

Table 1. The total non-S_I duplicate lines found in VALD3 as of 26/05/16. Each pair of lines represent two transitions which we have determined to be duplicated according to their electronic configurations and J-values. The duplicates have been manually checked for hyperfine transitions and isotopic transitions according to their respective references. The configurations are presented in the same unformatted manner as the VALD3 retrieval. The reference labels are those employed by VALD3 and can be found in full on their website at <http://www.astro.uu.se/valdwiki/linelistRefs>. Both the S_I and non-S_I tables are available in pdf and machine-readable form at brass.sdf.org.

| Ion | λ (Å) | $\log(gf)$ | E_{low} (eV) | J_{low} | E_{up} (eV) | J_{up} | Lower configuration | Upper configuration | References |
|-------|------------------|------------|-------------------|-----------|------------------|----------|-------------------------|-------------------------------|------------|
| F II | 4222.5170 | -1.970 | 32.8503 | 2.0 | 35.7858 | 2.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4212.6110 | -0.170 | 32.8503 | 2.0 | 35.7927 | 2.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4222.0730 | -1.960 | 32.8503 | 2.0 | 35.7861 | 1.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4212.9060 | -1.380 | 32.8503 | 2.0 | 35.7925 | 1.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4223.5150 | -1.890 | 32.8510 | 3.0 | 35.7858 | 2.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4213.6060 | -1.130 | 32.8510 | 3.0 | 35.7927 | 2.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4223.2000 | -2.800 | 32.8510 | 3.0 | 35.7860 | 4.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4215.5040 | 0.670 | 32.8510 | 3.0 | 35.7913 | 4.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4224.5190 | -0.860 | 32.8519 | 4.0 | 35.7860 | 4.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4216.8170 | -3.240 | 32.8519 | 4.0 | 35.7913 | 4.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4225.1760 | 0.780 | 32.8519 | 4.0 | 35.7855 | 5.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4216.8350 | -0.690 | 32.8519 | 4.0 | 35.7913 | 5.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4222.4210 | -1.900 | 32.8503 | 2.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4217.9900 | -1.970 | 32.8503 | 2.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4223.7380 | -1.180 | 32.8510 | 3.0 | 35.7856 | 4.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4218.6790 | -0.190 | 32.8510 | 3.0 | 35.7891 | 4.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4223.4190 | -1.310 | 32.8510 | 3.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4218.9870 | -0.020 | 32.8510 | 3.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| Mo I | 4228.7860 | -1.112 | 3.7394 | 3.0 | 6.6705 | 4.0 | LS 4d5.(4F).5s c3F | * | WBb |
| Mo I | 4219.0180 | -0.935 | 3.7394 | 3.0 | 6.6773 | 4.0 | LS 4d5.(4F).5s c3F | * | WBb |
| F II | 4225.0580 | 0.290 | 32.8519 | 4.0 | 35.7856 | 4.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4219.9940 | -2.880 | 32.8519 | 4.0 | 35.7891 | 4.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4229.4980 | -0.340 | 32.8554 | 0.0 | 35.7861 | 1.0 | LS 2s2.2p3.(2D*).3d 1S* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4220.2990 | -2.080 | 32.8554 | 0.0 | 35.7925 | 1.0 | LS 2s2.2p3.(2D*).3d 1S* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4224.7380 | -2.030 | 32.8519 | 4.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4220.3030 | -0.890 | 32.8519 | 4.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 3F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| Fe II | 4229.3048 | -3.276 | 10.6782 | 4.5 | 13.6089 | 5.5 | LS 3d6.(5D).4d e4F | LS 3d6.(3H).5p 4I* | K13 |
| Fe II | 4223.5571 | -3.005 | 10.6782 | 4.5 | 13.6129 | 5.5 | LS 3d6.(5D).4d e4F | LS 3d6.(3H).5p 4I* | K13 |
| Fe I | 4231.8176 | -4.401 | 4.4153 | 3.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p z5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4228.9695 | -2.827 | 4.4153 | 3.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p z5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4259.9376 | -4.397 | 4.4347 | 4.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p z3G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4257.0515 | -4.854 | 4.4347 | 4.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p z3G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |

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|------|-----------|--------|---------|-----|---------|-----|------------------------------|--------------------------------|-----|
| Cu I | 4263.1887 | -7.811 | 7.3955 | 0.5 | 10.3029 | 1.5 | LS 3d10.(1S).9s 2S | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4260.5687 | -5.110 | 7.3955 | 0.5 | 10.3047 | 1.5 | LS 3d10.(1S).9s 2S | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| F II | 4276.9240 | -2.590 | 32.8879 | 5.0 | 35.7860 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4269.0300 | -2.130 | 32.8879 | 5.0 | 35.7913 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4277.5980 | 0.140 | 32.8879 | 5.0 | 35.7855 | 5.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4269.0480 | -0.950 | 32.8879 | 5.0 | 35.7913 | 5.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4279.0720 | -0.970 | 32.8893 | 4.0 | 35.7860 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4271.1700 | -0.130 | 32.8893 | 4.0 | 35.7913 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4279.7460 | -0.720 | 32.8893 | 4.0 | 35.7855 | 5.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4271.1890 | 0.480 | 32.8893 | 4.0 | 35.7913 | 5.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4277.4770 | -0.900 | 32.8879 | 5.0 | 35.7856 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4272.2880 | -3.300 | 32.8879 | 5.0 | 35.7891 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| Fe I | 4276.1252 | -6.473 | 4.4457 | 2.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p z5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4273.2172 | -4.510 | 4.4457 | 2.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p z5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| F II | 4279.6250 | -1.470 | 32.8893 | 4.0 | 35.7856 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4274.4300 | -0.590 | 32.8893 | 4.0 | 35.7891 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4279.2970 | -1.440 | 32.8893 | 4.