neutral Technetium (Tc I)

Persistent Lines of Neutral Technetium (Tc I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3173.30 0.00 4 d 5 5 s 2 a 6 S 5 / 2 31503.93 4 d 6 (5 D)5 p y 4 P° 3 / 2 return 3182.37 0.00 4 d 5 5 s 2 a 6 S 5 / 2 31414.05 4 d 6 (5 D)5 p y 4 P° 7 / 2 return 3183.11 0.00 4 d 5 5 s 2 a 6 S 5 / 2 31406.74 4 d 6 (5 D)5 p y 4 P° 5 / 2 return 3466.28 2572.89 4 d 6 (5 D)5 s a 6 D 9 / 2 31414.05 4 d 6 (5 D)5 p y 4 P° 7 / 2 return 3636.07 2572.89 4 d 6 (5 D)5 s a 6 D 9 / 2 30067.29 4 d 6 (5 D)5 p z 6 F° 1 1 / 2 return 3718.86 3250.91 4 d 6 (5 D)5 s a 6 D 7 / 2 30133.26 4 d 6 (5 D)5 p z 6 F° 9 / 2 return 3984.97 2572.89 4 d 6 (5 D)5 s a 6 D 9 / 2 27660.10 4 d 6 (5 D)5 p z 6 D° 7 / 2 return 4031.63 2572.89 4 d 6 (5 D)5 s a 6 D 9 / 2 27369.79 4 d 6 (5 D)5 p z 6 D° 9 / 2 return 4095.67 3250.91 4 d 6 (5 D)5 s a 6 D 7 / 2 27660.10 4 d 6 (5 D)5 p z 6 D° 7 / 2 return 4238.19 0.00 4 d 5 5 s 2 a 6 S 5 / 2 23588.40 4 d 5 5 s (7 S)5 s z 6 P° 3 / 2 return 4262.27 0.00 4 d 5 5 s 2 a 6 S 5 / 2 23455.21 4 d 5 5 s (7 S)5 s z 6 P° 5 / 2 return 4297.06 0.00 4 d 5 5 s 2 a 6 S 5 / 2 23265.32 4 d 5 5 s (7 S)5 s z 6 P° 7 / 2 return 4853.59 10516.53 4 d 6 (5 D)5 s a 4 D 7 / 2 31114.08 4 d 6 (5 D)5 p z 4 F° 9 / 2 return

Persistent Lines of Neutral Tin (Sn I)

Persistent Lines of Neutral Tin (Sn I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2091.590 1691.806 5 p 2 3 P 1 49487.127 5 p 5 d 3 P° 0 return 2199.346 1691.806 5 p 2 3 P 1 47145.684 5 p 5 d 3 F° 2 return 2209.660 3427.673 5 p 2 3 P 2 48669.409 5 p 5 d 3 P° 2 return 2246.057 0.000 5 p 2 3 P 0 44508.677 5 p 5 d 3 D° 1 return 2268.930 3427.673 5 p 2 3 P 2 47487.696 5 p 5 d 3 F° 3 return 2354.850 1691.806 5 p 2 3 P 1 44144.368 5 p 5 d 3 D° 2 return 2421.694 8612.955 5 p 2 1 D 2 49893.823 5 p 5 d 1 F° 3 return 2429.495 3427.673 5 p 2 3 P 2 44576.006 5 p 5 d 3 D° 3 return 2661.244 1691.806 5 p 2 3 P 1 39257.053 5 p 6 s 1 P° 1 return 2706.505 1691.806 5 p 2 3 P 1 38628.876 5 p 6 s 3 P° 2 return 2839.976 3427.673 5 p 2 3 P 2 38628.876 5 p 6 s 3 P° 2 return 2863.315 0.000 5 p 2 3 P 0 34914.282 5 p 6 s 3 P° 1 return 3009.133 1691.806 5 p 2 3 P 1 34914.282 5 p 6 s 3 P° 1 return 3034.115 1691.806 5 p 2 3 P 1 34640.758 5 p 6 s 3 P° 0 return 3175.035 3427.673 5 p 2 3 P 2 34914.282 5 p 6 s 3 P° 1 return 3262.331 8612.955 5 p 2 1 D 2 39257.053 5 p 6 s 1 P° 1 return 3801.011 8612.955 5 p 2 1 D 2 34914.282 5 p 6 s 3 P° 1 return 4524.734 17162.499 5 p 2 1 S 0 39257.053 5 p 6 s 1 P° 1 return

Persistent Lines of Neutral Barium (Ba I)

Persistent Lines of Neutral Barium (Ba I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3071.584 0.000 6 s 2 1 S 0 32547.033 6 s 7 p 1 P° 1 return 3501.108 0.000 6 s 2 1 S 0 28554.221 5 d 6 p 1 P° 1 return 5535.481 0.000 6 s 2 1 S 0 18060.261 6 s 6 p 1 P° 1 return 6498.760 9596.533 6 s 5 d 3 D 3 24979.834 5 d 6 p 3 D° 3 return 6527.312 9215.501 6 s 5 d 3 D 2 24531.513 5 d 6 p 3 D° 2 return 6595.325 9033.966 6 s 5 d 3 D 1 24192.033 5 d 6 p 3 D° 1 return 6693.842 9596.533 6 s 5 d 3 D 3 24531.513 5 d 6 p 3 D° 2 return 7059.943 9596.533 6 s 5 d 3 D 3 23757.049 5 d 6 p 3 F° 4 return 7280.296 9215.501 6 s 5 d 3 D 2 22947.423 5 d 6 p 3 F° 3 return 7672.085 9033.966 6 s 5 d 3 D 1 22064.645 5 d 6 p 3 F° 2 return 8559.998 11395.350 6 s 5 d 1 D 2 23074.387 5 d 6 p 1 D° 2 return 14999.852 11395.350 6 s 5 d 1 D 2 18060.261 6 s 6 p 1 P° 1 return 23253.56 9215.501 6 s 5 d 3 D 2 13514.745 6 s 6 p 3 P° 2 return 25514.88 9596.533 6 s 5 d 3 D 3 13514.745 6 s 6 p 3 P° 2 return

Persistent Lines of Neutral Cerium (Ce I)

Persistent Lines of Neutral Cerium (Ce I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4632.320 0.000 4 f 5 d 6 s 2 1 G° 4 21581.408 4 f 5 d (3 H°)6 s 6 p (3 P°) 5 return 5009.098 3196.607 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 4 23154.693 3 return 5159.686 5315.803 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 7 24691.432 6 return 5161.484 7780.202 4 f 2 6 s 2 3 H 6 27149.080? 4 f 2 (3 H 6)6 s 6 p (1 P° 1) (6,1)°? 7 return 5223.461 4762.718 4 f 2 6 s 2 3 H 4 23901.786 4 f 2 (3 H 4)6 s 6 p (1 P° 1) (4,1)° 4 return 5245.916 4762.718 4 f 2 6 s 2 3 H 4 23819.871 4 f 2 (3 H 4)6 s 6 p (1 P° 1) (4,1)° 5 return 5601.280 6809.128 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 8 24657.245 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 I 8 return 5669.959 3210.583 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) ° 5 20842.504 4 f (2 F°)5 d 2 (3 F) (4 H°)6 p 5 I 6 return 5696.993 5315.803 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 7 22864.055 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 K 8 return 5699.226 6809.128 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 8 24350.503 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 K 9 return 5719.031 5802.108 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 H° 7 23282.722 4 f (2 F°)5 d 2 (3 F) (4 H°)6 p 5 I 8 return 5940.857 3764.008 4 f (2 F°) 5 d 2 (3 F)6 s (4 F) 5 I° 5 20591.937 4 f (2 F°)5 d 2 (3 F) (4 I°)6 p 5 K 6 return

Persistent Lines of Neutral Cesium (Cs I)

Persistent Lines of Neutral Cesium (Cs I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4555.28 0.0000 6 s 2 S 1 / 2 21946.396 7 p 2 P° 3 / 2 return 4593.17 0.0000 6 s 2 S 1 / 2 21765.35 7 p 2 P° 1 / 2 return 8521.13 0.0000 6 s 2 S 1 / 2 11732.3079 6 p 2 P° 3 / 2 return 8761.41 11178.2686 6 p 2 P° 1 / 2 22588.8210 6 d 2 D 3 / 2 return 8943.47 0.0000 6 s 2 S 1 / 2 11178.2686 6 p 2 P° 1 / 2 return 9172.32 11732.3079 6 p 2 P° 3 / 2 22631.6863 6 d 2 D 5 / 2 return 13588.29 11178.2686 6 p 2 P° 1 / 2 18535.529 7 s 2 S 1 / 2 return 14694.91 11732.3079 6 p 2 P° 3 / 2 18535.529 7 s 2 S 1 / 2 return 30103.27 11178.2686 6 p 2 P° 1 / 2 14499.2584 5 d 2 D 3 / 2 return 34900.13 11732.3079 6 p 2 P° 3 / 2 14596.8423 5 d 2 D 5 / 2 return

Persistent Lines of Neutral Iodine (I I)

Persistent Lines of Neutral Iodine (I I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1457.98 0.00 5 p 5 2 P° 3 / 2 68587.87 5 p 4 (1 D 2)6 s 2 [2] 5 / 2 return 1518.05 7603.15 5 p 5 2 P° 1 / 2 73477.24 5 p 4 (3 P 1)5 d 2 [1] 1 / 2 return 1702.07 7603.15 5 p 5 2 P° 1 / 2 66355.10 5 p 4 (3 P 2)5 d 2 [1] 3 / 2 return 1782.76 0.00 5 p 5 2 P° 3 / 2 56092.88 5 p 4 (3 P 2)6 s 2 [2] 3 / 2 return 1830.38 0.00 5 p 5 2 P° 3 / 2 54633.46 5 p 4 (3 P 2)6 s 2 [2] 5 / 2 return 1844.45 7603.15 5 p 5 2 P° 1 / 2 61819.76 5 p 4 (3 P 1)6 s 2 [1] 3 / 2 return 2061.63 7603.15 5 p 5 2 P° 1 / 2 56092.88 5 p 4 (3 P 2)6 s 2 [2] 3 / 2 return 5119.29 56092.88 5 p 4 (3 P 2)6 s 2 [2] 3 / 2 75621.41 5 p 4 (3 P 2)7 p 2 [1] 3 / 2 return 8043.74 54633.46 5 p 4 (3 P 2)6 s 2 [2] 5 / 2 67062.09 5 p 4 (3 P 2)6 p 2 [1]° 3 / 2 return 9058.33 54633.46 5 p 4 (3 P 2)6 s 2 [2] 5 / 2 65669.99 5 p 4 (3 P 2)6 p 2 [3]° 7 / 2 return

Persistent Lines of Neutral Lanthanum (La I)

Persistent Lines of Neutral Lanthanum (La I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3574.43 0.000 5 d 6 s 2 2 D 3 / 2 27968.54 4 f 5 d (3 D°)6 s ° 3 / 2 return 4060.33 4121.572 5 d 2 (3 F)6 s 4 F 9 / 2 28743.24 4 f 5 d (3 G°)6 s 4 G° 1 1 / 2 return 4187.32 0.000 5 d 6 s 2 2 D 3 / 2 23874.95 5 d 6 s (3 D)6 p ° 5 / 2 return 4280.27 1053.164 5 d 6 s 2 2 D 5 / 2 24409.68 4 f 5 d (1 G°)6 s ° 7 / 2 return 4949.77 0.000 5 d 6 s 2 2 D 3 / 2 20197.34 5 d 6 s (1 D)6 p ° 1 / 2 return 5145.42 3010.002 5 d 2 (3 F)6 s 4 F 5 / 2 22439.36 5 d 2 (3 F)6 p 4 D° 3 / 2 return 5177.31 3494.526 5 d 2 (3 F)6 s 4 F 7 / 2 22804.25 5 d 2 (3 F)6 p 4 D° 5 / 2 return 5211.86 4121.572 5 d 2 (3 F)6 s 4 F 9 / 2 23303.26 5 d 2 (3 F)6 p 4 D° 7 / 2 return 5234.27 4121.572 5 d 2 (3 F)6 s 4 F 9 / 2 23221.10 5 d 6 s (3 D)6 p ° 7 / 2 return 5455.15 1053.164 5 d 6 s 2 2 D 5 / 2 19379.40 5 d 2 (3 F)6 p 2 D° 5 / 2 return 5501.34 0.000 5 d 6 s 2 2 D 3 / 2 18172.35 5 d 2 (3 F)6 p 2 D° 3 / 2 return 5791.34 4121.572 5 d 2 (3 F)6 s 4 F 9 / 2 21384.00 5 d 2 (3 F)6 p 4 F° 9 / 2 return 6249.93 4121.572 5 d 2 (3 F)6 s 4 F 9 / 2 20117.38 5 d 2 (3 F)6 p 4 G° 1 1 / 2 return 6394.23 3494.526 5 d 2 (3 F)6 s 4 F 7 / 2 19129.31 5 d 2 (3 F)6 p 4 G° 9 / 2 return

Persistent Lines of Neutral Praseodymium (Pr I)

Persistent Lines of Neutral Praseodymium (Pr I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3959.44 return 4639.55 1376.60 4 f 3 6 s 2 4 I° 1 1 / 2 22924.39 9 / 2 return 4687.80 return 4695.77 return 4730.67 1376.60 4 f 3 6 s 2 4 I° 1 1 / 2 22509.40 9 / 2 return 4736.69 0.00 4 f 3 6 s 2 4 I° 9 / 2 21105.88 7 / 2 return 4924.60 1376.60 4 f 3 6 s 2 4 I° 1 1 / 2 21677.15 1 1 / 2 return 4939.74 2846.75 4 f 3 6 s 2 4 I° 1 3 / 2 23085.08 4 f 3 6 s 6 p ? 4 I? 1 3 / 2 return 4951.37 0.00 4 f 3 6 s 2 4 I° 9 / 2 20190.85 4 f 3 (4 I°)6 s 6 p (1 P°)? 4 I? 9 / 2 return 5019.76 2846.75 4 f 3 6 s 2 4 I° 1 3 / 2 22762.55 4 f 3 6 s 6 p ? 4 K? 1 5 / 2 return 5026.96 1376.60 4 f 3 6 s 2 4 I° 1 1 / 2 21263.71 4 f 3 (4 I°)6 s 6 p ? 4 K? 1 3 / 2 return 5045.52 4381.10 4 f 3 6 s 2 4 I° 1 5 / 2 24195.13 4 f 3 6 s 6 p ? 4 K? 1 7 / 2 return 5087.12 2846.75 4 f 3 6 s 2 4 I° 1 3 / 2 22498.81 1 5 / 2 return 5133.44 0.00 4 f 3 6 s 2 4 I° 9 / 2 19474.75 4 f 3 6 s 6 p ? 4 I? 1 1 / 2 return

Persistent Lines of Neutral Tellurium (Te I)

Persistent Lines of Neutral Tellurium (Te I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1822.155 0.000 5 p 4 3 P 2 54880.070 5 p 3 (2 D)6 s 3 D° 2 return 1857.296 4750.712 5 p 4 3 P 1 58592.434 5 p 3 (4 S)5 d 3 D° 2 return 1994.839 4750.712 5 p 4 3 P 1 54880.070 5 p 3 (2 D)6 s 3 D° 2 return 2002.028 4750.712 5 p 4 3 P 1 54683.886 5 p 3 (2 D)6 s 3 D° 1 return 2081.172 10557.877 5 p 4 1 D 2 58592.434 5 p 3 (4 S)5 d 3 D° 2 return 2142.822 0.000 5 p 4 3 P 2 46652.738 5 p 3 (4 S)6 s 3 S° 1 return 2147.260 10557.877 5 p 4 1 D 2 57114.206 5 p 3 (2 D)6 s 1 D° 2 return 2259.034 0.000 5 p 4 3 P 2 44253.000 5 p 3 (4 S)6 s 5 S° 2 return 2383.277 4706.500 5 p 4 3 P 0 46652.738 5 p 3 (4 S)6 s 3 S° 1 return 2385.792 4750.712 5 p 4 3 P 1 46652.738 5 p 3 (4 S)6 s 3 S° 1 return 9722.742 44253.000 5 p 3 (4 S)6 s 5 S° 2 54535.345 5 p 3 (4 S)6 p 5 P 3 return 10051.41 44253.000 5 p 3 (4 S)6 s 5 S° 2 54199.122 5 p 3 (4 S)6 p 5 P 2 return 11089.56 46652.738 5 p 3 (4 S)6 s 3 S° 1 55667.758 5 p 3 (4 S)6 p 3 P 2 return 11487.23 46652.738 5 p 3 (4 S)6 s 3 S° 1 55355.672 5 p 3 (4 S)6 p 3 P 1 return

Persistent Lines of Neutral Xenon (Xe I)

Persistent Lines of Neutral Xenon (Xe I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1192.0376 0.000 5 p 6 1 S 0 83889.971 5 p 5 (2 P° 3 / 2)5 d 2 [3 / 2]° 1 return 1250.2091 0.000 5 p 6 1 S 0 79986.619 5 p 5 (2 P° 3 / 2)5 d 2 [1 / 2]° 1 return 1295.5878 0.000 5 p 6 1 S 0 77185.040 5 p 5 (2 P° 1 / 2)6 s 2 [1 / 2]° 1 return 1469.6123 0.000 5 p 6 1 S 0 68045.156 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 return 8231.635 67067.547 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 79212.464 5 p 5 (2 P° 3 / 2)6 p 2 [3 / 2] 2 return 8280.117 68045.156 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 80118.962 5 p 5 (2 P° 3 / 2)6 p 2 [1 / 2] 0 return 8819.411 67067.547 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 78403.060 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 3 return 9923.190 68045.156 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 78119.798 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 2 return 12623.399 77269.144 5 p 5 (2 P° 3 / 2)6 p 2 [1 / 2] 1 85188.774 5 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 return 14732.816 78403.060 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 3 85188.774 5 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 return 31069.23 79212.464 5 p 5 (2 P° 3 / 2)6 p 2 [3 / 2] 2 82430.205 5 p 5 (2 P° 3 / 2)5 d 2 [5 / 2]° 3 return 35070.26 78119.798 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 2 80970.439 5 p 5 (2 P° 3 / 2)5 d 2 [7 / 2]° 3 return

Persistent Lines of Neutral Dysprosium (Dy I)

Persistent Lines of Neutral Dysprosium (Dy I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4045.970 0.000 4 f 1 0 6 s 2 5 I 8 24708.971 4 f 1 0 (5 I 8)6 s 6 p (1 P° 1) (8,1)° 7 return 4167.974 4134.222 4 f 1 0 6 s 2 5 I 7 28119.931 4 f 1 0 (5 I 7)6 s 6 p (1 P° 1) (7,1)° 6 return 4186.821 0.000 4 f 1 0 6 s 2 5 I 8 23877.739 4 f 1 0 (5 I 8)6 s 6 p (1 P° 1) (8,1)° 8 return 4191.640 4134.222 4 f 1 0 6 s 2 5 I 7 27984.513 4 f 9 (6 H°)5 d 2 (3 F) (8 L°)6 s ° 7 return 4194.846 0.000 4 f 1 0 6 s 2 5 I 8 23832.060 4 f 9 (6 H°)5 d 2 (3 F) (8 K°)6 s ° 8 return 4211.714 0.000 4 f 1 0 6 s 2 5 I 8 23736.610 4 f 1 0 (5 I 8)6 s 6 p (1 P° 1) (8,1)° 9 return 4215.159 4134.222 4 f 1 0 6 s 2 5 I 7 27851.435 4 f 9 (6 H°)5 d 2 (3 P) (8 I°)6 s ° 8 return 4218.092 4134.222 4 f 1 0 6 s 2 5 I 7 27834.933 4 f 1 0 (5 I 7)6 s 6 p (1 P° 1) (7,1)° 7 return 4221.110 4134.222 4 f 1 0 6 s 2 5 I 7 27818.000 4 f 1 0 (5 I 7)6 s 6 p (1 P° 1) (7,1)° 8 return 4225.154 7050.603 4 f 1 0 6 s 2 5 I 6 30711.717 4 f 1 0 (5 I 6)6 s 6 p (1 P° 1) (6,1)° 7 return 4589.364 0.000 4 f 1 0 6 s 2 5 I 8 21783.407 4 f 9 (6 H°)5 d 6 s 2 5 K° 7 return

Persistent Lines of Neutral Europium (Eu I)

Persistent Lines of Neutral Europium (Eu I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3111.427 0.00 4 f 7 6 s 2 a 8 S° 7 / 2 32130.25 4 f 6 (7 F)5 d 6 s 2 8 P 9 / 2 return 3212.804 0.00 4 f 7 6 s 2 a 8 S° 7 / 2 31116.38 4 f 6 (7 F)5 d 6 s 2 8 P 7 / 2 return 3334.313 0.00 4 f 7 6 s 2 a 8 S° 7 / 2 29982.50 4 f 6 (7 F)5 d 6 s 2 8 P 5 / 2 return 4594.03 0.00 4 f 7 6 s 2 a 8 S° 7 / 2 21761.26 4 f 7 (8 S°)6 s 6 p (1 P°) y 8 P 9 / 2 return 4627.22 0.00 4 f 7 6 s 2 a 8 S° 7 / 2 21605.17 4 f 7 (8 S°)6 s 6 p (1 P°) y 8 P 7 / 2 return 4661.88 0.00 4 f 7 6 s 2 a 8 S° 7 / 2 21444.58 4 f 7 (8 S°)6 s 6 p (1 P°) y 8 P 5 / 2 return 5215.10 13778.68 4 f 7 (8 S°)5 d (9 D°)6 s a 1 0 D° 1 3 / 2 32948.41 4 f 7 (8 S°)5 d (9 D°)6 p y 1 0 P 1 1 / 2 return 5357.61 13457.21 4 f 7 (8 S°)5 d (9 D°)6 s a 1 0 D° 1 1 / 2 32117.10 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 D 1 3 / 2 return 5830.98 13778.68 4 f 7 (8 S°)5 d (9 D°)6 s a 1 0 D° 1 3 / 2 30923.71 4 f 7 (8 S°)5 d (9 D°)6 p z 1 0 F 1 5 / 2 return

Persistent Lines of Neutral Gadolinium (Gd I)

Persistent Lines of Neutral Gadolinium (Gd I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3684.13 0.000 4 f 7 (8 S°)5 d 6 s 2 9 D° 2 27135.695 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 9 P 3 return 3713.57 215.124 4 f 7 (8 S°)5 d 6 s 2 9 D° 3 27135.695 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 9 P 3 return 3717.48 532.977 4 f 7 (8 S°)5 d 6 s 2 9 D° 4 27425.245 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 4 return 3783.05 999.121 4 f 7 (8 S°)5 d 6 s 2 9 D° 5 27425.245 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 4 return 4053.64 999.121 4 f 7 (8 S°)5 d 6 s 2 9 D° 5 25661.340 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 6 return 4058.22 215.124 4 f 7 (8 S°)5 d 6 s 2 9 D° 3 24849.514 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 4 return 4078.70 532.977 4 f 7 (8 S°)5 d 6 s 2 9 D° 4 25043.649 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 5 return 4175.54 1719.087 4 f 7 (8 S°)5 d 6 s 2 9 D° 6 25661.340 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 6 return 4190.78 999.121 4 f 7 (8 S°)5 d 6 s 2 9 D° 5 24854.297 4 f 8 (7 F)5 d (8 G)6 s 9 G 6 return 4225.85 1719.087 4 f 7 (8 S°)5 d 6 s 2 9 D° 6 25376.313 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 7 return 4313.84 215.124 4 f 7 (8 S°)5 d 6 s 2 9 D° 3 23389.782 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 3 return 4327.12 0.000 4 f 7 (8 S°)5 d 6 s 2 9 D° 2 23103.660 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 return 4346.46 999.121 4 f 7 (8 S°)5 d 6 s 2 9 D° 5 23999.912 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 5 return 4401.86 1719.087 4 f 7 (8 S°)5 d 6 s 2 9 D° 6 24430.425 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 6 return 4422.41 215.124 4 f 7 (8 S°)5 d 6 s 2 9 D° 3 22820.895 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 9 D 4 return 4430.63 0.000 4 f 7 (8 S°)5 d 6 s 2 9 D° 2 22563.824 4 f 7 (8 S°)5 d (7 D°)6 s 6 p (3 P°) 9 D 3 return 4519.66 215.124 4 f 7 (8 S°)5 d 6 s 2 9 D° 3 22334.508 4 f 7 (8 S°)5 d (9 D°)6 s 6 p (1 P°) 2 return 5103.45 7947.294 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 7 27536.397 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 8 return 5155.84 7480.348 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 s 1 1 F° 6 26870.393 4 f 7 (8 S°)5 d 2 (3 F) (1 0 F°)6 p 1 1 G 7 return

Persistent Lines of Neutral Holmium (Ho I)

Persistent Lines of Neutral Holmium (Ho I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4040.81 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 24740.52 4 f 1 0 5 d 6 s 2 1 3 / 2 return 4053.87 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 24660.80 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 5 / 2 return 4103.80 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 24360.81 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 7 / 2 return 4108.62 5419.70 4 f 1 1 6 s 2 4 I° 1 3 / 2 29751.91 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 3 / 2 return 4127.16 5419.70 4 f 1 1 6 s 2 4 I° 1 3 / 2 29642.60 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 5 / 2 return 4163.03 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 24014.22 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 3 / 2 return 4173.20 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 23955.69 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (3 P° 2) (1 3 / 2 ,2) 1 3 / 2 return 4227.13 5419.70 4 f 1 1 6 s 2 4 I° 1 3 / 2 29069.78 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 1 / 2 return 4254.38 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 23498.57 4 f 1 1 (4 I° 1 3 / 2)6 s 6 p (3 P° 2) (1 3 / 2 ,2) 1 7 / 2 return 4350.73 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 22978.19 4 f 1 0 (5 I 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 1 3 / 2 return 4939.01 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 20241.31 4 f 1 0 (5 I 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 1 3 / 2 return 5982.85 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 16709.82 4 f 1 1 (4 I° 1 5 / 2)6 s 6 p (3 P° 1) (1 5 / 2 ,1) 1 7 / 2 return 6604.91 0.00 4 f 1 1 6 s 2 4 I° 1 5 / 2 15136.06 4 f 1 0 (5 I 7)5 d 3 / 2 6 s 2 (7, 3 / 2) 1 5 / 2 return

Persistent Lines of Neutral Neodymium (Nd I)

Persistent Lines of Neutral Neodymium (Nd I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4621.94 2366.597 4 f 4 6 s 2 5 I 6 23996.513 ° 6 return 4634.24 0.000 4 f 4 6 s 2 5 I 4 21572.610 4 f 4 6 s 6 p 5 H° 3 return 4641.10 return 4649.67 return 4683.45 0.000 4 f 4 6 s 2 5 I 4 21345.837 ° 4 return 4719.02 0.000 4 f 4 6 s 2 5 I 4 21184.881 ° 4 return 4883.81 5048.602 4 f 4 6 s 2 5 I 8 25518.700 4 f 4 6 s 6 p 5 K° 9 return 4896.93 1128.056 4 f 4 6 s 2 5 I 5 21543.326 4 f 4 6 s 6 p 5 K° 6 return 4924.53 0.000 4 f 4 6 s 2 5 I 4 20300.875 4 f 4 6 s 6 p 5 K° 5 return 4944.83 1128.056 4 f 4 6 s 2 5 I 5 21345.572 ° 6 return 4954.78 0.000 4 f 4 6 s 2 5 I 4 20176.912 ° 5 return

Persistent Lines of Neutral Promethium (Pm I)

Persistent Lines of Neutral Promethium (Pm I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4734.27 803.82 4 f 5 6 s 2 6 H° 7 / 2 21920.49 9 / 2 return 4759.00 5089.79 4 f 5 6 s 2 6 H° 1 5 / 2 26096.75 1 7 / 2 return 4762.57 5089.79 4 f 5 6 s 2 6 H° 1 5 / 2 26080.99 1 7 / 2 return 4773.46 2797.10 4 f 5 6 s 2 6 H° 1 1 / 2 23740.42 1 3 / 2 return 4798.98 2797.10 4 f 5 6 s 2 6 H° 1 1 / 2 23629.06 1 3 / 2 return 4801.36 803.82 4 f 5 6 s 2 6 H° 7 / 2 21625.45 9 / 2 return 4811.85 7497.99 4 f 5 6 s 2 6 F° 9 / 2 28274.21 9 / 2 return 4837.66 1748.78 4 f 5 6 s 2 6 H° 9 / 2 22414.17 1 1 / 2 return 4860.74 803.82 4 f 5 6 s 2 6 H° 7 / 2 21371.05 7 / 2 return 4892.52 803.82 4 f 5 6 s 2 6 H° 7 / 2 21237.49 9 / 2 return 4932.99 0.00 4 f 5 6 s 2 6 H° 5 / 2 20265.98 5 / 2 return 4959.46 0.00 4 f 5 6 s 2 6 H° 5 / 2 20157.85 7 / 2 return 4997.10 0.00 4 f 5 6 s 2 6 H° 5 / 2 20006.04 3 / 2 return 5058.31 803.82 4 f 5 6 s 2 6 H° 7 / 2 20567.76 5 / 2 return 5127.34 2797.10 4 f 5 6 s 2 6 H° 1 1 / 2 22294.96 9 / 2 return 5146.30 3919.03 4 f 5 6 s 2 6 H° 1 3 / 2 23345.07 1 1 / 2 return 6100.21 return 6520.45 return 6598.15 return

Persistent Lines of Neutral Samarium (Sm I)

Persistent Lines of Neutral Samarium (Sm I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3745.465 1489.55 4 f 6 6 s 2 7 F 3 28180.95 4 f 5 (6 F°)5 d 6 s 2 7 F° 4 return 3990.025 3125.46 4 f 6 6 s 2 7 F 5 28180.95 4 f 5 (6 F°)5 d 6 s 2 7 F° 4 return 4296.743 4020.66 4 f 6 6 s 2 7 F 6 27287.58 4 f 6 (7 F)6 s 6 p (1 P°) 7 G° 7 return 4336.137 3125.46 4 f 6 6 s 2 7 F 5 26180.92 ° 6 return 4362.912 0.00 4 f 6 6 s 2 7 F 0 22914.07 4 f 6 (7 F)6 s 6 p (1 P°) 7 G° 1 return 4470.886 2273.09 4 f 6 6 s 2 7 F 4 24633.75 4 f 5 (6 F°)5 d 6 s 2 ° 4 return 4716.097 3125.46 4 f 6 6 s 2 7 F 5 24323.51 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 5 return 4728.423 1489.55 4 f 6 6 s 2 7 F 3 22632.30 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 3 return 4760.27 811.92 4 f 6 6 s 2 7 F 2 21813.22 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 2 return 4841.701 4020.66 4 f 6 6 s 2 7 F 6 24668.79 4 f 6 (7 F)6 s 6 p (1 P°) ° 5 return 4883.971 3125.46 4 f 6 6 s 2 7 F 5 23594.84 4 f 6 (7 F)6 s 6 p (1 P°) 7 D° 4 return

Persistent Lines of Neutral Terbium (Tb I)

Persistent Lines of Neutral Terbium (Tb I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3830.261 285.530 4 f 8 (7 F)5 d 6 s 2 8 G 1 3 / 2 26386.005 ° 1 5 / 2 return 3901.325 462.120 4 f 8 (7 F)5 d 6 s 2 8 G 1 5 / 2 26087.175 4 f 8 5 d 6 s 6 p ? ° 1 7 / 2 return 4032.284 2310.120 4 f 8 (7 F)5 d 6 s 2 8 D 1 1 / 2 27102.955 ° 1 1 / 2 return 4061.558 462.120 4 f 8 (7 F)5 d 6 s 2 8 G 1 5 / 2 25076.265 ° 1 5 / 2 return 4318.847 0.000 4 f 9 6 s 2 6 H° 1 5 / 2 23147.820 4 f 9 (6 H° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 5 / 2 return 4326.472 0.000 4 f 9 6 s 2 6 H° 1 5 / 2 23107.025 4 f 9 (6 H° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 7 / 2 return 4336.455 2771.675 4 f 9 6 s 2 6 H° 1 3 / 2 25825.505 4 f 9 (6 H° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 5 / 2 return 4338.435 0.000 4 f 9 6 s 2 6 H° 1 5 / 2 23043.310 4 f 9 (6 H° 1 5 / 2)6 s 6 p (1 P° 1) (1 5 / 2 ,1) 1 3 / 2 return 4356.837 2771.675 4 f 9 6 s 2 6 H° 1 3 / 2 25717.655 4 f 9 (6 H° 1 3 / 2)6 s 6 p (1 P° 1) (1 3 / 2 ,1) 1 3 / 2 return 5354.88 462.120 4 f 8 (7 F)5 d 6 s 2 8 G 1 5 / 2 19131.480 4 f 8 5 d 6 s 6 p ? ° 1 7 / 2 return

Persistent Lines of Neutral Erbium (Er I)

