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SPECTROSCOPY OF ECLIPSING BINARY HD 65498 THIRD COMPONENT DETECTED

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This paper presents the results of spectroscopic observations of HD65498 (DY Lynx). The object is listed in Simbad database as an eclipsing binary of Algol type with V magnitude of $9\overset{\mathrm{m}}{.}67$ and color index $(B-V) = 0\overset{\mathrm{m}}{.}56$. Eclipsing nature of HD65498 was detected by SAVS (Semi Automatded Variability Search) described in Maciejewski et al. 2003. The light curve is typical for detached binaries and suggests similar components and partial eclipses with amplitude 0.4 mag. The period of HD 65498 is 31.5 hours and the ephemeris is:

$$\begin{array}{c}\text{Min. I} = \text{HJD } 2452704.48836 + 1\overset{\mathrm{d}}{.}31324 \times E. \\ \pm 0.00054 \pm 0.00006\end{array} \quad (1)$$

To determine the spectral type of the star spectroscopic observations were made. The obtained spectrum corresponds to F5V star.

We have observed the object spectroscopically with PST (Poznań Spectroscopic Telescope), described in Baranowski et al. 2009, which is equipped with 0.5m mirror and fiber-fed echelle spectrograph. The exposure time was 1800s and the spectra cover range from 4500 to 8250 Å. The thorium argon lamp provides calibration of the spectra with sigma RV of 100m/s. The spectrograph box is thermally stabilized on the level of 0.1 deg. Data reduction was performed with IRAF echelle package based script. For the RV measurement we have used IRAF FXCOR task . Cross correlation functions reveal three peaks (Figure 4). Two of them low and broad are connected with the eclipsing pair and the central one - the detected third component (the peak is high and narrow). We examined the profile of H_α (Figure 3) and H_β and their shape is also tripple.

The light curve and radial velocities enable us to obtain Wilson-Devinney model (Wilson & Devinney 1971) of the system. We treat the third body as a third light. The time span of our spectra is about two months so they can be affected by the light time effect. The third component can be dynamically conected with the eclipsing pair or just on the same line of sight. Radial velocities of the third component are decreasing with time. The reason can be the mutual orbital motion.

Our spectroscopic data is shifted wzgledem the ephemeris. We calculated a new ephemeris based on both fotometric and spectroscopic observations:

$$\begin{array}{c}\text{Min. I} = \text{HJD } 2452704.489 + 1^{\text{d}}.313187 \times E. \\ \pm 0.001 \pm 0.000003\end{array} \quad (2)$$

Time span between spectroscopic and photometric data is about 6 years and is affected by light time effect.

The eclipsing pair consists of two similar components with masses $1.02M_{\odot}, 1.05M_{\odot}$ and radii $1.28R_{\odot}, 1.26R_{\odot}$, respectively (Table 2).

The components are slightly evolved. We have no direct information on the color index of the eclipsing pair. We apply temperature of the first component from evolutionary tracs for obtained values of mass and radii. The temperature of the second component was fitted during the modeling.

Table 1. Radial velocities measurements

HJD (+2454900)	RV1 (km/s)	RV2 (km/s)	RV3 (km/s)
12.319274	-103.9	145.7	58.0
12.474967	-54.6	91.6	58.3
12.504987	-37.2	95.7	59.3
16.330385	-81.7	121.4	56.6
16.356517	-70.6	111.0	57.2
16.383448	-61.0	120	58.4
24.527291	91.8	-14.4	55.4
24.569706	93.1	-45.8	55.6
25.413819	-110.1	155.3	55.6
25.440946	-114.6	157.3	55.5
35.327167	133.0	-100.7	52.3
35.353276	128.1	-93.4	51.9
35.379281	117.5	-79.4	52.5

Table 2. Preliminary solution for the eclipsing pair.

