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A STATISTICAL STUDY OF THE Si IV RESONANCE LINE PARAMETERS IN 19 Be STARS

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Abstract. Using the GR model, we analyze the ultraviolet Si IV resonance lines in the spectra of 19 Be stars of different spectral subtypes, in order to detect the presence of absorption components and to analyze their characteristics. From this analysis we can calculate the values of a group of physical parameters, such as the apparent rotational and radial velocities, the random velocities of the ion thermal motions, as well as the absorbed energy and the logarithm of the column density of the independent regions of matter which produce the main and the satellite components of the studied spectral lines.

Key words: stars: Be – techniques: spectroscopic – ultraviolet: Si IV resonance lines

1. INTRODUCTION

The ultraviolet resonance lines of Si IV at 1393.755 and 1402.77 Å have peculiar profiles in the spactra of Be-type stars, which indicate a multicomponent nature of their origin. This doublet is usually a strong feature in the spectra of early-type stars and is a useful tool for the study of the structure of stellar atmospheres. Many researchers have studied the existence of absorption components, which accompany the Si IV resonance lines in the spectra of Be-type stars and which are of circumstellar or interstellar origin (e.g., Underhill 1975; Snow et al. 1979; Sapar & Sapar 1992). Lyratzi et al. (2006), applying the model proposed by Danezis et al. (2003), investigated the presence of absorption components in the vicinity of the Si IV resonance lines in 68 Be-type stars and their kinematical characteristics.

In this paper, using the new Gauss-Rotation model (Danezis et al. 2007),

Table 1. Kinematical parameters for the studied Be stars (in km/s) determined from the two Si IV resonance lines (1 and 2).

Star	Spectral type	V_{rad1}	V_{rad2}	V_{rot1}	V_{rot2}	V_{rand1}	V_{rand2}
HD 53367	B0 IVe	–22		180		51	
HD 44458	B1 Vpe	10	–18	128	140	57	66
HD 58343	B2 Vne	–32	–22	118	128	44	38
HD 45910	B2 IIIe	–65	–69	200	180	26	26
HD 41335	B2 Vne	–5	–7	113	100	64	53
HD 52721	B2 Vne	–30	–25	183	173	25	25
HD 37202	B2 IVp	–73	–71	170	190	25	25
HD 32991	B2 Ve	21	26	127	140	28	25
HD 58050	B2 Ve	9	9	150	142	38	25
HD 37490	B3 IIIe	–43	–43	125	100	53	51
HD 25940	B3 Ve	–40	–42	193	175	38	25
HD 183362	B3 Ve	–10	–11	158	140	51	51
HD 67888	B4 IIIpe	22		100		48	
HD 89884	B5 IIIe	–48	–56	117	115	42	51
HD 23480	B6 IVe	–11	–15	103	100	39	38
HD 192044	B7 Ve	–18	–16	160	150	38	35
HD 29866	B8 IVne	–43	–43	100	95	38	31
HD 199218	B8 IVnne	–18	–12	95	90	36	33
HD 50138	B9 e	19	18	133	130	34	25
Mean		–20±28	–23±28	140±34	135±32	41±11	37±13

Table 2. Absorbed energy (in eV) and logarithm of the column density in one or two absorption components of the Si IV resonance lines.

		λ 1392.755 Å				λ 1402.772Å			
Star	Spectral type	E_{ab1}	E_{ab2}	log $CD1$	log $CD2$	E_{ab1}	E_{ab2}	log $CD1$	log $CD2$
HD 53367	B0 IVe	0.18		11.47		0.15		11.37	
HD 44458	B1 Vpe	0.76	0.57	11.28	10.30	0.61	0.45	11.18	10.20
HD 58343	B2 Vne	0.35	0.39	10.86	10.24	0.28	0.31	10.76	10.14
HD 45910	B2 IIIe	0.79	0.51	11.65	11.65	0.63	0.41	11.55	11.55
HD 41335	B2 Vne	0.67	0.61	11.23	11.23	0.54	0.49	11.13	11.13
HD 52721	B2 Vne	0.50	0.58	11.09	10.13	0.40	0.46	11.00	10.04
HD 37202	B2 IVp	0.67	0.57	11.22	10.70	0.54	0.46	11.13	10.61
HD 32991	B2 Ve	0.30	0.19	10.88	10.25	0.24	0.15	10.78	10.15
HD 58050	B2 Ve	0.54	0.58	11.13	10.73	0.43	0.46	11.04	10.64
HD 37490	B3 IIIe	0.65	0.62	11.21	10.11	0.52	0.50	11.11	10.01
HD 25940	B3 Ve	0.28	0.24	10.85	10.85	0.23	0.20	10.75	10.75
HD 183362	B3 Ve	0.66	0.56	11.27	9.97	0.52	0.45	11.17	9.87
HD 67888	B4 IIIpe	0.56		11.15		0.45		11.05	
HD 89884	B5 IIIe	0.36	0.37	10.95	11.49	0.28	0.30	10.85	11.40
HD 23480	B6 IVe	0.29	0.28	10.67	10.93	0.23	0.23	10.58	10.83
HD 192044	B7 Ve	0.26	0.22	10.81	10.08	0.21	0.20	10.71	9.99
HD 29866	B8 IVne	0.24	0.15	10.77	10.12	0.19	0.12	10.68	10.03
HD 199218	B8 IVnne	0.24	0.15	10.78	10.22	0.20	0.12	10.68	10.12
HD 50138	B9e	0.45	0.40	11.38	10.58	0.36	0.32	11.28	10.48
Mean		0.46	0.41	11.09	10.56	0.37	0.33	10.99	10.47
St. dev.		0.20	0.17	0.27	0.52	0.16	0.14	0.27	0.52