Persistent Lines of Neutral Erbium (Er I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3862.851 0.000 4 f 1 2 6 s 2 3 H 6 25880.274 4 f 1 2 (3 H)6 s 6 p ° 6 return 3892.684 0.000 4 f 1 2 6 s 2 3 H 6 25681.933 4 f 1 1 (4 F°)5 d 6 s 2 ° 5 return 3937.014 0.000 4 f 1 2 6 s 2 3 H 6 25392.779 4 f 1 1 (4 F°)5 d 6 s 2 ° 6 return 3944.420 5035.193 4 f 1 2 6 s 2 3 F 4 30380.282 4 f 1 1 (4 I°)5 d 2 (3 F) (4 F°)6 s ° 5 return 3973.036 0.000 4 f 1 2 6 s 2 3 H 6 25162.553 4 f 1 1 (4 I°)5 d 6 s 2 ° 5 return 3973.575 0.000 4 f 1 2 6 s 2 3 H 6 25159.143 ° 7 return 4007.965 0.000 4 f 1 2 6 s 2 3 H 6 24943.272 4 f 1 2 (3 H)6 s 6 p ° 7 return 4020.512 6958.329 4 f 1 2 6 s 2 3 H 5 31823.748 4 f 1 2 (3 H)6 s 6 p ° 6 return 4087.632 0.000 4 f 1 2 6 s 2 3 H 6 24457.139 4 f 1 1 (4 I°)5 d 6 s 2 ° 6 return 4151.108 0.000 4 f 1 2 6 s 2 3 H 6 24083.166 4 f 1 2 (3 H)6 s 6 p ° 5 return 4606.606 0.000 4 f 1 2 6 s 2 3 H 6 21701.885 4 f 1 1 (4 I° 1 1 / 2)5 d 5 / 2 6 s 2 (1 1 / 2 , 5 / 2)° 6 return 5826.786 0.000 4 f 1 2 6 s 2 3 H 6 17157.307 4 f 1 2 (3 H 6)6 s 6 p (3 P° 1) (6,1)° 7 return 6221.019 0.000 4 f 1 2 6 s 2 3 H 6 16070.095 4 f 1 1 (4 I° 1 3 / 2)5 d 3 / 2 6 s 2 (1 3 / 2 , 3 / 2)° 6 return

Persistent Lines of Neutral Hafnium (Hf I)

Persistent Lines of Neutral Hafnium (Hf I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2866.37 0.00 5 d 2 6 s 2 3 F 2 34877.04 5 d 2 (3 F)6 s (2 F)6 p 1 F° 3 return 2898.26 2356.68 5 d 2 6 s 2 3 F 3 36850.04 5 d 2 (1 G)6 s (2 G)6 p 3 G° 4 return 2904.41 4567.64 5 d 2 6 s 2 3 F 4 38987.85 5 d 2 (3 F)6 s (2 F)6 p 1 G° 4 return 2916.48 4567.64 5 d 2 6 s 2 3 F 4 38845.45 5 d 2 (1 G)6 s (2 G)6 p 3 G° 5 return 2940.77 0.00 5 d 2 6 s 2 3 F 2 33994.86 5 d 2 (1 G)6 s (2 G)6 p 3 F° 2 return 3072.88 0.00 5 d 2 6 s 2 3 F 2 32533.32 5 d 2 (3 F)6 s (2 F)6 p 3 G° 3 return 3682.24 0.00 5 d 2 6 s 2 3 F 2 27149.64 5 d 2 (3 F)6 s (4 F)6 p 3 F° 2 return 4174.34 2356.68 5 d 2 6 s 2 3 F 3 26305.78 5 d 2 (3 F)6 s (4 F)6 p 5 D° 3 return 7237.10 4567.64 5 d 2 6 s 2 3 F 4 18381.50 5 d 6 s 2 6 p 3 D° 3 return

Persistent Lines of Neutral Lutetium (Lu I)

Persistent Lines of Neutral Lutetium (Lu I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3081.47 1993.92 5 d (2 D)6 s 2 2 D 5 / 2 34436.49 5 d 6 s (3 D)6 p 2 P° 3 / 2 return 3118.43 0.00 5 d (2 D)6 s 2 2 D 3 / 2 32058.1 5 d 6 s (3 D)6 p 2 P° 1 / 2 return 3278.97 0.00 5 d (2 D)6 s 2 2 D 3 / 2 30488.62 6 s 2 (1 S)7 p 2 P° 3 / 2 return 3281.74 1993.92 5 d (2 D)6 s 2 2 D 5 / 2 32456.87 5 d 6 s (1 D)6 p 2 D° 5 / 2 return 3312.11 0.00 5 d (2 D)6 s 2 2 D 3 / 2 30183.55 5 d 6 s (3 D)6 p 2 F° 5 / 2 return 3359.56 1993.92 5 d (2 D)6 s 2 2 D 5 / 2 31751.17 5 d 6 s (3 D)6 p 2 F° 7 / 2 return 3376.50 0.00 5 d (2 D)6 s 2 2 D 3 / 2 29607.98 5 d 6 s (1 D)6 p 2 D° 3 / 2 return 3567.84 0.00 5 d (2 D)6 s 2 2 D 3 / 2 28020.18 5 d 6 s (1 D)6 p 2 F° 5 / 2 return 3647.77 4136.00 6 s 2 (1 S)6 p 2 P° 1 / 2 31542.24 6 s 2 (1 S)6 d 2 D 3 / 2 return 3841.18 1993.92 5 d (2 D)6 s 2 2 D 5 / 2 28020.18 5 d 6 s (1 D)6 p 2 F° 5 / 2 return 4124.73 7476.35 6 s 2 (1 S)6 p 2 P° 3 / 2 31713.60 6 s 2 (1 S)6 d 2 D 5 / 2 return 4518.57 0.00 5 d (2 D)6 s 2 2 D 3 / 2 22124.70 5 d 6 s (3 D)6 p 2 D° 3 / 2 return 5135.09 1993.92 5 d (2 D)6 s 2 2 D 5 / 2 21462.35 5 d 6 s (3 D)6 p 2 D° 5 / 2 return 6004.52 7476.35 6 s 2 (1 S)6 p 2 P° 3 / 2 24125.86 6 s 2 (1 S)7 s 2 S 1 / 2 return

Persistent Lines of Neutral Rhenium (Re I)

Persistent Lines of Neutral Rhenium (Re I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2003.53 0.00 5 d 5 6 s 2 6 S 5 / 2 49895.57 16° 3 / 2 return 2017.87 0.00 5 d 5 6 s 2 6 S 5 / 2 49540.96 15° 5 / 2 return 2049.08 0.00 5 d 5 6 s 2 6 S 5 / 2 48786.35 14° 7 / 2 return 2074.70 0.00 5 d 5 6 s 2 6 S 5 / 2 48184.20 13° 7 / 2 return 2085.59 0.00 5 d 5 6 s 2 6 S 5 / 2 47932.55 5 d 6 (5 D)6 p 6 F° 7 / 2 return 2097.12 0.00 5 d 5 6 s 2 6 S 5 / 2 47669.01 12° 7 / 2 return 2167.94 0.00 5 d 5 6 s 2 6 S 5 / 2 46112.24 11° 5 / 2 return 2999.60 11754.52 5 d 6 (5 D)6 s 6 D 9 / 2 45082.63 5 d 6 (5 D)6 p 6 F° 1 1 / 2 return 3399.30 11754.52 5 d 6 (5 D)6 s 6 D 9 / 2 41163.91 10° 7 / 2 return 3424.62 11754.52 5 d 6 (5 D)6 s 6 D 9 / 2 40946.53 5 d 5 6 s (5 P)6 p 6 D° 7 / 2 return 3451.88 0.00 5 d 5 6 s 2 6 S 5 / 2 28961.55 5 d 5 6 s (7 S)6 p 6 P° 3 / 2 return 3460.46 0.00 5 d 5 6 s 2 6 S 5 / 2 28889.72 5 d 5 6 s (7 S)6 p 6 P° 7 / 2 return 3464.73 0.00 5 d 5 6 s 2 6 S 5 / 2 28854.18 5 d 5 6 s (7 S)6 p 6 P° 5 / 2 return 3725.76 23631.82 5 d 5 6 s (7 S)6 p 8 P° 9 / 2 50464.34 5 d 5 6 s (7 S)6 d e 8 D 1 1 / 2 return

Persistent Lines of Neutral Tantalum (Ta I)

Persistent Lines of Neutral Tantalum (Ta I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2559.43 0.00 5 d 3 6 s 2 4 F 3 / 2 39059.52 17° 5 / 2 return 2608.63 2010.10 5 d 3 6 s 2 4 F 5 / 2 40333.03 19° 7 / 2 return 2647.47 0.00 5 d 3 6 s 2 4 F 3 / 2 37760.67 15° 3 / 2 return 2653.27 2010.10 5 d 3 6 s 2 4 F 5 / 2 39688.20 18° 5 / 2 return 2656.61 0.00 5 d 3 6 s 2 4 F 3 / 2 37630.09 14° 5 / 2 return 2661.34 5621.04 5 d 3 6 s 2 4 F 9 / 2 43185.09 20° 1 1 / 2 return 2698.30 2010.10 5 d 3 6 s 2 4 F 5 / 2 39059.52 17° 5 / 2 return 2714.67 0.00 5 d 3 6 s 2 4 F 3 / 2 36825.97 13° 5 / 2 return 2758.31 2010.10 5 d 3 6 s 2 4 F 5 / 2 38253.39 16° 5 / 2 return 2850.49 return 2850.98 5621.04 5 d 3 6 s 2 4 F 9 / 2 40686.42 5 d 3 6 s (3 G)6 p 4 G° 9 / 2 return 2933.55 0.00 5 d 3 6 s 2 4 F 3 / 2 34078.42 10° 3 / 2 return 2963.32 2010.10 5 d 3 6 s 2 4 F 5 / 2 35746.18 11° 7 / 2 return 3311.16 5621.04 5 d 3 6 s 2 4 F 9 / 2 35813.47 12° 1 1 / 2 return 4681.88 2010.10 5 d 3 6 s 2 4 F 5 / 2 23363.09 5 d 3 6 s (5 F)6 p 4 F° 5 / 2 return 5156.56 5621.04 5 d 3 6 s 2 4 F 9 / 2 25008.83 5 d 3 6 s (5 F)6 p 6 G° 1 1 / 2 return

Persistent Lines of Neutral Thulium (Tm I)

Persistent Lines of Neutral Thulium (Tm I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3717.914 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 26889.125 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 9 / 2 return 3744.064 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 26701.325 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) 7 / 2 return 3883.132 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 25745.117 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) 5 / 2 return 3887.348 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 25717.197 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 (5, 5 / 2) 7 / 2 return 3916.477 8771.243 4 f 1 3 (2 F°)6 s 2 2 F° 5 / 2 34297.17 4 f 1 3 (2 F° 5 / 2)6 s 6 p (1 P° 1) (5 / 2 ,1) 7 / 2 return 4094.187 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 24418.018 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) (7 / 2 ,1) 5 / 2 return 4105.841 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 24348.692 4 f 1 2 (3 H 5)5 d 3 / 2 6 s 2 (5, 3 / 2) 9 / 2 return 4187.615 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 23873.207 4 f 1 2 (3 F 4)5 d 5 / 2 6 s 2 7 / 2 return 4203.727 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 23781.698 4 f 1 2 (3 F 4)5 d 5 / 2 6 s 2 (4, 5 / 2) 9 / 2 return 4359.928 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 22929.717 4 f 1 2 (3 H 5)5 d 5 / 2 6 s 2 5 / 2 return 4386.434 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 22791.176 4 f 1 2 (3 H 5)5 d 3 / 2 6 s 2 (5, 3 / 2) 7 / 2 return 4733.335 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 21120.836 4 f 1 2 (3 F 4)5 d 3 / 2 6 s 2 (4, 3 / 2) 7 / 2 return 5307.116 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 18837.385 4 f 1 2 (3 H 6)5 d 5 / 2 6 s 2 (6, 5 / 2) 9 / 2 return 5675.835 0.000 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 17613.659 4 f 1 3 (2 F° 7 / 2)6 s 6 p (3 P° 1) (7 / 2 ,1) 9 / 2 return

Persistent Lines of Neutral Tungsten (W I)

Persistent Lines of Neutral Tungsten (W I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2551.35 0.00 5 d 4 6 s 2 5 D 0 39183.20 391° 1 return 2681.42 2951.29 5 d 5 (6 S)6 s 7 S 3 40233.97 402° 4 return 2724.35 2951.29 5 d 5 (6 S)6 s 7 S 3 39646.41 396° 3 return 2831.38 2951.29 5 d 5 (6 S)6 s 7 S 3 38259.40 382° 4 return 2896.44 2951.29 5 d 5 (6 S)6 s 7 S 3 37466.30 374° 2 return 2944.40 2951.29 5 d 5 (6 S)6 s 7 S 3 36904.16 369° 2 return 2946.99 2951.29 5 d 5 (6 S)6 s 7 S 3 36874.36 368° 3 return 3215.56 6219.33 5 d 4 6 s 2 5 D 4 37309.16 373° 5 return 3617.52 2951.29 5 d 5 (6 S)6 s 7 S 3 30586.64 5 d 4 (5 D)6 s 6 p (3 P°) 5 P° 3 return 4008.75 2951.29 5 d 5 (6 S)6 s 7 S 3 27889.68 5 d 5 (6 S)6 p 7 P° 4 return 4074.36 2951.29 5 d 5 (6 S)6 s 7 S 3 27488.11 5 d 5 (6 S)6 p 7 P° 3 return 4294.61 2951.29 5 d 5 (6 S)6 s 7 S 3 26229.77 5 d 5 (6 S)6 p 7 P° 2 return 4302.11 2951.29 5 d 5 (6 S)6 s 7 S 3 26189.20 5 d 4 (5 D)6 s 6 p (3 P°) 7 D° 3 return

Persistent Lines of Neutral Ytterbium (Yb I)

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Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2464.50 0.000 4 f 1 4 (1 S)6 s 2 1 S 0 40563.97 4 f 1 4 (1 S)6 s 7 p 1 P° 1 return 2671.958 0.000 4 f 1 4 (1 S)6 s 2 1 S 0 37414.59 4 f 1 3 (2 F°)5 d 6 s 2 ° 1 return 3464.37 0.000 4 f 1 4 (1 S)6 s 2 1 S 0 28857.014 4 f 1 3 (2 F° 7 / 2)5 d 5 / 2 6 s 2 (7 / 2 , 5 / 2)° 1 return 3987.99 0.000 4 f 1 4 (1 S)6 s 2 1 S 0 25068.222 4 f 1 4 (1 S)6 s 6 p 1 P° 1 return 3990.885 19710.388 4 f 1 4 (1 S)6 s 6 p 3 P° 2 44760.37 4 f 1 4 (1 S)6 p 2 3 P 2 return 4576.209 17992.007 4 f 1 4 (1 S)6 s 6 p 3 P° 1 39838.04 4 f 1 4 (1 S)6 s 6 d 3 D 2 return 4935.500 19710.388 4 f 1 4 (1 S)6 s 6 p 3 P° 2 39966.09 4 f 1 4 (1 S)6 s 6 d 3 D 3 return 5556.466 0.000 4 f 1 4 (1 S)6 s 2 1 S 0 17992.007 4 f 1 4 (1 S)6 s 6 p 3 P° 1 return 6799.60 17992.007 4 f 1 4 (1 S)6 s 6 p 3 P° 1 32694.692 4 f 1 4 (1 S)6 s 7 s 3 S 1 return 7699.49 19710.388 4 f 1 4 (1 S)6 s 6 p 3 P° 2 32694.692 4 f 1 4 (1 S)6 s 7 s 3 S 1 return

Persistent Lines of Neutral Gold (Au I)

Persistent Lines of Neutral Gold (Au I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1646.674 0.000 5 d 1 0 6 s 2 S 1 / 2 60728.49 5 d 1 0 7 p 2 P° 3 / 2 return 1699.339 0.000 5 d 1 0 6 s 2 S 1 / 2 58845.414 5 d 9 (2 D 3 / 2)6 s 6 p (1 P° 1) (3 / 2 ,1)° 3 / 2 return 2012.00 9161.177 5 d 9 6 s 2 2 D 5 / 2 58845.414 5 d 9 (2 D 3 / 2)6 s 6 p (1 P° 1) (3 / 2 ,1)° 3 / 2 return 2021.38 9161.177 5 d 9 6 s 2 2 D 5 / 2 58616.764 5 d 9 (2 D 3 / 2)6 s 6 p (3 P° 1) (3 / 2 ,1)° 5 / 2 return 2427.95 0.000 5 d 1 0 6 s 2 S 1 / 2 41174.613 5 d 1 0 6 p 2 P° 3 / 2 return 2675.954 0.000 5 d 1 0 6 s 2 S 1 / 2 37358.991 5 d 1 0 6 p 2 P° 1 / 2 return 2748.253 9161.177 5 d 9 6 s 2 2 D 5 / 2 45537.195 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 1) (5 / 2 ,1)° 7 / 2 return 3029.204 9161.177 5 d 9 6 s 2 2 D 5 / 2 42163.530 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 0) (5 / 2 ,0)° 5 / 2 return 3122.784 9161.177 5 d 9 6 s 2 2 D 5 / 2 41174.613 5 d 1 0 6 p 2 P° 3 / 2 return 6278.170 21435.191 5 d 9 6 s 2 2 D 3 / 2 37358.991 5 d 1 0 6 p 2 P° 1 / 2 return

Persistent Lines of Neutral Iridium (Ir I)

Persistent Lines of Neutral Iridium (Ir I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2033.57 0.00 5 d 7 6 s 2 4 F 9 / 2 49158.63 2° 9 / 2 return 2088.82 0.00 5 d 7 6 s 2 4 F 9 / 2 47858.45 1° 1 1 / 2 return 2158.05 2834.99 5 d 8 (3 F)6 s 4 F 9 / 2 49158.63 2° 9 / 2 return 2372.77 0.00 5 d 7 6 s 2 4 F 9 / 2 42131.84 5 d 8 (3 F)6 p 4 G° 1 1 / 2 return 2475.12 0.00 5 d 7 6 s 2 4 F 9 / 2 40389.83 5 d 6 6 s 2 (5 D)6 p 6 F° 9 / 2 return 2502.98 0.00 5 d 7 6 s 2 4 F 9 / 2 39940.37 5 d 6 6 s 2 (5 D)6 p 6 F° 1 1 / 2 return 2543.97 2834.99 5 d 8 (3 F)6 s 4 F 9 / 2 42131.84 5 d 8 (3 F)6 p 4 G° 1 1 / 2 return 2639.71 0.00 5 d 7 6 s 2 4 F 9 / 2 37871.69 5 d 7 (4 P)6 s 6 p (3 P°) 6 D° 9 / 2 return 2664.79 0.00 5 d 7 6 s 2 4 F 9 / 2 37515.32 5 d 7 (4 P)6 s 6 p (3 P°) 6 P° 7 / 2 return 2694.23 2834.99 5 d 8 (3 F)6 s 4 F 9 / 2 39940.37 5 d 6 6 s 2 (5 D)6 p 6 F° 1 1 / 2 return 2849.72 0.00 5 d 7 6 s 2 4 F 9 / 2 35080.70 5 d 7 (4 F)6 s 6 p (3 P°) 6 G° 9 / 2 return 2924.79 0.00 5 d 7 6 s 2 4 F 9 / 2 34180.46 5 d 7 (4 F)6 s 6 p (3 P°) 6 G° 1 1 / 2 return 3220.78 2834.99 5 d 8 (3 F)6 s 4 F 9 / 2 33874.44 5 d 7 (4 F)6 s 6 p (3 P°) 6 F° 7 / 2 return 3513.64 0.00 5 d 7 6 s 2 4 F 9 / 2 28452.31 5 d 7 (4 F)6 s 6 p (3 P°) 6 F° 1 1 / 2 return

Persistent Lines of Neutral Lead (Pb I)

Persistent Lines of Neutral Lead (Pb I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2022.016 0.000 6 p 2 1 / 2 (1 / 2 , 1 / 2) 0 49439.616 6 p 3 / 2 7 s 1 / 2 (3 / 2 , 1 / 2)° 1 return 2053.284 0.000 6 p 2 1 / 2 (1 / 2 , 1 / 2) 0 48686.934 6 p 1 / 2 8 s 1 / 2 (1 / 2 , 1 / 2)° 1 return 2170.005 0.000 6 p 2 1 / 2 (1 / 2 , 1 / 2) 0 46068.438 6 p 1 / 2 6 d 2 [3 / 2]° 1 return 2393.792 10650.327 6 p 1 / 2 6 p 3 / 2 (1 / 2 , 3 / 2) 2 52412.325 6 p 1 / 2 7 d 2 [5 / 2]° 3 return 2614.175 7819.263 6 p 1 / 2 6 p 3 / 2 (1 / 2 , 3 / 2) 1 46060.836 6 p 1 / 2 6 d 2 [3 / 2]° 2 return 2801.995 10650.327 6 p 1 / 2 6 p 3 / 2 (1 / 2 , 3 / 2) 2 46328.667 6 p 1 / 2 6 d 2 [5 / 2]° 3 return 2833.053 0.000 6 p 2 1 / 2 (1 / 2 , 1 / 2) 0 35287.224 6 p 1 / 2 7 s 1 / 2 (1 / 2 , 1 / 2)° 1 return 3639.568 7819.263 6 p 1 / 2 6 p 3 / 2 (1 / 2 , 3 / 2) 1 35287.224 6 p 1 / 2 7 s 1 / 2 (1 / 2 , 1 / 2)° 1 return 3683.462 7819.263 6 p 1 / 2 6 p 3 / 2 (1 / 2 , 3 / 2) 1 34959.908 6 p 1 / 2 7 s 1 / 2 (1 / 2 , 1 / 2)° 0 return 3739.935 21457.798 6 p 2 3 / 2 (3 / 2 , 3 / 2) 2 48188.630 6 p 3 / 2 7 s 1 / 2 (3 / 2 , 1 / 2)° 2 return 4057.807 10650.327 6 p 1 / 2 6 p 3 / 2 (1 / 2 , 3 / 2) 2 35287.224 6 p 1 / 2 7 s 1 / 2 (1 / 2 , 1 / 2)° 1 return 4062.136 21457.798 6 p 2 3 / 2 (3 / 2 , 3 / 2) 2 46068.438 6 p 1 / 2 6 d 2 [3 / 2]° 1 return

Persistent Lines of Neutral Mercury (Hg I)

Persistent Lines of Neutral Mercury (Hg I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1849.499 0.000 5 d 1 0 (1 S)6 s 2 1 S 0 54068.781 5 d 1 0 (1 S)6 s 6 p 1 P° 1 return 2536.517 0.000 5 d 1 0 (1 S)6 s 2 1 S 0 39412.300 5 d 1 0 (1 S)6 s 6 p 3 P° 1 return 2967.280 37645.080 5 d 1 0 (1 S)6 s 6 p 3 P° 0 71336.164 5 d 1 0 (1 S)6 s 6 d (1 / 2 , 3 / 2) 1 return 3650.153 44042.977 5 d 1 0 (1 S)6 s 6 p 3 P° 2 71431.311 5 d 1 0 (1 S)6 s 6 d (1 / 2 , 5 / 2) 3 return 4046.563 37645.080 5 d 1 0 (1 S)6 s 6 p 3 P° 0 62350.456 5 d 1 0 (1 S)6 s 7 s 3 S 1 return 4358.328 39412.300 5 d 1 0 (1 S)6 s 6 p 3 P° 1 62350.456 5 d 1 0 (1 S)6 s 7 s 3 S 1 return 5460.735 44042.977 5 d 1 0 (1 S)6 s 6 p 3 P° 2 62350.456 5 d 1 0 (1 S)6 s 7 s 3 S 1 return 10139.76 54068.781 5 d 1 0 (1 S)6 s 6 p 1 P° 1 63928.243 5 d 1 0 (1 S)6 s 7 s 1 S 0 return

Persistent Lines of Neutral Osmium (Os I)

Persistent Lines of Neutral Osmium (Os I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2018.14 0.00 5 d 6 6 s 2 5 D 4 49534.28 ° 5 return 2034.44 0.00 5 d 6 6 s 2 5 D 4 49138.11 ° 3 return 2045.36 0.00 5 d 6 6 s 2 5 D 4 48874.93 ° 3 return 2079.97 0.00 5 d 6 6 s 2 5 D 4 48062.22 ° 5 return 2637.13 0.00 5 d 6 6 s 2 5 D 4 37908.77 5 d 6 6 s (4 D)6 p 5 D° 4 return 2714.64 0.00 5 d 6 6 s 2 5 D 4 36826.39 5 d 6 6 s (6 D)6 p 5 D° 4 return 2806.91 0.00 5 d 6 6 s 2 5 D 4 35615.92 5 d 6 6 s (6 D)6 p 5 P° 3 return 2838.63 5143.92 5 d 7 (4 F)6 s 5 F 5 40361.92 5 d 6 6 s (4 D)6 p 3 F° 4 return 2909.06 0.00 5 d 6 6 s 2 5 D 4 34365.33 5 d 6 6 s (6 D)6 p 5 F° 5 return 3018.04 0.00 5 d 6 6 s 2 5 D 4 33124.48 5 d 6 6 s (6 D)6 p 7 P° 3 return 3058.66 0.00 5 d 6 6 s 2 5 D 4 32684.61 5 d 6 6 s (6 D)6 p 7 F° 4 return 3058.66 14091.37 5 d 7 (4 F)6 s 3 F 3 46776.29 5 d 7 (4 F)6 p 3 D° 3 return 3262.29 4159.32 5 d 6 6 s 2 5 D 3 34803.82 5 d 6 6 s (6 D)6 p 5 F° 4 return 3267.94 0.00 5 d 6 6 s 2 5 D 4 30591.45 5 d 6 6 s (6 D)6 p 7 P° 4 return 3301.56 0.00 5 d 6 6 s 2 5 D 4 30279.95 5 d 6 6 s (6 D)6 p 7 F° 5 return 3782.20 4159.32 5 d 6 6 s 2 5 D 3 30591.45 5 d 6 6 s (6 D)6 p 7 P° 4 return 4260.85 0.00 5 d 6 6 s 2 5 D 4 23462.90 5 d 6 6 s (6 D)6 p 7 D° 5 return 4420.47 0.00 5 d 6 6 s 2 5 D 4 22615.69 5 d 6 6 s (6 D)6 p 7 D° 4 return

Persistent Lines of Neutral Platinum (Pt I)

Persistent Lines of Neutral Platinum (Pt I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2487.1685 775.892 5 d 9 6 s 1 D 2 40970.165 5 d 8 (3 F)6 s 6 p (3 P°) 5 G° 3 return 2487.1685 0.000 5 d 9 6 s 3 D 3 40194.228 5 d 8 (3 F)6 s 6 p (3 P°) 5 F° 4 return 2628.0269 775.892 5 d 9 6 s 1 D 2 38815.908 5 d 8 (1 D)6 s 6 p (3 P°) 3 F° 2 return 2650.8524 823.678 5 d 8 6 s 2 3 F 4 38536.160 5 d 8 (3 F)6 s 6 p (3 P°) 5 G° 5 return 2659.4503 0.000 5 d 9 6 s 3 D 3 37590.569 5 d 9 6 p 3 F° 4 return 2702.3995 775.892 5 d 9 6 s 1 D 2 37769.073 5 d 9 6 p 3 D° 3 return 2705.8951 823.678 5 d 8 6 s 2 3 F 4 37769.073 5 d 9 6 p 3 D° 3 return 2733.9567 775.892 5 d 9 6 s 1 D 2 37342.101 5 d 9 6 p 3 P° 2 return 2830.2919 0.000 5 d 9 6 s 3 D 3 35321.653 5 d 8 (3 F)6 s 6 p (3 P°) 5 D° 3 return 2893.8630 775.892 5 d 9 6 s 1 D 2 35321.653 5 d 8 (3 F)6 s 6 p (3 P°) 5 D° 3 return 2929.7894 0.000 5 d 9 6 s 3 D 3 34122.165 5 d 9 6 p 3 F° 3 return 2997.9622 775.892 5 d 9 6 s 1 D 2 34122.165 5 d 9 6 p 3 F° 3 return 3042.6318 823.678 5 d 8 6 s 2 3 F 4 33680.402 5 d 8 (3 F)6 s 6 p (3 P°) 5 F° 5 return 3064.7110 0.000 5 d 9 6 s 3 D 3 32620.018 5 d 9 6 p 3 P° 2 return 3301.8596 6567.461 5 d 9 6 s 3 D 2 36844.710 5 d 9 6 p 3 P° 1 return 3315.0419 0.000 5 d 9 6 s 3 D 3 30156.854 5 d 8 (3 F)6 s 6 p (3 P°) 5 D° 4 return 3408.1308 823.678 5 d 8 6 s 2 3 F 4 30156.854 5 d 8 (3 F)6 s 6 p (3 P°) 5 D° 4 return 3818.6874 10116.729 5 d 8 6 s 2 3 F 3 36296.310 5 d 8 (3 F)6 s 6 p (3 P°) 5 G° 4 return

Persistent Lines of Neutral Thallium (Tl I)

Persistent Lines of Neutral Thallium (Tl I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2379.69 0.0 5 d 1 0 6 s 2 6 p 2 P° 1 / 2 42011.4 5 d 1 0 6 s 2 7 d 2 D 3 / 2 return 2580.14 0.0 5 d 1 0 6 s 2 6 p 2 P° 1 / 2 38745.9 5 d 1 0 6 s 2 8 s 2 S 1 / 2 return 2767.87 0.0 5 d 1 0 6 s 2 6 p 2 P° 1 / 2 36117.9 5 d 1 0 6 s 2 6 d 2 D 3 / 2 return 2918.32 7792.7 5 d 1 0 6 s 2 6 p 2 P° 3 / 2 42049.0 5 d 1 0 6 s 2 7 d 2 D 5 / 2 return 3229.75 7792.7 5 d 1 0 6 s 2 6 p 2 P° 3 / 2 38745.9 5 d 1 0 6 s 2 8 s 2 S 1 / 2 return 3519.24 7792.7 5 d 1 0 6 s 2 6 p 2 P° 3 / 2 36199.9 5 d 1 0 6 s 2 6 d 2 D 5 / 2 return 3529.43 7792.7 5 d 1 0 6 s 2 6 p 2 P° 3 / 2 36117.9 5 d 1 0 6 s 2 6 d 2 D 3 / 2 return 3775.72 0.0 5 d 1 0 6 s 2 6 p 2 P° 1 / 2 26477.5 5 d 1 0 6 s 2 7 s 2 S 1 / 2 return 5350.46 7792.7 5 d 1 0 6 s 2 6 p 2 P° 3 / 2 26477.5 5 d 1 0 6 s 2 7 s 2 S 1 / 2 return 11512.82 26477.5 5 d 1 0 6 s 2 7 s 2 S 1 / 2 35161.1 5 d 1 0 6 s 2 7 p 2 P° 3 / 2 return 13013.2 26477.5 5 d 1 0 6 s 2 7 s 2 S 1 / 2 34159.9 5 d 1 0 6 s 2 7 p 2 P° 1 / 2 return

Persistent Lines of Neutral Actinium (Ac I)

Persistent Lines of Neutral Actinium (Ac I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3885.56 0.00 6 d 7 s 2 2 D 3 / 2 25729.03 6 d 7 s (3 D)7 p 2 P° 1 / 2 return 4179.98 0.00 6 d 7 s 2 2 D 3 / 2 23916.84 6 d 7 s (3 D)7 p 2 F° 5 / 2 return 4183.12 0.00 6 d 7 s 2 2 D 3 / 2 23898.86 6 d 7 s (3 D)7 p 4 P° 5 / 2 return 4194.40 2231.43 6 d 7 s 2 2 D 5 / 2 26066.04 6 d 7 s (1 D)7 p 2 D° 3 / 2 return 4384.53 0.00 6 d 7 s 2 2 D 3 / 2 22801.10 6 d 7 s (3 D)7 p 4 P° 3 / 2 return 4396.71 2231.43 6 d 7 s 2 2 D 5 / 2 24969.30 6 d 7 s (3 D)7 p 2 F° 7 / 2 return 4462.73 0.00 6 d 7 s 2 2 D 3 / 2 22401.52 6 d 7 s (3 D)7 p 4 P° 1 / 2 return 4613.93 2231.43 6 d 7 s 2 2 D 5 / 2 23898.86 6 d 7 s (3 D)7 p 4 P° 5 / 2 return 4716.58 0.00 6 d 7 s 2 2 D 3 / 2 21195.87 6 d 7 s (3 D)7 p 4 D° 5 / 2 return 5258.24 0.00 6 d 7 s 2 2 D 3 / 2 19012.46 6 d 7 s (3 D)7 p 4 D° 3 / 2 return 6359.86 2231.43 6 d 7 s 2 2 D 5 / 2 17950.71 6 d 7 s (3 D)7 p 2 D° 5 / 2 return 6691.27 0.00 6 d 7 s 2 2 D 3 / 2 14940.72 6 d 7 s (3 D)7 p 4 F° 5 / 2 return 7290.40 0.00 6 d 7 s 2 2 D 3 / 2 13712.90 6 d 7 s (3 D)7 p 4 F° 3 / 2 return

Persistent Lines of Neutral Astatine (At I)

Persistent Lines of Neutral Astatine (At I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2162.25 0.0 6 p 5 2 P° 3 / 2 46233.6 ? 6 p 4 (3 P)7 s 4 P 3 / 2 return 2244.01 0.0 6 p 5 2 P° 3 / 2 44549.3 ? 6 p 4 (3 P)7 s 4 P 5 / 2 return

Persistent Lines of Neutral Bismuth (Bi I)

