

Elemental abundance analyses with DAO spectrograms – XIII. The superficially normal early A-type stars 68 Tauri, 21 Lyncis and Alpha Draconis

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ABSTRACT

Elemental abundances of three superficially normal, moderately sharp-lined early A stars, 68 Tau, 21 Lyn and α Dra, are derived consistently with previous studies of this series, using co-added photographic spectrograms supplemented by Reticon exposures. The first two stars are hot Am stars, while the third is slightly metal-poor. 68 Tau is relatively metal-rich compared to the Sun, with its abundance anomalies tending to increase with atomic number. The abundances of 21 Lyn are similar to those of α Dra for the light elements. Its derived abundance anomalies increase with atomic number for the heavy elements.

Key words: stars: abundances – stars: individual: 68 Tau – stars: individual: 21 Lyn – stars: individual – α Dra.

1 INTRODUCTION

Adelman (1991) analysed the elemental abundances of four sharp-lined late B stars, π Cet (B7 V), 21 Aql (B7 IV), 134 Tau (B9 V) and ν Cap (B9.5 V), and compared these results in particular with those for the three other superficially normal stars previously studied in this series, τ Her (B5 IV), o Peg (A1 IV) and θ Leo (A2 V) (Adelman 1988a, b). Most of the deduced abundances had values close to solar, but many of these stars had at least one abundance that differed by a factor of 2 from solar. Correlation analysis showed that sulphur and the iron-peak elements titanium, iron and nickel had abundances that varied together. Since then, Pintado & Adelman (1933) have studied γ Peg (B2 IV) and ι Her (B3 IV), while Kocer et al. (1991) have analysed θ Cyg (F4 V) and ι Psc (F7 V). Furthermore, Adelman & Gulliver (1990) used Dominion Astrophysical Observatory (DAO) Reticon exposures to analyse Vega in a manner consistent with this series, while Adelman & Philip (1992, 1994) examined γ Gem (A0 IV), HD 60825 (A), 7 Sex (A0 Vs) and HR 5780 (B6 IV) using mainly Kitt Peak National Observatory (KPNO) CCD spectrograms. This paper presents consistent abundance analyses of three moderately sharp-lined, normal early A stars: 68 Tauri (=HD 27962=HR 1389; A2 IV–Vs), 21 Lyncis (=HD 58142=HR 2818; A0mA1 V) and α Draconis (=HD 123299=HR 5291; A0 III) (the spectral types are from

Gray & Garrison 1987). These comprise the final group of superficially normal stars the analyses of which are based primarily on co-added, DAO, photographic region, 2.4 Å mm^{−1} IIa-O spectrograms.

When Conti (1965) reviewed the classification of main-sequence stars near spectral type A0, about one-half had anomalous Sc/Sr line strengths as judged by the ratio of Sc II λ 4246/Sr II λ 4215. Two of the most extreme stars in terms of the Sc/Sr line-strength ratio were 68 Tau and Sirius. Other stars with Sc/Sr < 1 included 21 Lyn, σ Aqr and o Peg. These can be considered to be ‘hot’ Am stars, but θ Leo, which is similar to o Peg, had the normal stellar ratio. If the hot Am stars are the continuation of the HgMn stars to cooler temperatures, then, among the superficially normal early A stars, one ought to find intermediate types such as HD 147550 (Lopez-Garcia & Adelman 1994). Furthermore, there should be stars for which all deduced elemental abundances are solar.

68 Tauri is a single-lined spectroscopic binary, as well as a blue straggler in the Hyades. Conti, Wallerstein & Wing (1965) found its elemental abundances to be similar to those of the Am stars. Hauck (1968) considered it to be a prototypical Am star. Wright et al. (1964) measured its equivalent widths in the blue spectral region. Okyudo & Sadakane’s (1990) analysis showed Ca and Sc to be underabundant, and also showed overabundances of heavy metals. Smith (1971) and Lyubimkov & Savanov (1985) have previously studied its elemental abundances. Adelman (1993) showed that his *uvby* photometry indicated constancy of 68 Tau, and also

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refuted claims that it was a photometric variable of small amplitude.

Alpha Draconis was most recently analysed by Adelman et al. (1987), using both KPNO spectra and the co-addition of six 2.4 Å mm^{-1} DAO spectrograms. The current co-addition includes these six spectrograms. On the whole, α Dra has elemental abundances, typically one-third solar, that exhibit a strong resemblance to those of Vega and other metal-poor stars. It is a single-lined spectroscopic binary with a period of 51.420 d (Pearce 1956).

2 THE SPECTRA

Eleven, ten and eleven 2.4 Å mm^{-1} , Ila-O baked spectrograms of 68 Tau, 21 Lyn and α Dra, respectively, were co-added and measured using the procedures of Adelman & Hill (1987). Further 2.4 Å mm^{-1} Reticon DAO exposures with a wavelength coverage of 67 Å were obtained, with central wavelengths of 4190, 4410, 4630, 4685, 4740, 4795, 4850 and 5180 Å for 68 Tau; 4190 and 4740 Å for 21 Lyn; and 3860, 4135, 4190, 4245, 4355, 4630, 4685 and 4740 Å for α Dra, as well as Reticon 20 Å mm^{-1} DAO spectrograms containing the $H\gamma$ region for 21 Lyn and α Dra. The Reticon exposures were flat-fielded with exposures of a lamp placed in the coude mirror train. A stop removed light from the centre of the beam, as did the secondary mirror of the telescope. FeAr or ThAr arc exposures were measured using the same routines as for photographic exposures. The spectra were rectified with the interactive computer graphics program VLINE (Hill, Fisher & Poeckert 1982). In the wavelength overlap regions, the measurements of the 2.4 Å mm^{-1} Reticon exposures with signal-to-noise ratio = 200 were used in the analyses, rather than those of the photographic co-additions with signal-to-noise ratio = 80.

Usually, Gaussian profiles were fitted to the metal lines of 68 Tau, while rotationally broadened profiles were fitted to those of 21 Lyn and α Dra. The rotational velocities, based on clearly single medium and strong lines near $\lambda 4481$, are 9 km s^{-1} for 68 Tau, 18 km s^{-1} for 21 Lyn and 25 km s^{-1} for α Dra. Literature values include $< 10 \text{ km s}^{-1}$ (Smith 1971) for 68 Tau; 24 km s^{-1} (Ramella et al. 1989) for 21 Lyn; and 18 km s^{-1} for 68 Tau, 16 km s^{-1} for 21 Lyn and 18 km s^{-1} for α Dra (Hoffleit 1982).

The weakest lines measured in the co-additions of 68 Tau, 21 Lyn and α Dra had equivalent widths of about 2.5, 3.0 and 3.5 mÅ , respectively, which are consistent with criteria

derived by Adelman (1987a) for usability in elemental abundance analyses. Slightly weaker lines were measured on the Reticon exposures.

Linear regression comparisons of equivalent widths (in mÅ) were made with two previous studies. For 68 Tau, a comparison of 91 lines with the results of Okyudo & Sadakane (1990), who used three 4.1 Å mm^{-1} and one 10.1 Å mm^{-1} Okayama Astrophysical Observatory Ila-O spectrograms, yields

$$W_{\lambda}(\text{DAO}) = (0.8813 \pm 0.0226) W_{\lambda}(\text{OAO}) + (9.143 \pm 2.603),$$

which is similar to the results of other such comparisons of this series, and indicates a major difference in the continuum placement in the analyses. For α Dra, a comparison for 100 lines with the results of Adelman et al. (1987) yields

$$W_{\lambda}(\text{DAO}) = (1.0097 \pm 0.0075) W_{\lambda}(\text{A et al.}) + (1.369 \pm 5.190),$$

which indicates a slight difference in continuum placement, but otherwise excellent agreement, as would be expected from two studies using the same camera with an overlap of material.

Stellar lines were identified by using the general references A Multiplet Table of Astrophysical Interest (Moore 1945) and Wavelengths and Transition Probabilities for Atoms and Atomic Ions, Part 1 (Reader & Corliss 1980), as well as Moore (1965) for Si II, Pettersson (1983) for S II, Hultdt et al. (1982) for Ti II, Catalan, Meggers & Garcia-Riquelme (1964) for Mn I, Iglesias & Velasco (1964) for Mn II, Dworetzky (1971), Johansson (1978), Guthrie (1985) and Adelman (1987b) for Fe II, and Nilsson, Johansson & Kurucz (1991) for Y II.

Table 1 lists the lines identified in the spectra of our three stars, and references to them. After the first reference for a star, successive entries list only additional species that were found. For 68 Tau, this study failed only to identify Na I, S I, Cu I and Mo II lines; the first three species have their strongest lines outside the observed region. In addition, He I lines are also possibly present in 68 Tau, and Si I and S II lines in 21 Lyn. Studies of wavelength coincidence statistics, similar to those of Cowley & Adelman (1990), are in agreement with most of these identifications.

The stellar radial velocities were found from comparisons of the stellar and laboratory wavelengths after corrections were applied for the Earth's orbital velocity. For 21 Lyn, which is not known to be a velocity variable, these values are $27.0 \pm 0.5 \text{ km s}^{-1}$ (*U* plates), $27.4 \pm 0.5 \text{ km s}^{-1}$ (*V* plates),

Table 1. Lines present in stellar spectra.

Star	Investigator(s)	Atomic Species
68 Tau	Okyudo & Sadakane (1990)	H I, Mg I, Mg II, Al I, Si II, Ca I, Ca II, Sc II, Ti II, V II, Cr I, Cr II, Mn I, Fe I, Fe II, Ni II, Sr II, Y II, Zr II, and Ba II
	Lyubimkov & Savanov (1985)	C I, Na I, Co I, Ni I, Zn I, La II, Ce II, Nd II, Eu II, and Gd II
	Smith (1971)	Si I, Cu I, and Sm II
	Wright et al. (1964)	Si I, Mn II, Ni II, and Mo II
	Adelman (This Paper)	Al II, S II, Ti I, V I, Cd I, Pr II, and Dy II
21 Lyn	Adelman (This Paper)	H I, He I, C I, Mg I, Mg II, Al I, Si II, Ca I, Ca II, Sc II, Ti II, V II, Cr I, Cr II, Mn I, Mn II, Co I, Ni I, Ni II, Sr II, Y II, Zr II, and Ba II
α Dra	Adelman et al. (1987)	H I, He I, C II, Mg I, Mg II, Al I, Si I, Si II, S II, Ca I, Ca II, Sc II, Ti II, V II, Cr I, Cr II, Mn I, Fe I, Fe II, Co I, Ni II, Sr II, and Ba II
	Cowley & Adelman (1990)	O I
	Adelman (This Paper)	C I, Al II, and Mn II

$27.6 \pm 0.4 \text{ km s}^{-1}$ (4190-Å Reticon) and $29.2 \pm 0.9 \text{ km s}^{-1}$ (4740-Å Reticon), which compare with $+24.1$ to $+27.0 \text{ km s}^{-1}$ (Abt & Biggs 1972). As the 4740-Å Reticon value depends on only four lines, this star probably has a constant radial velocity.

3 THE ABUNDANCE ANALYSES

The effective temperatures and surface gravities were initially estimated by using the computer program of Napiwotzki, Schönberner & Wenske (1993) and the homogeneous *uvby* data of Hauck & Mermilliod (1980) (see Table 2). To refine these values, optical region spectrophotometry of 68 Tau (Breger 1976; Lane & Lester 1980), 21 Lyn (Adelman & Pyper 1983) and α Dra (Adelman 1978), and the $H\gamma$ profiles (as derived from the co-added spectrograms for 68 Tau and from 20 Å mm^{-1} DAO Reticon spectra for the other stars) were compared with the predictions of local thermodynamic equilibrium (LTE) model atmospheres calculated with the ATLAS9 program (Kurucz 1993). The program SYNTH (Kurucz & Avrett 1981) was used to calculate synthetic spectra of the $H\gamma$ region. A scattered-light correction of 4 per cent was made for the observed spectrum. Initially, solar-composition models were used. After the iron abundance was found from Fe I and Fe II lines, in the process of deriving the microturbulences (see below), models with scaled solar metallicity were used to refine the effective temperatures and surface gravities so that the adopted models and the stars had the same metallicities. These values are also given in Table 2. The discrepancies from the photometric values are small. For 68 Tau, the spectrophotometric data from Lane & Lester (1980) were preferred to those from Breger (1976). The fit to the predicted continuum fluxes is satisfactory, except longward of $H\alpha$ where the predicted fluxes are lower than the observations.

