The article presents the results of physical parameters ($T_{\text{eff}}$, $\log g$, $L$, $M$, $R$, $v_e \sin i$, $v_e$) study for chemically peculiar stars in the Orion OB1 association. Spectral material of circularly polarized radiation for all CP stars was obtained at the 6-m BTA telescope in the SAO RAS. As a result, no statistical differences were found between magnetic and non-magnetic CP stars of the association. The difference was found for the projection of rotation velocity parameter $v_e \sin i$. However, a detailed study of the equatorial velocity $v_e$ showed that the average value for magnetic does not differ from non-magnetic Ap/Bp stars.
1. Introduction

Physical parameters are the basic information that can fully describe and classify stars. The data of stars in clusters or associations, what formed under common origin and matter, gives great importance. The most numerous grouping of early-type CP stars is in the Orion OB1 association. The goals, objectives and selection of research objects are described in paper [1] (59 Ap/Bp stars).

Our previous research [2] showed that no significant differences in physical parameters were found between the subgroups in the association, except for the projection of the rotation velocity $v_e \sin i$: for the 1c subgroup average value was in 2-3 times less than for other. Thanks to the completed analysis of the magnetic field [3–5], in this paper we carried out a statistical analysis of magnetic and non-magnetic Ap/Bp stars of the association.

2. Obtained data and methods

Circularly polarized radiation spectra were obtained with the Main Stellar Spectrograph (MSS) of the 6-m BTA telescope. Instruments, methods of observation and data analysis have been repeatedly described earlier [3–5]. The spectra have an average resolution $R = 15,000$, signal-to-noise ratio $S/N \approx 200 – 300$ and spectral range $4400 – 5000$ Å what appropriate for analyzing magnetic field and physical parameters. The primary spectra processing and extraction was carried out using standard methods in MIDAS context ZEEMAN [6] and IRAF.

We used the models of atmosphere method to estimate the $T_{\text{eff}}$, $\log g$, $v_e \sin i$ parameters. Comparing the observed hydrogen $H\beta$ line profile with the grid of theoretical spectra, the desired parameters were determined using the $\chi^2$ method. For calculation models of atmosphere and synthetic spectra we used ATLAS9, SYNTHMAG [7] codes and VALD3 [8] atomic database. To determine luminosity $L$, radius $R$ and $v_e$ standard formulas were used [9], evolutionary tracks were used to estimate the mass $M$ [10].

For statistical studies, the $\chi^2$ test and the Student’s $t$-test were used.

3. Conclusion

For analysis we used two samples of Ap/Bp stars: magnetic (31 mCP stars) and non-magnetic (28 CP stars). Statistical analysis shows that the average values of the $T_{\text{eff}}$, $\log g$, $L$, $M$, $R$ parameters have no significant differences between magnetic and non-magnetic Ap/Bp stars. The only difference was revealed in the projection of rotation velocity $v_e \sin i$: for mCP stars this value turned out to be almost in two times less than for non-magnetic CP stars (fig. 1). Additionally, the equatorial rotation velocity $v_e$ studies were carried out using the periods from the our paper [11]. As a result, the average $v_e$ values have no significant differences between magnetic and non-magnetic Ap/Bp stars (fig. 2). This means, that the difference in mean $v_e \sin i$ value gives the inclination angle $i$. For the next step magnetic modeling for mCP stars in the Orion OB1 association should be carried out to confirm this result.
Figure 1: Distribution of projection of rotational velocity \( v_e \sin i \) parameter for magnetic and non-magnetic Ap/Bp stars in the Orion OB1 association. Student’s \( t \)-test values are \( t_{\text{temp}} = 4.234 > t_{\text{crit}} = 2.048 \) for \( \alpha = 0.05 \).

Figure 2: Distribution of equatorial velocity \( v_e \) for magnetic and non-magnetic Ap/Bp stars in the Orion OB1 association. Student’s \( t \)-test values are \( t_{\text{temp}} = 0.290 < t_{\text{crit}} = 2.048 \) for \( \alpha = 0.05 \).

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References


