SPECTRUM OF PECULIAR A STAR 53 AUR.

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Abstract: The line identification and the equivalent widths measurement were made on nine spectrograms obtained with 2-m telescope.

Introduction

The peculiar star 53 Aur. is classified as the Eu, Cr-type by Bertaud (1959). This star is by Cameron (1967) listed among suspected magnetic stars and Osawa's classification of the peculiarity is "Hg–4077". The peculiarity types by Bertaud and Osawa are markedly different. While the first classification "Eu–Cr" alignes this star rather to cooler Ap-stars (later then A0), the second one, "Hg", marks one of the hottest Ap-atmosphere. The appearance of the spectrum is very complex, with many blends and, it seems, that the continuum is covered by lines entirely. In several cases it was not possible to exclude the variability of spectral lines. The K-line is weak and shallow.

The spectrum of this star we took for the quantitative analysis. The coarse analysis showed some overabundances, particularly rare earths, (Zverko, 1973). The model atmosphere analysis showed, in addition to, possible deviations from the LTE and differences from normal stellar atmospheric structure (Zverko, 1974).

In present paper we give complete line-identification list in the observed spectral region.

Observational Material

All spectroscopic observations were made at Ondřejov Observatory with the 2-m telescope. Table 1 lists the dates of obtained spectrograms. The plates taken from Mart 1972, when the new grating was installed, have the dispersion $\approx$ 9 Å/mm, the other ones are with the dispersion $\approx$ 8 Å/mm. The photographic emulsion is Kodak IIa–0 at all cases. All plates was exposed at the 700 mm coudè camera.

The sixth column of Table 1 gives the transparence of the plates as it was measured at $\lambda \approx 4600$ Å for the plate No. 726 and at $\lambda \approx 4250$ Å for the other ones. Essentially owing to the instability of local atmospherical conditions, the transparences occurs at markedly wide range. This is unfortunately, unfavourable for the line-intensity variations exploration. Therefore we cloud the equivalent widths and the line-profile measurements carry out only. The last column of Table 1 gives the use of single spectrograms. For the equivalent widths measurements we used four plates with relatively near values of the transparence.

Treatment

The appearance of the spectrum – many blends and apparently broad lines – make impossible the measurements by the comparator. It shows most suitable to measure the wavelengths on the intensity tracings directly. The microphotometric intensity tracings were made by the electronic intensitometer at Astronomical Institute of Slovak Academy of Sciences at Skalnaté Pleso. For each spectrogram for the wavelength measurements used we made two tracings, the second one with the shifting of the plate by 180 deg. The tracings were made at the scale $\approx$ 1 Å/cm.

The process of the measurement of the wavelengths was following: at first we identified the lines as the reference points at distances to about $\approx$ 50 Å. This we made with help of the work by Wright et al. (1964). Then we measured the positions of other lines on the both tracings and averaged. The lines are mostly weak and thus the grain of the emulsion and the number of blends

break the line profile. The finding and distinguishing of single line may be then sometimes mistaken. Owing to these facts we found the lines at limits up to $\approx \pm 0.2$ Å from the measured value of the wavelength. If it is not, in addition to, possible to measure the equivalent width due to the close blending, conclusive identification (by curve of growth) is impossible. Table 2 lists the found and measured lines together with the verified or the possible identification. We used the tables by Moore (1945) and by Harrison (1969).

The measurements of the equivalent widths was made by the triangle method. Not each line was measured on all spectrograms. The reasons are mentioned above. Table 2 gives the averaged values of the equivalent widths at milliangströms and the number of the measurings too. More theoretical wavelengths for the measured value indicate a non-unqueness of the identification. The braces indicate blends.

Acknowledgment

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Table 1

Plate No.	Spectrum	Seeing	Exp. time	Date	Transparence	Use
725	3700–4600 Å	2"–3"	2^h30^m	Jan. 12, 1971	0.232	W_λ, H_γ, H_δ
726	4200–4900	6"–7"/2"	8 15	Jan. 12, 13, 1971	0.028	H_β
727	3700–4600	4"	3 00	Jan. 14, 1971	0.179	W_λ, H_γ, H_δ
1076	3700–4900	5"	3 00	Jan. 13, 1972	0.485	H_γ, H_δ
1077	3700–4900	5"–7"	3 30	Jan. 14, 1972	0.699	
1078	3700–4900	6"–8"	3 30	Jan. 14, 1972	very underexposed	
1089	3700–4900	3"	2 00	March 25, 1972	0.224	W_λ, H_β, H_γ, H_δ
1095	3700–4900	3"	1 30	Apr. 15, 1972	0.505	H_β, H_γ, H_δ
1278	3700–4900	1"	0 30	Oct. 6, 1972	0.371	W_λ, H_γ, H_δ

Note: The spectrogram No. 726 was taken at two nights.

Table 2

λ_C	λ_T	Identification	W_λ	Notes	n
3754.0	53.958	Ce	106		2
	54.0	Bi II			
	.06	Ir			
	.12	P Rh II 7			
55.0	54.89	P Fe I 949			
	55.13	Cr II 20			
	.28	Sm II 34			
55.5	.54	Mo II 5	49		1
	.56	Gd II 85			
	.56	Fe II 154			
55.9	56.07	Fe I 74	40		1
56.2	.10	He I 66	36		1
56.6	.411	Sm II 44	65		2
56.7	.55	Cr II 144	62		2
	.86	Tm II 9			
	.94	Fe I 805			
	.96	Zr II 8			
57.5	.46	Fe I 668	46		1
	.52	Sm II			
57.7	.68	Ti II 72	104		1
58.7	.72	Cr I 12	62		1
	.9	Y II 14			
59.0	.00	Gd II 2	54		1
59.7	.56	Co I 3	89		1
	.68	Co I 131			
60.2	.24	V II 21	46		1
61.3	.20	V II 129	125	$W\lambda$= 45 for 1278	2
	.32	Ti II 13			
	.12	Eu II 11		on 1278 absent	
61.7	.69	Cr II 11	36		
	.82	P II 1			
62.2	.20	Fe I 705	36		1
62.8	.89	Fe II 192	52		1
	63.00	Gd II 1			
63.4	.36	Mo I 8			
	.38	Mn I 24			
	.48	Nd II			
64.1	.09	Fe II 29			
	.12	Ce II 41			
64.3	.37	Sm II 34			
	.38	Zr I 10			
64.7	.60	Gd II 85			
	.81	Pr II			
65.0	.04	Ce II 208			
65.4	.54	Fe I 608			
66.0	65.93	Eu II 11			
	66.09	Fe I 226			
67.5	.57	Cl II 6			
	.72	V II 100			
75.0	.03	P II 19			
75.4	.41	Eu			
	.44	U			
	.45	W			
	.45	Cb			
	.45	A I			
75.8	.72	Tl I 1			
	.86	Fe I 287			
76.8	.56	Y II 8			
	.69	W			
	.74	U			
	.80	S II 51			
	.93	Ir			
77.3	.32	Cr I 41			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3777.9	.92	Ru II 1			
	.93	Cr I 41			
78.3	.32	Fe I 367			
	.36	V II 21			
	.37	P Fe II 192			
79.0	.05	U			
	.16	Ir			
	.21	W			
	.21	Fe I 290			
79.7	.58	P Fe II 23			
	.65	V I 69			
80.0	.09	Hf II 18			
80.7	.76	Sm II			
	.77	W I 8			
	.93	Sm II 38			
81.2	.19	Fe I 74			
81.6	.51	Fe II 130			
	.60	Mo I 8			
	.62	Ce II 163			
	.68	He II 5			
81.8	.94	Fe I 917			
82.2	.20	Os I 3			
	.24	Zr II 44			
	.30	Y II 61			
82.5	.52	Ce II 142			
83.6	.53	Ni I 30	36		1
	.56	Tm II 11			
84.2	.27	P Fe I-607	126		1
84.8	.81	La II 13			
	.89	He I 64			
85.6	.42	Mn I 45	42		1
	.71	Fe I 608			
85.9	.78	P Fe I 704			
	.95	Fe I 177	54		1
86.6	.33	P Ti II 12			
	.37	P Fe II 15			
	.63	Ce II 51			
	.68	Fe I 22			
	.70	P II 1			
87.2	.16	Fe I 916			
	.24	V II 100			
87.9	.88	Fe I 21			
	.89	P Cr II 6			
88.5	.47	Rh I 6			
	.70	Y II 7			
89.3	.18	Fe I 289	32		1
	.49	Cr I 41			
	.57	Fe I 226			
89.8	.82	P Fe I 702	37		1
90.6	.66	Fe I 387	39		1
91.4	.17	Gd II 85			
	.21	Cb I 2			
	.39	Zr I 8			
	.50	Fe I 223			
92.3	.16	Fe I 287	68		1
	.32	Zr II 81			
	.33	Ce II 129			
	.34	Ni I 2			
93.1	.22	Rh I 9	77		1
	.00	Bi II			
	.02	Eu			
	.10	U			
3804.6	.476	Mn II 14	50		1

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3804.6	.589	V I 97			
07.5	.534	Fe I 73	61		2
08.0	.10	Co I 17			
08.4	.52	V I 9			
09.2	.22	Ce II 204			
09.7	.74	Eu			
10.1	.10	Cl II 62			
	.21	P Fe II 143			
10.4	.59	Ef II 96			
10.7	.724	Tm II 9			
	.759	Fe I 665	44		1
	.90	P Fe I 224			
11.0	.05	Fe I 223, 287	39		1
	.065	Co I 31			
	.073	Nd II 69			
	.32	Ni I 15			
11.8	.774	Nd II 31			
	.80	P Fe I 701			
	.892	Fe I 287	41		1
12.4	.250	Cr I 214	43		1
	.470	Co I 40			
13.0	12.964	Fe I 22	56		1
	.059	Fe I 222			
	.07	P Fe I 176			
	.12	V II 128			
13.4	.39	Ti II 12			
	.40	Be I 5			
	.50	He II 4			
13.5	.45	P V I 28	61		1
	.638	Fe I 283			
14.2	.00	Cr II 80			
	.121	Fe II 153			
14.8	.72	Nd II			
15.4	.38	V II 166	96		3
	.433	Cr I 71		W_λ 1278 = 25	
	.495	Eu II		on 1278 absent	
	.514	V I 28			
15.9	.831	Ce II 37	62		3
	.842	Fe I 45			
16.4	.318	Co I 61	32		1
	.458	Co I 62			
	.64	Gd II 1			
16.8	.753	Mn I 6	24		3
	.876	Co I 86			
	.92	P Fe I 387			
17.3	.20	Hf II 62	26		3
	.24	La II 168			
	.40	Tm II			
	.46	Ce II 222			
17.7	.64	Fe I 701	22		2
	.59	Zr II 18			
	.639	Ti I 189			
18.2	17.94	Co I 131			
	18.27	N I 11			
	.28	Pr II			
	.34	Y II 7			
18.8	.78	Zr II 111	39		1
	.862	Cb II 10			
19.1	.02	Ce II			
	.03	Ru I			
	.05	U			
	.07	Eu	33		3