Okuyado & Sadakane (1990) found $T_{\text{eff}} = 9000 \text{ K}$ and $\log g = 3.70$ for 68 Tau, in good agreement with the present study. The adopted values for α Dra are in reasonable agreement with $T_{\text{eff}} = 10075 \text{ K}$, and $\log g = 3.30$, found by Adelman et al. (1987) using ATLAS6 models. The largest change was an increase in the surface gravity.

The programs SYNSPEC (Hubeny, Lanz & Jeffery 1994) and WIDTH9 (Kurucz, private communication) were used to determine the helium and metal abundances, respectively. The adopted metal-line damping constants were the default semi-classical approximations, except for iron-peak element lines, the values of which were based on the data of Kurucz (1993);

Table 2. Effective temperature and surface gravity determinations.

Star	Teff (K)	Log g	Method
68 Tau	9025	3.95	Napiwotzki et al. with <i>uvby</i> photometry
	9025	3.95	Flux and $H\gamma$ Fitting Solar Model, $\xi = 2 \text{ km s}^{-1}$
	9025	3.95	Flux and $H\gamma$ Fitting [+0.2] Model, $\xi = 2 \text{ km s}^{-1}$
21 Lyn	9532	3.74	Napiwotzki et al. with <i>uvby</i> photometry
	9525	3.75	Flux and $H\gamma$ Fitting Solar Model, $\xi = 2 \text{ km s}^{-1}$
	9500	3.75	Flux and $H\gamma$ Fitting [-0.2] Model, $\xi = 2 \text{ km s}^{-1}$
α Dra	9975	3.63	Napiwotzki et al. with <i>uvby</i> photometry
	9975	3.65	Flux and $H\gamma$ Fitting Solar Model, $\xi = 2 \text{ km s}^{-1}$
	10025	3.75	Flux and $H\gamma$ Fitting [-0.2] Model, $\xi = 0 \text{ km s}^{-1}$

for lines of C II multiplet 6, Mg II multiplet 4, Si II multiplets 1 and 3, and Ca II multiplet 1, where the adopted values for the Stark broadening used the data of Sahal-Bréchet (1969) and Chapelle & Sahal-Bréchet (1970); and for Si II multiplets 1 and 3, the damping constants of which were from Lanz, Dimitrijevic & Artru (1988).

Abundances were derived from Fe I and Fe II lines for a range of possible microturbulences (ξ). The values (Table 3) are for the analyses with the adopted model atmospheres, and result in the derived abundances being independent of the equivalent widths (ξ_1) and having minimal scatter about the mean (ξ_2) (Blackwell, Shallis & Simmons 1982). Following Adelman & Fuhr (1985), the microturbulence was derived by using lines with *gf*-values given only by Martin,

Table 3. Microturbulence determinations from Fe I and Fe II lines.

Species	Number of Lines	ξ_1 (km s ⁻¹)	$\log \text{Fe}/N_T$	ξ_2 (km s ⁻¹)	$\log \text{Fe}/N_T$	<i>gf</i> values
68 Tau	296	2.7	-4.19 ± 0.24	2.7	-4.19 ± 0.24	MF + KX
	266	2.5	-4.19 ± 0.23	2.7	-4.21 ± 0.23	MF
	109	2.6	-4.17 ± 0.25	2.7	-4.18 ± 0.25	MF + KX
Fe II	44	2.9	-4.27 ± 0.18	2.9	-4.27 ± 0.18	MF
	adopted	2.7				
21 Lyn	118	1.2	-4.69 ± 0.25	1.4	-4.71 ± 0.25	MF + KX
	104	1.4	-4.73 ± 0.22	1.5	-4.74 ± 0.22	MF
	62	1.9	-4.72 ± 0.24	1.9	-4.72 ± 0.24	MF + KX
Fe II	37	1.9	-4.73 ± 0.15	2.0	-4.72 ± 0.15	MF
	adopted	1.6				
α Dra	57	0.2	-4.86 ± 0.25	0.0	-4.85 ± 0.25	MF + KX
	55	0.3	-4.87 ± 0.26	0.0	-4.86 ± 0.26	MF
	63	0.0	-4.75 ± 0.24	0.0	-4.75 ± 0.24	MF + KX
Fe II	39	0.0	-4.76 ± 0.19	0.0	-4.76 ± 0.19	MF
	adopted	0.1				

Note. *gf*-value sources: KX = Kurucz (1993); MF = Martin et al. (1988).

Table 4. Microturbulence determinations from non-iron species.

Species	Number of Lines	ξ_1 (km s ⁻¹)	$\log N/N_T$	ξ_2 (km s ⁻¹)	$\log N/N_T$	gf values
68 Tau						
Ti II	72	2.9	-6.80 ± 0.23	2.8	-6.79 ± 0.23	MF + BH + KX
	61	2.9	-6.81 ± 0.23	2.8	-6.80 ± 0.23	MF + BH
V II	34	3.7	-7.41 ± 0.23	3.7	-7.41 ± 0.23	BG + KX + YF
	20	3.3	-7.36 ± 0.21	3.2	-7.36 ± 0.21	BG + YF
Cr I	30	2.5	-5.70 ± 0.25	2.4	-5.69 ± 0.25	MF
Cr II	48	3.0	-5.80 ± 0.21	3.1	-5.80 ± 0.21	MF + KX
Ni I	31	2.1	-5.10 ± 0.24	2.4	-5.10 ± 0.24	MF + KX
Zr II	25	2.9	-8.38 ± 0.15	3.0	-8.39 ± 0.15	BG + GB
21 Lyn						
Ti II	56	2.1	-7.25 ± 0.23	2.2	-7.26 ± 0.23	MF + BH + KX
	50	2.1	-7.24 ± 0.23	2.2	-7.26 ± 0.23	MF + BH
Cr II	27	2.5	-6.50 ± 0.29	2.2	-6.51 ± 0.29	MF + KX
α Dra						
Ti II	42	0.0	-7.15 ± 0.25	0.0	-7.15 ± 0.25	MF + BH + KX

Note. *gf*-value sources: BG = Biemont et al. (1991); BH = Bizzarri et al. (1993); GB = Grevesse et al. (1981); KX = Kurucz (1993); MF = Martin et al. (1988) and Fuhr, Martin & Wiese (1988); YF = Younger et al. (1978).

Table 5. The analyses of the metal lines.

		68 Tau		21 Lyn		α Dra					
mult.	$\lambda(\text{\AA})$	log gf	Ref.	W_λ	log N/ N_T	W_λ	log N/ N_T	W_λ	log N/ N_T	W_λ	log N/ N_T
C I											
6	4762.41	-1.90	FW	...	...	12	-3.70	...	...	...	...
	4766.66	-2.40	FW	3	-4.03	7	-3.45	...	...	...	...
	4770.00	-2.28	FW	5	-3.97	...	...	...	...	...	...
	4771.77	-1.70	FW	...	...	8	-4.11	6	-3.96	...	...
	4775.87	-2.20	FW	15	-3.54	...	...	...	...	...	...
C II											
4	3918.98	-0.54	WS	...	...	...	...	...	...	...	...
	3920.68	-0.24	WS	...	...	...	...	8	-3.46	...	...
6	4267.15	+0.97	WS	...	...	...	...	16	-3.30	...	...
				...	...	...	...	10	-3.91	...	...
O I											
5	4368.30	-1.70	HB	...	...	...	...	14	-3.54	...	...
Mg I											
2	5172.68	-0.38	FW	180	-4.16	...	...	...	...	...	...
	5183.60	-0.16	FW	198	-4.08	...	...	...	...	...	...
3	3829.35	-0.19	WS	138	-4.85	87	-5.96	...	...	...	...
11	4702.99	-0.38	FW	84	-4.56	...	...	21	-4.75	...	...
15	4167.27	-0.81	SC	68	-4.37	20	-4.74	13	-4.56	...	...
Mg II											
4	4481.23	+0.97	WM	403	-4.80	316	-4.85	281	-4.82	...	...
5	3848.24	-1.60	WM	27	-4.60	16	-4.92	22	-4.72	...	...
	3850.39	-1.88	WM	13	-4.69	7	-5.06	15	-4.67	...	...
9	4428.00	-1.20	WS	20	-4.49	12	-4.79	15	-4.70	...	...
	4433.99	-0.90	WS	34	-4.47	22	-4.78	24	-4.74	...	...
10	4384.64	-0.78	WM	42	-4.48	29	-4.73	...	...	...	...
	4390.58	-0.53	WS	60	-4.47	46	-4.65	49	-4.55	...	...
Al I											
1	3944.01	-0.64	WS	146	-5.18	71	-5.87	35	-6.02	...	...
	3961.52	-0.34	WS	113	-6.06*	60	-6.34	39	-6.23	...	...
Al II											
2	4663.10	-0.28	FW	29	-5.16	...	...	15	-5.81	...	...
Si II											
1	3853.66	-1.44	LA	87	-4.54	64	-4.78	50	-4.88	...	...
	3856.02	-0.49	LA	174	-4.43	147	-4.43	88	-5.17	...	...
	3862.59	-0.74	LA	149	-4.44	116	-4.59	75	-5.13	...	...
3	4128.07	+0.38	LA	129	-4.26	97	-4.49	86	-4.70	...	...
	4130.89	+0.53	LA	111	-4.59	104	-4.55	90	-4.81	...	...
S II											
44	4162.70	+0.78	WS	4	-4.40	...	...	7	-4.65	...	...
45	4028.75	0.00	WS	3	-3.95	...	...	...	...	...	...
Ca I											
2	4226.73	+0.24	WS	121	-5.88	65	-5.99	15	-6.33	...	...
4	4425.44	-0.35	WM	12	-5.93	4	-5.99	...	...	...	...
	4434.96	-0.03	WS	34	-5.69	5	-6.14	...	...	...	...
	4435.69	-0.52	WM	14	-5.67	...	...	...	...	...	...
	4455.89	-0.53	WM	17	-5.60	...	...	...	...	...	...
5	4283.01	-0.22	WS	22	-5.74	6	-5.87	...	...	...	...
	4289.36	-0.30	WM	16	-5.83	...	...	...	...	...	...
	4302.53	+0.28	WS	42	-5.86	9	-6.15	...	...	...	...
	4318.63	-0.21	WS	...	...	4	-6.10	...	...	...	...
23	4578.56	-0.56	FW	3	-5.90	...	...	...	...	...	...
	4585.87	-0.19	FW	9	-5.85	...	...	...	...	...	...
36	4526.94	-0.43	FW	4	-5.80	...	...	...	...	...	...
Ca II											
1	3933.66	+0.13	WM	782	-6.28	1001	-5.70	605	-5.66	...	...
Sc II											
7	4246.83	+0.32	MF	39	-10.08	60	-9.40	26	-9.66	...	...
14	4374.46	-0.44	MF	9	-9.91	18	-9.32	...	...	...	...
	4400.36	-0.51	WF	7	-9.93	13	-9.42	...	...	...	...
	4415.56	-0.64	WF	6	-9.91	8	-9.53	...	...	...	...
15	4314.08	-0.10	MF	28	-9.66	29	-9.40	...	...	...	...
	4320.74	-0.26	MF	18	-9.74	17	-9.56	...	...	...	...
	4325.76	-0.44	MF	...	...	16	-9.40	10	-9.26	...	...
Ti I											
4	5173.74	-1.12	MF	2	-6.41	...	...	...	...	...	...
	5210.39	-0.88	MF	7	-6.10	...	...	...	...	...	...
42	4533.24	+0.48	MF	11	-6.75	...	...	...	...	...	...
Ti II											
11	3981.99	-2.53	KX	17	-7.15	11	-7.23	...	...	...	...
	3987.61	-2.73	MF	17	-6.93	...	...	...	...	...	...
	4025.14	-1.98	MF	63	-6.90	22	-7.37	26	-6.97	...	...
	4056.19	-3.26	KX	16	-6.45	4	-6.94	...	...	...	...
12	3786.33	-2.47	BH	47	-6.60	14	-7.12	...	...	...	...
	3813.39	-2.02	BH	67	-6.77	24	-7.27	12	-7.34	...	...
	3814.58	-1.72	MF	...	...	...	...	21	-7.35	...	...
13	3759.30	0.20	MF	196	-6.85	...	...	...	...	...	...
	3761.33	0.17	BH	166	-7.17	133	-6.84	68	-7.78	...	...
17	4762.78	-2.71	MF	10	-6.97	...	...	...	...	...	...
18	4469.12	-2.87	KX	13	-6.65	...	...	...	...	...	...
	4500.35	-3.34	BH	7	-6.47	...	...	...	...	...	...
19	4518.33	-2.55	KX	18	-6.83	3	-7.53	...	...	...	...
	4395.03	-0.66	MF	139	-6.75	87	-7.06	55	-7.20	...	...
	4443.80	-0.70	BH	139	-6.75	72	-7.37	46	-7.44	...	...
	4450.49	-1.51	BH	91	-6.73	32	-7.35	20	-7.33	...	...
20	4287.89	-2.02	MF	79	-6.36	20	-7.11	12	-7.11	...	...
	4344.30	-2.09	MF	25	-7.10	8	-7.50	...	...	...	...