Persistent Lines of Neutral Bismuth (Bi I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1954.706 0.000 6 p 3 4 S° 3 / 2 51158.494 6 p 2 (3 P 0)7 d 2 [2] 5 / 2 return 1960.049 0.000 6 p 3 4 S° 3 / 2 51019.090 6 p 2 (3 P 0)7 d 2 [2] 3 / 2 return 2021.149 0.000 6 p 3 4 S° 3 / 2 49460.910 6 p 2 (3 P 2)7 s 2 [2] 3 / 2 return 2061.634 0.000 6 p 3 4 S° 3 / 2 48489.869 6 p 2 (3 P 2)7 s 2 [2] 5 / 2 return 2110.217 0.000 6 p 3 4 S° 3 / 2 47373.477 6 p 2 (3 P 0)8 s 2 [0] 1 / 2 return 2228.203 0.000 6 p 3 4 S° 3 / 2 44865.076 6 p 2 (3 P 1)7 s 2 [1] 3 / 2 return 2230.602 0.000 6 p 3 4 S° 3 / 2 44816.841 6 p 2 (3 P 0)6 d 2 [2] 5 / 2 return 2897.965 11419.039 6 p 3 2 D° 3 / 2 45915.883 6 p 2 (3 P 1)7 s 2 [1] 1 / 2 return 2938.297 15437.501 6 p 3 2 D° 5 / 2 49460.910 6 p 2 (3 P 2)7 s 2 [2] 3 / 2 return 2989.019 11419.039 6 p 3 2 D° 3 / 2 44865.076 6 p 2 (3 P 1)7 s 2 [1] 3 / 2 return 2993.336 11419.039 6 p 3 2 D° 3 / 2 44816.841 6 p 2 (3 P 0)6 d 2 [2] 5 / 2 return 3024.621 15437.501 6 p 3 2 D° 5 / 2 48489.869 6 p 2 (3 P 2)7 s 2 [2] 5 / 2 return 3067.700 0.000 6 p 3 4 S° 3 / 2 32588.221 6 p 2 (3 P 0)7 s 2 [0] 1 / 2 return 4722.527 11419.039 6 p 3 2 D° 3 / 2 32588.221 6 p 2 (3 P 0)7 s 2 [0] 1 / 2 return 9657.04 32588.221 6 p 2 (3 P 0)7 s 2 [0] 1 / 2 42940.519 6 p 2 (3 P 0)7 p 2 [1]° 3 / 2 return 11710.83 32588.221 6 p 2 (3 P 0)7 s 2 [0] 1 / 2 41124.985 6 p 2 (3 P 0)7 p 2 [1]° 1 / 2 return

Persistent Lines of Neutral Francium (Fr I)

Persistent Lines of Neutral Francium (Fr I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4225.655 0.000 7 s 2 S 1 / 2 23658.306 8 p 2 P 3 / 2 return 4325.361 0.000 7 s 2 S 1 / 2 23112.960 8 p 2 P° 1 / 2 return 7179.866 0.000 7 s 2 S 1 / 2 13923.998 7 p 2 P° 3 / 2 return 8169.418 0.000 7 s 2 S 1 / 2 12237.409 7 p 2 P° 1 / 2 return

Persistent Lines of Neutral Polonium (Po I)

Persistent Lines of Neutral Polonium (Po I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2450.08 0.00 6 p 4 3 P 2 40802.70 6 p 3 (4 S°)7 s 3 S° 1 return 2558.01 0.00 6 p 4 3 P 2 39081.19 6 p 3 (4 S°)7 s 5 S° 2 return 3003.21 7514.69 6 p 4 3 P 0 40802.70 6 p 3 (4 S°)7 s 3 S° 1 return 4170.52 16831.61 6 p 4 3 P 1 40802.70 6 p 3 (4 S°)7 s 3 S° 1 return

Persistent Lines of Neutral Protactinium (Pa I)

Persistent Lines of Neutral Protactinium (Pa I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3636.52 825.415 5 f 2 (3 H)6 d 7 s 2 4 I 9 / 2 28316.365 ° 9 / 2 return 3982.23 0.000 5 f 2 (3 H)6 d 7 s 2 4 K 1 1 / 2 25104.455 ° 1 1 / 2 return 6945.72 0.000 5 f 2 (3 H)6 d 7 s 2 4 K 1 1 / 2 14393.410 5 f 2 6 d 7 s 7 p 6 L° 1 1 / 2 return 7114.89 825.415 5 f 2 (3 H)6 d 7 s 2 4 I 9 / 2 14876.545 ° 9 / 2 return 7368.25 825.415 5 f 2 (3 H)6 d 7 s 2 4 I 9 / 2 14393.410 5 f 2 6 d 7 s 7 p 6 L° 1 1 / 2 return 7493.15 3323.860 5 f 2 (3 H)6 d 7 s 2 9 / 2 16665.690 ° 7 / 2 return 7608.20 3323.860 5 f 2 (3 H)6 d 7 s 2 9 / 2 16463.970 ° 9 / 2 return 7626.79 3711.625 5 f 2 (3 H)6 d 7 s 2 4 K 1 3 / 2 16819.670 ° 1 1 / 2 return 7635.18 7512.695 5 f 2 (3 H)6 d 7 s 2 4 K 1 5 / 2 20606.365 ° 1 3 / 2 return 7669.34 4121.450 5 f 2 (3 H)6 d 7 s 2 4 I 1 1 / 2 17156.785 5 f 2 6 d 7 s 7 p 6 K° 1 1 / 2 return 7749.19 1618.325 5 f 2 6 d 7 s 2 a 4 G 5 / 2 14519.355 ° 5 / 2 return 8039.34 3711.625 5 f 2 (3 H)6 d 7 s 2 4 K 1 3 / 2 16147.025 5 f 3 7 s 2 4 I° 1 1 / 2 return 8099.84 4121.450 5 f 2 (3 H)6 d 7 s 2 4 I 1 1 / 2 16463.970 ° 9 / 2 return 8199.04 825.415 5 f 2 (3 H)6 d 7 s 2 4 I 9 / 2 13018.610 5 f 3 7 s 2 4 I° 9 / 2 return 8271.87 825.415 5 f 2 (3 H)6 d 7 s 2 4 I 9 / 2 12911.260 ° 7 / 2 return 8532.66 2966.530 5 f 2 6 d 7 s 2 a 4 H 7 / 2 14683.005 ° 5 / 2 return 8572.96 7000.290 5 f 2 (3 H)6 d 2 (3 F)(5 L)7 s 6 L 1 1 / 2 18661.700 ° 9 / 2 return 8735.27 0.000 5 f 2 (3 H)6 d 7 s 2 4 K 1 1 / 2 11444.705 5 f 2 7 s 2 7 p 1 / 2 (4, 1 / 2)° 9 / 2 return 11791.73 2966.530 5 f 2 6 d 7 s 2 a 4 H 7 / 2 11444.705 5 f 2 7 s 2 7 p 1 / 2 (4, 1 / 2)° 9 / 2 return 13522.40 7000.290 5 f 2 (3 H)6 d 2 (3 F)(5 L)7 s 6 L 1 1 / 2 14393.410 5 f 2 6 d 7 s 7 p 6 L° 1 1 / 2 return 14344.76 5149.465 5 f 2 6 d 7 s 2 b 4 H 7 / 2 12118.750 5 f 2 7 s 2 7 p 1 / 2 (4, 1 / 2)° 7 / 2 return

Persistent Lines of Neutral Radium (Ra I)

Persistent Lines of Neutral Radium (Ra I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4825.91 0.00 7 s 2 1 S 0 20715.71 7 s 7 p 1 P° 1 return 5660.81 14707.35 7 s 6 d 3 D 3 32367.78 6 d 7 p 3 F° 4 return 6200.30 13993.97 7 s 6 d 3 D 2 30117.78 6 d 7 p 3 F° 3 return 7141.21 0.00 7 s 2 1 S 0 13999.38 7 s 7 p 3 P° 1 return

Persistent Lines of Neutral Radon (Rn I)

Persistent Lines of Neutral Radon (Rn I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1451.56 0.0 6 p 6 1 S 0 68891.34 6 p 5 (2 P° 3 / 2)6 d 2 [1 / 2]° 1 return 1786.07 0.0 6 p 6 1 S 0 55989.03 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 1 return 4349.60 54620.35 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 77604.53 6 p 5 (2 P° 3 / 2)8 p 2 [5 / 2] 3 return 7055.42 54620.35 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 68789.93 6 p 5 (2 P° 3 / 2)7 p 2 [3 / 2] 2 return 7268.11 55989.03 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 1 69743.98 6 p 5 (2 P° 3 / 2)7 p 2 [1 / 2] 0 return 7450.00 54620.35 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 68039.48 6 p 5 (2 P° 3 / 2)7 p 2 [5 / 2] 3 return 7809.82 55989.03 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 1 68789.93 6 p 5 (2 P° 3 / 2)7 p 2 [3 / 2] 2 return 8099.51 55989.03 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 1 68332.10 6 p 5 (2 P° 3 / 2)7 p 2 [3 / 2] 1 return 8270.96 54620.35 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 66707.53 6 p 5 (2 P° 3 / 2)7 p 2 [5 / 2] 2 return 8600.07 54620.35 6 p 5 (2 P° 3 / 2)7 s 2 [3 / 2]° 2 66244.97 6 p 5 (2 P° 3 / 2)7 p 2 [1 / 2] 1 return

Persistent Lines of Neutral Thorium (Th I)

Persistent Lines of Neutral Thorium (Th I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3304.2383 0.000 6 d 2 7 s 2 3 F 2 30255.452 ° 3 return 3348.7684 0.000 6 d 2 7 s 2 3 F 2 29853.143 ° 2 return 3421.2100 4961.659 6 d 2 7 s 2 3 F 4 34182.708 ° 5 return 3706.7672 8111.005 6 d 2 7 s 2 1 G 4 35081.017 ° 5 return 3719.4347 0.000 6 d 2 7 s 2 3 F 2 26878.162 6 d 2 7 s 7 p 3 G° 3 return 3803.0750 0.000 6 d 2 7 s 2 3 F 2 26287.049 6 d 2 7 s 7 p 3 D° 1 return 3828.3846 0.000 6 d 2 7 s 2 3 F 2 26113.270 ° 2 return 3895.4192 7795.275 5 f 6 d 7 s 2 3 H° 4 33459.180 5 f 6 d 7 s 7 p 3 H 4 return 3967.3921 4961.659 6 d 2 7 s 2 3 F 4 30160.003 ° 4 return 4012.4952 2869.259 6 d 2 7 s 2 3 F 3 27784.366 ° 2 return 4112.7545 0.000 6 d 2 7 s 2 3 F 2 24307.749 ° 2 return 4115.7589 5563.142 6 d 3 (4 F)7 s 5 F 1 29853.143 ° 2 return 5067.9737 7795.275 5 f 6 d 7 s 2 3 H° 4 27521.527 4 return 5231.1597 2558.057 6 d 2 7 s 2 3 P 0 21668.956 6 d 2 7 s 7 p 5 P° 1 return 5760.5508 0.000 6 d 2 7 s 2 3 F 2 17354.639 5 f 6 d 7 s 2 3 D° 1 return 6169.8221 4961.659 6 d 2 7 s 2 3 F 4 21165.096 5 f 6 d 7 s 2 3 D° 3 return 6457.2824 7795.275 5 f 6 d 7 s 2 3 H° 4 23277.387 5 f 6 d 7 s 7 p 5 I 5 return 6989.6553 7795.275 5 f 6 d 7 s 2 3 H° 4 22098.187 5 f 6 d 7 s 7 p 5 I 4 return 8967.6403 8800.251 6 d 3 (4 F)7 s 5 F 4 19948.395 6 d 2 7 s 7 p 5 F° 4 return

Persistent Lines of Neutral Uranium (U I)

Persistent Lines of Neutral Uranium (U I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3489.3672 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 28650.294 5 return 3514.6107 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 28444.517 5 return 3561.8038 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 28067.646 5 return 3566.5909 620.323 5 f 3 (4 I°)6 d 7 s 2 5 K° 5 28650.294 5 return 3584.8774 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 27886.995 5 f 3 6 d 2 7 p 7 N 7 return 3659.1548 620.323 5 f 3 (4 I°)6 d 7 s 2 5 K° 5 27941.253 6 return 3811.9911 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 26225.569 6 return 3839.6255 3800.829 5 f 3 (4 I°)6 d 7 s 2 5 L° 7 29837.643 7 return 3871.0353 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 25825.565 6 return 3943.8161 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 25348.977 6 return 4042.7496 620.323 5 f 3 (4 I°)6 d 7 s 2 5 K° 5 25348.977 6 return 4153.9710 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 24066.566 7 return 4156.6483 620.323 5 f 3 (4 I°)6 d 7 s 2 5 K° 5 24671.388 6 return 4355.7400 620.323 5 f 3 (4 I°)6 d 7 s 2 5 K° 5 23572.086 6 return 4362.0510 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 22918.553 5 f 3 6 d 7 s 7 p 5 L 7 return 5915.385 0.000 5 f 3 (4 I°)6 d 7 s 2 5 L° 6 16900.386 5 f 3 6 d 7 s 7 p 7 M 7 return

Persistent Lines of Neutral Americium (Am I)

Persistent Lines of Neutral Americium (Am I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3510.127 0.00 5 f 7 (8 S°)7 s 2 8 S° 7 / 2 28480.87 5 f 7 (8 S° 7 / 2)7 s 7 p (1 P 1) (7 / 2 ,1) 9 / 2 return 3569.163 0.00 5 f 7 (8 S°)7 s 2 8 S° 7 / 2 28009.81 5 f 7 (8 S° 7 / 2)7 s 7 p (1 P 1) (7 / 2 ,1) 7 / 2 return 3673.121 0.00 5 f 7 (8 S°)7 s 2 8 S° 7 / 2 27217.14 5 f 7 (8 S° 7 / 2)7 s 7 p (1 P 1) (7 / 2 ,1) 5 / 2 return 4289.258 0.00 5 f 7 (8 S°)7 s 2 8 S° 7 / 2 23307.41 9 / 2 return 4662.790 0.00 5 f 7 (8 S°)7 s 2 8 S° 7 / 2 21440.37 5 f 7 (8 S° 7 / 2)7 s 7 p (3 P 2) (7 / 2 ,2) 7 / 2 return 6054.64 0.00 5 f 7 (8 S°)7 s 2 8 S° 7 / 2 16511.82 5 f 7 (8 S° 7 / 2)7 s 7 p (3 P 1) (7 / 2 ,1) 9 / 2 return

Persistent Lines of Neutral Berkelium (Bk I)

Persistent Lines of Neutral Berkelium (Bk I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3288.750 5416.690 5 f 9 7 s 2 6 F° 1 1 / 2 35814.60 1 3 / 2 return 3289.347 return 3426.951 0.000 5 f 9 7 s 2 6 H° 1 5 / 2 29172.103 5 f 9 (6 H° 1 3 / 2)7 s 7 p (3 P° 2) (1 3 / 2 ,2) 1 7 / 2 return 3442.664 0.000 5 f 9 7 s 2 6 H° 1 5 / 2 29038.930 5 f 9 (6 H° 1 3 / 2)7 s 7 p (3 P° 2) (1 3 / 2 ,2) 1 5 / 2 return 3609.614 0.000 5 f 9 7 s 2 6 H° 1 5 / 2 27695.870 1 5 / 2 return 4363.636 0.000 5 f 9 7 s 2 6 H° 1 5 / 2 22910.225 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 2) (1 5 / 2 ,2) 1 5 / 2 return 4466.457 0.000 5 f 9 7 s 2 6 H° 1 5 / 2 22382.830 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 2) (1 5 / 2 ,2) 1 7 / 2 return 5212.53 0.000 5 f 9 7 s 2 6 H° 1 5 / 2 19179.210 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 1) (1 5 / 2 ,1) 1 5 / 2 return 5271.95 6530.720 5 f 9 7 s 2 6 H° 1 3 / 2 25493.793 1 3 / 2 return 5659.03 0.000 5 f 9 7 s 2 6 H° 1 5 / 2 17665.980 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 1) (1 5 / 2 ,1) 1 7 / 2 return 5910.71 0.000 5 f 9 7 s 2 6 H° 1 5 / 2 16913.770 5 f 9 (6 H° 1 5 / 2)7 s 7 p (3 P° 0) (1 5 / 2 ,0) 1 5 / 2 return 11293.14 9141.115 5 f 8 6 d 7 s 2 8 G 1 3 / 2 17993.628 5 f 8 (7 F 6)7 s 2 7 p 1 / 2 (6, 1 / 2)° 1 3 / 2 return 11500.30 9300.585 5 f 8 6 d 7 s 2 8 D 1 1 / 2 17993.628 5 f 8 (7 F 6)7 s 2 7 p 1 / 2 (6, 1 / 2)° 1 3 / 2 return 11793.09 9300.585 5 f 8 6 d 7 s 2 8 D 1 1 / 2 17777.808 5 f 8 (7 F 6)7 s 2 7 p 1 / 2 (6, 1 / 2)° 1 1 / 2 return

Persistent Lines of Neutral Californium (Cf I)

Persistent Lines of Neutral Californium (Cf I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3298.14 0.000 5 f 1 0 7 s 2 5 I 8 30311.400 ° 7 return 3352.71 0.000 5 f 1 0 7 s 2 5 I 8 29818.055 5 f 9 6 d 7 s 2 ° 8 return 3598.77 0.000 5 f 1 0 7 s 2 5 I 8 27779.345 5 f 1 0 (5 I 8)7 s 7 p (1 P° 1) (8,1)° 9 return 4329.03 0.000 5 f 1 0 7 s 2 5 I 8 23093.355 5 f 1 0 (5 I 8)7 s 7 p (1 P° 2) (8,2)° 9 return 5408.88 0.000 5 f 1 0 7 s 2 5 I 8 18483.060 5 f 1 0 (5 I 8)7 s 7 p (3 P° 1) (8,1)° 9 return 8141.29 19907.460 5 f 9 (6 H° 1 5 / 2)6 d 3 / 2 7 s 2 (1 5 / 2 , 3 / 2)° 9 32187.145 5 f 9 (6 H° 1 5 / 2)7 s 2 7 p 3 / 2 (1 5 / 2 , 3 / 2) 9 return 11941.33 16909.535 5 f 9 (6 H° 1 5 / 2)6 d 3 / 2 7 s 2 (1 5 / 2 , 3 / 2)° 8 25281.530 5 f 9 (6 H° 1 5 / 2)7 s 2 7 p 1 / 2 (1 5 / 2 , 1 / 2) 8 return 12787.41 16909.535 5 f 9 (6 H° 1 5 / 2)6 d 3 / 2 7 s 2 (1 5 / 2 , 3 / 2)° 8 24727.600 5 f 9 (6 H° 1 5 / 2)7 s 2 7 p 1 / 2 (1 5 / 2 , 1 / 2) 7 return

Persistent Lines of Neutral Curium (Cm I)

Persistent Lines of Neutral Curium (Cm I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3109.690 1214.203 5 f 8 7 s 2 7 F 6 33362.424 5 f 7 6 d 7 s 2 ° 6 return 3116.411 0.000 5 f 7 6 d 7 s 2 9 D° 2 32078.886 5 f 7 6 d 7 s 7 p 5 P 2 return 3224.226 1764.268 5 f 7 6 d 7 s 2 9 D° 5 32770.516 5 f 7 6 d 7 s 7 p 4 return 3225.108 1764.268 5 f 7 6 d 7 s 2 9 D° 5 32762.036 5 f 7 6 d 7 s 7 p 6 return 3304.849 1214.203 5 f 8 7 s 2 7 F 6 31464.053 ° 7 return 3452.922 3809.355 5 f 7 6 d 7 s 2 9 D° 6 32762.036 5 f 7 6 d 7 s 7 p 6 return 3458.338 1214.203 5 f 8 7 s 2 7 F 6 30121.545 ° 5 return 3816.304 1214.203 5 f 8 7 s 2 7 F 6 27410.123 ° 7 return 3936.666 1214.203 5 f 8 7 s 2 7 F 6 26609.213 5 f 8 ()7 s 7 p (1 P° 1) (6,1)° 7 return 3995.100 0.000 5 f 7 6 d 7 s 2 9 D° 2 25023.578 5 f 7 6 d 7 s 7 p 7 D 3 return 4211.62 1214.203 5 f 8 7 s 2 7 F 6 24951.328 5 f 7 6 d 2 7 s 9 F° 7 return 4330.82 0.000 5 f 7 6 d 7 s 2 9 D° 2 23083.822 5 f 7 6 d 7 s 7 p 9 D 3 return 4459.16 1214.203 5 f 8 7 s 2 7 F 6 23633.638 5 f 8 ()7 s 7 p (3 P° 2) (6,2)° 6 return 4608.40 1214.203 5 f 8 7 s 2 7 F 6 22907.611 5 f 8 ()7 s 7 p (3 P° 2) (6,2)° 7 return 5952.41 1214.203 5 f 8 7 s 2 7 F 6 18009.483 5 f 8 (7 F 6)7 s 7 p (3 P° 1) (6,1)° 7 return 6376.71 0.000 5 f 7 6 d 7 s 2 9 D° 2 15677.750 5 f 7 6 d 7 s 7 p 1 1 F 3 return 6706.85 815.655 5 f 7 6 d 7 s 2 9 D° 4 15721.679 5 f 7 (8 S°)7 s 2 7 p (7 / 2 , 3 / 2) 5 return 7162.69 1764.268 5 f 7 6 d 7 s 2 9 D° 5 15721.679 5 f 7 (8 S°)7 s 2 7 p (7 / 2 , 3 / 2) 5 return 7720.47 9064.880 5 f 7 6 d 7 s 2 7 D° 5 22013.913 5 f 7 6 d 7 s 7 p 9 F 5 return 8392.37 3809.355 5 f 7 6 d 7 s 2 9 D° 6 15721.679 5 f 7 (8 S°)7 s 2 7 p (7 / 2 , 3 / 2) 5 return 10542.98 302.153 5 f 7 6 d 7 s 2 9 D° 3 9784.543 5 f 7 (8 S°)7 s 2 7 p (7 / 2 , 1 / 2) 4 return 10792.25 0.000 5 f 7 6 d 7 s 2 9 D° 2 9263.374 5 f 7 (8 S°)7 s 2 7 p (7 / 2 , 1 / 2) 3 return

Persistent Lines of Neutral Einsteinium (Es I)

Persistent Lines of Neutral Einsteinium (Es I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3428.48 0.00 5 f 1 1 7 s 2 4 I° 1 5 / 2 29159.28 1 5 / 2 , 1 7 / 2 return 3498.11 0.00 5 f 1 1 7 s 2 4 I° 1 5 / 2 28578.60 5 f 1 0 6 d 7 s 2 1 5 / 2 , 1 7 / 2 return 3514.33 0.00 5 f 1 1 7 s 2 4 I° 1 5 / 2 28447.02 5 f 1 1 7 s 7 p 1 3 / 2 return 3521.38 10244.29 5 f 1 1 7 s 2 ° 1 3 / 2 38634.04 1 1 / 2 return 3523.49 0.00 5 f 1 1 7 s 2 4 I° 1 5 / 2 28372.78 5 f 1 0 6 d 7 s 2 1 3 / 2 , 1 5 / 2 , 1 7 / 2 return 3555.34 0.00 5 f 1 1 7 s 2 4 I° 1 5 / 2 28118.65 5 f 1 0 6 d 7 s 2 1 3 / 2 return 3801.49 7894.54 5 f 1 1 7 s 2 4 F° 9 / 2 34192.6 9 / 2 return 5161.74 0.00 5 f 1 1 7 s 2 4 I° 1 5 / 2 19367.85 5 f 1 0 6 d 7 s 2 6 I 1 7 / 2 return 5204.40 0.00 5 f 1 1 7 s 2 4 I° 1 5 / 2 19209.15 5 f 1 1 7 s 7 p 6 I 1 7 / 2 return 5615.51 0.00 5 f 1 1 7 s 2 4 I° 1 5 / 2 17803.09 5 f 1 1 7 s 7 p 6 I 1 5 / 2 return

Persistent Lines of Neutral Neptunium (Np I)

Persistent Lines of Neutral Neptunium (Np I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3481.93 0.000 5 f 4 (5 I)6 d 7 s 2 6 L 1 1 / 2 28711.465 ° 1 3 / 2 return 3501.50 0.000 5 f 4 (5 I)6 d 7 s 2 6 L 1 1 / 2 28551.035 ° 1 3 / 2 return 3986.89 0.000 5 f 4 (5 I)6 d 7 s 2 6 L 1 1 / 2 25075.145 ° 1 3 / 2 return 5044.66 2033.965 5 f 4 (5 I)6 d 7 s 2 6 K 9 / 2 21851.300 ° 9 / 2 return 5878.04 0.000 5 f 4 (5 I)6 d 7 s 2 6 L 1 1 / 2 17007.700 5 f 4 6 d 7 s 7 p 6 M° 1 3 / 2 return 6930.31 2033.965 5 f 4 (5 I)6 d 7 s 2 6 K 9 / 2 16459.340 5 f 4 (5 I)6 d 7 s 7 p 8 L° 9 / 2 return 6972.09 0.000 5 f 4 (5 I)6 d 7 s 2 6 L 1 1 / 2 14338.880 5 f 4 (5 I)6 d 7 s 7 p 8 M° 1 1 / 2 return 7735.14 6903.440 5 f 4 (5 I)6 d 7 s 2 6 L 1 5 / 2 19827.885 5 f 4 (5 I)6 d 7 s 7 p 8 M° 1 5 / 2 return 7765.75 7112.430 5 f 4 (5 I)6 d 2 (3 F)7 s 8 M 1 1 / 2 19985.980 ° 9 / 2 return 7791.38 3502.855 5 f 4 (5 I)6 d 7 s 2 6 L 1 3 / 2 16334.010 5 f 4 (5 I)6 d 7 s 7 p 8 M° 1 3 / 2 return 8339.12 7112.430 5 f 4 (5 I)6 d 2 (3 F)7 s 8 M 1 1 / 2 19100.810 ° 9 / 2 return 8372.88 0.000 5 f 4 (5 I)6 d 7 s 2 6 L 1 1 / 2 11940.075 5 f 4 (5 I 4)7 s 2 7 p 1 / 2 ° 9 / 2 return 8529.96 6474.180 5 f 4 (5 I)6 d 7 s 2 6 G 3 / 2 18194.400 5 f 4 (5 I 4)7 s 2 7 p 3 / 2 ° 5 / 2 return 9016.18 7112.430 5 f 4 (5 I)6 d 2 (3 F)7 s 8 M 1 1 / 2 18200.530 ° 9 / 2 return 9379.33 2033.965 5 f 4 (5 I)6 d 7 s 2 6 K 9 / 2 12692.765 5 f 4 (5 I 4)7 s 2 7 p 1 / 2 ° 7 / 2 return 9468.66 5185.015 5 f 4 (5 I)6 d 7 s 2 6 K 1 1 / 2 15743.235 5 f 4 (5 I 5)7 s 2 7 p 1 / 2 ° 1 1 / 2 return 10091.99 2033.965 5 f 4 (5 I)6 d 7 s 2 6 K 9 / 2 11940.075 5 f 4 (5 I 4)7 s 2 7 p 1 / 2 ° 9 / 2 return 10817.45 3450.995 5 f 4 (5 I)6 d 7 s 2 6 I 7 / 2 12692.765 5 f 4 (5 I 4)7 s 2 7 p 1 / 2 ° 7 / 2 return 11776.64 3450.995 5 f 4 (5 I)6 d 7 s 2 6 I 7 / 2 11940.075 5 f 4 (5 I 4)7 s 2 7 p 1 / 2 ° 9 / 2 return 12377.42 4615.670 5 f 4 (5 I)6 d 7 s 2 4 G 5 / 2 12692.765 5 f 4 (5 I 4)7 s 2 7 p 1 / 2 ° 7 / 2 return

Persistent Lines of Neutral Plutonium (Pu I)

Persistent Lines of Neutral Plutonium (Pu I)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3753.628 0.000 5 f 6 7 s 2 7 F 0 26633.288 5 f 6 7 s 7 p 1 return 3755.940 2203.606 5 f 6 7 s 2 7 F 1 28820.548 5 f 6 7 s 7 p 0 return 3758.338 10238.473 5 f 6 7 s 2 7 F 6 36838.42 6 return 3774.384 2203.606 5 f 6 7 s 2 7 F 1 28690.480 1 return 3851.007 0.000 5 f 6 7 s 2 7 F 0 25959.849 5 f 5 6 d 2 7 s 1 return 3878.540 2203.606 5 f 6 7 s 2 7 F 1 27979.161 5 f 6 7 s 7 p 2 return 4206.481 0.000 5 f 6 7 s 2 7 F 0 23766.139 5 f 5 7 s 7 p 7 D° 1 return 6304.661 0.000 5 f 6 7 s 2 7 F 0 15856.888 5 f 5 (6 F°)6 d 7 s 2 7 G° 1 return 6486.707 2203.606 5 f 6 7 s 2 7 F 1 17615.482 5 f 5 (6 F°)6 d 7 s 2 7 F° 2 return 6488.853 0.000 5 f 6 7 s 2 7 F 0 15406.760 5 f 5 (6 H°)6 d 7 s 2 7 G° 1 return 6887.710 6313.866 5 f 5 (6 H°)6 d 7 s 2 7 K° 4 20828.477 5 f 5 6 d 7 s (8 K°)7 p 9 L 4 return 8630.189 6313.866 5 f 5 (6 H°)6 d 7 s 2 7 K° 4 17897.919 5 f 5 (6 H° 5 / 2)7 s 2 7 p 1 / 2 (5 / 2 , 1 / 2) 3 return

Persistent Lines of Singly Ionized Helium (He I|)

Persistent Lines of Singly Ionized Helium (He II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 256.3166 0.0000 1 s 2 S 1 / 2 390142.5605 3 p 2 P° 3 / 2 return 256.3177 0.0000 1 s 2 S 1 / 2 390140.8250 3 p 2 P° 1 / 2 return 303.7804 0.0000 1 s 2 S 1 / 2 329185.1511 2 p 2 P° 3 / 2 return 303.7858 0.0000 1 s 2 S 1 / 2 329179.2940 2 p 2 P° 1 / 2 return 1640.3321 329179.2940 2 p 2 P° 1 / 2 390142.5576 3 d 2 D 3 / 2 return 1640.3447 329179.7623 2 s 2 S 1 / 2 390142.5605 3 p 2 P° 3 / 2 return 1640.3750 329179.2940 2 p 2 P° 1 / 2 390140.9646 3 s 2 S 1 / 2 return 1640.3914 329179.7623 2 s 2 S 1 / 2 390140.8250 3 p 2 P° 1 / 2 return 1640.4742 329185.1511 2 p 2 P° 3 / 2 390143.1361 3 d 2 D 5 / 2 return 1640.4897 329185.1511 2 p 2 P° 3 / 2 390142.5576 3 d 2 D 3 / 2 return 1640.5326 329185.1511 2 p 2 P° 3 / 2 390140.9646 3 s 2 S 1 / 2 return 4685.3769 390140.8250 3 p 2 P° 1 / 2 411477.8537 4 d 2 D 3 / 2 return 4685.4072 390140.9646 3 s 2 S 1 / 2 411477.8550 4 p 2 P° 3 / 2 return 4685.7038 390142.5576 3 d 2 D 3 / 2 411478.0973 4 f 2 F° 5 / 2 return 4685.7044 390142.5605 3 p 2 P° 3 / 2 411478.0978 4 d 2 D 5 / 2 return 4685.8041 390143.1361 3 d 2 D 5 / 2 411478.2193 4 f 2 F° 7 / 2 return

Persistent Lines of Singly Ionized Hydrogen (H I|)

Persistent Lines of Singly Ionized Hydrogen (H II)

Null Null

Persistent Lines of Singly Ionized Lithium (Li I|)

Persistent Lines of Singly Ionized Lithium (Li II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 178.014 0. 1 s 2 1 S 0 561751.50 1 s 3 p 1 P° 1 return 199.280 0. 1 s 2 1 S 0 501807.59 1 s 2 p 1 P° 1 return 5483.56 476034.24 1 s 2 s 3 S 1 494265.57 1 s 2 p 3 P° 0 return 5484.50 476034.24 1 s 2 s 3 S 1 494262.48 1 s 2 p 3 P° 2 return 5485.11 476034.24 1 s 2 s 3 S 1 494260.32 1 s 2 p 3 P° 1 return 9581.42 491373.58 1 s 2 s 1 S 0 501807.59 1 s 2 p 1 P° 1 return

Persistent Lines of Singly Ionized Beryllium (Be I|)

Persistent Lines of Singly Ionized Beryllium (Be II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1512.269 31928.744 1 s 2 2 p 2 P° 1 / 2 98054.55 1 s 2 3 d 2 D 3 / 2 return 1512.412 31935.320 1 s 2 2 p 2 P° 3 / 2 98055.10 1 s 2 3 d 2 D 5 / 2 return 1512.412 31935.320 1 s 2 2 p 2 P° 3 / 2 98054.55 1 s 2 3 d 2 D 3 / 2 return 3130.4219 0.000 1 s 2 2 s 2 S 1 / 2 31935.320 1 s 2 2 p 2 P° 3 / 2 return 3131.0667 0.000 1 s 2 2 s 2 S 1 / 2 31928.744 1 s 2 2 p 2 P° 1 / 2 return 4360.663 96495.34 1 s 2 3 p 2 P° 1 / 2 119421.18 1 s 2 4 d 2 D 3 / 2 return 4360.988 96497.26 1 s 2 3 p 2 P° 3 / 2 119421.42 1 s 2 4 d 2 D 5 / 2 return 4673.329 98054.55 1 s 2 3 d 2 D 3 / 2 119446.59 1 s 2 4 f 2 F° 5 / 2 return 4673.423 98055.10 1 s 2 3 d 2 D 5 / 2 119446.71 1 s 2 4 f 2 F° 7 / 2 return 5270.811 96497.26 1 s 2 3 p 2 P° 3 / 2 115464.38 1 s 2 4 s 2 S 1 / 2 return