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3819.3	.564	Cr I 70	20		1
19.6	.67	Eu II 1	17		2
20.1	19.91	Co I 130			
	.96	V I 28			
	.97	Cr I 40	31		3
20.4	.299	V I 44			
	.428	Fe I 20	33		3
21.2	.18	Fe I 608	27		2
21.5	.487	V I 28	37		2
	.582	Cr I 40			
22.1	21.83	Fe I 222			
	.92	P Fe II 14	25		3
	22.009	V I 9			
	.03	Ti I 189			
	.076	Ti I			
22.4	.26	Rh I 8			
	.41	Zr I 10			
22.6	.63	P O I 36	17		1
23.5	.41	Zr II 44	25		3
	.47	O I 36			
	.513	Mn I 6			
	.522	Cr I 24			
	.571	Pr II 14			
23.8	.893	Mn I 6	13		1
24.1	.07	Fe I 224	34		2
	.18	Sm II 18			
24.4	.444	Fe I 4	30		2
25.6	.09	O I 36			
25.8	.884	Fe I 20	56		1
26.5	.42	Nd II 33			
	.63	P Fe I 176	26		2
26.8	.70	Mo I 8			
	.84	Fe I 283	22		2
27.2	.08	Fe II 153			
	.27	Zr II	24		2
27.9	.825	Fe I 45	95		1
28.1	.06	U			
	.14	Th			
	.17	Nd			
	.18	Sc			
	.18	Er			
	.19	Dy			
	.21	Ce			
29.1	.133	W I 3	34		1
32.5	.2996	Mg I 3	166		1
	.3037	Mg I 3			
38.3	.2918	Mg I 3	81		1
	.2943	Mg I 3			
39.1	.259	Fe I 529	62		1
46.5	.516	Y II 83			
46.8	.803	Fe I 664	33		1
	.949	Fe I 176			
47.1	.01	Zr I 10			
	.09	F II 1			
47.4	.323	V I 7	21		1
47.9	.84	Eu			
48.3	.23	Nd II 19			
	.24	Mg II 5			
	.30	Fe I 224			
49.5	.52	Hf II 61			
	.58	Ni II 11			
49.8	.758	V II 33	35		3
	.969	Fe I 20			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3849.8	.978	Fe II 1			
50.3	.40	Mg II 5			
50.6	.69	Gd II 2	39		3
51.7	.62	Pr II	34		2
	.67	F II 1			
52.1	51.88	Sm II 29	63		2
	52.10	V II 3			
	.218	Cr I 24			
52.6	.57	Fe I 73	21		1
53.1	.164	Ce II 39	39		3
53.7	.66	Si II 1	48		2
54.1	.177	Gd II 50	45		3
54.4	.38	Fe I 567	26		2
54.9	.905	Pr II	46		3
	.91	La II 55			
55.5	.43	Zr II 18			
	.56	Gd II 2			
55.8	.846	Fe I 567	63		1
56.1	.021	Si II 1	56		2
	.281	Cr I 69			
56.5	.37	Fe I 4	41		1
	.52	Rh I 7			
57.6	.63	Cr I 69	48		2
58.6	.48	P Fe I 565	32		2
59.2	.21	Fe I 175	35		1
	.24	Mg I 21			
59.7	.36	P Sc II 1	58		2
	.91	Fe I 4			
60.1	.13	Cr I 39	25		1
60.5	.401	Ce	10		1
	.619	Sm			
	.626	Ce			
61.1	.16	Co I 33	28		2
61.4	.341	Fe I 283, 663	31		2
	.60	Fe I 663			
62.0	.05	Sm II 10	26		1
62.6	.592	Si II 1	49		3
63.2	.33	Nd II 27	44		2
63.6	.61	Co I 131	26		2
63.9	.745	Fe I 280	18		2
64.5	.335	W I 3	30		3
65.0	64.862	V I 7	32		3
65.3	.458	Pr II	36		3
65.6	.59	Cr II 167	30		3
	.72	V II 20			
66.0	.01	Cr II 130	26		3
66.7	.54	Cr II 130	30		3
	.744	V II 11			
67.1	.219	Fe I 488	21		1
67.8	.84	Ru I 9	20		2
68.3	67.99	W II 7	13		1
	68.41	Pt			
	.24	Fe I 430			
	.35	La			
68.5	.397	Ti I 175	8		1
68.8	.84	C II 18	15		1
69.7	.73	Eu			
	.75	U			
70.2	.06	Al II 74			
	.27	Cr I 11			
70.7	.64	Si			
	.7	Na			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3870.7	.81	Fe			
71.3	.21	Ru I	18		1
	.35	Au			
	.38	U			
	.39	Zr			
71.5	.54	Gd II 1	24		1
71.6	.64	La II 13			
71.9	.750	Fe I 429	30		1
72.3	.31	Y II 61	48		2
72.6	.504	Fe I 20	68		1
72.9	.98	P Fe II 128	59		3
	73.120	Co I 18			
74.2	73.95	Co I 18			
	74.053	Fe I 120	31		3
	.37	Zr II 89			
74.9	.76	P Cr II 149	21		1
	75.036	Ce II 162			
75.7	.67	V II 20	19		2
76.7	.65	Lu II 3	16		2
	.67	C II 33			
	.67	Fe I 121			
	.83	Co I 17, 62			
77.0	76.97	Ce II 82	19		2
77.7	.60	Zr I 58	32		2
78.0	.021	Fe I 20	33		2
	.180	He I 59			
	.19	P Fe I 565			
78.3	.28	Y II 7	27		2
	.372	Ce II 48			
78.7	.715	V II 33	34		2
78.9	.750	Co I 52	22		2
	79.04	Zr I 6			
81.8	.869	Co I 18	34		1
93.6	.43	V II 20	27		1
	.437	Tm II 5			
	.660	Cr I 138			
94.3	.49	Fe I 566	54		1
97.3	.290	Ti I 175	29		1
	.449	Fe I 429			
98.1	.012	Fe I 20	51		1
	.120	Mg I 47			
	.143	V I 63			
99.2	.037	Fe I 175	24		1
99.4	.46	Eu	34		2
	.33	Mn			
3900.0	.09	Cs II	21		1
	.11	Pr			
	.11	K II			
	.17	Eu			
	.18	V I 126			
00.4	.51	Zr I 6	37		1
02.1	.09	P Sc II 9	47		3
02.4	.40	Gd II 19	38		2
	.56	V I 43			
02.9	.948	Fe I 45	56		2
03.2	.16	Cr I 23			
	.27	V II 11			
03.7	.77	Zr II 7			
	.902	Fe I 429	38		2
04.1	.02	Mg I 19	32		2
05.2	.01	P Fe I 703	27		1
	.18	P Fe I 564			
05.5	.64	Cr II 167	39		2

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3906.2	.04	Fe II 173	77		2
	.29	Co I 17			
06.6	.48	Fe I 4	138		1
	.75	Fe I 664			
07.1	.10	Eu II 5	38		2
07.8	.937	Fe I 280	32		3
	08.033	Pr II 11			
08.5	.408	Ce II 65	29		1
	.431	Pr II 11			
	.54	P Fe II 29			
	.54	Ce II 127			
09.1	.04	Ce	18		
	.07	U			
	.08	Ru			
	.15	Tb			
	.15	Tl II			
	.17	Pb II			
	.18	Hf			
09.4	.37	Br			
	.38	Au I			
	.48	I			
	.49	Tl			
09.6	.66	Fe I 565			
09.9	.83	Fe I 364			
	.91	Ba I 8			
10.5	.52	P Fe I 562			
	.84	Fe I 284			
11.0	.185	Ti I 175	31		3
11.4	.32	Cr II 129	8		1
11.6	.70	Fe I 664	38		1
11.9	.81	Sc I 8	31		3
12.6	.59	Kr II			
	.61	Pr I			
13.3	.464	Ti II 34	58		2
14.4	.33	V II 33	22		1
	.34	Zr II 134			
	.42	P Fe I 652			
	.48	Fe II 3			
15.1	.08	W			
15.3	.30	P Cr II 128			
	.384	Ir I 6			
	.503	Co I 113			
15.8	.69	Er			
	.88	U			
	.94	Zr II			
16.1	.04	La II 42			
16.5	.418	V II 10	32		2
	.508	Gd II 20			
16.8	.73	Fe I 606			
17.3	.29	Eu II 10			
18.3	.236	Gd II 50	25		1
19.0	18.856	Pr II 11	40		3
	19.069	Fe I 430			
20.0	19.882	Ti I 130	27		2
	20.040	N			
20.3	.260	Fe I 4	24		2
20.4	.35	U			
	.49	V I 42			
20.8	.645	Fe I 153			
	.839	Fe I 567	40		2
	.965	Nd II			
21.6	.54	La II 40			
	.73	Ce II 195			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3921.9	.90	V I 42	18		3
	22.00	Ce II 50			
22.4	.36	Zr II 143			
	.40	Sm II 38			
	.43	V I 42			
22.7	.68	P Fe I 429	55		2
	.76	Co I 32			
22.9	.914	Fe I 4			
23.1	.03	P Fe I 661	31		2
	.11	Ce II 191			
	.25	Gd II 50			
	.39	P Ti II 97			
23.6	.50	Sc II 9	15		1
24.0	23.92	Zr II 100			
	24.08	Mn I			
24.2	.18	P Ni I 240	41		1
24.4	.35	In II			
	.37	W			
	.39	Ga II			
	.43	Ir			
	.44	Si			
25.0	.00	Sr			
	.00	Ce			
	.03	Os			
	.09	La II 135			
	.10	Os			
	.14	W			
	.15	Co I 131			
25.4	.46	Pr II 11	26		2
25.8	.71	A II 105	27		1
26.1	.00	Fe 562	28		2
27.0	26.97	Eu			
27.4	.383	Ce II 43			
	.45	Eu			
	.56	La I			
27.9	.92	Fe I 4	44		2
28.3	.28	Sm II 17			
29.0	.87	Eu II 10	16		1
29.2	.11	Fe I 280			
	.15	P Ti II 97			
30.3	.299	Fe I 4	86		3
	.31	P Fe II 3			
30.6	.50	Eu II 5			
	.67	Y II 16			
31.0	.088	Ce II 49	34		1
	.122	Fe I 565			
32.1	.01	Ti II 34			
32.3	.30	S II 30			
32.7	.63	Fe I 280,652			
32.9	.92	Th			
	.92	Cu I			
	.92	Fe			
	.97	Sm			
	.97	Gd			
	.97	Ir			
33.4	.38	Sc I 8			
33.7	.664	Ca II 1–K	646		1
33.9	.92	Co I 17			
	34.013	V I 42			
34.5	.46	P Ce II 3			
35.2	.18	P Cr II 10	48		2
35.8	.72	Ba I 8	128		3
	.764	Sm II 28			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
	3935.77	Al I 18			
	.815	Fe I 362			
	.914	He I 57			
	.942	Fe II 173			
	.96	Co I 32			
36.2	.22	La II 13	34		2
36.9	.79	P Fe I 564	22		2
	.95	Cr II 128			
37.4	.329	Fe I 278	17		3
37.8	.762	Mn	30		3
	.807	Ce			
	.870	Ba I 8			
	38.005	Ti I 246			
38.3	.289	Fe II 3	40		2
	.400	Mg I 18			
39.0	38.969	Fe II 190	20		3
39.2	.20	Eu			
39.4	.51	P Sc II 9			
40.1	.04	Fe I 731	11		1
40.8	.882	Fe I 20	13		3
	.89	Co I 18			
41.3	.283	Fe I 562	19		3
41.8	.73	Co I 17	13		1
42.3	.24	Hg			
	.35	Eu			
42.6	.59	Hg	17		2
	.63	Nd			
	.64	Gd			
42.7	.75	Ce II 57	25		1
43.2	.14	Ce II 113	20		2
	.24	Sm II 9			
43.7	.66	V I 42	24		2
44.0	.009	Al I 1	14		3
44.5	.421	Nd	24		
	.423	Er			
	.58	Sb II			
	.592	Eu			
	.617	Pr			
45.2	.119	Fe I 280	46		3
	.21	P Fe II 3			
	.33	Co I 29			
46.0	45.968	Cr I 134			
	46.00	Hf II 115			
46.3	.21	Y II 24			
	.406	Al II 63	9		2
	.511	Sm II 17			
46.7	.63	Co I 60			
	.68	Ce II 255			
47.5	.49	O I 3			
	.50	A I 2			
	.53	Fe I 361, 426	29		2
	.59	O I 3			
48.0	47.84	Sm II 33			
	48.00	P Fe I 652			
48.7	.78	Fe I 604			
49.1	.10	La II 41	23		1
49.9	.95	Fe I 72	18		2
50.4	.35	Y II 6	30		1
	.42	S II 45			
50.8	.78	P Fe I 153	28		2
51.1	.15	Nd II 19	32		1
	.16	Fe I 661			
51.6	.417	Co I 171	13		1