we analyze the Si IV resonance lines in the spectra of 19 Be stars of different spectral subtypes. For this we calculate the models for grids of different physical parameters: the apparent rotational and radial velocities, the random velocities of

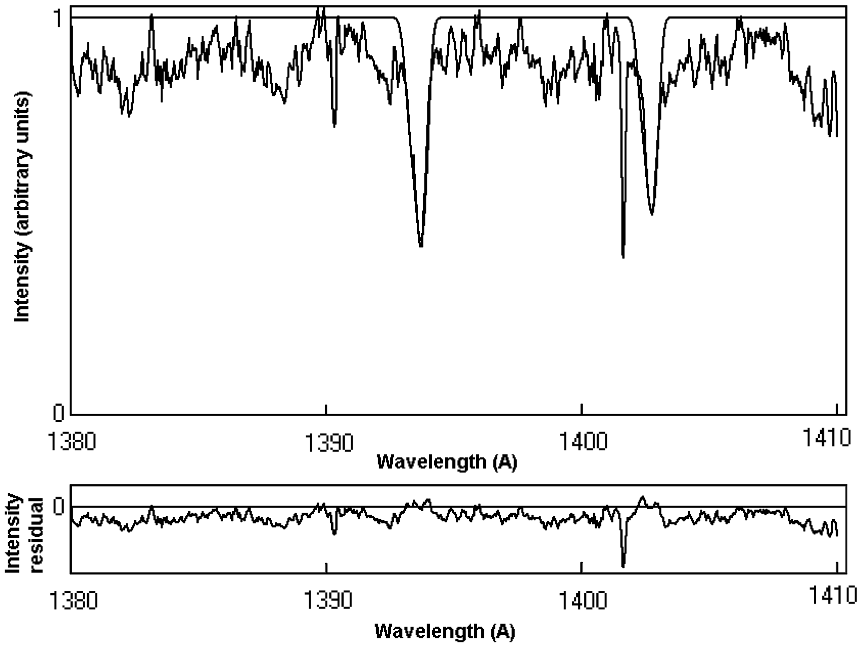

Fig. 1. The region around the Si IV resonance lines at 1393.755 and 1402.778 Å in the spectrum of HD 29866 fitted to the synthetic line profiles of the model. Each of the Si IV lines consists of two components. The graph below shows the differences between the observed and the model line profiles.

the thermal motions of ions, as well as the absorbed energy and the the column density of the distinct regions in the atmosphere and above it, which produce the main and the satellite components of the studied spectral lines.

2. RESULTS

The spectrograms of 19 Be-stars, listed in Table 1, have been obtained with the IUE satellite short wavelength range camera (SWP) at high resolution (0.1 to 0.3 Å). Table 1 also gives the values of the kinematical parameters measured for the two Si IV lines: the apparent radial velocities (columns 3 and 4), rotational velocities (columns 5 and 6) and the random velocities of the thermal motions of ions in one or two satellite absorption components (columns 7 and 8). In Table 2 we give the values of the absorbed energy (columns 3–4 and 7–8) and the logarithms of column density (columns 5–6 and 9–10) for the same absorption components.

In Figure 1, we present the spectrum of a B2 Ve star HD 29866 in the vicinity of the Si IV doublet and the best fit of these lines to a model. The best fit has been obtained with two absorption components. The graph below shows the differences between the observed and the model line profiles.

We conclude that the values of the parameters of a set of Be stars calculated using the new GR model (Danezis et al. 2007) are in agreement with the values of the parameters calculated earlier by Lyratzi et al. (2006).

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