Physical Parameters of Long-Period CP Stars

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1 Introduction

Physical parameters ($v_e \sin i$, V_R, T_{eff}, log g, $L/L_\odot$, $M/M_\odot$, $R/R_\odot$) are the main characteristics that describe the physical and evolutionary state of objects, what is important aspect for understanding their nature. This knowledge is important for creating a reliable observational base for the theory of formation and evolution magnetic field of chemically peculiar stars (CP stars).

In this work we analyzed confirmed long-period objects: HD 965, HD 18078, HD 50169. The paper presents the results of the analysis the physical parameters of an interesting objects among CP stars – stars with extremely long rotation period (tens – hundreds years) and large-scale magnetic field. The nature of these objects is still not clear, so studying physical parameters will help to be closer of understanding them.

2 Observations and Reduction Technique

The observed data were obtained at the 6-m BTA telescope using the Main Stellar Spectrograph (MSS[4]) (Panchuk et al. 2014), equipped with a circular polarization analyzer developed by Chountonov (2004). The common operating spectral range is 4400-5000 Å. The spectral resolution (R=15000) and signal-to-noise ratio (S/N=250) allow us to determine the fundamental parameters of stars with quite high accuracy.

[4] Main Stellar Spectrograph – https://www.sao.ru/hq/lizm/mss/en/index.html

The primary data analysis was performed in the ESO MIDAS system using the ZEEMAN context (Kudryavtsev 2000). All the spectra were normalized to the continuum level (IRAF, Spectool[5]).

3 Methods of Determination Fundamental Parameters

We use stellar atmosphere models for determination the parameters $v_e \sin i$, V_R, T_{eff}, $\log g$: method is based on the comparison of the observed Hβ hydrogen line profile with the grid of synthetic profiles. To find the best-fitted solution with the required parameters, we used the χ^2 test. Parameters ($\log g$, $L/L_\odot$, $M/M_\odot$, $R/R_\odot$) were determined using fundamental laws and evolutionary tracks. More details see at Moiseeva et al. (2019). We use well-known stars for calibration our results (see at Moiseeva et al. (2019, Table 1, p. 63)).

4 Results

In this work, we study confirmed long-period stars: HD 965 (Romanyuk et al. 2015), HD 18078 (Mathys et al. 2016), HD 50169 (Mathys et al. 2019). We measured fundamental parameters for this stars at first time, using the homogeneous spectral material and the same methods. These results are shown in Table 1.

Table 1. Fundamental parameters of long-period CP stars.

Parameter	HD 965	HD 18078	HD 50169
T_{eff} (phot/spec), K	7480 / 7300 ± 310	8412 / 8500 ± 270	8620 / 8700 ± 260
$\log g$ (phot/spec)	3.8 / 4.0 ± 0.3	3.2 / 3.2 ± 0.3	3.8 / 3.1 ± 0.4
$\log(L/L_\odot)$	1.2 ± 0.1	2.0 ± 0.2	1.9 ± 0.1
$M,\ M_\odot$	1.7 ± 0.4	2.6 ± 0.5	2.5 ± 0.5
$R,\ R_\odot$	2.3 ± 0.5	5.7 ± 0.8	5.6 ± 0.8
$\log t$	9.2	8.8	8.9

For determination evolutionary status we put this stars at HR diagram, using evolutionary tracks from paper Girardi et al. (2000) (see in Fig. 1). To compare the obtained parameters, a well-known object of the same type HD 201601 was added.

[5] User guide – http://iraf.noao.edu/projects/spectroscopy/spectool/spectool.html

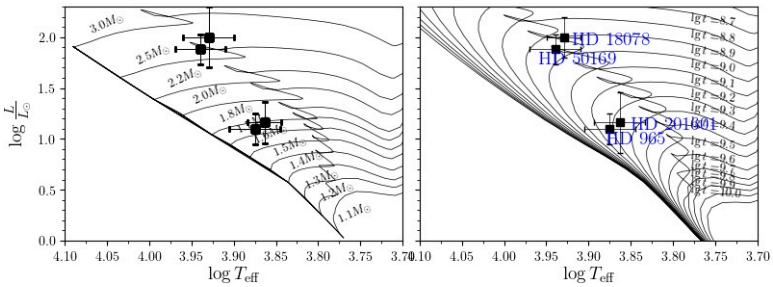

Fig. 1. Evolution tracks for selected long-period CP stars.

As we can see, selected stars are different. For full statistical analysis we need more such stars. But it is difficult, because a lot of time for monitoring are required.

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