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3951.6	.59	Y II 16			
	.765	Cr I 136			
52.0	51.97	V II 10	48		2
	.99	O I 30			
	52.00	Gd II 1			
52.4	.326	Co I 16	40		3
	.399	Cr I 136			
52.9	.917	Co I 28	32		3
53.4	.516	Pr II 9	21		2
53.7	.66	Ce II 141			
53.9	.863	Fe I 362	30		1
54.4	.596	O I 30	8		1
	.687	O I 30			
55.0	.00	Pr	32		2
	.05	Mo			
	.07	Tb			
	.10	Y			
55.8	.75	Eu			
	.77	P Fe I 219			
	.82	P Zr II 17			
56.3	.28	Co I 2	30		1
	.28	Ce II 202			
56.5	.46	Fe I 604			
56.8	.68	Fe I 278	58		2
79.1	.08	La II 140			
	.12	P Fe I 426			
80.0	.04	Eu			
80.9	.65	Fe I 153			
	.90	Ce II 194			
	81.11	Fe I 22			
81.7	.61	P Fe II 3			
	.62	P Fe I 428			
	.78	Fe I 278			
82.0	81.998	Ti II 11	50		1
	82.01	Zr II 142			
	.063	Pr II 28			
82.8	.90	Ce II 172			
	83.01	Gd II 49			
83.2	.188	Sm II 38	21		2
	.237	Cr I 213			
	.35	Fe I 425			
84.2	83.907	Cr I 38	37		2
	84.03	Hf II 19			
	.140	Ni I 171			
	.18	Mn I 33			
	.313	Ti I 188			
86.2	.18	Fe I 655			
	.18	P Fe I 560			
	.201	Mo II 4			
86.7	.68	Sm II 17			
	.75	Mg I 17			
	.83	Mn I 33			
87.0	86.826	Mn I 33	38		1
	87.090	Ni I 137			
	.098	Mn I 33			
87.6	.46	Mn I 33			
	.63	P Ti II 11			
90.2	.299	Co I 58	29		1
	.38	Fe I 527			
91.3	.14	Zr II 30	26		2
	.47	V II 10			
91.6	.328	Co I 170	35		3

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
3992.4	.386	Ce II 134	16		2
92.9	.845	Cr I 67	14		1
	.915	Ce II 226			
93.4	.308	Sm II 4			
	.40	Ba I 8			
93.6	.53	S II 29			
94.5	.683	Ti I 188	28		3
95.0	94.996	N II 12			
	95.10	K II 1	25		2
95.2	.199	Fe I 604	10		1
	.31	Co I 31			
96.2	.075	Al II 47	26		1
	.159	Al II 47			
	.26	P Fe I 561			
	.28	P Fe I 427			
	.323	Al II 47			
98.0	97.90	Co I 32	41		3
	98.054	Fe I 276			
98.5	.46	P Fe I 606	11		2
	.51	Hf II 59			
	.55	Co I 33			
98.8	.73	V I 89	21		2
99.0	.00	P Cr II 10	17		1
	.07	P Cr II 10			
	.195	V II 202			
4000.5	.466	Fe I 426	26		3
01.2	.444	Cr I 268	22		3
01.7	.67	Fe I 72	32		2
02.0	.07	Fe II 29			
02.6	.549	Fe II 190	34		3
02.9	.94	V II 9	38		1
03.4	.33	Cr II 194	23		3
03.9	.850	Gd II 104	30		3
04.3	.15	P Fe II 127	9		1
	.24	Sm II			
	.26	Nd			
04.8	.832	Fe I 601	26		3
05.3	.246	Fe I 43	27		3
05.8	.7	Al II 89	12		1
	.71	V II 32			
06.6	.63	Fe I 488			
	.77	Fe I 320			
07.0	.04	P Cr II 194	33		1
	.195	Ti I 187			
	.233	Fe I 119			
	.277	Fe I 277			
	.435	Nd II			
08.0	07.98	Eu	9		2
	08.02	Mn			
	.05	Ir I			
09.0	08.97	Ir I	16		1
	09.06	Ce			
	.16	Eu			
	.17	U			
09.2	.27	He I 55	8		1
10.0	.18	Fe I 915	4		1
11.0	10.77	Fe I 219, 320	10		1
	11.09	Co I 2			
11.8	.69	Eu II 22			
	.71	Fe I 153			
12.1	.10	K II 2			
	.16	Fe I 601	24		1

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	*n*
4012.3	.250	Nd II 10	61		1
	.372	Ti II 11		on 1278 only	
	.369	Ce II 206			
12.6	.50	Cr II 183	59		1
13.8	.942	Co I 58	20		1
	.953	Gd II 17			
14.5	.489	Sc II 8	26		3
14.9	.899	Ce II 157	32	on 1278 only	1
15.4	.389	Pr II 32	18		2
15.9	.877	Ce II 256	13		2
16.1	.103	Ce			
	.109	W			
	.12	I			
	.15	Ca			
16.7	.54	Fe I 277	31		1
	.81	P Fe I 428			
17.0	.156	Fe I 527	41		2
17.6	.56	Ni I 171			
	.58	Eu II 10			
	.60	Ce II 163			
18.1	.102	Mn I 5	20		2
	.28	Fe I 560			
18.8	.83	Nd II 9			
20.0	19.982	Sm II 16	20		3
	20.05	P Fe I 556			
20.4	.25	Hf II 40	33		1
	.399	Sc I 7			
	.490	Fe I 913			
21.0	20.87	Nd II 19	6		1
21.3	.33	Nd II 36			
22.0	21.869	Fe I 278	20		2
22.4	.36	Cr II 183	26		2
	.45	Fe I 173			
22.8	.74	Fe I 556, 654	6		1
23.2	.23	Sm II 4	5		1
23.4	.40	Co I 59	9		1
23.7	.69	Sc I 7	15		1
24.6	.45	Zr II 54	45		1
	.491	Ce II 49			
	.552	Fe II 127			
	.573	Ti I 12			
24.8	.73	F II 2			
	.74	Fe I 560			
	.78	Nd II 24			
25.0	24.92	Zr I 46			
	25.012	Cr I 37			
	.07	P Ti I 208			
	.114	Ni I 240			
25.2	.136	Ti II 11	12		2
25.8	.87	La II 42			
26.2	.166	Cr I 37	32		1
26.8	.84	Pr	20		1
27.2	.032	Co I 3			
	.103	Cr I 37	12		3
27.9	.80	U			
	.88	Ce			
	.95	Tb			
28.3	.332	Ti II 87	9		2
28.6	.52	Eu	20		1
	.59	Mn			
	.63	Eu			
29.7	.68	Zr II 41	29		1

