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LETTER

Letter to the Editor

EV Sct – a double system with two Cepheid components in NGC 6664?

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Abstract. Spectroscopic manifestations of the s-Cepheid EV Sct binarity are reported. All the lines in the spectrum of this faint Cepheid are strongly asymmetrical or even splitted indicating that this system consists of two components. Both components have close effective temperatures, the difference in the visual magnitudes seems to be not great. Together with the preliminary results of the frequency analysis based on the published photometrical data, this means that the secondary component is probably also situated within the instability strip, being a very short-period Cepheid ($P \approx 1.2$ day)

Key words: stars: binaries: spectroscopic – stars: individual: EV Sct

1. Introduction

EV Sct is a famous Cepheid (P=3.091^d) belonging to the NGC 6664 cluster, which was for a long time used for $P-L$ calibration. Berdnikov & Pastukhova (1995) detected $O-C$ variations for this Cepheid with probable period $\approx 10000^d$. They reported its light curve elements:

$$JDMax = 2441406.711 + 3.090998 \times E \quad (1)$$

While working with the spectrum of EV Sct (the high-resolution one observed by Fry & Carney (1997), spectral interval 5350–8660 Å, resolving power R=30000, S/N=100), we found that *all* the lines in the EV Sct spectrum appeared to be either strongly asymmetrical or, in some cases, even splitted, resembling those from the spectra of spectroscopic binary stars. The blueward shift of the satellite lines achieves 0.33 Å(at λ 6000 Å). The satellite lines are approximately 1.5 times weaker than those of the primary (see Fig. 1).

2. Spectroscopic characteristics

Applying the spectroscopic criteria for lines of the component (see for details Kovtyukh et al., 1998), we found that its effective temperature is $T_{\rm eff}$ = 5920 $\pm$75 K. The same method applied for EV Sct itself gave $T_{\rm eff}$ = 6100 $\pm$25 K. Note that the quoted errors reflect only the formal precision of the applied method. It should be also mentioned that the number of used criteria for determination of the effective temperature of the component was 19, while for primary we used 23 criteria.

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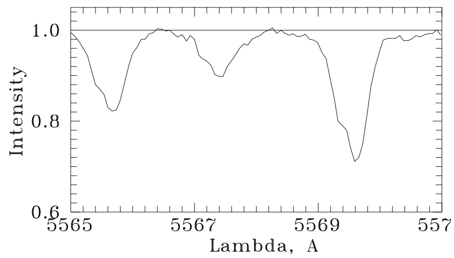

Fig. 1. Fragment of the EV Sct spectrum in the vicinity of FeI lines.

Taking into account that 1) both components have practically the same effective temperatures and 2) the lines of the secondary are only slightly weaker than those of the Cepheid (i.e. the difference in the visual magnitudes between two stars is not great, being probably less than $0.^m5$), one can make the conclusion that the unknown component is also situated within the instability strip being also a Cepheid (likely the small amplitude one).

An independent confirmation of this fact can be found in the work of Pel (1976) and Mermilliod et al.(1987). For example, Pel (1976) wrote “The scatter in the lightcurve is large for a star of this brightness, and it seems to be largest around maximum. Maybe the lightcurve is variable”. Accordingly to Mermilliod et al. (1987) “The scatter between phases 0.0 and 0.4 is abnormally large and it cannot yet be excluded that either we used a wrong value of the period (although the Fourier analysis did not reveal any other possible value) or a second pulsation mode of small amplitude is present.” A clear scattering of the lighcurve could be seen in the work of Barrell (1982).

3. Frequency analysis

We have analysed all published data on the photometrical and radial velocity measurements collected in the database of Dr. D.L. Welch:
(www.physics.mcmaster.ca/Cepheid/Classical.html).