Persistent Lines of Singly Ionized Boron (B I|)

Persistent Lines of Singly Ionized Boron (B II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1362.463 0.00 2 s 2 1 S 0 73396.51 2 s 2 p 1 P° 1 return 1623.597 37342.15 2 s 2 p 3 P° 1 98933.76 2 p 2 3 P 2 return 1623.790 37336.04 2 s 2 p 3 P° 0 98920.37 2 p 2 3 P 1 return 1624.023 37358.30 2 s 2 p 3 P° 2 98933.76 2 p 2 3 P 2 return 1624.376 37358.30 2 s 2 p 3 P° 2 98920.37 2 p 2 3 P 1 return 1842.820 73396.51 2 s 2 p 1 P° 1 127661.19 2 p 2 1 S 0 return 2395.048 102362.77 2 p 2 1 D 2 144103.17 2 s 3 p 1 P° 1 return 3451.303 73396.51 2 s 2 p 1 P° 1 102362.77 2 p 2 1 D 2 return

Persistent Lines of Singly Ionized Carbon (C I|)

Persistent Lines of Singly Ionized Carbon (C II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 687.0526 0.00 2 s 2 (1 S)2 p 2 P° 1 / 2 145549.27 2 s 2 (1 S)3 d 2 D 3 / 2 return 687.346 63.42 2 s 2 (1 S)2 p 2 P° 3 / 2 145550.70 2 s 2 (1 S)3 d 2 D 5 / 2 return 904.1416 63.42 2 s 2 (1 S)2 p 2 P° 3 / 2 110665.56 2 s 2 p 2 2 P 3 / 2 return 1036.3367 0.00 2 s 2 (1 S)2 p 2 P° 1 / 2 96493.74 2 s 2 p 2 2 S 1 / 2 return 1037.0182 63.42 2 s 2 (1 S)2 p 2 P° 3 / 2 96493.74 2 s 2 p 2 2 S 1 / 2 return 1334.5323 0.00 2 s 2 (1 S)2 p 2 P° 1 / 2 74932.62 2 s 2 p 2 2 D 3 / 2 return 1335.7077 63.42 2 s 2 (1 S)2 p 2 P° 3 / 2 74930.10 2 s 2 p 2 2 D 5 / 2 return 2836.710 96493.74 2 s 2 p 2 2 S 1 / 2 131735.52 2 s 2 (1 S)3 p 2 P° 3 / 2 return 2837.603 96493.74 2 s 2 p 2 2 S 1 / 2 131724.37 2 s 2 (1 S)3 p 2 P° 1 / 2 return 3918.978 131724.37 2 s 2 (1 S)3 p 2 P° 1 / 2 157234.07 2 s 2 (1 S)4 s 2 S 1 / 2 return 3920.693 131735.52 2 s 2 (1 S)3 p 2 P° 3 / 2 157234.07 2 s 2 (1 S)4 s 2 S 1 / 2 return 4267.003 145549.27 2 s 2 (1 S)3 d 2 D 3 / 2 168978.34 2 s 2 (1 S)4 f 2 F° 5 / 2 return 4267.258 145550.70 2 s 2 (1 S)3 d 2 D 5 / 2 168978.34 2 s 2 (1 S)4 f 2 F° 7 / 2 return 4267.258 145550.70 2 s 2 (1 S)3 d 2 D 5 / 2 168978.34 2 s 2 (1 S)4 f 2 F° 5 / 2 return 6578.05 116537.65 2 s 2 (1 S)3 s 2 S 1 / 2 131735.52 2 s 2 (1 S)3 p 2 P° 3 / 2 return 7231.32 131724.37 2 s 2 (1 S)3 p 2 P° 1 / 2 145549.27 2 s 2 (1 S)3 d 2 D 3 / 2 return 7236.42 131735.52 2 s 2 (1 S)3 p 2 P° 3 / 2 145550.70 2 s 2 (1 S)3 d 2 D 5 / 2 return

Persistent Lines of Singly Ionized Fluorine (F I|)

Persistent Lines of Singly Ionized Fluorine (F II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 484.602 20873.4 2 s 2 2 p 4 1 D 2 227228.42 2 s 2 2 p 3 (2 P°)3 s 1 P° 1 return 605.669 0.00 2 s 2 2 p 4 3 P 2 165106.66 2 s 2 p 5 3 P° 1 return 606.288 341.1400 2 s 2 2 p 4 3 P 1 165279.19 2 s 2 p 5 3 P° 0 return 606.804 0.00 2 s 2 2 p 4 3 P 2 164797.88 2 s 2 p 5 3 P° 2 return 606.923 341.1400 2 s 2 2 p 4 3 P 1 165106.66 2 s 2 p 5 3 P° 1 return 607.472 489.6845 2 s 2 2 p 4 3 P 0 165106.66 2 s 2 p 5 3 P° 1 return 608.062 341.1400 2 s 2 2 p 4 3 P 1 164797.88 2 s 2 p 5 3 P° 2 return 3847.086 176493.93 2 s 2 2 p 3 (4 S°)3 s 5 S° 2 202480.26 2 s 2 2 p 3 (4 S°)3 p 5 P 3 return 3849.985 176493.93 2 s 2 2 p 3 (4 S°)3 s 5 S° 2 202460.69 2 s 2 2 p 3 (4 S°)3 p 5 P 2 return 3851.668 176493.93 2 s 2 2 p 3 (4 S°)3 s 5 S° 2 202449.35 2 s 2 2 p 3 (4 S°)3 p 5 P 1 return 4024.726 182864.40 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 207703.79 2 s 2 2 p 3 (4 S°)3 p 3 P 2 return 4025.010 182864.40 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 207702.04 2 s 2 2 p 3 (4 S°)3 p 3 P 0 return 4025.491 182864.40 2 s 2 2 p 3 (4 S°)3 s 3 S° 1 207699.07 2 s 2 2 p 3 (4 S°)3 p 3 P 1 return

Persistent Lines of Singly Ionized Neon (Ne I|)

Persistent Lines of Singly Ionized Neon (Ne II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 352.9549 0.00 2 s 2 2 p 5 2 P° 3 / 2 283322.35 2 s 2 2 p 4 (3 P)4 s 2 P 3 / 2 return 354.9620 0.00 2 s 2 2 p 5 2 P° 3 / 2 281720.28 2 s 2 2 p 4 (3 P)3 d 2 P 3 / 2 return 445.0393 0.00 2 s 2 2 p 5 2 P° 3 / 2 224699.27 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 return 446.2552 0.00 2 s 2 2 p 5 2 P° 3 / 2 224087.02 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 return 446.5902 780.34 2 s 2 2 p 5 2 P° 1 / 2 224699.27 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 return 460.7284 0.00 2 s 2 2 p 5 2 P° 3 / 2 217047.61 2 s 2 p 6 2 S 1 / 2 return 462.3908 780.34 2 s 2 2 p 5 2 P° 1 / 2 217047.61 2 s 2 p 6 2 S 1 / 2 return 1916.0818 224087.02 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 276276.85 2 s 2 2 p 4 (1 D)3 p 2 P° 3 / 2 return 1930.0345 224699.27 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 276511.82 2 s 2 2 p 4 (1 D)3 p 2 P° 1 / 2 return 3027.016 246192.45 2 s 2 2 p 4 (3 P)3 p 4 P° 5 / 2 279218.66 2 s 2 2 p 4 (3 P)3 d 4 D 5 / 2 return 3028.864 219947.46 2 s 2 2 p 4 (3 P)3 s 4 P 1 / 2 252953.54 2 s 2 2 p 4 (3 P)3 p 4 S° 3 / 2 return 3198.586 249445.99 2 s 2 2 p 4 (3 P)3 p 4 D° 5 / 2 280700.77 2 s 2 2 p 4 (3 P)3 d 2 F 7 / 2 return 3323.745 224087.02 2 s 2 2 p 4 (3 P)3 s 2 P 3 / 2 254165.01 2 s 2 2 p 4 (3 P)3 p 2 P° 3 / 2 return 3378.216 224699.27 2 s 2 2 p 4 (3 P)3 s 2 P 1 / 2 254292.19 2 s 2 2 p 4 (3 P)3 p 2 P° 1 / 2 return 3766.259 219648.44 2 s 2 2 p 4 (3 P)3 s 4 P 3 / 2 246192.45 2 s 2 2 p 4 (3 P)3 p 4 P° 5 / 2 return 3777.133 219947.46 2 s 2 2 p 4 (3 P)3 s 4 P 1 / 2 246415.04 2 s 2 2 p 4 (3 P)3 p 4 P° 3 / 2 return

Persistent Lines of Singly Ionized Nitrogen (N I|)

Persistent Lines of Singly Ionized Nitrogen (N II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 644.635 0.00 2 s 2 (1 S)2 p 2 3 P 0 155126.73 2 s (2 S)2 p 3 3 S° 1 return 644.837 48.67 2 s 2 (1 S)2 p 2 3 P 1 155126.73 2 s (2 S)2 p 3 3 S° 1 return 645.179 130.80 2 s 2 (1 S)2 p 2 3 P 2 155126.73 2 s (2 S)2 p 3 3 S° 1 return 775.967 15316.17 2 s 2 (1 S)2 p 2 1 D 2 144187.94 2 s (2 S)2 p 3 1 D° 2 return 915.613 0.00 2 s 2 (1 S)2 p 2 3 P 0 109216.44 2 s (2 S)2 p 3 3 P° 1 return 915.963 48.67 2 s 2 (1 S)2 p 2 3 P 1 109223.34 2 s (2 S)2 p 3 3 P° 0 return 916.019 48.67 2 s 2 (1 S)2 p 2 3 P 1 109216.93 2 s (2 S)2 p 3 3 P° 2 return 916.019 48.67 2 s 2 (1 S)2 p 2 3 P 1 109216.44 2 s (2 S)2 p 3 3 P° 1 return 916.708 130.80 2 s 2 (1 S)2 p 2 3 P 2 109216.93 2 s (2 S)2 p 3 3 P° 2 return 916.708 130.80 2 s 2 (1 S)2 p 2 3 P 2 109216.44 2 s (2 S)2 p 3 3 P° 1 return 1083.994 0.00 2 s 2 (1 S)2 p 2 3 P 0 92251.46 2 s (2 S)2 p 3 3 D° 1 return 1084.580 48.67 2 s 2 (1 S)2 p 2 3 P 1 92251.46 2 s (2 S)2 p 3 3 D° 1 return 1084.580 48.67 2 s 2 (1 S)2 p 2 3 P 1 92249.91 2 s (2 S)2 p 3 3 D° 2 return 1085.550 130.80 2 s 2 (1 S)2 p 2 3 P 2 92251.46 2 s (2 S)2 p 3 3 D° 1 return 1085.550 130.80 2 s 2 (1 S)2 p 2 3 P 2 92249.91 2 s (2 S)2 p 3 3 D° 2 return 1085.710 130.80 2 s 2 (1 S)2 p 2 3 P 2 92236.46 2 s (2 S)2 p 3 3 D° 3 return 3995.00 149187.80 2 s 2 2 p (2 P°)3 s 1 P° 1 174212.03 2 s 2 2 p (2 P°)3 p 1 D 2 return 4447.03 164610.76 2 s 2 2 p (2 P°)3 p 1 P 1 187091.37 2 s 2 2 p (2 P°)3 d 1 D° 2 return 4630.54 149076.52 2 s 2 2 p (2 P°)3 s 3 P° 2 170666.23 2 s 2 2 p (2 P°)3 p 3 P 2 return 5005.15 166678.64 2 s 2 2 p (2 P°)3 p 3 D 3 186652.49 2 s 2 2 p (2 P°)3 d 3 F° 4 return 5679.56 149076.52 2 s 2 2 p (2 P°)3 s 3 P° 2 166678.64 2 s 2 2 p (2 P°)3 p 3 D 3 return 5941.65 170666.23 2 s 2 2 p (2 P°)3 p 3 P 2 187491.90 2 s 2 2 p (2 P°)3 d 3 D° 3 return 6482.05 149187.80 2 s 2 2 p (2 P°)3 s 1 P° 1 164610.76 2 s 2 2 p (2 P°)3 p 1 P 1 return 6610.56 174212.03 2 s 2 2 p (2 P°)3 p 1 D 2 189335.16 2 s 2 2 p (2 P°)3 d 1 F° 3 return

Persistent Lines of Singly Ionized Oxygen (O I|)

Persistent Lines of Singly Ionized Oxygen (O II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 429.918 0.00 2 s 2 2 p 3 4 S° 3 / 2 232602.492 2 s 2 2 p 2 (3 P)3 d 4 P 1 / 2 return 430.041 0.00 2 s 2 2 p 3 4 S° 3 / 2 232535.949 2 s 2 2 p 2 (3 P)3 d 4 P 3 / 2 return 430.177 0.00 2 s 2 2 p 3 4 S° 3 / 2 232462.724 2 s 2 2 p 2 (3 P)3 d 4 P 5 / 2 return 537.8319 26830.57 2 s 2 2 p 3 2 D° 3 / 2 212762.25 2 s 2 p 4 2 P 1 / 2 return 538.2636 26810.55 2 s 2 2 p 3 2 D° 5 / 2 212593.82 2 s 2 p 4 2 P 3 / 2 return 538.318 26830.57 2 s 2 2 p 3 2 D° 3 / 2 212593.82 2 s 2 p 4 2 P 3 / 2 return 539.0855 0.00 2 s 2 2 p 3 4 S° 3 / 2 185499.124 2 s 2 2 p 2 (3 P)3 s 4 P 5 / 2 return 539.5489 0.00 2 s 2 2 p 3 4 S° 3 / 2 185340.577 2 s 2 2 p 2 (3 P)3 s 4 P 3 / 2 return 539.8544 0.00 2 s 2 2 p 3 4 S° 3 / 2 185235.281 2 s 2 2 p 2 (3 P)3 s 4 P 1 / 2 return 718.5036 26810.55 2 s 2 2 p 3 2 D° 5 / 2 165988.46 2 s 2 p 4 2 D 5 / 2 return 718.5663 26830.57 2 s 2 2 p 3 2 D° 3 / 2 165996.50 2 s 2 p 4 2 D 3 / 2 return 832.7587 0.00 2 s 2 2 p 3 4 S° 3 / 2 120082.86 2 s 2 p 4 4 P 1 / 2 return 833.3302 0.00 2 s 2 2 p 3 4 S° 3 / 2 120000.43 2 s 2 p 4 4 P 3 / 2 return 834.4655 0.00 2 s 2 2 p 3 4 S° 3 / 2 119837.21 2 s 2 p 4 4 P 5 / 2 return 3134.720 207002.482 2 s 2 2 p 2 (3 P)3 p 4 D° 7 / 2 238893.96 2 s 2 2 p 2 (3 P)4 s 4 P 5 / 2 return 3911.957 206971.68 2 s 2 2 p 2 (1 D)3 s 2 D 5 / 2 232527.09 2 s 2 2 p 2 (1 D)3 p 2 P° 3 / 2 return 3973.2562 189068.514 2 s 2 2 p 2 (3 P)3 s 2 P 3 / 2 214229.671 2 s 2 2 p 2 (3 P)3 p 2 P° 3 / 2 return 4075.862 207002.482 2 s 2 2 p 2 (3 P)3 p 4 D° 7 / 2 231530.246 2 s 2 2 p 2 (3 P)3 d 4 F 9 / 2 return 4414.905 189068.514 2 s 2 2 p 2 (3 P)3 s 2 P 3 / 2 211712.732 2 s 2 2 p 2 (3 P)3 p 2 D° 5 / 2 return 4641.810 185340.577 2 s 2 2 p 2 (3 P)3 s 4 P 3 / 2 206877.865 2 s 2 2 p 2 (3 P)3 p 4 D° 5 / 2 return 4649.135 185499.124 2 s 2 2 p 2 (3 P)3 s 4 P 5 / 2 207002.482 2 s 2 2 p 2 (3 P)3 p 4 D° 7 / 2 return

Persistent Lines of Singly Ionized Sodium (Na I|)

Persistent Lines of Singly Ionized Sodium (Na II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 300.15 0.00 2 p 6 1 S 0 333162.94 2 p 5 (2 P° 1 / 2)4 s 2 [1 / 2]° 1 return 372.08 0.00 2 p 6 1 S 0 268762.96 2 p 5 3 s 1 P° 1 return 3092.73 264924.32 2 p 5 3 s 3 P° 2 297248.82 2 p 5 3 p 3 D 3 return 3285.60 268762.96 2 p 5 3 s 1 P° 1 299189.96 2 p 5 3 p 1 D 2 return

Persistent Lines of Singly Ionized Aluminum (Al I|)

Persistent Lines of Singly Ionized Aluminum (Al II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1539.830 59852.02 3 s 3 p 1 P° 1 124794.13 3 s 4 d 1 D 2 return 1670.7886 0.00 3 s 2 1 S 0 59852.02 3 s 3 p 1 P° 1 return 1719.440 37393.03 3 s 3 p 3 P° 0 95551.44 3 s 3 d 3 D 1 return 1721.271 37453.91 3 s 3 p 3 P° 1 95550.51 3 s 3 d 3 D 2 return 1724.984 37577.79 3 s 3 p 3 P° 2 95549.42 3 s 3 d 3 D 3 return 1763.952 37577.79 3 s 3 p 3 P° 2 94268.68 3 p 2 3 P 2 return 1858.026 37453.91 3 s 3 p 3 P° 1 91274.50 3 s 4 s 3 S 1 return 1862.311 37577.79 3 s 3 p 3 P° 2 91274.50 3 s 4 s 3 S 1 return 2816.185 59852.02 3 s 3 p 1 P° 1 95350.60 3 s 4 s 1 S 0 return 4663.056 85481.35 3 p 2 1 D 2 106920.56 3 s 4 p 1 P° 1 return 6243.36 105470.93 3 s 4 p 3 P° 2 121483.50 3 s 4 d 3 D 3 return

Persistent Lines of Singly Ionized Argon (Ar I|)

Persistent Lines of Singly Ionized Argon (Ar II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 661.8690 0.0000 3 s 2 3 p 5 2 P° 3 / 2 151087.3128 3 s 2 3 p 4 (3 P)3 d 2 D 5 / 2 return 670.9455 1431.5831 3 s 2 3 p 5 2 P° 1 / 2 150474.9900 3 s 2 3 p 4 (3 P)3 d 2 D 3 / 2 return 671.8513 0.0000 3 s 2 3 p 5 2 P° 3 / 2 148842.4674 3 s 2 3 p 4 (1 D)4 s 2 D 5 / 2 return 723.3606 0.0000 3 s 2 3 p 5 2 P° 3 / 2 138243.6442 3 s 2 3 p 4 (3 P)4 s 2 P 3 / 2 return 919.7810 0.0000 3 s 2 3 p 5 2 P° 3 / 2 108721.53 3 s 3 p 6 2 S 1 / 2 return 932.0537 1431.5831 3 s 2 3 p 5 2 P° 1 / 2 108721.53 3 s 3 p 6 2 S 1 / 2 return 4277.528 148842.4674 3 s 2 3 p 4 (1 D)4 s 2 D 5 / 2 172213.8800 3 s 2 3 p 4 (1 D)4 p 2 P° 3 / 2 return 4348.064 134241.7392 3 s 2 3 p 4 (3 P)4 s 4 P 5 / 2 157234.0200 3 s 2 3 p 4 (3 P)4 p 4 D° 7 / 2 return 4609.567 148842.4674 3 s 2 3 p 4 (1 D)4 s 2 D 5 / 2 170530.4041 3 s 2 3 p 4 (1 D)4 p 2 F° 7 / 2 return 4726.868 138243.6442 3 s 2 3 p 4 (3 P)4 s 2 P 3 / 2 159393.3850 3 s 2 3 p 4 (3 P)4 p 2 D° 3 / 2 return 4764.865 139258.3384 3 s 2 3 p 4 (3 P)4 s 2 P 1 / 2 160239.4280 3 s 2 3 p 4 (3 P)4 p 2 P° 3 / 2 return 4806.020 134241.7392 3 s 2 3 p 4 (3 P)4 s 4 P 5 / 2 155043.1622 3 s 2 3 p 4 (3 P)4 p 4 P° 5 / 2 return 4879.864 138243.6442 3 s 2 3 p 4 (3 P)4 s 2 P 3 / 2 158730.2997 3 s 2 3 p 4 (3 P)4 p 2 D° 5 / 2 return

Persistent Lines of Singly Ionized Chlorine (Cl I|)

Persistent Lines of Singly Ionized Chlorine (Cl II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 839.297 696.00 3 s 2 3 p 4 3 P 1 119843.31 3 s 2 3 p 3 (4 S°)3 d 3 D° 1 return 839.599 696.00 3 s 2 3 p 4 3 P 1 119800.32 3 s 2 3 p 3 (4 S°)3 d 3 D° 2 return 841.414 996.47 3 s 2 3 p 4 3 P 0 119843.31 3 s 2 3 p 3 (4 S°)3 d 3 D° 1 return 851.691 11653.58 3 s 2 3 p 4 1 D 2 129066.96 3 s 2 3 p 3 (2 D°)4 s 1 D° 2 return 1063.831 0.00 3 s 2 3 p 4 3 P 2 93999.88 3 s 3 p 5 3 P° 1 return 1067.945 696.00 3 s 2 3 p 4 3 P 1 94333.84 3 s 3 p 5 3 P° 0 return 1071.036 0.00 3 s 2 3 p 4 3 P 2 93367.56 3 s 3 p 5 3 P° 2 return 1071.767 696.00 3 s 2 3 p 4 3 P 1 93999.88 3 s 3 p 5 3 P° 1 return 1075.230 996.47 3 s 2 3 p 4 3 P 0 93999.88 3 s 3 p 5 3 P° 1 return 1079.080 696.00 3 s 2 3 p 4 3 P 1 93367.56 3 s 3 p 5 3 P° 2 return 3850.991 128663.57 3 s 2 3 p 3 (4 S°)4 p 5 P 2 154623.57 3 s 2 3 p 3 (4 S°)4 d 5 D° 3 return 3851.373 128663.57 3 s 2 3 p 3 (4 S°)4 p 5 P 2 154620.97 3 s 2 3 p 3 (4 S°)4 d 5 D° 2 return 3860.83 128730.82 3 s 2 3 p 3 (4 S°)4 p 5 P 3 154624.66 3 s 2 3 p 3 (4 S°)4 d 5 D° 4 return 4132.498 129066.96 3 s 2 3 p 3 (2 D°)4 s 1 D° 2 153258.61 3 s 2 3 p 3 (2 D°)4 p 1 D 2 return 4794.55 107879.66 3 s 2 3 p 3 (4 S°)4 s 5 S° 2 128730.82 3 s 2 3 p 3 (4 S°)4 p 5 P 3 return 4810.06 107879.66 3 s 2 3 p 3 (4 S°)4 s 5 S° 2 128663.57 3 s 2 3 p 3 (4 S°)4 p 5 P 2 return 4896.77 126784.37 3 s 2 3 p 3 (2 D°)4 s 3 D° 3 147200.24 3 s 2 3 p 3 (2 D°)4 p 3 F 4 return 4904.776 126744.97 3 s 2 3 p 3 (2 D°)4 s 3 D° 2 147127.57 3 s 2 3 p 3 (2 D°)4 p 3 F 3 return 4917.731 126726.70 3 s 2 3 p 3 (2 D°)4 s 3 D° 1 147055.61 3 s 2 3 p 3 (2 D°)4 p 3 F 2 return 5078.264 126784.37 3 s 2 3 p 3 (2 D°)4 s 3 D° 3 146470.64 3 s 2 3 p 3 (2 D°)4 p 3 D 3 return 5217.94 112609.36 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 131768.66 3 s 2 3 p 3 (4 S°)4 p 3 P 2 return 5221.355 112609.36 3 s 2 3 p 3 (4 S°)4 s 3 S° 1 131756.12 3 s 2 3 p 3 (4 S°)4 p 3 P 1 return 5392.119 129066.96 3 s 2 3 p 3 (2 D°)4 s 1 D° 2 147607.37 3 s 2 3 p 3 (2 D°)4 p 1 F 3 return 5423.23 110296.84 3 s 2 3 p 3 (4 S°)3 d 5 D° 4 128730.82 3 s 2 3 p 3 (4 S°)4 p 5 P 3 return 5443.37 110297.72 3 s 2 3 p 3 (4 S°)3 d 5 D° 3 128663.57 3 s 2 3 p 3 (4 S°)4 p 5 P 2 return

Persistent Lines of Singly Ionized Magnesium (Mg I|)

Persistent Lines of Singly Ionized Magnesium (Mg II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1025.9681 0.00 3 s 2 S 1 / 2 97468.92 5 p 2 P° 3 / 2 return 1026.1134 0.00 3 s 2 S 1 / 2 97455.12 5 p 2 P° 1 / 2 return 1239.9253 0.00 3 s 2 S 1 / 2 80650.02 4 p 2 P° 3 / 2 return 1240.3946 0.00 3 s 2 S 1 / 2 80619.50 4 p 2 P° 1 / 2 return 2790.7767 35669.31 3 p 2 P° 1 / 2 71491.06 3 d 2 D 3 / 2 return 2795.5301 0.00 3 s 2 S 1 / 2 35760.88 3 p 2 P° 3 / 2 return 2797.998 35760.88 3 p 2 P° 3 / 2 71490.19 3 d 2 D 5 / 2 return 2802.7056 0.00 3 s 2 S 1 / 2 35669.31 3 p 2 P° 1 / 2 return 4481.126 71490.19 3 d 2 D 5 / 2 93799.75 4 f 2 F° 7 / 2 return 4481.325 71491.06 3 d 2 D 3 / 2 93799.63 4 f 2 F° 5 / 2 return

Persistent Lines of Singly Ionized Phosphorus (P I|)

Persistent Lines of Singly Ionized Phosphorus (P II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1310.700 469.12 3 s 2 3 p 2 3 P 2 76764.06 3 s 3 p 3 3 P° 2 return 1532.530 0.00 3 s 2 3 p 2 3 P 0 65251.45 3 s 3 p 3 3 D° 1 return 1535.917 164.90 3 s 2 3 p 2 3 P 1 65272.35 3 s 3 p 3 3 D° 2 return 1536.410 164.90 3 s 2 3 p 2 3 P 1 65251.45 3 s 3 p 3 3 D° 1 return 1542.297 469.12 3 s 2 3 p 2 3 P 2 65307.17 3 s 3 p 3 3 D° 3 return 4588.04 103339.14 3 s 2 3 p 4 p 3 D 2 125128.87 3 s 2 3 p 4 d 3 F° 3 return 4589.86 103165.61 3 s 2 3 p 4 p 3 D 1 124946.73 3 s 2 3 p 4 d 3 F° 2 return 4602.08 103667.86 3 s 2 3 p 4 p 3 D 3 125391.13 3 s 2 3 p 4 d 3 F° 4 return 6024.18 86743.96 3 s 2 3 p 4 s 3 P° 1 103339.14 3 s 2 3 p 4 p 3 D 2 return 6043.12 87124.60 3 s 2 3 p 4 s 3 P° 2 103667.86 3 s 2 3 p 4 p 3 D 3 return 6459.99 88192.13 3 s 2 3 p 3 d 3 F° 4 103667.86 3 s 2 3 p 4 p 3 D 3 return 6503.46 87966.81 3 s 2 3 p 3 d 3 F° 3 103339.14 3 s 2 3 p 4 p 3 D 2 return 6507.97 87804.10 3 s 2 3 p 3 d 3 F° 2 103165.61 3 s 2 3 p 4 p 3 D 1 return

Persistent Lines of Singly Ionized Potassium (K I|)

Persistent Lines of Singly Ionized Potassium (K II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 600.77 0.0 3 p 6 1 S 0 166461.5 3 p 5 4 s 1 P° 1 return 607.93 0.0 3 p 6 1 S 0 164496.1 3 p 5 3 d 3 P° 1 return 612.62 0.0 3 p 6 1 S 0 163237.0 3 p 5 4 s 3 P° 1 return

Persistent Lines of Singly Ionized Silicon (Si I|)

Persistent Lines of Singly Ionized Silicon (Si II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1190.4160 0.00 3 s 2 (1 S)3 p 2 P° 1 / 2 84004.26 3 s 3 p 2 2 P 3 / 2 return 1193.2898 0.00 3 s 2 (1 S)3 p 2 P° 1 / 2 83801.95 3 s 3 p 2 2 P 1 / 2 return 1194.5004 287.24 3 s 2 (1 S)3 p 2 P° 3 / 2 84004.26 3 s 3 p 2 2 P 3 / 2 return 1260.4223 0.00 3 s 2 (1 S)3 p 2 P° 1 / 2 79338.50 3 s 2 (1 S)3 d 2 D 3 / 2 return 1264.7379 287.24 3 s 2 (1 S)3 p 2 P° 3 / 2 79355.02 3 s 2 (1 S)3 d 2 D 5 / 2 return 1533.4318 287.24 3 s 2 (1 S)3 p 2 P° 3 / 2 65500.47 3 s 2 (1 S)4 s 2 S 1 / 2 return 3856.017 55325.18 3 s 3 p 2 2 D 5 / 2 81251.32 3 s 2 (1 S)4 p 2 P° 3 / 2 return 4128.067 79338.50 3 s 2 (1 S)3 d 2 D 3 / 2 103556.16 3 s 2 (1 S)4 f 2 F° 5 / 2 return 4130.893 79355.02 3 s 2 (1 S)3 d 2 D 5 / 2 103556.03 3 s 2 (1 S)4 f 2 F° 7 / 2 return 5041.026 81191.34 3 s 2 (1 S)4 p 2 P° 1 / 2 101023.05 3 s 2 (1 S)4 d 2 D 3 / 2 return 5055.981 81251.32 3 s 2 (1 S)4 p 2 P° 3 / 2 101024.35 3 s 2 (1 S)4 d 2 D 5 / 2 return 5669.562 114529.14 3 s 3 p (3 P°)3 d 4 F° 9 / 2 132162.29 3 s 3 p (3 P°)4 p 4 D 7 / 2 return 6347.103 65500.47 3 s 2 (1 S)4 s 2 S 1 / 2 81251.32 3 s 2 (1 S)4 p 2 P° 3 / 2 return 6371.359 65500.47 3 s 2 (1 S)4 s 2 S 1 / 2 81191.34 3 s 2 (1 S)4 p 2 P° 1 / 2 return

Persistent Lines of Singly Ionized Sulfur (S I|)

Persistent Lines of Singly Ionized Sulfur (S II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1250.578 0.00 3 s 2 3 p 3 4 S° 3 / 2 79962.61 3 s 3 p 4 4 P 1 / 2 return 1253.805 0.00 3 s 2 3 p 3 4 S° 3 / 2 79756.83 3 s 3 p 4 4 P 3 / 2 return 1259.518 0.00 3 s 2 3 p 3 4 S° 3 / 2 79395.39 3 s 3 p 4 4 P 5 / 2 return 5428.667 109560.69 3 s 2 3 p 2 (3 P)4 s 4 P 1 / 2 127976.34 3 s 2 3 p 2 (3 P)4 p 4 D° 3 / 2 return 5432.815 109831.59 3 s 2 3 p 2 (3 P)4 s 4 P 3 / 2 128233.20 3 s 2 3 p 2 (3 P)4 p 4 D° 5 / 2 return 5453.828 110268.60 3 s 2 3 p 2 (3 P)4 s 4 P 5 / 2 128599.16 3 s 2 3 p 2 (3 P)4 p 4 D° 7 / 2 return 5473.620 109560.69 3 s 2 3 p 2 (3 P)4 s 4 P 1 / 2 127825.08 3 s 2 3 p 2 (3 P)4 p 4 D° 1 / 2 return 5509.718 109831.59 3 s 2 3 p 2 (3 P)4 s 4 P 3 / 2 127976.34 3 s 2 3 p 2 (3 P)4 p 4 D° 3 / 2 return 5606.151 110766.56 3 s 2 3 p 2 (3 P)3 d 4 F 9 / 2 128599.16 3 s 2 3 p 2 (3 P)4 p 4 D° 7 / 2 return 5639.972 113461.54 3 s 2 3 p 2 (3 P)4 s 2 P 3 / 2 131187.19 3 s 2 3 p 2 (3 P)4 p 2 D° 5 / 2 return 7578.909 127128.35 3 s 2 3 p 2 (1 D)3 d 2 G 9 / 2 140319.23 3 s 2 3 p 2 (1 D)4 p 2 F° 7 / 2 return 7629.740 127127.10 3 s 2 3 p 2 (1 D)3 d 2 G 7 / 2 140230.10 3 s 2 3 p 2 (1 D)4 p 2 F° 5 / 2 return 7967.371 112937.57 3 s 2 3 p 2 (3 P)4 s 2 P 1 / 2 125485.29 3 s 2 3 p 2 (3 P)4 p 2 S° 1 / 2 return 8314.594 113461.54 3 s 2 3 p 2 (3 P)4 s 2 P 3 / 2 125485.29 3 s 2 3 p 2 (3 P)4 p 2 S° 1 / 2 return