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
30.0	.194	Fe I 72	12		1
30.8	.47	Nd II 32			
	.755	Mn I 2	86		1
	.867	Al II 72			
31.5	.456	Fe II 151	22		2
	.68	La II 40			
31.9	.968	Fe I 655	16		2
32.7	.64	Fe I 44	41		1
33.0	.073	Mn I 72	66		1
	32.98	Ga I 1			
33.6	.55	Sb I 1	12		1
	.68	P II 17			
34.2	.10	Zr II 42	9		1
	.49	Mn I 2			
34.8	.84	Zr II 70	8		1
35.5	.728	Mn I 5	23		2
36.1	35.96	P Ni I 150	11		1
	.98	P Fe I 426			
	36.23	P II 16			
37.4	.135	Eu			
	.332	Gd II 49	22		1
37.6	.66	Ce II 218	16		1
38.0	.03	Cr II 194	15		3
38.6	.54	V II 155			
	.62	Fe I 600, 728			
38.9	.80	Fe	10		1
	.90	Pr			
39.3	.302	Al II 62	9		1
	.36	Pr II 15			
	.397	Al II 62			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4039.8	.83	Y I 5	25		1
40.2	.24	Zr II 54	22		2
40.8	.76	Ce II 138	33		3
41.4	.361	Mn I 5	22		3
42.0	41.911	Fe I 602	20		3
44.1	43.90	Fe I 276, 557	38		3
	.98	P Fe I 559			
	44.01	P Fe II 172			
	.14	K I 3			
44.4	.42	A I 4			
44.8	.82	Pr II 8	15		2
45.2	.386	Co I 31	44		3
45.8	.815	Fe I 43	78		3
47.0	46.81	P Fe II 126	33		1
	.96	Er			
	47.05	U			
	.09	Gd			
	.10	Pr			
	.16	Sm II 16			
47.9	.79	Sc I 7	13		1
48.2	.22	O II 50			
48.6	.68	Zr II 43	27		1
	.76	Mn I 5			
48.9	.831	Fe II 172			
	.999	Mn I 48	64		3
	49.03	V II 215			
	.14	Cr II 193			
49.6	.57	Sm II	17		2
	.61	Pr			
	.858	Gd II			
50.0	.08	La II 85			
50.7	.32	Zr II 43			
	.68	Hf II 259			
51.2	.06	V II 32			
	.14	Nd II 66			
	.18	P Ni I 239			
	.21	P Fe I 172			
51.6	.61	Ce			
	.62	Gd			
	.64	Cl			
52.1	51.97	Cr II 19			
52.7	.72	P Fe I 557	29		1
53.4	.294	Gd II	27		2
	.45	Cr II 19			
	.506	Ce II 36			
53.8	.814	Ti II 87	26		2
54.1	.11	Cr II 19	42		3
55.2	.011	Ti I 80	14		1
	.046	Fe I 218			
55.8	.543	Mn I 5	9		1
56.3	.212	Ti II 11	8		2
	.270	V II 14			
56.7	.793	Cr I 306	7		1
	.8	Al II 88			
57.5	.356	Fe I 277	22		1
	.457	Fe II 212			
58.2	.139	Ti I 254	13		3
	.183	Co I 16			
58.9	.77	Fe I 120	20		2
	.912	Ca I 40			
	.93	Mn I 5			
	.933	Cb I 1			
59.6	.39	Mn I 29			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4060.4	.73	Fe I 767			
60.4	.263	Ti I 254	9		1
	.62	Cr I 156			
61.4	.74	Mn I 29	14		2
61.9	.787	Fe II 189	25		3
62.4	.22	Ce II 34			
	.446	Fe I 359	24		1
63.6	.597	Fe I 43	62		3
63.9	.94	P Cr II 19	42		2
64.5	.46	Fe I 44	19		3
64.8	.75	P Fe II 39			
	.99	Y II 24			
65.5	.40	Fe I 698			
65.8	.716	Cr I 279	9		1
66.3	.16	P Cr II 182	7		1
	.328	Fe II 214			
	.36	Co I 30			
67.2	.275	Fe I 217	32		1
	.28	Ce II 22			
	.39	La II 26			
68.1	.00	Mn I 5	16		1
68.6	.54	Co I 58			
68.9	.84	Ce II 82	10		1
69.0	.08	Fe I 557			
70.3	.279	Mn I 5	20		3
70.4	.39	Gd II 17	17		1
	.45	P Fe I 525			
70.9	.90	Cr II 193	31		2
71.7	.74	Fe I 43	35		1
72.2	.13	P II 16	25		1
72.6	.518	Fe I 698	26		1
73.0	72.917	Ce II 109	16		1
73.1	.20	Gd II 34			
73.8	.760	Fe I 558	18		2
	.759	Gd II 44			
75.8	.853	Ce II 206	50		1
	.95	P Fe II 21			
76.7	.71	La II 11			
	.78	Si II			
76.9	.87	Cr II 19	71		1
	77.05	Zr II 54			
77.7	.714	Sr II 1	133		1
77.8	.81	Hg I 1			
78.5	.321	Ce II 19			
	.365	Fe I 217	34		2
	.444	Gd II 15			
78.7	.700	Gd I 5	20		1
79.2	.241	Mn I 5			
80.3	.226	Fe I 558	20		1
	.435	Ce II 36			
81.3	.222	Ce II 4	12		2
82.5	.396	Sc I 6	32		3
	.44	Fe I 906			
	.59	Co I 16			
	.600	Sm II 54			
83.3	.23	Ce II 160			
83.7	.628	Mn I 5	34		1
84.0	.17	P Fe I 557			
84.4	.39	Mo I 12			
	.50	Fe I 698			
84.7	.69	Gd			
	.74	Pr			
	.78	Ce			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4084.7	.89	Eu			
85.1	.01	Fe I 358			
86.6	.51	Eu II 10	40		2
	.56	Gd II 50			
	.50	V II 214			
	.68	Zr II 54			
86.2	.14	Cr II 26	29		3
	.31	Co I 58			
87.6	.63	Cr II 19	23		1
88.0	87.86	Eu	23		
	.959	Hf			
	88.123	Ce			
96.1	.12	Fe I 911	40		1
4109.5	.405	Sm II 28	22		1
	.455	Nd II 10			
	.54	Mg II 21			
	.706	Co I 1			
10.5	.33	Ca II 17	68		1
	.381	Ce II 29			
	.472	Nd II 15			
	.532	Co I 29			
13.2	.24	Cr II 18	22		1
14.4	.449	Fe I 357	11		1
14.9	.957	Fe I 695	16		1
16.1	15.982	Ni I 255	3		1
17.1	.013	Ce II 35	16		1
18.0	17.872	Fe I 700, 1103	18		1
18.3	.14	Ce II 11			
	.48	Pr II 8			
18.6	.549	Fe I 801	60		1
	.774	Co I 28			
19.4	.457	V I 41	22		1
	.53	Fe II 21			
19.8	.78	Ce II 22			
	.88	Ce II 83			
21.3	.318	Co I 28	24		2
21.6	.88	Zr I 32	32		1
21.8	.81	Fe I 356			
22.5	.522	Fe I 356	22		1
	.64	Fe II 28			
22.8	.76	Mn I 57			
23.0	.069	Na II 19	44		1
	.188	V I 112			
23.4	.28	Mn I 47			
	.38	Zr II 54			
23.7	.75	Fe I 217, 422			
24.9	.91	Y II 14	10		1
26.0	25.884	Fe I 354	8		1
	26.099	Cr I 65			
	.192	Fe I 695			
26.6	.521	Cr I 35	18		2
28.0	.053	Si II 3	85		2
28.2	.14	Mn II 2	62		1
	.31	Y I 5			
28.7	.735	Fe II 27	42		3
	.858	V I 112			
	.87	P Mn II 2			
29.0	.176	Ce II 227	46		2
	.21	Cr I 97			
29.7	.73	Eu II 1	45		3
30.0	29.96	P Cr I 97	42		2
	30.035	Fe I 44, 486			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	*n*
4130.3	.37	Gd II 19, 49	26		1
30.8	.884	Si II 3	33		1
31.8	.74	La II 167			
	.75	P Fe I 1075			
32.1	.06	Fe I 43			
	.155	Co I 30			
32.4	.275	Gd II 49	156		1
	.41	Cr II 26			
	.50	La II 150			
33.2	.01	Sc I 20	32		2
33.9	.800	Ce II 4	28		1
	.869	Fe I 698			
34.4	.343	Fe I 3	20		2
	.488	V I 27			
34.6	.68	Fe I 357	23		2
	.72	K II 1			
35.5	.443	Ce II 188	16		2
35.8	.77	P C II 163			
	.77	Fe I 1073			
	.78	Os I 3			
36.3	.39	V I 26			
37.0	.002	Fe I 726	26		2
37.4	.26	Mn I 37	26		2
38.0	37.97	P Fe I 320	8		1
	38.21	P Fe II 150			
38.8	.84	Fe I 117	11		2
40.4	.30	Sc I 20	11		1
	.45	Gd II 48			
41.0	.017	Gd II 117	10		1
41.6	.73	La II 40			
42.6	.47	Cr I 179			
	.63	Fe I 1103			
	.66	V I 26	12		1
43.9	.871	Fe I 43	39		3
44.2	.16	Ru I 7	18		1
44.5	.49	Ce II 3	16		2
45.3	.21	Fe I 274	28		2
45.6	.77	Cr II 162	18		1
46.0	.07	Fe I 422	19		1
46.7	.695	Cr I 107	28		2
46.9	.94	S II 65	23		2
	47.09	Cl II 60			
47.3	.34	P Fe I 693	10		2
47.6	.673	Fe I 42	22		3
48.1	.155	La II	12		2
	.27	P Fe I 832			
49.0	.15	Ce II 22	10		1
49.3	.37	Fe I 694	24		1
49.6	.76	P Fe I 3	11		1
49.9	.94	Ce II 158, 189			
	50.08	P V II 37			
50.9	.97	Zr II 42			
	51.0	Cr II 163			
51.4	.46	N I 6	6		1
52.0	51.970	Ce II 2	51		1
	.98	La II 40			
	52.07	P Fe I 1049			
	.172	Fe I 18			
52.5	.355	Sc I 20			
	.58	Cb I 1			
53.0	52.98	P Fe II 45	8		1
53.8	.816	Cr I 35	23		2

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4153.8	.91	Fe I 695			
54.7	.862	Gd II 67	29		2
55.0	54.98	Fe III	21		1
55.3	.22	Sm II 8,50			
55.6	.52	Mn I 37			
	.53	Ce II 29			
56.1	.24	Zr II 29	16		1
56.6	.67	Fe I 419	16		1
56.8	.803	Fe I 354	29		3
57.4	.33	P	13		2
	.403	Mo			
	.513	La I			
	.572	Ce			
57.8	.788	Fe I 695	18		3
58.5	.45	P Fe II 12			
	.42	Co I 144			
	.59	A I 2			
58.9	.80	Fe I 695	31		2
	.90	hf II 41			
59.1	.033	Ce II 246	36		2
60.3	.28	P Fe II 149			
60.8	.62	P Fe II 39	75		1
	61.05	Cr II 162			
61.6	.52	Ti II 21	82		1
	.56	P Cr II 127			
61.8	.796	Sr II 3			
	.94	La II			
62.8	.73	Gd II 17			
62.9	.93	P Fe I 476a	15		1
	63.09	Gd II 44			
	.16	P Cr I 35			
63.8	.625	Cr I 35	15		1
	.644	Ti II 105			
	.655	V II 175			
	.658	Cb I 1			
	.676	Fe I 274, 695			
	.94	Cr I 241			
64.2	.18	A I 2			
	.19	Pr II 8			
	.24	P Fe I 694			
64.7	.80	Fe I 418	9		1
65.3	.184	Sc I 20	10		2
65.8	.606	Ce II 10	8		1
66.8	.73	P II 16			
67.1	.159	Gd II 18	20		1
67.5	.52	Y I 7	22		2
	.67	P Ti II 21			
	.69	P Fe II 149			
67.8	.80	Ce II 29			
	.86	Fe I 599			
68.3	.31	Cr I 261	6		1
69.0	.09	P Fe I 18			
70.0	69.838	Cr I 270	27		2
	70.108	Gd II 35			
	.20	Cr I 278			
70.9	.86	Cr II 181	56		1
	.906	Fe I 482			
71.8	.82	Pr II 16			
	.90	Ti II 105			
72.0	71.92	Cr II 18	56		3
	72.06	Ga I 1			
72.4	.27	Pr II 13			
72.5	.60	Cr II 18	40		1