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4274.7460 | -1.480 | 32.8893 | 4.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4283.0130 | -0.060 | 32.8920 | 3.0 | 35.7860 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4275.0970 | -0.670 | 32.8920 | 3.0 | 35.7913 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4283.5680 | -1.100 | 32.8920 | 3.0 | 35.7856 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4278.3630 | 0.650 | 32.8920 | 3.0 | 35.7891 | 4.0 | LS 2s2.2p3.(2D*).3d 3G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4286.8460 | -0.140 | 32.8946 | 4.0 | 35.7860 | 4.0 | LS 2s2.2p3.(2D*).3d 1G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4278.9160 | -0.760 | 32.8946 | 4.0 | 35.7913 | 4.0 | LS 2s2.2p3.(2D*).3d 1G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4287.5230 | -3.360 | 32.8946 | 4.0 | 35.7855 | 5.0 | LS 2s2.2p3.(2D*).3d 1G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4278.9340 | 0.620 | 32.8946 | 4.0 | 35.7913 | 5.0 | LS 2s2.2p3.(2D*).3d 1G* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4287.4020 | -0.690 | 32.8946 | 4.0 | 35.7856 | 4.0 | LS 2s2.2p3.(2D*).3d 1G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4282.1880 | -1.910 | 32.8946 | 4.0 | 35.7891 | 4.0 | LS 2s2.2p3.(2D*).3d 1G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4287.0730 | -1.560 | 32.8946 | 4.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 1G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4282.5050 | -1.260 | 32.8946 | 4.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 1G* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| Ti I | 4297.0694 | -3.993 | 3.4238 | 4.0 | 6.3084 | 5.0 | LS 3d2.(3F).4s.4p.(1P*) y3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 4297.0556 | -5.301 | 3.4238 | 4.0 | 6.3084 | 5.0 | LS 3d2.(3F).4s.4p.(1P*) y3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| F II | 4316.9410 | -0.640 | 32.9147 | 3.0 | 35.7860 | 4.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4308.8990 | -0.700 | 32.9147 | 3.0 | 35.7913 | 4.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4321.6770 | -3.570 | 32.9180 | 2.0 | 35.7861 | 1.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4312.0730 | -0.730 | 32.9180 | 2.0 | 35.7925 | 1.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[3/2] | KP |
| F II | 4317.5040 | 0.550 | 32.9147 | 3.0 | 35.7856 | 4.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4312.2160 | -3.490 | 32.9147 | 3.0 | 35.7891 | 4.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |

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|-------|-----------|--------|---------|-----|---------|-----|------------------------------|--------------------------------|-----|
| F II | 4317.1700 | -1.430 | 32.9147 | 3.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4312.5380 | -0.150 | 32.9147 | 3.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| Fe I | 4317.3008 | -6.123 | 4.4733 | 3.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p z3G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4314.3365 | -3.113 | 4.4733 | 3.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p z3G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| F II | 4322.0420 | -0.930 | 32.9180 | 2.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4317.3990 | 0.370 | 32.9180 | 2.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 3D* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| Ti I | 4322.2198 | -5.483 | 3.4406 | 5.0 | 6.3084 | 6.0 | LS 3d2.(3F).4s.4p.(1P*) y3G* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 4322.1837 | -5.089 | 3.4406 | 5.0 | 6.3084 | 6.0 | LS 3d2.(3F).4s.4p.(1P*) y3G* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 4322.2355 | -4.631 | 3.4406 | 5.0 | 6.3084 | 5.0 | LS 3d2.(3F).4s.4p.(1P*) y3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 4322.2215 | -4.423 | 3.4406 | 5.0 | 6.3084 | 5.0 | LS 3d2.(3F).4s.4p.(1P*) y3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Cu I | 4340.4915 | -8.082 | 7.4473 | 1.5 | 10.3029 | 1.5 | LS 3d10.(1S).8d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4337.7757 | -5.911 | 7.4473 | 1.5 | 10.3047 | 1.5 | LS 3d10.(1S).8d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4340.6460 | -7.025 | 7.4474 | 2.5 | 10.3029 | 1.5 | LS 3d10.(1S).8d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4337.9300 | -5.037 | 7.4474 | 2.5 | 10.3047 | 1.5 | LS 3d10.(1S).8d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Al II | 4347.2750 | -1.330 | 15.3023 | 3.0 | 18.1536 | 4.0 | LS 3s.4f 3F* | LS 3s.9g 1G | KP |
| Al II | 4347.2750 | -1.100 | 15.3023 | 3.0 | 18.1536 | 4.0 | LS 3s.4f 3F* | LS 3s.9g 1G | KP |
| Al II | 4347.8250 | -2.450 | 15.3027 | 4.0 | 18.1536 | 4.0 | LS 3s.4f 3F* | LS 3s.9g 1G | KP |
| Al II | 4347.8250 | -2.310 | 15.3027 | 4.0 | 18.1536 | 4.0 | LS 3s.4f 3F* | LS 3s.9g 1G | KP |
| Al II | 4356.7580 | -1.310 | 15.3086 | 3.0 | 18.1536 | 4.0 | LS 3s.4f 1F* | LS 3s.9g 1G | KP |
| Al II | 4356.7580 | -1.080 | 15.3086 | 3.0 | 18.1536 | 4.0 | LS 3s.4f 1F* | LS 3s.9g 1G | KP |
| Fe I | 4433.4818 | -3.831 | 4.5486 | 4.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p y3F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4430.3559 | -4.537 | 4.5486 | 4.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p y3F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Cu I | 4442.5317 | -7.966 | 7.5128 | 1.5 | 10.3029 | 1.5 | LS 3d10.(1S).9d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4439.6867 | -5.869 | 7.5128 | 1.5 | 10.3047 | 1.5 | LS 3d10.(1S).9d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4442.6343 | -6.961 | 7.5129 | 2.5 | 10.3029 | 1.5 | LS 3d10.(1S).9d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4439.7892 | -4.986 | 7.5129 | 2.5 | 10.3047 | 1.5 | LS 3d10.(1S).9d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Fe I | 4449.4236 | -3.188 | 4.5586 | 3.0 | 7.3443 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) y5P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4446.2751 | -2.185 | 4.5586 | 3.0 | 7.3463 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) y5P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| F II | 4471.2150 | 0.470 | 33.0136 | 2.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 1D* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4466.2480 | -1.020 | 33.0136 | 2.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 1D* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4508.2690 | -1.720 | 33.0364 | 2.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 3P* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4503.2190 | -0.610 | 33.0364 | 2.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 3P* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| Cu I | 4515.2455 | -7.844 | 7.5578 | 1.5 | 10.3029 | 1.5 | LS 3d10.(1S).10d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4512.3067 | -5.797 | 7.5578 | 1.5 | 10.3047 | 1.5 | LS 3d10.(1S).10d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4515.3332 | -6.877 | 7.5578 | 2.5 | 10.3029 | 1.5 | LS 3d10.(1S).10d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4512.3943 | -4.908 | 7.5578 | 2.5 | 10.3047 | 1.5 | LS 3d10.(1S).10d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| F II | 4527.3320 | 0.580 | 33.0481 | 3.0 | 35.7860 | 4.0 | LS 2s2.2p3.(2D*).3d 1F* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |
