

THE UV SPECTRUM OF THE Be STAR 88 HERCULIS

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Abstract. In this paper, we give a detailed list and analysis of line identifications of the UV spectrum of the Be star 88 Her in the wavelength range $\lambda\lambda 1958\text{--}3002\text{ \AA}$ recorded in 1984, 23 May with the International Ultraviolet Explorer (IUE). The spectrum is crowded by shell absorptions lines, mostly those of singly ionized iron peak elements.

The detailed analysis of the radial velocities measured in the whole spectral range $1100\text{--}3002\text{ \AA}$ is also given.

1. Introduction

Since the late fifties when Bidelman and Svolopoulos (1960) (a) announced the presence of hydrogen emission and shell lines on spectrograms of 88 Herculis taken in 1959 and (b) classified the object as a Be star, the interest of the astronomical community for this star has been increasing continuously. Herman and Duval (1962) found that the emission was present on their low-dispersion spectrograms taken from June 1955 to September 1958. Harmanec *et al.* (1972a, b, 1974) from a study of the radial velocities of the hydrogen shell lines suggested that 88 Herculis is probably a single-line spectroscopic binary with a period of about 87 days. Doazan (1973) announced long-term variations of emission and shell lines of the star and published additional velocity data. Svolopoulos (1973) published equivalent widths and central intensities of the H I measured on several spectrograms from 1970 and 1971. Haupt (1974) published three *UBV* measurements of 88 Her from 1968–1969 and appealed to photometrists to look for possible eclipses of the components. Intense *UBV* photoelectric observations of 88 Her performed from 1972 to 1977 at Brno and Hvar observatories, and from 1975 at Bologna and Chiran, showed that 88 Her is a variable star but not an eclipsing binary (Harmanec *et al.*, 1978). In this discovery paper on light variability studies (Harmanec *et al.*, 1978) presented in detail the light and colours variations of 88 Her, which were observed between 1968 and 1977. For a complete review of this star see the complex studies by Doazan *et al.* (1982a, b), where all the available observational data for the star are presented, and the various types of the changes observed described quantitatively. The studied star 88 Herculis (V744 Her, HD 162732, HR 6664, BD + 48° 2581, Boss 4514; $V = 6^m.67 - 6^m.90$ var; spectrum B6–7Ve, $v \sin i = 300\text{ km s}^{-1}$) is a Be star varying cyclically between Be and Be shell phases. More recently, Barylak and Doazan (1986) and Doazan *et al.* (1986) described the luminosity and colour variation through phase changes from the far UV to the visual spectral range. Danezis and Theodossiou (1988) presented a line-list of the far UV spectrum of 88 Her in the range $1100\text{--}2100\text{ \AA}$. In this paper, we give the identification list and analysis of the spectral lines, which are

present in the spectral range $\lambda\lambda 1958\text{--}3002\text{ \AA}$ and some general conclusions derived from the measured radial velocities in the whole spectral range $\lambda\lambda 1100\text{--}3002\text{ \AA}$.

2. Observational Data and their Reduction

The high resolution UV spectrum of the Be star 88 Her $\lambda\lambda 1958\text{--}3002\text{ \AA}$ analysed in this paper (LWP 3408) was taken during a new strong increasing shell phase of the star in 23 May, 1984, with the International Ultraviolet Explorer satellite (IUE) by Dr V. Doazan at the Villafranca Satellite Tracking Station of the European Space Agency (VILSPA).

The line-identifications were performed on the basis of the multiplet tables of Moore (1968) and Kelly (1979). The compilation of Kurucz (1981) for the Fe II lines was also used for a number of lines not listed in the previous ones.

A Kurucz photospheric model with $T_{\text{eff}} = 13\,000\text{ K}$ and $\log g = 4.0$ represents in a satisfactory way the observed flux distribution of 88 Herculis (Doazan *et al.*, 1986). So we have used the list of Hubeny *et al.*, 1985 (private communication) to demonstrate that our line identification in the range $2000\text{--}2040\text{ \AA}$ (the beginning of Table I) can be also challenged. The calculations of Hubeny *et al.* (1985) were carried out with the help of SYN-SPEC code in LTE mode, using LTE Kurucz's model atmospheres and assuming solar abundances. They are based on the line lists by Kurucz and Peytremann (1975) and Kurucz (1981). In addition the same photospheric model provides identifications for some unidentified lines quoted in our paper (Table II).

In this paper we present three tables.

Table I gives the list of absorption lines observed in the spectrum of 88 Herculis (LWP 3408). The successive columns in Table I give:

- (1) The measured wavelength in $\text{\AA}$ for the principal ions.
- (2) The laboratory wavelength.
- (3) The identification of the principal ions contributing to the line.
- (4) The multiplet number.
- (5) The intensity (Kelly, 1979).
- (6) The radial velocity, measured at the line center.
- (7) The value of FWHM/observed wavelength, multiplied by 10^4 for unblended lines.
- (8) Remarks: indicating the presence of blends.

Table II gives the strong, well-defined lines which are present in the spectrum that we were not able to identify unambiguously. We also give the corresponding ions which may possibly produce these lines around these wavelengths. A great number of these lines is unclassified. The successive columns in Table II give:

- (1) The measured wavelength in $\text{\AA}$ for the principal ions.
- (2) The laboratory wavelength.
- (3) The identification of the principal ions contributing to the line.
- (4) The multiplet number.
- (5) The intensity (Kelly, 1979).
- (?) The proposed identification remains doubtful.

TABLE I
LWP 3408

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
1958.60	1958.58	Fe III	55	700	0.00	00		
1979.95	1979.95	Cu II	17	200	0.00	00		
1999.25	1999.46	Fe II	186	150	-0.21	-31		Fe II [187]
1999.40	1999.58	Fe III	55	600	-0.19	-25		
1999.60	1999.69	Cu II	16	250	-0.10	-15		Fe II (K)
2000.30	2000.36	Fe II	122	300	-0.07	-10		Fe II (K)
2003.35	2003.49	Fe III	55	150	-0.14	-22		
2004.10	2004.26	Ni II	33	50	-0.17	-25		
2005.05	2005.08	Fe III	55	40	0.00	00		
2006.85	2007.01	Fe II	187	120	-0.16	-23		
2007.35	2007.45	Fe II	83	150	-0.10	-14		
2007.60	2007.71	Fe II	83	120	-0.11	-16		
2007.75	2007.84	Fe III	55	90	-0.10	-14		
2010.65	2010.68	Fe II	122	250	0.00	00		
2013.70	2013.82	Cr III	53	350	-0.13	-19		
2014.55	2014.69	Cr III	53	300	-0.14	-20		
2015.45	2015.50	Fe II	83	200	-0.05	-07		
2015.85	2016.09	Fe II	187	100	-0.24	-35		
2018.65	2018.77	Fe II	94	250	-0.12	-17		
2018.85	2019.03	Ni II	43	50	-0.18	-26		
2020.60	2020.73	Fe II	83	250	-0.13	-19		
2020.85	2020.98	Ni II	43	50	-0.14	-20		
2023.25	2023.48	Fe III	<i>k</i>					
2023.55	2023.71	Fe II	187	10	-0.15	-22		
2024.45	2024.61	Fe II	<i>k</i>					
2025.50	2025.48	Zn II	1	300	0.00	00		C II [17]
2029.10	2029.18	Fe II	93	80	-0.08	-11		Ni II [43]
2032.25	2032.40	Fe II	94	250	-0.15	-22		
2033.25	2033.47	Ni II	<i>k</i>					
2034.30	2034.46	Fe II	186	10	-0.16	-23		
2035.65	2035.85	Cu II	15	275	-0.25	-36		
2036.40	2036.43	Fe II	137	200	0.00	00		Cr III [69]
2039.50	2039.66	Cr III	69	350	-0.16	-23		
2040.50	2040.68	Fe II	93	10	-0.18	-26		
2043.70	2043.80	Cu II	15	350	-0.10	-15		
2044.85	2044.97	Fe III	60	40	-0.12	-17		
2047.10	2047.26	Cr III	69	350	-0.16	-23		
2048.30	2048.49	Fe II	121	50	-0.19	-27		
2050.60	2050.73	Fe III	60	120	-0.13	-19		
2051.05	2051.02	Fe II	93	250	0.00	00		
2054.90	2054.96	Cu II	15	300	-0.07	-10		
2055.15	2055.27	Fe II	109	200	-0.12	-17		
2055.60	2055.59	Cr II	1	200	0.00	00		
2056.95	2057.05	Fe III	78	90	-0.11	-16		
2057.30	2057.33	Fe II	82	120	0.00	00		
2059.55	2059.67	Fe III	78	120	-0.13	-18		
2061.35	2061.54	Cr II	1	195	-0.17	-24		Fe III [48]
2061.55	2061.75	Fe III	78	200	-0.21	-30		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2061.90	2062.00	Zn II	1	300	-0.10	-14		
2063.70	2063.67	Fe II	92	200	0.00	00		
2064.15	2064.22	Zn II	4	200	-0.08	-11		
2065.40	2065.46	Cr II	1	150	-0.06	-08		
2065.90	2066.00	Fe II	109	150	0.00	00		
2067.75	2067.91	Fe II	137	200	-0.15	-21		
2068.05	2068.24	Fe III	48	350	-0.19	-27		
2069.80	2069.95	Fe II	273	100	-0.15	-21		
2070.15	2070.33	Fe II	273	80	-0.18	-26		
2071.85	2072.01	Si II	9	200	-0.16	-23		Fe II [107]
2072.55	2072.70	Si II	9	200	-0.15	-21		
2072.95	2073.14	Fe II	81	80	-0.19	-27		
2073.10	2073.36	Cr III	18	15	-0.16	-23		
2074.00	2074.19	Fe II	91	80	-0.19	-27		
2075.65	2075.68	Fe II	107	50	0.00	00		
2077.35	2077.50	Fe II	136	120	-0.15	-21		Mn III [10]
2077.90	2078.16	Fe II	91	80	-0.26	-37	0.5	
2078.55	2078.66	Cu II	78	100	-0.11	-15		
2078.80	2078.98	Fe III	48	500	-0.18	-25		
2080.60	2080.85	Ni II	16	20	-0.25	-36	0.5	
2084.30	2084.34	Fe III	67	250	0.00	00		Fe III [67]
2085.00	2085.27	Cu II	14	8	-0.27	-38		
2087.35	2087.52	Fe II	108	8	-0.17	-24		
2088.40	2088.62	Fe III	67	60	-0.22	-31		
2089.85	2090.14	Fe III	67	350	-0.28	-40		Mn III [10]
2090.10	2090.24	Fe III	59	90	-0.14	-20		
2091.25	2091.34	Ga II	1	1000	-0.10	-14		
2093.45	2093.71	Fe II	290	50	-0.26	-37		
2094.45	2094.64	Fe II	107	10	-0.19	-27		
2096.25	2096.43	Fe III	59	90	-0.18	-27		
2096.45	2096.72	Cr III	38	120	-0.27	-37		
2096.95	2097.09	Ni II	31	140	-0.14	-20		
2097.35	2097.48	Fe III	67	570	-0.13	-18		Fe II [80] Fe III [66]
2099.00	2099.23	Fe III	66	60	-0.23	-32		
2099.70	2099.94	Zn II	4	300	-0.23	-32		Mn III [10]
2100.85	2100.96	Fe II	250	50	-0.11	-15		
2103.25	2103.34	Cr III	41	350	-0.10	-14	0.3	Cr III [41] Ni III [31]
2103.75	2103.80	Fe III	66	350	-0.05	-07	0.2	
2104.70	2104.79	Cu II	15	325	-0.09	-12	0.2	
2104.90	2105.02	Fe III	146	60	-0.12	-17	0.2	Cr III [41]
2107.10	2107.32	Fe III	66	250	-0.22	-31		
2107.40	2107.55	Fe II	250	100	-0.15	-21		
2107.75	2107.95	Ni II	60	140	-0.20	-28		
2107.95	2108.14	Fe II	81	150	-0.19	-27		
2108.95	2108.94	Fe II	227	250	0.00	00		Ni II [60] Fe III [227]
2110.30	2110.29	Fe II	290	250	0.00	00		
2110.60	2110.72	Fe II	108	2	-0.12	-17		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2113.45	2113.57	Ni II	60	180	-0.13	-18		
2113.60	2113.81	Cr III	41	570	-0.21	-29		
2114.10	2114.30	Cr III	41	300	-0.20	-28		
2114.30	2114.57	Cr III	61	300	-0.27	-38		
2114.75	2114.90	Cr III	41	400	-0.15	-21		
2116.45	2116.58	Fe III	58	120	-0.15	-21		
2116.95	2116.96	Fe II	213	250	0.00	00	0.7	
2118.00	2118.19	Fe II	120	80	-0.19	-28		
2118.30	2118.56	Fe III	58	90	-0.26	-38		Fe III [58]
2118.95	2119.05	Fe II	120	120	-0.10	-14		
2120.30	2120.39	Cr III	41	250	-0.09	-12	0.2	
2120.60	2120.76	Fe III	58	40	-0.16	-24		Fe III [58]
2122.30	2122.48	Cr III	61	300	-0.18	-25		
2122.55	2122.78	Cr III	41	200	-0.23	-32	0.2	
2122.75	2122.96	Cu II	54	350	-0.21	-29	0.2	
2123.45	2123.55	Cr III	61	400	-0.10	-14		
2125.00	2125.10	Cu II	136	100	-0.10	-14	0.6	Ni II [14]
2125.40	2125.63	Cr III	41	120	-0.23	-33		
2125.80	2125.91	Ni II	13	25	-0.11	-15		
2125.95	2126.04	Cu II	14	350	-0.10	-14		
2129.70	2129.89	Cr II	24	50	-0.19	-26		
2130.10	2130.22	Cr II	14	50	-0.12	-16		Ni II [14] Cr II [24]
2131.00	2131.04	Ni II	31	60	-0.05	-07		
2131.85	2131.99	Cr III	61	300	-0.14	-19		
2133.40	2133.49	Cr II	23	100	-0.10	-14		
2133.90	2133.99	Fe II	213	80	-0.10	-14		
2134.10	2134.28	Ni II	31	50	-0.19	-26		
2134.15	2134.34	Cu II	52	425	-0.19	-26		
2134.40	2134.52	Cr II	23	100	-0.12	-16		Fe II [212] Cr II [28]
2135.25	2135.42	Cr II	23	50	-0.17	-23		
2135.85	2135.98	Cu II	14	900	-0.13	-18	0.6	
2136.20	2136.36	Fe III	76	60	-0.16	-22		
2137.20	2137.36	Fe III	58	150	-0.16	-23		
2137.60	2137.73	Fe II	6	150	-0.13	-19		
2138.00	2138.10	Fe II	135	200	-0.10	-14		
2139.00	2139.14	Cr III	48	400	-0.14	-21		
2139.50	2139.67	Fe II	6	250	-0.17	-25		
2140.95	2141.18	Cr III	40	500	-0.23	-32		
2142.95	2143.04	Fe III	76	120	-0.10	-13		
2143.15	2143.47	Fe III	59	150	-0.32	-44		Fe III [59]
2143.60	2143.82	Fe III	58	120	-0.23	-32		Fe III [59]
2144.05	2144.28	Fe III	58	150	-0.23	-32		
2144.15	2144.18	Cr III	40	500	0.00	00	0.7	
2145.50	2145.61	Fe III	59	90	-0.11	-15		Cr II [78]
2145.95	2146.05	Fe II	6	100	-0.10	-15		Fe III [59]
2146.15	2146.33	Fe III	59	90	-0.19	-26		
2146.25	2146.41	Cr III	52	250	-0.16	-22		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2147.05	2147.21	Cr III	40	500	-0.17	-23		Cr III [41] Cr II [14]
2147.45	2147.61	Cr III	48	350	-0.17	-23		
2147.60	2147.71	Fe II	213	2	-0.12	-16		
2147.85	2147.90	Fe III	59	120	-0.05	-06		
2148.85	2148.98	Cu II	14	400	-0.13	-18		
2149.50	2149.52	Cr III	52	300	0.00	00		
2150.50	2150.76	Fe II	248	100	-0.26	-36		
2151.05	2151.09	Fe II	106	250	-0.04	-05		
2151.55	2151.77	Fe III	112	570	-0.22	-30		
2152.25	2152.37	Fe III	106	120	-0.12	-16	0.5	
2153.05	2153.28	Fe II	225	50	-0.23	-32		
2153.60	2153.87	Fe II	6	10	-0.27	-37	0.2	
2154.45	2154.66	Cr III	48	300	-0.21	-29		
2155.70	2155.83	Fe II	213	120	-0.13	-18		
2157.00	2157.19	Cr III	52	350	-0.19	-26		
2157.60	2157.71	Fe III	70	350	-0.11	-15		
2158.15	2158.47	Fe III	145	350	-0.32	-44		
2158.40	2158.51	Fe II	89	250	-0.11	-15		
2158.55	2158.74	Ni II	13	50	-0.19	-26	0.6	
2158.95	2159.15	Fe II	6	100	-0.20	-27		Cr III [48]
2159.55	2159.75	Cr III	40	90	-0.20	-27		
2161.00	2166.16	Fe II	227	150	-0.16	-22	0.5	Fe II [213]
2161.25	2161.31	Fe II	227	200	-0.06	-08	0.7	Ni II [14] Fe II [370]
2163.25	2163.37	Fe II	372	200	-0.12	-16		
2163.75	2163.87	Cr III	48	400	-0.12	-16		
2164.25	2164.33	Fe II	79	200	-0.09	-16		Fe II [372]
2164.40	2164.55	Fe II	213	250	-0.15	-20		Fe II [370]
2165.50	2165.55	Ni II	13	320	-0.06	-08	0.8	
2166.15	2166.26	Cr III	52	350	-0.12	-16		
2166.80	2166.95	Fe III	70	350	-0.15	-20		
2167.80	2167.88	Fe II	213	150	-0.08	-11		
2168.10	2168.25	Cr III	48	200	-0.16	-22		
2169.30	2169.43	Fe II	370	100	-0.13	-17		
2169.80	2169.95	Fe II	370	120	-0.15	-20		
2170.15	2170.19	Fe II	372	50	-0.03	-04		
2170.90	2171.04	Fe III	70	350	-0.15	-20		
2172.65	2172.67	Fe II	372	80	-0.03	-04	0.3	
2172.90	2172.98	Fe II	134	150	-0.09	-12		
2173.05	2173.22	Fe II	248	200	-0.17	-23		
2173.60	2173.72	Fe II	79	150	-0.12	-16		
2174.65	2174.65	Fe III	70	570	0.00	00		Ni II [14]
2175.05	2175.14	Ni II	13	390	-0.09	-12		
2176.60	2176.82	Fe II	370	200	-0.22	-30		
2177.00	2177.02	Fe II	106	100	0.00	00		Ni II [40]
2177.20	2177.36	Ni II	40	200	-0.16	-22		
2179.30	2179.41	Cu II	14	700	-0.11	-15		Ni II [12] Ni II [40]
2179.90	2179.91	Ni II	33	50	-0.09	-12		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2180.10	2180.25	Fe II	370	120	-0.15	-20		
2180.30	2180.41	Fe III	70	350	-0.11	-15		Ni II [40]
2180.65	2180.87	Fe II	370	120	-0.22	-30		
2181.10	2181.13	Fe II	370	80	0.00	00		
2181.05	2181.21	Fe III	123	10	-0.16	-22		
2181.35	2181.40	Fe II	370	50	-0.06	-08		Cr III [51]
2184.55	2184.60	Ni II	13	280	-0.05	-06	0.5	
2185.50	2185.62	Fe II	271	80	-0.12	-16	0.7	Ni II [40]
2187.30	2187.44	Fe II	271	120	-0.14	-19		
2187.90	2187.86	Fe II	135	150	0.00	00	0.7	Ni II [12]
2189.50	2189.62	Cu II	53	700	-0.12	-16		
2190.55	2190.76	Cr III	51	350	-0.13	-17		
2190.80	2190.96	Ni II	29	30	-0.16	-21		
2191.00	2191.26	Cr III	47	200	-0.26	-35		
2191.50	2191.59	Cr III	51	300	-0.10	-13		
2191.85	2191.93	Fe II	367	100	-0.09	-12		
2192.30	2191.26	Cu II	14	900	0.00	00		
2192.50	2192.67	Fe II	226	50	-0.17	-23		
2195.05	2195.08	Fe III	123	60	-0.03	-04		
2195.35	2195.53	Fe III	123	90	-0.18	-24	0.2	
2195.50	2195.68	Cu II	135	400	-0.18	-24		
2197.15	2197.23	Fe II	226	50	-0.12	-16		
2197.60	2197.89	Cr III	51	500	-0.29	-39		
2198.50	2198.66	Fe II	367	40	-0.16	-21		
2200.90	2201.00	Cr III	51	250	-0.10	-13		
2201.10	2201.19	Cr III	47	350	-0.09	-12		
2201.35	2201.40	Ni II	13	240	-0.09	-12	0.7	
2201.90	2201.94	Cr III	58	350	-0.05	-06		
2202.35	2202.45	Fe III	74	150	-0.11	-14		
2203.10	2203.22	Cr III	47	400	-0.12	-16		
2206.55	2206.71	Ni II	13	620	-0.15	-20		
2207.40	2207.44	Cr III	47	150	-0.05	-06		
2208.60	2208.70	Cr III	58	400	-0.10	-13		
2209.70	2209.80	Cu II	134	200	-0.10	-13		Fe III [123]
2210.35	2210.26	Cu II	52	750	+0.03	+04		Ni II [13]
2211.05	2211.11	Fe II	289	50	-0.06	-08		
2211.50	2211.44	Cr III	47	200	0.00	00		
2213.15	2213.19	Ni II	30	120	-0.04	-05	0.5	
2213.60	2213.68	Cr II	247	30	-0.08	-10		Cr II [21]
2214.45	2214.61	Fe III	69	40	-0.16	-21	0.3	
2216.45	2216.48	Ni II	12	800	-0.03	-04	0.8	
2217.55	2217.75	Cr III	47	300	-0.20	-27		
2218.05	2218.26	Fe II	367	12	-0.12	-28		
2218.05	2218.10	Cu II	13	750	-0.05	-06		
2219.40	2219.58	Cr III	47	300	-0.18	-24		
2220.35	2220.54	Mn III	16	900	-0.20	-27		Ni II [28] Fe II [371]
2221.65	2221.83	Fe III	69	250	-0.18	-24		
2222.85	2222.95	Ni II	12	300	-0.10	-13		
2224.50	2224.69	Cu II	178	100	-0.19	-25	0.9	Ni II [21] Cr III [58]