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
	.609	Ti I 163			
	.641	Fe I 689			
4172.7	.77	Cr II 18			
	.75	Fe I 19			
	.73.05	P Ti II 96			
73.2	.18	P Fe I 698	46		2
	.23	Os I 4			
73.5	.45	Fe II 27	36		2
	.537	Ti II 21			
	.56	Gd II 117			
73.9	.76	Y II 23	26		2
	.93	Fe I 19			
74.3	.13	Y I 6	24		1
	.31	P Mn I 2			
75.6	.54	Gd I 5	13		1
	.61	Nd II 39			
	.64	Fe I 354			
76.3	.44	P Fe II 149	21		2
76.6	.57	Fe I 695			
77.3	.17	Cr I 133	22		2
	.321	Nd II 13			
	.357	Ti I 163			
77.9	.70	P Fe II 21	33		2
78.5	.39	V II 25			
78.9	.855	Fe II 28	50		2
80.0	79.90	P Co I 1			
	.92	P Cr II 127			
80.4	.41	P Fe I 274			
80.8	.86	V II 13			
	.97	P Fe II 148			
	.97	La II 133			
81.6	.50	Cr II 181			
	.76	Fe I 354			
82.0	81.838	A I 7	47		1
	82.384	Fe I 476a			
82.8	.69	P Fe II 149			
	.79	Fe I 694			
83.3	.20	P Fe II 21	12		1
	.31	Zr I 51			
83.6	.44	V II 37	13		1
	.76	Sm II 4			
84.0	.09	Fe III 22	26		2
84.3	.252	Gd II 15	28		3
	.33	Ti II 21			
85.0	84.895	Cr I 155	9		1
85.7	.66	P Fe I 1104			
86.0	.01	P Ti I 220	9		1
	.033	Nd II 24			
	.08	P Cr II 127			
	.119	Ti I 129			
86.4	.24	K II 1	12		2
	.36	Cr I 249			
86.7	.70	Zr II 97	27		1
87.2	.25	Co I 93			
87.4	.32	Ce II 86			
87.8	.802	Fe I 152	62		1
88.1	.10	Gd II 17			
	.13	Sm II 50			
88.6	.694	Ti I 220	20		3
88.9	.82	Cl II 43			
89.6	.52	Pr II 8	17		1
	.56	Fe I 940			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4189.8	.84	V I 24			
90.0	.16	Cr I 84	11		1
	.29	Ti II 21			
90.6	.63	Ce II 169	21		2
	.66	Cr I 35			
91.1	.03	A I 7			
	.07	Gd II 34			
91.4	.44	Fe I 152			
	.50	Zr II 108			
	.615	Pr II 12			
91.8	.685	Fe I 355	30		3
93.0	.094	Ce I 79	15		2
93.6	.44	Mg II 28	16		2
	.51	S II 10			
	.662	Cr I 248			
93.9	.87	Ce II 85			
95.3	.34	Fe I 693	35		2
	.41	Cr II 161			
95.6	.615	Fe I 478			
96.0	95.83	V II 19	26		1
	96.22	Fe I 693			
96.4	.335	Ce II 123	10		1
	.55	La II 41			
96.8	.64	P Ti II 21			
97.3	.10	P Fe I 18			
	.38	P Fe I 976	7		1
	.47	Cr I 149			
97.6	.67	Ce II 136			
	.68	Gd II			
98.0	97.95	P Ti II 96			
	98.00	Ce II 209			
98.3	.268	Fe I 693	57		3
	.310	Fe I 152			
98.6	.61	V I 24			
	.64	Fe I 693			
	.67	Ce II 7			
99.0	.098	Fe I 552	27		1
	.27	Y II 5			
4200.1	4199.97	Fe I 3	17		1
	4200.09	P Fe I 993			
00.6	.46	Ni I 89			
	.60	A I 2			
00.8	.78	P Fe I 44			
01.0	00.930	Fe I 689	26		3
01.6	.50	La II			
01.8	.72	Ni I 238			
	.73	Fe I 799			
	.85	Rb I 2			
02.0	.031	Fe I 42	28		3
02.5	.4	Al II 87	14		3
	.755	Fe I 476a, 521			
03.1	02.94	Ce II 186	13		3
	03.051	Sm II 42			
	.30	Fe I 418			
04.0	.20	V II 25	20		1
04.6	.66	P Cr II 127			
	.69	Y II 1			
05.0	.05	Eu II 1	59		1
	.08	V II 37			
05.4	.37	P Mn II 2			
05.8	.91	Zr II 133	15		1
06.2	.375	Mn II 7	14		3
06.8	.70	Fe I 3			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4206.8	.74	Pr I 8			
07.1	.13	Fe I 352			
	.23	P Mn II 2			
07.4	.35	Cr II 26			
	.51	Cr I 133	11		1
08.7	.610	Fe I 689, 696	36		3
09.0	08.99	Zr II 41	23		3
	09.02	Cr II 162			
09.9	.756	Cr I 155	34		1
	.84	P Ce II 180			
10.0	.22	La II			
10.6	.62	Zr II 97			
11.0	10.987	Nd	16		1
	11.024	Mo			
	.16	Tb			
	.2	Sr			
11.8	.729	Ti I 279			
	.80	P Fe II 21			
	.88	Zr II 15			
	12.00	Gd II 15			
	.06	P Fe I 697			
	.06	Ru I 6			
13.0	12.95	Pd I 7			
	13.04	Ce II 169			
13.4	.42	P Fe I 274			
13.6	.65	Fe I 355			
	.86	Zr I 45			
14.0	.04	Ce II 203	19		1
14.5	.73	N I 5	3		1
15.0	.02	Gd II 32			
15.5	.52	Sr II 1	81		1
15.9	.76	Zr II 68			
	.77	Cr II 18			
	.92	N I 5			
	.975	Fe I 273			
	16.04	Ba II 17			
	.186	Fe I 3			
17.2	.07	Cr II 18	45		3
	.195	Gd II 49			
18.1	.12	P Fe I 19	8		1
19.4	.38	W I 3	18		1
20.1	.047	V II 25	9		1
	.05	P Fe I 994			
21.1	.08	Eu	5		1
22.1	.00	Cr II 180	14		3
22.3	.41	Zr II 80			
	.49	Fe I 152			
22.7	.599	Ce II 36			
	.73	Cr I 132			
	.78	O I 33			
	.97	K II 7			
	.98	Pr II 4			
23.6	.47	Cr I 132	8		1
	.73	P Fe I 417			
24.2	.09	P Cr II 31	25		3
	.176	Fe I 689			
	.27	Zr II 29			
	.30	P Fe I 1104			
24.8	.85	Cr II 162	26		2
25.3	.15	Gd II 14			
	.23	V II 37			
	.33	Pr II 8			
	.33	Sm II 22			
	.46	Fe I 693			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4225.7	.67	K II 4	30		1
	.71	P Fe I 1102			
	.79	P Fe 118			
	.850	Gd I 4			
26.8	.728	Ca I 2	16		2
27.1	.14	Gd II 43			
27.6	.34	P Ti II 33			
	.42	P Fe I 689	32		2
	.420	Al II 46			
	.434	Fe I 693			
	.503	Al II 46			
	.654	Ti I 278			
	.719	Nd II 19			
	.73	Cr II 155			
	.76	Zr I 45			
29.5	.52	Fe I 416, 649			
29.8	.704	Sm II 4	34		1
	.760	Fe I 41			
	.803	Gd II 117			
	.81	Cr II 26			
	.955	Co I 1			
30.8	.95	La II 83	7		2
32.4	.222	Cr I 294	5		1
	.378	Nd II 8			
	.43	Hf II 72			
	.460	V I 111			
33.0	32.72	Fe I 3	66		2
	.96	P Cr II 180			
33.3	.167	Fe II 27			
	.25	Cr II 31			
	.32	O I 33			
34.2	.25	V II 24	14		1
	.55	V II 200			
35.2	.140	Mn I 23	26		1
	.290	Mn I 23			
35.9	.73	Y II 5	24		1
	.94	Y I 5			
36.5	.33	P Cr II 17	17		3
	.56	Zr II 110			
	.66	P Fe I 907			
37.1	.085	Fe I 19	12		1
	.162	Fe I			
37.5	.67	P Fe I 418	11		3
38.0	.027	Fe I 689, 696			
38.3	.38	La II 41	18		1
38.9	.79	P Mn II 2	21		1
	.96	Cr I 131			
39.3	.31	Zr I 45	21		1
	.36	P Fe I 907			
39.6	.72	Mn I 23			
	.74	Fe I 416			
39.8	.85	Fe I 18, 273			
40.1	39.912	Ce II 2	26		1
	.95	P Fe I 476a			
41.0	.112	Fe I 351	12		3
41.6	.68	Zr I 45	11		2
42.1	.15	Tm II 5	17		1
42.4	.38	Cr II 31	28		3