Table 5 – continued

mult.		λ (Å)	log gf	Ref.	W_λ	68 Tau $\log N/N_T$	W_λ	21 Lyn $\log N/N_T$	W_λ	α Dra $\log N/N_T$	α Dra W_λ $\log N/N_T$	
Ti II (continued)												
94	Ti II	4316.81	-1.42	MF	31	-7.03	10	-7.49	3	-7.76		
		4330.24	-1.51	MF	23	-7.11	...	...	...	...		
		4350.83	-1.40	MF	22	-7.23	6	-7.77	...	...		
104		4367.66	-1.27	MF	...	...	24	-6.84	17	-6.79		
		4386.86	-1.26	MF	46	-6.61	15	-7.11	10	-7.11		
105		4163.64	-0.40	MF	113	-6.46	66	-6.86	35	-7.15		
		4171.92	-0.56	MF	...	...	40	-7.19	31	-7.09		
		4174.05	-1.25	MF	30	-6.87	11	-7.26	...	...		
106		4064.35	-1.71	KX	14	-6.78	6	-7.09	...	...		
107		3761.88	-0.61	MF	...	...	...	...	21	-7.28		
114		4874.01	-0.79	MF	27	-7.10	...	...	...	...		
115		4411.08	-1.06	MF	43	-6.54	16	-6.98	13	-6.86		
		4456.63	-1.41	KX	14	-6.79	...	...	...	...		
		4488.32	-0.82	MF	61	-6.51	22	-7.04	17	-6.93		
H		4188.98	-0.59	KX	5	-6.73	...	...	...	...		
V I												
22		4379.23	+0.58	MF	4	-7.59	...	...	...	...		
V II												
9		3997.13	-1.07	BG	63	-7.30	19	-7.76	...	...		
		4002.94	-1.45	BG	37	-7.32	...	...	...	...		
		4036.78	-1.59	BG	25	-7.37	5	-8.01	...	...		
10		3896.16	-1.80	YF	32	-7.07	...	...	...	...		
		3916.42	-1.05	BG	69	-7.26	15	-8.08	9	-8.10		
		3951.97	-0.78	BG	46	-7.82	26	-8.02	10	-8.32		
11		3866.74	-1.55	BG	26	-7.42	...	...	...	...		
		3903.27	-0.94	BG	53	-7.55	17	-8.09	...	...		
21		3718.16	-1.39	BG	26	-7.39	...	...	...	...		
24		4234.25	-2.03	KX	3	-7.80	...	...	...	...		
25		4178.39	-1.56	BG	16	-7.52	...	...	...	...		
		4202.35	-1.52	BG	42	-7.02	11	-7.59	...	...		
		4204.20	-2.07	KX	13	-7.12	...	...	...	...		
		4209.74	-1.94	KX	14	-7.22	...	...	...	...		
30		3929.73	-1.63	YF	30	-7.26	...	...	...	...		
32		4005.71	-0.52	BG	96	-7.16	36	-7.85	15	-8.14		
		4008.17	-2.07	BG	12	-7.07	...	...	...	...		
		4023.39	-0.69	BG	75	-7.31	24	-7.95	10	-8.19		
		4035.63	-0.77	BG	...	...	27	-7.81	10	-8.13		
		4051.06	-1.65	KX	15	-7.39	...	...	...	...		
33		3884.85	-1.41	BG	10	-7.80	...	...	...	...		
		3899.14	-0.78	BG	58	-7.44	12	-8.21	...	...		
		3914.33	-0.96	BG	...	...	42	-7.29	...	...		
37		4164.02	-2.10	KX	4	-7.38	...	...	...	...		
		4183.44	-1.11	BG	44	-7.18	11	-7.84	...	...		
		4225.23	-1.46	BG	27	-7.13	14	-7.35	...	...		
56		4528.51	-1.01	BG	...	...	...	...	9	-7.68		
		4564.59	-1.39	BG	22	-7.18	...	...	...	...		
		4600.19	-1.52	BG	...	...	4	-7.77	...	...		
		4605.35	-2.21	KX	6	-6.98	...	...	...	...		
100		3787.24	-0.62	KX	36	-7.47	11	-8.01	...	...		

Table 5 – continued

68 Tau										21 Lyn										α Dra									
W_{λ} log N/N _T										W_{λ} log N/N _T										W_{λ} log N/N _T									
Ref.										Ref.										Ref.									
λ (Å)										λ (Å)										λ (Å)									
log gf										log gf										log gf									
mult.										mult.										mult.									
V II (continued)										Cr II (continued)										Cr II (continued)									
1116	3728.34	-0.52	KX	23	-7.82	...	...	...	...	26	4072.56	-2.41	KX	...	...	...	...	...	...	5	-6.60	...	...	...	...	...	...	...	...
1116	3815.38	-0.16	KX	43	-7.58	...	...	...	...	26	4086.14	-2.42	KX	20	-5.96	...	...	...	...	...	...	...	...	...	...	...	...	...	...
212	4512.72	-0.88	KX	5	-7.44	...	...	...	...	26	4132.41	-2.34	KX	35	-5.72	...	...	...	...	...	...	...	...	...	...	...	...	...	...
215	4053.59	-0.32	KX	12	-7.59	...	...	...	...	26	4179.43	-1.77	KX	80	-5.59	...	...	...	...	...	...	...	...	...	...	...	...	...	...
215	4065.07	-0.24	KX	13	-7.61	7	-7.82	...	...	26	4207.35	-2.47	KX	11	-6.13	...	...	...	...	...	...	...	...	...	...	...	...	...	...
225	4232.04	-0.59	KX	12	-7.22	5	-7.55	...	...	26	4229.81	-3.32	KX	5	-5.67	...	...	...	...	...	...	...	...	...	...	...	...	...	...
225	4278.89	-0.71	KX	4	-7.54	...	...	...	...	30	4812.34	-1.80	MF	43	-6.08	...	...	...	...	...	...	...	...	...	...	...	...	...	...
log Cr/N _T = -5.71 ± 0.25										-6.54 ± 0.09										-6.31									
Cr I										14										-6.31									
1	4254.35	-0.11	MF	109	-5.65	29	-6.44	...	...	39	4539.62	-2.53	MF	30	-5.45	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1	4274.80	-0.23	MF	85	-5.94	18	-6.60	...	...	44	4565.78	-2.11	MF	49	-5.56	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7	5206.02	+0.02	MF	54	-6.07	...	...	...	...	44	4558.66	-0.66	MF	144	-5.50	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7	5208.42	+0.16	MF	99	-5.57	...	...	...	...	44	4588.22	-0.63	MF	122	-5.92	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10	4545.95	-1.37	MF	7	-5.74	...	...	...	...	44	4592.09	-1.22	MF	79	-6.02	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	4591.41	-1.74	MF	6	-5.42	...	...	...	...	44	4616.64	-1.29	MF	77	-5.98	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	4600.75	-1.26	MF	10	-5.65	...	...	...	...	129	3911.32	-2.06	KX	15	-5.73	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	4616.12	-1.19	MF	11	-5.71	...	...	...	...	130	3866.01	-2.35	KX	14	-5.48	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	4626.18	-1.32	MF	4	-6.00	...	...	...	...	162	4145.77	-1.77	KX	...	-5.28	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	4646.15	-0.70	MF	18	-5.92	...	...	...	...	167	3905.64	-0.90	KX	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	4652.16	-1.03	MF	12	-5.81	...	...	...	...	167	4224.85	-1.73	KX	40	-5.28	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22	4371.28	-1.09	MF	17	-5.57	...	...	...	...	177	4697.61	-1.88	MF	7	-5.84	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23	3928.65	-1.22	MF	5	-6.02	...	...	...	...	179	4362.93	-1.89	KX	12	-5.60	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31	4619.54	-0.59	MF	4	-5.47	...	...	...	...	183	3979.51	-0.73	KX	40	-6.08	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31	4789.32	-0.37	MF	6	-5.85	...	...	...	...	191	4022.37	-2.02	KX	7	-5.70	...	...	...	...	...	...	...	...	...	...	...	...	...	...
33	4530.73	-0.27	MF	14	-5.50	...	...	...	...	191	4465.77	-1.18	KX	8	-6.02	...	...	...	...	...	...	...	...	...	...	...	...	...	...
33	4540.52	-0.49	MF	9	-5.51	...	...	...	...	193	4049.14	-0.86	KX	20	-5.87	...	...	...	...	...	...	...	...	...	...	...	...	...	...
99	4727.13	-0.66	MF	5	-5.29	...	...	...	...	194	4003.33	-0.60	KX	30	-5.91	...	...	...	...	...	...	...	...	...	...	...	...	...	...
145	4737.33	-0.10	MF	3	-6.02	...	...	...	...	D	4254.03	-0.56	KX	36	-5.83	...	...	...	...	...	...	...	...	...	...	...	...	...	...
150	4511.90	-0.34	MF	11	-5.21	...	...	...	...	-	3778.70	-2.20	KX	12	-5.63	...	...	...	...	...	...	...	...	...	...	...	...	...	...
168	4792.49	-0.35	MF	8	-5.32	...	...	...	...	Mn I	4306.95	-1.19	KX	17	-5.99	...	...	...	...	...	...	...	...	...	...	...	...	...	...
186	4639.52	-0.67	MF	3	-5.54	...	...	...	...	2	4030.76	-0.47	MF	77	-6.29	...	...	...	...	...	...	...	...	...	...	...	...	...	...
233	4708.02	0.11	MF	4	-6.05	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
233	4718.43	0.09	MF	6	-5.89	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
233	4622.47	-0.04	MF	2	-5.92	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
233	4665.90	-0.53	MF	4	-5.25	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
log Cr/N _T = -5.78 ± 0.22										-6.45 ± 0.25										-6.39 ± 0.21									
Cr II										10										-6.39 ± 0.21									
18	4111.01	-1.82	KX	...	...	...	...	...	...	10	4465.77	-1.18	KX	8	-6.02	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19	4172.60	-2.36	KX	44	-5.97	...	...	...	...	193	4049.14	-0.86	KX	20	-5.87	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19	4051.96	-2.19	KX	...	...	...	...	...	...	194	4003.33	-0.60	KX	30	-5.91	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20	4054.10	-2.59	MF	28	-5.99	...	...	...	...	194	4003.33	-0.60	KX	30	-5.91	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20	4087.63	-3.22	MF	8	-6.02	...	...	...	...	D	4254.03	-0.56	KX	36	-5.83	...	...	...	...	...	...	...	...	...	...	...	...	...	
20	3754.59	-2.19	KX	57	-5.91	...	...	...	...	-	3778.70	-2.20	KX	12	-5.63	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	3801.21	-1.16	KX	13	-5.91	...	...	...	...	2	4030.76	-0.47	MF	77	-6.29	...	...	...	...	...	...	...	...	...	...	...	...	...	...
24	5153.50	-2.70	KX	36	-5.37	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
24	5210.87	-2.94	KX	16	-5.57	...	...	...	...	2	4030.76	-0.47	MF	77	-6.29	...	...	...	...	...	...	...	...	...	...	...	...	...	...
log Mn/N _T = -6.19 ± 0.22										-6.93 ± 0.18										-6.89									
Mn I										13										-6.89									
2	4030.76	-0.47	MF	77	-6.29	...	...	...	...	2	4030.76	-0.47	MF	77	-6.29	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	4034.49	-0.81	MF	54	-6.27	...	...	...	...	2	4034.49	-0.81	MF	54	-6.27	...													