Persistent Lines of Singly Ionized Calcium (Ca I|)

Persistent Lines of Singly Ionized Calcium (Ca II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3158.869 25191.51 4 p 2 P° 1 / 2 56839.25 4 d 2 D 3 / 2 return 3179.332 25414.40 4 p 2 P° 3 / 2 56858.46 4 d 2 D 5 / 2 return 3706.026 25191.51 4 p 2 P° 1 / 2 52166.93 5 s 2 S 1 / 2 return 3736.901 25414.40 4 p 2 P° 3 / 2 52166.93 5 s 2 S 1 / 2 return 3933.6614 0.00 4 s 2 S 1 / 2 25414.40 4 p 2 P° 3 / 2 return 3968.4673 0.00 4 s 2 S 1 / 2 25191.51 4 p 2 P° 1 / 2 return 8542.089 13710.88 3 d 2 D 5 / 2 25414.40 4 p 2 P° 3 / 2 return 8662.140 13650.19 3 d 2 D 3 / 2 25191.51 4 p 2 P° 1 / 2 return

Persistent Lines of Singly Ionized Chromium (Cr I|)

Persistent Lines of Singly Ionized Chromium (Cr II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1426.208 12496.44 3 d 4 (5 D)4 s a 6 D 9 / 2 82612.69 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 1 1 / 2 return 1431.323 12496.44 3 d 4 (5 D)4 s a 6 D 9 / 2 82362.19 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 9 / 2 return 1431.865 12303.86 3 d 4 (5 D)4 s a 6 D 7 / 2 82143.15 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 7 / 2 return 1432.056 12147.82 3 d 4 (5 D)4 s a 6 D 5 / 2 81978.08 3 d 3 (4 F)4 s 4 p (3 P°) y 6 D° 7 / 2 return 1433.004 12032.58 3 d 4 (5 D)4 s a 6 D 3 / 2 81816.29 3 d 3 (4 F)4 s 4 p (3 P°) y 6 D° 5 / 2 return 1434.808 12496.44 3 d 4 (5 D)4 s a 6 D 9 / 2 82192.59 3 d 3 (4 F)4 s 4 p (3 P°) y 6 D° 9 / 2 return 1435.207 12147.82 3 d 4 (5 D)4 s a 6 D 5 / 2 81824.40 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 3 / 2 return 1435.582 12303.86 3 d 4 (5 D)4 s a 6 D 7 / 2 81962.29 3 d 3 (4 F)4 s 4 p (3 P°) y 6 F° 5 / 2 return 2055.59 0.00 3 d 5 a 6 S 5 / 2 48632.12 3 d 4 (5 D)4 p z 6 P° 7 / 2 return 2061.54 0.00 3 d 5 a 6 S 5 / 2 48491.10 3 d 4 (5 D)4 p z 6 P° 5 / 2 return 2065.46 0.00 3 d 5 a 6 S 5 / 2 48398.95 3 d 4 (5 D)4 p z 6 P° 3 / 2 return 2677.19 12496.44 3 d 4 (5 D)4 s a 6 D 9 / 2 49838.38 3 d 4 (5 D)4 p z 6 D° 9 / 2 return 2762.58 12303.86 3 d 4 (5 D)4 s a 6 D 7 / 2 48491.10 3 d 4 (5 D)4 p z 6 P° 5 / 2 return 2766.55 12496.44 3 d 4 (5 D)4 s a 6 D 9 / 2 48632.12 3 d 4 (5 D)4 p z 6 P° 7 / 2 return 2835.63 12496.44 3 d 4 (5 D)4 s a 6 D 9 / 2 47751.62 3 d 4 (5 D)4 p z 6 F° 1 1 / 2 return 2843.24 12303.86 3 d 4 (5 D)4 s a 6 D 7 / 2 47464.55 3 d 4 (5 D)4 p z 6 F° 9 / 2 return 2849.83 12147.82 3 d 4 (5 D)4 s a 6 D 5 / 2 47227.24 3 d 4 (5 D)4 p z 6 F° 7 / 2 return 2855.67 12032.58 3 d 4 (5 D)4 s a 6 D 3 / 2 47040.35 3 d 4 (5 D)4 p z 6 F° 5 / 2 return 2862.57 12303.86 3 d 4 (5 D)4 s a 6 D 7 / 2 47227.24 3 d 4 (5 D)4 p z 6 F° 7 / 2 return 2865.10 12147.82 3 d 4 (5 D)4 s a 6 D 5 / 2 47040.35 3 d 4 (5 D)4 p z 6 F° 5 / 2 return

Persistent Lines of Singly Ionized Cobalt (Co I|)

Persistent Lines of Singly Ionized Cobalt (Co II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2286.159 3350.494 3 d 7 (4 F)4 s a 5 F 5 47078.491 3 d 7 (4 F)4 p z 5 G° 6 return 2307.860 4028.988 3 d 7 (4 F)4 s a 5 F 4 47345.842 3 d 7 (4 F)4 p z 5 G° 5 return 2311.604 4560.789 3 d 7 (4 F)4 s a 5 F 3 47807.490 3 d 7 (4 F)4 p z 5 G° 4 return 2314.056 4950.062 3 d 7 (4 F)4 s a 5 F 2 48150.937 3 d 7 (4 F)4 p z 5 G° 3 return 2347.399 4950.062 3 d 7 (4 F)4 s a 5 F 2 47537.362 3 d 7 (4 F)4 p z 5 D° 2 return 2353.422 4560.789 3 d 7 (4 F)4 s a 5 F 3 47039.102 3 d 7 (4 F)4 p z 5 D° 3 return 2363.800 4028.988 3 d 7 (4 F)4 s a 5 F 4 46320.829 3 d 7 (4 F)4 p z 5 D° 4 return 2378.626 3350.494 3 d 7 (4 F)4 s a 5 F 5 45378.751 3 d 7 (4 F)4 p z 5 F° 4 return 2383.459 4028.988 3 d 7 (4 F)4 s a 5 F 4 45972.033 3 d 7 (4 F)4 p z 5 F° 3 return 2386.370 4560.789 3 d 7 (4 F)4 s a 5 F 3 46452.697 3 d 7 (4 F)4 p z 5 F° 2 return 2388.917 3350.494 3 d 7 (4 F)4 s a 5 F 5 45197.708 3 d 7 (4 F)4 p z 5 F° 5 return

Persistent Lines of Singly Ionized Iron (Fe I|)

Persistent Lines of Singly Ionized Iron (Fe II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2343.4951 0.000 3 d 6 (5 D)4 s a 6 D 9 / 2 42658.224 3 d 6 (5 D)4 p z 6 P° 7 / 2 return 2382.0376 0.000 3 d 6 (5 D)4 s a 6 D 9 / 2 41968.046 3 d 6 (5 D)4 p z 6 F° 1 1 / 2 return 2395.6254 384.790 3 d 6 (5 D)4 s a 6 D 7 / 2 42114.818 3 d 6 (5 D)4 p z 6 F° 9 / 2 return 2404.8858 667.683 3 d 6 (5 D)4 s a 6 D 5 / 2 42237.033 3 d 6 (5 D)4 p z 6 F° 7 / 2 return 2493.2637 21251.608 3 d 6 (3 H)4 s a 4 H 1 3 / 2 61347.614 3 d 6 (3 H)4 p z 4 I° 1 5 / 2 return 2585.8758 0.000 3 d 6 (5 D)4 s a 6 D 9 / 2 38660.043 3 d 6 (5 D)4 p z 6 D° 7 / 2 return 2598.3692 384.790 3 d 6 (5 D)4 s a 6 D 7 / 2 38858.958 3 d 6 (5 D)4 p z 6 D° 5 / 2 return 2599.3956 0.000 3 d 6 (5 D)4 s a 6 D 9 / 2 38458.981 3 d 6 (5 D)4 p z 6 D° 9 / 2 return 2607.0871 667.683 3 d 6 (5 D)4 s a 6 D 5 / 2 39013.206 3 d 6 (5 D)4 p z 6 D° 3 / 2 return 2611.8736 384.790 3 d 6 (5 D)4 s a 6 D 7 / 2 38660.043 3 d 6 (5 D)4 p z 6 D° 7 / 2 return 2739.5474 7955.299 3 d 6 (5 D)4 s a 4 D 7 / 2 44446.878 3 d 6 (5 D)4 p z 4 D° 7 / 2 return 2749.3216 8391.938 3 d 6 (5 D)4 s a 4 D 5 / 2 44753.799 3 d 6 (5 D)4 p z 4 F° 7 / 2 return 2755.7365 7955.299 3 d 6 (5 D)4 s a 4 D 7 / 2 44232.512 3 d 6 (5 D)4 p z 4 F° 9 / 2 return

Persistent Lines of Singly Ionized Manganese (Mn I|)

Persistent Lines of Singly Ionized Manganese (Mn II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2576.103 0.00 3 d 5 (6 S)4 s a 7 S 3 38806.67 3 d 5 (6 S)4 p z 7 P° 4 return 2593.720 0.00 3 d 5 (6 S)4 s a 7 S 3 38543.08 3 d 5 (6 S)4 p z 7 P° 3 return 2605.680 0.00 3 d 5 (6 S)4 s a 7 S 3 38366.18 3 d 5 (6 S)4 p z 7 P° 2 return 2933.054 9472.97 3 d 5 (6 S)4 s a 5 S 2 43557.14 3 d 5 (6 S)4 p z 5 P° 1 return 2939.308 9472.97 3 d 5 (6 S)4 s a 5 S 2 43484.64 3 d 5 (6 S)4 p z 5 P° 2 return 2949.205 9472.97 3 d 5 (6 S)4 s a 5 S 2 43370.51 3 d 5 (6 S)4 p z 5 P° 3 return 3441.985 14325.86 3 d 6 a 5 D 4 43370.51 3 d 5 (6 S)4 p z 5 P° 3 return

Persistent Lines of Singly Ionized Nickel (Ni I|)

Persistent Lines of Singly Ionized Nickel (Ni II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1741.547 0.00 3 d 9 2 D 5 / 2 57420.16 3 d 8 (3 F)4 p 2 D° 5 / 2 return 2165.553 8393.90 3 d 8 (3 F)4 s 4 F 9 / 2 54557.05 3 d 8 (3 F)4 p 4 F° 9 / 2 return 2174.666 9330.04 3 d 8 (3 F)4 s 4 F 7 / 2 55299.65 3 d 8 (3 F)4 p 2 G° 9 / 2 return 2185.504 25036.38 3 d 8 (1 D)4 s 2 D 5 / 2 70778.12 3 d 8 (3 P)4 p 4 D° 7 / 2 return 2192.090 53365.17 3 d 8 (3 F)4 p 4 G° 9 / 2 98969.44 3 d 8 (3 F)4 d 2 H 1 1 / 2 return 2205.548 53496.49 3 d 8 (3 F)4 p 4 G° 1 1 / 2 98822.55 3 d 8 (3 F)4 d 4 H 1 3 / 2 return 2206.715 10115.66 3 d 8 (3 F)4 s 4 F 5 / 2 55417.83 3 d 8 (3 F)4 p 4 F° 7 / 2 return 2216.482 8393.90 3 d 8 (3 F)4 s 4 F 9 / 2 53496.49 3 d 8 (3 F)4 p 4 G° 1 1 / 2 return 2270.214 9330.04 3 d 8 (3 F)4 s 4 F 7 / 2 53365.17 3 d 8 (3 F)4 p 4 G° 9 / 2 return 2316.039 8393.90 3 d 8 (3 F)4 s 4 F 9 / 2 51557.85 3 d 8 (3 F)4 p 4 D° 7 / 2 return

Persistent Lines of Singly Ionized Scandium (Sc I|)

Persistent Lines of Singly Ionized Scandium (Sc II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3353.724 2540.95 3 d 4 s 1 D 2 32349.98 3 d 4 p 1 F° 3 return 3372.150 177.76 3 d 4 s 3 D 3 29823.93 3 d 4 p 3 P° 2 return 3572.530 177.76 3 d 4 s 3 D 3 28161.17 3 d 4 p 3 D° 3 return 3576.340 67.72 3 d 4 s 3 D 2 28021.29 3 d 4 p 3 D° 2 return 3580.928 0.00 3 d 4 s 3 D 1 27917.78 3 d 4 p 3 D° 1 return 3613.831 177.76 3 d 4 s 3 D 3 27841.35 3 d 4 p 3 F° 4 return 3630.742 67.72 3 d 4 s 3 D 2 27602.45 3 d 4 p 3 F° 3 return 3642.782 0.00 3 d 4 s 3 D 1 27443.71 3 d 4 p 3 F° 2 return 4246.820 2540.95 3 d 4 s 1 D 2 26081.34 3 d 4 p 1 D° 2 return

Persistent Lines of Singly Ionized Titanium (Ti I|)

Persistent Lines of Singly Ionized Titanium (Ti II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3078.651 225.73 3 d 2 (3 F)4 s a 4 F 7 / 2 32697.99 3 d 2 (3 F)4 p z 4 D° 5 / 2 return 3088.042 393.44 3 d 2 (3 F)4 s a 4 F 9 / 2 32767.07 3 d 2 (3 F)4 p z 4 D° 7 / 2 return 3234.513 393.44 3 d 2 (3 F)4 s a 4 F 9 / 2 31301.01 3 d 2 (3 F)4 p z 4 F° 9 / 2 return 3236.581 225.73 3 d 2 (3 F)4 s a 4 F 7 / 2 31113.65 3 d 2 (3 F)4 p z 4 F° 7 / 2 return 3239.038 94.10 3 d 2 (3 F)4 s a 4 F 5 / 2 30958.50 3 d 2 (3 F)4 p z 4 F° 5 / 2 return 3349.029 4897.65 3 d 2 (3 F)4 s a 2 F 7 / 2 34748.40 3 d 2 (3 F)4 p z 2 G° 9 / 2 return 3349.405 393.44 3 d 2 (3 F)4 s a 4 F 9 / 2 30240.88 3 d 2 (3 F)4 p z 4 G° 1 1 / 2 return 3361.227 225.73 3 d 2 (3 F)4 s a 4 F 7 / 2 29968.30 3 d 2 (3 F)4 p z 4 G° 9 / 2 return 3372.798 94.10 3 d 2 (3 F)4 s a 4 F 5 / 2 29734.54 3 d 2 (3 F)4 p z 4 G° 7 / 2 return 3383.769 0.00 3 d 2 (3 F)4 s a 4 F 3 / 2 29544.37 3 d 2 (3 F)4 p z 4 G° 5 / 2 return 3685.205 4628.58 3 d 2 (3 F)4 s a 2 F 5 / 2 31756.51 3 d 2 (3 F)4 p z 2 D° 3 / 2 return 3685.205 4897.65 3 d 2 (3 F)4 s a 2 F 7 / 2 32025.47 3 d 2 (3 F)4 p z 2 D° 5 / 2 return 3759.300 4897.65 3 d 2 (3 F)4 s a 2 F 7 / 2 31490.82 3 d 2 (3 F)4 p z 2 F° 7 / 2 return 3761.326 4628.58 3 d 2 (3 F)4 s a 2 F 5 / 2 31207.42 3 d 2 (3 F)4 p z 2 F° 5 / 2 return

Persistent Lines of Singly Ionized Vanadium (V I|)

Persistent Lines of Singly Ionized Vanadium (V II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2687.954 339.21 3 d 4 a 5 D 4 37531.08 3 d 3 (4 F)4 p z 5 D° 4 return 2700.937 339.21 3 d 4 a 5 D 4 37352.45 3 d 3 (4 F)4 p z 5 F° 5 return 2893.307 2968.27 3 d 3 (4 F)4 s a 5 F 4 37520.57 3 d 3 (4 F)4 p z 5 D° 3 return 2908.810 3162.80 3 d 3 (4 F)4 s a 5 F 5 37531.08 3 d 3 (4 F)4 p z 5 D° 4 return 2924.017 3162.80 3 d 3 (4 F)4 s a 5 F 5 37352.45 3 d 3 (4 F)4 p z 5 F° 5 return 2924.630 2968.27 3 d 3 (4 F)4 s a 5 F 4 37150.51 3 d 3 (4 F)4 p z 5 F° 4 return 3093.102 3162.80 3 d 3 (4 F)4 s a 5 F 5 35483.39 3 d 3 (4 F)4 p z 5 G° 6 return 3102.292 2968.27 3 d 3 (4 F)4 s a 5 F 4 35193.13 3 d 3 (4 F)4 p z 5 G° 5 return 3110.709 2808.82 3 d 3 (4 F)4 s a 5 F 3 34946.55 3 d 3 (4 F)4 p z 5 G° 4 return 3118.376 2687.11 3 d 3 (4 F)4 s a 5 F 2 34745.72 3 d 3 (4 F)4 p z 5 G° 3 return 3125.282 2604.88 3 d 3 (4 F)4 s a 5 F 1 34592.75 3 d 3 (4 F)4 p z 5 G° 2 return 3190.686 9097.83 3 d 3 (4 F)4 s a 3 F 4 40430.04 3 d 3 (4 F)4 p z 3 F° 4 return 3276.130 9097.83 3 d 3 (4 F)4 s a 3 F 4 39612.96 3 d 3 (4 F)4 p z 3 G° 5 return

Persistent Lines of Singly Ionized Arsenic (As I|)

Persistent Lines of Singly Ionized Arsenic (As II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1243.08 1063.49 4 p 2 3 P 1 81508.925 4 p 5 s (3 / 2 , 1 / 2)° 2 return 1263.77 0.0 4 p 2 3 P 0 79128.33 4 p 5 s (1 / 2 , 1 / 2)° 1 return 1341.55 10095.82 4 p 2 1 D 2 84636.186 4 p 4 d 3 P° 1 return 1369.77 10095.82 4 p 2 1 D 2 83100.804 4 p 4 d 1 D° 2 return 1375.07 10095.82 4 p 2 1 D 2 82819.214 4 p 5 s (3 / 2 , 1 / 2)° 1 return

Persistent Lines of Singly Ionized Bromine (Br I|)

Persistent Lines of Singly Ionized Bromine (Br II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 889.25 0.00 4 p 4 3 P 2 112454.52 4 p 3 (4 S°)4 d 3 D° 3 return 1015.53 0.00 4 p 4 3 P 2 98470.12 4 p 3 (4 S°)5 s 3 S° 1 return 1048.94 3136.50 4 p 4 3 P 1 98470.12 4 p 3 (4 S°)5 s 3 S° 1 return 4704.92 93921.36 4 p 3 (4 S°)5 s 5 S° 2 115170.02 4 p 3 (4 S°)5 p 5 P 3 return 4785.48 93921.36 4 p 3 (4 S°)5 s 5 S° 2 114812.00 4 p 3 (4 S°)5 p 5 P 2 return 4816.68 93921.36 4 p 3 (4 S°)5 s 5 S° 2 114676.79 4 p 3 (4 S°)5 p 5 P 1 return

Persistent Lines of Singly Ionized Copper (Cu I|)

Persistent Lines of Singly Ionized Copper (Cu II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1358.773 0.000 3 d 1 0 1 S 0 73595.813 3 d 9 4 p 1 P° 1 return 1367.951 0.000 3 d 1 0 1 S 0 73102.038 3 d 9 4 p 3 D° 1 return 1979.956 22847.131 3 d 9 4 s 3 D 2 73353.292 3 d 9 4 p 3 D° 2 return 1999.698 21928.754 3 d 9 4 s 3 D 3 71920.102 3 d 9 4 p 3 D° 3 return 2035.854 23998.381 3 d 9 4 s 3 D 1 73102.038 3 d 9 4 p 3 D° 1 return 2037.127 22847.131 3 d 9 4 s 3 D 2 71920.102 3 d 9 4 p 3 D° 3 return 2043.802 21928.754 3 d 9 4 s 3 D 3 70841.470 3 d 9 4 p 1 F° 3 return 2135.981 21928.754 3 d 9 4 s 3 D 3 68730.893 3 d 9 4 p 3 F° 4 return 2192.268 22847.131 3 d 9 4 s 3 D 2 68447.741 3 d 9 4 p 3 F° 3 return 2218.108 22847.131 3 d 9 4 s 3 D 2 67916.555 3 d 9 4 p 3 P° 1 return 2247.002 21928.754 3 d 9 4 s 3 D 3 66418.687 3 d 9 4 p 3 P° 2 return

Persistent Lines of Singly Ionized Gallium (Ga I|)

Persistent Lines of Singly Ionized Gallium (Ga II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1414.401 0.00 4 s 2 1 S 0 70701.27 4 s 4 p 1 P° 1 return 1535.309 48749.74 4 s 4 p 3 P° 2 113883.19 4 s 4 d 3 D 3 return 1813.878 47814.05 4 s 4 p 3 P° 1 102944.55 4 s 5 s 3 S 1 return 1845.199 48749.74 4 s 4 p 3 P° 2 102944.55 4 s 5 s 3 S 1 return 2090.771 0.00 4 s 2 1 S 0 47814.05 4 s 4 p 3 P° 1 return 6334.05 102944.55 4 s 5 s 3 S 1 118727.89 4 s 5 p 3 P° 2 return 6419.23 102944.55 4 s 5 s 3 S 1 118518.47 4 s 5 p 3 P° 1 return 6455.89 102944.55 4 s 5 s 3 S 1 118430.02 4 s 5 p 3 P° 0 return

Persistent Lines of Singly Ionized Germanium (Ge I|)

Persistent Lines of Singly Ionized Germanium (Ge II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1106.74 1767.357 4 s 2 4 p 2 P° 3 / 2 92122.7 4 s 4 p 2 2 P 3 / 2 return 1120.46 1767.357 4 s 2 4 p 2 P° 3 / 2 91016.2 4 s 4 p 2 2 P 1 / 2 return 1188.73 1767.357 4 s 2 4 p 2 P° 3 / 2 85890.55 4 s 4 p 2 2 S 1 / 2 return 1237.059 0.000 4 s 2 4 p 2 P° 1 / 2 80836.880 4 s 2 4 d 2 D 3 / 2 return 1261.905 1767.357 4 s 2 4 p 2 P° 3 / 2 81012.598 4 s 2 4 d 2 D 5 / 2 return 1576.855 1767.357 4 s 2 4 p 2 P° 3 / 2 65184.738 4 s 4 p 2 2 D 5 / 2 return 1938.008 1767.357 4 s 2 4 p 2 P° 3 / 2 53366.738 4 s 4 p 2 4 P 5 / 2 return 1938.891 0.000 4 s 2 4 p 2 P° 1 / 2 51575.885 4 s 4 p 2 4 P 1 / 2 return 2831.843 65015.672 4 s 4 p 2 2 D 3 / 2 100317.976 4 s 2 4 f 2 F° 5 / 2 return 2845.527 65184.738 4 s 4 p 2 2 D 5 / 2 100317.283 4 s 2 4 f 2 F° 7 / 2 return 4741.806 79006.985 4 s 2 5 p 2 P° 1 / 2 100090.088 4 s 2 5 d 2 D 3 / 2 return 4814.608 79366.627 4 s 2 5 p 2 P° 3 / 2 100130.936 4 s 2 5 d 2 D 5 / 2 return 5893.389 62403.15 4 s 2 5 s 2 S 1 / 2 79366.627 4 s 2 5 p 2 P° 3 / 2 return 6021.041 62403.15 4 s 2 5 s 2 S 1 / 2 79006.985 4 s 2 5 p 2 P° 1 / 2 return

Persistent Lines of Singly Ionized Krypton (Kr I|)

Persistent Lines of Singly Ionized Krypton (Kr II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 844.06 0.00 4 p 5 2 P° 3 / 2 118474.36 4 p 4 (3 P)5 s 2 P 3 / 2 return 886.30 0.00 4 p 5 2 P° 3 / 2 112828.27 4 p 4 (3 P)5 s 4 P 5 / 2 return 917.43 0.00 4 p 5 2 P° 3 / 2 109000.36 4 s 4 p 6 2 S 1 / 2 return 964.97 5370.10 4 p 5 2 P° 1 / 2 109000.36 4 s 4 p 6 2 S 1 / 2 return 4355.477 112828.27 4 p 4 (3 P)5 s 4 P 5 / 2 135781.42 4 p 4 (3 P)5 p 4 D° 7 / 2 return 4619.166 118474.36 4 p 4 (3 P)5 s 2 P 3 / 2 140117.23 4 p 4 (3 P)5 p 2 D° 5 / 2 return 4658.876 112828.27 4 p 4 (3 P)5 s 4 P 5 / 2 134286.67 4 p 4 (3 P)5 p 4 P° 3 / 2 return 4739.002 112828.27 4 p 4 (3 P)5 s 4 P 5 / 2 133923.86 4 p 4 (3 P)5 p 4 P° 5 / 2 return 4765.744 115092.01 4 p 4 (3 P)5 s 4 P 3 / 2 136069.23 4 p 4 (3 P)5 p 4 D° 5 / 2 return 4832.077 115092.01 4 p 4 (3 P)5 s 4 P 3 / 2 135781.26 4 p 4 (3 P)5 p 4 P° 1 / 2 return 4846.612 118474.36 4 p 4 (3 P)5 s 2 P 3 / 2 139101.57 4 p 4 (3 P)5 p 2 P° 1 / 2 return 9577.52 129697.19 4 p 4 (3 P)4 d 4 F 5 / 2 140135.40 4 p 4 (3 P)5 p 2 P° 3 / 2 return 10221.46 126000.82 4 p 4 (3 P)4 d 4 F 9 / 2 135781.42 4 p 4 (3 P)5 p 4 D° 7 / 2 return

Persistent Lines of Singly Ionized Rubidium (Rb I|)

Persistent Lines of Singly Ionized Rubidium (Rb II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 589.419 0.00 4 p 6 1 S 0 169658.536 4 p 5 4 d 1 P° 1 return 697.049 0.00 4 p 6 1 S 0 143461.977 4 p 5 4 d 3 P° 1 return 711.187 0.00 4 p 6 1 S 0 140610.047 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 1 return 741.456 0.00 4 p 6 1 S 0 134869.751 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 return 3940.51 133341.607 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 158711.854 4 p 5 (2 P° 3 / 2)5 p 2 [3 / 2] 2 return 4244.40 133341.607 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 156895.486 4 p 5 (2 P° 3 / 2)5 p 2 [5 / 2] 3 return 4775.95 133341.607 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 2 154273.980 4 p 5 (2 P° 3 / 2)5 p 2 [1 / 2] 1 return 5152.08 134869.751 4 p 5 (2 P° 3 / 2)5 s 2 [3 / 2]° 1 154273.980 4 p 5 (2 P° 3 / 2)5 p 2 [1 / 2] 1 return 6458.33 138794.380 4 p 5 (2 P° 1 / 2)5 s 2 [1 / 2]° 0 154273.980 4 p 5 (2 P° 3 / 2)5 p 2 [1 / 2] 1 return

Persistent Lines of Singly Ionized Selenium (Se I|)

Persistent Lines of Singly Ionized Selenium (Se II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1013.40 0.0 4 s 2 4 p 3 4 S° 3 / 2 98674.4 4 s 2 4 p 2 (3 P)5 s 4 P 5 / 2 return 1033.56 0.0 4 s 2 4 p 3 4 S° 3 / 2 96753.3 4 s 2 4 p 2 (3 P)5 s 4 P 3 / 2 return 1049.65 0.0 4 s 2 4 p 3 4 S° 3 / 2 95270.0 4 s 2 4 p 2 (3 P)5 s 4 P 1 / 2 return 1192.24 0.0 4 s 2 4 p 3 4 S° 3 / 2 83876.7 4 s 4 p 4 4 P 5 / 2 return 4180.90 117798.7 4 s 2 4 p 2 (3 P)5 p 4 D° 7 / 2 141710.1 4 s 2 4 p 2 (3 P)5 d 4 F 9 / 2 return 5227.533 98674.4 4 s 2 4 p 2 (3 P)5 s 4 P 5 / 2 117798.7 4 s 2 4 p 2 (3 P)5 p 4 D° 7 / 2 return 6055.84 104873.7 7 3 / 2 121381.9 4 s 2 4 p 2 (3 P)5 p 2 P° 3 / 2 return

Persistent Lines of Singly Ionized Strontium (Sr I|)

Persistent Lines of Singly Ionized Strontium (Sr II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2152.84 14555.90 4 d 2 D 3 / 2 60991.7 4 f 2 F° 5 / 2 return 2165.96 14836.24 4 d 2 D 5 / 2 60991.7 4 f 2 F° 5 / 2 return 3380.71 23715.19 5 p 2 P° 1 / 2 53286.31 5 d 2 D 3 / 2 return 3464.46 24516.65 5 p 2 P° 3 / 2 53372.97 5 d 2 D 5 / 2 return 4077.71 0.00 5 s 2 S 1 / 2 24516.65 5 p 2 P° 3 / 2 return 4215.52 0.00 5 s 2 S 1 / 2 23715.19 5 p 2 P° 1 / 2 return 4305.45 24516.65 5 p 2 P° 3 / 2 47736.53 6 s 2 S 1 / 2 return 10327.31 14836.24 4 d 2 D 5 / 2 24516.65 5 p 2 P° 3 / 2 return

Persistent Lines of Singly Ionized Zinc (Zn I|)

Persistent Lines of Singly Ionized Zinc (Zn II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2025.4845 0.000 3 d 1 0 4 s 2 S 1 / 2 49355.003 3 d 1 0 4 p 2 P° 3 / 2 return 2062.0011 0.000 3 d 1 0 4 s 2 S 1 / 2 48481.077 3 d 1 0 4 p 2 P° 1 / 2 return 2064.2266 48481.077 3 d 1 0 4 p 2 P° 1 / 2 96909.893 3 d 1 0 4 d 2 D 3 / 2 return 2099.9273 49355.003 3 d 1 0 4 p 2 P° 3 / 2 96960.588 3 d 1 0 4 d 2 D 5 / 2 return 2501.9945 48481.077 3 d 1 0 4 p 2 P° 1 / 2 88437.149 3 d 1 0 5 s 2 S 1 / 2 return 2557.9460 49355.003 3 d 1 0 4 p 2 P° 3 / 2 88437.149 3 d 1 0 5 s 2 S 1 / 2 return 4911.6269 96909.893 3 d 1 0 4 d 2 D 3 / 2 117264.063 3 d 1 0 4 f 2 F° 5 / 2 return 4924.0132 96960.588 3 d 1 0 4 d 2 D 5 / 2 117263.558 3 d 1 0 4 f 2 F° 7 / 2 return

Persistent Lines of Singly Ionized Molybdenum (Mo I|)

Persistent Lines of Singly Ionized Molybdenum (Mo II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2015.109 0.00 4 d 5 a 6 S 5 / 2 49608.74 4 d 4 (5 D)5 p z 6 P° 5 / 2 return 2020.314 0.00 4 d 5 a 6 S 5 / 2 49481.04 4 d 4 (5 D)5 p z 6 P° 7 / 2 return 2038.452 0.00 4 d 5 a 6 S 5 / 2 49040.82 4 d 4 (5 D)5 p z 6 P° 3 / 2 return 2045.973 0.00 4 d 5 a 6 S 5 / 2 48860.57 4 d 4 (5 D)5 p z 4 P° 5 / 2 return 2081.681 0.00 4 d 5 a 6 S 5 / 2 48022.45 4 d 4 (5 D)5 p z 4 P° 3 / 2 return 2089.52 15199.25 4 d 5 a 4 G 5 / 2 63041.47 4 d 4 (3 H)5 p y 4 G° 5 / 2 return 2092.50 15330.56 4 d 5 a 4 G 7 / 2 63104.63 4 d 4 (a 3 F)5 p y 4 F° 7 / 2 return 2093.11 15446.97 4 d 5 a 4 G 1 1 / 2 63207.43 4 d 4 (3 H)5 p y 4 G° 1 1 / 2 return 2100.84 15427.73 4 d 5 a 4 G 9 / 2 63012.24 1° 7 / 2 return 2775.402 13460.70 4 d 4 (5 D)5 s a 6 D 9 / 2 49481.04 4 d 4 (5 D)5 p z 6 P° 7 / 2 return 2816.158 13460.70 4 d 4 (5 D)5 s a 6 D 9 / 2 48959.68 4 d 4 (5 D)5 p z 6 F° 1 1 / 2 return 2848.233 12900.33 4 d 4 (5 D)5 s a 6 D 7 / 2 47999.47 4 d 4 (5 D)5 p z 6 F° 9 / 2 return 2871.512 12417.28 4 d 4 (5 D)5 s a 6 D 5 / 2 47231.98 4 d 4 (5 D)5 p z 6 F° 7 / 2 return

Persistent Lines of Singly Ionized Niobium (Nb I|)