| F II | 4518.4890 | -0.830 | 33.0481 | 3.0 | 35.7913 | 4.0 | LS 2s2.2p3.(2D*).3d 1F* | JK 2s2.2p3.(2D*).4f 2[9/2] | KP |

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|-------|-----------|--------|---------|-----|---------|-----|------------------------------|--------------------------------|-----|
| F II | 4527.9510 | -0.790 | 33.0481 | 3.0 | 35.7856 | 4.0 | LS 2s2.2p3.(2D*).3d 1F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4522.1370 | -0.180 | 33.0481 | 3.0 | 35.7891 | 4.0 | LS 2s2.2p3.(2D*).3d 1F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4527.5840 | 0.100 | 33.0481 | 3.0 | 35.7858 | 3.0 | LS 2s2.2p3.(2D*).3d 1F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| F II | 4522.4910 | -1.120 | 33.0481 | 3.0 | 35.7889 | 3.0 | LS 2s2.2p3.(2D*).3d 1F* | JK 2s2.2p3.(2D*).4f 2[7/2] | KP |
| Fe I | 4528.1436 | -3.346 | 4.6070 | 2.0 | 7.3443 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) y5P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4524.8828 | -1.978 | 4.6070 | 2.0 | 7.3463 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) y5P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Ti I | 4525.3734 | -5.464 | 3.5693 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p y5F* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 4525.3580 | -4.573 | 3.5693 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p y5F* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Fe I | 4529.2063 | -4.866 | 4.6076 | 3.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p y3F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4525.9439 | -2.138 | 4.6076 | 3.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p y3F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Ti I | 4547.5217 | -4.940 | 3.5827 | 5.0 | 6.3084 | 6.0 | LS 3d3.(4F).4p y5F* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 4547.4818 | -6.594 | 3.5827 | 5.0 | 6.3084 | 6.0 | LS 3d3.(4F).4p y5F* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 4547.5391 | -5.306 | 3.5827 | 5.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p y5F* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 4547.5236 | -3.734 | 3.5827 | 5.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p y5F* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Cu I | 4568.6209 | -6.749 | 7.5898 | 2.5 | 10.3029 | 1.5 | LS 3d10.(1S).11d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4565.6122 | -4.799 | 7.5898 | 2.5 | 10.3047 | 1.5 | LS 3d10.(1S).11d 2D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Fe II | 4582.6842 | -2.367 | 12.7190 | 5.5 | 15.4238 | 6.5 | LS 3d6.(3G).5s f4G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4575.0752 | -3.477 | 12.7190 | 5.5 | 15.4283 | 6.5 | LS 3d6.(3G).5s f4G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe I | 4603.9663 | -5.227 | 4.6521 | 2.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p y3F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4600.5954 | -2.014 | 4.6521 | 2.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p y3F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Al II | 4639.7930 | -1.090 | 15.3023 | 3.0 | 17.9738 | 4.0 | LS 3s.4f 3F* | LS 3s.8g 1G | KP |
| Al II | 4639.7930 | -0.860 | 15.3023 | 3.0 | 17.9738 | 4.0 | LS 3s.4f 3F* | LS 3s.8g 1G | KP |
| Al II | 4640.4200 | -2.210 | 15.3027 | 4.0 | 17.9738 | 4.0 | LS 3s.4f 3F* | LS 3s.8g 1G | KP |
| Al II | 4640.4200 | -2.070 | 15.3027 | 4.0 | 17.9738 | 4.0 | LS 3s.4f 3F* | LS 3s.8g 1G | KP |
| Al II | 4650.5960 | -1.060 | 15.3086 | 3.0 | 17.9738 | 4.0 | LS 3s.4f 1F* | LS 3s.8g 1G | KP |
| Al II | 4650.5960 | -0.840 | 15.3086 | 3.0 | 17.9738 | 4.0 | LS 3s.4f 1F* | LS 3s.8g 1G | KP |
| C IV | 4664.6800 | -0.716 | 55.7860 | 3.5 | 58.4432 | 2.5 | LS 1s2.5f 2F* | LS 1s2.6d 2D | Wd |
| C IV | 4664.6800 | -0.667 | 55.7860 | 3.5 | 58.4432 | 2.5 | LS 1s2.5f 2F* | LS 1s2.6d 2D | Wd |
| C IV | 4664.6800 | -2.016 | 55.7860 | 2.5 | 58.4432 | 2.5 | LS 1s2.5f 2F* | LS 1s2.6d 2D | Wd |
| C IV | 4664.6800 | -1.967 | 55.7860 | 2.5 | 58.4432 | 2.5 | LS 1s2.5f 2F* | LS 1s2.6d 2D | Wd |
| Fe II | 4740.1182 | -9.122 | 12.1871 | 5.5 | 14.8021 | 5.5 | LS 3d6.(3H).5s e4H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 4737.1176 | -8.779 | 12.1871 | 5.5 | 14.8037 | 5.5 | LS 3d6.(3H).5s e4H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe I | 4746.9822 | -4.050 | 4.7332 | 3.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p y3D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4743.3987 | -4.976 | 4.7332 | 3.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p y3D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe II | 4774.1869 | -7.205 | 12.2058 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3H).5s e4H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 4771.1431 | -8.163 | 12.2058 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3H).5s e4H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Ti I | 4781.3560 | -3.589 | 3.7160 | 4.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) x3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 4781.3389 | -4.437 | 3.7160 | 4.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) x3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |

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|-------|-----------|--------|---------|-----|---------|-----|------------------------------|--------------------------------|-----|