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4242.4	.47	Mg II 20			
	.59	Fe I 273			
44.4	.26	Mn II 7	20		2
	.374	W I 1			
45.2	.258	Fe I 352	9		1
46.0	45.98	Ce II 158			
	46.02	P Fe I 649			
	.09	Fe I 906			
46.8	.829	Sc II 7	30		1
47.8	.432	Fe I 693	10		1
48.4	.228	Fe I 482	12		2
49.0	.114	Ti I 252	14		2
49.9	.99	La II 79	8		1
50.2	.125	Fe I 152	34		3
51.0	50.790	Fe I 42	28		2
	.90	P Fe I 478			
	51.185	A I 2			
51.6	.49	P Fe II 12	15		2
51.8	.733	Gd II 15	13		3
52.9	.30	Co I 1			
	.62	Cr II 31			
	53.02	Mn II 7			
53.4	.28	N I 4	18		1
	.366	Gd II 46			
54.1	53.98	O II 101	39		2
	54.346	Cr I 1			
54.6	.41	V II 18	42		3
	.42	Pr II 27			
	.7	N I 4			
55.7	.78	Ce II 81			
56.4	.212	Fe I 690	19		2
	.239	Nd II 59			
	.32	P Fe I 172			
	.393	Sm II 37			
58.2	.05	Zr II 15			
	.16	Fe II 28			
58.5	.32	Fe I 3	50		1
58.6	.62	Fe I 351	12		1
59.2	.203	Mn II 7	18		1
59.8	.75	Ce II 176			
	.988	Fe I 689	16		1
60.8	.75	V II 18, 24	51		1
	.854	Os I 1			
61.9	.92	Cr II 31	50		3
63.8	.59	La II 84			
	.84	V II 24	20		1
	.90	Fe II			
64.1	.209	Fe I 692			
64.5	.370	Ce II 239	23		1
	.50	V II 24			
65.6	.723	Ti I 162	5		1
66.0	65.92	Mn I 23	12		1
66.2	.227	Ti I 252	15		1
66.6	.72	Zr II 80	6		
	.82	Cr I 105			
67.3	.30	P Zr I 132	3		1
68.2	.00	Zr I 45	7		1
69.0	68.93	Cr II 192			
69.4	.28	Cr II 31	112		1
	.50	La II 76			
70.7	.64	V II 23	24		1
	.72	Ce II 21			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4271.3	.06	Cr I 154	40		3
	.159	Fe I 152			
71.9	.76	Fe I 42			
	.94	P Ti II 95			
72.3	.271	Pr II 15	57		1
73.3	.317	Fe II 27	29		1
	.52	Zr II 28			
74.0	73.87	Fe I 478	10		1
74.8	.803	Cr I 1	33		1
75.7	.64	La II 40	27		1
76.0	75.973	Cr I 240	33		1
76.9	.96	V I 88	12		1
77.3	.41	P Fe I 214	4		2
78.2	.10	Cr II 161			1
	.128	Fe II 32			
	.234	Fe I 691			
80.0	79.93	Sc II 15	14		1
80.7	.63	P Fe I 416	31		2
	.79	Sm II 46			
81.0	.009	Sm II	44		1
	.03	P Cr II 17			
	.099	Mn I 23			
81.3	.371	Ti I 44	44		1
82.0	81.94	Hg	22		1
	82.026	Zr I			
82.4	.41	Fe I 71			
	.44	Pr II 19			
	.44	Nd II			
82.8	.97	Al II 86			
84.0	.084	Mn I 23	7		1
84.3	.21	Cr II 31			
	.42	Fe I 417			
	.42	Mn II 6			
84.8	.683	Ni I 86	41		1
	.988	Ti I 148			
85.4	.37	Ca II 11	14		1
	.44	Fe I 597			
	.50	Sm II 27			
86.0	.006	Ti I 44	25		1
86.3	.13	V II 23			
	.31	Fe II			
86.7	.51	Zr II 69	16		1
	.640	Sm II 42			
	.97	La II 75			
87.3	.405	Ti I 44	19		1
88.1	.00	Ni I 178	18		2
	.15	Fe I 273			
88.3	.247	Mo	20		1
	.350	Cs II			
	.35	W			
	.381	Cr			
88.5	.65	Mo I 7	24		1
89.2	.18	Zr II 117	12		2
	.29	P Fe I 117			
90.2	89.721	Cr I 1	95		1
	90.222	Ti II 41			
92.0	91.964	Cr I 240	12		3
	92.13	P Fe I 70			
92.3	.25	Mn II 6	16		1
93.2	.14	Zr II 110	8		2
	.228	Mo I 7			
94.0	.04	P Fe I 214	7		1
	.10	Ti II 20			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4294.2	.13	Fe I 41	10		1
94.9	.767	Sc II 14, 15	11		1
95.3	.37	P Cr II 37	10		2
96.4	.57	Fe II 28	22		2
	.30	Cr I 176			
96.7	.68	Ce II 2	36		3
97.0	.050	Cr I 64	31		1
	.173	Gd II			
97.6	.60(	Ba II 7			
	.71	Ru I 5			
	.76	Pr II 7			
98.2	.21	P Fe I 476a			
98.8	.664	Ti I 44	9		2
99.4	.17	P Ti I 45			
	.24	Fe I 152			
	.36	Ce II 47			
	.49	P Fe I 648			
99.7	.636	Ti I 43	25		1
4300.1	.052	Ti II 41	46		1
01.1	.130	V II 225	9		1
02.1	01.928	Ti II 41	25		1
	02.123	W I 7			
	.19	Fe I 520			
02.9	.88	Zr I 145			
03.2	.166	Fe II 27	30		1
	.235	Co I 1			
03.9	.573	Nd II 10	27		1
	.82	O II 54			
04.5	.552	Fe I 414			
05.0	.00	K II 5			
05.3	.20	Fe I 760			
	.45	Sr II 3			
05.6	.453	Cr I 96	34		1
	.46	Fe I 476a			
	.728	Sc II 15			
	.76	Pr II 8			
06.2	.340	Gd I 4	12		1
	.44	V I 5			
06.7	.72	Ce II 1	21		1
07.0	.08	P Fe I 690	17		1
	.184	V I 5			
	.20	Al II 85			
07.8	.900	Ti II 41	45		1
09.6	.62	Y II 5	23		2
10.6	.70	Ce II 133			
	.72	P V II 36			
11.0	10.981	Gd II 15	11		1
13.0	12.861	Ti II 41	13		1
	13.034	Fe II 220			
	.04	P Fe I 273			
	.11	N I			
13.4	.30	V II 23	20		1
	.43	O II 74			
14.3	.08	Sc II 15	28		3
	.289	Fe II 32			
15.1	14.979	Ti II 41	36		3
	15.087	Fe I 71			
16.0	15.90	La II 41	30		1
	16.052	Gd II 43			
16.7	.81	Ti II 94			
17.3	.32	Zr II 40	6		2

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4318.2	.216	Fe II 220	13		1
18.6	.631	Ti I 235	20		2
	.652	Ca I 5			
	.77	P Cr II 37			
	.81	P Fe I 215			
19.6	.64	Cr I 96	16		1
	.717	Fe II 220			
20.9	.965	Ti II 41	24		3
21.3	.341	Fe II 220	12		1
21.8	.62	Cr I 177	9		1
22.1	.02	V II 17			
	.20	Gd II 15			
22.5	.51	La II 25			
22.8	.70	P Fe I 215	8		1
23.7	.62	Zr II 141			
24.1	.06	Gd II 68	12		1
24.8	.96	Fe I 70			
25.7	.765	Fe I 42	84		1
27.2	.100	Fe I 761	39		1
29.0	28.91	P Cr II 37	26		1
	29.016	Sm II 15			
43.7	.699	Fe I 517	33		1
	.798	Ti I 204			
	.86	P Fe I 756			
44.4	.291	Ti II 20	74		1
	.300	Gd II 44			
	.487	Gd II 31			
51.0	50.834	Ti II 94	16		2
	51.051	Cr I 22			
51.2	.295	Nd II 10	25		1
	.37	P Fe I 691			
51.7	.764	Fe II 27			
	.77	Cr I 22			
	.849	Pr II 23			
52.1	.1	C I 5	32		1
	.101	Sm II			
52.9	.68	P Cr II 37	14		2
	.733	Ce II 220			
	.737	Fe I 71			
53.1	52.87	V I 5	20		1
53.4			15		2
54.6	.61	Sc II 14	25		1
55.0	.03	P Fe II 202	32		1
	.09	Eu II 22			
56.3	.157	Ce	23		1
	.222	Pr			
	.287	Cr			
	.327	Hf			
57.7	.53	P Fe I 994	8		1
	.574	Fe II			
	.85	P Ni I 256			
58.0	.17	Nd II 10	27		1
58.4	.343	Hg I 1	14		1
	.50	Fe I 412			
59.8	.74	Zr II 79	10		1
	.795	Pr II 26			
60.1	.16	Ce II 245	10		1
61.0	60.917	Gd II 16	21		1
61.7	.66	Ce II 157	28		1
62.7	.678	Sm II	18		1
	.716	Th			
	.72	Hf II			
	.795	Ce			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
	.80	Pr			
4362.7	62.93	Cr II 179	35		1
63.3	.30	Cl I 8	36		1
63.5	.525	V I 23	27		1
	.644	Mo II 3			
66.0	65.902	Fe I 415			
	66.165	Fe II 216	28		2
66.9	.9	V II 36			
	67.07	P Fe I 1170			
67.4	.36	P Ni I 88	24		1
	.581	Fe I 414			
67.7	.657	Ti II 104	22		3
68.0	67.906	Fe I 41	33		2
	.966	Cb II 8			
	68.031	Sm II 37			
68.3	.234	Ce II 227	18		3
	.327	Pr II 5			
68.8	.941	Ti I 245	12		1
69.1	.28	O II 26			
69.6	.61	P Fe II 148			
	.73	P Fe I 976			
70.2	.041	Ni I 149	15		1
	.27	V II 31			
70.9	.875	Mn I 17	55		1
	.95	Hf II 26			
	.96	Zr II 49			
	71.00	Fe I 69			
71.4	.17	P V II 36	17		1
	.33	C I 14			
72.4	.22	P Fe II 33	11		1
	.38	Ti I 277			
	.40	Ce II 169			
73.9	.82	Ce II 202	19		1
74.3	.455	Sc II 14	47		1
74.7	.61	P Cr II 179	36		2
	.825	Ti II 93			
75.0	74.94	Y II 13	39		2
75.3	.333	Cr I 103	28		1
	.35	P Ti II 104			
75.7	.48	P Fe I 797			
	.918	Ce II 134			
	.932	Fe I 2			
77.2	.330	Fe I 990			
77.6	.549	Cr I 83	7		2
77.8	.765	Mo II 3	17		1
	.796	Fe I 645			
79.1	.238	V I 22	16		1
80.1	.060	Ce II 155	12		2
80.5	.38	Mg I 12	17		3
	.642	Gd II 68			
81.0	.112	Cr I 64	14		1
81.7	.79	P Fe II 9	14		1
82.5	.33	P V II 36	28		1
82.7	.777	Fe I 799a			
83.1	82.95	Zr II 109			
	83.10	Zr II 97			
	.119	Gd II 67			
	.17	Eu II 27			
	.44	La II 76			
	.54	Fe I 41			
84.2	.13	P Fe I 1101			
	.33	P Fe II 32			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
	.543	Ni I 86			
84.8	.6	P Ni IL 10			
	.643	Mg II 10			
	.682	Fe I 474			
	.813	Sc II 14			
85.2	.381	Fe II 27	68		1
86.4	.57	P Fe II 26	30		2
86.7	.835	Ce II 57			
	.858	Ti II 104	20		3
87.1	.213	V I 40	16		1
87.5	.38	Cr I 84	24		2
87.7	.674	Gd II 15	32		2
	.897	Fe I 476			
88.1	.007	Ce II 5			
	.16	K II 7			
89.1	.12	P V II 13	10		1
	.224	Fe I 2			
90.2	89.974	V I 22	12		3
	90.14	Na I 17			
	.322	Ni I 136			
90.9	.954	Fe I 414	40		1
91.7	.568	Co I 150			
	.661	Ce II 81			
	.87	P Fe I 992	33		1
93.1	.03	P Fe 473	17		2
93.6	.45	Na I 17	9		1
	.70	P Fe I 899			
94.7	.719	Gd II 44	19		1
	.779	Ce II 259			
95.0	.031	Ti II 19	23		3
	.23	V I 22			
95.6	.514	Fe I 991, 992	16		1
95.9	.788	Pr II 29	16		3
	.848	Ti II 61			
96.8	.759	Sm	10		1
	.79	La I			
	.850	Mo			
	.872	Pr			
97.7	.71	Eu	10		1
98.0	.02	Y II 5			
	.314	Ti II 61			
99.6	.44	Zr II 67	18		2
	.607	Ni I 196			
99.8	.767	Ti II 51	14		1
	.823	Cr I 129			
4400.4	.36	Sc II 14	17		2
	.575	V I 22			
01.1	.02	A II 1	20		1
01.3	.293	Fe I 828	16		2
02.3	01.97	P II 24	21		1
	02.158	Pr			
	.30	Yb			
	.303	U			
	.374	Ne I			
	.412	Ce			
03.0	02.876	Fe II	24		1
	03.03	Cl I 6			
03.2	.35	Zr II 79	23		1
	.360	Sm II 22			
	.372	Cr I 128			
04.2	.10	P Fe I 987			
04.4	.40	Ti I 78	14		1

