

Spectroscopic Investigations of the Main-Sequence B Stars in the Association Cas OB2 and the Open Cluster Platais 1 (C2128+488)

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Abstract. A spectroscopic investigation of four main-sequence stars in the association Cas OB2 (HD 17327A and B, HD 16893, HD 17443) and of two stars in the open cluster Platais 1 (No. 1 (1921) and No. 111 (1600)) was carried out using high-resolution CCD spectra, obtained with echelle-spectrometer "LYNX" (6-m telescope, Special Astrophysical Observatory, Russian Academy of Sciences). We have determined the atmospheric parameters for the program stars, their projected rotational velocities and elemental abundances in their atmospheres. Two new HgMn stars - HD 17327A and Platais No. 1 - were detected. HD 17443 is not a Be star.

1. Introduction

The most informative results on galactic chemical evolution can be obtained from the investigation of open clusters and associations. These stellar systems allow us the unique possibility to study evolutionary changes in the chemical composition among genetically connected stars.

In this work we present the results of a spectroscopic investigation of some main-sequence stars in the association Cas OB2 and in the open cluster Platais 1 (C2128+488). The main aim was to determine the atmospheric parameters and chemical composition for the selected stars.

2. Program stars

For the observations we selected six stars, four of which are members of the association Cas OB2, and two are members of the open cluster Platais 1 (C2128+488). The members of Cas OB2, HD 17443 (B9 V) and HD 16893 (A3 Vp), are situated within the strip of main-sequence stars. The secondary component of the visual binary ADS 2142 - HD 17327B (A2 Vn) is also a main-sequence star, while the primary HD 17327A (B8 III) has its position near to the "turn-off" point of this association. HD 17443 is a possible candidate for a Be type star.

From the open cluster Platais (C2128+488) (Turner et al. 1994) we have selected two B-stars, No. 111 (Platais 1600, B9.5 V) which is a main sequence object, while No. 1 (Platais 1921, B9 IIIp) is situated in the vicinity of the "turn-off" point.

3. Observations and method of analysis

The high-resolution spectra of these stars have been obtained with echelle-spectrometer PFES, equipped with a 1040×1170 pixel CCD (Panchuk et al. 1998), installed on the 6-m telescope of Special Astrophysical Observatory, Russian Academy of Sciences (Russia, Northern Caucasus). The resolving power was 24000, with S/N $\approx 70 - 100$. Information concerning the program star spectra is given in Table 1.

Table 1. Program stars spectra

Star	V	HJD 2450000+	Region (Å)	Exposure (min)	$v \sin i$ (km s^{-1})	T_{eff}	$\log g$	V_t
HD 16893	8.53	1006.528	4682 - 8596	20	25	8500	4.00	3.0
HD 17327a	7.53	1003.527	4420 - 7767	20	40	11700	3.20	1.0
		1246.172	4383 - 7960	3				
		1246.179	4383 - 7960	7				
HD 17327b	10.33	1246.202	4383 - 7960	30	200	10000	4.00	3.0
HD 17443	8.74	1003.480	4420 - 7767	30	180	10900	4.05	3.0
No. 1 (1921)	11.53	1003.304	4420 - 7767	30	15	10000	3.50	3.5
No. 111(1600)	12.54	1004.461	4420 - 7767	54	150	13000	4.00	3.0

The CCD spectra have been reduced using the DECH20 code (Galazutdinov 1992). The analysis has been carried out using Kurucz' (1992) WIDTH9 code. Atmosphere models have been interpolated from Kurucz's (1992) grid. Oscillator strengths were taken from Kurucz (1995) database (CD-ROMs 15, 18). For the star HD 16893 we also used additional data from Adelman et al. (1996).

To evaluate line blends in the spectra of stars with high projected rotational velocities, the spectrum synthesis technique was applied. This was performed with the help of the SYNSPEC code (Hubeny et al. 1994). The projected rotational velocities for the program stars were estimated by fitting the synthesized spectrum to the observed one. Results are given in Table 1.

4. Atmospheric parameters and chemical composition

We used several approaches to estimate the atmosphere parameters of the program stars. Among them: $(U - B)$, $(B - V) - T_{\text{eff}}$, $\log g$ and $(b - y) - T_{\text{eff}}$, $\log g$ calibrations from Castelli (1991), $(b - y)$, $m1$, $c1$, $\beta - T_{\text{eff}}$, $\log g$ calibrations from Moon & Dworetsky (1985); and comparisons of the observed H α and H β line profiles with the synthetically generated ones.

For the coolest star of our sample, HD 16893, the surface gravity was determined by forcing Fe I and Fe II to produce the same abundance. Its microturbulent velocity was obtained by forcing the abundances from Fe I lines to be independent of the equivalent line widths. In case of HD17327A and Platais No. 1 (1921) for the determination of V_t we have used Fe II lines. For the rest

Table 2. Abundances for HD 16893.