| Ti I | 4796.9571 | -5.387 | 3.7244 | 5.0 | 6.3084 | 6.0 | LS 3d2.(1G).4s.4p.(3P*) x3G* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 4796.9127 | -4.906 | 3.7244 | 5.0 | 6.3084 | 6.0 | LS 3d2.(1G).4s.4p.(3P*) x3G* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 4796.9764 | -4.785 | 3.7244 | 5.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) x3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 4796.9592 | -7.773 | 3.7244 | 5.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) x3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Fe II | 4806.4147 | -0.644 | 12.8449 | 5.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4798.0454 | -1.253 | 12.8449 | 5.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Ti I | 4801.8542 | -4.916 | 3.7270 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p x5D* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 4801.8369 | -4.021 | 3.7270 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p x5D* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Fe II | 4810.3809 | -1.996 | 12.8471 | 6.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4H | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4801.9977 | -4.365 | 12.8471 | 6.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4H | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4831.0580 | -3.534 | 12.8581 | 7.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4822.6027 | -4.550 | 12.8581 | 7.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4841.6208 | -1.975 | 12.8637 | 5.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4H | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4833.1285 | -1.445 | 12.8637 | 5.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4H | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4860.5433 | -2.638 | 12.8737 | 6.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4851.9845 | -2.596 | 12.8737 | 6.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe I | 4863.0602 | -4.334 | 4.7955 | 2.0 | 7.3443 | 3.0 | LS 3d7.(4F).4p y3D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 4859.2994 | -2.869 | 4.7955 | 2.0 | 7.3463 | 3.0 | LS 3d7.(4F).4p y3D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe II | 4871.5126 | -3.346 | 12.8794 | 7.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4862.9152 | -4.389 | 12.8794 | 7.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4885.3754 | -3.486 | 12.8866 | 5.5 | 15.4238 | 6.5 | LS 3d6.(5D).5d 6F | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4876.7290 | -4.005 | 12.8866 | 5.5 | 15.4283 | 6.5 | LS 3d6.(5D).5d 6F | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4894.2679 | -3.314 | 12.8912 | 5.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4885.5900 | -2.105 | 12.8912 | 5.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4916.1413 | -1.776 | 12.9025 | 6.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4907.3858 | -2.600 | 12.9025 | 6.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4929.4924 | -3.118 | 12.9093 | 7.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 2K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4920.6893 | -3.336 | 12.9093 | 7.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 2K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4942.7864 | -1.428 | 12.9161 | 5.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 4I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4933.9358 | -1.510 | 12.9161 | 5.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 4I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Cu I | 4961.4906 | -4.570 | 7.8047 | 2.5 | 10.3029 | 1.5 | LS 3d9.4s.(3D).5s 4D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 4957.9424 | -4.434 | 7.8047 | 2.5 | 10.3047 | 1.5 | LS 3d9.4s.(3D).5s 4D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Fe II | 4977.5081 | -2.156 | 12.9336 | 6.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 2K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4968.5328 | -1.042 | 12.9336 | 6.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 2K | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4990.2864 | -5.863 | 12.9400 | 6.5 | 15.4238 | 6.5 | LS 3d6.(5D).5d 6G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4981.2650 | -7.124 | 12.9400 | 6.5 | 15.4283 | 6.5 | LS 3d6.(5D).5d 6G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 4985.2876 | -8.590 | 12.3157 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3H).5s e2H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 4981.9688 | -9.388 | 12.3157 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3H).5s e2H | JK 3d6.(5D<1>).6h 2[5]* | K13 |

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|--------|-----------|--------|---------|-----|---------|-----|------------------------------|--------------------------------|-----|
| Fe II | 5047.3507 | -2.822 | 12.9681 | 5.5 | 15.4238 | 6.5 | LS 3d6.(5D).5d 6G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 5038.1220 | -2.981 | 12.9681 | 5.5 | 15.4283 | 6.5 | LS 3d6.(5D).5d 6G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 5045.9661 | -7.932 | 12.3456 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3F2).5s f4F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 5042.5659 | -8.173 | 12.3456 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3F2).5s f4F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 5054.7557 | -1.862 | 12.9716 | 6.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 2I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 5045.5000 | -2.065 | 12.9716 | 6.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 2I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 5091.6090 | -0.631 | 12.9894 | 5.5 | 15.4238 | 6.5 | LS 3d6.(3H).4d 2I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 5082.2180 | -1.117 | 12.9894 | 5.5 | 15.4283 | 6.5 | LS 3d6.(3H).4d 2I | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Si III | 5091.3640 | -3.480 | 28.5541 | 4.0 | 30.9886 | 5.0 | LS 3s.5g 3G | LS 3s.7h 1H* | KP |
| Si III | 5091.3640 | 0.270 | 28.5541 | 4.0 | 30.9886 | 5.0 | LS 3s.5g 3G | LS 3s.7h 1H* | KP |
| Si III | 5091.4550 | -4.050 | 28.5541 | 4.0 | 30.9886 | 5.0 | LS 3s.5g 1G | LS 3s.7h 1H* | KP |
| Si III | 5091.4550 | 0.270 | 28.5541 | 4.0 | 30.9886 | 5.0 | LS 3s.5g 1G | LS 3s.7h 1H* | KP |
| Si III | 5091.5430 | -1.480 | 28.5541 | 5.0 | 30.9886 | 5.0 | LS 3s.5g 3G | LS 3s.7h 1H* | KP |
| Si III | 5091.5430 | -1.370 | 28.5541 | 5.0 | 30.9886 | 5.0 | LS 3s.5g 3G | LS 3s.7h 1H* | KP |
