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The Main Parameters of SPB Stars on the Basis of IUE Spectra

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Abstract. We derive mean stellar parameters for 14 SPB stars observed during the IUE satellite mission, using an algorithmic procedure fitting theoretical flux distributions (Kurucz, 1996) to the IUE low-resolution spectra. We focus our attention on the metallicity parameter $[m/H]$. We found the mean value of $[m/H] = -0.27 \pm 0.22$.

1. Introduction

Knowledge of abundances of the iron-group elements in B-type stars is important for a number of reasons. In particular, the spectral lines of these elements are the major source of opacity in hot stars driving pulsations in β Cephei and SPB stars by the classical κ-mechanism (Dziembowski & Pamyatnykh, 1993; Gautschy & Saio, 1993). Recently, Fitzpatrick & Massa (1999) demonstrated the usefulness of the low-resolution IUE observations in deriving the metal abundance parameter, $[m/H]$, simultaneously with the effective temperature ($T_{\rm eff}$), surface gravity (g), angular diameter (θ) and interstellar reddening parameter ($E(B-V)$). The method was also tested by Niemczura et al. (2000) and applied to the standard stars listed in Code et al. (1976).

2. Observations and their analysis

We used IUE NEWSIPS observations of SPB stars obtained with the large aperture from both long- and short-wavelength cameras with high and low spectral resolutions. The observations expressed in the absolute units were supplemented by the optical spectrophotometric measurements taken from the literature. We use the Johnson V magnitudes if no optical spectrophotometric data were available. The method of analysis is based on the least-squares optimization algorithm (Fitzpatrick & Massa, 1999; Niemczura et al., 2000), which enables us to obtain various parameters involved with stellar spectra. The original method was modified in such a way that the stellar gravities were obtained from evolutionary models calculated by Townsend (2001). We found the relation $\log g = -12.4294 + 4.4628 \log T_{\rm eff} - 0.8208 \log L/L_{\odot}$ to be valid for main-sequence models with masses between 3.0 and 6.5 $M_{\odot}$. The standard deviation for this formula is equal to 0.01 dex. In order to calculate $\log L/L_{\odot}$, knowledge of the stellar parallaxes is necessary. We use HIPPARCOS parallaxes (ESA, 1997). During the best-fit procedure, the current luminosity has to be corrected for

Table 1. The best-fit parameters for the analysed SPB stars.

HD	$\log T_{\rm eff}$	$\log g$	$E(B-V)$	θ	$[m/H]$	$\log L/L_\odot$
1976	4.201 ± 0.004	3.46	0.081 ± 0.004	0.162 ± 0.007	-0.33	3.48 ± 0.02
25558	4.216 ± 0.007	3.63	0.100 ± 0.010	0.172 ± 0.013	-0.37	3.36 ± 0.04
26326	4.174 ± 0.004	3.67	0.001 ± 0.004	0.181 ± 0.020	-0.40	3.08 ± 0.17
27396	4.198 ± 0.008	3.95	0.140 ± 0.009	0.226 ± 0.015	-0.32	2.87 ± 0.06
37151	4.123 ± 0.006	4.26	0.036 ± 0.006	0.081 ± 0.030	-0.20	2.08 ± 0.03
74195	4.213 ± 0.005	3.56	0.006 ± 0.004	0.387 ± 0.023	-0.42	3.42 ± 0.03
74560	4.229 ± 0.004	4.05	0.006 ± 0.004	0.207 ± 0.009	-0.08	2.91 ± 0.02
147394	4.176 ± 0.003	3.90	0.011 ± 0.003	0.360 ± 0.006	-0.31	2.81 ± 0.01
160762	4.264 ± 0.004	3.75	0.045 ± 0.003	0.321 ± 0.011	-0.47	3.47 ± 0.03
181558	4.209 ± 0.006	4.08	0.090 ± 0.005	0.116 ± 0.027	-0.36	2.77 ± 0.16
182255	4.180 ± 0.003	4.15	0.012 ± 0.003	0.196 ± 0.011	-0.62	2.53 ± 0.03
183133	4.240 ± 0.013	3.92	0.107 ± 0.025	0.086 ± 0.042	-0.27	3.13 ± 0.06
208057	4.225 ± 0.003	4.03	0.006 ± 0.020	0.190 ± 0.008	-0.10	2.91 ± 0.06
215573	4.152 ± 0.002	4.07	0.016 ± 0.003	0.193 ± 0.006	-0.23	2.47 ± 0.02

the Lutz-Kelker (1975) bias (Jerzykiewicz & Molenda-Zakowicz, 2000). First, we search for the best-fit solutions with the fixed values of $[m/H]$. Then we fit the Lagrangian polynomials to the relation $\chi^2([m/H])$ to find metallicity corresponding to the minimum of χ^2. Table 1 shows the best-fit parameters (with errors) for the analysed SPB stars.

The UV spectral region of main-sequence B stars is very rich in spectral lines of iron-group elements and our results may provide an important clue to fix the metallicity of these stars. Some questions remain open. In particular, a verification of the metallicities using high-resolution spectra is needed. We therefore plan to study high-resolution IUE observations for known SPB stars in the near future.

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