Persistent Lines of Singly Ionized Niobium (Nb II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2029.3423 4146.036 4 d 3 (4 F)5 s 5 F 5 53407.279 4 d 2 (3 F)5 s 5 p (3 P) 5 D° 4 return 2033.0102 3542.561 4 d 3 (4 F)5 s 5 F 4 52714.892 4 d 2 (3 F)5 s 5 p (3 P) 5 D° 3 return 2109.4384 4146.036 4 d 3 (4 F)5 s 5 F 5 51537.014 4 d 2 (3 F)5 s 5 p (3 P) 5 F° 5 return 2697.060 1224.823 4 d 4 5 D 4 38291.252 4 d 3 (4 F)5 p 5 D° 4 return 2716.622 1224.823 4 d 4 5 D 4 38024.336 4 d 3 (4 F)5 p 5 F° 5 return 2721.981 801.326 4 d 4 5 D 3 37528.382 4 d 3 (4 F)5 p 5 F° 4 return 2875.390 3029.629 4 d 3 (4 F)5 s 5 F 3 37797.316 4 d 3 (4 F)5 p 5 D° 2 return 2883.174 3542.561 4 d 3 (4 F)5 s 5 F 4 38216.387 4 d 3 (4 F)5 p 5 D° 3 return 2927.814 4146.036 4 d 3 (4 F)5 s 5 F 5 38291.252 4 d 3 (4 F)5 p 5 D° 4 return 2950.882 4146.036 4 d 3 (4 F)5 s 5 F 5 38024.336 4 d 3 (4 F)5 p 5 F° 5 return 3094.176 4146.036 4 d 3 (4 F)5 s 5 F 5 36455.457 4 d 3 (4 F)5 p 5 G° 6 return 3130.782 3542.561 4 d 3 (4 F)5 s 5 F 4 35474.197 4 d 3 (4 F)5 p 5 G° 5 return 3163.401 3029.629 4 d 3 (4 F)5 s 5 F 3 34632.033 4 d 3 (4 F)5 p 5 G° 4 return 3194.975 2629.132 4 d 3 (4 F)5 s 5 F 2 33919.244 4 d 3 (4 F)5 p 5 G° 3 return 3225.467 2356.816 4 d 3 (4 F)5 s 5 F 1 33351.090 4 d 3 (4 F)5 p 5 G° 2 return

Persistent Lines of Singly Ionized Palladium (Pd I|)

Persistent Lines of Singly Ionized Palladium (Pd II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1162.1700 0.000 4 d 9 2 D 5 / 2 86046.027 4 d 8 (1 G)5 p 2 F° 7 / 2 return 1183.4003 3539.242 4 d 9 2 D 3 / 2 88041.479 4 d 8 (3 P)5 p 2 P° 1 / 2 return 1196.4051 3539.242 4 d 9 2 D 3 / 2 87122.977 4 d 8 (1 G)5 p 2 F° 5 / 2 return 1203.9645 0.000 4 d 9 2 D 5 / 2 83058.993 4 d 8 5 p 7° 7 / 2 return 1218.6219 0.000 4 d 9 2 D 5 / 2 82059.859 4 d 8 (1 D)5 p 2 D° 5 / 2 return 1237.0677 3539.242 4 d 9 2 D 3 / 2 84375.505 4 d 8 (3 P)5 p 2 D° 3 / 2 return 1320.0229 0.000 4 d 9 2 D 5 / 2 75756.251 4 d 8 (3 F)5 p 3° 5 / 2 return 1363.6892 0.000 4 d 9 2 D 5 / 2 73330.436 4 d 8 (3 F)5 p 4 F° 7 / 2 return 1367.7039 0.000 4 d 9 2 D 5 / 2 73115.191 4 d 8 (3 F)5 p 2° 5 / 2 return 1374.8481 0.000 4 d 9 2 D 5 / 2 72735.273 4 d 8 (3 F)5 p 4 F° 5 / 2 return 2231.5907 25084.270 4 d 8 (3 F)5 s 4 F 9 / 2 69881.432 4 d 8 (3 F)5 p 4 F° 9 / 2 return 2296.5164 25084.270 4 d 8 (3 F)5 s 4 F 9 / 2 68615.072 4 d 8 (3 F)5 p 4 G° 1 1 / 2 return 2351.3469 27097.084 4 d 8 (3 F)5 s 4 F 7 / 2 69612.887 4 d 8 (3 F)5 p 4 G° 7 / 2 return 2367.9664 25084.270 4 d 8 (3 F)5 s 4 F 9 / 2 67301.702 4 d 8 (3 F)5 p 1° 9 / 2 return 2446.1888 27097.084 4 d 8 (3 F)5 s 4 F 7 / 2 67964.621 4 d 8 (3 F)5 p 4 D° 5 / 2 return 2486.5260 27097.084 4 d 8 (3 F)5 s 4 F 7 / 2 67301.702 4 d 8 (3 F)5 p 1° 9 / 2 return 2488.9146 25084.270 4 d 8 (3 F)5 s 4 F 9 / 2 65250.309 4 d 8 (3 F)5 p 4 D° 7 / 2 return 2498.7769 32280.538 4 d 8 (3 F)5 s 2 F 7 / 2 72288.057 4 d 8 (3 F)5 p 4 G° 9 / 2 return 2854.5776 32280.538 4 d 8 (3 F)5 s 2 F 7 / 2 67301.702 4 d 8 (3 F)5 p 1° 9 / 2 return

Persistent Lines of Singly Ionized Rhodium (Rh I|)

Persistent Lines of Singly Ionized Rhodium (Rh II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1604.45 0.0 4 d 8 a 3 F 4 62326.1 4 d 7 (4 F)5 p z 3 F° 4 return 1624.47 2401.3 4 d 8 a 3 F 3 63959.5 4 d 7 (4 F)5 p z 3 G° 4 return 1628.94 3580.7 4 d 8 a 3 F 2 64970.4 4 d 7 (4 F)5 p z 3 F° 2 return 1634.72 0.0 4 d 8 a 3 F 4 61173.1 4 d 7 (4 F)5 p z 5 G° 4 return 1637.88 2401.3 4 d 8 a 3 F 3 63454.9 4 d 7 (4 F)5 p z 3 F° 3 return 2334.77 16884.8 4 d 7 (4 F)5 s a 5 F 5 59702.4 4 d 7 (4 F)5 p z 5 G° 6 return 2415.84 19792.4 4 d 7 (4 F)5 s a 5 F 3 61173.1 4 d 7 (4 F)5 p z 5 G° 4 return 2461.03 18540.4 4 d 7 (4 F)5 s a 5 F 4 59161.5 4 d 7 (4 F)5 p z 5 D° 4 return 2490.79 16884.8 4 d 7 (4 F)5 s a 5 F 5 57020.8 4 d 7 (4 F)5 p z 5 F° 5 return 2520.52 16884.8 4 d 7 (4 F)5 s a 5 F 5 56547.3 4 d 7 (4 F)5 p z 5 F° 4 return 2715.27 25376.9 4 d 7 (4 F)5 s b 3 F 4 62194.4 4 d 7 (4 F)5 p z 3 G° 5 return 2910.15 25376.9 4 d 7 (4 F)5 s b 3 F 4 59729.4 4 d 7 (4 F)5 p z 5 G° 5 return

Persistent Lines of Singly Ionized Ruthenium (Ru I|)

Persistent Lines of Singly Ionized Ruthenium (Ru II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1875.564 0.0 4 d 7 a 4 F 9 / 2 53317.1 4 d 6 (5 D)5 p z 4 D° 7 / 2 return 1888.043 0.0 4 d 7 a 4 F 9 / 2 52964.4 4 d 6 (5 D)5 p z 4 F° 9 / 2 return 1903.221 1523.1 4 d 7 a 4 F 7 / 2 54065.4 4 d 6 (5 D)5 p z 4 D° 5 / 2 return 1916.816 2493.9 4 d 7 a 4 F 5 / 2 54663.4 4 d 6 (5 D)5 p z 4 D° 3 / 2 return 1939.043 2493.9 4 d 7 a 4 F 5 / 2 54065.4 4 d 6 (5 D)5 p z 4 D° 5 / 2 return 1939.505 3104.2 4 d 7 a 4 F 3 / 2 54663.4 4 d 6 (5 D)5 p z 4 D° 3 / 2 return 2357.916 9151.4 4 d 6 (5 D)5 s a 6 D 9 / 2 51548.8 4 d 6 (5 D)5 p z 6 P° 7 / 2 return 2402.72 9151.4 4 d 6 (5 D)5 s a 6 D 9 / 2 50758.3 4 d 6 (5 D)5 p z 6 F° 1 1 / 2 return 2456.438 10851.7 4 d 6 (5 D)5 s a 6 D 5 / 2 51548.8 4 d 6 (5 D)5 p z 6 P° 7 / 2 return 2456.57 10150.4 4 d 6 (5 D)5 s a 6 D 7 / 2 50845.3 4 d 6 (5 D)5 p z 6 F° 9 / 2 return 2478.93 10851.7 4 d 6 (5 D)5 s a 6 D 5 / 2 51179.7 4 d 6 (5 D)5 p z 6 F° 5 / 2 return 2507.01 11303.8 4 d 6 (5 D)5 s a 6 D 3 / 2 51179.7 4 d 6 (5 D)5 p z 6 F° 5 / 2 return 2661.61 9151.4 4 d 6 (5 D)5 s a 6 D 9 / 2 46711.5 4 d 6 (5 D)5 p z 6 D° 7 / 2 return 2678.76 9151.4 4 d 6 (5 D)5 s a 6 D 9 / 2 46471.0 4 d 6 (5 D)5 p z 6 D° 9 / 2 return 2712.41 10851.7 4 d 6 (5 D)5 s a 6 D 5 / 2 47708.6 4 d 6 (5 D)5 p z 6 D° 3 / 2 return 2734.35 10150.4 4 d 6 (5 D)5 s a 6 D 7 / 2 46711.5 4 d 6 (5 D)5 p z 6 D° 7 / 2 return 2976.584 19378.7 4 d 6 (5 D)5 s a 4 D 7 / 2 52964.4 4 d 6 (5 D)5 p z 4 F° 9 / 2 return

Persistent Lines of Singly Ionized Technetium (Tc I|)

Persistent Lines of Singly Ionized Technetium (Tc II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2543.23 0.00 4 d 5 (6 S)5 s a 7 S 3 39308.38 4 d 5 (6 S)5 p z 7 P° 4 return 2609.99 0.00 4 d 5 (6 S)5 s a 7 S 3 38302.80 4 d 5 (6 S)5 p z 7 P° 3 return 2647.01 0.00 4 d 5 (6 S)5 s a 7 S 3 37767.21 4 d 5 (6 S)5 p z 7 P° 2 return 3195.20 12617.20 4 d 5 (6 S)5 s a 5 S 2 43905.00 4 d 5 (6 S)5 p z 5 P° 1 return 3212.02 12617.20 4 d 5 (6 S)5 s a 5 S 2 43741.33 4 d 5 (6 S)5 p z 5 P° 2 return 3237.02 12617.20 4 d 5 (6 S)5 s a 5 S 2 43500.96 4 d 5 (6 S)5 p z 5 P° 3 return

Persistent Lines of Singly Ionized Yttrium (Y I|)

Persistent Lines of Singly Ionized Yttrium (Y II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3242.272 1449.752 4 d 5 s 3 D 3 32283.420 4 d 5 p 3 P° 2 return 3549.002 1045.076 4 d 5 s 3 D 2 29213.958 4 d 5 p 3 D° 3 return 3600.731 1449.752 4 d 5 s 3 D 3 29213.958 4 d 5 p 3 D° 3 return 3611.043 1045.076 4 d 5 s 3 D 2 28730.010 4 d 5 p 3 D° 2 return 3633.121 0.000 5 s 2 1 S 0 27516.699 4 d 5 p 1 P° 1 return 3710.287 1449.752 4 d 5 s 3 D 3 28394.177 4 d 5 p 3 F° 4 return 3774.330 1045.076 4 d 5 s 3 D 2 27532.321 4 d 5 p 3 F° 3 return 3832.889 1449.752 4 d 5 s 3 D 3 27532.321 4 d 5 p 3 F° 3 return 3982.592 1045.076 4 d 5 s 3 D 2 26147.252 4 d 5 p 1 D° 2 return 4177.528 3296.180 4 d 5 s 1 D 2 27227.027 4 d 5 p 3 F° 2 return 4374.933 3296.180 4 d 5 s 1 D 2 26147.252 4 d 5 p 1 D° 2 return 4883.682 8743.322 4 d 2 3 F 4 29213.958 4 d 5 p 3 D° 3 return 4900.118 8328.039 4 d 2 3 F 3 28730.010 4 d 5 p 3 D° 2 return 5087.418 8743.322 4 d 2 3 F 4 28394.177 4 d 5 p 3 F° 4 return 5205.722 8328.039 4 d 2 3 F 3 27532.321 4 d 5 p 3 F° 3 return

Persistent Lines of Singly Ionized Zirconium (Zr I|)

Persistent Lines of Singly Ionized Zirconium (Zr II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2568.871 1322.730 4 d 2 (a 3 F)5 s a 4 F 9 / 2 40238.668 4 d 5 s (a 3 D)5 p x 4 D° 7 / 2 return 2571.457 763.428 4 d 2 (a 3 F)5 s a 4 F 7 / 2 39640.238 4 d 5 s (a 3 D)5 p x 4 D° 5 / 2 return 2678.632 1322.730 4 d 2 (a 3 F)5 s a 4 F 9 / 2 38644.130 4 d 5 s (a 3 D)5 p y 4 F° 9 / 2 return 2722.609 1322.730 4 d 2 (a 3 F)5 s a 4 F 9 / 2 38041.326 4 d 2 (a 3 P)5 p y 4 D° 7 / 2 return 2734.851 314.673 4 d 2 (a 3 F)5 s a 4 F 5 / 2 36868.921 4 d 5 s (a 3 D)5 p y 4 F° 5 / 2 return 3279.264 763.428 4 d 2 (a 3 F)5 s a 4 F 7 / 2 31249.288 4 d 2 (a 3 F)5 p z 4 F° 7 / 2 return 3391.972 1322.730 4 d 2 (a 3 F)5 s a 4 F 9 / 2 30795.649 4 d 2 (a 3 F)5 p z 4 G° 1 1 / 2 return 3438.231 763.428 4 d 2 (a 3 F)5 s a 4 F 7 / 2 29839.821 4 d 2 (a 3 F)5 p z 4 G° 9 / 2 return 3479.387 5752.868 4 d 2 (a 3 F)5 s a 2 F 5 / 2 34485.338 4 d 2 (a 3 F)5 p z 2 G° 7 / 2 return 3481.155 6467.509 4 d 2 (a 3 F)5 s a 2 F 7 / 2 35185.385 4 d 2 (a 3 F)5 p z 2 G° 9 / 2 return 3496.206 314.673 4 d 2 (a 3 F)5 s a 4 F 5 / 2 28908.930 4 d 2 (a 3 F)5 p z 4 G° 7 / 2 return 3551.951 763.428 4 d 2 (a 3 F)5 s a 4 F 7 / 2 28908.930 4 d 2 (a 3 F)5 p z 4 G° 7 / 2 return 3556.594 3757.732 4 d 3 b 4 F 9 / 2 31866.493 4 d 2 (a 3 F)5 p z 4 F° 9 / 2 return 3572.468 0.000 4 d 2 (a 3 F)5 s a 4 F 3 / 2 27983.864 4 d 2 (a 3 F)5 p z 4 G° 5 / 2 return 3576.853 3299.732 4 d 3 b 4 F 7 / 2 31249.288 4 d 2 (a 3 F)5 p z 4 F° 7 / 2 return 3836.761 4505.496 4 d 2 (a 1 D)5 s a 2 D 5 / 2 30561.756 4 d 2 (a 3 F)5 p z 2 F° 7 / 2 return 4149.198 6467.509 4 d 2 (a 3 F)5 s a 2 F 7 / 2 30561.756 4 d 2 (a 3 F)5 p z 2 F° 7 / 2 return

Persistent Lines of Singly Ionized Antimony (Sb I|)

Persistent Lines of Singly Ionized Antimony (Sb II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1274.938 12789.8 5 s 2 5 p 2 1 D 2 91225.0 5 s 2 5 p 5 d 1 F° 3 return 1327.378 3054.6 5 s 2 5 p 2 3 P 1 78390.9 5 s 5 p 3 3 P° 2 return 1384.656 3054.6 5 s 2 5 p 2 3 P 1 75274.5 5 s 2 5 p 6 s 3 P° 2 return 1387.565 5658.2 5 s 2 5 p 2 3 P 2 77726.9 5 s 2 5 p 5 d 3 F° 3 return 1436.447 5658.2 5 s 2 5 p 2 3 P 2 75274.5 5 s 2 5 p 6 s 3 P° 2 return 1576.099 3054.6 5 s 2 5 p 2 3 P 1 66502.3 5 s 5 p 3 3 D° 2 return 1606.952 5658.2 5 s 2 5 p 2 3 P 2 67887.5 5 s 5 p 3 3 D° 3 return 5568.12 75898.9 5 s 2 5 p 6 s 1 P° 1 93853.2 5 s 2 5 p 6 p 1 D 2 return 6005.57 69535.7 5 s 2 5 p 6 s 3 P° 1 86183.6 5 s 2 5 p 6 p 3 D 2 return 6130.00 75274.5 5 s 2 5 p 6 s 3 P° 2 91583.2 5 s 2 5 p 6 p 3 D 3 return

Persistent Lines of Singly Ionized Barium (Ba I|)

Persistent Lines of Singly Ionized Barium (Ba II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2304.247 4873.852 5 d 2 D 3 / 2 48258.617 4 f 2 F° 5 / 2 return 2335.267 5674.824 5 d 2 D 5 / 2 48483.332 4 f 2 F° 7 / 2 return 3891.779 20261.561 6 p 2 P° 1 / 2 45949.472 6 d 2 D 3 / 2 return 4130.649 21952.404 6 p 2 P° 3 / 2 46154.847 6 d 2 D 5 / 2 return 4554.033 0.000 6 s 2 S 1 / 2 21952.404 6 p 2 P° 3 / 2 return 4934.077 0.000 6 s 2 S 1 / 2 20261.561 6 p 2 P° 1 / 2 return 6141.713 5674.824 5 d 2 D 5 / 2 21952.404 6 p 2 P° 3 / 2 return 6496.898 4873.852 5 d 2 D 3 / 2 20261.561 6 p 2 P° 1 / 2 return

Persistent Lines of Singly Ionized Cadmium (Cd I|)

Persistent Lines of Singly Ionized Cadmium (Cd II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2144.408 0.00 4 d 1 0 5 s 2 S 1 / 2 46618.55 4 d 1 0 5 p 2 P° 3 / 2 return 2265.018 0.00 4 d 1 0 5 s 2 S 1 / 2 44136.08 4 d 1 0 5 p 2 P° 1 / 2 return 2312.766 46618.55 4 d 1 0 5 p 2 P° 3 / 2 89843.78 4 d 1 0 5 d 2 D 5 / 2 return 2572.930 44136.08 4 d 1 0 5 p 2 P° 1 / 2 82990.66 4 d 1 0 6 s 2 S 1 / 2 return 2748.549 46618.55 4 d 1 0 5 p 2 P° 3 / 2 82990.66 4 d 1 0 6 s 2 S 1 / 2 return

Persistent Lines of Singly Ionized Cesium (Cs I|)

Persistent Lines of Singly Ionized Cesium (Cs II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 808.76 0.0 5 p 6 1 S 0 123645.5813 5 p 5 (2 P° 3 / 2)5 d 2 [3 / 2]° 1 return 813.84 0.0 5 p 6 1 S 0 122875.4487 5 p 5 (2 P° 1 / 2)6 s 2 [1 / 2]° 1 return 901.27 0.0 5 p 6 1 S 0 110954.3607 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 1 return 926.66 0.0 5 p 6 1 S 0 107914.1587 5 p 5 (2 P° 3 / 2)5 d 2 [1 / 2]° 1 return 4526.74 107914.1587 5 p 5 (2 P° 3 / 2)5 d 2 [1 / 2]° 1 129998.9106 5 p 5 (2 P° 3 / 2)6 p 2 [3 / 2] 1 return 4603.79 107401.5602 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 129116.7070 5 p 5 (2 P° 3 / 2)6 p 2 [5 / 2] 3 return 5227.04 107401.5602 5 p 5 (2 P° 3 / 2)6 s 2 [3 / 2]° 2 126527.5324 5 p 5 (2 P° 3 / 2)6 p 2 [1 / 2] 1 return

Persistent Lines of Singly Ionized Indium (In I|)

Persistent Lines of Singly Ionized Indium (In II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1586.340 0.0 5 s 2 1 S 0 63038.18 5 s 5 p 1 P° 1 return 1936.217 42276.4 5 s 5 p 3 P° 0 93923.40 5 s 6 s 3 S 1 return 1966.711 63038.18 5 s 5 p 1 P° 1 113884.44 5 s 5 d 1 D 2 return 1977.359 43350.9 5 s 5 p 3 P° 1 93923.40 5 s 6 s 3 S 1 return 2078.608 45829.6 5 s 5 p 3 P° 2 93923.40 5 s 6 s 3 S 1 return 2306.046 0.0 5 s 2 1 S 0 43350.9 5 s 5 p 3 P° 1 return 2554.434 63038.18 5 s 5 p 1 P° 1 102174.00 5 s 5 d 3 D 2 return 2890.179 63038.18 5 s 5 p 1 P° 1 97627.98 5 p 2 1 D 2 return 2941.050 63038.18 5 s 5 p 1 P° 1 97029.73 5 s 6 s 1 S 0 return 6891.56 93923.40 5 s 6 s 3 S 1 108429.89 5 s 6 p 3 P° 2 return 7182.89 93923.40 5 s 6 s 3 S 1 107841.54 5 s 6 p 3 P° 1 return

Persistent Lines of Singly Ionized Iodine (I I|)

Persistent Lines of Singly Ionized Iodine (I II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1034.66 0.0 5 p 4 3 P 2 96650.55 5 p 3 (2 D°)6 s 3 D° 3 return 1139.80 0.0 5 p 4 3 P 2 87734.06 5 p 3 (4 S)5 d 5 D° 1 return 1160.56 0.0 5 p 4 3 P 2 86164.86 5 p 3 (4 S)5 d 5 D° 2 return 1166.48 0.0 5 p 4 3 P 2 85727.98 5 p 3 (4 S)5 d 5 D° 3 return 1178.65 0.0 5 p 4 3 P 2 84842.87 5 p 3 (4 S)6 s 3 S° 1 return 1187.34 0.0 5 p 4 3 P 2 84222.19 5 s 5 p 5 3 P° 1 return 1190.85 13727.2 5 p 4 1 D 2 97700.81 5 p 3 (2 D°)6 s 1 D° 2 return 1220.89 0.0 5 p 4 3 P 2 81907.83 5 s 5 p 5 3 P° 2 return 1234.06 0.0 5 p 4 3 P 2 81032.70 5 p 3 (4 S)6 s 5 S° 2 return 1336.52 7087.0 5 p 4 3 P 1 81907.83 5 s 5 p 5 3 P° 2 return 5161.20 81032.70 5 p 3 (4 S)6 s 5 S° 2 100402.68 5 p 3 (4 S)6 p 5 P 3 return 5338.22 93691.35 5 p 3 (2 D°)6 s 3 D° 2 112419.04 5 p 3 (2 D°)6 p 3 F 3 return 5345.15 96650.55 5 p 3 (2 D°)6 s 3 D° 3 115353.94 5 p 3 (2 D°)6 p 3 F 4 return 5464.62 81032.70 5 p 3 (4 S)6 s 5 S° 2 99327.14 5 p 3 (4 S)6 p 5 P 2 return 5625.69 84842.87 5 p 3 (4 S)6 s 3 S° 1 102613.52 5 p 3 (4 S)6 p 3 P 2 return

Persistent Lines of Singly Ionized Silver (Ag I|)

Persistent Lines of Singly Ionized Silver (Ag II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1106.9931 0.000 4 d 1 0 1 S 0 90334.836 4 d 9 (2 D)5 p 3 D° 1 return 1112.4006 0.000 4 d 1 0 1 S 0 89895.502 4 d 9 (2 D)5 p 1 P° 1 return 1195.8092 0.000 4 d 1 0 1 S 0 83625.479 4 d 9 (2 D)5 p 3 P° 1 return 2113.8250 39168.032 4 d 9 (2 D)5 s 3 D 3 86460.650 4 d 9 (2 D)5 p 3 D° 3 return 2246.4120 39167.986 4 d 9 (2 D)5 s 3 D 3 83669.614 4 d 9 (2 D)5 p 3 F° 4 return 2248.7490 40745.335 4 d 9 (2 D)5 s 3 D 2 85200.721 4 d 9 (2 D)5 p 3 F° 2 return 2279.9812 46049.029 4 d 9 (2 D)5 s 1 D 2 89895.502 4 d 9 (2 D)5 p 1 P° 1 return 2320.2451 46049.029 4 d 9 (2 D)5 s 1 D 2 89134.688 4 d 9 (2 D)5 p 1 F° 3 return 2324.6670 39167.986 4 d 9 (2 D)5 s 3 D 3 82171.697 4 d 9 (2 D)5 p 3 F° 3 return 2331.3665 40745.335 4 d 9 (2 D)5 s 3 D 2 83625.479 4 d 9 (2 D)5 p 3 P° 1 return 2413.1883 40745.335 4 d 9 (2 D)5 s 3 D 2 82171.697 4 d 9 (2 D)5 p 3 F° 3 return 2437.7832 39167.986 4 d 9 (2 D)5 s 3 D 3 80176.425 4 d 9 (2 D)5 p 3 P° 2 return

Persistent Lines of Singly Ionized Tellurium (Te I|)

Persistent Lines of Singly Ionized Tellurium (Te II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1077.66 0.000 5 s 2 5 p 3 4 S° 3 / 2 92793.22 17 5 / 2 return 1174.34 0.000 5 s 2 5 p 3 4 S° 3 / 2 85159.66 7 3 / 2 return 1175.79 0.000 5 s 2 5 p 3 4 S° 3 / 2 85049.41 6 5 / 2 return 1324.92 12421.854 5 s 2 5 p 3 2 D° 5 / 2 87899.86 11 7 / 2 return 3521.11 71192.53 5 s 5 p 4 4 P 5 / 2 99584.59 5 s 2 5 p 2 (3 P)6 p 20° 3 / 2 return 4006.52 71192.53 5 s 5 p 4 4 P 5 / 2 96144.74 5 s 2 5 p 2 (3 P)6 p 4 D° 3 / 2 return 4654.37 76300.87 1 1 / 2 97780.09 5 s 2 5 p 2 (3 P)6 p 2 S° 1 / 2 return 5649.26 78448.22 2 1 / 2 96144.74 5 s 2 5 p 2 (3 P)6 p 4 D° 3 / 2 return 5708.12 85591.83 8 5 / 2 103105.86 5 s 2 5 p 2 (3 P)6 p 4 D° 7 / 2 return

Persistent Lines of Singly Ionized Tin (Sn I|)

Persistent Lines of Singly Ionized Tin (Sn II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1400.440 0.000 5 s 2 (1 S)5 p 2 P° 1 / 2 71406.139 5 s 2 (1 S)5 d 2 D 3 / 2 return 1474.997 4251.494 5 s 2 (1 S)5 p 2 P° 3 / 2 72048.257 5 s 2 (1 S)5 d 2 D 5 / 2 return 1899.881 4251.494 5 s 2 (1 S)5 p 2 P° 3 / 2 56886.365 5 s 2 (1 S)6 s 2 S 1 / 2 return 2150.844 4251.494 5 s 2 (1 S)5 p 2 P° 3 / 2 50730.255 5 s 5 p 2 4 P 5 / 2 return 2266.016 4251.494 5 s 2 (1 S)5 p 2 P° 3 / 2 48368.188 5 s 5 p 2 4 P 3 / 2 return 2368.226 4251.494 5 s 2 (1 S)5 p 2 P° 3 / 2 46464.291 5 s 5 p 2 4 P 1 / 2 return 3283.140 58844.182 5 s 5 p 2 2 D 3 / 2 89294.052 5 s 2 (1 S)4 f 2 F° 5 / 2 return 3351.952 59463.482 5 s 5 p 2 2 D 5 / 2 89288.248 5 s 2 (1 S)4 f 2 F° 7 / 2 return 5332.339 71493.275 5 s 2 (1 S)6 p 2 P° 1 / 2 90241.555 5 s 2 (1 S)6 d 2 D 3 / 2 return 5561.910 72377.450 5 s 2 (1 S)6 p 2 P° 3 / 2 90351.894 5 s 2 (1 S)6 d 2 D 5 / 2 return 5588.815 71406.139 5 s 2 (1 S)5 d 2 D 3 / 2 89294.052 5 s 2 (1 S)4 f 2 F° 5 / 2 return 5798.860 72048.257 5 s 2 (1 S)5 d 2 D 5 / 2 89288.248 5 s 2 (1 S)4 f 2 F° 7 / 2 return 6453.542 56886.365 5 s 2 (1 S)6 s 2 S 1 / 2 72377.450 5 s 2 (1 S)6 p 2 P° 3 / 2 return 6844.186 56886.365 5 s 2 (1 S)6 s 2 S 1 / 2 71493.275 5 s 2 (1 S)6 p 2 P° 1 / 2 return

Persistent Lines of Singly Ionized Xenon (Xe I|)

Persistent Lines of Singly Ionized Xenon (Xe II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 972.77 0.00 5 p 5 (2 P°3/ 2) 2 P° 3 / 2 102799.07 5 p 4 (3 P)6 s 2 P 3 / 2 return 1041.31 0.00 5 p 5 2 P° 3 / 2 96033.48 5 p 4 (3 P)5 d 4 D 3 / 2 return 1048.27 0.00 5 p 5 2 P° 3 / 2 95396.74 5 p 4 (3 P)5 d 4 D 5 / 2 return 1051.92 0.00 5 p 5 2 P° 3 / 2 95064.38 5 p 4 (3 P)6 s 4 P 3 / 2 return 1074.48 0.00 5 p 5 2 P° 3 / 2 93068.44 5 p 4 (3 P)6 s 4 P 5 / 2 return 1100.43 0.00 5 p 5 2 P° 3 / 2 90873.83 5 s 5 p 6 2 S 1 / 2 return 1183.05 10537.01 5 p 5 2 P° 1 / 2 95064.38 5 p 4 (3 P)6 s 4 P 3 / 2 return 1244.76 10537.01 5 p 5 2 P° 1 / 2 90873.83 5 s 5 p 6 2 S 1 / 2 return 4844.33 93068.44 5 p 4 (3 P)6 s 4 P 5 / 2 113705.40 5 p 4 (3 P)6 p 4 D° 7 / 2 return 5292.22 93068.44 5 p 4 (3 P)6 s 4 P 5 / 2 111958.89 5 p 4 (3 P)6 p 4 P° 5 / 2 return 5419.15 95064.38 5 p 4 (3 P)6 s 4 P 3 / 2 113512.36 5 p 4 (3 P)6 p 4 D° 5 / 2 return 5976.46 95064.38 5 p 4 (3 P)6 s 4 P 3 / 2 111792.17 5 p 4 (3 P)6 p 4 P° 3 / 2 return 6051.15 95437.67 5 p 4 (3 P)5 d 4 D 7 / 2 111958.89 5 p 4 (3 P)6 p 4 P° 5 / 2 return 6097.59 95396.74 5 p 4 (3 P)5 d 4 D 5 / 2 111792.17 5 p 4 (3 P)6 p 4 P° 3 / 2 return

Persistent Lines of Singly Ionized Cerium (Ce I|)

Persistent Lines of Singly Ionized Cerium (Ce II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3655.843 2563.233 4 f (2 F°)5 d 2 (3 F) 4 I° 1 1 / 2 29908.904 4 f 5 d (3 G°)6 p 4 H 9 / 2 return 3801.520 7233.627 4 f 5 d (3 G°)6 s 4 G° 1 1 / 2 33531.388 4 f 5 d (3 G°)6 p 4 H 1 3 / 2 return 3942.157 0.000 4 f (2 F°)5 d 2 (3 F) 4 H° 7 / 2 25359.686 4 f 5 d (3 F°)6 p 4 G 5 / 2 return 3942.746 6913.392 4 f 5 d (3 H°)6 s 4 H° 1 3 / 2 32269.252 4 f 5 d (3 H°)6 p 4 I 1 5 / 2 return 3952.545 2641.559 4 f 5 d (1 G°)6 s ° 7 / 2 27934.638 4 f 5 d (3 H°)6 p 9 / 2 return 3999.237 2382.246 4 f 5 d (1 G°)6 s ° 9 / 2 27379.949 4 f 5 d (1 G°)6 p 1 1 / 2 return 4012.387 4523.033 4 f 5 d (3 H°)6 s 4 H° 9 / 2 29438.817 4 f 5 d (3 H°)6 p 1 1 / 2 return 4040.752 3593.882 4 f 5 d (1 G°)6 s ° 9 / 2 28334.756 4 f 5 d (3 H°)6 p 9 / 2 return 4133.802 6967.547 4 f 2 (3 H)6 s 4 H 1 3 / 2 31151.534 4 f 2 (3 H 6)6 p 3 / 2 (6, 3 / 2)° 1 1 / 2 return 4137.649 4165.550 4 f 2 (3 H)6 s 4 H 9 / 2 28327.071 4 f 2 (3 H 4)6 p 3 / 2 (4, 3 / 2)° 1 1 / 2 return 4186.596 6967.547 4 f 2 (3 H)6 s 4 H 1 3 / 2 30846.582 4 f 2 (3 H 6)6 p 3 / 2 (6, 3 / 2)° 1 5 / 2 return 4289.935 2641.559 4 f 5 d (1 G°)6 s ° 7 / 2 25945.396 4 f 5 d (1 G°)6 p 7 / 2 return 4460.204 3854.012 4 f 2 (3 H)6 s 4 H 7 / 2 26268.203 4 f 2 (3 H 4)6 p 1 / 2 (4, 1 / 2)° 7 / 2 return 4562.358 3854.012 4 f 2 (3 H)6 s 4 H 7 / 2 25766.355 4 f 2 (3 H 4)6 p 1 / 2 (4, 1 / 2)° 9 / 2 return