Table 5 - continued

mult.		λ (Å)	log gf	Ref.	W_λ	log N/N _T	68 Tau	21 Lyn	α Dra	W_λ	log N/N _T	α Dra
Mn I (continued)												
5	4018.11	-0.31	MF	18	...	-6.09	...	...	...	...	...	...
	4041.36	0.28	MF	48	8	-6.10	...	-6.72	...	...	...	...
	4055.55	-0.07	MF	19	...	-6.27	...	...	...	...	...	...
	4079.42	-0.42	MF	17	...	-5.97	...	...	...	...	...	...
	4082.95	-0.35	MF	8	...	-6.39	...	...	...	...	...	...
	4083.63	-0.25	MF	8	...	-6.53	...	...	...	...	...	...
6	3809.59	-0.60	MF	16	...	-5.83	...	...	...	...	...	...
	3823.51	0.06	MF	14	...	-6.54	...	...	...	...	...	...
16	4754.05	-0.09	MF	11	...	-6.46	...	...	...	...	...	...
	4783.42	0.04	MF	27	...	-6.14	...	...	...	...	...	...
21	4709.71	-0.34	MF	5	...	-6.21	...	...	...	...	...	...
	4765.86	-0.08	MF	8	...	-6.24	...	...	...	...	...	...
	4766.43	0.10	MF	12	...	-6.23	...	...	...	...	...	...
22	4498.90	-0.34	MF	12	...	-5.78	...	...	...	...	...	...
23	4235.30	0.17	MF	8	...	-6.50	...	...	...	...	...	...
	4281.10	-0.42	MF	5	...	-6.06	...	...	...	...	...	...
28	4461.09	-0.38	MF	7	...	-5.89	...	...	...	...	...	...
Mn II												
log Mn/N _T = -6.06 ± 0.28 -6.49 ± 0.21 -6.59												
-	3844.17	-1.38	KX	12	...	-6.27	...	...	...	...	...	...
	4244.24	-2.40	KX	4	...	-5.82	...	...	...	...	...	...
	4205.39	-3.38	KX	19	...	-6.31	...	...	...	...	...	...
	4206.37	-1.57	KX	15	...	-6.06	...	-6.48	...	...	...	...
	4251.74	-1.06	KX	14	...	-6.13	4	-6.75	...	...	...	...
	4252.96	-1.14	KX	12	...	-6.13	6	-6.47	...	...	...	...
	4259.20	-1.59	KX	16	...	-5.99	6	-6.45	...	...	...	...
	4281.94	-2.55	KX	6	...	-5.53	...	...	...	...	...	...
	4283.77	-2.20	KX	6	...	-5.86	...	...	...	...	...	...
	4284.43	-2.26	KX	10	...	-5.57	...	...	...	...	...	...
	4326.63	-1.25	KX	22	...	-6.17	...	-6.75	...	...	...	...
	4365.22	-1.35	KX	...	...	...	5	-6.13	...	...	...	...
	4377.74	-2.14	KX	3	...	-6.18	...	...	...	...	...	...
	4393.38	-2.32	KX	4	...	-5.82	...	...	...	...	...	...
	4478.64	-0.95	KX	11	...	-6.06	...	...	...	...	...	...
	4738.30	-2.24	KX	3	...	-6.11	...	...	...	...	...	...
	4755.73	-1.24	KX	8	...	-6.67	12	-6.42	7	...	-6.59	...
	4764.73	-1.35	KX	11	...	-6.42	...	...	...	...	...	...
Fe I												
log Fe/N _T = -4.20 ± 0.24 -4.74 ± 0.24 -4.86 ± 0.25												
2	4375.93	-3.03	MF	24	...	-4.14	...	...	...	...	...	...
	4427.31	-2.91	KX	31	...	-4.10	6	-4.51	...	...	...	...
	4461.65	-3.21	MF	30	...	-3.80	...	...	...	...	...	...
3	4206.70	-3.88	MF	5	...	-4.04	...	...	...	...	...	...
	4216.19	-3.36	MF	18	...	-3.97	...	...	...	...	...	...
	3824.44	...	...	...	...	...	50	-4.76	29	...	-4.61	...
4	3856.37	-1.29	MF	115	...	-4.28	29	-5.25	19	...	-4.94	...
	3859.91	-0.71	MF	146	...	-4.22	67	-5.04	32	...	-5.17	...
	3878.57	-1.35	MF	...	...	...	...	...	...	...	...	...
	3895.66	-1.67	MF	...	...	...	...	-5.08	...	...	...	...
	3899.71	-1.53	MF	93	...	-4.47	27	-5.03	...	...	...	...
	3906.48	-2.25	MF	64	...	-4.17	13	-4.73	...	...	...	...

Table 5 – continued

	mult.	λ (Å)	log gf	Ref.	W_λ	68 Tau log N/N $_T$	21 Lyn log N/N $_T$	W_λ	α Dra log N/N $_T$	W_λ	21 Lyn log N/N $_T$	W_λ	21 Lyn log N/N $_T$	W_λ	α Dra log N/N $_T$
Fe I (continued)															
68	23	4407.71	-1.92	MF	23	-3.90	8	-4.04	...	...	...	...	...	...	...
	21	4408.42	-1.71	MF	21	-4.15	6	-4.38	...	...	...	...	...	...	...
	23	4430.62	-1.66	MF	23	-4.12	...	...	...	...	...	...	...	...	...
	42	4442.34	-1.26	MF	42	-4.19	7	-4.80	...	...	...	...	...	...	...
	43	4447.22	-1.34	MF	43	-4.09	5	-4.79	...	...	...	...	...	...	...
	...	4459.12	-1.28	MF	...	...	11	-4.52	...	...	...	...	...	...	...
	60	4494.57	-1.41	MF	60	-3.79	...	...	...	...	...	...	...	...	...
	100	4528.62	-0.82	MF	100	-3.82	24	-4.60	...	...	...	...	...	...	...
71	...	4282.41	-0.81	MF	...	...	22	-4.65	10	-4.58	...	...	...	...	...
	34	4352.74	-1.26	MF	34	-4.30	...	...	...	...	...	...	...	...	...
72	39	3949.95	-1.20	MF	39	-4.28	7	-4.80	8	-4.33	...	...	...	...	...
	15	4001.66	-1.88	MF	15	-4.13	...	...	...	...	...	...	...	...	...
	44	4009.71	-1.20	MF	44	-4.18	7	-4.77	...	...	...	...	...	...	...
73	21	3753.61	-1.01	MF	21	-4.79	...	...	...	...	...	...	...	...	...
	33	3807.53	-1.06	MF	33	-4.48	...	...	...	...	...	...	...	...	...
	24	3816.34	-1.46	MF	24	-4.27	...	...	...	...	...	...	...	...	...
	43	3852.57	-1.24	MF	43	-4.17	13	-4.46	...	...	...	...	...	...	...
76	21	3760.54	-1.29	MF	21	-4.49	...	...	...	...	...	...	...	...	...
115	7	4630.12	-2.60	MF	7	-3.76	...	...	...	...	...	...	...	...	...
152	77	4187.04	-0.55	MF	77	-4.22	22	-4.71	11	-4.66	...	...	...	...	...
	103	4187.79	-0.55	MF	103	-3.84	39	-4.37	18	-4.39	...	...	...	...	...
	79	4191.44	-0.74	KX	79	-4.00	19	-4.61	...	...	...	...	...	...	...
	89	4198.31	-0.72	MF	89	-3.90	20	-4.44	13	-4.40	...	...	...	...	...
	60	4210.35	-0.87	MF	60	-4.13	12	-4.72	5	-4.72	...	...	...	...	...
	50	4222.22	-0.97	MF	50	-4.18	10	-4.73	...	...	...	...	...	...	...
	69	4233.61	-0.60	MF	69	-4.28	15	-4.87	9	-4.71	...	...	...	...	...
	71	4235.94	-0.34	MF	71	-4.55	31	-4.73	12	-4.84	...	...	...	...	...
	87	4260.12	-0.40	MF	87	-4.22	31	-4.66	16	-4.59	...	...	...	...	...
	88	4260.48	-0.02	MF	88	...	48	-4.73	27	-4.64	...	...	...	...	...
	88	4271.16	-0.35	MF	88	-4.26	31	-4.70	11	-4.86	...	...	...	...	...
	100	4299.24	-0.46	KX	100	-4.00	25	-4.75	12	-4.69	...	...	...	...	...
175	57	3859.21	-0.68	MF	57	-4.37	14	-4.84	...	...	...	...	...	...	...
	48	3873.76	-0.79	MF	48	-4.38	8	-5.02	...	...	...	...	...	...	...
177	...	3760.05	-0.85	MF	...	...	15	-4.62	...	...	...	...	...	...	...
	57	3785.95	-0.93	MF	57	-4.10	8	-4.86	...	...	...	...	...	...	...
217	16	4067.28	-1.42	MF	16	-4.32	...	...	...	...	...	...	...	...	...
	22	4078.36	-1.50	KX	22	-4.04	...	...	...	...	...	...	...	...	...
	13	4095.88	-1.40	MF	13	-4.43	...	...	...	...	...	...	...	...	...
218	23	4055.05	-1.80	MF	23	-3.75	...	...	...	...	...	...	...	...	...
221	11	3867.93	-1.92	MF	11	-3.99	...	...	...	...	...	...	...	...	...
222	...	3821.81	+0.30	MF	...	...	...	...	...	...	...	...	...	...	...
228	9	3730.95	-1.26	MF	9	-4.72	...	...	...	...	...	...	...	...	...
273	9	4266.96	-1.68	MF	9	-4.26	...	...	...	...	...	...	...	...	...
	4	4288.15	-1.92	MF	4	-4.33	...	...	...	...	...	...	...	...	...
277	...	3983.96	-0.90	MF	...	...	9	-4.64	...	...	...	...	...	...	...
	20	4007.28	-1.30	MF	20	-4.21	...	...	...	...	...	...	...	...	...
278	7	4024.11	-2.30	MF	7	-3.70	...	...	...	...	...	...	...	...	...
	68	3952.61	-0.98	MF	68	...	8	-4.68	...	...	...	...	...	...	...
	6	3956.68	-0.58	KX	6	-4.15	...	...	...	...	...	...	...	...	...
	44	3981.77	-1.08	MF	44	-3.98	...	...	...	...	...	...	...	...	...
	13	3937.33	-1.45	MF	13	-4.29	...	...	...	...	...	...	...	...	...
	58	3997.39	-0.39	MF	58	-4.46	16	-4.89	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table 5 - continued