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2224.70	2224.86	Ni II	12	140	-0.16	-21	0.9	
2226.25	2226.32	Ni II	12	100	-0.08	-10	0.6	
2226.55	2226.67	Cr III	39	1000	-0.12	-16		
2227.75	2227.84	Fe III	69	120	-0.10	-13		
2228.75	2228.86	Cu II	13	350	-0.11	-14		
2229.25	2229.26	Fe III	128	250	-0.12	-16		
2229.70	2229.85	Cu II	135	150	-0.15	-20		Ni II [51]
2230.80	2230.95	Cu II	167	100	-0.15	-20		
2231.60	2231.78	Cr III	45	500	-0.18	-24	0.3	
2233.60	2233.65	Fe III	128	90	-0.05	-06		
2233.80	2233.78	Cr III	45	700	0.00	00		
2235.60	2235.69	Fe III	69	90	-0.10	-13		
2235.75	2235.91	Cr III	39	800	-0.16	-21		
2237.45	2237.57	Fe II	365	200	-0.12	-16		Cr III [45]
2237.90	2238.15	Fe III	139	250	-0.25	-32		
2238.85	2239.04	Fe II	365	250	-0.19	-25	0.3	
2241.30	2241.42	Fe II	365	200	-0.12	-16		
2241.40	2241.54	Fe III	109	350	-0.14	-18		
2242.55	2242.62	Cu II	52	900	-0.07	-09		
2243.50	2243.62	Cr II	77	50	-0.12	-16		
2244.05	2244.21	Fe II	365	80	-0.16	-21	0.2	
2244.70	2244.89	Cr III	39	700	-0.19	-25		
2245.40	2245.50	Fe II	365	450	-0.10	-13	0.4	
2245.55	2245.77	Fe III	128	40	-0.22	-29		
2246.90	2247.00	Cu II	13	1000	-0.10	-13		
2247.05	2247.23	Ni II	30	100	-0.18	-24		
2247.55	2247.69	Fe II	365	350	-0.14	-18		
2248.75	2248.95	Cr III	45	250	-0.20	-26		
2248.90	2249.06	Fe II	365	300	-0.16	-21		Fe II [365]
2249.05	2249.18	Fe II	365	250	-0.13	-17		
2250.05	2250.17	Fe II	4	10	-0.12	-15	0.3	
2250.75	2250.93	Fe II	4	50	-0.19	-25		
2251.30	2251.46	Cr III	39	570	-0.16	-21		
2251.55	2251.83	Fe II	365	800	-0.18	-23		
2251.75	2251.97	Cr III	39	400	-0.22	-29		
2253.70	2253.84	Ni II	12	220	-0.15	-19		Ni II [29]
2253.95	2254.06	Fe II	365	80	-0.12	-15		Ni II [12]
2255.25	2255.47	Cr III	45	300	-0.22	-29		
2255.60	2255.69	Fe II	365	500	-0.09	-11		
2255.95	2256.01	Cr II	77	50	-0.06	-07		Fe II [4] Ni II [51]
2256.75	2256.89	Fe II	365	100	-0.14	-18		
2257.15	2257.38	Cr III	39	500	-0.24	-31		
2257.30	2257.40	Fe III	73	150	-0.10	-13		
2257.40	2257.55	Cr III	50	650	-0.15	-19		
2257.85	2257.78	Fe II	365	250	+0.07	+09		Cr III [39] Cr III [50]
2260.06	2260.22	Fe II	5	50	-0.18	-23		Fe II [4]

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2260.70	2260.85	Fe II	4	50	-0.15	-19		
2261.45	2261.68	Cr III	39	400	-0.23	-30		
2262.50	2262.68	Fe II	5	50	-0.18	-23		Cr III [45]
2262.85	2262.89	Ni II	39	30	-0.05	-06		
2264.45	2264.46	Ni II	12	320	0.00	00	0.9	
2264.80	2264.91	Cr III	39	350	-0.11	-14		
2265.10	2265.34	Ni II	39	30	-0.24	-31	0.3	
2267.40	2267.58	Fe II	4	50	-0.18	-23		Fe III [133]
2270.15	2270.21	Ni II	12	440	-0.06	-07	0.4	
2273.15	2273.34	Cr III	67	570	-0.19	-25		
2275.30	2275.47	Cr III	67	350	-0.017	-22		
2275.60	2275.68	Ni II	39	100	-0.08	-10		
2276.15	2276.25	Cu II	13	200	-0.10	-13		
2276.40	2276.43	Ni II	51	140	0.00	00		
2276.65	2276.87	Fe III	73	150	-0.22	-28		
2277.30	2277.46	Cr III	67	400	-0.16	-21	0.7	
2278.80	2278.77	Ni II	22	280	-0.07	-09		
2279.30	2279.37	V II	27	15	-0.08	-10		
2279.80	2279.92	Fe II	4	20	-0.12	-17	0.7	
2281.60	2281.60	V II	26	60	-0.15	-19		
2286.55	2286.64	Cu II	152	100	-0.10	-13		Cr III [50]
2287.05	2287.09	Ni II	22	180	0.00	00	0.9	
2287.50	2287.64	Ni II	38	220	-0.15	-19		
2289.05	2289.22	V II	27	70	-0.17	-22		
2290.50	2290.66	Cr III	50	570	-0.16	-20		
2291.65	2291.85	Fe III	156	90	-0.20	-26		
2293.00	2293.05	Fe III	156	250	-0.06	-07		
2294.30	2294.36	Cu II	13	175	-0.07	-09		
2294.80	2294.99	V II	26	40	-0.19	-24		
2295.35	2295.50	V II	26	20	-0.15	-19		
2296.55	2296.55	Ni II	21	200	0.00	00		
2297.05	2297.14	Ni II	11	200	-0.09	-11		Cr II [19]
2297.30	2297.49	Ni II	11	180	-0.19	-24		
2297.80	2297.91	Cr III	50	350	-0.11	-14		
2298.65	2298.96	Mn II	2	60	-0.30	-39		
2299.55	2299.65	Ni II	27	140	-0.10	-13		
2300.05	2300.09	Ni II	27	180	-0.05	-06		
2300.90	2301.01	Ni II	39	20	-0.11	-14		
2302.40	2302.46	Ni II	59	140	-0.06	-07		
2302.80	2302.99	Ni II	11	320	-0.19	-24		
2303.65	2303.84	Ni II	51	50	-0.20	-26		
2304.70	2305.00	Mn II	2	100	-0.30	-39		
2305.10	2305.24	Ni II	38	140	-0.14	-18		
2307.05	2307.19	Cr II	19	35	-0.14	-18		
2307.60	2307.78	Ni II	38	50	-0.18	-23		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2308.50	2308.52	Ni II	50	120	0.00	00		
2309.45	2309.57	Fe II	144	40	-0.08	-10		
2312.10	2312.24	Ni II	27	50	-0.14	-18		
2312.90	2312.91	Ni II	58	140	0.00	00		
2314.70	2314.71	Cr II	19	40	0.00	00		Cr III [44]
2316.00	2316.03	Ni II	11	320	0.00	00	0.6	
2317.25	2317.37	Fe II	183	8	-0.12	-15		
2318.35	2318.50	Ni II	38	140	-0.15	-19		Fe II [183]
2319.00	2319.06	Cr III	44	700	-0.06	-07		
2319.30	2319.46	Fe III	144	150	-0.16	-20		
2319.70	2319.72	Ni II	37	220	0.00	00		
2321.50	2321.68	Fe II	183	10	-0.18	-23		
2321.55	2321.71	Fe III	132	250	-0.16	-20		
2322.20	2322.32	Fe II	183	6	-0.12	-15		
2324.15	2324.36	Fe III	156	150	-0.20	-25	0.5	
2324.75	2324.89	Cr III	44	800	-0.24	-18		
2325.15	2325.29	Fe II	183	10	-0.14	-18		
2326.30	2326.45	Ni II	11	50	-0.15	-19		N II [29]
2326.75	2326.94	Fe III	121	250	-0.20	-25		
2327.35	2327.39	Fe II	3	100	0.00	00		
2327.75	2327.95	Fe II	183	8	-0.20	-25		
2331.10	2331.07	Fe II	183	5	0.00	00		
2331.25	2331.31	Fe II	35	100	-0.06	-07		
2332.70	2332.79	Fe II	3	170	-0.10	-12	0.5	
2334.40	2334.58	Ni II	20	220	-0.18	-23		
2336.30	2336.45	Ni II	27					
2336.65	2336.76	Ni II	50	100	-0.12	-15		Fe III [121]
2338.00	2338.00	Fe II	3	140	0.00	00	0.9	
2339.30	2339.40	Fe II	105	8	-0.10	-12		
2340.50	2340.64	Cl II	19	600	-0.14	-17		
2341.10	2341.20	Ni II	50	220	-0.10	-12		
2342.35	2342.45	Cr III	44	300	-0.11	-14		
2343.40	2343.49	Fe II	3	240	-0.10	-12		Ni II [37]
2344.00	2343.96	Fe II	35	80	0.00	00		
2344.20	2344.27	Fe II	3	125	-0.08	-10		
2345.25	2345.34	Fe II	165	50	-0.08	-10	0.2	Ni II [58]
2346.50	2346.50	Fe II	379	1	0.00	00		
2348.15	2348.12	Fe II	36	140	0.00	00		
2348.30	2348.30	Fe II	3	155	0.00	00	1.1	
2349.94	2350.18	Fe II	379	12	-0.25	-31		
2351.15	2351.20	Fe II	165	50	-0.05	-06		
2351.55	2351.67	Fe II	379	15	-0.12	-15		
2352.15	2352.31	Fe II	379	25	-0.16	-20		
2353.05	2353.09	Si II	35	20	0.00	00		
2353.55	2353.68	Fe II	379	15	-0.13	-16		
2354.45	2354.47	Fe II	165	50	0.00	00	0.5	
2354.85	2354.88	Fe II	35	40	0.00	00		
2355.15	2355.22	Fe II	165	12	-0.07	-08		
2355.25	2355.35	Fe II	379	40	-0.10	-12		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2356.25	2356.40	Ni II	22	100	-0.15	-19	0.6	
2356.25	2356.29	Si II	35	100	0.00	00		
2356.50	2356.64	Cu II	13	20	-0.14	-17		
2357.00	2357.00	Fe II	333	40	0.00	00		Fe II [379]
2357.90	2357.97	Si II	35	50	-0.07	-08		
2359.10	2359.11	Fe II	3	140	0.00	00		Fe II [165] Fe II [379]
2359.55	2359.59	Fe II	165	15	0.00	00	0.6	
2359.95	2359.99	Fe II	35	125	-0.05	-05		
2360.30	2360.29	Fe II	36	110	0.00	00		
2361.60	2361.72	Fe II	165	40	-0.12	-15		
2362.00	2362.02	Fe II	35	40	0.00	00		
2363.70	2363.85	Fe II	379	60	-0.15	-19	0.6	Fe II [270]
2364.85	2364.83	Fe II	3	140	0.00	00	0.8	
2366.55	2366.58	Fe II	35	25	0.00	00		Ni II [36]
2366.80	2366.86	Fe II	2	5	-0.06	-07		Fe II [165]
2367.30	2367.38	Ni II	11	100	-0.08	-10		
2368.65	2368.59	Fe II	36	80	+0.05	+06		
2369.05	2369.21	Ni II	36	50	-0.17	-21		
2369.75	2369.96	Fe II	379	80	-0.21	-26		
2370.55	2370.49	Fe II	35	25	+0.06	+07	0.5	
2372.60	2372.63	Fe II	333	10	0.00	00		
2373.60	2373.73	Fe II	2	125	-0.13	-16	0.8	
2375.20	2375.19	Fe II	36	60	0.00	00	1.5	
2375.40	2375.42	Ni II	21	320	0.00	00		
2376.30	2376.43	Fe II	379	110	-0.13	-16		
2378.55	2378.52	Fe II	279	20	0.00	00		Fe II [377]
2379.00	2379.15	Fe II	211	20	-0.15	-18		V II [43]
2379.20	2379.27	Fe II	36	80	-0.07	-08	1.0	
2380.70	2380.76	Fe II	3	110	-0.06	-07	0.7	
2381.95	2382.03	Fe II	2	320	-0.09	-11	1.3	
2382.25	2382.35	Fe II	35	40	-0.10	-12		
2383.05	2383.06	Fe II	2	20	0.00	00		
2383.20	2383.24	Fe II	36	60	0.00	00		
2384.30	2384.39	Fe II	36	50	-0.09	-11		
2385.00	2384.99	Fe II	35	10	-0.10	-12		
2386.35	2386.38	Fe II	396	20	0.00	00		
2387.65	2387.76	Ni II	10	100	-0.11	-13		
2388.35	2388.37	Fe II	117	40	0.00	00		
2388.55	2388.63	Fe II	2	170	-0.08	-10		
2389.00	2389.14	V II	43	2	-0.14	-17		
2389.25	2389.53	Fe III	131	150	-0.28	-35		
2391.35	2391.47	Fe II	35	15	-0.13	-16		
2392.00	2392.10	Ni II	36	30	-0.10	-12		
2392.50	2392.58	Fe II	36	100	-0.90	-11		Ni II [36]
2394.45	2394.73	Ni II	20					
2395.45	2395.62	Fe II	2	320	-0.17	-21	1.1	Fe II [2]
2396.55	2396.71	Fe II	211	15	-0.17	-21	0.5	