Element	log <i>gf</i> (Kurucz)			log <i>gf</i> (Adelman et al.)		
	[E]/H	σ	NL	[E]/H	σ	NL
C I	-0.45	0.17	7	-0.50	0.18	5
N I	+0.09	0.03	2	-0.20	0.51	5
O I	-0.12	0.00	1	-0.07	0.18	4
Na I	+0.29	0.00	1	-	-	-
Mg I	-0.98	0.22	2	-0.58	0.00	1
Mg II	-	-	-	+0.54	0.00	1
Al I	+0.92	0.08	2	+0.92	0.08	2
Si II	-0.45	0.00	1	-0.14	0.38	3
S I	+0.20	0.20	3	+0.20	0.20	3
Ca I	-0.02	0.23	15	-	-	-
Sc II	+0.04	0.38	6	-0.12	0.12	2
Ti I	-	-	-	+0.37	0.26	2
Ti II	-0.20	0.15	13	-0.05	0.28	13
V II	+0.78	0.00	1	+0.78	0.00	1
Cr II	-0.09	0.15	10	-0.03	0.24	10
Mn I	+0.65	0.24	4	-	-	-
Mn II	-	-	-	+1.05	0.02	2
Fe I	-0.21	0.17	18	-0.68	0.00	1
Fe II	-0.17	0.09	10	-0.14	0.42	13
Co I	+1.10	0.18	5	+1.19	0.26	6
Ni I	+0.06	0.20	8	-	-	-
Cu I	+0.22	0.00	1	+0.22	0.00	1
Zn I	-0.01	0.27	2	-	-	-
Sr I	+1.43	0.00	1	-	-	-
Y I	+2.56	0.00	1	-	-	-
Y II	+0.58	0.49	5	+0.41	0.34	3
Zr II	+0.63	0.28	3	+0.63	0.28	3
Ba II	+0.23	0.42	4	+0.35	0.00	1
La II	+1.14	0.01	2	+1.14	0.01	2
Ce II	+1.21	0.43	3	+1.43	0.56	4
Pr II	-	-	-	+1.72	0.00	1
Nd II	+1.85	0.00	1	+1.85	0.00	1
Sm II	+1.90	0.00	1	-	-	-

NL - number of lines

of the program stars a microturbulent velocity of 3 km s⁻¹ was adopted as a more appropriate value for the late B stars. All the finally adopted atmospheric parameters are listed in Table 1. In Tables 2 and 3 we give the calculated abundances for HD 16893, HD 17327A and Platais No. 1 (1921), respectively.

It should be noted that for the rapidly rotating B stars HD 17443 and Platais No. 111 (1600) we estimated only the helium and magnesium abundance from two strong features He I 4471 Å and Mg II 4481 Å. This was performed using spectral synthesis. In both cases the helium and magnesium abundances appeared to be solar.

Our abundance analysis revealed the following.

1. two stars, HD 17327A and Platais No. 1, appeared to be mercury-manganese stars. Their chemical composition is typical for that kind of stars: a strong overabundance of Mn and Hg accompanied by the overabundances of C, S, P, Y and Zr. This overabundance could be explained by the light-inductive drift mechanism (LID) (Atutov & Shalagin, 1988)

2. HD 16893 also demonstrates some Mn overabundance, but its mercury content was not measured. The final classification of this star requires therefore additional investigation.

3. an interesting result was obtained for the helium content. This element is overabundant in the atmospheres of HD 17327A and Platais No. 1 (1921), while

Table 3. Abundances for HD 17327A and Platais No. 1 (1921).

Element	HD 17327a									Platais No. 1 (1921)		
	1			2			3			[El/H]	σ	NL
	[El/H]	σ	NL	[El/H]	σ	NL	[El/H]	σ	NL			
He I	+0.17	0.57	2	+0.40	0.00	1	+0.20	0.00	1	+0.79	0.12	2
C I	+0.78	0.00	2	+0.41	0.00	1	+0.47	0.31	3	+0.42	0.38	2
N I				+0.31	0.00	1				-0.48	0.00	1
O I	-0.39	0.32	2	-0.10	0.32	5	+0.02	0.44	3	+0.37	0.28	4
Mg I	-0.56	0.00	1	-0.46	0.00	1				-0.35	0.21	3
Mg II	+0.08	0.00	1				-0.31	0.44	3	+0.24	0.00	1
Al II	-0.36	0.00	1									
Si II	-0.63	0.33	6	-0.75	0.20	6	-0.43	0.24	6	-0.73	0.34	5
P II	+0.47	0.00	1	+1.11	0.00	1	+1.48	0.00	1	+1.54	0.69	2
S II	+0.20	0.05	3	+0.46	0.32	3	+0.43	0.00	1			
Sc II	+1.25	0.00	1	+1.35	0.00	1				+0.64	0.35	2
Ti II	+0.71	0.28	9	+0.45	0.40	4	+0.40	0.51	4	-0.08	0.28	10
Cr II	+0.47	0.26	15	+0.46	0.31	13	+0.44	0.36	9	+1.08	0.18	10
Mn I										+1.65	0.00	1
Mn II	+1.94	0.20	18	+2.01	0.24	11	+1.73	0.24	14	+1.66	0.18	12
Fe II	-0.09	0.26	66	-0.08	0.25	32	-0.14	0.21	26	+0.13	0.26	23
Y II	+2.51	0.00	1	+1.57	0.38	2	+1.84	0.00	1	+1.16	0.35	3
Zr II										+2.02	0.50	2
Hg I	+4.57	0.00	1	+4.20	0.00	1				+4.05	0.00	1

NL - number of lines

its content in Platais No. 111 and HD 17443 is normal. It should be noted that HD 17327A and Platais No. 1 (1921) have low projected rotational velocities that might be favorable to the LID mechanism in atmospheres. As a result, we have obtained the helium overabundance.

4. HD 17443 is not likely to be a Be star because we did not detect any emission features in H α line profile.

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