				68 Tau		21 Lyn		α Dra	
		W_λ	$\log N/N_T$	W_λ	$\log N/N_T$	W_λ	$\log N/N_T$	W_λ	$\log N/N_T$
		Ref.	log gf	Ref.	log gf	Ref.	log gf	Ref.	log gf
		Fe I (continued)							
429	3897.45	-1.25	MF	10	-4.46	...	...	...	...
430	3903.90	-0.70	MF	49	-4.12	...	...	...	...
430	3919.07	-1.10	MF	34	-3.96	...	...	...	...
430	3944.89	-1.46	MF	12	-4.14	...	...	...	...
430	3953.16	-1.11	MF	22	-4.18	...	...	...	...
467	4786.81	-1.59	MF	6	-4.37	...	...	...	...
472	4464.77	-1.78	MF	7	-4.09	...	...	...	...
472	4517.53	-1.84	MF	5	-4.17	...	...	...	...
476	4387.90	-1.47	MF	8	-4.33	...	...	...	...
476a	4182.38	-1.19	MF	9	-4.57	...	...	...	...
482	4170.91	-1.10	MF	59	-3.58	11	-4.22	...	...
482	4220.34	-1.29	MF	14	-4.20	...	...	...	...
482	4248.21	-1.32	MF	16	-4.10	...	...	...	...
488	3867.22	-0.42	MF	21	-4.16	5	-4.50	...	...
488	3955.96	-1.47	MF	50	-4.36	13	-4.76	...	...
514	4514.19	-2.05	MF	10	-4.23	...	...	...	...
516	4436.93	-2.11	KX	30	-3.70	...	...	...	...
518	4369.77	-0.73	MF	4	-4.07	...	...	...	...
520	4298.04	-1.37	MF	6	-3.78	...	...	...	...
521	4225.96	-1.39	MF	32	-4.36	11	-4.58	...	...
522	4199.10	+0.25	MF	12	-4.22	...	...	...	...
523	4143.42	-0.47	KX	15	-4.10	...	...	...	...
524	4074.79	-0.97	MF	95	-4.37	31	-4.96	13	-5.01
524	4074.79	-0.97	MF	74	-3.97	21	-4.47	...	...
526	3994.11	-1.47	MF	29	-4.15	...	...	...	...
527	4017.16	-0.92	MF	13	-4.08	...	...	...	...
528	3843.26	-0.14	MF	36	-4.06	...	...	...	...
554	4598.12	-1.57	MF	45	-4.74	...	...	...	...
554	4613.20	-1.67	MF	9	-4.00	...	...	...	...
554	4625.05	-1.34	MF	11	-3.83	...	...	...	...
557	4013.80	-1.62	KX	14	-4.08	...	...	...	...
557	4013.80	-1.62	KX	13	-3.96	...	...	...	...
558	4058.22	-1.07	MF	20	-4.14	...	...	...	...
558	4073.76	-0.92	MF	27	-4.36	9	-4.57	...	...
559	4067.98	-0.43	MF	13	-3.96	...	...	...	...
559	4067.98	-0.43	MF	19	-4.18	...	...	...	...
560	4024.72	-0.71	MF	28	-4.08	...	...	...	...
560	4024.72	-0.71	MF	43	-4.42	...	...	...	...
561	3946.99	-0.95	MF	14	-4.15	...	...	...	...
561	3946.99	-0.95	MF	41	-4.38	16	-4.55	...	...
562	3941.28	-1.01	MF	31	-4.26	...	...	...	...
562	3941.28	-1.01	MF	18	-4.55	...	...	...	...
562	3948.10	-0.26	KX	74	-3.62	15	-4.32	...	...
562	3955.34	-1.01	MF	25	-4.14	...	...	...	...
562	3957.03	-0.59	MF	23	-4.11	4	-4.66	...	...
565	3928.08	-0.77	KX	41	-4.53	7	-5.10	...	...
565	3931.11	-1.14	MF	27	-4.01	...	...	...	...
565	3931.11	-1.14	MF	31	-4.35	...	...	...	...
565	3931.11	-1.14	MF	15	-4.62	...	...	...	...
565	3931.11	-1.14	MF	22	-4.62	...	...	...	...
565	3931.11	-1.14	MF	14	-4.61	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14	...	...	...	...
565	3931.11	-1.14	MF	17	-4.14				

Table 5 – continued

				68 Tau			21 Lyn			α Dra		
mult.		$\lambda(\text{\AA})$	log gf	Ref.	W_λ	$\log N/N_T$	W_λ	$\log N/N_T$	W_λ	$\log N/N_T$	W_λ	$\log N/N_T$
Fe I (continued)												
698	4154.81	-0.37	MF	50	-4.23	...	...	...	...	...	...	...
705	3762.21	-1.18	MF	5	-4.59	...	...	...	...	...	...	...
726	4137.00	-0.54	MF	44	-4.11	13	-4.45	...	...	...	...	...
728	4003.76	-1.29	MF	12	-4.05	...	...	...	...	...	...	...
731	3806.20	-0.82	MF	19	-4.29	...	...	...	...	...	...	...
753	4789.86	-0.91	MF	15	-4.28	...	...	...	...	...	...	...
755	4547.85	-0.78	MF	21	-4.23	...	...	...	...	...	...	...
761	4327.09	-0.96	MF	13	-4.28	...	...	...	...	...	...	...
767	4059.73	-1.22	MF	10	-4.12	...	...	...	...	...	...	...
795	4587.13	-1.78	MF	7	-3.78	...	...	...	...	...	...	...
799a	4382.77	-1.28	MF	11	-4.05	...	...	...	...	...	...	...
800	4219.36	0.12	MF	69	-4.30	17	-4.86	7	-4.92	...	...	...
801	4118.55	0.28	MF	73	-4.40	25	-4.80	7	-5.06	...	...	...
802	4014.53	-0.20	MF	48	-4.29	10	-4.80	...	...	...	...	...
804	3846.41	-0.43	MF	22	-4.51	...	...	...	...	...	...	...
805	3756.94	-0.25	MF	19	-4.74	...	...	...	...	...	...	...
820	4643.47	-1.29	MF	11	-3.98	...	...	...	...	...	...	...
821	4673.17	-0.98	MF	12	-4.24	...	...	...	...	...	...	...
821	4619.29	-1.12	MF	13	-4.11	...	...	...	...	...	...	...
826	4669.17	-1.41	MF	12	-3.82	...	...	...	...	...	...	...
826	4525.14	-0.95	KX	33	-3.77	...	...	...	...	...	...	...
828	4611.28	-1.02	KX	24	-3.85	...	...	...	...	...	...	...
828	4401.29	-0.92	MF	25	-3.96	...	...	...	...	...	...	...
846	4446.84	-1.33	MF	8	-4.04	...	...	...	...	...	...	...
848	4482.75	-1.35	MF	5	-4.25	...	...	...	...	...	...	...
830	4484.23	-0.72	MF	25	-4.17	...	...	...	...	...	...	...
830	4388.41	-0.59	MF	25	-4.29	...	...	...	...	...	...	...
849	4309.04	-1.10	MF	12	-4.13	...	...	...	...	...	...	...
888	4799.41	-2.23	MF	3	-3.61	...	...	...	...	...	...	...
894	4542.41	-2.05	MF	3	-3.85	...	...	...	...	...	...	...
906	4088.57	-1.53	MF	4	-4.15	...	...	...	...	...	...	...
935	4700.19	-1.68	MF	17	-3.94	...	...	...	...	...	...	...
940	4189.56	-1.33	MF	5	-4.28	...	...	...	...	...	...	...
992	4458.16	-0.99	KX	17	-3.94	...	...	...	...	...	...	...
993	4265.26	-1.42	KX	4	-4.09	...	...	...	...	...	...	...
995	3839.61	-0.36	MF	11	-4.70	...	...	...	...	...	...	...
1032	5187.91	-1.26	MF	4	-4.14	...	...	...	...	...	...	...
1042	4800.65	-1.26	MF	8	-3.85	...	...	...	...	...	...	...
1068	4835.87	-1.50	MF	6	-3.78	...	...	...	...	...	...	...
1069	4842.79	-1.56	MF	3	-4.11	...	...	...	...	...	...	...
1070	4841.78	-1.88	MF	4	-3.59	...	...	...	...	...	...	...
1080	5184.26	-1.00	MF	14	-3.78	...	...	...	...	...	...	...
1089	5162.77	+0.02	MF	62	-3.95	...	...	...	...	...	...	...
1091	5159.06	-0.82	MF	10	-4.11	...	...	...	...	...	...	...
1103	4112.97	-0.33	MF	13	-4.51	...	...	...	...	...	...	...
1166	4125.62	-0.61	KX	21	-3.99	...	...	...	...	...	...	...
1166	5180.07	-1.26	MF	6	-3.79	...	...	...	...	...	...	...
				log Fe/N _T = -4.20 ± 0.22			-4.67 ± 0.20			-4.76 ± 0.22		
				log gf			log N/N _T			log N/N _T		
				Ref.			W _λ			W _λ		
				λ(Å)			λ(Å)			λ(Å)		
				mult.			mult.			mult.		
				Fe II			Fe II			Fe II		
3	3914.48	-4.05	MF	35	-4.66	...	...	...	...	...	...	...
3	3938.29	-3.89	MF	89	-4.02	39	-4.59	...	...	...	...	...
14	3945.21	-4.19	MF	61	-4.12	22	-4.66	...	...	...	...	...
14	3783.35	-3.16	KX	84	-4.44	...	...	...	...	...	...	...
21	3821.93	-3.82	KX	...	...	22	-4.65	...	...	...	...	...
21	4119.53	-4.90	KX	19	-3.62	...	...	...	...	...	...	...
22	4124.79	-4.20	MF	37	-3.95	...	...	...	...	...	...	...
23	3779.58	-3.74	KX	44	-4.28	8	-5.12	...	...	...	...	...
25	4648.94	-4.51	KX	12	-4.25	...	...	...	...	...	...	...
26	4461.43	-4.20	KX	9	-4.68	...	...	...	...	...	...	...
27	4128.74	-3.77	MF	53	-4.11	22	-4.56	...	...	...	...	...
27	4273.32	-3.34	MF	80	-4.10	36	-4.61	...	...	...	...	...
28	4303.17	-2.49	MF	133	-4.07	75	-4.62	...	...	...	...	...
28	4351.76	-2.10	MF	168	-3.89	97	-4.48	...	...	...	...	...
28	4385.38	-2.57	MF	108	-4.41	69	-4.65	...	...	...	...	...
28	4416.82	-2.60	MF	101	-4.48	65	-4.72	...	...	...	...	...
28	4087.27	-4.71	MF	6	-4.37	...	...	...	...	...	...	...
28	4122.64	-3.38	MF	...	...	35	-4.65	...	...	...	...	...
28	4178.86	-2.48	MF	138	-4.03	88	-4.37	...	...	...	...	...
28	4258.16	-3.40	MF	...	...	38	-4.49	...	...	...	...	...
29	4296.57	-3.01	MF	115	-3.86	54	-4.56	...	...	...	...	...
29	4369.40	-3.67	MF	50	-4.15	17	-4.69	...	...	...	...	...
29	3824.91	-3.41	MF	55	-4.43	28	-4.76	...	...	...	...	...
30	3872.76	-3.22	KX	48	-4.65	20	-5.08	...	...	...	...	...
30	4002.08	-3.37	KX	44	-4.51	17	-5.00	...	...	...	...	...
30	4825.74	-4.83	KX	5	-4.31	...	...	...	...	...	...	...
32	4833.18	-4.78	MF	8	-4.09	...	...	...	...	...	...	...
32	4278.16	-3.83	KX	...	...	13	-4.74	...	...	...	...	...
32	4314.29	-3.49	KX	47	-4.43	25	-4.71	...	...	...	...	...
32	4384.33	-3.50	MF	69	-4.13	26	-4.70	...	...	...	...	...
35	5154.40	-4.14	KX	16	-4.31	...	...	...	...	...	...	...
35	5178.96	-5.38	KX	3	-3.90	...	...	...	...	...	...	...
37	4472.92	-3.43	MF	56	-4.26	20	-4.82	...	...	...	...	...
37	4489.18	-2.97	MF	100	-4.11	50	-4.63	...	...	...	...	...
37	4491.40	-2.70	MF	85	-4.59	53	-4.81	...	...	...	...	...
37	4515.34	-2.48	MF	114	-4.32	72	-4.63	...	...	...	...	...
37	4520.22	-2.60	MF	116	-4.22	63	-4.74	...	...	...	...	...
37	4555.89	-2.29	MF	138	-4.14	71	-4.86	...	...	...	...	...
37	4582.84	-3.10	MF	73	-4.36	33	-4.84	...	...	...	...	...
37	4629.34	-2.37	MF	133	-4.17	66	-4.90	...	...	...	...	...
38	4666.75	-3.33	MF	...	...	...	...	...	...	...	...	...
38	4508.28	-2.21	MF	132	-4.32	72	-4.91	...	...	...	...	...
38	4522.63	-2.03	MF	147	-4.25	87	-4.73	...	...	...	...	...
38	4583.83	-2.02	MF	169	-3.95	110	-4.22	...	...	...	...	...
38	4541.52	-3.05	MF	90	-4.16	44	-4.65	...	...	...	...	...
38	4576.33	-3.04	MF	85	-4.25	46	-4.63	...	...	...	...	...
38	4595.68	-4.22	KX	7	-4.58	...	...	...	...	...	...	...
38	4620.51	-3.28	MF	69	-4.25	32	-4.68	...	...	...	...	...