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2398.60	2398.66	Fe II	402	20	- 0.06	- 07	0.8	
2399.30	2399.23	Fe II	2	170	+ 0.06	+ 07		
2399.45	2399.49	Fe II	396	5	- 0.05	- 06		
2400.00	2400.11	Cu II	50	60	- 0.11	- 13	0.5	Fe II [181]
2400.30	2400.33	Fe II	244	70	0.00	00		
2401.30	2401.30	Fe II	402	15	0.00	00		
2402.10	2402.25	Fe II	181	20	- 0.15	- 18	C II [16]	
2402.30	2402.45	Fe II	377	80	- 0.15	- 18		
2402.45	2402.60	Fe II	36	40	- 0.15	- 18		
2404.45	2404.43	Fe II	2	50	0.00	00		
2404.90	2404.88	Fe II	2	280	0.00	00		
2405.05	2405.16	Ni II	49	100	- 0.11	- 13		
2405.40	2405.50	Cu II	23	500	- 0.10	- 12		
2405.60	2405.68	Fe II	402	10	- 0.09	- 11		
2406.15	2406.39	Ni II	36	15	- 0.24	- 29		
2406.55	2406.66	Fe II	2	155	- 0.11	- 13	0.9	Ni II [36]
2406.85	2406.98	Fe II	302	80	- 0.13	- 16		
2408.50	2408.65	Fe II	402	20	- 0.15	- 18		
2410.50	2410.52	Fe II	2	170	0.00	00	0.6	Ni II [12]
2411.00	2411.07	Fe II	2	140	- 0.07	- 08		
2412.25	2412.34	Cu II	23	450	- 0.09	- 11		
2412.85	2413.04	Ni II	19	50	- 0.19	- 26		
2413.20	2413.30	Fe II	2	125	- 0.10	- 12		
2414.95	2415.07	Fe II	181	40	- 0.12	- 14		
2415.95	2416.13	Ni II	20	440	- 0.19	- 23		
2416.40	2416.45	Fe II	396	20	- 0.06	- 07		
2417.70	2417.86	Fe II	244	80	- 0.16	- 19		
2419.80	2419.89	Fe II	180	5	- 0.09	- 11		
2419.90	2419.99	Fe II	396	8	- 0.10	- 12		
2420.00	2420.11	Cr II	26	100	- 0.11	- 13		
2422.55	2422.68	Fe II	301	60	- 0.14	- 17		
2423.10	2423.21	Fe II	301	40	- 0.11	- 13		
2424.10	2424.14	Fe II	180	125	0.00	00		
2424.50	2424.59	Fe II	301	40	- 0.09	- 11	0.7	Fe II [180]
2425.50	2425.68	Fe II	224	10	- 0.18	- 22		
2425.80	2425.90	Fe II	130	20	- 0.10	- 12		
2428.30	2428.36	Fe II	300	110	- 0.06	- 08		Fe II [301]
2428.90	2428.97	Fe II	375	60	- 0.07	- 08		
								Fe II [385]
2429.45	2429.49	Fe II	180	20	- 0.05	- 06	0.8	Fe II [30]
2430.00	2430.08	Fe II	180	110	- 0.08	- 09		
2430.65	2430.88	Fe II	375	6	- 0.23	- 28		
2431.10	2431.23	Fe II	375	30	- 0.13	- 16	1.0	
2431.40	2431.56	Ni II	49	40	- 0.16	- 19		
2432.60	2432.87	Fe II	321	60	- 0.27	- 33		
2432.95	2433.05	Fe II	384	10	- 0.10	- 12		Ni II [19]
2433.40	2433.49	Fe II	164	70	- 0.10	- 12		
								Fe II [359]

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2433.95	2434.06	Fe II	375	25	-0.11	-13		
2434.10	2434.23	Fe II	384	20	-0.14	-17		
2434.65	2434.73	Fe II	321	50	-0.08	-09	0.9	Fe II [375]
2434.85	2434.95	Fe II	180	50	-0.10	-12		Fe II [385]
2436.05	2436.22	Fe II	209	4	-0.17	-20		
2436.45	2436.62	Fe II	384	25	-0.17	-20		Fe II [375]
2436.95	2437.10	Fe II	375	50	-0.15	-18		
2437.20	2437.25	Fe II	313	40	-0.06	-07	0.6	
2437.45	2437.63	Fe II	375	200	-0.18	-22		
2437.75	2437.89	Ni II	18	220	-0.14	-17	0.8	
2439.30	2439.30	Fe II	209	125	0.00	00		
			26	500	-0.19	-23		
2439.75	2439.86	Fe II	375	80	-0.11	-13		
2440.35	2440.42	Fe II	300	40	-0.07	-08	0.7	
2440.95	2441.13	Fe II	395	10	-0.18	-22		
2443.65	2443.84	Fe II	375	150	-0.19	-23		
2444.14	2444.27	Fe II	375	100	-0.12	-14		
2444.50	2444.51	Fe II	148	100	0.00	00	0.6	
2445.00	2445.10	Fe II	375	50	-0.10	-12		
2445.60	2445.57	Fe II	148	100	0.00	00		Fe II [300]
2446.00	2446.11	Fe II	300	50	-0.11	-08		
2446.35	2446.40	Fe II	375	15	-0.05	-06		
2446.40	2446.47	Fe II	164	30	-0.07	-08		
2447.15	2447.20	Fe II	300	40	-0.05	-06		
2447.55	2447.75	Fe II	320	30	-0.20	-24		
2449.70	2449.74	Fe II	34	5	-0.04	-04		
2450.05	2450.20	Fe II	300	25	-0.15	-18	1.0	Fe II [375]
2451.15	2451.10	Fe II	34	20	+0.05	+06	1.0	Fe II [209]
2452.75	2452.91	Fe II	300	5	-0.16	-19	0.4	
2453.70	2453.75	Fe II	375	150	-0.05	-06		
2453.85	2453.93	Fe II	375	250	-0.09	-11		
2454.00	2454.16	Fe II	222	20	-0.16	-19		
2454.45	2454.57	Fe II	320	20	-0.12	-14	0.6	
2455.75	2455.89	Fe II	384	15	-0.15	-18	0.3	
2456.55	2456.64	Fe II	320	20	-0.09	-10	0.5	
2456.70	2456.81	Fe II	209	20	-0.11	-13		
2456.95	2457.09	Fe II	269	15	-0.10	-12		
2458.70	2458.78	Fe II	209	125	-0.08	-09	0.6	
2458.95	2459.09	Fe II	163	20	-0.14	-17		Ni II [61] Fe II [312]
2460.30	2460.44	Fe II	395	60	-0.14	-17		
2460.55	2460.64	Fe II	359	20	-0.10	-12		
2461.30	2461.29	Fe II	209	80	0.00	00	0.6	
2461.75	2461.86	Fe II	209	100	-0.11	-13	0.8	
2463.25	2463.29	Fe II	208	50	0.00	00		
2463.60	2463.72	Fe II	129	20	-0.12	-14		Fe II [162]
2463.95	2464.00	Fe II	208	40	-0.06	-07	0.8	Fe II [385]
2465.00	2465.19	Fe II	148	10	-0.19	-28	0.8	Fe II [208]

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2465.80	2465.91	Fe II	208	50	-0.11	-23	0.5	
2468.15	2468.29	Fe II	163	70	-0.14	-17		Fe II [145]
2469.00	2469.13	Cr II	92	20	-0.13	-15		
2469.55	2469.71	Fe II	382	80	-0.16	-19		
2470.50	2470.67	Fe II	179	80	-0.17	-20		Fe II [223]
2466.67	2466.80	Fe II	179	60	-0.13	-16	0.8	Fe II [179]
2472.40	2472.42	Fe II	179	40	0.00	00		
2473.00	2473.15	Ni II	19	100	-0.15	-18		
2473.15	2473.32	Fe II	148	50	-0.17	-20		
2474.60	2474.76	Fe II	208	10	-0.16	-19	0.7	
2475.05	2475.11	Fe II	395	50	-0.07	-08		
2475.50	2475.54	Fe II	395	40	0.00	00		Cr II [92]
2476.20	2476.26	Fe II	163	15	-0.06	-07		
2477.30	2477.34	Fe II	162	25	0.00	00	0.6	Fe II [133]
2478.05	2478.11	Fe II	224	10	-0.06	-07		
2478.35	2478.45	Fe II	161	20	-0.10	-12		Cr I [61]
2478.55	2478.57	Fe II	179	60	0.00	00		
2479.25	2479.38	Fe II	382	30	-0.13	-15		
2480.05	2480.15	Fe II	179	100	-0.10	-12	0.8	
2481.00	2481.05	Fe II	243	15	-0.05	-06		
2481.45	2481.57	Fe II	331	20	-0.13	-15		
2482.00	2482.11	Fe II	161	80	-0.11	-13		
2482.45	2482.64	Fe II	207	100	-0.20	-24		
2482.65	2482.86	Fe II	400	15	-0.21	-25		
2483.70	2483.72	Fe II	331	15	0.00	00	0.6	Cr II [310]
2484.15	2484.24	Fe II	243	60	-0.09	-10		Ni II [61]
2484.35	2484.44	Fe II	400	30	-0.09	-10		
2485.75	2485.79	Cu II	92	100	0.00	00		
2486.25	2486.34	Fe II	92	100	-0.09	-10	0.6	
2487.25	2487.35	Fe II	385	50	-0.10	-12		
2489.50	2489.48	Fe II	161	80	0.00	00		Si III [17]
2489.70	2489.82	Fe II	207	50	-0.12	-14		
2490.75	2490.70	Fe II	331	100	+0.05	+06		Fe II [179]
2491.30	2491.39	Fe II	207	100	-0.10	-10		
2492.30	2492.34	Fe II	243	25	0.00	00		
2493.15	2493.26	Fe II	161	220	-0.12	-14	0.8	
2493.70	2493.87	Fe II	400	20	-0.17	-20		
2494.05	2494.11	Fe II	161	20	-0.06	-07		
2494.70	2494.89	Fe II	382	20	-0.19	-22		
2297.20	2297.30	Fe II	208	5	-0.10	-12		
2497.75	2497.81	Fe II	207	50	-0.07	-08	0.9	Ni II [18]
								Fe II [207]
2498.85	2498.89	Fe II	161	450	-0.05	-06	0.6	Cr II [40]
2500.85	2500.92	Fe II	357	40	-0.07	-08	0.6	
2501.75	2501.99	Zn II	3	1000	-0.24	-28		
2503.30	2503.56	Fe II	161	110	-0.26	-31		Fe II [175]
2503.80	2503.87	Fe II	285	60	-0.07	-08		
2505.15	2505.21	Fe II	33	20	-0.07	-08		
2505.65	2505.84	Ni II	48	120	-0.19	-22		Cr II [200]

