THE HeI λ10830 Å OBSERVATIONS OF TWO RS CVn SYSTEMS ζ AND λ AND

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Abstract. Magnetically active late-type stars have inhomogeneities on their surfaces that cause various observable effects in the spectral lines and light curves. Such inhomogeneities are magnetic starspots, plages etc. in active regions on the photospheric and chromospheric level. The variations of the spectral lines and light curves originating in these inhomogeneities undergo modulations following stellar rotation.

The HeI λ10830 Å observations of late-type stars are important because they provide valuable information about the chromospheric and low chromospheric-coronal transition region. It is well known that the 10830-absorption is associated with active regions in the solar chromosphere as well as with the bright points in the corona (Shcherbakov and Shcherbakova, 1991).

A project devoted to the study of spectroscopic properties of RS CVn and BY Dra systems in the region of CaII, H and K lines was started in 1985 at the University of Complutense de Madrid and was supplemented by observations of active binaries in the HeI λ 10830 Å line at the Crimean Astrophysical Observatory jointly with the Observatory of Helsinki University (cf. Fernandez-Figueroa et al. 1986, Armentia et al. 1990, Fernandez-Figueroa et al. 1991, Shcherbakov et al. 1990, Shcherbakov and Tuominen 1992).

Here we present briefly the preliminary results for the HeI 10830 observations of two active binaries ζ And and λ And. Both stars are single-line RS CVn binaries with orbital periods near to 20 days.

The high dispersion spectra of both stars were obtained in October - November 1990, and July - November 1991, at the Crimean Astrophysical Observatory, using the Astromed 2000 CCD system (in 1990) and the CCD system of Ista Ltd, St. Petersburg (in 1991). Both systems were installed at the coude spectrograph of the 2.6-m telescope. The original reciprocal dispersion was 0.12 Å/pixel. The slit width corresponded to the spectral resolution of 1.4 Å. Signal-to-noise ratios varied in the range 25-150 depending on seeing and atmospheric transparency.

The strong and very wide HeI λ10830 Å line was observed in the spectra of both stars. The centre of gravity of this wide line was shifted in the wavelength from date-to-date. The measurements of the equivalent width and of the centres of gravity of the profiles (to determine the radial velocities) were carried out for all observational dates. The phases of orbital periods for both stars were computed from the ephemeris given by Strassmeier et al. (1988).

It appears that the measured values of the radial velocities are scattered around

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orbits of primaries for both stars and confirm that the HeI absorption originates from the outer atmospheres of their primaries. The results of the measurements of the equivalent width are presented in Fig. 1. It is seen that the equivalent width of the line shows a dependence on the orbital phase for both stars. We notice a large scatter of the data measured for ζ And in comparision with those of λ And. That is hard to explain by observational errors, because the S/N ratios for the spectra of this star are even higher than that for the spectra of λ And. It is, in this case, more probable that we observe the rapid variations of the activity level in the HeI line. Another possibility is that the helium line is not formed within a local uniform active region (spot), but that there are inhomogeneities distributed over the surface of the star, apparently on one hemisphere (like in solar HeI spectroheliograms).

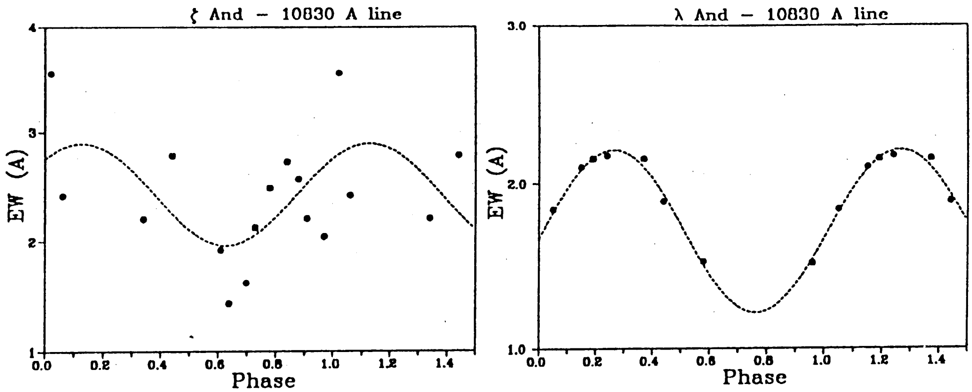

Fig. 1. *Variability of the equivalent width of the HeI line with the orbital phase. Dots represent the measured EW. Dashed curves show the trigonometric approximation of EW*

As mentioned above, both stars are single-line spectroscopic binaries with P_{orb} equal to 17.8 days for ζ And and 20.5 days for λ And. Contrary to the synchronous rotation of ζ And, the photometric rotation period of λ And is 54 days which is more than twice the orbital period. It is surprising that the equivalent width of the helium line of λ And does not vary with the rotational period, but correlates well with the orbital period. The most probable explanation is that two large active regions exist on the surface of the primary star.

Thus we can draw the following conclusions:

The hot active regions (because of the high excitation potential of the line) exist in the chromospheres of both stars. These hot regions are not extremely localized ones because the line does not drop down to zero. It is more likely that the temperature varies in the chromospheres of both stars, connected with their spot (or magnetic) activity. In the case of ζ And we have a complex spot structure (like in the Sun). In the case of λ And two large hot spots most probably exist on the surface of this star.

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