Table 5 – continued

mult.		$\lambda(\text{\AA})$	log gf	Ref.	W_λ	log N/N _T	68 Tau	W_λ	log N/N _T	21 Lyn	W_λ	log N/N _T	α Dra	W_λ	log N/N _T	α Dra
Fe II (continued)																
-	39	4361.25	-2.08	KX	15	-4.43	...	...	...	...	...	...	...	...	...	...
	40	4402.88	-2.75	KX	16	-3.73	...	...	...	...	...	...	...	...	...	...
	41	4418.98	-1.97	KX	4	-4.11	...	...	...	...	...	...	...	...	...	...
	42	4451.54	-1.82	KX	...	...	...	...	...	...	...	...	...	...	...	...
	43	4455.26	-1.99	KX	39	-3.91	...	...	...	...	...	...	...	...	...	...
	44	4461.71	-2.03	KX	...	...	...	...	...	...	...	...	...	...	...	...
	45	4480.69	-2.34	KX	21	-3.94	...	...	...	...	...	...	...	...	...	...
	46	4499.72	-1.76	KX	8	-4.16	...	...	...	...	...	...	...	...	...	...
	47	4579.52	-2.36	KX	19	-3.94	...	...	...	...	...	...	...	...	...	...
	48	4596.02	-1.82	KX	...	...	...	...	...	...	...	...	...	...	...	...
	49	4638.05	-1.47	KX	...	...	...	...	...	...	...	...	...	...	...	...
	50	4640.84	-1.81	KX	11	-3.95	...	...	...	...	...	...	...	...	...	...
	51	4826.68	-0.44	KX	8	-4.04	...	...	...	...	...	...	...	...	...	...
	52	5149.46	0.40	KX	23	-4.13	...	...	...	...	...	...	...	...	...	...
	53	5150.49	-0.12	KX	10	-4.08	...	...	...	...	...	...	...	...	...	...
	54	5159.91	-1.19	KX	2	-3.71	...	...	...	...	...	...	...	...	...	...
	55	5166.55	-0.03	KX	7	-4.37	...	...	...	...	...	...	...	...	...	...
	56	5170.78	-0.36	KX	8	-3.96	...	...	...	...	...	...	...	...	...	...
	57	5180.31	0.04	KX	8	-4.35	...	...	...	...	...	...	...	...	...	...
	58	5186.87	-0.03	KX	5	-4.50	...	...	...	...	...	...	...	...	...	...
	59	5199.12	0.10	KX	13	-4.19	...	...	...	...	...	...	...	...	...	...
	60	5200.81	-0.37	KX	7	-4.06	...	...	...	...	...	...	...	...	...	...
	61	5203.64	-0.05	KX	16	-3.93	...	...	...	...	...	...	...	...	...	...
Co I																
18	3873.12	-0.66	MF	23	-6.37	...	...	...	...	...	...	...	...	...	...	...
19	3873.95	-0.87	MF	8	-6.62	...	...	...	...	...	...	...	...	...	...	...
20	4118.77	-0.49	MF	12	-6.49	...	...	...	...	...	...	...	...	...	...	...
21	4121.32	-0.32	MF	21	-6.47	...	...	...	...	...	...	...	...	...	...	...
22	4092.39	-0.94	MF	13	-6.10	...	...	...	...	...	...	...	...	...	...	...
23	3995.31	-0.22	MF	35	-6.26	...	...	...	...	...	...	...	...	...	...	...
24	33842.05	-0.77	MF	13	-6.22	...	...	...	...	...	...	...	...	...	...	...
25	3845.47	0.01	MF	27	-6.63	...	...	...	...	...	...	...	...	...	...	...
Ni I																
30	3783.53	-1.31	MF	55	-5.43	...	...	...	...	...	...	...	...	...	...	...
31	3831.69	-2.00	MF	11	-5.63	...	...	...	...	...	...	...	...	...	...	...
32	3858.30	-0.97	MF	102	-5.02	...	...	...	...	...	...	...	...	...	...	...
33	3775.57	-1.35	MF	44	-5.53	...	...	...	...	...	...	...	...	...	...	...
34	3807.14	-1.18	MF	66	-5.40	...	...	...	...	...	...	...	...	...	...	...
35	4331.65	-2.10	MF	5	-5.14	...	...	...	...	...	...	...	...	...	...	...
36	4401.54	+0.08	MF	37	-5.40	...	...	...	...	...	...	...	...	...	...	...
37	4470.48	-0.40	MF	24	-5.03	...	...	...	...	...	...	...	...	...	...	...
38	4462.46	-0.60	MF	16	-5.01	...	...	...	...	...	...	...	...	...	...	...
39	4410.52	-1.08	MF	7	-5.00	...	...	...	...	...	...	...	...	...	...	...
40	4604.99	-0.29	MF	28	-5.01	...	...	...	...	...	...	...	...	...	...	...
41	4648.66	-0.16	MF	41	-4.95	...	...	...	...	...	...	...	...	...	...	...
42	4686.22	-0.64	MF	13	-5.01	...	...	...	...	...	...	...	...	...	...	...
43	4714.42	+0.23	MF	50	-5.24	...	...	...	...	...	...	...	...	...	...	...
44	4715.78	-0.34	MF	17	-5.18	...	...	...	...	...	...	...	...	...	...	...
45	4756.52	-0.34	MF	14	-5.35	...	...	...	...	...	...	...	...	...	...	...
log Co/N _T = -6.40 ± 0.18 -6.71																
log Ni/N _T = -5.12 ± 0.24 -5.75 ± 0.16																

Table 5 – continued

mult.	$\lambda(\text{\AA})$	log gf	Ref.	W_λ	68 Tau $\log N/N_T$	21 Lyn W_λ	α Dra $\log N/N_T$	W_λ	21 Lyn W_λ	68 Tau $\log N/N_T$	W_λ	α Dra $\log N/N_T$
Ni I (continued)												
9	4244.80	-3.11	KX	31	-4.81	7	-5.57	...	-5.96 $\pm$ 0.09	-4.85 $\pm$ 0.12	-5.52 $\pm$ 0.16	-5.96 $\pm$ 0.09
10	4362.10	-2.72	KX	48	-4.90	16	-5.52	6	-6.00	-4.90	-5.52	-6.00
11	4192.07	-3.05	KX	35	-4.79	13	-5.32	...	...	-4.79	-5.32	...
12	4015.48	-2.42	KX	83	-4.68	31	-5.42	10	-6.01	-4.68	-5.42	10
Zn I												
2	4680.14	-0.86	BG	10	-6.62	...	...	...	...	-6.62	...	...
3	4722.16	-0.39	BG	20	-6.76	...	...	...	...	-6.76	...	...
4	4810.53	-0.17	BG	41	-6.54	...	...	...	...	-6.54	...	...
Sr II												
1	4077.71	+0.15	WM	196	-7.94	111	-8.22	30	-9.60	-7.94	-8.22	30
2	4215.52	-0.17	WM	193	-7.72	98	-8.26	24	-9.54	-7.72	-8.26	24
3	4161.80	-0.47	WM	38	-8.14	...	...	...	...	-8.14	...	...
4	4305.45	-0.14	WM	...	...	17	-8.53	...	...	...	...	...
Y II (continued)												
1	4204.69	-1.76	HL	9	-9.00	...	...	...	...	-9.00	...	...
2	4235.73	-1.50	HL	33	-8.47	...	...	...	...	-8.47	...	...
3	4308.62	-0.75	HL	33	-9.21	14	-9.37	...	...	-9.21	14	...
4	4358.73	-1.32	HL	28	-8.78	...	...	...	...	-8.78	...	...
5	4398.02	-1.00	HL	31	-9.03	...	...	...	...	-9.03	...	...
6	3950.35	-0.49	HL	63	-9.02	16	-9.53	...	...	-9.02	16	...
7	3982.59	+0.21	HL	51	-9.18	8	-9.88	...	...	-9.18	8	...
8	3774.33	+0.21	HL	71	-9.56	23	-10.00	...	...	-9.56	23	...
9	3788.70	-0.07	HL	76	-9.22	16	-9.95	...	...	-9.22	16	...
10	3818.34	-0.98	HL	35	-8.92	8	-9.39	...	...	-8.92	8	...
11	3747.55	-0.91	HL	14	-9.48	...	...	...	...	-9.48	...	...
12	4682.32	-1.51	HL	7	-9.10	...	...	...	...	-9.10	...	...
13	4235.77	-0.43	HL	31	-8.66	...	...	...	...	-8.66	...	...
14	4235.77	-0.43	HL	57	-8.66	...	...	...	...	-8.66	...	...
Ba II												
1	4554.03	+0.16	WM	134	-8.53	49	-9.33	...	...	-8.53	49	...
2	4166.00	-0.41	WM	5	-8.83	...	...	...	...	-8.83	...	...
3	4130.70	+0.44	WM	53	-8.38	...	...	...	...	-8.38	...	...
La II												
10	4086.72	+0.13	MC	12	-10.15	...	...	...	...	-10.15	...	...
11	3790.83	0.11	MC	11	-10.07	...	...	...	...	-10.07	...	...
12	3849.02	-0.36	MC	7	-9.93	...	...	...	...	-9.93	...	...
13	3871.64	+0.05	MC	25	-9.61	...	...	...	...	-9.61	...	...
14	3995.75	+0.08	MC	9	-10.14	...	...	...	...	-10.14	...	...
15	4429.90	-0.20	MC	11	-9.74	...	...	...	...	-9.74	...	...
16	3988.52	+0.32	MC	18	-9.88	...	...	...	...	-9.88	...	...
17	4141.73	-0.61	MC	6	-9.52	...	...	...	...	-9.52	...	...
18	3949.10	+0.84	MC	35	-9.83	5	-10.44	...	...	-9.83	5	...
19	4123.23	+0.25	MC	16	-9.94	...	...	...	...	-9.94	...	...