Persistent Lines of Singly Ionized Europium (Eu I|)

Persistent Lines of Singly Ionized Europium (Eu II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2727.78 0.00 4 f 7 (8 S°)6 s a 9 S° 4 36648.95 4 f 6 (7 F)5 d (8 P)6 s y 9 P 5 return 2813.94 0.00 4 f 7 (8 S°)6 s a 9 S° 4 35527.02 4 f 6 (7 F)5 d (8 P)6 s y 9 P 4 return 2906.68 0.00 4 f 7 (8 S°)6 s a 9 S° 4 34393.57 4 f 6 (7 F)5 d (8 P)6 s y 9 P 3 return 3688.42 0.00 4 f 7 (8 S°)6 s a 9 S° 4 27104.07 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 3 return 3724.94 0.00 4 f 7 (8 S°)6 s a 9 S° 4 26838.50 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 4 return 3819.67 0.00 4 f 7 (8 S°)6 s a 9 S° 4 26172.83 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 5 return 3907.10 1669.21 4 f 7 (8 S°)6 s a 7 S° 3 27256.35 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 2 return 3930.48 1669.21 4 f 7 (8 S°)6 s a 7 S° 3 27104.07 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 3 return 3971.96 1669.21 4 f 7 (8 S°)6 s a 7 S° 3 26838.50 4 f 7 (8 S° 7 / 2)6 p 3 / 2 (7 / 2 , 3 / 2) 4 return 4129.70 0.00 4 f 7 (8 S°)6 s a 9 S° 4 24207.86 4 f 7 (8 S° 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2) 4 return 4205.05 0.00 4 f 7 (8 S°)6 s a 9 S° 4 23774.28 4 f 7 (8 S° 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2) 3 return 4435.56 1669.21 4 f 7 (8 S°)6 s a 7 S° 3 24207.86 4 f 7 (8 S° 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2) 4 return 4522.57 1669.21 4 f 7 (8 S°)6 s a 7 S° 3 23774.28 4 f 7 (8 S° 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2) 3 return

Persistent Lines of Singly Ionized Gadolinium (Gd I|)

Persistent Lines of Singly Ionized Gadolinium (Gd II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3350.47 1158.943 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 1 1 / 2 30996.851 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 1 3 / 2 return 3358.62 261.841 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 7 / 2 30027.378 4 f 7 (8 S°)5 d (9 D°)6 p 8 D 9 / 2 return 3362.23 633.273 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 9 / 2 30366.818 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 1 1 / 2 return 3422.47 1935.310 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 1 3 / 2 31145.651 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 1 5 / 2 return 3545.80 1158.943 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 1 1 / 2 29353.344 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 1 3 / 2 return 3584.96 1158.943 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 1 1 / 2 29045.291 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 9 / 2 return 3646.19 1935.310 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 1 3 / 2 29353.344 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 1 3 / 2 return 3743.47 1158.943 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 1 1 / 2 27864.534 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 1 1 / 2 return 3768.39 633.273 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 9 / 2 27162.224 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 9 / 2 return 3796.37 261.841 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 7 / 2 26595.222 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 7 / 2 return 3850.97 0.000 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 5 / 2 25960.073 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 3 / 2 return 3852.45 261.841 4 f 7 (8 S°)5 d (9 D°)6 s 1 0 D° 7 / 2 26211.912 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 5 / 2 return 3916.51 4841.106 4 f 7 (8 S°)5 d (9 D°)6 s 8 D° 1 1 / 2 30366.818 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 1 1 / 2 return 4049.86 7992.268 4 f 8 (7 F)6 s 8 F 1 3 / 2 32677.540 4 f 8 (7 F 6)6 p 1 / 2 (6, 1 / 2)° 1 3 / 2 return 4098.61 6605.154 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 1 5 / 2 30996.851 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 D 1 3 / 2 return 4130.37 5897.264 4 f 7 (8 S°)5 d 2 (3 F) 1 0 F° 1 3 / 2 30101.366 4 f 7 (8 S°)5 d (9 D°)6 p 1 1 / 2 return 4184.25 3972.167 4 f 7 (8 S°)5 d (9 D°)6 s 8 D° 9 / 2 27864.534 4 f 7 (8 S°)5 d (9 D°)6 p 1 0 F 1 1 / 2 return

Persistent Lines of Singly Ionized Lanthanum (La I|)

Persistent Lines of Singly Ionized Lanthanum (La II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3759.08 1970.70 5 d 2 a 3 F 4 28565.40 5 d 6 p x 3 F° 4 return 3790.83 1016.10 5 d 2 a 3 F 3 27388.11 5 d 6 p y 3 D° 2 return 3794.78 1970.70 5 d 2 a 3 F 4 28315.25 5 d 6 p y 3 D° 3 return 3871.64 1016.10 5 d 2 a 3 F 3 26837.66 5 d 6 p x 3 F° 3 return 3949.10 3250.35 5 d 6 s a 3 D 3 28565.40 5 d 6 p x 3 F° 4 return 3988.52 3250.35 5 d 6 s a 3 D 3 28315.25 5 d 6 p y 3 D° 3 return 3995.75 1394.46 5 d 2 2 26414.01 5 d 6 p x 3 F° 2 return 4031.69 2591.60 5 d 6 s a 3 D 2 27388.11 5 d 6 p y 3 D° 2 return 4042.91 7473.32 5 d 2 a 1 G 4 32201.05 5 d 6 p x 1 F° 3 return 4077.35 1895.15 5 d 6 s a 3 D 1 26414.01 5 d 6 p x 3 F° 2 return 4086.72 0.00 5 d 2 a 3 F 2 24462.66 5 d 6 p y 1 D° 2 return 4123.23 2591.60 5 d 6 s a 3 D 2 26837.66 5 d 6 p x 3 F° 3 return 4333.74 1394.46 5 d 2 2 24462.66 5 d 6 p y 1 D° 2 return

Persistent Lines of Singly Ionized Neodymium (Nd I|)

Persistent Lines of Singly Ionized Neodymium (Nd II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3784.25 3066.755 4 f 4 (5 I)6 s 4 I 1 1 / 2 29484.605 4 f 4 (5 I)6 p 4 I° 1 1 / 2 return 3805.36 2585.460 4 f 4 (5 I)6 s 6 I 1 3 / 2 28856.895 4 f 4 (5 I)6 p 6 I° 1 5 / 2 return 3851.66 2585.460 4 f 4 (5 I)6 s 6 I 1 3 / 2 28540.945 ° 1 5 / 2 return 3851.74 1470.105 4 f 4 (5 I)6 s 6 I 1 1 / 2 27425.000 4 f 4 (5 I)6 p 6 H° 9 / 2 return 3863.33 0.000 4 f 4 (5 I)6 s 6 I 7 / 2 25877.160 4 f 4 (5 I)6 p 6 I° 9 / 2 return 3863.40 0.000 4 f 4 (5 I)6 s 6 I 7 / 2 25876.545 4 f 4 (5 I)6 p 6 H° 5 / 2 return 3900.21 3801.930 4 f 4 (5 I)6 s 6 I 1 5 / 2 29434.255 4 f 4 (5 I)6 p 6 H° 1 3 / 2 return 3911.16 3801.930 4 f 4 (5 I)6 s 6 I 1 5 / 2 29362.520 ° 1 5 / 2 return 3941.51 513.330 4 f 4 (5 I)6 s 6 I 9 / 2 25877.160 4 f 4 (5 I)6 p 6 I° 9 / 2 return 3951.16 1470.105 4 f 4 (5 I)6 s 6 I 1 1 / 2 26772.080 4 f 4 (5 I)6 p 6 I° 1 1 / 2 return 4012.25 5085.640 4 f 4 (5 I)6 s 6 I 1 7 / 2 30002.310 4 f 4 (5 I)6 p 6 K° 1 9 / 2 return 4040.80 1470.105 4 f 4 (5 I)6 s 6 I 1 1 / 2 26210.740 ° 1 3 / 2 return 4061.09 3801.930 4 f 4 (5 I)6 s 6 I 1 5 / 2 28418.970 4 f 4 (5 I)6 p 6 K° 1 7 / 2 return 4109.46 2585.460 4 f 4 (5 I)6 s 6 I 1 3 / 2 26912.765 4 f 4 (5 I)6 p 6 K° 1 5 / 2 return 4156.08 1470.105 4 f 4 (5 I)6 s 6 I 1 1 / 2 25524.470 4 f 4 (5 I)6 p 6 K° 1 3 / 2 return 4177.32 513.330 4 f 4 (5 I)6 s 6 I 9 / 2 24445.380 4 f 4 (5 I)6 p 6 K° 1 1 / 2 return 4247.38 0.000 4 f 4 (5 I)6 s 6 I 7 / 2 23537.380 ° 9 / 2 return 4303.58 0.000 4 f 4 (5 I)6 s 6 I 7 / 2 23229.980 4 f 4 (5 I)6 p 6 K° 9 / 2 return

Persistent Lines of Singly Ionized Praseodymium (Pr I|)

Persistent Lines of Singly Ionized Praseodymium (Pr II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 4062.804 3403.21 4 f 3 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 6 28009.80 4 f 3 (4 I°)6 p 3 K 7 return 4062.806 2998.36 4 f 3 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 7 27604.94 4 f 2 5 d 2 6 return 4100.717 4437.14 4 f 3 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 28816.25 4 f 3 (4 I°)6 p 5 K 9 return 4143.112 2998.36 4 f 3 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 7 27128.00 4 f 3 (4 I°)6 p 5 K 8 return 4179.391 1649.01 4 f 3 (4 I° 1 1 / 2)6 s 1 / 2 (1 1 / 2 , 1 / 2)° 6 25569.19 4 f 3 (4 I°)6 p 5 K 7 return 4189.479 2998.36 4 f 3 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 7 26860.95 4 f 3 (4 I°)6 p 5 I 7 return 4206.719 4437.14 4 f 3 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 28201.95 4 f 3 (4 I°)6 p 5 I 8 return 4222.931 441.95 4 f 3 (4 I° 9 / 2)6 s 1 / 2 (9 / 2 , 1 / 2)° 5 24115.48 4 f 3 (4 I°)6 p 5 K 6 return 4225.346 0.00 4 f 3 (4 I° 9 / 2)6 s 1 / 2 (9 / 2 , 1 / 2)° 4 23660.08 4 f 3 (4 I°)6 p 5 I 4 return

Persistent Lines of Singly Ionized Promethium (Pm I|)

Persistent Lines of Singly Ionized Promethium (Pm II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3892.15 return 3910.26 2950.31 4 f 5 (6 H°)6 s 7 H° 6 28516.85 7 return 3919.10 return 3936.48 1983.52 4 f 5 (6 H°)6 s 7 H° 5 27379.79 6 return 3957.74 return 3998.96 1133.45 4 f 5 (6 H°)6 s 7 H° 4 26132.87 5 return 4075.84 0.00 4 f 5 (6 H°)6 s 7 H° 2 24527.89 3 return 4086.10 0.00 4 f 5 (6 H°)6 s 7 H° 2 24466.32 3 return 4297.78 0.00 4 f 5 (6 H°)6 s 7 H° 2 23261.30 4 f 5 (6 H°)6 p 7 I 3 return 4417.96 1133.45 4 f 5 (6 H°)6 s 7 H° 4 23761.98 3 return 4453.95 return 4529.21 return 5546.08 6131.47 4 f 5 (6 H°)5 d 7 K° 5 24157.20 4 f 5 (6 H°)6 p 7 I 4 return 5576.02 5332.36 4 f 5 (6 H°)5 d 7 K° 4 23261.30 4 f 5 (6 H°)6 p 7 I 3 return

Persistent Lines of Singly Ionized Samarium (Sm I|)

Persistent Lines of Singly Ionized Samarium (Sm II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3568.271 3909.62 4 f 6 (7 F)6 s 8 F 1 3 / 2 31926.40 4 f 5 5 d 6 s ? ° 1 5 / 2 return 3592.603 3052.65 4 f 6 (7 F)6 s 8 F 1 1 / 2 30879.74 4 f 5 5 d 6 s ? ° 1 3 / 2 return 3609.491 2237.97 4 f 6 (7 F)6 s 8 F 9 / 2 29934.80 4 f 5 5 d 6 s ? ° 1 1 / 2 return 3634.290 1489.16 4 f 6 (7 F)6 s 8 F 7 / 2 28997.14 4 f 5 5 d 6 s ? ° 9 / 2 return 3693.989 0.00 4 f 6 (7 F)6 s 8 F 1 / 2 27063.30 4 f 5 5 d 6 s ? ° 3 / 2 return 3739.117 326.64 4 f 6 (7 F)6 s 8 F 3 / 2 27063.30 4 f 5 5 d 6 s ? ° 3 / 2 return 3739.197 4386.03 4 f 6 (7 F)6 s 6 F 9 / 2 31122.17 ° 1 1 / 2 return 3745.605 0.00 4 f 6 (7 F)6 s 8 F 1 / 2 26690.30 4 f 5 5 d 6 s ? 8 G° 1 / 2 return 3885.286 3909.62 4 f 6 (7 F)6 s 8 F 1 3 / 2 29640.51 4 f 6 (7 F)6 p ? ° 1 3 / 2 return 3922.397 3052.65 4 f 6 (7 F)6 s 8 F 1 1 / 2 28540.12 4 f 6 (7 F)6 p ° 1 1 / 2 return 4256.393 3052.65 4 f 6 (7 F)6 s 8 F 1 1 / 2 26540.12 4 f 5 5 d 6 s ° 1 3 / 2 return 4280.789 3909.62 4 f 6 (7 F)6 s 8 F 1 3 / 2 27263.25 4 f 5 5 d 6 s ° 1 5 / 2 return 4424.339 3909.62 4 f 6 (7 F)6 s 8 F 1 3 / 2 26505.53 4 f 6 (7 F)6 p ° 1 1 / 2 return 4467.342 5317.56 4 f 6 (7 F)6 s 6 F 1 1 / 2 27695.96 4 f 5 5 d 6 s ? ° 1 3 / 2 return

Persistent Lines of Singly Ionized Dysprosium (Dy I|)

Persistent Lines of Singly Ionized Dysprosium (Dy II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3385.014 828.314 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 30361.810 4 f 1 0 (5 I)6 p 4 H° 1 3 / 2 return 3407.792 0.000 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 7 / 2 29336.093 4 f 1 0 (5 I)6 p 6 I° 1 7 / 2 return 3460.966 0.000 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 7 / 2 28885.393 4 f 1 0 (5 I)6 p ° 1 5 / 2 return 3494.489 828.314 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 29436.610 4 f 1 0 (5 I)6 p ° 1 5 / 2 return 3531.703 0.000 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 7 / 2 28306.843 4 f 1 0 (5 I)6 p 6 K° 1 9 / 2 return 3536.018 4341.104 4 f 1 0 (5 I 7)6 s 1 / 2 (7, 1 / 2) 1 5 / 2 32613.423 4 f 9 (6 H°)5 d 2 (3 F) ° 1 7 / 2 return 3630.239 4341.104 4 f 1 0 (5 I 7)6 s 1 / 2 (7, 1 / 2) 1 5 / 2 31879.655 4 f 1 0 (5 I)6 p 6 K° 1 7 / 2 return 3645.396 828.314 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 28252.357 4 f 9 (6 H°)5 d 2 (1 G) ° 1 7 / 2 return 3694.811 828.314 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 27885.593 4 f 9 (6 H°)5 d 2 (3 F) ° 1 5 / 2 return 3757.367 828.314 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 27435.132 4 f 9 (6 H°)5 d 2 (3 P) ° 1 5 / 2 return 3872.103 0.000 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 7 / 2 25818.435 4 f 1 0 (5 I)6 p ° 1 7 / 2 return 3898.528 4755.673 4 f 1 0 (5 I 7)6 s 1 / 2 (7, 1 / 2) 1 3 / 2 30399.107 4 f 9 (6 H°)5 d 2 (3 F) ° 1 5 / 2 return 3944.679 0.000 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 7 / 2 25343.427 4 f 9 (6 H°)5 d 2 (3 P) ° 1 7 / 2 return 3968.384 0.000 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 7 / 2 25192.039 4 f 1 0 (5 I)6 p ° 1 5 / 2 return 4000.449 828.314 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 25818.435 4 f 1 0 (5 I)6 p ° 1 7 / 2 return 4077.965 828.314 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 25343.427 4 f 9 (6 H°)5 d 2 (3 P) ° 1 7 / 2 return 4103.305 828.314 4 f 1 0 (5 I 8)6 s 1 / 2 (8, 1 / 2) 1 5 / 2 25192.039 4 f 1 0 (5 I)6 p ° 1 5 / 2 return

Persistent Lines of Singly Ionized Erbium (Er I|)

Persistent Lines of Singly Ionized Erbium (Er II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3230.582 440.434 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 1 / 2 31385.667 ° 1 1 / 2 return 3264.782 0.000 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 30621.102 4 f 1 2 (3 H 6)6 p 3 / 2 ? (6, 3 / 2)°? 1 3 / 2 return 3312.424 440.434 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 1 / 2 30621.102 4 f 1 2 (3 H 6)6 p 3 / 2 ? (6, 3 / 2)°? 1 3 / 2 return 3372.71 0.000 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 29640.863 4 f 1 2 (3 H 6)6 p 3 / 2 ? (6, 3 / 2)°? 1 5 / 2 return 3391.998 0.000 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 29472.789 ° 1 5 / 2 return 3499.104 440.434 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 1 / 2 29011.015 4 f 1 2 (3 H 6)6 p 3 / 2 ? (6, 3 / 2)°? 9 / 2 return 3616.565 0.000 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 27642.658 ° 1 1 / 2 return 3692.650 440.434 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 1 / 2 27513.555 ° 1 3 / 2 return 3830.482 0.000 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 26098.972 4 f 1 2 (3 H 6)6 p 1 / 2 ? (6, 1 / 2)°? 1 3 / 2 return 3896.234 440.434 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 1 / 2 26098.972 4 f 1 2 (3 H 6)6 p 1 / 2 ? (6, 1 / 2)°? 1 3 / 2 return 3906.311 0.000 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 25592.343 4 f 1 2 (3 H 6)6 p 1 / 2 ? (6, 1 / 2)°? 1 1 / 2 return 3938.626 0.000 4 f 1 2 (3 H 6)6 s 1 / 2 (6, 1 / 2) 1 3 / 2 25382.379 ° 1 1 / 2 return

Persistent Lines of Singly Ionized Holmium (Ho I|)

Persistent Lines of Singly Ionized Holmium (Ho II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3398.95 0.00 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 29412.38 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 8 return 3416.44 637.40 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 29899.21 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 7 return 3453.11 637.40 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 29588.49 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 6 return 3456.02 0.00 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 28926.70 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 9 return 3474.25 637.40 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 29412.38 4 f 1 1 (4 I° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 8 return 3484.80 637.40 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 29325.2 7 return 3515.56 637.40 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 29074.26 6 return 3748.17 return 3796.75 0.00 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 26330.85 4 f 1 1 (4 I° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 8 return 3810.74 0.00 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 26234.19 4 f 1 1 (4 I° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 7 return 3888.96 5849.74 4 f 1 1 (4 I° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 6 31556.3 4 f 1 1 (4 I° 1 3 / 2)6 p 1 / 2 (1 3 / 2 , 1 / 2) 7 return 3890.94 637.40 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 26330.85 4 f 1 1 (4 I° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 8 return 4045.47 0.00 4 f 1 1 (4 I° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 24712.0 7 return

Persistent Lines of Singly Ionized Lutetium (Lu I|)

Persistent Lines of Singly Ionized Lutetium (Lu II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2195.54 0.00 6 s 2 1 S 0 45532.33 5 d 6 p 3 D° 1 return 2615.42 0.00 6 s 2 1 S 0 38223.49 6 s 6 p 1 P° 1 return 2701.71 14199.08 5 d 6 s 3 D 3 51201.66 5 d 6 p 3 P° 2 return 2754.17 12435.32 5 d 6 s 3 D 2 48733.19 5 d 6 p 3 D° 3 return 2894.84 14199.08 5 d 6 s 3 D 3 48733.19 5 d 6 p 3 D° 3 return 2900.30 12435.32 5 d 6 s 3 D 2 46904.38 5 d 6 p 3 D° 2 return 2911.39 14199.08 5 d 6 s 3 D 3 48536.83 5 d 6 p 3 F° 4 return 2963.32 11796.24 5 d 6 s 3 D 1 45532.33 5 d 6 p 3 D° 1 return 3020.54 12435.32 5 d 6 s 3 D 2 45532.33 5 d 6 p 3 D° 1 return 3077.60 12435.32 5 d 6 s 3 D 2 44918.68 5 d 6 p 3 F° 3 return 3254.31 14199.08 5 d 6 s 3 D 3 44918.68 5 d 6 p 3 F° 3 return 3397.07 11796.24 5 d 6 s 3 D 1 41224.96 5 d 6 p 3 F° 2 return 3472.48 12435.32 5 d 6 s 3 D 2 41224.96 5 d 6 p 3 F° 2 return 3507.39 0.00 6 s 2 1 S 0 28503.16 6 s 6 p 3 P° 1 return 3554.43 17332.58 5 d 6 s 1 D 2 45458.56 5 d 6 p 1 D° 2 return 5476.69 14199.08 5 d 6 s 3 D 3 32453.26 6 s 6 p 3 P° 2 return 6221.87 12435.32 5 d 6 s 3 D 2 28503.16 6 s 6 p 3 P° 1 return

Persistent Lines of Singly Ionized Terbium (Tb I|)

Persistent Lines of Singly Ionized Terbium (Tb II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3324.413 3423.295 4 f 8 (7 F)5 d (8 G)6 s 9 G 8 33495.130 ° 9 return 3509.146 0.000 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 28488.810 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 9 return 3561.708 3010.050 4 f 9 (6 H° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 7 31078.460 4 f 9 (6 H° 1 3 / 2)6 p 3 / 2 (1 3 / 2 , 3 / 2) 8 return 3568.513 0.000 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 28014.875 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 8 return 3650.421 3423.295 4 f 8 (7 F)5 d (8 G)6 s 9 G 8 30809.590 4 f 8 5 d 6 p ? ° 8 return 3658.891 1016.380 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 28339.285 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 6 return 3676.363 1016.380 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 28209.430 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 7 return 3702.856 1016.380 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 28014.875 4 f 9 (6 H° 1 5 / 2)6 p 3 / 2 (1 5 / 2 , 3 / 2) 8 return 3703.930 3235.190 4 f 8 (7 F)5 d (8 G)6 s 9 G 7 30225.865 4 f 8 5 d 6 p ? ° 7 return 3765.136 3440.825 4 f 8 (7 F)5 d (8 G)6 s 6 29992.75 ° 5 return 3776.489 3440.825 4 f 8 (7 F)5 d (8 G)6 s 6 29912.930 4 f 8 5 d 6 p ? ° 6 return 3848.740 0.000 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 25975.160 4 f 9 (6 H° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 8 return 3874.172 0.000 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 25804.650 4 f 9 (6 H° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 7 return 3899.197 3010.050 4 f 9 (6 H° 1 3 / 2)6 s 1 / 2 (1 3 / 2 , 1 / 2)° 7 28649.095 4 f 9 (6 H° 1 3 / 2)6 p 1 / 2 (1 3 / 2 , 1 / 2) 7 return 3976.845 0.000 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 25138.450 8 return 4033.027 1016.380 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 7 25804.650 4 f 9 (6 H° 1 5 / 2)6 p 1 / 2 (1 5 / 2 , 1 / 2) 7 return 4645.31 0.000 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 21521.040 7 return 4752.53 0.000 4 f 9 (6 H° 1 5 / 2)6 s 1 / 2 (1 5 / 2 , 1 / 2)° 8 21035.530 8 return

Persistent Lines of Singly Ionized Thulium (Tm I|)

Persistent Lines of Singly Ionized Thulium (Tm II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3131.26 0.00 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 31926.82 4 f 1 2 5 d 6 s 5 return 3362.61 236.95 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 29967.17 4 f 1 2 5 d 6 s 2 return 3425.08 236.95 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 29424.98 4 f 1 2 5 d 6 s 3 return 3441.50 236.95 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 29285.72 4 f 1 3 6 p 2 return 3453.66 236.95 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 29183.39 4 f 1 2 5 d 6 s 4 return 3462.20 0.00 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 28875.12 4 f 1 2 5 d 6 s 5 return 3700.26 236.95 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 27254.42 4 f 1 2 5 d 6 s 4 return 3701.36 0.00 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 27009.39 4 f 1 2 5 d 6 s 4 return 3761.33 0.00 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 26578.77 4 f 1 2 (3 F)6 s 2 3 F 3 return 3761.91 0.00 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 26574.66 4 f 1 2 5 d 6 s 4 return 3795.75 236.95 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 26574.66 4 f 1 2 5 d 6 s 4 return 3848.02 0.00 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 4 25980.02 4 f 1 3 6 p 3 return 4242.15 236.95 4 f 1 3 (2 F° 7 / 2)6 s 1 / 2 (7 / 2 , 1 / 2)° 3 23803.28 4 f 1 2 5 d 6 s 4 return

Persistent Lines of Singly Ionized Ytterbium (Yb I|)

Persistent Lines of Singly Ionized Ytterbium (Yb II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2116.67 0.00 4 f 1 4 (1 S)6 s 2 S 1 / 2 47228.96 4 f 1 3 (2 F° 5 / 2)5 d 6 s (1 D) 1 [1 / 2]° 1 / 2 return 2126.74 0.00 4 f 1 4 (1 S)6 s 2 S 1 / 2 47005.46 4 f 1 3 (2 F° 5 / 2)5 d 6 s (1 D) 1 [3 / 2]° 3 / 2 return 2185.71 0.00 4 f 1 4 (1 S)6 s 2 S 1 / 2 45737.29 4 f 1 3 (2 F° 7 / 2)5 d 2 (3 F) ° 3 / 2 return 2224.46 0.00 4 f 1 4 (1 S)6 s 2 S 1 / 2 44940.61 4 f 1 3 (2 F° 5 / 2)5 d 6 s (3 D) ° 3 / 2 return 2653.75 21418.75 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 59090.13 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) 7 / 2 return 2750.477 21418.75 4 f 1 3 (2 F°)6 s 2 2 F° 7 / 2 57765.32 4 f 1 3 (2 F° 7 / 2)6 s 6 p (1 P° 1) (7 / 2 ,1) 9 / 2 return 2891.384 0.00 4 f 1 4 (1 S)6 s 2 S 1 / 2 34575.37 4 f 1 3 (2 F° 7 / 2)5 d 6 s (1 D) 1 [3 / 2]° 3 / 2 return 2970.564 0.00 4 f 1 4 (1 S)6 s 2 S 1 / 2 33653.86 4 f 1 3 (2 F° 7 / 2)5 d 6 s (3 D) 3 [3 / 2]° 1 / 2 return 3289.370 0.00 4 f 1 4 (1 S)6 s 2 S 1 / 2 30392.23 4 f 1 4 (1 S)6 p 2 P° 3 / 2 return 3694.190 0.00 4 f 1 4 (1 S)6 s 2 S 1 / 2 27061.82 4 f 1 4 (1 S)6 p 2 P° 1 / 2 return

Persistent Lines of Singly Ionized Gold (Au I|)

Persistent Lines of Singly Ionized Gold (Au II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1224.592 0.00 5 d 1 0 1 S 0 81659.828 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 1 / 2)° 1 return 1362.326 0.00 5 d 1 0 1 S 0 73403.839 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 3 / 2)° 1 return 2082.077 15039.572 5 d 9 (2 D 5 / 2)6 s (5 / 2 , 1 / 2) 3 63053.318 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 1 / 2)° 2 return 2110.685 17640.616 5 d 9 (2 D 5 / 2)6 s (5 / 2 , 1 / 2) 2 65003.594 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 1 / 2)° 3 return 2263.627 76659.700 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 1 / 2)° 2 120822.927 5 d 9 (2 D 3 / 2)7 s (3 / 2 , 1 / 2) 1 return 2802.036 72495.129 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 3 / 2)° 4 108172.952 5 d 9 (2 D 5 / 2)7 s (5 / 2 , 1 / 2) 3 return 2822.546 85700.201 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 3 / 2)° 3 121118.779 5 d 9 (2 D 3 / 2)7 s (3 / 2 , 1 / 2) 2 return 2893.247 86565.667 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 3 / 2)° 2 121118.779 5 d 9 (2 D 3 / 2)7 s (3 / 2 , 1 / 2) 2 return 2918.235 86565.667 5 d 9 (2 D 3 / 2)6 p (3 / 2 , 3 / 2)° 2 120822.927 5 d 9 (2 D 3 / 2)7 s (3 / 2 , 1 / 2) 1 return 2994.800 74791.477 5 d 9 (2 D 5 / 2)6 p (5 / 2 , 3 / 2)° 3 108172.952 5 d 9 (2 D 5 / 2)7 s (5 / 2 , 1 / 2) 3 return

Persistent Lines of Singly Ionized Hafnium (Hf I|)

Persistent Lines of Singly Ionized Hafnium (Hf II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2012.78 3050.88 5 d 6 s 2 2 D 5 / 2 52717.46 5 d 2 (3 P)6 p 4 D° 3 / 2 return 2028.18 13485.56 5 d 2 (3 P)6 s 4 P 5 / 2 62774.9 5 d 2 (1 G)6 p 2 F° 5 / 2 return 2516.88 3050.88 5 d 6 s 2 2 D 5 / 2 42770.6 5 d 6 s (3 D)6 p 2 P° 3 / 2 return 2641.41 8361.76 5 d 2 (3 F)6 s 4 F 9 / 2 46209.05 5 d 2 (3 F)6 p 4 G° 1 1 / 2 return 2773.36 6344.34 5 d 2 (3 F)6 s 4 F 7 / 2 42391.09 5 d 2 (3 F)6 p 4 G° 9 / 2 return 2820.22 3050.88 5 d 6 s 2 2 D 5 / 2 38498.53 5 d 2 (3 F)6 p 4 G° 7 / 2 return 3134.72 3050.88 5 d 6 s 2 2 D 5 / 2 34942.36 5 d 2 (3 F)6 p 4 G° 5 / 2 return 3253.70 3050.88 5 d 6 s 2 2 D 5 / 2 33776.24 5 d 6 s (3 D)6 p 4 F° 7 / 2 return 3399.80 0.00 5 d 6 s 2 2 D 3 / 2 29405.12 5 d 6 s (3 D)6 p 4 F° 5 / 2 return 4093.16 3644.65 5 d 2 (3 F)6 s 4 F 3 / 2 28068.79 5 d 6 s (3 D)6 p 4 F° 3 / 2 return

Persistent Lines of Singly Ionized Iridium (Ir I|)

Persistent Lines of Singly Ionized Iridium (Ir II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2126.81 0.00 5 d 7 (4 F)6 s 5 F 5 47003.98 5 d 7 (4 F 9 / 2)6 p 1 / 2 (9 / 2 , 1 / 2)° 5 return 2152.68 4787.93 5 d 7 (4 F)6 s 5 F 4 51226.62 5 d 7 (4 F 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2)° 3 return 2169.42 return 2204.96 8186.96 5 d 7 (4 F)6 s 5 F 3 53525.25 5 d 7 (4 F 7 / 2)6 p 1 / 2 (7 / 2 , 1 / 2)° 4 return 2242.69 0.00 5 d 7 (4 F)6 s 5 F 5 44575.66 5 d 7 (4 F 9 / 2)6 p 1 / 2 (9 / 2 , 1 / 2)° 4 return 2281.02 return 2368.04 4787.93 5 d 7 (4 F)6 s 5 F 4 47003.98 5 d 7 (4 F 9 / 2)6 p 1 / 2 (9 / 2 , 1 / 2)° 5 return 3731.36 return

Persistent Lines of Singly Ionized Mercury (Hg I|)

Persistent Lines of Singly Ionized Mercury (Hg II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1649.9373 0.000 5 d 1 0 (1 S)6 s 2 S 1 / 2 60608.362 5 d 1 0 (1 S)6 p 2 P° 3 / 2 return 1942.273 0.000 5 d 1 0 (1 S)6 s 2 S 1 / 2 51486.070 5 d 1 0 (1 S)6 p 2 P° 1 / 2 return 2052.828 35514.624 5 d 9 6 s 2 2 D 5 / 2 84212.404 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 1) (5 / 2 ,1)° 7 / 2 return 2262.223 35514.624 5 d 9 6 s 2 2 D 5 / 2 79705.262 5 d 9 (2 D 5 / 2)6 s 6 p (3 P° 0) (5 / 2 ,0)° 5 / 2 return 2847.675 60608.362 5 d 1 0 (1 S)6 p 2 P° 3 / 2 95714.406 5 d 1 0 (1 S)7 s 2 S 1 / 2 return 3983.931 35514.624 5 d 9 6 s 2 2 D 5 / 2 60608.362 5 d 1 0 (1 S)6 p 2 P° 3 / 2 return 5425.253 104984.138 5 d 1 0 (1 S)6 d 2 D 3 / 2 123411.351 5 d 1 0 (1 S)5 f 2 F° 5 / 2 return 5677.105 105544.042 5 d 1 0 (1 S)6 d 2 D 5 / 2 123153.775 5 d 1 0 (1 S)5 f 2 F° 7 / 2 return 6149.475 95714.406 5 d 1 0 (1 S)7 s 2 S 1 / 2 111971.464 5 d 1 0 (1 S)7 p 2 P° 3 / 2 return 7944.555 95714.406 5 d 1 0 (1 S)7 s 2 S 1 / 2 108298.183 5 d 1 0 (1 S)7 p 2 P° 1 / 2 return