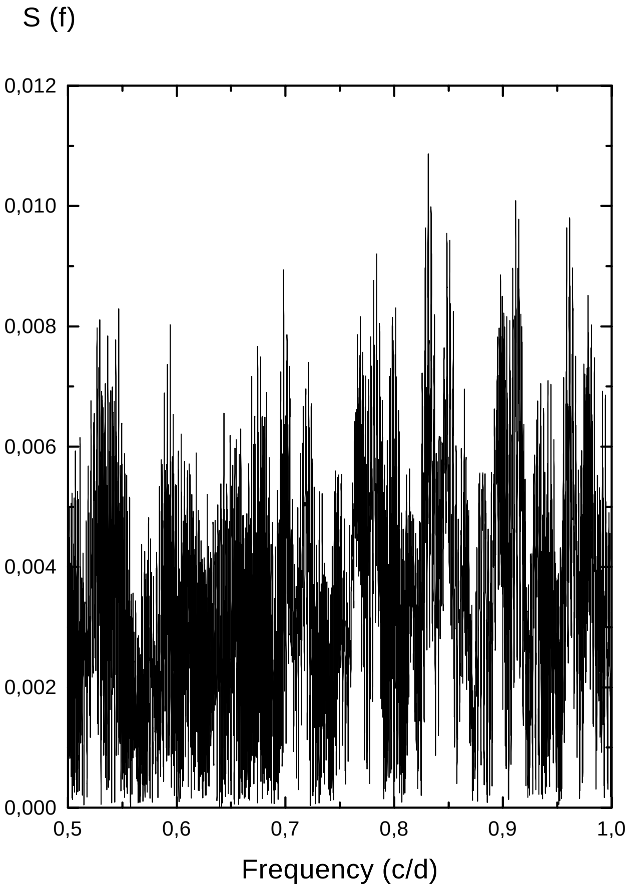

Fig. 2. Results of the frequency analysis.

We also used the relevant data mentioned by Berdnikov & Pastukhova (1995). Generally, 308 V estimates were involved in the analysis. Our preliminary result has shown that possible secondary's pulsations have an amplitude of $\approx 0.^m02$. Therefore for the following accurate analysis we have selected only the most numerous observations and those which were performed using the standard star: Pel (1976), Barrell (1982) and Moffett & Barnes (1984), i.e. in common 185 V estimates. Pel (1976) and Barrell (1982) used the same standard (star "A", V=10.^{m}59 from NGC 6664), while Moffett & Barnes (1984) used three standards situated close to EV Sct. The V measurements of Moffett & Barnes (1984) were reduced to a system common with Barrell's (1982) observations, as being the most numerous (118 V estimates).

For the frequency analysis we applied the code PERIOD of Breger (1990) and FDCN of Andronov (1994). From the several peaks showed in Fig. 2 one can select the most significant one corresponding to the frequency f=0.831204 c/d (P = 1.20309 day).

The secondary's oscillations with V amplitude of $0.^m020 \pm 0.^m002$ were detected. The resulting elements are the following:

$$JDMax = 2443303.8 + 1.20309 \times E \quad (2)$$

The standard deviation equals $0.^m014$ that is comparable with the accuracy of the photoelectrical observations. This means that the obtained elements can be considered only as preliminary ones. To specify them, additional and specially organized observations are necessary.

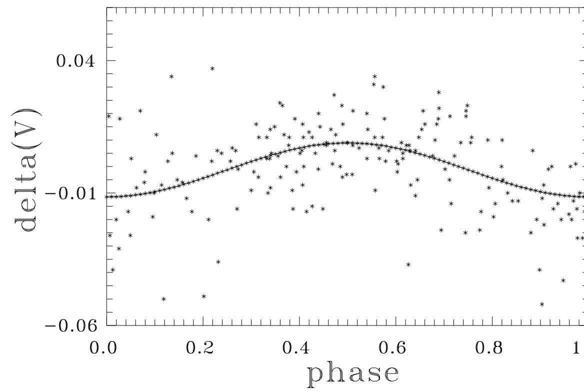

Fig. 3. The light curve of EV Sct folded with the 1.2 day period. The primary period is subtracted.

In Fig. 3 we show the light curve of EV Sct folded with the detected 1.2 day period and with the primary period subtracted.

4. Conclusion

If the future observations confirm our preliminary results, then EV Sct can be considered as the second double system containing two Cepheids known in the Galaxy (an already known system is CE Cas in NGC 7790). It is also quite plausible that the secondary component of EV Sct system is the Cepheid with the shortest pulsational period in the Galaxy.

To find the orbital period of EV Sct, the monitoring of the radial velocity of this star should be performed.

We do not insist on the definite conclusion based on the reported results of the frequency analysis and consider them only as preliminary ones, requiring further investigation and specification.

Finally, it should be noted that EV Sct, due to its peculiarity, must not be used for $P-L$ calibration.

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