Table 5 – continued

mult.	$\lambda(\text{\AA})$	log gf	Ref.	68 Tau		21 Lyn		α Dra	
				W_λ	log N/N _T	W_λ	log N/N _T	W_λ	log N/N _T
La II (continued)									
41	4238.38	-0.16	MC	5	-10.06	...	...	...	...
66	4042.91	+0.50	MC	13	-9.91	...	...	...	...
75	4286.97	0.44	MC	11	-9.29	...	...	...	...
-	4296.50	+0.24	MC	8	-9.34	...	...	...	...
Ce II									
				log Ce/N _T = -9.01 ± 0.24		...		...	
1	4248.68	-0.14	MC	6	-9.01	...	...	...	...
	4562.36	-0.04	MC	6	-9.32	...	...	...	...
	4628.16	-0.11	MC	6	-9.25	...	...	...	...
2	4137.65	+0.03	MC	10	-9.06	...	...	...	...
	4460.21	+0.04	MC	7	-9.30	...	...	...	...
6	4593.93	-0.29	MC	11	-8.64	...	...	...	...
8	4471.24	-0.05	MC	8	-8.98	...	...	...	...
10	4165.61	0.11	MC	14	-8.73	...	...	...	...
12	3993.82	-0.02	MC	12	-8.66	...	...	...	...
36	4222.60	-0.37	MC	4	-9.33	...	...	...	...
57	4075.71	+0.04	MC	6	-9.23	...	...	...	...
59	3808.12	-0.35	MC	12	-8.71	...	...	...	...
60	4083.23	-0.18	MC	8	-8.82	...	...	...	...
81	4391.66	-0.21	MC	10	-8.97	...	...	...	...
108	4527.35	-0.53	MC	8	-8.79	...	...	...	...
135	4364.66	-0.36	MC	3	-9.30	...	...	...	...
140	4042.56	-0.31	MC	6	-8.96	...	...	...	...
150	4483.90	-0.24	MC	3	-9.14	...	...	...	...
Pr II									
				log Pr/N _T = -9.29 ± 0.14		...		...	
4	4143.12	0.06	MC	8	-9.10	...	...	...	...
	4408.84	-0.43	MC	3	-9.33	...	...	...	...
20	4062.82	+0.21	MC	5	-9.44	...	...	...	...
Nd II									
				log Nd/N _T = -9.61 ± 0.24		...		...	
10	4061.09	+0.57	WV	11	-9.44	...	...	...	...
	4303.58	+0.26	WV	6	-9.78	...	...	...	...
Sm II									
				log Sm/N _T = -9.30 ± 0.28		...		...	
1	4092.27	-0.61	MC	4	-9.50	...	...	...	...
18	3854.21	+0.31	MC	23	-9.11	...	...	...	...
Eu II									
				log Eu/N _T = -10.75 ± 0.31		...		...	
1	4129.73	+0.20	BK	12	-10.53	...	...	...	...
5	3907.10	0.20	BK	3	-10.97	...	...	...	...
Gd II									
				log Gd/N _T = -9.36 ± 0.28		...		...	
50	4049.43	-0.04	MC	10	-9.42	...	...	...	...
-	4049.86	+0.41	MC	9	-9.67	...	...	...	...
	4053.29	+0.13	MC	15	-9.00	...	...	...	...
Dy II									
				log Dy/N _T = -9.94 ± 0.33		...		...	
-	3757.37	-0.19	BL	7	-9.48	...	...	...	...
	3872.11	+0.28	MC	8	-10.28	...	...	...	...
	3944.70	+0.42	MC	19	-10.04	...	...	...	...

Notes.

* = not used.

The explanation of the symbols is given in the text.

gf-value references follow.

GB: Biemont et al. (1989) for V II; Biemont & Godefroid (1980) for Zn I; Biemont et al. (1981) for Zr II; BH: Bizzarri et al. (1993); BK: Biemont et al. (1982); BL: Biemont & Lowe (1993); FW: Fuhr & Wiese (1990); GB: Grevesse et al. (1981); HB: Hibbert et al. (1991); HL: Hannaford et al. (1982); KX: Kurucz (1993); LA: Lanz & Artru (1985); MC: Magazzu & Cowley (1986); MF: Fuhr et al. (1988); Martin et al. (1988); PN: Pitts & Newson (1986); SC: Schaeffer (1971); WF: Wiese & Fuhr (1975); WM: Wiese & Martin (1980); WS: Wiese, Smith & Glennon (1966); Wiese, Smith & Miles (1969); WV: Ward (1985); YF: Younger et al. (1978).

Fuhr & Wiese (1988), and then by using these lines and those with gf-values from the compatible, but less accurate, source of Kurucz (1993). Table 4 shows results obtained by using non-iron species. For 68 Tau, these average 2.7 km s⁻¹, in close agreement with the results from the Fe I and Fe II lines, but for 21 Lyn the Ti II and Cr II lines suggest a value of about

2.2 km s⁻¹, rather than the 1.6 km s⁻¹ average from the Fe I and Fe II lines. In comparison, Okyudo & Sadakane (1990) found $\xi = 3.5$ km s⁻¹ for 68 Tau, 0.8 km s⁻¹ greater than the value found in this study, while Adelman et al. (1987) found $\xi = 0.4$ km s⁻¹ for α Dra instead of the result here of 0.1 km s⁻¹.

The helium abundances were found by comparing the line profiles with theoretical predictions, which were convolved with the rotational velocity and the instrumental profile. For 68 Tau and 21 Lyn, both $\lambda\lambda 4026$ and 4472 gave identical results: $\text{He}/\text{H} = 0.09 \pm 0.01$ and 0.08 ± 0.01 , respectively, or $\log \text{He}/\text{H} = -1.05$ and -1.10 . For α Dra, $\lambda\lambda 4026$ and 4388 both yielded $\text{He}/\text{H} = 0.10$, while $\lambda\lambda 4472$ gave 0.09 and $\lambda\lambda 4714$ gave 0.08 . The average $\text{He}/\text{H} = 0.091$, or $\log \text{He}/\text{H} = -1.04$, while Adelman et al. (1987) found $\text{He}/\text{H} = 0.04$. The discrepancy is largely due to the higher signal-to-noise ratio of the data used in this study, which makes it easier to find the broad, shallow, extended wings of the He I lines. Thus all three stars have nearly solar He/H ratios.

The summary of the line spectra analyses (Table 5) contains, for each line, the multiplet number (Moore 1945), the laboratory wavelength in Å, the logarithm of the gf -value and its source, the observed equivalent width in mÅ, and the deduced abundance. A scattered light correction of 4 per cent was later applied in the analyses to the equivalent widths. When, in the analysis of a particular atomic species, gf -values from both KX (Kurucz 1993) and a more accurate source (or sources) are used, the KX values are given half-weight. To convert $\log N/N_T$ values to $\log N/\text{H}$ values, 0.05 dex is added for both 68 Tau and α Dra, while, for 21 Lyn,

0.04 dex is added. Table 6 summarizes the average values and gives n , the number of lines used in analysing each species, and finally compares the results with the solar values from Anders & Grevesse (1989), as supplemented by the more recent solar abundances derived by Biemont et al. (1991, 1993a), Biemont, Quinet & Zeippen (1993b), Biemont & Lowe (1993), Bizzarri et al. (1993), Holweger et al. (1991) and Pinnington et al. (1992, 1993). When the Ca II K line has a large equivalent width is large and there are many Ca I lines, as is the case for 68 Tau and 21 Lyn, the abundance from the Ca I lines is probably the more reliable. For 68 Tau, the $[\text{Cd}/\text{H}]$ value is very large. It depends on two lines and should be regarded as tentative.

4 DISCUSSION

Table 7 compares the derived abundances with those of Okyudo & Sadakane (1990) for 68 Tau and Adelman et al. (1987) for α Dra. For 68 Tau, the discrepancy in the adopted value of ξ , 2.7 as opposed to 3.5 km s^{-1} , produces major differences, especially when only strong lines are measured (as in Okyudo & Sadakane 1990). This is the case for Al I, Fe I, Fe II and Sr II, for example. For the higher signal-to-noise ratio of the spectra in this study, the weaker lines serve as a

Table 6. Summary of abundances.

Species	68 Tau		21 Lyn		α Dra		Sun
	$\log N/\text{H}$	n	$\log N/\text{H}$	n	$\log N/\text{H}$	n	$\log N/\text{H}$
He I	-1.05	2	-1.10	2	-1.04	4	(-1.00)
C I	-3.80 $\pm$ 0.22	3	-3.71 $\pm$ 0.27	3	-3.91	1	-3.43
C II	...	...	...	...	-3.51 $\pm$ 0.32	3	-3.43
O I	...	...	...	...	-3.49	1	-3.14
Mg I	-4.35 $\pm$ 0.28	5	-4.86 $\pm$ 0.23	2	-4.61 $\pm$ 0.13	2	-4.42
Mg II	-4.52 $\pm$ 0.12	7	-4.79 $\pm$ 0.12	7	-4.65 $\pm$ 0.09	5	-4.42
Al I	-5.13	1	-6.06 $\pm$ 0.33	2	-6.07 $\pm$ 0.15	2	-5.53
Al II	-5.11	1	...	...	-5.76	1	-5.53
Si II	-4.40 $\pm$ 0.11	5	-4.53 $\pm$ 0.12	5	-4.89 $\pm$ 0.20	5	-4.45
S II	-4.13 $\pm$ 0.32	2	...	...	-4.60	1	-4.67
Ca I	-5.74 $\pm$ 0.11	11	-6.00 $\pm$ 0.10	6	-6.28	1	-5.64
Ca II	-6.23	1	-5.66	1	-5.61	1	-5.64
Sc II	-9.82 $\pm$ 0.14	6	-9.39 $\pm$ 0.08	8	-9.41 $\pm$ 0.28	2	-8.90
Ti I	-6.37 $\pm$ 0.27	3	...	...	...	...	-6.96
Ti II	-6.73 $\pm$ 0.23	72	-7.15 $\pm$ 0.25	56	-7.10 $\pm$ 0.25	42	-6.96
V I	-7.54	1	...	...	...	...	-8.00
V II	-7.31 $\pm$ 0.23	34	-7.79 $\pm$ 0.26	17	-8.04 $\pm$ 0.22	6	-8.00
Cr I	-5.66 $\pm$ 0.25	30	-6.50 $\pm$ 0.08	3	-6.26	1	-6.26
Cr II	-5.73 $\pm$ 0.22	48	-6.41 $\pm$ 0.25	27	-6.34 $\pm$ 0.21	21	-6.26
Mn I	-6.15 $\pm$ 0.22	19	-6.89 $\pm$ 0.18	3	-6.84	1	-6.45
Mn II	-6.01 $\pm$ 0.28	17	-6.45 $\pm$ 0.21	7	-6.54	1	-6.45
Fe I	-4.15 $\pm$ 0.24	296	-4.70 $\pm$ 0.24	118	-4.81 $\pm$ 0.25	57	-4.52
Fe II	-4.15 $\pm$ 0.22	109	-4.63 $\pm$ 0.20	62	-4.71 $\pm$ 0.22	63	-4.52
Co I	-6.35 $\pm$ 0.18	8	-6.67	1	...	...	-7.08
Ni I	-5.07 $\pm$ 0.24	31	-5.71 $\pm$ 0.16	5	...	...	-5.75
Ni II	-4.80 $\pm$ 0.12	5	-5.48 $\pm$ 0.16	5	-5.91 $\pm$ 0.09	4	-5.75
Zn I	-6.59 $\pm$ 0.11	3	...	...	...	...	-7.40
Sr II	-7.88 $\pm$ 0.21	3	-8.30 $\pm$ 0.17	3	-9.52 $\pm$ 0.04	2	-9.10
Y II	-8.94 $\pm$ 0.31	15	-9.65 $\pm$ 0.26	6	...	...	-9.76
Zr II	-8.32 $\pm$ 0.15	25	-8.94 $\pm$ 0.14	15	...	...	-9.40
Cd I	-6.57 $\pm$ 0.15	2	...	...	...	...	-10.14
Ba II	-8.53 $\pm$ 0.23	3	-9.29	1	-10.07	1	-9.87
La II	-9.76 $\pm$ 0.27	14	-10.40	1	...	...	-10.78
Ce II	-8.96 $\pm$ 0.24	18	...	...	...	...	-10.45
Pr II	-9.24 $\pm$ 0.14	3	...	...	...	...	-11.29
Nd II	-9.56 $\pm$ 0.24	2	...	...	...	...	-10.50
Sm II	-9.25 $\pm$ 0.28	2	...	...	...	...	-11.00
Eu II	-10.70 $\pm$ 0.31	2	...	...	...	...	-11.49
Gd II	-9.31 $\pm$ 0.28	3	...	...	...	...	-10.88
Dy II	-9.89 $\pm$ 0.33	3	...	...	...	...	-10.80

check on the derived microturbulence. The difference for Ni II is due to the gf -values.