| Fe I | 5098.1024 | -3.170 | 4.9130 | 4.0 | 7.3443 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5093.9694 | -2.057 | 4.9130 | 4.0 | 7.3463 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe II | 5117.1428 | -4.219 | 13.0015 | 5.5 | 15.4238 | 6.5 | LS 3d6.(5D).5d 4G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 5107.6574 | -2.317 | 13.0015 | 5.5 | 15.4283 | 6.5 | LS 3d6.(5D).5d 4G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Cu I | 5123.2743 | -5.176 | 7.8836 | 1.5 | 10.3029 | 1.5 | LS 3d9.4s.(3D).5s 4D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Cu I | 5119.4910 | -3.234 | 7.8836 | 1.5 | 10.3047 | 1.5 | LS 3d9.4s.(3D).5s 4D | JK 3d9.4s.(3D<1>).8p 2[2]* | K12 |
| Al II | 5144.9420 | -0.760 | 15.3023 | 3.0 | 17.7115 | 4.0 | LS 3s.4f 3F* | LS 3s.7g 1G | KP |
| Al II | 5144.9420 | -0.540 | 15.3023 | 3.0 | 17.7115 | 4.0 | LS 3s.4f 3F* | LS 3s.7g 1G | KP |
| Al II | 5145.7130 | -1.890 | 15.3027 | 4.0 | 17.7115 | 4.0 | LS 3s.4f 3F* | LS 3s.7g 1G | KP |
| Al II | 5145.7130 | -1.750 | 15.3027 | 4.0 | 17.7115 | 4.0 | LS 3s.4f 3F* | LS 3s.7g 1G | KP |
| Ti I | 5155.7733 | -3.722 | 3.9042 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p w3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 5155.7533 | -5.142 | 3.9042 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p w3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Al II | 5158.2290 | -0.740 | 15.3086 | 3.0 | 17.7115 | 4.0 | LS 3s.4f 1F* | LS 3s.7g 1G | KP |
| Al II | 5158.2290 | -0.520 | 15.3086 | 3.0 | 17.7115 | 4.0 | LS 3s.4f 1F* | LS 3s.7g 1G | KP |
| Fe II | 5170.1047 | 0.734 | 13.0264 | 5.5 | 15.4238 | 6.5 | LS 3d6.(3F2).4d 4G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 5160.4221 | 0.056 | 13.0264 | 5.5 | 15.4283 | 6.5 | LS 3d6.(3F2).4d 4G | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Rb I | 5165.0650 | -5.686 | 0.0000 | 0.5 | 2.3998 | 1.5 | LS 4p6.5s 2S | LS 4p6.4d 2D | Wc |
| Rb I | 5165.0650 | -5.686 | 0.0000 | 0.5 | 2.3998 | 1.5 | LS 4p6.5s 2S | LS 4p6.4d 2D | Wc |
| Fe I | 5189.1463 | -3.338 | 4.9557 | 3.0 | 7.3443 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5184.8645 | -2.326 | 4.9557 | 3.0 | 7.3463 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Ti I | 5193.0338 | -5.397 | 3.9215 | 5.0 | 6.3084 | 6.0 | LS 3d3.(4F).4p w3G* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 5192.9818 | -4.556 | 3.9215 | 5.0 | 6.3084 | 6.0 | LS 3d3.(4F).4p w3G* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 5193.0565 | -5.370 | 3.9215 | 5.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p w3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 5193.0362 | -5.142 | 3.9215 | 5.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p w3G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |

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|-------|-----------|--------|---------|-----|---------|-----|-------------------------------|--------------------------------|-----|
| Fe I | 5211.3769 | -5.537 | 4.9659 | 2.0 | 7.3443 | 3.0 | LS 3d5.(6S).4s2.4p y7P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5207.0584 | -5.865 | 4.9659 | 2.0 | 7.3463 | 3.0 | LS 3d5.(6S).4s2.4p y7P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe II | 5231.0586 | 0.271 | 13.0543 | 6.5 | 15.4238 | 6.5 | LS 3d6.(3F2).4d 4H | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Fe II | 5221.1466 | -0.790 | 13.0543 | 6.5 | 15.4283 | 6.5 | LS 3d6.(3F2).4d 4H | JK 3d6.(3F2<4>).4f 2[6]* | K13 |
| Ti I | 5247.9274 | -4.546 | 3.9465 | 4.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 5247.9067 | -6.148 | 3.9465 | 4.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Fe I | 5253.8432 | -4.968 | 4.9851 | 3.0 | 7.3443 | 3.0 | LS 3d5.(6S).4s2.4p y7P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5249.4540 | -3.607 | 4.9851 | 3.0 | 7.3463 | 3.0 | LS 3d5.(6S).4s2.4p y7P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5260.5460 | -4.684 | 4.9881 | 2.0 | 7.3443 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5256.1456 | -3.101 | 4.9881 | 2.0 | 7.3463 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Ti I | 5271.2369 | -5.266 | 3.9569 | 5.0 | 6.3084 | 6.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 5271.1833 | -5.027 | 3.9569 | 5.0 | 6.3084 | 6.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 5271.2603 | -4.067 | 3.9569 | 5.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 5271.2394 | -4.480 | 3.9569 | 5.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 5298.9125 | -5.663 | 3.9692 | 6.0 | 6.3084 | 7.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[15/2] | K10 |
| Ti I | 5298.5196 | -5.081 | 3.9692 | 6.0 | 6.3086 | 7.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[15/2] | K10 |
| Ti I | 5298.9684 | -6.282 | 3.9692 | 6.0 | 6.3084 | 6.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 5298.9142 | -5.550 | 3.9692 | 6.0 | 6.3084 | 6.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 5298.9920 | -5.652 | 3.9692 | 6.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 5298.9710 | -5.781 | 3.9692 | 6.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(3P*) z3H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Fe I | 5313.8418 | -4.435 | 5.0117 | 4.0 | 7.3443 | 3.0 | LS 3d5.(6S).4s2.4p y7P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5309.3518 | -4.416 | 5.0117 | 4.0 | 7.3463 | 3.0 | LS 3d5.(6S).4s2.4p y7P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5363.0137 | -3.639 | 5.0331 | 4.0 | 7.3443 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5358.4403 | -2.354 | 5.0331 | 4.0 | 7.3463 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5435.2438 | -5.277 | 5.0638 | 3.0 | 7.3443 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5430.5464 | -5.718 | 5.0638 | 3.0 | 7.3463 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5450.9020 | -3.546 | 5.0704 | 2.0 | 7.3443 | 3.0 | LS 3d6.(a3P).4s.4p.(3P*) z5S* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5446.1776 | -2.445 | 5.0704 | 2.0 | 7.3463 | 3.0 | LS 3d6.(a3P).4s.4p.(3P*) z5S* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5487.7240 | -5.235 | 5.0856 | 2.0 | 7.3443 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5482.9355 | -5.024 | 5.0856 | 2.0 | 7.3463 | 3.0 | LS 3d6.(5D).4s.4p.(1P*) x5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe II | 5652.2978 | -9.916 | 12.6091 | 4.5 | 14.8021 | 5.5 | LS 3d6.(5D).6s 6D | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 5648.0318 | -8.321 | 12.6091 | 4.5 | 14.8037 | 5.5 | LS 3d6.(5D).6s 6D | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Ti I | 5819.4735 | -5.563 | 4.1784 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p w3F* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 5819.4481 | -5.673 | 4.1784 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4F).4p w3F* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Fe II | 5950.5389 | -9.547 | 12.7190 | 5.5 | 14.8021 | 5.5 | LS 3d6.(3G).5s f4G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 5945.8110 | -9.100 | 12.7190 | 5.5 | 14.8037 | 5.5 | LS 3d6.(3G).5s f4G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe I | 5985.3840 | -3.621 | 5.2734 | 3.0 | 7.3443 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) x5P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 5979.6881 | -2.621 | 5.2734 | 3.0 | 7.3463 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) x5P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |

| | | | | | | | | | |
|-------|-----------|--------|---------|-----|---------|-----|-------------------------------|--------------------------------|-----|
| Fe II | 6036.7801 | -7.154 | 12.7488 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3G).5s f4G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6031.9143 | -8.417 | 12.7488 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3G).5s f4G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe I | 6104.9184 | -4.736 | 5.3140 | 2.0 | 7.3443 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) x5P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6098.9928 | -3.665 | 5.3140 | 2.0 | 7.3463 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) x5P* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe II | 6163.4426 | -9.713 | 12.7910 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3P).4d 4F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6158.3705 | -6.896 | 12.7910 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3P).4d 4F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe I | 6166.3756 | -4.398 | 5.3342 | 4.0 | 7.3443 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) y5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6160.3301 | -3.171 | 5.3342 | 4.0 | 7.3463 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) y5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Ti I | 6178.8832 | -6.723 | 4.3023 | 5.0 | 6.3084 | 6.0 | LS 3d3.(2G).4p z1H* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 6178.8095 | -7.156 | 4.3023 | 5.0 | 6.3084 | 6.0 | LS 3d3.(2G).4p z1H* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 6178.9153 | -4.161 | 4.3023 | 5.0 | 6.3084 | 5.0 | LS 3d3.(2G).4p z1H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 6178.8867 | -4.872 | 4.3023 | 5.0 | 6.3084 | 5.0 | LS 3d3.(2G).4p z1H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Al II | 6182.3330 | -0.310 | 15.3023 | 3.0 | 17.3073 | 4.0 | LS 3s.4f 3F* | LS 3s.6g 1G | KP |
| Al II | 6182.3330 | -0.080 | 15.3023 | 3.0 | 17.3073 | 4.0 | LS 3s.4f 3F* | LS 3s.6g 1G | KP |
| Al II | 6183.4450 | -1.430 | 15.3027 | 4.0 | 17.3073 | 4.0 | LS 3s.4f 3F* | LS 3s.6g 1G | KP |
| Al II | 6183.4450 | -1.290 | 15.3027 | 4.0 | 17.3073 | 4.0 | LS 3s.4f 3F* | LS 3s.6g 1G | KP |
| Al II | 6185.1820 | -2.940 | 16.6368 | 4.0 | 18.6408 | 3.0 | LS 3s.5g 1G | LS 3s.17f 3F* | KP |
| Al II | 6185.1820 | -2.040 | 16.6368 | 4.0 | 18.6408 | 3.0 | LS 3s.5g 1G | LS 3s.17f 3F* | KP |
| Al II | 6185.1820 | -4.080 | 16.6368 | 4.0 | 18.6408 | 4.0 | LS 3s.5g 1G | LS 3s.17f 3F* | KP |
| Al II | 6185.1820 | -3.940 | 16.6368 | 4.0 | 18.6408 | 4.0 | LS 3s.5g 1G | LS 3s.17f 3F* | KP |
| Fe I | 6199.2340 | -5.440 | 5.3449 | 4.0 | 7.3443 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) z5I* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6193.1240 | -4.244 | 5.3449 | 4.0 | 7.3463 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) z5I* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Al II | 6198.0280 | -2.900 | 16.6368 | 4.0 | 18.6367 | 3.0 | LS 3s.5g 1G | LS 3s.17f 1F* | KP |
| Al II | 6198.0280 | -2.150 | 16.6368 | 4.0 | 18.6367 | 3.0 | LS 3s.5g 1G | LS 3s.17f 1F* | KP |
| Al II | 6201.5270 | -0.280 | 15.3086 | 3.0 | 17.3073 | 4.0 | LS 3s.4f 1F* | LS 3s.6g 1G | KP |
| Al II | 6201.5270 | -0.060 | 15.3086 | 3.0 | 17.3073 | 4.0 | LS 3s.4f 1F* | LS 3s.6g 1G | KP |
| Fe I | 6210.2362 | -5.915 | 5.3484 | 3.0 | 7.3443 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) y5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6204.1045 | -4.812 | 5.3484 | 3.0 | 7.3463 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) y5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6238.3466 | -6.323 | 5.3574 | 2.0 | 7.3443 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) y5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6232.1593 | -4.436 | 5.3574 | 2.0 | 7.3463 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) y5G* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Al II | 6260.7930 | -3.010 | 16.6368 | 4.0 | 18.6166 | 3.0 | LS 3s.5g 1G | LS 3s.16f 3F* | KP |
| Al II | 6260.7930 | -2.120 | 16.6368 | 4.0 | 18.6166 | 3.0 | LS 3s.5g 1G | LS 3s.16f 3F* | KP |
| Al II | 6260.7930 | -4.160 | 16.6368 | 4.0 | 18.6166 | 4.0 | LS 3s.5g 1G | LS 3s.16f 3F* | KP |
| Al II | 6260.7930 | -4.020 | 16.6368 | 4.0 | 18.6166 | 4.0 | LS 3s.5g 1G | LS 3s.16f 3F* | KP |
| Al II | 6276.5560 | -2.970 | 16.6368 | 4.0 | 18.6117 | 3.0 | LS 3s.5g 1G | LS 3s.16f 1F* | KP |
| Al II | 6276.5560 | -2.230 | 16.6368 | 4.0 | 18.6117 | 3.0 | LS 3s.5g 1G | LS 3s.16f 1F* | KP |
| Fe I | 6283.8083 | -5.818 | 5.3718 | 3.0 | 7.3443 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) z5H* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6277.5305 | -4.651 | 5.3718 | 3.0 | 7.3463 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) z5H* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |

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|--------|-----------|--------|---------|-----|---------|-----|-------------------------------|-------------------------------|-----|
| Al II | 6322.3940 | -0.500 | 16.5450 | 3.0 | 18.5055 | 4.0 | LS 3s.5f 3F* | LS 3s.13g 1G | KP |
| Al II | 6322.3940 | -0.320 | 16.5450 | 3.0 | 18.5055 | 4.0 | LS 3s.5f 3F* | LS 3s.13g 1G | KP |
| Fe I | 6330.2589 | -5.052 | 5.3863 | 4.0 | 7.3443 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) z5H* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6323.8880 | -3.907 | 5.3863 | 4.0 | 7.3463 | 3.0 | LS 3d6.(3H).4s.4p.(3P*) z5H* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Al II | 6325.1900 | -1.650 | 16.5459 | 4.0 | 18.5055 | 4.0 | LS 3s.5f 3F* | LS 3s.13g 1G | KP |
