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HD 45583 – a CP star with a complex magnetic field sturcture

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Abstract. HD 45583 has a double-wave longitudinal field curve, indicating the presence of a strong and complex magnetic field. We have estimated the surface magnetic field and chemical composition of this star.

Key words: stars: chemically peculiar – stars: magnetic

1. Observations

Twenty Zeeman spectra were obtained with the Main Stellar Spectrograph, and one with the Nasmyth Echelle Spectrograph, of the 6 m telescope at the Special Astrophysical Observatory during 4 observing runs. The reduction was performed using standard technique with MIDAS and IRAF.

2. Measurement of the magnetic field

Our measurements of the longitudinal magnetic field $B_{\rm e}$ are presented in Fig. 1. The rotation period ($P = 1.177177^d$) of the star was estimated by North (1987) from the photometric variability. The curve of $B_{\rm e}$ that we constructed from our measurements agrees well with the period reported by North. The curve clearly exhibits a double-wave form.

Based on Zeeman broadening of some iron lines we have also estimated the surface magnetic field $B_{\rm s}$ to be approximately 34 kG.

3. Model atmosphere and chemical abundances

The atmosphere of HD 45583 was modelled using the LTE approach. For spectrum synthesis we used the SYNTHMAG_FAST code (Kochukhov, 2007). The model atmosphere was computed with Atlas9 for $T_{\rm eff} = 12\,600$ K, $\log g = 3.9$ and [M/H] = 1. The effective temperature and surface gravity was determined using calibrations of *uvby* photometry and by comparing the observed profile of Hβ with a synthetic one. Our temperature determined from the hydrogen line is in a good agreement with that reported by Glagolevskij (1994) and Landstreet *et al.* (2007), while the photometric calibrations give higher values.

We have determined abundances of some chemical elements using VALD linelists. Strong blending and spectral variability affect the derived abundances. We derived: Fe: -3.6 dex (average of a few lines). Si: -3.6 (-3.9) using Si II

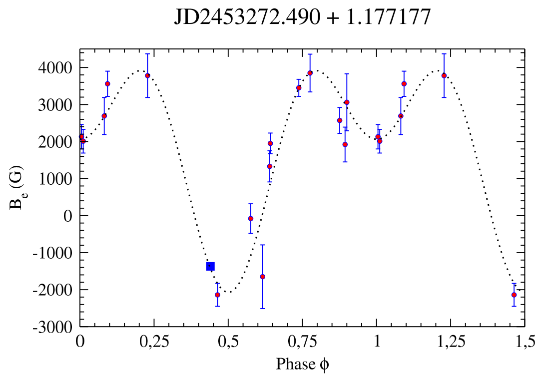

Figure 1. Curve of B_e derived from our measurements. The square is a value reported by Bagnulo *et al.* (2006).

5041.0 Å and 5055.9 Å, respectively. Cr: −4.65 extracted from analysis of the Cr II lines at 4824.1 and 5313.56 Å. Mg: −4.8 dex using the line Mg II 4481.126 Å. Nd: −7.45 (Nd III 4759.5 Å).

Taking into account the deficit of helium (approximately 1 dex lower than the solar abundace), this abundance pattern is typical for Si stars.

4. Conclusions

The double-wave curve of the B_e variation, together with rapid rotation and significant spectral variability, suggest that HD 45583 hosts a strong and complex non-dipolar magnetic field. The derived surface magnetic field, $B_s = 34$ kG, is one of the largest known for a main sequence peculiar star.

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