This study and that of Adelman et al. (1987) have both found a similar metallicity for α Dra, but some details have changed. The Sc II and Ni II abundances reflect gf -value differences. The higher signal-to-noise ratio and extended spectral region have resulted in new abundances from C I and Al II, as well as the use of more lines.

Table 7. Comparison of abundance studies.

68 Tau		
Species	O&S (1990)	This Paper
Mg I	-4.41	-4.35
Mg II	-4.27	-4.52
Al I	-5.96	-5.13
Si II	-4.43	-4.40
Ca I	-5.95	-5.74
Ca II	-6.10	-6.23
Sc II	-9.99	-9.82
Ti II	-6.86	-6.73
V II	-7.27	-7.31
Cr I	-6.12	-5.66
Cr II	-5.66	-5.73
Mn I	-6.46	-6.15
Fe I	-4.52	-4.15
Fe II	-4.42	-4.15
Ni II	-5.87	-4.80
Sr II	-8.69	-7.88
Y II	-9.18	-8.94
Zr II	-8.54	-8.32
Ba II	-8.90	-8.53
α Dra		
Species	A et al. (1987)	This Paper
He I	-1.40	-1.04
C II	-3.76	-3.51
Mg I	-4.75	-4.61
Mg II	-4.78	-4.65
Al I	-6.10	-6.07
Si II	-4.89	-4.89
S II	-5.03	-4.60
Ca I	-6.16	-6.28
Ca II	-5.95	-5.61
Sc II	-9.81	-9.41
Ti II	-7.26	-7.10
V II	-7.93	-8.04
Cr I	-6.37	-6.26
Cr II	-6.28	-6.34
Mn I	-6.73	-6.84
Fe I	-4.89	-4.81
Fe II	-4.90	-4.71
Ni II	-6.90	-5.91
Sr II	-9.58	-9.52
Ba II	-10.05	-10.07

Notes. A et al. (1987): Adelman et al. (1987); O&S (1990): Okyudo & Sadakane (1990).

Fig. 1 shows the abundance anomalies of 68 Tau, 21 Lyn and α Dra plotted against atomic number. α Dra is the most metal-poor star, with no particular dependence of abundance anomaly on atomic number. For both 68 Tau and 21 Lyn, the anomalies tend to increase with atomic number. 68 Tau shows the signature of the hot Am stars, with Sc quite underabundant. This is also true for 21 Lyn, but in the context of its general underabundance of the light elements. Its trend of abundances increasing with atomic number indicates that it is a mild hot Am star.

In Table 8, the average values are compared with those of other superficially normal late B and A stars (Adelman 1991), HR 4072 B, an Am star (Adelman 1994), Vega (Adelman & Gulliver 1990) and the Sun. The abundances of α Dra are within the range of other stars of similar effective temperature, but tend to be below the average trend. 21 Lyn's values are most like those of α Dra, except beyond the iron peak where they tend to be slightly above solar. α Dra is more metal-rich than Vega, whose abundances were derived by using a single model atmosphere. Gulliver, Hill & Adelman (1994) have found that Vega is a fast rotating star seen nearly pole-on. An analysis that takes this fact into consideration will have slightly different results. The abundances of ν Cap, a similar star, also have to be modified for the same reason (Gulliver et al. 1991). 68 Tau's abundances are similar to those of α Peg, another hot Am prototype, but there are some differences in the rare earths. 68 Tau's anomalies tend to be greater than those of HR 4072 B, which is more like θ Leo, another hot Am star. The three stars featured in this paper are different from 7 Sex, γ Gem and HD 60825 (Adelman & Philip 1994), which have generally solar abundances.

21 Lyn is a metal-poor star, with the Am phenomenon barely operating in its envelope. θ Leo, HR 4072 B, α Peg and 68 Tau appear to form a sequence of progressively more metal-rich hot Am stars. Whether this is due to initial zero-

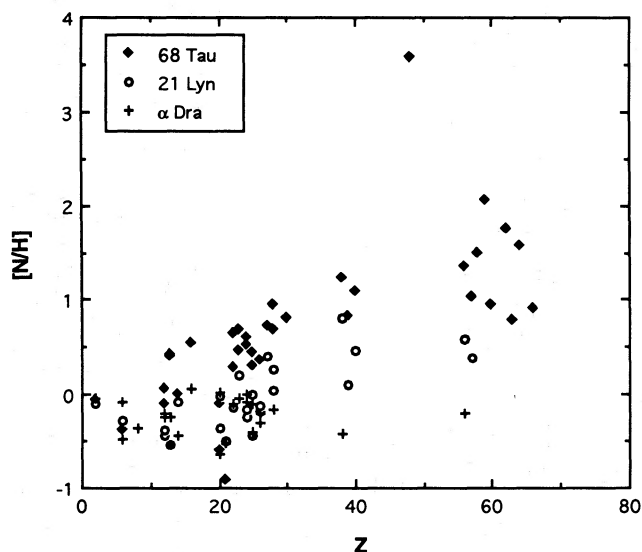


Figure 1. The abundance anomalies of 68 Tau (filled diamonds), 21 Lyn (open circles) and α Dra (pluses), plotted against atomic number. 68 Tau is clearly the most metal-rich, while α Dra is the most metal-poor. 21 Lyn shows generally slightly metal-poor light elements and slightly metal-rich heavy elements.

Table 8. Comparison of derived and solar abundances.

	134 Tau	ν Cap	α Dra	σ Peg	21 Lyn	Vega	θ Leo	68 Tau	HR4072B	Sun
Spec.	log N/H	log N/H	log N/H	log N/H	log N/H	log N/H	log N/H	log N/H	log N/H	log N/H
He I	-1.00	-1.19	-1.04	-1.26	-1.10	-1.52	-1.22	-1.05	...	(-1.00)
C I	...	...	-3.91	...	-3.71	-3.81	...	-3.80	-3.94	-3.43
C II	-3.45	-3.39	-3.51	-4.40	...	...	...	...	...	-3.43
O I	...	-3.33	-3.49	-3.36	...	...	...	...	...	-3.14
Mg I	-5.19	-4.71	-4.61	-4.49	-4.86	-5.07	-4.53	-4.35	-5.12	-4.42
Mg II	-4.53	-4.61	-4.65	-4.54	-4.79	-5.11	-4.66	-4.52	-4.64	-4.42
Al I	-5.85	-6.03	-6.07	-5.58	-6.06	...	-6.03	-5.13	-6.59	-5.53
Al II	...	...	-5.76	...	...	-6.63	...	-5.11	...	-5.53
Si I	-4.55	...	...	-4.69	...	...	...	...	-5.37	-4.45
Si II	-4.51	-4.69	-4.89	-4.43	-4.53	...	-4.46	-4.40	-5.18	-4.45
S II	-4.53	-4.85	-4.60	-4.00	...	...	-4.32	-4.13	...	-4.67
Ca I	-5.92	-5.98	-6.28	-5.61	-6.00	-6.21	-5.76	-5.74	-6.45	-5.64
Ca II	-5.33	-5.55	-5.61	-5.43	-5.66	...	-5.57	-6.23	...	-5.64
Sc II	-9.25	-9.34	-9.41	-9.30	-9.39	-9.62	-9.27	-9.82	-10.07	-8.90
Ti I	...	...	...	...	...	...	...	-6.37	...	-7.01
Ti II	-7.06	-7.05	-7.10	-6.86	-7.15	-7.47	-6.95	-6.73	-7.06	-7.01
V I	...	...	...	...	...	...	...	-7.54	...	-8.00
V II	-8.11	-7.64	-8.04	-7.31	-7.79	...	-7.45	-7.31	-7.80	-8.00
Cr I	-5.87	-6.20	-6.26	-6.16	-6.50	...	-6.31	-5.66	-6.28	-6.26
Cr II	-6.41	-6.13	-6.34	-6.17	-6.41	-6.77	-6.32	-5.73	-6.16	-6.26
Mn I	...	...	-6.84	-6.42	-6.89	-7.16	-6.70	-6.15	-6.51	-6.45
Mn II	...	-6.69	-6.54	-6.22	-6.45	-7.20	-6.31	-6.01	-5.97	-6.45
Fe I	-4.50	-4.58	-4.81	-4.32	-4.70	-5.05	-4.52	-4.15	-4.51	-4.52
Fe II	-4.63	-4.47	-4.71	-4.35	-4.63	-5.12	-4.43	-4.15	-4.54	-4.52
Fe III	...	...	...	-4.00	...	...	...	...	...	-4.52
Co I	...	...	...	-6.54	-6.67	...	-6.95	-6.35	-7.09	-7.08
Co II	...	...	...	-7.04	...	...	...	...	...	-7.08
Ni I	...	-5.67	...	-5.31	-5.71	-6.38	-5.35	-5.07	-5.46	-5.75
Ni II	-5.85	-5.67	-5.91	-5.00	-5.48	-6.29	-5.34	-4.80	-5.45	-5.75
Zn I	...	...	...	...	...	...	...	-6.59	...	-7.40
Sr II	-9.23	-8.77	-9.52	-8.01	-8.30	...	-8.31	-7.88	-8.50	-9.10
Y II	...	...	...	-9.13	-9.65	...	-9.48	-8.94	-8.64	-9.76
Zr II	...	-9.36	...	-8.43	-8.94	...	-8.72	-8.32	-8.99	-9.40
Cd I	...	...	...	...	...	...	...	-6.57	...	-10.14
Ba II	...	-9.29	-10.07	>-8.49	-9.29	-10.58	>-8.98	-8.53	-7.45	-9.87
La II	...	...	...	-9.94	-10.40	...	-10.36	-9.76	-10.13	-10.78
Ce II	...	...	...	...	...	...	...	-8.96	-9.37	-10.45
Pr II	...	...	...	...	...	...	...	-9.24	...	-11.29
Nd II	...	...	...	-9.29	...	...	...	-9.56	-9.62	-10.50
Sm II	...	...	...	...	...	...	...	-9.25	...	-11.00
Eu II	...	...	...	-10.21	...	...	...	-10.70	...	-11.49
Gd II	...	...	...	...	...	...	...	-9.31	...	-10.88
Dy II	...	...	...	-10.31	...	...	...	-9.89	...	-10.80
Er II	...	...	...	-10.17	...	...	...	...	...	-11.07
Tm II	...	...	...	...	...	...	...	...	-10.80	-12.00
Hf II	...	...	...	-10.30	...	...	...	...	...	-11.12
T_{eff}	10825	10250	10025	9600	9500	9400	9250	9025	8900	
log g	3.88	3.90	3.75	3.60	3.75	4.03	3.55	3.95	4.20	
ξ (km/s)	0.0	0.0	0.0	1.8	1.6	0.6	1.7	2.5	1.0	

age main-sequence photospheric metallicities or to other factors, such as 68 Tau being a blue straggler and the other Am stars not being so, is unclear, just as how the hot Am stars merge into the cool end of the HgMn sequence is unclear. HD 147550 (Lopez-Garcia & Adelman 1994) is an intermediate star with an Hg II λ 3984 line. It is difficult at this point, however, to relate 21 Lyn and 68 Tau to the coolest HgMn star ν Cnc, with $T_{\text{eff}} = 10\,375$ K (Adelman 1989), or to the mild Am star 15 Vul ($T_{\text{eff}} = 7600$ K: Bolcal, Kocer & Adelman 1992), the hottest of the other superficially normal

stars of this series that are not in Table 8. Studies of additional stars are needed to help to sort out these issues.

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