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4404.8	.68	V II 30	35		2
	.752	Fe I 41			
	.81	Zr II 118			
06.7	.641	V I 22	22		3
	.67	Gd II 103			
07.7	.678	Ti II 51	17		3
	.714	Fe I 68			
08.3	.204	V I 22			
	.25	Gd II 44			
	.419	Fe I 68			
09.1	.123	Fe I 645	28		2
	.22	Ti II 61			
10.5	.516	Ni I 88	16		2
	.641	Ce II 33			
11.3	.21	La II 138	17		1
	.34	S I 5			
11.9	.936	Ti II 61	14		1
13.2	.04	Zr I 61	24		3
	.40	P Fe I 1046			
13.7	.60	Fe II 32	29		3
	.765	Pr II 26			
	.87	Cr I 234			
14.6	.432	Nd II 3	24		3
	.47	P Fe I 643			
	.54	Zr II 79			
15.1	.125	Fe I 41	38		2
15.4	.559	Sc II 14	28		3
16.6	.474	V I 22	16		3
	.535	Ti I 161			
16.8	.817	Fe II 27	48		2
17.3	.274	Ti I 161	30		2
	.398	Co I 150			
18.4	.340	Ti II 51	22		3
	.78	Ce II 21			
19.0	.032	Gd II 15	18		4
	.10	Cr I 128			
	.16	La II 89			
19.8	.78	P Fe I 644			
20.8	.665	Sc II 14	10		1
	.75	P Fe II 9			
	.90	A II 1			
21.1	.138	Sm II 37	14		2
	.231	Pr II 13			
	.24	Gd II 103			
21.9	.949	Ti II 93	36		1
22.5	.570	Fe I 350	38		4
	.59	Y II 5			
23.3	.22	P Ti II 61	17		2
24.2	.281	Cr I 129	33		4
27.2	.30	P Fe I 828	26		3
	.312	Fe I 2			
27.8	.90	P Ti II 61	18		2
	.917	Ce II 171			
	.995	Mg II 9			
30.0	29.938	Cr I 234	32		3
	30.023	Ti I 267			
	.167	Ti I 472			
30.4	.366	Ti I 113	33		3
	.486	Cr I 234			
	.618	Fe I 68			
31.4	.284	Ti I 218	12		1
32.7	.572	Fe I 797	14		2

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
	4432.80	P Fe I 471			
	.82	Al II 84			
	.90	P Fe I 271			
	.95	La II 11			
33.8	.793	Fe I 825	52		1
	.885	Sm II 41			
	.991	Mg II 9			
34.3	.323	Sm II 36	9		1
35.0	.151	Fe I 2	49		2
35.6	.58	Eu II 4	12		1
36.2	.138	V I 21	21		1
	.225	Gd II 117			
	.352	Mn I 22			
41.6	.683	V I 21	17		2
42.1	.268	Cr I 102	31		3
	.343	Fe I 68			
43,0	42.99	Zr II 88	14		2
44.1	.09	La II 133			
	.20	Pr II 30	30		2
	.207	V I 21			
	.259	Sm II			
44.6	.559	Ti I 31			
	.563	Fe II 201			
47.1	46.90	P Fe I 596	30		1
	47.134	Fe I 69			
47.6	.722	Fe I 68	24		2
50.5	.487	Ti II 19	32		2
51.6	.586	Mn I 22	26		2
54.2	.383	Fe I 350	22		1
54.8	.629	Sm II 49	29		1
	.655	Fe I 902			
	.781	Ca I 4			
	.80	Zr II 40			
55.3	.318	Mn I 28	33		2
	.321	Ti I 113			
55.8	.79	La II 53			
	.821	Mn I 28			
	.85	P Fe II 140			
	.887	Ca I 4			
56.9	.650	Ti II 115	29		2
	.84	P Cr II 16			
58.5	.336	Pr II 8			
	.517	Sm II 7			
	.538	Cr I 127	23		1
59.4	.34	Cr I 63	28		2
	.734	Cr I 127			
60.9	61.085	Mn I 28	12		1
	.138	Ce II 10			
61.3	.205	Fe I 471	28		3
	.22	Zr II 67			
	.37	Fe I 725			
	.43	P Fe II 26			
61.9	.65	Fe I 2	12		2
	62.02	Mn I 28			
64.2	.32	V II 199	43		2
	.458	Ti II 40			
64.6	.677	Mn I 22			
	.69	P Fe I 555			
65.5	.4	Y II 81	7		1
	.601	Nd II 13	52	present on 1077	1