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2506.05	2506.09	Fe II	207	80	-0.05	-05		
2506.45	2506.43	Fe II	128	12	0.00	00		
2506.70	2506.79	Fe II	175	40	-0.10	-11		
2506.95	2507.03	Fe II	207	8	-0.08	-09		
2507.70	2507.68	Fe II	363	15	0.00	00		Fe II [363]
2509.00	2509.12	Fe II	242	15	-0.12	-14		
2509.10	2509.12	C II	14	250	0.00	00		
2509.60	2509.86	Fe II	363	12	-0.26	-31		
2510.00	2510.24	Cr II	200	20	-0.24	-28		
2510.70	2510.87	Ni II	18	220	-0.17	-20	0.8	
2511.80	2512.06	C II	14	350	-0.26	-31	0.8	
2512.50	2512.52	Fe II	343	15	0.00	00		
2513.10	2513.15	Fe II	363	20	-0.06	-07		
2513.30	2513.37	Fe II	207	5	-0.07	-08		
2514.35	2514.38	Fe II	285	50	0.0	00		
2514.65	2514.62	Ni II	61	140	0.00	00		
2515.00	2514.91	Fe II	175	40	+0.09	+10		
2516.00	2516.05	Ti III	7	1000	-0.05	-05	0.7	
2517.05	2517.13	Fe II	147	50	-0.08	-09	0.6	
2518.15	2518.29	Cr II	308	100	-0.14	-16		
2519.00	2519.05	Fe II	268	60	-0.05	-05		
2519.30	2519.40	Fe II	222	20	-0.10	-11		
2520.05	2520.26	Fe II	363	8	-0.11	-13		
2520.65	2520.66	Fe II	242	20	0.00	00		
2521.10	2521.09	Fe II	268	40	0.00	00		
2521.80	2521.81	Fe II	330	30	0.00	00		
2522.05	2522.19	Fe II	159	15	-0.14	-16		
2522.85	2523.24	Cr II	308	150	-0.29	-34		
2523.30	2523.44	Fe II	363	15	-0.14	-16		
2523.90	2523.95	V II	38	100	-0.05	-05		
2524.50	2524.41	C IV	14	600	+0.09	+10		
2525.10	2525.10	Fe II	330	15	0.00	00		
2525.20	2525.29	Ni II	61	180	-0.10	-11		
2525.45	2525.38	Fe II	159	140	+0.06	+07		
2525.85	2525.86	Fe II	241	12	0.00	00		
2526.20	2526.29	Fe II	145	170	-0.09	-10		Fe II [159]
2526.65	2526.83	Fe II	33	8	-0.18	-21		
2527.05	2527.10	Fe II	159	20	-0.06	-07		
2527.65	2527.84	Ti III	7	920	-0.19	-22		
2529.05	2529.23	Fe II	241	25	-0.18	-21		Fe II [357]
2529.20	2529.30	Cu II	131	150	-0.10	-11		
2529.50	2529.55	Fe II	177	155	-0.50	-05		Fe II [145]
2530.05	2529.98	Cr II	15	900	-0.07	-08		Cr II [108] Cr II [308]
2531.00	2531.08	Fe II	33	5	-0.08	-09	0.4	
2533.60	2533.62	Fe II	159	110	0.00	00	0.8	
2534.35	2534.41	Fe II	159	100	-0.06	-07	0.8	
2535.45	2535.48	Fe II	177	110	0.00	00	0.8	
2536.80	2536.82	Fe II	159	140	0.00	00		Fe II [363]
2538.15	2538.31	Cr II	308	100	-0.16	-18		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2538.45	2538.50	Fe II	160	40	-0.05	-05		Fe II [363] Fe II [268]
2538.80	2538.79	Fe II	158	100	0.00	00		Fe II [158]
2538.85	2538.99	Fe II	158	125	-0.14	-16		Ni II [48]
2539.95	2540.05	Ti III	7	800	-0.11	-12		
2540.60	2540.67	Fe II	343	160	-0.07	-08	0.8	Fe II [349] Fe II [177]
2541.05	2541.10	Fe II	177	80	-0.05	-05	0.8	
2541.75	2541.81	Si III	6	1000	-0.07	-08	0.8	
2542.20	2542.31	Fe II	33	5	-0.12	-14		
2542.30	2542.44	Ti III	7	100	-0.14	-16		
2542.60	2542.73	Fe II	223	20	-0.14	-16		
2543.35	2543.38	Fe II	159	60	0.00	00	0.6	Fe II [177]
2544.60	2544.80	Cu II	92	300	-0.20	-23		
2544.80	2544.97	Fe II	147	40	-0.17	-20		
2545.05	2545.22	Fe II	159	40	-0.17	-20	1.4	
2545.80	2545.90	Ni II	18	140	-0.10	-11	0.9	
2546.65	2546.66	Fe II	177	80	0.00	00	0.7	
2547.25	2547.34	Fe II	158	15	-0.09	-10		
2549.05	2549.08	Fe II	284	80	0.00	00		
2549.20	2549.27	V II	38	120	-0.07	-08		
2549.40	2549.39	Fe II	177	80	0.00	00		Ni II [48] Fe II [117] Fe II [365]
2549.95	2550.03	Fe II	240	60	-0.08	-09		
2550.40	2550.57	Fe II	158	20	-0.17	-19		
2550.60	2550.68	Fe II	240	50	-0.08	-09		
2551.05	2551.20	Fe II	328	12	-0.15	-17		
2553.65	2553.74	Fe II	127	20	-0.09	-10		
2555.00	2555.07	Fe II	177	15	-0.07	-08		
2555.40	2555.45	Fe II	177	15	-0.05	-05		
2556.50	2556.57	Mn II	20	320	-0.07	-08		
2557.00	2557.08	Fe II	158	20	-0.08	-09		
2557.40	2557.50	Fe II	175	10	-0.10	-11		Cr II [89]
2557.75	2557.94	Zn II	3	1000	-0.20	-23	0.6	
2558.45	2558.60	Mn II	20	450	-0.15	-17		
2559.20	2559.23	Fe II	266	20	0.00	00		
2562.05	2562.09	Fe II	221	20	0.00	00		
2562.55	2562.53	Fe II	64	200	0.00	00	1.0	
2563.50	2563.47	Fe II	64	140	0.00	00	1.0	Fe II [266]
2563.80	2563.83	Fe II	266	70	0.00	00		
2565.10	2565.22	Mn II	20	170	-0.11	-12		
2565.35	2565.43	Ti III	6	850	-0.07	-08	0.7	
2566.25	2566.22	Fe II	404	20	0.00	00		Fe II [405]
2566.60	2566.62	Fe II	174	70	0.00	00		
2566.90	2566.90	Fe II	64	60	0.00	00		
2567.45	2567.55	Ti III	6	775	-0.10	-11		
2568.70	2568.87	Fe II	175	40	-0.18	-21		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2569.75	2569.77	Fe II	226	70	0.00	00	0.6	Fe II [349]
2570.80	2570.84	Fe II	284	30	-0.05	-05	0.6	
2571.55	2571.75	Cu II	131	100	-0.20	-23	0.6	
2571.70	2571.78	Cr II	89	50	-0.08	-09		
2571.80	2571.89	Mn II	67	100	-0.09	-10		
2573.10	2573.21	Fe II	205	10	-0.11	-12	0.7	
2573.70	2573.75	Fe II	284	5	-0.05	-05		
2574.30	2574.36	Fe II	144	125	-0.06	-06	0.7	
2576.05	2576.10	Mn II	1	1000	-0.06	-07	0.8	
2576.80	2576.85	Fe II	326	25	-0.06	-07	0.8	
2578.00	2577.92	Fe II	64	60	+0.08	+09		
2578.80	2578.81	Mn II	89	140	0.00	00		
2579.35	2579.40	Fe II	266	40	-0.05	-05		
2580.30	2580.45	Ti III	6	360	-0.15	-17		
2582.50	2582.58	Fe II	64	100	-0.08	-09	1.4	
2582.90	2583.05	Fe II	174	20	-0.10	-11		
2583.95	2583.99	Ni II	48	140	0.00	00		
2585.70	2585.87	Fe II	1	750	-0.17	-19	0.9	Fe II [326] Mn II [89]
2587.90	2587.94	Fe II	326	220	-0.05	-05	0.8	
2588.75	2588.78	Fe II	265	40	0.00	00	0.6	
2590.45	2590.54	Fe II	145	70	-0.09	-10	0.8	Cu II [130]
2591.50	2591.54	Fe II	64	450	0.00	00	0.6	
2592.70	2592.78	Fe II	318	360	-0.08	-09	0.6	
2593.60	2593.72	Fe II	64	220	-0.12	-13	0.6	Mn II [1]
2595.15	2595.28	Fe II	172	20	-0.13	-15		
2597.95	2597.94	Fe II	342	20	0.00	00		
2598.30	2598.36	Fe II	1	870	-0.07	-08	1.5	
2599.30	2599.39	Fe II	1	870	-0.09	-10	1.4	
2605.55	2605.68	Fe II	1	320	-0.13	-15		
2606.20	2606.25	Ni II	65	220	-0.05	-05	0.8	
2606.45	2606.51	Fe II	324	170	-0.06	-06		
2607.05	2607.08	Fe II	1	750	-0.04	-04	1.0	
2609.00	2609.12	Fe II	310	12	-0.12	-13		
2609.40	2609.43	Fe II	265	4	0.00	00		
2609.85	2610.20	Mn II	19	1000	-0.35	-40		
2610.45	2610.81	Cr II	316	50	-0.36	-41		Cr II [316]
2611.05	2611.07	Fe II	64	20	0.00	00		
2611.30	2611.40	Fe II	173	5	-0.04	-04		
2611.90	2611.87	Fe II	1	240	0.00	00	1.2	
2613.40	2613.57	Fe II	172	20	-0.17	-19		
2613.70	2613.82	Fe II	1	750	-0.12	-13		
2614.70	2614.86	Fe II	171	20	-0.16	-18		
2615.00	2615.05	Ni II	65	220	-0.06	-06		
2616.40	2616.52	Mn II	19	100	-0.12	-13		
2617.60	2617.62	Fe II	1	650	0.00	00	0.8	
2618.00	2618.14	Mn II	19	700	-0.14	-16		
2619.05	2619.07	Fe II	171	20	0.00	00	0.8	
2620.00	2620.17	Fe II	173	10	-0.17	-19		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2620.40	2620.40	Fe II	1	12	0.00	00		Cr II [316]
2620.65	2620.69	Fe II	171	20	-0.05	-05		
2621.55	2621.67	Fe II	1	40	-0.12	-13	0.6	
2623.05	2623.20	Cr II	324	40	-0.14	-17		
2623.70	2623.72	Fe II	171	15	0.00	00		Mn II [19] Fe II [318]
2625.60	2625.66	Fe II	1	140	-0.06	-06	0.8	
2628.20	2628.29	Fe II	1	125	-0.09	-10	0.7	Fe II [171] Cr II [8]
2629.50	2629.59	Fe II	171	285	-0.09	-10	0.8	
2630.05	2630.07	Fe II	171	20	0.00	00	0.8	
2631.20	2631.04	Fe II	1	135	+0.15	+17		
2631.35	2631.32	Fe II	1	155	0.00	00		Fe II [238]
2631.95	2632.00	Mn II	19	140	-0.05	-05		
2632.20	2632.35	Mn II	19	450	-0.15	-17	0.8	
2633.10	2633.20	Fe II	365	8	-0.10	-11	0.6	
2635.40	2635.40	Fe II	296	5	0.00	00		Mn II [19] S II [11]
2636.55	2636.68	Fe II	356	5	-0.13	-14		
2637.50	2637.64	Fe II	221	15	-0.14	-15		
2638.00	2638.17	Mn II	19	450	-0.17	-19		
2639.45	2639.56	Fe II	221	12	-0.11	-12		Fe II [309]
2639.70	2639.85	Mn II	52	170	-0.15	-17		
2641.95	2642.01	Fe II	309	8	-0.06	-06	0.8	
2645.15	2645.33	Fe II	426	3	-0.18	-20	0.8	
2649.35	2649.47	Fe II	427	6	-0.12	-13	0.8	Fe II [429] Fe II [427]
2651.60	2651.71	Fe II	355	25	-0.11	-12		
2655.85	2655.92	Mn II	52	170	-0.07	-07	0.6	
2657.90	2657.92	Fe II	283	3	0.00	00		
2658.20	2658.25	Fe II	309	10	-0.05	-05		Fe II [429]
2661.10	2661.22	Cr II	309	50	-0.12	-13		
2661.60	2661.73	Cr II	8	50	-0.13	-14		
2664.20	2664.20	Fe II	237	20	0.00	00		
2664.65	2664.66	Fe II	263	60	0.00	00		Fe II [429]
2665.95	2666.05	Cr II	8	80	-0.07	-07		
2666.15	2666.29	Cu II	130	200	-0.14	-15		
2666.60	2666.63	Fe II	263	30	0.00	00	0.8	
2667.00	2667.03	Mn II	52	170	0.00	00		Cr III [32]
2668.60	2668.71	Cr II	8	70	-0.11	-12		
2668.80	2669.00	Fe II	429	12	-0.12	-22		
2669.00	2669.16	Al II	1	160	-0.16	-17		
2670.40	2670.38	Fe II	355	20	0.00	00		V II [3]
2672.10	2672.14	Fe II	429	40	-0.04	-04		
2672.40	2672.55	Fe II	429	6	-0.14	-15		
2672.70	2672.83	Cr II	8	90	-0.13	-14		
2673.15	2673.38	Mn II	52	140	-0.23	-25		V II [3]
2674.40	2674.44	Mn II	63	220	-0.04	-04		
2674.70	2674.98	Mn II	52	140	-0.28	-31		
2677.05	2677.19	Cr II	8	125	-0.14	-15	1.2	
2677.65	2677.85	Mn II	52	140	-0.20	-22		V II [3]
2678.40	2678.57	V II	3	100	-0.17	-19		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2678.80	2678.79	Cr II	7	100	0.00	00		
2678.90	2679.16	Mn II	52	140	-0.26	-29		
2679.25	2679.32	V II	3	200	-0.08	-08	0.6	
2680.15	2680.33	Mn II	63	220	-0.19	-21		
2680.55	2680.70	Fe II	429	15	-0.15	-16		
2682.35	2682.51	Fe II	425	6	-0.15	-16		
2682.90	2682.99	Fe II	416	6	-0.10	-11		V II [3]
2683.00	2683.09	V II	3	100	-0.09	-10		
2684.65	2684.75	Fe II	283	220	-0.10	-11	0.6	Mn II [63]
2685.50	2685.68	V II	3	30	-0.19	-21		
2686.30	2686.38	Fe II	262	5	-0.09	-10		
2687.00	2687.09	Cr II	7	65	-0.09	-10		
2687.95	2687.96	V II	3	260	0.00	00		
2688.15	2688.28	Cr II	84	55	-0.13	-14		
2688.40	2688.41	Cr II	186	45	0.00	00		
2688.70	2688.71	V II	3	100	0.00	00		
2689.10	2689.29	Cu II	130	750	-0.20	-22	0.6	Cu II [85]
2689.70	2689.88	V II	3	100	-0.18	-20		
2690.10	2690.25	V II	3	150	-0.15	-16		
2690.45	2690.48	Ni II	65	120	0.00	00		
2691.50	2691.73	Fe II	202	6	-0.23	-25		
2692.50	2692.60	Fe II	283	60	-0.10	-11	0.7	Fe II [62]
2693.50	2693.53	Cr II	84	45	0.00	00		
2693.70	2693.85	Fe II	261	2	-0.16	-17	0.9	
2694.60	2694.74	V II	2	20	-0.14	-15		
2697.55	2697.79	Fe II	431	10	-0.24	-26	0.7	
2697.80	2697.90	Cr II	84	30	-0.10	-11		Cr II [267]
2699.10	2699.19	Fe II	416	3	-0.10	-11		
2700.90	2700.96	Cu II	165	700	-0.06	-06		V II [1]
2702.10	2702.18	V II	2	200	-0.08	-08		
2703.10	2703.18	Cu II	130	650	-0.08	-08		
2704.00	2703.98	Fe II	261	60	0.00	00		Cu II [7]
2704.05	2703.98	Mn II	18	320	-0.07	-07		
2704.30	2704.56	Fe II	202	5	-0.26	-28		
2705.10	2705.22	V II	2	40	-0.12	-13		
2705.60	2705.60	Mn II	18	320	-0.12	-13		
2706.10	2706.17	V II	1	200	-0.07	-07		
2706.60	2706.56	Fe II	341	220	+0.04	+04	0.8	
2707.20	2707.12	Fe II	339	160	+0.07	+07	0.8	
2707.50	2707.54	Mn II	18	220	0.00	00		
2707.75	2707.86	V II	2	200	-0.11	-12		
2708.35	2708.45	Mn II	18	320	-0.10	-11		
2708.50	2708.78	Cr II	186	65	-0.22	-31		
2709.00	2709.05	Fe II	218	20	-0.05	-05		
2709.25	2709.37	Fe II	62	5	-0.12	-13		
2709.75	2709.97	Mn II	18	170	-0.22	-24		
2710.20	2710.33	Mn II	18	320	-0.13	-14		
2710.85	2710.92	Cr II	289	65	-0.07	-07		
2711.70	2711.84	Fe II	201	10	-0.14	-15		
2712.20	2712.29	Fe II	431	15	-0.09	-09		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2712.30	2712.39	Fe II	201	10	-0.09	-09		Cr II [6]
2713.00	2713.05	V II	2	40	-0.05	-05		
2714.05	2714.20	V II	2	50	-0.15	-16		
2414.30	2414.41	Fe II	63	80	-0.11	-12	0.6	
2715.50	2715.67	V II	1	180	-0.17	-18		V II [1]
2716.20	2716.21	Fe II	261	50	0.00	00	0.9	Fe II [339]
2716.70	2716.79	Mn II	33	170	-0.10	-11		
2717.65	2717.88	Fe II	431	50	-0.24	-26		
2717.55	2717.52	Mn II	33	170	0.00	00		
2718.30	2718.32	Cr II	102	40	0.00	00		
2718.60	2718.77	Cu II	175	650	-0.17	-18	0.8	Fe II [417]
2719.30	2719.30	Fe II	339	12	0.00	00	0.8	
2720.10	2720.25	Cr II	102	40	-0.15	-16		
2721.95	2722.09	Mn II	33	170	-0.12	-13		
2722.65	2722.74	Cr II	7	70	-0.09	-09	0.6	Fe II [416]
2723.60	2723.64	Cr II	59	60	-0.04	-04		
2724.95	2724.89	Fe II	62	30	+0.05	+05	0.7	
2726.50	2726.50	Fe II	261	40	0.00	00	0.4	
2727.55	2727.53	Fe II	63	80	0.00	00	0.7	
2728.50	2728.64	V II	1	150	-0.14	-10		
2728.90	2728.90	Fe II	260	80	0.00	00		
2729.40	2729.42	Fe II	220	5	0.00	00		Fe II [417]
2732.00	2732.00	Fe II	236	5	0.00	00		
2732.50	2732.44	Fe II	32	20	+0.06	+06		
2732.90	2732.93	Fe II	417	40	-0.04	-04		
2733.90	2733.90	V II	1	25	0.00	00		
2734.70	2734.80	Fe II	416	20	-0.10	-10		
2736.40	2736.50	Fe II	220	5	-0.10	-10		
2736.95	2736.96	Fe II	63	650	0.00	00	0.5	Cu II [130]
2737.50	2737.63	Fe II	200	70	-0.13	-14		
2739.60	2739.54	Fe II	63	200	+0.05	+05	0.6	Cu II [174]
2741.35	2741.39	Fe II	260	100	-0.05	-05		Fe II [417]
2742.30	2742.43	V II	1	25	-0.13	-14		
2743.10	2743.19	Fe II	62	140	-0.10	-10	0.7	
2744.90	2744.89	Fe II	260	40	0.00	00		
1746.40	1746.48	C II	15	250	-0.09	-09		
2746.90	2746.97	Fe II	63	870	-0.08	-08		C II [15]
2749.30	2749.17	Fe II	63	750	+0.12	+13	1.2	Fe II [63] Fe II [62]
2750.20	2750.00	Fe II	199	20	+0.18	+19		
2750.70	2750.89	Fe II	200	40	-0.19	-20		
2751.00	2751.12	Fe II	217	20	-0.12	-13		
2751.90	2751.85	Cr II	6	85	+0.05	+05		
2753.30	2753.28	Fe II	235	80	0.00	00	0.6	
2754.80	2754.88	Fe II	373	30	-0.09	-09		
2755.70	2755.73	Fe II	62	280	0.00	00	0.9	
2756.30	2756.30	Cr II	101	40	0.00	00		
2756.30	2756.50	Fe II	200	6	-0.20	-21		
2756.90	2757.03	Fe II	199	8	-0.13	-14		
2757.60	2757.72	Cr II	6	80	-0.12	-13		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2758.90	2758.99	Cr II	252	40	-0.09	-09		
2759.25	2759.33	Fe II	32	20	-0.09	-09		Cr II [101]
2759.70	2759.73	Cr II	101	30	0.00	00		
2760.30	2760.36	Cr II	100	20	-0.06	-06		
2761.80	2761.81	Fe II	63	125	0.00	00	0.6	
2762.30	2762.34	Fe II	373	70	-0.04	-04	0.6	
2762.40	2762.44	Fe II	199	70	-0.04	-04		Cr II [6]
2763.70	2763.91	Fe II	199	40	-0.21	-22		
2764.20	2764.28	Cr II	100	15	-0.08	-08		
2764.50	2764.78	Fe II	198	40	-0.28	-30		
2765.30	2765.49	Fe II	324	5	-0.19	-20		
2766.10	2766.20	Fe II	324	5	-0.10	-10		
2766.40	2766.55	Cr II	6	150	-0.15	-16		Cr II [100] Mn II [46] Fe II [373]
2767.55	2767.50	Fe II	235	750	+0.05	+05		
2768.50	2768.59	Cr II	252	50	-0.09	-09		
2769.20	2769.35	Fe II	198	25	-0.15	-16		Fe II [200]
2770.40	2770.50	Fe II	198	4	-0.10	-10		Fe II [199]
2772.60	2772.72	Fe II	63	5	-0.12	-12		
2773.30	2773.30	Cr II	58	30	0.00	00		
2774.50	2774.44	Cr II	266	50	+0.06	+06		
2774.70	2774.68	Fe II	218	20	0.00	00	0.9	
2775.10	2775.34	Fe II	32	5	-0.24	-25		
2776.10	2776.18	Fe II	199	70	-0.08	-08		
2776.80	2776.90	Fe II	373	15	-0.10	-10		
2777.90	2777.89	Fe II	233	5	0.00	00		Fe II [281]
2779.30	2779.29	Fe II	234	40	0.00	00	0.7	
2779.90	2779.83	Mg I	6	160	+0.07	+07		
2780.25	2780.30	Cr II	185	85	-0.05	-05		Cr II [252]
2781.05	2781.07	Cr II	260	25	0.00	00		
2781.40	2781.41	Mg I	6	130	0.00	00		
2782.00	2782.14	Mn II	71	100	-0.14	-15		
2782.90	2782.97	Mg I	6	130	-0.07	-07		
2783.70	2783.69	Fe II	234	50	0.00	00	0.6	
2784.10	2784.28	Fe II	295	20	-0.18	-19		
2785.00	2785.19	Fe II	373	30	-0.19	-20		Fe II [372]
2785.55	2785.69	Cr II	183	65	-0.14	-15		
2787.10	2787.24	Fe II	380	5	-0.14	-15		
2787.50	2787.61	Cr II	58	55	-0.11	-11	0.5	
2789.30	2789.39	Cr II	276	40	-0.09	-09		Cr II [327]
2790.60	2790.77	Mg II	3	150	-0.17	-18	0.9	Fe II [282]
2793.10	2793.24	Fe II	337	20	-0.14	-15		
2793.80	2793.88	Fe II	198	20	-0.09	-09		
2795.50	2795.51	Mg II	1	400	0.00	00	2.1	Fe II [281]
2796.45	2796.62	Fe II	373	10	-0.17	-18		
2796.90	2797.02	V II	100	60	-0.12	-12		
2797.00	2797.19	Fe II	436	10	-0.19	-20		
2797.85	2797.98	Mg II	3	350	-0.14	-15		Fe II [234]
2798.65	2798.75	V II	100	80	-0.10	-10		
2799.25	2799.29	Fe II	233	30	-0.05	-05		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2800.80	2800.77	Cr II	182	75	0.00	00		
2802.55	2802.69	Mg II	1	300	-0.14	-14	2.1	Fe II [438]
2803.85	2804.02	Fe II	259	40	-0.17	-18		
2805.35	2805.32	Fe II	295	40	0.00	00		
2805.65	2805.78	Fe II	259	70	-0.13	-13	0.9	
2807.00	2807.18	Fe II	281	3	-0.18	-19	0.4	
2808.15	2808.34	Ni II	26	20	-0.19	-20		
2809.65	2809.78	Fe II	380	10	-0.13	-13		
2810.05	2810.25	Mn II	71	80	-0.20	-21		
2811.15	2811.27	Fe II	196	40	-0.21	-22	0.7	
2812.00	2812.00	Cr II	182	85	0.00	00		Cr II [256]
2812.10	2812.26	Mn II	71	100	-0.16	-17		
2812.45	2812.49	Fe II	215	40	-0.04	-04		
2812.45	2812.58	Mn II	71	100	-0.13	-13		
2813.40	2813.61	Fe II	198	110	-0.21	-22	0.6	
2817.05	2817.09	Fe II	380	6	-0.04	-04		
2818.20	2818.36	Cr II	182	75	-0.16	-17		
2819.30	2819.32	Fe II	196	40	0.00	00		
2822.00	2822.01	Cr II	182	65	0.00	00		
2822.45	2822.66	Fe II	231	5	-0.22	-23		Cr II [82]
2825.70	2825.74	Fe II	195	40	-0.05	-05		
2825.90	2826.04	Fe II	255	70	-0.12	-12		
2827.45	2827.43	Fe II	231	110	0.00	00	0.7	
2828.65	2828.63	Fe II	231	6	0.00	00		Fe II [255]
2829.85	2830.06	Fe II	259	1	-0.21	-22		
2830.30	2830.46	Cr II	82	100	-0.16	-16		
2830.60	2830.60	Cr II	81	60	0.00	00		
2830.96	2830.96	Fe II	280	6	-0.06	-06		
2831.55	2831.56	Fe II	217	25	0.00	00		
2832.30	2832.45	Cr II	195	60	-0.15	-15		
2833.00	2833.08	Fe II	380	10	-0.08	-08		
2834.10	2834.24	Cr II	195	60	-0.14	-14		
2835.65	2835.71	Fe II	216	12	-0.06	-06		Cr II [5]
2836.00	2836.18	Fe II	294	70	-0.18	-19		
2836.45	2836.50	Fe II	294	70	-0.05	-05		
2836.60	2836.71	C II	13	1000	-0.11	-11		
2837.25	2837.30	Fe II	231	110	-0.05	-05		
2837.60	2837.60	C II	13	800	0.00	00		
2838.65	2838.78	Cr II	250	65	-0.13	-13		
2839.15	2839.51	Fe II	391	30	-0.35	-36		
2839.95	2840.01	Cr II	82	85	-0.06	-06		
2840.20	2840.34	Fe II	195	6	-0.14	-14		
2840.55	2840.65	Fe II	217	15	-0.09	-09		Fe II [280]
2841.30	2841.35	Fe II	196	20	-0.05	-05		
2842.00	2842.07	Fe II	196	40	-0.07	-07		
2842.30	2842.41	Ni II	54	50	-0.11	-11		
2842.60	2842.78	Cr II	250	20	-0.18	-19		
2843.20	2843.32	Fe II	231	70	-0.12	-12		Cr II [5]
2843.40	2843.48	Fe II	294	110	-0.08	-08	0.9	
2845.30	2845.39	Fe II	294	70	-0.09	-09		Ge II [12]