| Al II | 6325.1900 | -1.510 | 16.5459 | 4.0 | 18.5055 | 4.0 | LS 3s.5f 3F* | LS 3s.13g 1G | KP |
| Fe II | 6336.7455 | -8.189 | 12.8460 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3G).5s 2G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6331.3843 | -9.471 | 12.8460 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3G).5s 2G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe I | 6353.1086 | -3.958 | 5.3933 | 4.0 | 7.3443 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) w5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6346.6916 | -2.905 | 5.3933 | 4.0 | 7.3463 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) w5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Al II | 6354.4720 | -3.050 | 16.6368 | 4.0 | 18.5874 | 3.0 | LS 3s.5g 1G | LS 3s.15f 3F* | KP |
| Al II | 6354.4720 | -2.180 | 16.6368 | 4.0 | 18.5874 | 3.0 | LS 3s.5g 1G | LS 3s.15f 3F* | KP |
| Al II | 6354.4720 | -4.240 | 16.6368 | 4.0 | 18.5874 | 4.0 | LS 3s.5g 1G | LS 3s.15f 3F* | KP |
| Al II | 6354.4720 | -4.100 | 16.6368 | 4.0 | 18.5874 | 4.0 | LS 3s.5g 1G | LS 3s.15f 3F* | KP |
| Fe II | 6366.6719 | -7.419 | 12.8552 | 4.5 | 14.8021 | 5.5 | LS 3d6.(5D).5d 4F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6361.2599 | -7.940 | 12.8552 | 4.5 | 14.8037 | 5.5 | LS 3d6.(5D).5d 4F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Al II | 6373.7970 | -3.010 | 16.6368 | 4.0 | 18.5815 | 3.0 | LS 3s.5g 1G | LS 3s.15f 1F* | KP |
| Al II | 6373.7970 | -2.290 | 16.6368 | 4.0 | 18.5815 | 3.0 | LS 3s.5g 1G | LS 3s.15f 1F* | KP |
| Fe II | 6394.6060 | -9.731 | 12.8637 | 5.5 | 14.8021 | 5.5 | LS 3d6.(3H).4d 4H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6389.1465 | -9.381 | 12.8637 | 5.5 | 14.8037 | 5.5 | LS 3d6.(3H).4d 4H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6402.6617 | -7.846 | 12.8661 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3H).4d 4G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6397.1884 | -9.172 | 12.8661 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3H).4d 4G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Al II | 6419.2990 | -0.510 | 16.5746 | 3.0 | 18.5055 | 4.0 | LS 3s.5f 1F* | LS 3s.13g 1G | KP |
| Al II | 6419.2990 | -0.330 | 16.5746 | 3.0 | 18.5055 | 4.0 | LS 3s.5f 1F* | LS 3s.13g 1G | KP |
| Fe II | 6445.1444 | -7.435 | 12.8789 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3H).4d 4H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6439.5983 | -9.178 | 12.8789 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3H).4d 4H | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6471.1527 | -8.342 | 12.8866 | 5.5 | 14.8021 | 5.5 | LS 3d6.(5D).5d 6F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6465.5617 | -7.546 | 12.8866 | 5.5 | 14.8037 | 5.5 | LS 3d6.(5D).5d 6F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6477.0223 | -7.683 | 12.8884 | 4.5 | 14.8021 | 5.5 | LS 3d6.(5D).5d 6F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6471.4212 | -6.856 | 12.8884 | 4.5 | 14.8037 | 5.5 | LS 3d6.(5D).5d 6F | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Si III | 6471.4830 | -3.710 | 30.0632 | 4.0 | 31.9786 | 5.0 | LS 3s.6g 3G | LS 3s.9h 1H* | KP |
| Si III | 6471.4830 | -0.070 | 30.0632 | 4.0 | 31.9786 | 5.0 | LS 3s.6g 3G | LS 3s.9h 1H* | KP |
| Si III | 6471.6550 | -4.630 | 30.0633 | 4.0 | 31.9786 | 5.0 | LS 3s.6g 1G | LS 3s.9h 1H* | KP |
| Si III | 6471.6550 | -0.070 | 30.0633 | 4.0 | 31.9786 | 5.0 | LS 3s.6g 1G | LS 3s.9h 1H* | KP |
| Si III | 6471.8810 | -1.810 | 30.0634 | 5.0 | 31.9786 | 5.0 | LS 3s.6g 3G | LS 3s.9h 1H* | KP |
| Si III | 6471.8810 | -1.710 | 30.0634 | 5.0 | 31.9786 | 5.0 | LS 3s.6g 3G | LS 3s.9h 1H* | KP |
| Al II | 6472.6730 | -3.090 | 16.6368 | 4.0 | 18.5518 | 3.0 | LS 3s.5g 1G | LS 3s.14f 3F* | KP |
| Al II | 6472.6730 | -2.210 | 16.6368 | 4.0 | 18.5518 | 3.0 | LS 3s.5g 1G | LS 3s.14f 3F* | KP |

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|--------|-----------|--------|---------|-----|---------|-----|-------------------------------|---------------------------------|-----|
| Al II | 6472.6730 | -4.260 | 16.6368 | 4.0 | 18.5518 | 4.0 | LS 3s.5g 1G | LS 3s.14f 3F* | KP |
| Al II | 6472.6730 | -4.120 | 16.6368 | 4.0 | 18.5518 | 4.0 | LS 3s.5g 1G | LS 3s.14f 3F* | KP |
| Si III | 6473.9180 | -0.580 | 30.0555 | 3.0 | 31.9701 | 4.0 | LS 3s.6f 3F* | LS 3s.9g 3G | KP |
| Si III | 6473.9180 | -0.440 | 30.0555 | 3.0 | 31.9701 | 4.0 | LS 3s.6f 3F* | LS 3s.9g 3G | KP |
| Si III | 6474.0980 | -1.750 | 30.0555 | 4.0 | 31.9701 | 4.0 | LS 3s.6f 3F* | LS 3s.9g 3G | KP |
| Si III | 6474.0980 | -1.610 | 30.0555 | 4.0 | 31.9701 | 4.0 | LS 3s.6f 3F* | LS 3s.9g 3G | KP |
| Ti I | 6480.8731 | -4.331 | 4.3958 | 4.0 | 6.3084 | 5.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[[11/2] | K10 |
| Ti I | 6480.8416 | -4.794 | 4.3958 | 4.0 | 6.3084 | 5.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[[11/2] | K10 |
| Al II | 6497.0710 | -3.050 | 16.6368 | 4.0 | 18.5446 | 3.0 | LS 3s.5g 1G | LS 3s.14f 1F* | KP |
| Al II | 6497.0710 | -2.320 | 16.6368 | 4.0 | 18.5446 | 3.0 | LS 3s.5g 1G | LS 3s.14f 1F* | KP |
| Al II | 6508.7370 | -1.450 | 16.5450 | 3.0 | 18.4494 | 4.0 | LS 3s.5f 3F* | LS 3s.12g 1G | KP |
| Al II | 6508.7370 | -1.270 | 16.5450 | 3.0 | 18.4494 | 4.0 | LS 3s.5f 3F* | LS 3s.12g 1G | KP |
| Al II | 6511.7000 | -2.600 | 16.5459 | 4.0 | 18.4494 | 4.0 | LS 3s.5f 3F* | LS 3s.12g 1G | KP |
| Al II | 6511.7000 | -2.460 | 16.5459 | 4.0 | 18.4494 | 4.0 | LS 3s.5f 3F* | LS 3s.12g 1G | KP |
| Fe I | 6528.6754 | -3.436 | 5.4458 | 3.0 | 7.3443 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) w5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6521.8991 | -2.324 | 5.4458 | 3.0 | 7.3463 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) w5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Ti I | 6525.5082 | -4.517 | 4.4089 | 5.0 | 6.3084 | 6.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[[13/2] | K10 |
| Ti I | 6525.4260 | -4.059 | 4.4089 | 5.0 | 6.3084 | 6.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[[13/2] | K10 |
| Ti I | 6525.5440 | -5.796 | 4.4089 | 5.0 | 6.3084 | 5.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[[11/2] | K10 |
| Ti I | 6525.5121 | -4.658 | 4.4089 | 5.0 | 6.3084 | 5.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[[11/2] | K10 |
| Si III | 6535.1640 | -0.180 | 30.0838 | 5.0 | 31.9804 | 6.0 | LS 3s.6h 1H* | LS 3s.9i 1I | KP |