Persistent Lines of Singly Ionized Osmium (Os I|)

Persistent Lines of Singly Ionized Osmium (Os II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2067.21 3593.15 5 d 6 (5 D)6 s 6 D 7 / 2 51951.61 5 d 6 (5 D)6 p 6 F° 9 / 2 return 2070.67 3928.94 5 d 6 (5 D)6 s 6 D 5 / 2 52206.48 5 d 6 (5 D)6 p 6 F° 7 / 2 return 2194.39 3593.15 5 d 6 (5 D)6 s 6 D 7 / 2 49149.39 5 d 5 6 s (7 S)6 p 6 P° 7 / 2 return 2255.85 0.00 5 d 6 (5 D)6 s 6 D 9 / 2 44315.40 5 d 6 (5 D)6 p 6 D° 9 / 2 return 2282.26 0.00 5 d 6 (5 D)6 s 6 D 9 / 2 43802.36 5 d 6 (5 D)6 p 6 D° 7 / 2 return 2336.80 3593.15 5 d 6 (5 D)6 s 6 D 7 / 2 46373.51 5 d 6 (5 D)6 p 6 D° 5 / 2 return 2367.35 3928.94 5 d 6 (5 D)6 s 6 D 5 / 2 46157.19 5 d 6 (5 D)6 p 6 D° 3 / 2 return 2486.24 3593.15 5 d 6 (5 D)6 s 6 D 7 / 2 43802.36 5 d 6 (5 D)6 p 6 D° 7 / 2 return 2538.00 0.00 5 d 6 (5 D)6 s 6 D 9 / 2 39389.49 5 d 5 6 s (7 S)6 p 8 P° 7 / 2 return

Persistent Lines of Singly Ionized Platinum (Pt I|)

Persistent Lines of Singly Ionized Platinum (Pt II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1777.0866 4786.611 5 d 8 (3 F)6 s 4 F 9 / 2 61058.490 5 d 8 (3 F 4)6 p 3 / 2 (4, 3 / 2)° 1 1 / 2 return 1883.0587 13329.227 5 d 8 (3 P)6 s 4 P 5 / 2 66434.315 5 d 8 (3 P 2)6 p 3 / 2 (2, 3 / 2)° 7 / 2 return 1911.7092 9356.274 5 d 8 (3 F)6 s 4 F 7 / 2 61665.485 5 d 8 (3 F 4)6 p 3 / 2 (4, 3 / 2)° 7 / 2 return 1929.2449 9356.274 5 d 8 (3 F)6 s 4 F 7 / 2 61190.026 5 d 8 (3 F 4)6 p 3 / 2 (4, 3 / 2)° 5 / 2 return 2036.4666 4786.611 5 d 8 (3 F)6 s 4 F 9 / 2 53875.493 5 d 8 (3 F 4)6 p 1 / 2 (4, 1 / 2)° 9 / 2 return 2144.2458 4786.611 5 d 8 (3 F)6 s 4 F 9 / 2 51408.370 5 d 8 (3 F 4)6 p 1 / 2 (4, 1 / 2)° 7 / 2 return 2240.8965 56587.934 5 d 8 (3 P 2)6 p 1 / 2 (2, 1 / 2)° 3 / 2 101199.085 5 d 8 (1 D)7 s 2 D 5 / 2 return 2245.5244 9356.274 5 d 8 (3 F)6 s 4 F 7 / 2 53875.493 5 d 8 (3 F 4)6 p 1 / 2 (4, 1 / 2)° 9 / 2 return 2246.5216 57018.130 5 d 8 (3 P 2)6 p 1 / 2 (2, 1 / 2)° 5 / 2 101517.59 5 d 8 (1 D)7 s 2 D 3 / 2 return 2262.7185 57018.130 5 d 8 (3 P 2)6 p 1 / 2 (2, 1 / 2)° 5 / 2 101199.085 5 d 8 (1 D)7 s 2 D 5 / 2 return 2288.2050 13329.227 5 d 8 (3 P)6 s 4 P 5 / 2 57018.130 5 d 8 (3 P 2)6 p 1 / 2 (2, 1 / 2)° 5 / 2 return 2310.9626 13329.227 5 d 8 (3 P)6 s 4 P 5 / 2 56587.934 5 d 8 (3 P 2)6 p 1 / 2 (2, 1 / 2)° 3 / 2 return 2719.5239 64757.343 5 d 8 (3 F 3)6 p 1 / 2 (3, 1 / 2)° 5 / 2 101517.59 5 d 8 (1 D)7 s 2 D 3 / 2 return 2743.2944 64757.343 5 d 8 (3 F 3)6 p 1 / 2 (3, 1 / 2)° 5 / 2 101199.085 5 d 8 (1 D)7 s 2 D 5 / 2 return 2875.6314 66434.315 5 d 8 (3 P 2)6 p 3 / 2 (2, 3 / 2)° 7 / 2 101199.085 5 d 8 (1 D)7 s 2 D 5 / 2 return

Persistent Lines of Singly Ionized Rhenium (Re I|)

Persistent Lines of Singly Ionized Rhenium (Re II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1973.1340 0.000 5 d 5 (6 S)6 s 7 S 3 50680.795 5 d 4 6 s (6 D)6 p 7 P° 4 return 2139.04 return 2142.74 return 2214.2749 0.000 5 d 5 (6 S)6 s 7 S 3 45147.445 5 d 4 6 s (6 D)6 p 7 P° 3 return 2275.2532 0.000 5 d 5 (6 S)6 s 7 S 3 43937.578 5 d 4 6 s (6 D)6 p 7 P° 2 return 2502.35 20976.4 5 d 5 (4 G)6 s 5 G 5 60926.8 12° 5 return 2568.64 14882.6 5 d 6 5 D 4 53802.1 11° 3 return 2608.50 14352.2 5 d 5 (4 D)6 s 2 2 52677.0 10° 2 return 2733.04 17223.5 5 d 5 (6 S)6 s 5 S 2 53802.1 11° 3 return 3580.15 17223.5 5 d 5 (6 S)6 s 5 S 2 45147.5 5 d 4 6 s (6 D)6 p 7 P° 3 return

Persistent Lines of Singly Ionized Tantalum (Ta I|)

Persistent Lines of Singly Ionized Tantalum (Ta II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2146.87 1031.36 5 d 3 (4 F)6 s 5 F 2 47595.98 9° 1 return 2196.03 4415.79 5 d 3 (4 F)6 s 5 F 4 49937.74 13° 4 return 2199.67 0.00 5 d 3 (4 F)6 s 5 F 1 45446.85 6° 2 return 2210.03 0.00 5 d 3 (4 F)6 s 5 F 1 45233.91 5° 1 return 2210.19 4415.79 5 d 3 (4 F)6 s 5 F 4 49646.62 12° 3 return 2239.48 4415.79 5 d 3 (4 F)6 s 5 F 4 49055.18 11° 5 return 2239.48 2642.26 5 d 3 (4 F)6 s 5 F 3 47280.89 8° 4 return 2387.06 4415.79 5 d 3 (4 F)6 s 5 F 4 46295.03 7° 5 return 2400.63 6186.81 5 d 3 (4 F)6 s 5 F 5 47829.75 10° 6 return 2635.58 1031.36 5 d 3 (4 F)6 s 5 F 2 38962.32 3° 3 return 2685.17 4124.85 5 d 2 6 s 2 3 P 0 41355.11 4° 1 return 2685.17 0.00 5 d 3 (4 F)6 s 5 F 1 37230.75 1° 2 return 3012.54 5330.77 5 d 2 6 s 2 3 P 1 38515.55 2° 2 return

Persistent Lines of Singly Ionized Thallium (Tl I|)

Persistent Lines of Singly Ionized Thallium (Tl II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1321.644 0.00 5 d 1 0 6 s 2 1 S 0 75663.33 5 d 1 0 6 s 6 p 1 P° 1 return 1792.827 49451.45 5 d 1 0 6 s 6 p 3 P° 0 105229.28 5 d 1 0 6 s 7 s 3 S 1 return 1814.776 61727.68 5 d 1 0 6 s 6 p 3 P° 2 116830.90 5 d 1 0 6 s 6 d 3 D 3 return 1908.617 0.00 5 d 1 0 6 s 2 1 S 0 52393.96 5 d 1 0 6 s 6 p 3 P° 1 return 2298.058 61727.68 5 d 1 0 6 s 6 p 3 P° 2 105229.28 5 d 1 0 6 s 7 s 3 S 1 return 2530.740 75663.33 5 d 1 0 6 s 6 p 1 P° 1 115165.60 5 d 1 0 6 s 6 d 1 D 2 return 3091.570 75663.33 5 d 1 0 6 s 6 p 1 P° 1 107999.96 5 d 1 0 6 s 7 s 1 S 0 return 5078.54 116436.16 5 d 1 0 6 s 6 d 3 D 2 136115. 5 d 1 0 6 s 5 f 3 F° 3 return 5152.14 116830.90 5 d 1 0 6 s 6 d 3 D 3 136230. 5 d 1 0 6 s 5 f 3 F° 4 return 5949.48 105229.28 5 d 1 0 6 s 7 s 3 S 1 122029. 5 d 1 0 6 s 7 p 3 P° 2 return

Persistent Lines of Singly Ionized Tungsten (W I|)

Persistent Lines of Singly Ionized Tungsten (W II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1951.051 0.000 5 d 4 (5 D)6 s 6 D 1 / 2 51254.429 5° 3 / 2 return 1962.140 3172.473 5 d 4 (5 D)6 s 6 D 5 / 2 54137.225 8° 3 / 2 return 1989.394 6147.085 5 d 4 (5 D)6 s 6 D 9 / 2 56413.649 12° 9 / 2 return 2001.712 3172.473 5 d 4 (5 D)6 s 6 D 5 / 2 53113.533 6° 5 / 2 return 2008.095 4716.278 5 d 4 (5 D)6 s 6 D 7 / 2 54498.608 10° 7 / 2 return 2009.982 1518.829 5 d 4 (5 D)6 s 6 D 3 / 2 51254.429 5° 3 / 2 return 2026.088 4716.278 5 d 4 (5 D)6 s 6 D 7 / 2 54056.594 7° 9 / 2 return 2029.995 6147.085 5 d 4 (5 D)6 s 6 D 9 / 2 55392.446 11° 9 / 2 return 2079.118 6147.085 5 d 4 (5 D)6 s 6 D 9 / 2 54229.082 9° 1 1 / 2 return 2079.120 3172.473 5 d 4 (5 D)6 s 6 D 5 / 2 51254.429 5° 3 / 2 return 2094.751 1518.829 5 d 4 (5 D)6 s 6 D 3 / 2 49242.042 4° 5 / 2 return 2204.483 6147.085 5 d 4 (5 D)6 s 6 D 9 / 2 51495.054 5 d 4 (5 D)6 p 6 F° 1 1 / 2 return 2248.758 0.000 5 d 4 (5 D)6 s 6 D 1 / 2 44455.212 5 d 3 (4 F)6 s 6 p 6 F° 1 / 2 return 2554.853 0.000 5 d 4 (5 D)6 s 6 D 1 / 2 39129.460 2° 3 / 2 return 2555.095 3172.473 5 d 4 (5 D)6 s 6 D 5 / 2 42298.223 5 d 4 (5 D)6 p 3° 3 / 2 return 2764.261 0.000 5 d 4 (5 D)6 s 6 D 1 / 2 36165.356 5 d 4 6 p 1° 1 / 2 return

Persistent Lines of Singly Ionized Actinium (Ac I|)

Persistent Lines of Singly Ionized Actinium (Ac II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3565.59 5267.16 6 d 7 s 3 D 2 33304.96 6 d 7 p 3 D° 2 return 3863.12 7426.52 6 d 7 s 3 D 3 33304.96 6 d 7 p 3 D° 2 return 4088.44 7426.52 6 d 7 s 3 D 3 31878.87 6 d 7 p 1 D° 2 return 4168.40 5267.16 6 d 7 s 3 D 2 29250.40 6 d 7 p ° 1 return 4386.41 9087.54 6 d 7 s 1 D 2 31878.87 6 d 7 p 1 D° 2 return 4507.20 0.00 7 s 2 1 S 0 22180.52 7 s 7 p 3 P° 1 return 5910.85 5267.16 6 d 7 s 3 D 2 22180.52 7 s 7 p 3 P° 1 return

Persistent Lines of Singly Ionized Astatine (At I|)

Persistent Lines of Singly Ionized Astatine (At II)

Null Null

Persistent Lines of Singly Ionized Bismuth (Bi I|)

Persistent Lines of Singly Ionized Bismuth (Bi II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1241.045 0.000 6 p 2 (1 / 2 , 1 / 2) 0 80577.071 6 p 6 d (1 / 2 , 3 / 2)° 1 return 1283.715 17031.698 6 p 2 (3 / 2 , 1 / 2) 2 94930.640 6 s 6 p 3 3 D° 2 return 1436.810 0.000 6 p 2 (1 / 2 , 1 / 2) 0 69598.475 6 p 7 s (1 / 2 , 1 / 2)° 1 return 1591.76 13325.401 6 p 2 (3 / 2 , 1 / 2) 1 76148.712 6 s 6 p 3 5 S° 2 return 1777.05 13325.401 6 p 2 (3 / 2 , 1 / 2) 1 69598.475 6 p 7 s (1 / 2 , 1 / 2)° 1 return 1791.842 13325.401 6 p 2 (3 / 2 , 1 / 2) 1 69133.891 6 p 7 s (1 / 2 , 1 / 2)° 0 return 1823.728 33938.718 6 p 2 (3 / 2 , 3 / 2) 2 88771.443 6 p 7 s (3 / 2 , 1 / 2)° 2 return 1902.341 17031.698 6 p 2 (3 / 2 , 1 / 2) 2 69598.475 6 p 7 s (1 / 2 , 1 / 2)° 1 return 2186.930 44173.768 6 p 2 (3 / 2 , 3 / 2) 0 89885.675 6 p 7 s (3 / 2 , 1 / 2)° 1 return 2368.384 33938.718 6 p 2 (3 / 2 , 3 / 2) 2 76148.712 6 s 6 p 3 5 S° 2 return 3792.564 79091.141 6 p 6 d (1 / 2 , 3 / 2)° 2 105451.045 6 p 5 f (1 / 2 , 5 / 2) 3 return 4259.413 82257.251 6 p 6 d (1 / 2 , 5 / 2)° 3 105728.060 6 p 5 f (1 / 2 , 7 / 2) 4 return 4301.697 82049.632 6 p 6 d (1 / 2 , 5 / 2)° 2 105289.732 6 p 5 f (1 / 2 , 7 / 2) 3 return 4705.285 84280.446 6 p 7 p (1 / 2 , 1 / 2) 1 105527.197 6 p 7 d (1 / 2 , 3 / 2)° 2 return 5124.356 88771.443 6 p 7 s (3 / 2 , 1 / 2)° 2 108280.656 6 p 7 p (3 / 2 , 3 / 2) 3 return 5144.492 69133.891 6 p 7 s (1 / 2 , 1 / 2)° 0 88566.685 6 p 7 p (1 / 2 , 3 / 2) 1 return 5209.325 69598.475 6 p 7 s (1 / 2 , 1 / 2)° 1 88789.478 6 p 7 p (1 / 2 , 3 / 2) 2 return

Persistent Lines of Singly Ionized Francium (Fr I|)

Persistent Lines of Singly Ionized Francium (Fr II)

Null Null

Persistent Lines of Singly Ionized Lead (Pb I|)

Persistent Lines of Singly Ionized Lead (Pb II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 1433.906 0.000 6 s 2 6 p 2 P° 1 / 2 69739.603 6 s 2 6 d 2 D 3 / 2 return 1512.298 0.000 6 s 2 6 p 2 P° 1 / 2 66124.53 6 s 6 p 2 4 P 3 / 2 return 1726.802 0.000 6 s 2 6 p 2 P° 1 / 2 57910.48 6 s 6 p 2 4 P 1 / 2 return 1822.052 14081.074 6 s 2 6 p 2 P° 3 / 2 68964.310 6 s 2 6 d 2 D 5 / 2 return 2203.534 14081.074 6 s 2 6 p 2 P° 3 / 2 59448.56 6 s 2 7 s 2 S 1 / 2 return 4244.92 68964.310 6 s 2 6 d 2 D 5 / 2 92515.24 6 s 2 5 f 2 F° 7 / 2 return 4386.46 69739.603 6 s 2 6 d 2 D 3 / 2 92530.66 6 s 2 5 f 2 F° 5 / 2 return 5042.58 74458.99 6 s 2 7 p 2 P° 1 / 2 94284.58 6 s 2 7 d 2 D 3 / 2 return 5608.85 59448.56 6 s 2 7 s 2 S 1 / 2 77272.57 6 s 2 7 p 2 P° 3 / 2 return 6075.74 92515.24 6 s 2 5 f 2 F° 7 / 2 108969.58 6 s 2 6 g 2 G 9 / 2 return 6081.409 92530.66 6 s 2 5 f 2 F° 5 / 2 108969.67 6 s 2 6 g 2 G 7 / 2 return 6660.20 59448.56 6 s 2 7 s 2 S 1 / 2 74458.99 6 s 2 7 p 2 P° 1 / 2 return

Persistent Lines of Singly Ionized Neptunium (Np I|)

Persistent Lines of Singly Ionized Neptunium (Np II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 5380.98 5451.830 5 f 4 6 d 7 s 7 I 4 24030.585 5 f 4 7 s 7 p ° 4 return

Persistent Lines of Singly Ionized Polonium (Po I|)

Persistent Lines of Singly Ionized Polonium (Po II)

Null Null

Persistent Lines of Singly Ionized Protactinium (Pa I|)

Persistent Lines of Singly Ionized Protactinium (Pa II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3957.85 5458.850 5 f 2 6 d 7 s 5 K 7 30717.935 ° 7 return 4056.20 823.265 5 f 2 6 d 7 s 5 K 5 25469.955 ° 5 return 4070.40 return 4217.23 1764.365 5 f 2 6 d 7 s 5 K 6 25469.955 ° 5 return 4248.083 0.000 5 f 2 7 s 2 3 H 4 23533.415 ° 5 return

Persistent Lines of Singly Ionized Radium (Ra I|)

Persistent Lines of Singly Ionized Radium (Ra II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2813.76 13743.11 6 d 2 D 5 / 2 49272.31 5 f 2 F° 7 / 2 return 3649.55 21351.20 7 p 2 P° 1 / 2 48744.04 7 d 2 D 3 / 2 return 3814.42 0.00 7 s 2 S 1 / 2 26208.86 7 p 2 P° 3 / 2 return 4340.64 26208.86 7 p 2 P° 3 / 2 49240.48 7 d 2 D 5 / 2 return 4533.11 21351.20 7 p 2 P° 1 / 2 43405.01 8 s 2 S 1 / 2 return 4682.28 0.00 7 s 2 S 1 / 2 21351.20 7 p 2 P° 1 / 2 return 8019.70 13743.11 6 d 2 D 5 / 2 26208.86 7 p 2 P° 3 / 2 return

Persistent Lines of Singly Ionized Radon (Rn I|)

Persistent Lines of Singly Ionized Radon (Rn II)

Null Null

Persistent Lines of Singly Ionized Thorium (Th I|)

Persistent Lines of Singly Ionized Thorium (Th II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2837.2954 6213.490 6 d 2 (3 F)7 s 4 F 9 / 2 41447.959 6 d 2 (3 F)7 p 4 G° 1 1 / 2 return 3180.1937 1521.896 6 d 2 (3 F)7 s 4 F 5 / 2 32957.429 6 d 2 (3 F)7 p 4 G° 7 / 2 return 3351.2286 1521.896 6 d 2 (3 F)7 s 4 F 5 / 2 31353.125 6 d 7 s (3 D)7 p ° 3 / 2 return 3392.0349 1521.896 6 d 2 (3 F)7 s 4 F 5 / 2 30994.266 6 d 7 s (3 D)7 p 4 F° 7 / 2 return 3433.9988 1859.938 6 d 2 (3 F)7 s 4 F 3 / 2 30972.162 6 d 2 (3 F)7 p ° 5 / 2 return 3469.9208 4146.576 6 d 2 (3 F)7 s 4 F 7 / 2 32957.429 6 d 2 (3 F)7 p 4 G° 7 / 2 return 3609.4452 4113.359 6 d (2 D)7 s 2 5 / 2 31810.548 6 d 7 s (3 D)7 p ° 5 / 2 return 3741.1830 1521.896 6 d 2 (3 F)7 s 4 F 5 / 2 28243.812 6 d 7 s (3 D)7 p ° 5 / 2 return 4019.1289 0.000 6 d 2 (3 F)7 s 3 / 2 24873.983 6 d 7 s (3 D)7 p ° 5 / 2 return 4116.7137 6168.356 5 f 6 d (3 H°)7 s 4 H° 7 / 2 30452.725 5 f 6 d (3 H°)7 p 9 / 2 return 4381.8616 6700.186 5 f 6 d (3 H°)7 s ° 9 / 2 29515.134 5 f 2 (3 F)7 s 9 / 2 return 4391.1105 4490.262 5 f (2 F°)7 s 2 2 F° 5 / 2 27257.149 5 f 7 s (3 F°)7 p 7 / 2 return

Persistent Lines of Singly Ionized Uranium (U I|)

Persistent Lines of Singly Ionized Uranium (U II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 3670.0701 914.765 5 f 3 (4 I°)6 d 7 s 6 K° 9 / 2 28154.450 5 f 3 6 d 7 p 6 L 1 1 / 2 return 3782.8407 289.041 5 f 3 (4 I°)6 d 7 s 6 L° 1 1 / 2 26716.697 1 3 / 2 return 3831.4593 4663.803 5 f 4 (5 I)7 s 6 I 7 / 2 30756.116 5 f 4 7 p ° 9 / 2 return 3854.6448 4663.803 5 f 4 (5 I)7 s 6 I 7 / 2 30599.179 5 f 4 (5 I°)7 p 6 K° 9 / 2 return 3859.5716 289.041 5 f 3 (4 I°)6 d 7 s 6 L° 1 1 / 2 26191.309 5 f 3 6 d 7 p 6 M 1 3 / 2 return 3865.9176 2294.696 5 f 3 (4 I°)6 d 7 s ° 1 1 / 2 28154.450 5 f 3 6 d 7 p 6 L 1 1 / 2 return 3890.3615 289.041 5 f 3 (4 I°)6 d 7 s 6 L° 1 1 / 2 25986.312 1 3 / 2 return 3932.0221 289.041 5 f 3 (4 I°)6 d 7 s 6 L° 1 1 / 2 25714.049 1 3 / 2 return 4050.0412 0.000 5 f 3 (4 I°)7 s 2 4 I° 9 / 2 24684.132 5 f 3 7 s 7 p 6 I 9 / 2 return 4090.1319 1749.123 5 f 3 (4 I°)6 d 7 s 6 L° 1 3 / 2 26191.309 5 f 3 6 d 7 p 6 M 1 3 / 2 return 4171.5886 1749.123 5 f 3 (4 I°)6 d 7 s 6 L° 1 3 / 2 25714.049 1 3 / 2 return 4241.6646 4585.434 5 f 3 (4 I°)6 d 2 (3 F) ° 1 3 / 2 28154.450 5 f 3 6 d 7 p 6 L 1 1 / 2 return 4341.6865 289.041 5 f 3 (4 I°)6 d 7 s 6 L° 1 1 / 2 23315.090 5 f 3 7 s 7 p 6 K 9 / 2 return 4543.6255 914.765 5 f 3 (4 I°)6 d 7 s 6 K° 9 / 2 22917.451 6 L 1 1 / 2 return

Persistent Lines of Singly Ionized Americium (Am I|)

Persistent Lines of Singly Ionized Americium (Am II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2832.258 0.00 5 f 7 (8 S°)7 s 9 S° 4 35297.13 5 return 3483.308 2598.32 5 f 7 (8 S°)7 s 7 S° 3 31298.50 4 return 3777.504 2598.32 5 f 7 (8 S°)7 s 7 S° 3 29063.30 3 return 3926.248 2598.32 5 f 7 (8 S°)7 s 7 S° 3 28060.74 4 return 4089.291 0.00 5 f 7 (8 S°)7 s 9 S° 4 24447.22 4 return 4509.450 2598.32 5 f 7 (8 S°)7 s 7 S° 3 24767.76 4 return 4575.590 2598.32 5 f 7 (8 S°)7 s 7 S° 3 24447.22 4 return

Persistent Lines of Singly Ionized Berkelium (Bk I|)

Persistent Lines of Singly Ionized Berkelium (Bk II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2878.572 0.00 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 34729.28 5 f 9 (6 H° 1 5 / 2)7 p 3 / 2 (1 5 / 2 , 3 / 2) 9 return 2951.761 1487.51 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 35355.68 8 return 3247.262 0.00 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 30786.30 7 return 3412.131 1487.51 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 30786.30 7 return 3542.187 0.00 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 28223.10 5 f 8 6 d 7 s 7 H 8 return 3894.547 1487.51 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 27157.155 5 f 9 (6 H° 1 5 / 2)7 p 1 / 2 (1 5 / 2 , 1 / 2) 8 return 3906.094 0.00 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 25593.755 5 f 8 6 d 7 s 9 H 8 return 4189.692 0.00 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 23861.38 7 return 4197.441 0.00 5 f 9 (6 H° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 23817.32 7 return

Persistent Lines of Singly Ionized Californium (Cf I|)

Persistent Lines of Singly Ionized Californium (Cf II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2759.10 0.00 5 f 1 0 (5 I 8)7 s (8, 1 / 2) 1 7 / 2 36233.01 5 f 1 0 (5 I 8)7 p 3 / 2 ° 1 7 / 2 return 2774.52 0.00 5 f 1 0 (5 I 8)7 s (8, 1 / 2) 1 7 / 2 36031.74 5 f 1 0 (5 I 8)7 p 3 / 2 (8, 3 / 2)° 1 9 / 2 return 3626.76 0.00 5 f 1 0 (5 I 8)7 s (8, 1 / 2) 1 7 / 2 27564.94 5 f 1 0 (5 I 8)7 p 1 / 2 (8, 1 / 2)° 1 7 / 2 return 3722.11 0.00 5 f 1 0 (5 I 8)7 s (8, 1 / 2) 1 7 / 2 26858.90 5 f 1 0 (5 I 8)7 p 1 / 2 (8, 1 / 2)° 1 5 / 2 return 3993.57 1180.52 5 f 1 0 (5 I 8)7 s (8, 1 / 2) 1 5 / 2 26213.78 5 f 9 6 d 7 s ° 1 7 / 2 return 6927.10 21599.67 5 f 1 0 (5 I 8)6 d 3 / 2 (8, 3 / 2) 1 9 / 2 36031.74 5 f 1 0 (5 I 8)7 p 3 / 2 (8, 3 / 2)° 1 9 / 2 return 12183.05 19359.06 5 f 1 0 (5 I 8)6 d 3 / 2 (8, 3 / 2) 1 5 / 2 27564.94 5 f 1 0 (5 I 8)7 p 1 / 2 (8, 1 / 2)° 1 7 / 2 return 13376.89 20091.38 5 f 1 0 (5 I 8)6 d 3 / 2 (8, 3 / 2) 1 7 / 2 27564.94 5 f 1 0 (5 I 8)7 p 1 / 2 (8, 1 / 2)° 1 7 / 2 return 16759.06 21599.67 5 f 1 0 (5 I 8)6 d 3 / 2 (8, 3 / 2) 1 9 / 2 27564.94 5 f 1 0 (5 I 8)7 p 1 / 2 (8, 1 / 2)° 1 7 / 2 return

Persistent Lines of Singly Ionized Curium (Cm I|)

Persistent Lines of Singly Ionized Curium (Cm II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2462.764 0.000 5 f 7 7 s 2 8 S° 7 / 2 40592.510 5 f 7 (8 S°)7 s 7 p (1 P°) 8 P 5 / 2 return 2636.281 4411.540 5 f 7 6 d 7 s 1 0 D° 7 / 2 42332.445 5 f 7 6 d 7 p 8 D 9 / 2 return 2824.204 0.000 5 f 7 7 s 2 8 S° 7 / 2 35397.790 5 f 7 (8 S°)7 s 7 p (3 P°) 8 P 9 / 2 return 2833.580 0.000 5 f 7 7 s 2 8 S° 7 / 2 35280.665 5 f 7 6 d 7 p 1 0 D 5 / 2 return 2912.965 2093.870 5 f 8 7 s 8 F 1 3 / 2 36413.100 ° 1 3 / 2 return 2928.922 2093.870 5 f 8 7 s 8 F 1 3 / 2 36226.140 ° 1 5 / 2 return 3044.848 2093.870 5 f 8 7 s 8 F 1 3 / 2 34926.680 5 f 8 (7 F 6)7 p 3 / 2 (6, 3 / 2)° 1 3 / 2 return 3242.657 2093.870 5 f 8 7 s 8 F 1 3 / 2 32923.880 5 f 7 6 d 2 ° 1 3 / 2 return 3572.949 0.000 5 f 7 7 s 2 8 S° 7 / 2 27980.085 5 f 7 (8 S°)7 s 7 p (3 P°) 8 P 5 / 2 return 3904.064 2093.870 5 f 8 7 s 8 F 1 3 / 2 27700.945 5 f 8 (7 F 6)7 p 1 / 2 (6, 1 / 2)° 1 3 / 2 return 3908.238 0.000 5 f 7 7 s 2 8 S° 7 / 2 25579.725 5 f 7 (8 S°)7 s 7 p (3 P°) 1 0 P 9 / 2 return 4207.66 3941.439 5 f 8 7 s 6 F 1 1 / 2 27700.945 5 f 8 (7 F 6)7 p 1 / 2 (6, 1 / 2)° 1 3 / 2 return

Persistent Lines of Singly Ionized Einsteinium (Es I|)

Persistent Lines of Singly Ionized Einsteinium (Es II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2708.66 0.00 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 36907.83 5 f 1 1 (4 I° 1 5 / 2)7 p (1 5 / 2 , 3 / 2) 9 return 2787.10 938.65 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 36807.72 5 f 1 0 6 d 7 s 7 return 2815.15 938.65 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 36450.29 5 f 1 1 (2 H° 1 1 / 2)7 p (1 1 / 2 , 1 / 2) 6 return 3547.75 0.00 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 28178.81 5 f 1 1 7 p (1 5 / 2 , 1 / 2) 8 return 3602.43 0.00 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 8 27751.11 5 f 1 1 7 p (1 5 / 2 , 1 / 2) 7 return 3670.01 938.65 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 28178.81 5 f 1 1 7 p (1 5 / 2 , 1 / 2) 8 return 3728.55 938.65 5 f 1 1 (4 I° 1 5 / 2)7 s (1 5 / 2 , 1 / 2)° 7 27751.11 5 f 1 1 7 p (1 5 / 2 , 1 / 2) 7 return

Persistent Lines of Singly Ionized Plutonium (Pu I|)

Persistent Lines of Singly Ionized Plutonium (Pu II)

Wavelength Energy Configuration Term J (Å) Levels (cm -1) 2933.602 0.000 5 f 6 7 s 8 F 1 / 2 34077.84 5 f 6 7 p ° 3 / 2 return 2951.820 0.000 5 f 6 7 s 8 F 1 / 2 33867.55 ° 3 / 2 return 2964.644 0.000 5 f 6 7 s 8 F 1 / 2 33721.06 ° 3 / 2 return 2969.035 3969.850 5 f 6 7 s 8 F 5 / 2 37641.00 ° 5 / 2 return 2972.500 9707.985 5 f 6 7 s 8 F 1 3 / 2 43339.89 ° 1 5 / 2 return 3198.467 0.000 5 f 6 7 s 8 F 1 / 2 31255.97 ° 3 / 2 return 3220.942 2014.970 5 f 6 7 s 8 F 3 / 2 33052.83 ° 1 / 2 return 3224.873 0.000 5 f 6 7 s 8 F 1 / 2 31000.03 5 f 5 6 d 7 s ° 3 / 2 return 3245.206 2014.970 5 f 6 7 s 8 F 3 / 2 32820.810 5 f 6 7 p ° 5 / 2 return 3273.111 2014.970 5 f 6 7 s 8 F 3 / 2 32558.12 ° 1 / 2 return 3275.125 5502.070 5 f 6 7 s 6 F 3 / 2 36026.44 ° 5 / 2 return 3279.326 3235.775 5 f 6 7 s 6 F 1 / 2 33721.06 ° 3 / 2 return 3289.977 7278.870 5 f 6 7 s 8 F 9 / 2 37665.47 ° 9 / 2 return 3290.345 2014.970 5 f 6 7 s 8 F 3 / 2 32398.17 5 f 5 7 s 2 6 P° 5 / 2 return 3312.647 9707.985 5 f 6 7 s 8 F 1 3 / 2 39886.62 ° 1 1 / 2 return 3337.708 0.000 5 f 6 7 s 8 F 1 / 2 29952.07 ° 3 / 2 return 3350.330 9242.365 5 f 6 7 s 6 F 7 / 2 39081.59 ° 9 / 2 return 3391.405 9707.985 5 f 6 7 s 8 F 1 3 / 2 39185.84 ° 1 1 / 2 return 4536.146 0.000 5 f 6 7 s 8 F 1 / 2 22038.970 5 f 6 7 p 8 G° 1 / 2 return