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2846.50	2846.44	Cr II	82	30	+ 0.06	+ 06		Cr II [250]
2847.25	2847.21	Fe II	179	70	+ 0.05	+ 05		
2848.00	2848.05	Fe II	196	8	- 0.05	- 05		
2848.90	2848.89	Fe II	317	110	0.00	00		
2849.60	2849.60	Fe II	196	4	0.00	00	1.2	Cr II [5]
2851.25	2851.35	Cr II	82	60	- 0.10	- 10		Fe II [195]
2852.00	2852.12	Mg I	1	1000	- 0.13	- 13	0.6	
2853.05	2853.20	Fe II	197	20	- 0.15	- 15		
2855.00	2855.05	Cr II	214	35	- 0.05	- 05		
2855.60	2855.69	Fe II	196	8	- 0.09	- 09		Cr II [5]
2856.10	2856.14	Fe II	195	4	- 0.05	- 05		
2857.05	2857.17	Fe II	294	5	- 0.12	- 12		
2857.35	2857.41	Fe II	195	70	- 0.06	- 06		
2858.35	2858.34	Fe II	279	550	0.00	00	0.7	
2861.20	2861.18	Fe II	61	40	0.00	00		Cr II [5]
2861.95	2861.90	Fe II	280	5	+ 0.05	+ 05		
2863.70	2863.69	Ni II	26	100	0.00	00		
2864.10	2864.13	Fe II	380	40	0.00	00		
2865.45	2865.47	Fe II	391	20	0.00	00		
2869.10	2869.15	Fe II	257	70	- 0.05	- 05		
2869.55	2869.69	Fe II	257	80	- 0.14	- 14		
2870.40	2870.43	Cr II	11	100	0.00	00		
2870.60	2870.60	Fe II	195	40	0.00	00		
2871.10	2871.05	Fe II	195	60	0.00	00		
2872.35	2872.38	Fe II	230	360	0.00	00		
2873.50	2873.40	Fe II	279	450	+ 0.10	+ 10		Cr II [295]
2873.75	2873.81	Cr II	11	50	- 0.06	- 06		
2874.30	2874.44	Cr II	266	50	- 0.14	- 14		
2875.20	2875.34	Fe II	258	8	- 0.14	- 14		
2876.05	2875.97	Cr II	11	100	+ 0.08	+ 08		
2876.20	2876.23	Cr II	5	60	0.00	00		
2876.70	2876.80	Fe II	257	4	- 0.10	- 10		
2877.55	2877.69	Cu II	174	600	- 0.15	- 15		
2879.10	2879.24	Fe II	272	70	- 0.14	- 14		
2879.30	2879.48	Mn II	61	220	- 0.18	- 18		
2879.50	2879.54	Fe II	230	20	0.00	00		
2879.90	2880.02	V II	12	150	- 0.12	- 12		
2880.70	2880.83	Fe II	258	4	- 0.13	- 13	0.9	
2881.70	2881.86	Cr II	302	55	- 0.16	- 16		
2881.90	2881.91	Cr II	206	45	0.00	00		
2882.50	2882.50	Fe II	442	6	0.00	00		V II [12]
2883.65	2883.71	Fe II	230	8	- 0.06	- 06	0.5	
2884.85	2885.13	Mn II	69	125	- 0.28	- 29		
2885.35	2885.47	C II	54	90	- 0.12	- 12	0.4	
2885.90	2885.93	Fe II	317	2	0.00	00		
2886.15	2886.23	Fe II	229	40	- 0.08	- 08	0.5	
2887.15	2887.31	Fe II	257	40	- 0.16	- 16		
2887.60	2887.88	Mn II	61	100	- 0.28	- 30		
2887.95	2888.09	Fe II	215	4	- 0.14	- 14		
2890.90	2891.06	Cr II	210	25	- 0.16	- 16		