parameter	component 1	component 2
i	$89°.2 \pm 1°.5$	
q	1.03 ± 0.13	
$a(R_{\odot})$	6.42 ± 0.09	
V_{γ} (km/s)	23.2 ± 1.4	
Ω	6.07 ± 0.22	6.27 ± 0.62
l	4.01 ± 0.20	3.72 ± 0.20
$T(K)$	5400	5340 ± 10
$M(M_{\odot})$	1.017 ± 0.050	1.048 ± 0.050
$R(R_{\odot})$	1.280 ± 0.054	1.260 ± 0.123

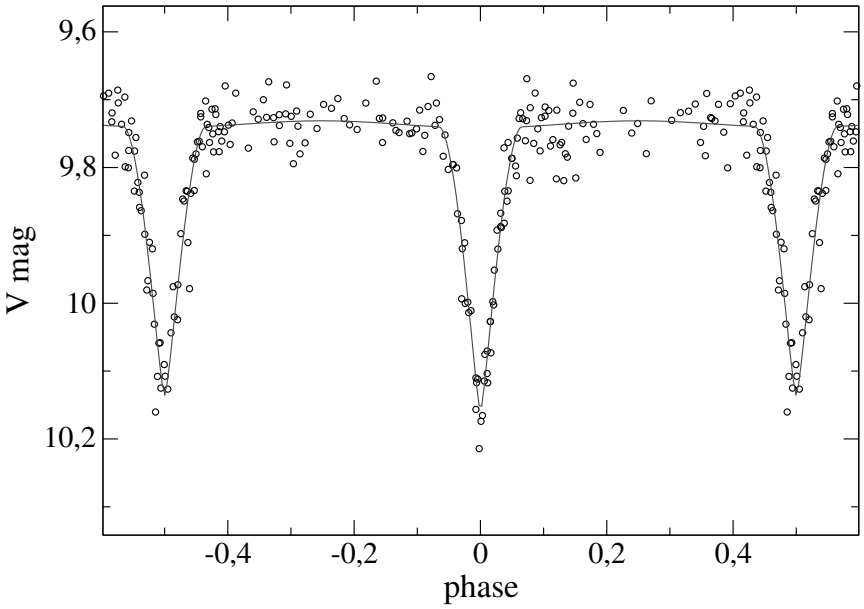

Figure 1. Light curve of HD 65498 compared with the synthetic curve.

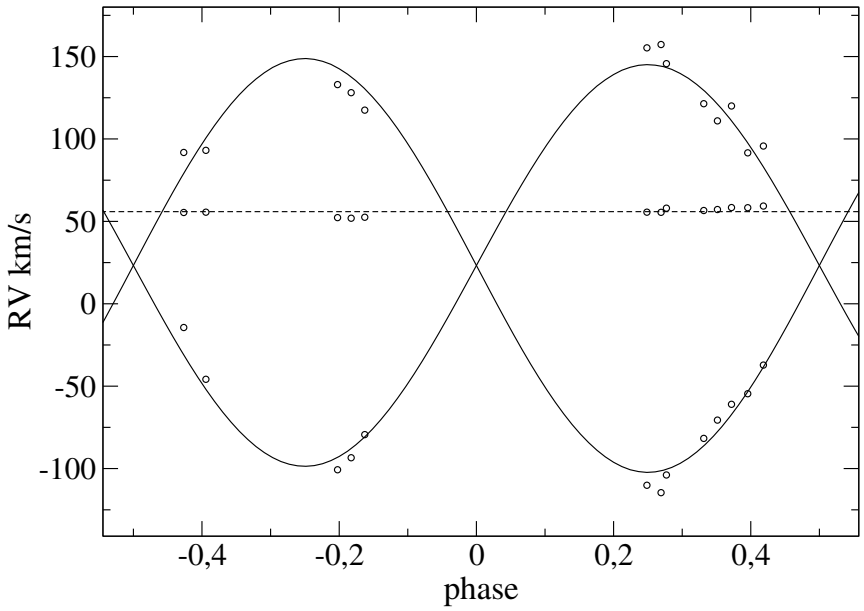

Figure 2. Radial velocity curve for the three components of HD65498. The solid line presents RV measurements for the eclipsing pair and the dashed line for the third component.