| Si III | 6535.1640 | -0.170 | 30.0838 | 5.0 | 31.9804 | 6.0 | LS 3s.6h 1H* | LS 3s.9i 1I | KP |
| Si III | 6535.1640 | -3.630 | 30.0838 | 5.0 | 31.9804 | 6.0 | LS 3s.6h 1H* | LS 3s.9i 1I | KP |
| Si III | 6535.1640 | -0.170 | 30.0838 | 5.0 | 31.9804 | 6.0 | LS 3s.6h 1H* | LS 3s.9i 1I | KP |
| Si III | 6535.1640 | -4.840 | 30.0838 | 5.0 | 31.9804 | 6.0 | LS 3s.6h 1H* | LS 3s.9i 1I | KP |
| Si III | 6535.1640 | -0.170 | 30.0838 | 5.0 | 31.9804 | 6.0 | LS 3s.6h 1H* | LS 3s.9i 1I | KP |
| Si III | 6535.1640 | -2.080 | 30.0838 | 5.0 | 31.9804 | 5.0 | LS 3s.6h 1H* | LS 3s.9i 3I | KP |
| Si III | 6535.1640 | -1.980 | 30.0838 | 5.0 | 31.9804 | 5.0 | LS 3s.6h 1H* | LS 3s.9i 3I | KP |
| Si III | 6535.1640 | -2.070 | 30.0838 | 6.0 | 31.9804 | 6.0 | LS 3s.6h 3H* | LS 3s.9i 1I | KP |
| Si III | 6535.1640 | -1.980 | 30.0838 | 6.0 | 31.9804 | 6.0 | LS 3s.6h 3H* | LS 3s.9i 1I | KP |
| Fe I | 6571.5296 | -3.649 | 5.4582 | 4.0 | 7.3443 | 3.0 | LS 3d6.(3F2).4s.4p.(3P*) v5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6564.6641 | -2.603 | 5.4582 | 4.0 | 7.3463 | 3.0 | LS 3d6.(3F2).4s.4p.(3P*) v5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe II | 6572.2683 | -9.310 | 12.9161 | 5.5 | 14.8021 | 5.5 | LS 3d6.(3H).4d 4I | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6566.5014 | -9.511 | 12.9161 | 5.5 | 14.8037 | 5.5 | LS 3d6.(3H).4d 4I | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Si III | 6570.9830 | -2.370 | 30.0838 | 5.0 | 31.9701 | 4.0 | LS 3s.6h 1H* | LS 3s.9g 3G | KP |
| Si III | 6570.9830 | -2.370 | 30.0838 | 5.0 | 31.9701 | 4.0 | LS 3s.6h 1H* | LS 3s.9g 3G | KP |
| Si III | 6570.9830 | -4.140 | 30.0838 | 4.0 | 31.9701 | 4.0 | LS 3s.6h 3H* | LS 3s.9g 3G | KP |
| Si III | 6570.9830 | -4.000 | 30.0838 | 4.0 | 31.9701 | 4.0 | LS 3s.6h 3H* | LS 3s.9g 3G | KP |

| | | | | | | | | | |
|--------|-----------|--------|---------|-----|---------|-----|-------------------------------|--------------------------------|-----|
| Si III | 6570.9830 | -4.120 | 30.0838 | 5.0 | 31.9701 | 5.0 | LS 3s.6h 1H* | LS 3s.9g 3G | KP |
| Si III | 6570.9830 | -4.010 | 30.0838 | 5.0 | 31.9701 | 5.0 | LS 3s.6h 1H* | LS 3s.9g 3G | KP |
| Fe II | 6580.1423 | -9.264 | 12.9184 | 4.5 | 14.8021 | 5.5 | LS 3d6.(3H).4d 4I | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6574.3615 | -8.601 | 12.9184 | 4.5 | 14.8037 | 5.5 | LS 3d6.(3H).4d 4I | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Ti I | 6579.3312 | -4.758 | 4.4244 | 6.0 | 6.3084 | 7.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[15/2] | K10 |
| Ti I | 6578.7255 | -4.198 | 4.4244 | 6.0 | 6.3086 | 7.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[15/2] | K10 |
| Ti I | 6579.4173 | -5.444 | 4.4244 | 6.0 | 6.3084 | 6.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 6579.3338 | -5.546 | 4.4244 | 6.0 | 6.3084 | 6.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[13/2] | K10 |
| Ti I | 6579.4537 | -4.408 | 4.4244 | 6.0 | 6.3084 | 5.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 6579.4212 | -4.770 | 4.4244 | 6.0 | 6.3084 | 5.0 | LS 3d3.(2G).4p y3H* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 6610.8754 | -8.134 | 4.4334 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4P).4p w5D* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 6610.8426 | -4.177 | 4.4334 | 4.0 | 6.3084 | 5.0 | LS 3d3.(4P).4p w5D* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Al II | 6611.4840 | -1.460 | 16.5746 | 3.0 | 18.4494 | 4.0 | LS 3s.5f 1F* | LS 3s.12g 1G | KP |
| Al II | 6611.4840 | -1.270 | 16.5746 | 3.0 | 18.4494 | 4.0 | LS 3s.5f 1F* | LS 3s.12g 1G | KP |
| Al II | 6625.3830 | -3.100 | 16.6368 | 4.0 | 18.5077 | 3.0 | LS 3s.5g 1G | LS 3s.13f 3F* | KP |
| Al II | 6625.3830 | -2.240 | 16.6368 | 4.0 | 18.5077 | 3.0 | LS 3s.5g 1G | LS 3s.13f 3F* | KP |
| Al II | 6625.3830 | -4.300 | 16.6368 | 4.0 | 18.5077 | 4.0 | LS 3s.5g 1G | LS 3s.13f 3F* | KP |
| Al II | 6625.3830 | -4.160 | 16.6368 | 4.0 | 18.5077 | 4.0 | LS 3s.5g 1G | LS 3s.13f 3F* | KP |
| Fe I | 6634.1876 | -4.236 | 5.4760 | 3.0 | 7.3443 | 3.0 | LS 3d6.(3F2).4s.4p.(3P*) v5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6627.1906 | -3.321 | 5.4760 | 3.0 | 7.3463 | 3.0 | LS 3d6.(3F2).4s.4p.(3P*) v5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6641.8665 | -3.776 | 5.4781 | 2.0 | 7.3443 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) w5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6634.8533 | -2.591 | 5.4781 | 2.0 | 7.3463 | 3.0 | LS 3d6.(3P2).4s.4p.(3P*) w5D* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Al II | 6656.8820 | -3.070 | 16.6368 | 4.0 | 18.4988 | 3.0 | LS 3s.5g 1G | LS 3s.13f 1F* | KP |
| Al II | 6656.8820 | -2.350 | 16.6368 | 4.0 | 18.4988 | 3.0 | LS 3s.5g 1G | LS 3s.13f 1F* | KP |
| Fe II | 6676.4616 | -8.607 | 12.9455 | 4.5 | 14.8021 | 5.5 | LS 3d6.(5D).5d 6D | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6670.5105 | -5.907 | 12.9455 | 4.5 | 14.8037 | 5.5 | LS 3d6.(5D).5d 6D | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe I | 6687.1052 | -4.905 | 5.4908 | 2.0 | 7.3443 | 3.0 | LS 3d6.(3F2).4s.4p.(3P*) w5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6679.9962 | -3.610 | 5.4908 | 2.0 | 7.3463 | 3.0 | LS 3d6.(3F2).4s.4p.(3P*) w5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Ti I | 6718.7301 | -5.406 | 4.4635 | 4.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(1P*) y1G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Ti I | 6718.6962 | -5.569 | 4.4635 | 4.0 | 6.3084 | 5.0 | LS 3d2.(1G).4s.4p.(1P*) y1G* | JK 3d2.4s.(4F<7/2>).5g 2[11/2] | K10 |
| Fe I | 6745.5913 | -4.748 | 5.5068 | 4.0 | 7.3443 | 3.0 | LS 3d6.(3F2).4s.4p.(3P*) w5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe I | 6738.3575 | -4.685 | 5.5068 | 4.0 | 7.3463 | 3.0 | LS 3d6.(3F2).4s.4p.(3P*) w5F* | JK 3d6.4s.(6D<9/2>).6d 2[7/2] | K14 |
| Fe II | 6758.4367 | -7.644 | 12.9681 | 5.5 | 14.8021 | 5.5 | LS 3d6.(5D).5d 6G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Fe II | 6752.3385 | -7.411 | 12.9681 | 5.5 | 14.8037 | 5.5 | LS 3d6.(5D).5d 6G | JK 3d6.(5D<1>).6h 2[5]* | K13 |
| Al II | 6765.3970 | -1.290 | 16.5450 | 3.0 | 18.3771 | 4.0 | LS 3s.5f 3F* | LS 3s.11g 1G | KP |
| Al II | 6765.3970 | -1.110 | 16.5450 | 3.0 | 18.3771 | 4.0 | LS 3s.5f 3F* | LS 3s.11g 1G | KP |
| Al II | 6768.5990 | -2.440 | 16.5459 | 4.0 | 18.3771 | 4.0 | LS 3s.5f 3F* | LS 3s.11g 1G | KP |
| Al II | 6768.5990 | -2.300 | 16.5459 | 4.0 | 18.3771 | 4.0 | LS 3s.5f 3F* | LS 3s.11g 1G | KP |