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4466.5	.554	Fe I 350	35		2
	.55	Gd II 44			
67.0	66.881	Co I 150	33		2
67.3	.227	Gd II 82			
	.342	Sm II 53			
	.446	Fe I 1048			
67.8	.561	Cr I 127	39	on 1077 strong	3
	.690	O II			
	.853	Nd			
	.853	U			
	.89	Dy			
68.5	.493	Ti II 31	76	on 1278	3
69.3	.381	Fe I 830	41		3
69.6	.547	Co I 150			
	.710	V I 87			
70.9	.864	Ti II 40	26		2
71.3	.24	Ce II 8	22		2
	.29	Gd II 82			
71.7	.68	P Fe I 2	44		1
	.688	He I 14			
	.81	P Fe I 972			2
72.8	.92	Fe II 37	32	on 727 strong blend	
75.6	.72	Y I 14	38	with 73.015 Sm II 26	4
76.7	.61	P Ti I 984	26	on 1077 stronger	3
77.2	.02	Cr I 63	17		1
	.45	Y I 14			
78.4	.319	Co I 150	22		2
79.0	.00	P Fe I 987, 899			
	.29	Ca II 6	11		2
81.2	.129	Mg II 4	393		5
	.327	Mg II 4			
82.2	.17	Fe I 2	7		1
82.6	.688	Ti I 113	9		1
	.75	Fe I 828			
83.9	.78	P Fe I 898	41		2
	.900	Ce II 3			
	.918	Co I 150			
88.4	.319	Ti II 115			
	.401	Gd II 82	25		3
89.2	.185	Fe II 37	67		5
91.4	.401	Fe II 37	42		4
92.3	.312	Cr I 197	20		2
93.3	.53	Ti II 18	36		3
	.579	Fe II 222			
94.1	.05	P Fe I 973	18		2
	.180	Na I 15			
94.4	.41	Zr II 130	20		4
	.47	P Fe I 411			
94.6	.568	Fe I 68	24		2
95.0	94.853	Gd II 14	11		2
	95.05	P Fe I 973			
	.180	Na I 15			
95.4	.386	Fe I 319, 970	15		3
	.389	Ce II 154			
	.44	Zr II 79			
	.46	P Ti II 40			
	.52	P Fe II 147			
	.566	Fe I 827			
96.8	.862	Cr I 10	15		3
97.2	96.96	Zr II 40	12		1
97.7	.657	Na I 15	26		2
	.849	Ce II 19			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4500.6	.32	P Ti II 18	25		4
	.86	P V II 30	53		2
01.4	.270	Ti II 31	42		5
02.2	.220	Mn I 22	18		3
02.9	03.05	Cr I 310	18		2
	.13	P V II 13			
04.8	.838	Fe I 555	18		4
06.6	.582	Nd II 7	26		2
	.624	Ca I 24			
	.74	P Ti II 30			
07.2	.19	P Cr II 16	32		4
	.195	Fe II 213			
07.6	.417	Ca I 24	23		3
	.854	Ca I 24	20		2
08.3	.283	Fe II 38	49		4
11.7	.82	P Cr II 191	23		2
	.829	Sm II 14			
12.0	11.903	Cr I 150	17		1
14.4	.373	Cr I 278	37		5
	.505	Gd II 103			
15.0	.094	Sm II	10		1
	.17	P Fe I 319			
	.19	P Fe II 20			
15.4	.337	Fe II 37	49		4
15.8	.838	Zr	22		3
	.857	Ce			
	.881	W			
16.5	.45	P Fe I 825	25		4
16.8	.56	P Cr II 191			
17.0	.094	Co I 150			
18.3	.30	P Ti II 18	19		3
	.38	V II 212			
	.45	Fe I 593			
19.1	.02	Hf II			
	.19	Cl II 41			
19.5	.556	Eu	34	on 1076 strong	3
	.633	Sm II 49			
20.1	.07	Gd II 82			
	.225	Fe II 37	41		3
	.24	P Fe I 471			
	.37	P Ti II 30			
21.0	.141	Cr I 277, 287	13		1
22.0	21.924	Ni I 116	18		1
	.94	Gd II 135			
22.6	.59	Eu II 4	103		5
	.634	Fe II 38			
23.0	.08	Ce II 2	25		1
23.4	.403	Fe I 829	14		1
24.8	.732	Ti II 60	21		3
25.2	.142	Fe I 826	40		5
26.0	25.75	P Fe II 9	41		6
	.875	Fe I 319			
	26.12	La II 50			
	.20	Cl I 15			
26.6	.47	Cr I 33	27		1
	.563	Fe I 471			
	.565	Tm II 1			
	.58	P Fe II 171			
29.4	.376	Tm II 5	38		1
	.465	Ti II 82			
	.56	P Fe II 171			
	.562	Fe I 987			
29.8	.85	Cr I 33			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4530.7	.755	Cr I 33	44		5
31.1	30.949	Co I 150	17		1
	31.152	Fe I 39			
33.0	.14	Fe I 641	14		2
	.18	Hf II 25		strong on 1076, 1077	
33.9	.966	Ti II 50	80		4
	.985	Co I 150			
34.9	.782	Ti I 42	9		2
	35.146	Cr I 33			
35.8	.721	Cr I 33, 276	28		3
	.920	Ti I 42			
36.6	.509	Fe II 896	13		2
	.78	Cl II 41			
37.9	.677	Fe I 594	26		5
	.751	Ne I 11			
	.952	Sm II 45			
38.2	.20	P Fe I 1071	22		2
39.7	.62	Cr II 39	54		4
	.755	Ce II 108			
	40.014	V I 100			
	.016	Gd II 135			
41.4	.523	Fe II 38	26		2
42.5	.422	Fe I 894	14		2
	.603	Nd II			
43.9	.948	Sm II 32	26		2
	44.009	Ti II 60			
49.6	.467	Fe II 38	178		5
	.622	Ti II 82			
51.1	50.954	Gd II 44	24		2
51.4	.667	Fe I 972	20		2
52.7	.659	Sm II 23			
55.0	.02	Cr II 44	59		3
55.3	.30	Cr I 212	22		1
	.421	Cs I 2			
56.0	55.890	Fe II 37	63		5
	.922	Cu II 1			
	56.136	Nd II 6			
57.2	56.939	Fe I 638	25		4
	57.237	Sc I			
58.8	.659	Cr II 44	119		6
	.83	Cr II 44			
59.3	.28	La II 53	33		6
60.2	.096	Fe I 823	26		3
	.28	Ce II 8			
61.3	.20	Cr I 34	19		4
	.461	Pr II 23			
62.3	.360	Ce II 1	9		1
63.3	.245	Cr I 246	29		1
63.8	.761	Ti II 50	40	weak on 1077	4
64.2	.592	V II 56			
65.4	.324	Fe I 641	66		
	.43	Zr II 116			
	.45	P Ni I 99			
	.578	Co I 150	22		1
	.78	Cr II 39			
66.3	.206	Sm II 32	13		1
	.520	Fe I 641	23		1
68.6	.54	Pr II 33	14		1
	.62	P Fe I 989			
69.0	.06	P Fe I 593	29		1
69.3	.192	U	16		1
	.25	Tm			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
	4569.29	Tb			
	.330	Er			
	.372	Pr			
	.42	Cl II 35			
69.6	.644	Cr I 173	38		5
70.9	.906	Ti I 266	14		4
	.98	Gd II 84			
72.0	71.971	Ti II 82	58		6
72.4	.277	Cl II 1	30		2
74.1	.03	Ni I 87	20		1
	.240	Fe I 554			
.76.0	75.80	Fe I 593, 970	12		2
76.3	.331	Fe II 38	41		4
76.9	.76	Cr I 148	12		1
	77.13	P V II 56			
77.5	.173	V I 4	15		3
78.9	.728	V I 109			
	79.05	P Fe I 988			
	.07	P Fe I 640			
79.6	.446	Cb II 8			
	.523	Fe II			
	.68	P Fe I 894			
80.0	.05	La II 53			
	.055	Fe II 26	27		3
81.8	.77	P II 9			
82.1	.12	P Fe II 19	48		4
	.38	Gd II 82			
	.502	Ce II 7			
	.53	Gd II 65			
82.8	.835	Fe II 37	41		2
83.2	82.94	Fe I 348	51		1
83.8	.44	Ti II 39	111		4
	.829	Fe II 38			
	.99	P Fe II 26			
84.2	.28	Cl II			
85.1	.03	Cl II 34	21		1
86.1	85.820	Al II 45	22		2
	.94	V I 61			
	86.138	Cr I 172			
	.25	Hf II 23			
87.2	.132	Fe I 795	20		4
88.0	.082	Al II 45	19	on 1278 strong	6
	.194	Al II 45			
88.3	.217	Cr II 44	55		3
	.40	P Cr II 16			
89.7	.689	Al II 45	26		5
	.750	Al II 45			
89.9	.89	Cr II 44	56		5
	.961	Ti II 52			
90.0	.00	P Cr II 16	19		1
90.8	.8	S II 47	19		1
91.4	.26	P Fe II 17	18		2
91.8	.818	Sm II 14			
92.0	.09	Cr II 44			
92.5	.529	Ni I 98			
	.655	Fe I 39			
93.1	.159	Cs I 2			
93.6	.544	Fe I 971	36		1
	.544	Sm II 36			
94.0	.03	Eu I 1			
94.7	.633	Co I 176			
95.3	.291	Sm II 45			
	.363	Fe I 594			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4595.6	.68	P Fe II 38	18		1
95.9	.951	Ni I 101	22		1
	96.059	Fe I 820			
	.097	A I 9			
	.37	V II 210			
97.7	.91	Gd II 44			
98.2	.122	Fe I 554			
99.3	.46	Hf II 92			
4600.4	.19	V II 56	21		1
	.28	P Ti II 60			
	.372	Ni I 38			
00.8	.937	Fe I 591			
01.0	.00	Cl I 15			
	.05	Gd II 44			
01.4	.34	P Fe II 43			
03.8	.956	Fe I 410	13		1
04.1	.23	P Fe I 348			
04.4	.42	Zr I 29			
04.9	.85	P Fe I 846			
	.994	Ni I 98			
05.3	.352	V II 56	16		1
	.363	Mn I			
06.4	.15	V I 4	11		1
	.402	Ce II 6			
	.514	Sm II 1			
07.6	.655	Fe I 554, 969			
07.8	.94	Y II 80			
08.8	.908	Co I 57	11		1
10.5	.59	P Fe II 170	10		1
10.8	.925	V I 39	14		1
12.4	.473	Nd II 3			
13.0	.210	Fe I 554	16		1
13.5	.38	La II 50	29		1
14.2	.216	Fe I 638	18		1
15.4	.441	Sm II 49	13		1
15.7	.690	Sm II 22	15		1
16.3	.137	Cr I 21	27		1
16.6	.64	Cr II 44	64		2
16.9	.783	Os	54		1
	.911	Ne I			
	.95	Fe II 108			
	.969	Ce			
18.4	.52	V II 252	18		1
18.8	.83	Cr II 44	60		1
19.3	.294	Fe I 821	40		2
	.329	Co I 27			
20.3	.13	P Fe I 468			
	.38	Ni I 163			
20.7	.513	Fe II 38	15		1
21.5	.41	P Cr II 25			
	.63	P Fe I 989			
21.8	.893	Cr I 32			
22.1	.40	P Fe II 17			
22.8	.71	Hf II 70	18		1
	.71	P II 36			
24.4	.404	V I 39			
	.561	Co I 141			
24.8	.86	Zr II 116	17		1
	.899	Ce II 27			
25.2			16		1
25.6	.549	Fe II 219			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4625.9	.911	Fe II 186	34		1
26.4	.467	Mo I 6			
27.0	.78	P Fe II 170	18		1
	.22	Eu I 1			
27.7	.48	V II 210			
	.66	Gd II 43			
28.3	.16	Ce II 1			
29.0	28.821	Fe II 219			
	.908	Co I 15			
	29.07	Zr II 1392			
29.3	.29	P Ti II 38			
	.336	Fe II 37			
	.359	Co I 156			
29.6	.7	Al II 35			
	.814	Zr I 8			
30.0	29.90	P Fe II 170			
	.98	P Ni I 223			
	30.125	Fe I 115			
30.9	.785	Fe I 969			
31.8	.895	Fe II 219	14		1
33.7	.764	Fe I 410			
34.1	.11	V II 210			
	.4	Cr II 44			
34.7	.60	P Fe II 25	27		1
35.0	34.95	La II 133			
35.3	.328	Fe II 186			
35.6	.62	P Fe I 319			
	.7	Al II 97			
36.5	.42	La II 101	15		1
37.9	.016	Fe I 822			
40.4	.362	Al II 69			
	.384	Al II 69			
41.9	.811	O II 1			
42.3	.235	Sm II 36			
42.7	.58	P Fe I 688	11		1
	.77	Eu			
44.0	.09	P Fe II 31	8		1
44.4	.37	Er	12		1
	.371	Th			
	.445	V I			
	.536	Ir II			
44.7	.82	Zr I 64	14		1
45.8	.971	V I 4	16		1
46.2	.059	Pr II 22	19		1
	.326	Gd II 82			
46.9	.94	P Ni I 145			
47.4	.42	P Ni I 148			
	.437	Fe I 409			
	.50	La II 77			
48.4	.23	P Fe II 38			
	.62	Al II 82			
	.659	Ni I 98			
49.0	48.933	Fe II 25			
	49.06	A II 51			
	.139	O II 1			
49.4	.461	Cr I 32	12		1
49.7	.828	Fe I 592	15		1
50.7	.544	Al II 59			
	.646	Al II 59			
51.3	.285	Cr I 21	23		2
51.6	.42	P V II 45	20		1
	.517	Pr II 6			

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4652.1	.280	Fe II 219	65		1
54.1	.23	O I 18	44	strong on 1278	2
54.6	.501	Fe I 39	12		
	.56	O I 18			
	.628	Fe I 554, 821			
54.9	.986	Gd II 65	12		1
	55.05	Al II 106			
55.5	.49	La II 75	19		2
	.661	Ni I 115			
56.8	.80	Si II			
57.0	.974	Fe II 43			
57.2	.210	Ti II 59			
	.38	Ni I 254			
57.9	58.03	P Fe II 170			
	.03	Lu I 2			
60.2	.156	Pr	26		1
	.17	Tb			
	.277	Nd			
	.28	Hg II			
	.294	Cu II			
	.37	Eu			
60.7	.93	P Fe II 146	45		1
61.5	.538	Fe I 1207			
	.635	O II 1			
61.7	.78	Zr II 129			
	.88	Eu II 1			
63.0	.059	Al II 2	15		
63.4	.403	Co I 156	54	stronger on 1278	2
63.7	.700	Fe II 44	21		1
64.0	.14	Hf II 14	26		1
	.272	Gd II 127			
64.4	.32	P Ni I 147	13		1
64.8	.79	P Fe II 17	26		2
	.811	Na I 12			
66.1	.149	V I 94	36	strong on 1278	2
66.5	.448	Gd II 101	24		
	.750	FevII 37			
66.9	.8	Al II 1015	30		
	.994	Ni I 146			
67.8	.766	Ni I 163	17		2
68.1	.07	P Fe I 826	17		2
	.142	Fe I 554			
68.4	.56	Na I 12	16		1
69.0	68.91	La II 76			
	69.174	Fe I 821			
69.5	.502	Ce II	21		2
	.650	Sm II 26			
70.0	69.977	Ru I 11	34		2
	70.170	Fe II 25			
73.2	.169	Fe 820			
	.28	P Fe I 822			
	.462	Bc II 6			
77.6	.528	Co I 15			
	.59	P Fe I 1072			
78.1	.160	Cd I 2			
82.2	.12	La II 37	17		1
	.28	Ra II 1			
84.4	.457	V I 94	25		2
	.484	Ti I 203			
	.605	Ce II 228			
84.7	.77	Cr II 178	18		2
87.0	.183	Sm II 3	18		1

Table 2 – continued

λ_C	λ_T	Identification	W_λ	Notes	n
4688.3	.38	P Fe I 1071	20		1
	.45	P V II 45			
90.2	.146	Fe I 820		–	
	.38	P Fe I 17			
98.2	.276	Sc II 13			

SPEKTRUM PEKULIÁRNEJ A HVIEZDY 53 AURIGA

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Súhrn

Deväť spektrogramov pekuliárnej hviezdy 53 Auriga sa získalo dvojmetrovým ďalekohľadom v Ondřejove. Registrácia spektier sa urobila na intenzitometri v Astronomickom ústave SAV na Skalnatom Plese. Identifikácia spektrálnych čiar a merané hodnoty ekvivalentných čiar udáva tabuľka 2.

СПЕКТР ПЕКУЛЯРНОЙ А ЗВЕЗДЫ 53 AURIGA

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Резюме

При помощи двухметрового телескопа мы получили 9 спектрограмм пекулярной звезды 53 Aur. Измерение длин волн спектральных линий и эквивалентных ширин проведено на регистрограммах, записанных в единицах интенсивности. В таблице 2 приведена идентификация линий и величины эквивалентных ширин.