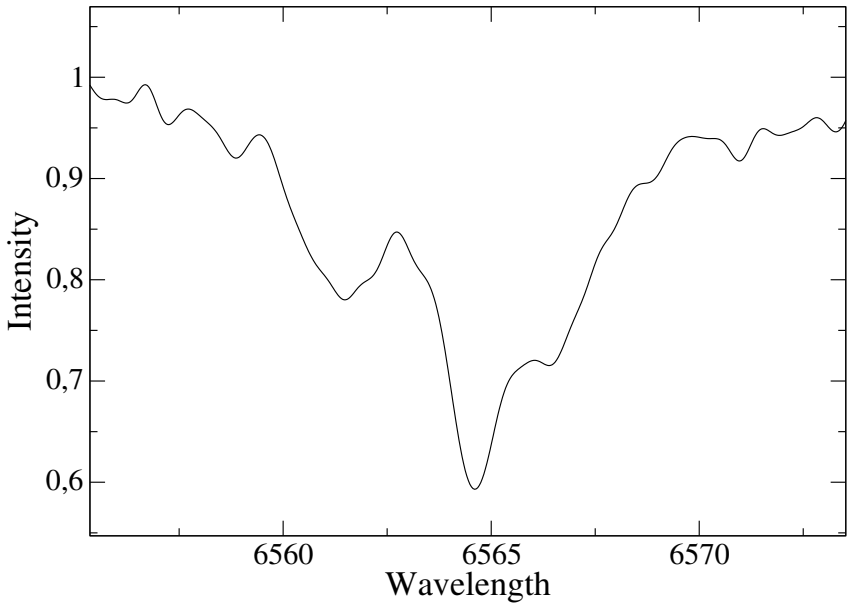

Figure 3. The H_α line profile is tripple, we can see two and shallow lines conected with the eclipsing pair and deepcentral line - the third component.

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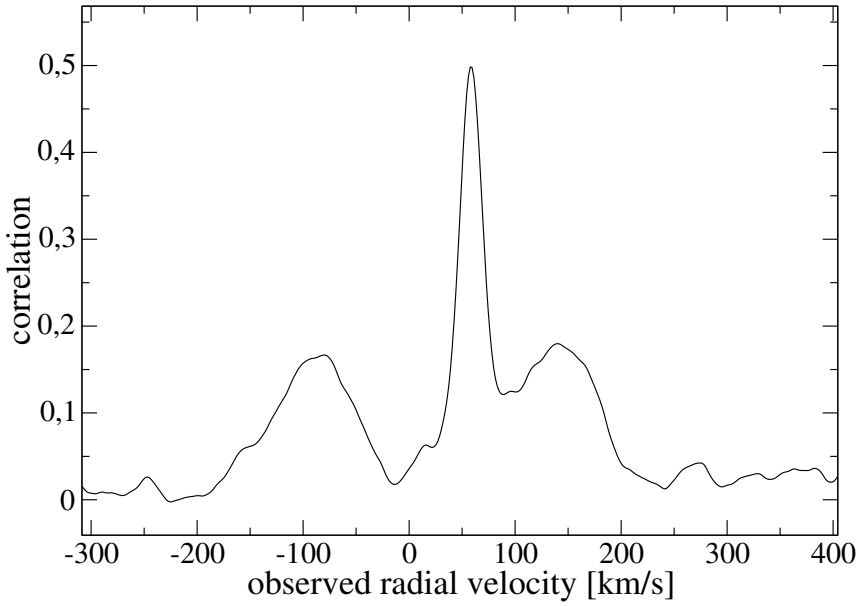

Figure 4. The crosscorrelation function for the same spectrum as in figure 3. We have the low and broad peaks of the eclipsing pair and high and thin peak of the third component.