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2891.05	2891.20	Cr II	238	20	-0.15	-15	0.7	
2891.05	2891.33	Mn II	69	140	-0.18	-18		
2891.45	2891.63	V II	12	150	-0.18	-18		
2893.20	2893.31	V II	12	230	-0.11	-11		
2894.10	2894.24	Cr II	288	25	-0.14	-14		
2894.75	2894.77	Fe II	230	3	0.00	00		
2894.85	2894.90	Mn II	61	100	-0.05	-05		
2894.95	2895.07	Fe II	257	40	-0.12	-12		
2895.05	2895.22	Fe II	294	8	-0.17	-17		
2896.00	2896.19	V II	11	100	-0.19	-19		
2896.35	2896.45	Cr II	159	40	-0.10	-10		Cr II [288]
2897.25	2897.26	Fe II	254	5	0.00	00	0.7	
2898.50	2898.73	Fe II	352	5	-0.23	-23	0.9	Mn II [61] Cr II [95]
2905.15	2905.18	Fe II	255	5	0.00	00		
2907.35	2907.45	V II	10	120	-0.10	-10		
2907.90	2907.85	Fe II	60	40	+0.05	+05		
2909.90	2910.00	V II	11	140	-0.10	-10		
2910.15	2910.38	V II	11	150	-0.23	-23		
2910.65	2910.76	Fe II	278	40	-0.11	-11	0.5	
2913.40	2913.59	Ni II	26	100	-0.19	-19		
2916.90	2916.93	Fe II	229	20	0.00	00	0.5	
2917.20	2917.36	V II	11	50	-0.16	-16		
2917.40	2917.46	Fe II	61	70	-0.06	-06		
2921.10	2921.23	Cr II	286	50	-0.13	-13		
2921.75	2921.81	Cr II	95	40	-0.06	-06		
2922.00	2922.03	Fe II	293	110	0.00	00	0.8	
2923.30	2923.46	Cr II	286	30	-0.16	-16		
2923.60	2923.67	Cr II	286	40	-0.07	-07		
2924.15	2924.16	Fe II	351	5	0.00	00		
2926.05	2926.15	Cr II	95	18	-0.10	-10		
2926.60	2926.58	Fe II	60	10	0.00	00	0.8	
2928.15	2928.32	Cr II	95	50	-0.17	-17		Cr II [256]
2931.40	2931.49	Fe II	215	5	-0.09	-09	0.7	
2932.40	2932.49	Cr II	95	30	-0.29	-29		
2932.80	2933.05	Mn II	5	450	-0.25	-25		
2933.70	2933.95	Cr II	95	35	-0.25	-25		
2934.30	2934.39	V II	10	60	-0.09	-09		
2936.50	2936.50	Mg II	2	100	0.00	00	1.2	
2939.20	2939.50	Fe II	60	110	-0.20	-20		Mn II [5]
2941.60	2941.96	Cr II	294	35	-0.36	-36		
2944.40	2944.39	Fe II	78	12	0.00	00		
2944.50	2944.56	V II	10	230	-0.07	-07	0.8	
2945.15	2945.26	Fe II	60	20	-0.11	-11		
2946.80	2946.81	Cr II	192	50	0.00	00		
2947.50	2947.65	Fe II	78	750	-0.15	-15	0.7	
2949.10	2949.17	Fe II	277	450	-0.08	-08	1.2	Mn II [5]
2950.15	2950.34	V II	10	80	-0.19	-19		
2951.85	2952.07	V II	10	150	-0.22	-22		
2953.70	2953.77	Fe II	60	550	-0.07	-07	1.2	

Table I (continued)

$\lambda_{\text{mes.}}$	$\lambda_{\text{lab.}}$	Ion	Mult.	Int.	Shift	R.V.	FWHM	Remarks
2957.50	2957.52	V II	10	100	0.00	00		
2959.50	2959.60	Fe II	254	3	-0.10	-10	1.2	
2961.10	2961.27	Fe II	60	110	-0.17	-17		
2964.20	2964.13	Fe II	252	220	+0.07	+07		
2964.60	2964.62	Fe II	78	360	0.00	00		
2964.85	2965.03	Fe II	78	8	-0.18	-18	1.2	
2969.85	2969.93	Fe II	277	285	-0.08	-08		
2970.45	2970.68	Fe II	276	110	-0.23	-23		Fe II [60]
2971.50	2971.61	Fe II	252	5	-0.11	-11		
2971.95	2971.90	Cr II	80	75	+0.05	+05		
2975.80	2975.93	Fe II	69	110	-0.14	-14		
2979.80	2979.73	Cr II	80	80	+0.07	+07		
2981.95	2982.09	Fe II	335	285	-0.11	-11		
2984.75	2984.74	Ti III	8	775	0.00	00		
2985.35	2985.54	Fe II	78	750	-0.19	-19		
2986.55	2986.61	Fe II	254	70	-0.07	-07		
2989.00	2989.20	Cr II	80	75	-0.20	-20	1.1	
2992.30	2992.61	C II	8	800	-0.31	-31		
2997.25	2997.29	Fe II	335	220	-0.05	-05	0.8	
2998.80	2998.85	Fe II	252	20	-0.05	-05		
3002.65	3002.65	Fe II	78	750	0.00	00	1.2	

k: Whenever the identification comes from the Kurucz (1981) compilation we have added *k* in the column of multiplet.

Whenever the identification comes from the Kurucz compilation (1981) we have added *K* in the column of multiplet in Table II.

Table III gives the radial velocities of the main ions which are appeared in the whole UV spectral range. The successive columns in Table II give:

- (1) The identified ion.
- (2) The number of lines which have been studied.
- (3) The low ionization potential.
- (4) The mean radial velocity.
- (5) The standard deviation of the mean radial velocity.

The study of the interstellar lines (Morton, 1975, 1978), in the spectrograph SWP 23079 indicates a systematic line shift of about $-0.13 \text{ \AA}$.

The values of the radial velocities estimated from the spectrograph SWP 23079 have been corrected from this systematic line shift.

The precision of the observed line position is limited by the IUE resolution ($\pm 0.1 \text{ \AA}$ and more) and by the severe blending due to the crowding of the lines.

The resolution of the spectrograph, $\pm 0.1 \text{ \AA}$, translates into 12 km s^{-1} in velocity, therefore, tabulating radial velocities the values are rounded since hundredths of km s^{-1} has no justification. Thus errors of the order of $\pm 12 \text{ km s}^{-1}$ are to be expected, additionally most of the features are blends of several lines so that, e.g., the radial

TABLE II
SWP 3408

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2019.85	2019.82	Fe II	K	10
2027.10	2027.31	Mn III	11	4
2027.50	2027.88	Fe III	—	300
2027.90	2028.19	Fe II	K	0
2028.65	2028.86	Cr II	—	5
2029.00	2029.18	Fe II	K	80
2030.25	2030.32	Fe II	K	—
2030.75	2031.03	Cu II	79	45
2031.00	2031.20	Fe II	K	1
2031.40	2031.51	Mn III	11	100
	2031.56	Fe II	—	1
2031.70	2031.99	Fe II	—	20
2032.15	2032.30	Ni II	33	25
2034.10	2034.29	Fe III	—	10
2037.70	2037.74	Fe II	K	—
2038.70	2038.90	Fe III	10	60
	2038.95	Mn III	11	100
2041.30	2042.53	Ca III	—	350
2042.05	2042.23	Fe III	—	10
	2042.25	Cr III	—	90
2042.35	2042.50	Mn II	—	10
2042.80	2042.78	Cr II	135	5
2043.10	2043.32	Fe II	K	—
2043.40	2043.79	Fe II	—	50
2044.10	2044.30	Fe II	71	40
2044.40	2044.57	Mn III	11	300
2045.40	?	?		
2045.80	2046.04	Fe III	—	4
2046.00	?	?		
2046.10	2046.36	Fe II	K	—
2046.37	2046.37	Cr III	—	4
2046.60	2046.98	Cr II	28	8
2047.00	2047.12	Fe III	—	10
2047.50	2047.71	Fe II	—	10
2047.70	2048.02	Fe II	K	—
2048.00	2048.49	Fe II	K	50
2048.80	2048.93	Mn II	—	400
2049.30	2049.38	Fe III	71	120
2049.50	2049.68	Mn III	11	500
2049.75	2050.09	Fe II	K	—
2050.10	2050.32	Cr II	135	10
2050.25	2050.35	Ni II	—	1
2050.50	2050.66	Mn III	—	20
2051.75	2051.84	Fe III	—	10
2052.15	2052.26	Fe III	—	25
2053.20	2053.52	Fe III	—	25
2053.50	2053.52	Fe III	—	25
	2053.72	Fe II	—	0
2053.85	2054.06	Fe II	K	5

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2054.45	2054.54	Ti II	11	30
	2054.75	Cr II	27	10
2056.40	2056.75	Fe II	K	—
2056.70	2056.80	Mn III	—	300
	2057.01	Fe II	K	—
2057.85	2058.03	Fe II	K	—
2058.15	2058.24	Fe II	K	—
2058.60	2058.56	Fe III	100	150
2059.95	2060.30	Fe II	K	—
2059.30	2059.67	Fe III	78	120
2060.30	2061.22	Cr III	—	200
2050.65	2060.81	Fe II	K	—
2061.15	2061.17	Fe II	K	—
2061.35	2061.55	Fe III	48	250
2062.25	2062.41	Cu II	80	25
2062.65	2062.74	Fe II	K	—
2062.90	2063.13	Mn III	—	85
	2063.15	Mn III	—	20
2063.20	2063.42	N I	43	50
	2063.45	Cr III	—	1
2063.65	2063.76	Cr II	52	4
2065.15	2065.26	Fe III	—	25
2065.70	2065.89	Mn III	—	100
2066.50	2066.48	Fe II	K	—
2067.45	2067.67	Fe II	K	—
2068.60	2068.83	Fe II	K	—
2069.60	2069.65	Fe II	K	—
2070.50	2070.50	Fe III	99	150
2070.80	2070.94	Fe II	K	—
2071.20	2071.22	Ni II	—	30
	2071.34	Zn II	—	30
2071.40	2071.82	Fe II	107	100
2072.30	2072.57	Fe II	—	10
2073.50	2073.63	Al III	—	—
	2073.68	Al III	—	—
2075.30	2075.50	Cr III	—	250
2075.50	2075.67	Cr III	—	300
2076.20	2076.21	Mn II	—	170
2076.35	2076.37	Zn II	—	20
2076.70	2076.94	N II	14	70
2076.85	2076.94	Mn II	—	15
	2076.96	Cr II	38	30
	2077.03	Cr III	—	75
2077.00	2077.41	Fe II	K	—
2077.30	2077.37	Mn III	10	900
2077.85	2078.12	Mn III	—	300
2078.35	2078.41	Cr III	—	250
2079.30	2079.30	Fe III	—	25
	2079.32	Cr III	—	120
2079.45	2079.63	Fe II	K	—

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2079.65	2079.88	Zn II	—	50
2079.80	2079.88	Zn II	—	50
2080.15	2080.24	Fe II	92 B	—
2080.95	2081.14	Mn III	—	75
2081.40	2081.66	Fe II	K	—
	2081.54	Mn II	—	20
2081.65	?	?		
2081.80	2082.01	Cr III	—	350
2082.00	2082.01	Cr III	—	25
2082.45	2082.78	Fe II	K	—
2082.65	2082.81	Cl II	—	100
2082.80	2082.81	Cl II	—	100
2083.20	2083.43	Mn III	—	20
	2083.53	Fe III	124	90
2084.85	2084.87	Ni II	42	30
	2084.96	Fe III	77	66
2085.10	2085.31	Ni II	—	25
2085.60	2085.65	Ni II	—	50
2086.10	2086.12	Fe III	105	40
2086.35	2086.51	Ni II	—	20
2086.70	2086.95	Zn I	—	200
2088.25	2088.35	Fe II	K	—
2088.80	2089.11	Fe II	K	—
2090.40	2090.70	Cr II	38	20
2092.40	2092.59	Mn III	—	30
2092.70	2092.94	Fe III	129	90
2092.80	2094.94	Fe III	129	90
2093.90	2094.14	Mn III	—	300
2094.50	2094.78	Mn III	10	500
2095.70	2095.68	Fe III	—	40
	2095.80	Mn III	—	75
2095.80	2096.19	N III	16	70
2096.10	2096.43	Fe III	59	90
2098.75	2098.81	Fe III	—	25
2100.50	2100.48	Cr III	—	500
	2100.81	Cr III	—	500
2101.40	2101.69	Fe II	—	10
2101.65	2101.61	Fe II	K	—
2101.80	2102.17	Zn II	4	200
2102.60	2102.60	Fe II	K	—
2103.00	2103.22	Cr III	41	350
2105.50	2105.58	Cr III	—	300
2106.25	2106.18	Fe II	K	—
2106.45	2106.76	Mn II	—	30
2107.00	2107.18	Cr III	61	150
2108.40	2108.67	Fe III	105	60
2108.60	2108.98	Mn III	—	50
2110.10	2110.24	Fe II	K	—
2111.30	2111.50	Fe II	K	—
2111.45	2111.75	Fe II	K	—

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2111.80	2112.10	Cu II	55	300
2112.30	2112.31	Fe II	K	—
2113.00	2113.40	Fe II	K	—
2113.30	2113.54	Cr III	—	250
2115.35	2115.71	Fe II	K	—
2115.60	2115.71	Fe II	K	—
2115.85	2115.75	Fe II	K	—
2116.10	?	?		
2116.90	2117.30	Cu II	94	325
2119.35	2119.63	Cr III	—	200
	2119.65	Mn III	—	100
2119.60	2119.78	Mn II	—	60
2119.70	2119.78	Fe II	—	—
2120.00	2120.23	Fe III	58	60
2121.80	2121.71	Cr III	—	300
2121.90	2122.02	Fe II	K	—
2122.15	2122.02	Fe III	—	60
2123.45	2123.55	Cr III	—	400
	2124.22	Fe III	—	40
2124.50	2124.71	Cr III	—	300
2125.40	2125.42	Fe II	K	—
2126.85	2126.83	Ni II	—	180
	2126.98	Cr III	—	150
2127.20	2127.18	Mn III	—	150
2127.80	2127.96	Fe II	290	100
2128.30	2128.58	Ni II	15	700
2128.70	2128.76	Fe II	K	—
2129.10	2129.27	Cr III	41	60
2129.20	?	?		
2129.50	2129.60	Cr III	—	300
2130.40	2130.52	Fe II	249	120
2130.70	2130.52	Fe II	120	249
2130.90	2130.82	Fe III	—	25
2131.60	2131.80	Cr III	41	150
2132.40	2132.53	Fe II	272	20
2132.55	2132.89	Fe II	K	—
2133.35	2133.45	Mn II	—	100
2133.80	2133.81	Cr III	—	120
2136.70	2136.94	Cr III	—	400
2139.90	2140.14	Fe II	K	—
2140.15	2140.35	Mn II	—	20
2140.85	2141.03	Fe II	—	50
2141.60	2141.74	Cr III	—	150
2142.10	2142.19	Fe II	K	
2142.30	2142.63	Cr III	41	150
2142.70	2142.63	Cr III	41	150
2143.90	2144.91	Mn III	—	80
2144.70	2144.74	Fe III	98	120
2145.30	2145.69	Cr III	—	200
2149.30	2149.45	Mn III	—	15

