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HD 3980: a New "Li-spotted" roAp Star

N.S. Polosukhina[1], N.A. Drake[2], M. Hack[3], R. de la Reza[2], and D. Shakhovskoy[1]

[1] *Crimean Astrophysical Observatory, Nauchny, Crimea, 334413, Ukraine*

[2] *Observatório Nacional/MCT, Rua General José Cristino 77, 20921-400, Rio de Janeiro, Brazil*

[3] *Department of Astronomy, Trieste University, Via Tiepolo 11, 34131 Trieste, Italy*

Abstract. We report on preliminary results of new high-resolution spectroscopic observations of the roAp star HD 3980 in the Li I 6708 Å line region. Strong variations of position and intensity of this line with the rotation phase enable us to consider this star as a new member of the intriguing group of "Li-spotted" CP stars.

1. Main Results

We present the results of the spectral monitoring of the roAp star HD 3980 in the Li I 6708 Å spectral region. The high spectral resolution observations ($R = 88\,000$) were carried out at Mount Stromlo Observatory (Australia) during an observing run in September-October 2001 with the 74-inch telescope and the echelle spectrograph.

Among the program stars besides HD 3980, we observed also HD 15144 and HD 24712 which have similar physical atmospheric parameters ($T_{\rm eff}$ and $\log g$). Analysis of the spectra of these stars showed that only HD 3980 has a strong and variable Li I 6708 Å line. Even though the monitoring of HD 15144 and HD 24712 was not sufficiently long, no Li I lines were detected in the spectra of these stars. The most interesting and important result of our observations was obtained for HD 3980. This star is a late type Ap star with strong photometric variations in the Strömgren-v pass band (Maitzen et al. 1980). Its photometric curve has two minima (the primary minimum depth amounts to 0.13 mag and the secondary minimum shows a half of this value). Both maxima are nearly equal and all extrema are separated by 0.25 phase of the rotation period. The magnetic field ($H_{\rm eff}$) of HD 3980 was studied by Maitzen et al. (1980). Unfortunately, due to the large scattering and bad phase covering of the magnetic field measurements, a construction of a reliable magnetic curve is difficult.

The monitoring of the Li I line 6708 Å spectral region shows large spectral variations, especially in the profiles of the Li I 6707.8 Å and Pr III 6706.7 Å lines (see Figures 1 and 2 in Polosukhina et al. 2002). The behavior of the Li I 6708 Å line in HD 3980 is very similar to that of HD 83368 (see Polosukhina et al. 1999;

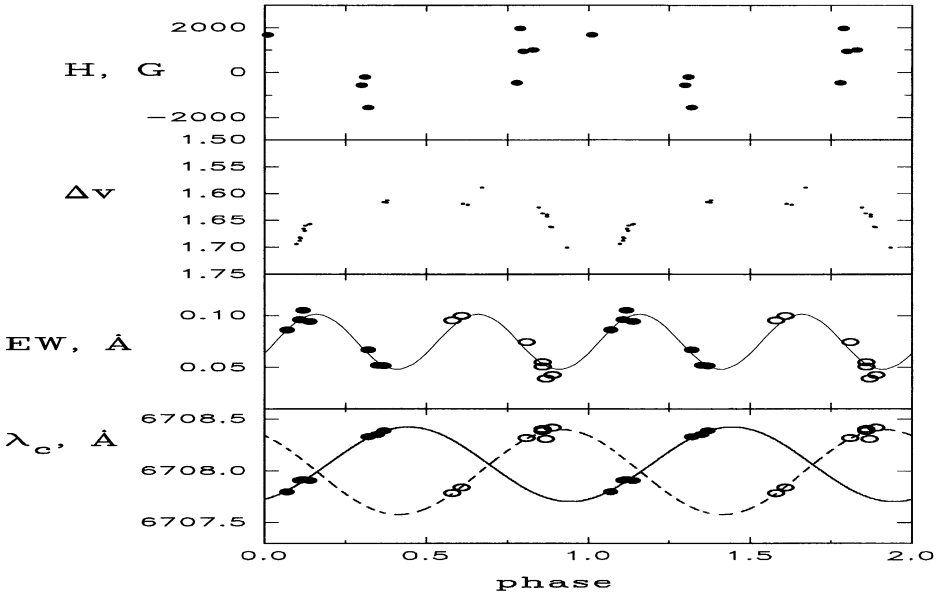

Figure 1. HD 3980. From top to bottom: magnetic field and photometric variations (from Maitzen et al. 1980), equivalent width and position variations of the Li I 6708 Å line with the phase. Filled and open circles on both bottom figures correspond to spot 1 and spot 2 respectively.

Kochukhov, Drake, & de la Reza 2002). This gives us an opportunity to place these stars in the group of CP stars with lithium spots.

On Fig. 1 we show the obtained variations with the rotating phase of the equivalent width and position of the Li I 6708 Å line as well as the magnetic field variations and light curve taken from Maitzen at al. The rotational phases of HD 3980 were calculated using the ephemeris from Maitzen et al.

The synchronism of the variations of the Li I line profile and magnetic field strength can be explained in terms of a spotted rotator model. A good correlation of the Li spots positions with the magnetic field structure shows that Li spots are connected with magnetic poles and that the theory of ambipolar diffusion is able to explain the behavior of the lithium line.

References

O. Kochukhov, N.A. Drake, R. de la Reza. 2002, IAU Symposium 210 "Modelling of Stellar Atmospheres" (in press)

Maitzen, H.M., Weiss, W.W., Wood, H.J. 1980, A&A81, 323

Polosukhina, N., Kurtz, D., Hack, M., North, P., Ilyin, I., Zverko, J., Shakhovskoy, D. 1999, A&A351, 283

Polosukhina, N.S., Drake, N.A., Hack, M., de la Reza, R., Wood, P.R., & Shavrina, A.V. 2002, IAU Symposium 210 "Modelling of Stellar Atmospheres" (in press)

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