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2150.15	2150.38	Fe II	K	—
2150.40	2150.65	Cr II	37	200
2150.90	2151.29	Fe II	K	—
2155.40	2155.50	Fe II	K	—
2155.55	2155.63	Ni II	—	35
2156.35	2156.51	Fe II	K	—
2156.65	2156.77	Fe II	K	—
2158.15	2158.31	Mn III	—	100
2160.40	2160.47	Fe II	185	20
	2160.65	Fe III	140	90
2160.70	2160.77	Fe III	—	120
2160.90	2161.00	Cr III	—	150
2161.00	2161.27	Fe III	70	270
2162.00	2162.28	Fe III	140	60
2162.45	2162.94	C III	15	360
2162.70	2162.68	Ti II	19	40
	2162.94	C III	15	360
2163.10	2163.37	Fe II	372	200
2163.55	2163.87	Cr III	—	400
2165.20	2165.55	Fe II	K	—
2165.70	2165.91	Fe II	K	—
2166.60	2166.71	Fe II	—	80
2167.30	2167.29	Ni II	—	120
	2167.40	Fe II	119	120
2167.55	2167.81	Ni II	—	50
2168.50	2168.48	Ni II	—	80
2168.80	2168.92	Fe II	247	80
2171.25	2171.62	Fe II	K	—
2172.40	2172.70	Fe II	K	—
2173.40	2173.82	Fe III	75	120
2174.20	2174.15	Mn III	—	700
2175.60	2175.64	Fe II	K	—
2176.25	2176.56	Fe II	K	—
2176.55	2176.82	Fe II	K	—
2178.40	2178.64	Cr III	—	150
2178.60	2178.94	Fe III	3	400
2179.20	2179.35	Ni II	40	200
	2179.25	Fe III	75	90
	2179.41	Cu II	14	700
	2182.68	Cr III	—	250
	2182.80	Cr III	—	350
2182.90	2183.11	Fe II	K	—
2183.00	2183.30	Fe II	89	120
2183.60	2183.74	Cr III	60	350
2184.10	2184.11	Fe III	122	40
2186.10	2186.48	Fe I	21	155
2186.85	2186.87	Fe III	—	90
2188.45	2188.47	Fe II	K	—
2188.60	2188.58	S III	—	200
2188.80	2188.73	Fe III	—	40

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2189.00	2189.52	Fe II	K	—
2189.20	2189.52	Fe II	K	—
2190.00	2190.09	Cr III	60	250
2190.25	2190.46	Fe II	K	—
2193.40	2193.56	Mn III	—	150
2198.40	2198.42	Ni II	—	110
	2196.63	Cr III	68	570
2199.20	2199.22	Ti III	—	160
	2199.18	Ni II	—	20
2202.70	2202.70	Mn II	—	40
2204.80	2205.07	Fe II	K	—
2205.00	2205.54	Ni II	—	700
2205.90	2206.08	N II	15	160
2206.20	2206.58	Fe II	134	120
2207.30	2207.26	Ni II	—	120
2208.15	?	?		
2209.00	2208.85	Fe III	110	250
2209.30	2209.36	Fe II	K	—
2212.15	2212.10	Ni II	—	120
	2212.42	Mn III	16	600
2212.90	2212.74	Cu II	166	75
	2212.91	Ni II	—	40
2213.90	2213.19	Ni II	30 B	—
2215.50	2215.65	Cu II	22	320
	2215.84	Cr III	58	300
2217.25	2217.51	Cr III	—	570
2220.10	2220.40	Ni II	28	280
2222.50	2222.67	Fe II	K	—
2222.85	2222.87	Fe II	K	—
2223.00	2223.00	Fe II	K	—
2223.40	2223.45	Ni II	—	180
2223.70	2223.71	Fe II	K	—
2224.10	2224.28	Fe II	K	—
	2225.76	Ni II	—	50
2228.25	2228.26	Fe II	K	—
2228.60	2228.75	Cr III	—	350
	2228.76	Fe II	366	300
2229.25	2229.63	Cr III	—	200
	2230.58	Cr III	—	150
2231.40	2231.51	Fe II	368	100
2232.00	2232.43	Fe III	64	250
2232.30	2232.69	Fe III	139	250
2233.00	2233.54	Fe III	—	150
2235.20	2235.23	Fe II	K	—
2236.20	2235.90	Fe III	139	250
2236.55	2236.87	S II	—	500
2237.00	2237.57	Cr III	45	650
2237.25	2237.22	Ti III	—	230
2239.30	2239.46	Cr III	—	250
2240.70	2240.99	Fe II	K	—

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2245.20	2245.26	Fe II	K	—
2248.30	2248.30	Cr II	49	50
2254.60	2254.81	Ni II	14	40
2255.20	2255.41	Fe II	K	—
2256.00	2256.13	Ni II	51	75
2258.20	2258.18	Cr III	—	150
	2258.61	Cr III	—	500
2258.80	2258.93	Fe III	—	20
2259.20	2259.00	Cr III	—	150
2266.20	2266.51	Cr III	67	60
2266.50	2266.69	Fe II	351	1
2268.20	2268.47	Fe II	K	—
2269.80	2269.87	Mn II	—	30
2272.00	2272.11	Fe II	K	—
2272.60	2272.54	Fe III	—	20
2272.75	2272.75	Fe III	—	110
2273.95	2274.00	Fe III	153	150
	2275.22	Cr III	39	250
2278.00	2278.31	Ni II	—	200
2281.15	2281.15	Fe II	K	—
2282.10	2283.12	Fe II	K	—
	2283.99	Fe II	132	5
2284.70	2284.64	Fe III	—	40
	2284.92	Fe III	—	110
2286.25	2286.58	Cr III	50	400
	2289.13	Fe III	—	40
	2289.24	Cr III	—	500
	2290.12	Fe III	153	110
	2292.52	Cr III	—	150
2296.15	2296.08	Ni II	—	100
2301.90	2301.96	Fe II	K	—
2306.90	2307.02	Zn III	—	10
2307.40	2307.59	Zn III	—	20
2309.35	2309.51	Cu II	—	50
2310.10	2310.03	Cr III	—	500
2310.30	2310.47	Fe II	K	—
2311.35	2311.58	Ni II	—	75
2311.70	2311.60	Fe II	K	—
2312.30	2312.24	Ni II	27	50
2320.60	2320.69	Fe II	K	—
2322.85	2322.33	Fe II	183 B	4
2323.35	2323.54	Ni II	—	30
2328.15	2328.12	C II	—	84
2328.70	2328.64	Mn II	—	15
2329.15	2329.30	Cr III	—	150
2329.50	2329.90	Fe III	72	250
2330.40	2330.10	Ni II	—	30
2333.50	2333.70	Fe II	—	10
2333.80	2333.95	Fe II	K	—
2334.40	2334.34	Ti III	—	360

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2335.35	2335.33	Cr III	—	250
2336.20	2236.38	S III	—	600
2338.90	2338.96	Fe III	72	250
	2339.00	Ti III	—	460
2341.90	2342.23	Fe II	104	20
2345.00	2345.26	Ni II	58	140
2346.80	2346.78	Ti III	—	520
2347.20	2347.20	Fe II	K	—
2350.45	2350.52	Fe II	—	8
	2350.87	Ti III	18	20
2352.85	2352.69	Cr III	—	200
	2353.00	Ni II	—	10
2358.50	2358.44	Mn II	38	50
2360.80	2360.90	Fe II	K	—
2364.10	2364.30	Ni II	—	50
	2372.47	Cr III	—	90
2372.40	2372.75	Fe II	K	—
2373.45	2373.35	Mn II	38	140
2374.80	2374.98	Ti III	10	520
2375.15	2375.51	Fe II	K	—
2376.80	2377.15	Cr III	—	60
2380.40	2380.65	Fe II	K	—
2382.80	2382.89	Fe II	117	20
2383.90	2383.92	Mn II	—	30
	2383.92	Zn II	—	30
2384.20	2384.30	Fe II	K	—
2385.40	2385.82	Fe II	K	—
2387.60	2387.38	Fe II	—	20
2389.70	2389.99	Fe II	K	—
2390.70	2390.76	Fe II	402	20
2396.85	2396.84	Fe II	K	—
2397.50	2397.75	Cr II	43	40
2398.35	2398.28	Ni II	—	75
2398.50	2398.40	Fe II	K	—
2404.00	2404.01	Cr III	—	650
2408.10	2407.89	Ni II	—	40
	2407.94	Fe II	116	20
2409.00	2409.34	Fe II	K	—
2409.60	2409.96	Fe II	K	—
2410.25	2410.22	Mn III	—	40
	2410.58	Mn II	37	100
2411.80	2411.80	Fe II	—	50
2418.75	2418.73	Zn III	—	1000
2420.75	2420.73	Zn III	—	100
2422.30	2422.68	Fe II	301 B	—
2426.65	2426.94	Zn III	—	500
2427.20	2427.37	Mn II	74	140
2428.20	2428.29	Fe II	301	30
2432.20	2432.26	Fe II	180	80
2449.30	2449.34	Ni II	—	15

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2458.55	2457.86	Fe II	—	10
2460.00	2458.53	Ni II	—	50
2466.30	2460.03	Mn II	64	80
2474.00	2466.41	Fe II	—	30
2480.00	2474.05	Fe II	—	100
2485.20	2480.15	Fe II	K	—
2488.45	2485.38	Fe II	—	20
2475.50	2488.33	Zn III	—	500
2577.60	2475.79	Cr III	57	400
2581.20	2477.73	Fe II	K	—
2582.00	2581.16	Cr II	231	20
2586.70	2582.10	Fe II	K	—
2589.60	2586.77	Mn II	54	220
2595.80	2589.72	Ni II	—	10
2596.00	2595.97	Cr II	217	40
2601.90	2596.17	Mn II	—	50
2612.60	2601.96	Mn II	—	60
2615.90	2612.63	Cr II	—	50
2627.20	2616.18	Fe II	K	—
2627.40	2627.18	?	—	—
2644.60	?	Ni II	—	10
2647.80	2644.72	Fe II	K	—
2648.70	2648.00	Fe II	K	—
2648.90	2648.69	Fe II	K	—
2659.25	2648.99	Mn II	—	50
	2659.27	Fe III	—	40
2662.85	2662.33	Fe II	K	—
2665.10	2663.26	Mn II	62	80
2675.75	2665.17	Cr II	292	15
	2675.74	Mn II	2	20
2684.40	2676.53	Mn II	63	170
2715.00	2684.53	Mn II	—	40
2739.10	2714.98	Fe II	K	—
2740.20	2739.11	Mn II	—	30
2740.85	2740.22	Mn II	—	100
2786.55	2740.78	Mn II	—	50
2807.80	2786.45	Fe II	K	—
2809.30	2807.92	Mn II	—	50
2815.20	2809.38	Fe II	K	—
2815.60	2815.60	Fe III	—	110
2823.40	2815.76	Fe II	K	—
2825.20	2823.47	Ni II	25	15
2829.50	2825.23	Ni II	—	3
	2829.54	Ni II	—	1
2854.10	2854.14	Mn II	—	20
	2854.19	Fe III	—	40
2854.40	2854.31	Mn II	—	40
2902.30	2902.30	Zn II	—	100
	2902.31	Fe II	257	40
2904.60	2904.66	Mn II	—	40

Table II (continued)

λ_{mes}	λ_{lab}	Ion	Mult.	Int.
2913.10	2913.13	Mn II	—	60
2915.10	2915.28	Cr II	239	15
2918.80	?	?		
2919.10	2919.05	Ni II	—	75
2919.70	2919.72	Fe II	K	—
2930.10	2930.42	Fe II	K	—
2938.00	2938.03	Mn II	—	10
2942.40	2942.37	V II	118	15
2943.00	2943.04	Fe II	K	—
2943.80	2943.89	Mn II	82	140
2951.10	2951.09	Fe II	214	20
	2951.16	Mn II	82	140
2953.50	?	?		
2958.90	2958.94	Mn II	49	100
2962.60	2962.91	Fe II	K	—
2963.60	2963.86	Fe II	K	—
2967.80	2967.86	C II	120	40
2968.60	2968.68	Cr II	176	15
	2968.73	Fe II	253	20
2972.70	2972.74	Fe II	K	—
2974.20	2974.43	Fe II	K	—
2974.60	2974.65	N II	43	20
	2974.62	Fe II	K	—
2977.00	2976.97	N II	43	70
2978.20	?	?		
2989.00	2989.07	Fe II	0	390
2995.30	?	?		

?: The proposed identification remains doubtful.

K: Whenever the identification comes from the Kurucz (1981) compilation we have added K in the column of multiplet.

B: Bauer and Stencel, 1989.

velocities listed in Table I may be somewhat arbitrary and it is evident that the information from these data must be treated with caution and in a statistical sense only.

The study of the interstellar lines (Morton, 1975, 1978) in the spectrograph LWP 3408 indicates the absence of line shift.

3. Description of the Spectrum

The majority of the spectral features observed in the IUE spectra of 88 Her $\lambda\lambda 1100\text{--}3002 \text{ \AA}$ consists of shell absorption lines of singly ionized elements, mostly those due to Fe II, Ni II (Figures 1, 2, 3, 4, 5).

In this section additionally we present a summary of the relevant atomic species and some comments on their presence or absence.

TABLE III

Ion	Number of lines	I.P. (low)	R.V. (km s ⁻¹)	S.D. (km s ⁻¹)
C I	18	0.00	- 04	7
N I	9	0.00	+ 06	11
Al II	9	5.98	- 17	5
V II	44	6.74	- 14	5
Cr II	58	6.76	- 15	7
Mn II	37	7.43	- 18	10
Ni II	78	7.63	- 17	7
Mg II	3	7.64	- 16	2
Cu II	39	7.72	- 16	7
Fe II	108	7.87	- 15	6
Si II	13	8.15	- 17	7
Zn II	7	9.39	- 19	9
C II	9	11.26	- 22	9
Ti III	11	13.58	- 11	6
Fe III	103	16.18	- 19	8
Cr III	65	16.50	- 21	8
Ni III	13	18.16	- 24	2

– Helium

He I: The lines of He I at 2677.135, 2829.07, and 2945.10 Å seems to be absent.

– Carbon

It appears mainly as C II and C IV.

C II: The lines of this ion are present (Multiples 13 and 14).

C III: The presence of C III is uncertain.

C IV: This ion is present in the expanding shell and in the photosphere. Longward of 2000 Å only one (multiplet 14) of the possible C IV lines was found, since it is difficult to detect well features on our tracing.

– Nitrogen

It appears in the first two ionization stages but its presence is doubtful.

– Magnesium

It appears as neutral ($\lambda\lambda$ 2852.12, 2779.83, 2781.41, 2792.97 Å) and in the first ionization stage. The resonance lines of Mg II at 2795.51 and 2802.69 Å are present.

– Aluminium

The strong resonance line of Al II at 2669.16 Å is present. Al II high excitation lines at 2094.80 and 2816.19 Å are not present. The presence of Al III lines is uncertain.

– Silicon

It appears in the first two ionization stages. The two lines of Si II at 2072 Å are present.

Only one line of Si III at 2541.81 Å is present.

Si IV: this ion is absent.

– Sulfur

S II: The presence of Si II is uncertain blended with Mn II.

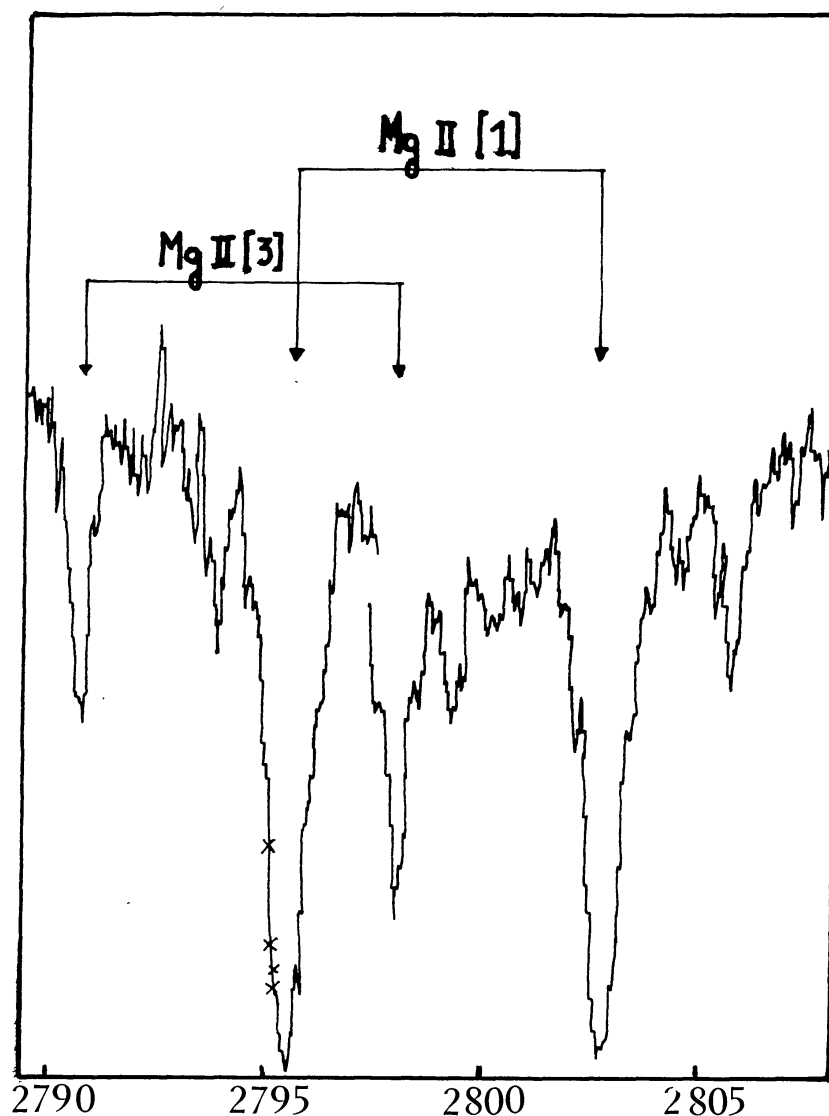


Fig. 1. The structure of the Mg II [1] resonance lines.

S III: This ion is possibly absent.

– Chlorine

Cl II: The presence of Cl II is doubtful.

– Calcium

Calcium is possibly absent.

The presence of Ca II and Ca III is very doubtful. The lines with strongest laboratory intensities, if present, are very faint.

– Titanium

The presence of Ti II is doubtful.

Ti III is present (multiplets: 6, 7, and 8).

– Vanadium

The presence of V II is evident.

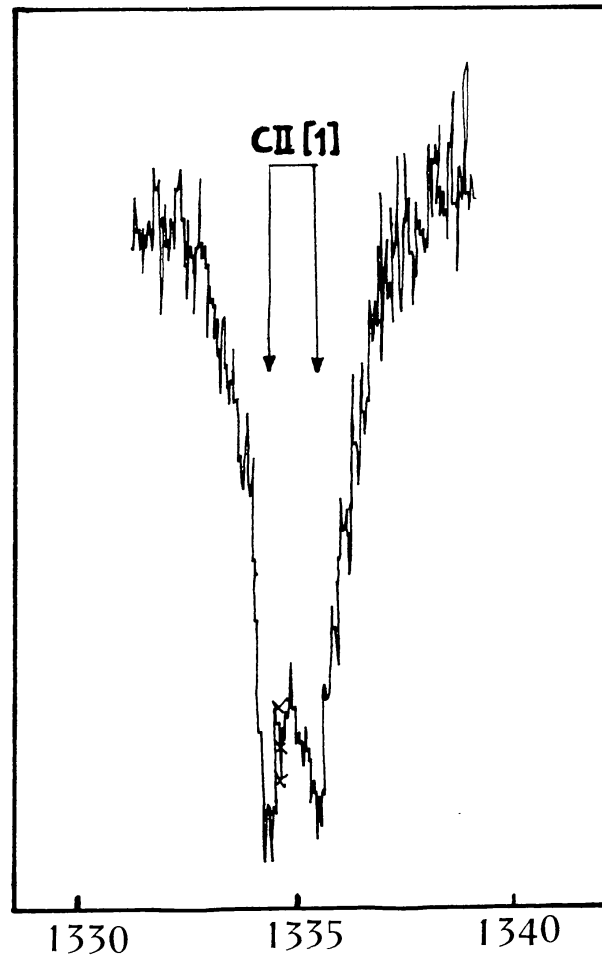


Fig. 2. The structure of the C II [1] resonance lines.

- Chromium
It appears in the first two ionization stages.
The presence of Cr II is evident.
Cr III is present (multiplets: 39, 40, and 41).
- Manganese
The presence of Mn II is evident.
Mn III: This ion is possibly present blended with Fe II.
- Iron
It is the main contributor to the spectrum of 88 Her. Even the weakest lines of Fe II are present.
Fe III: The spectrum of Fe III is also clearly evident.
- Cobalt
Co II is probably absent or blended with Fe II.
- Nickel
Ni II is present. Many and strong features observed have been attributed to Ni II.

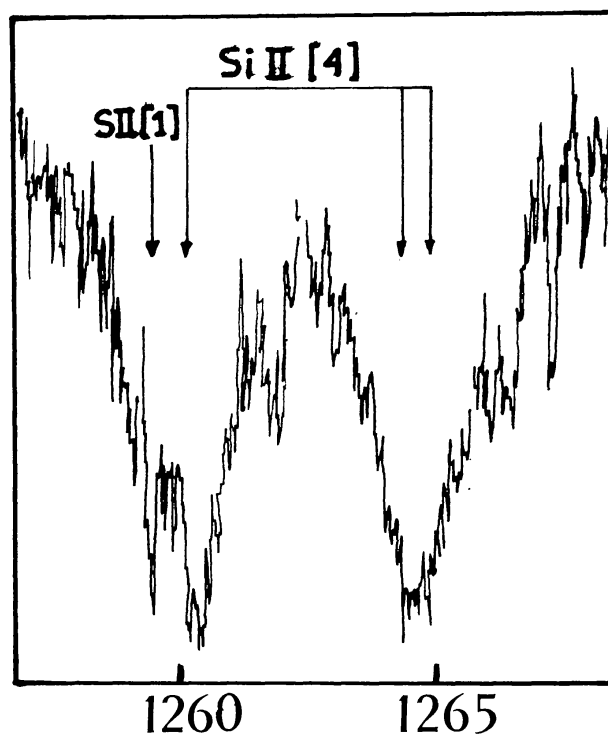


Fig. 3. The profiles of some Si II [1], Si II [4], and Si II [4] lines.

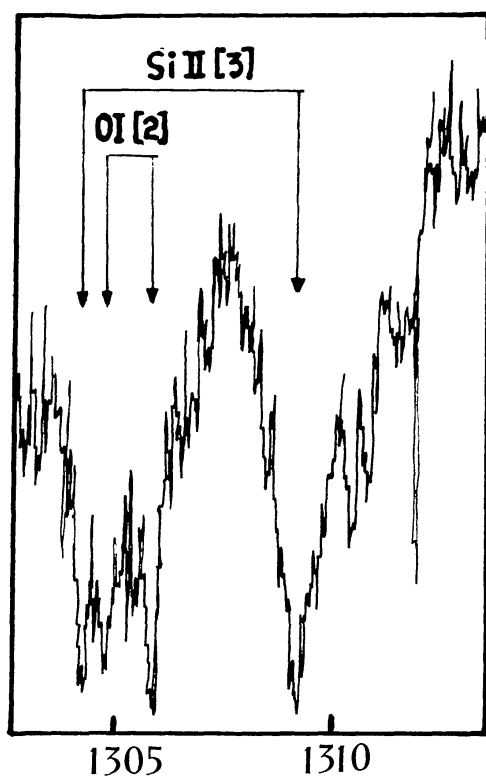


Fig. 4. The profile of Si II [3] and O I [2] lines.

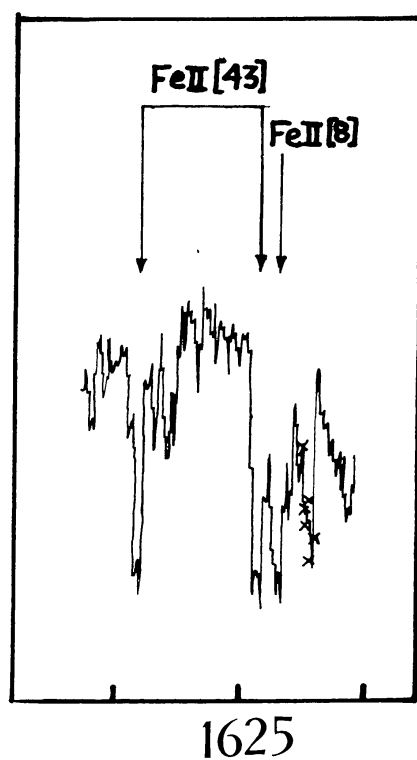


Fig. 5. The profile of Fe II [43], [8] lines.

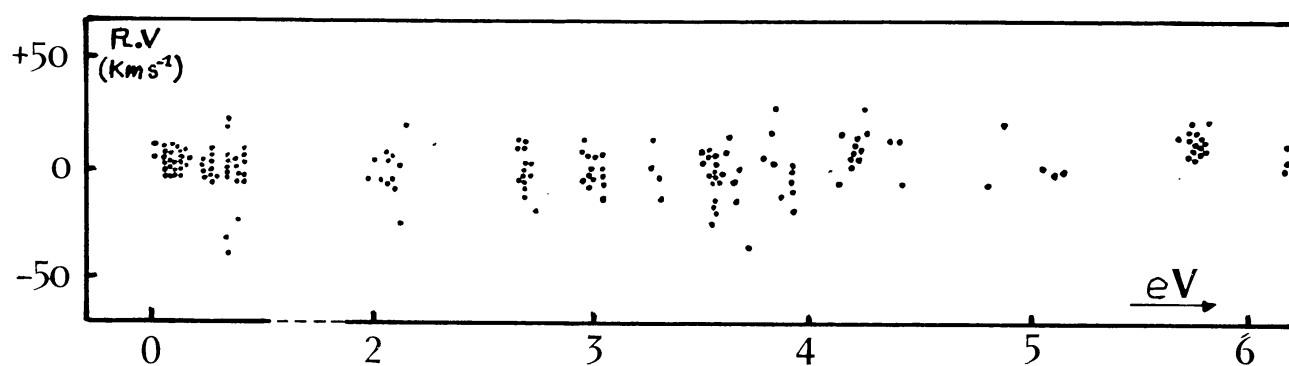


Fig. 6. The relation between the radial velocities of Fe II lines and the excitation potential.

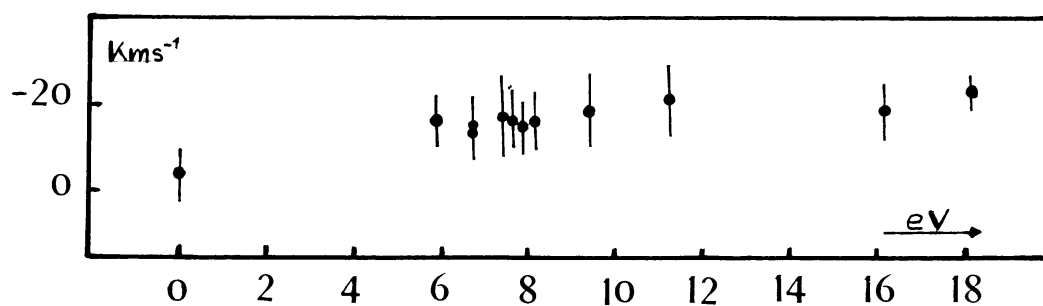


Fig. 7. The relation between the mean radial velocity of each component of the element features and the ionization potential (Table III).

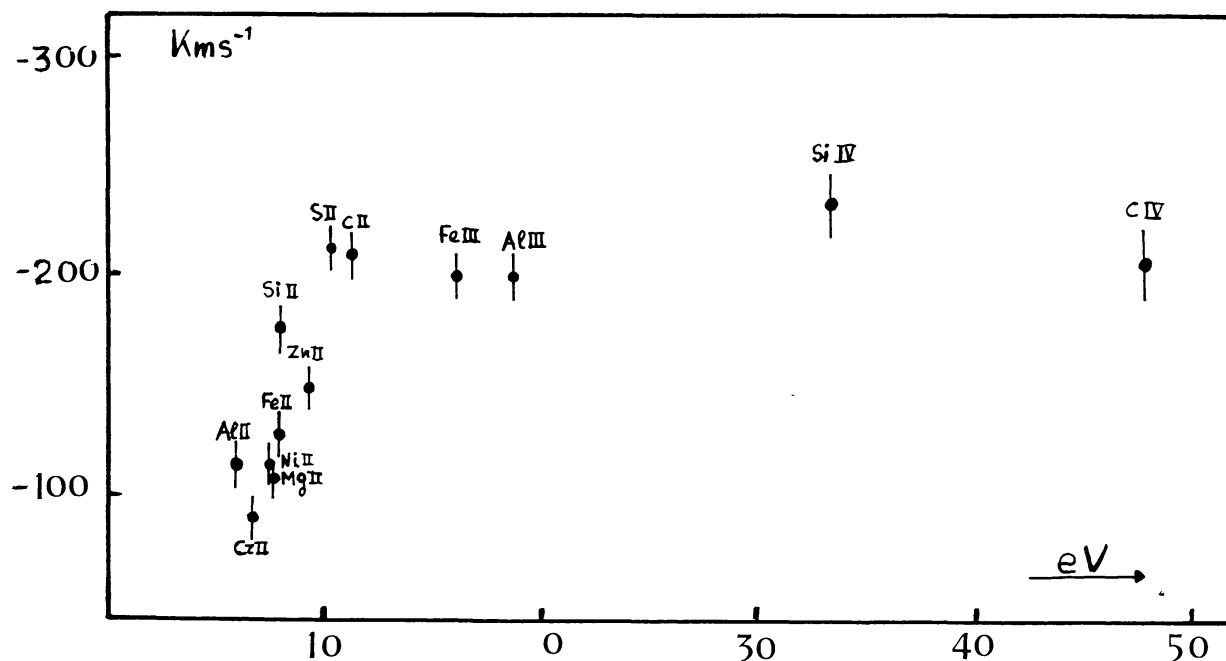


Fig. 8. The relation between the mean blue edge velocity of each component of the element features and the ionization potential.

– Copper

Cu II is present.

– Zinc

Zn II is present. Apart from the two resonance lines of Zn II at 2025.48 and 2062.00 Å which may have an interstellar contribution we reported Zn II multiplet 3 at 2557.94, 2501.99 Å and Zn II multiplet 4 at 2064.22, 2099.94 Å, respectively.

Zn III: The presence of Zn III is uncertain.

– Gallium

Only the resonance line of Ga II at 2091.34 Å is present.

Ga III: The presence of Ga III is doubtful.

– Germanium

Germanium is possibly absent or blended with Fe II.

There is no evidence of elements heavier than germanium.

In Figure 6 the velocities' variation of Fe II lines from this spectrum (LWP 3408) and from SWP 23079 spectrum (Paper I), with the low excitation potential is shown. In this figure, the spectral lines with intensities higher than 100 (Kelly, 1979) and without noted blends are included.

Figure 7 gives the mean velocities' variation of the whole ions $\lambda\lambda 1100\text{--}3002$ Å (SWP 23079 and LWP 3408), with the ionization potential (Table III).

Figure 8 gives the relation between the mean blue edge velocity of each component of the element features and the ionization potential.

We did not detect any emission lines in the UV spectrum ($\lambda\lambda 1958\text{--}3002$ Å) of 88 Her.

4. Conclusion

A complete line-list and detailed analysis of the UV spectrum of 88 Her in the range $\lambda\lambda 1958\text{--}3002\text{ \AA}$ has been presented in this paper. This list could be useful for future variability studies of 88 Her, which is known to be a variable star.

A mean radial velocity of the absorption components of the main ions for the whole spectral range $\lambda\lambda 1100\text{--}3002\text{ \AA}$ (combined data from Danezis and Theodossiou, 1988 and the present work) is derived (-10 km s^{-1}) and it is found to be in agreement to that expected from the orbital solution of Doazan *et al.* (1982).

This object exhibits very interesting variations and we conclude with our hope that simultaneous far UV, X-ray and optical observations could be undertaken systematically to explain further the behaviour of the expanding envelope around 88 Herculis.

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