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Peculiarities in the Spectrum of the Early-type System MY Ser

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Abstract. MY Ser is an eclipsing early-type contact system. Both components are of spectral type O6 III. Using ESO archive spectra, we show that the radial velocity of the third body, which contributes about half of the total luminosity, changed from 2006 to 2009. The line profiles of the eclipsing system have peculiar shapes and strengths; namely around conjunctions, they are affected by circumbinary matter.

Keywords. (stars:) binaries: eclipsing, stars: early-type, stars: individual (MY Ser)

The eclipsing binary MY Ser (HD 167791) belongs to the rare class of early-type contact systems. It has a period of 3.32 days, its magnitude in maximum is V = 7.3, and both minima have depths of 0.3 mag. The integral spectrum was classified as O8 Ib(f)p by Walborn (1972). Leitherer *et al.* (1987) found that the spectrum is dominated by lines of a third component, probably of spectral type O8 Ib, and that the lines of the eclipsing components belong to stars of earlier type. Mayer *et al.* (2010) solved the UBV light curves and derived an overcontact solution with a large filling factor.

The ESO archive contains 150 FEROS spectra of MY Ser, taken in the years 2008 and 2009 (plus one spectrum from 2006). These spectra are available in a pipeline processed form. We chose He I 5876 and He II 5411 Å lines for this study, selected about half of the available spectra and averaged groups of them to represent 22 different phase points. We fitted Gaussian profiles to obtain the positions, widths, and depths of all line components.

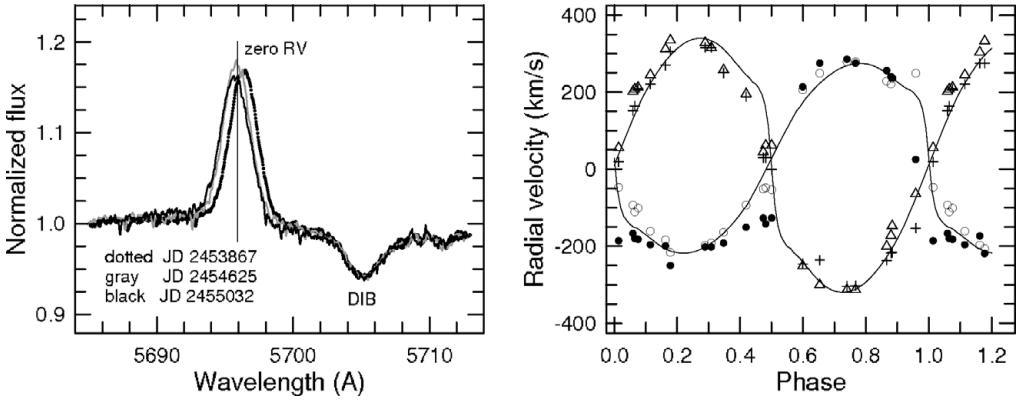

Figure 1. Left: The emission line C III 5696 Å proves the change of the third body radial velocity. Right: The radial velocity curves. Open circles - primary, line 5411 Å; full circles - primary, line 5876 Å; triangles - secondary, line 5411 Å; crosses - secondary, line 5876 Å.

Table 1. Parameters of the binary.

	K (km/s)	Vγ	a sin i ($R_\odot$)	M $\sin^3 i$ ($M_\odot$)
Primary	284	28	18.8	36.7
Secondary	305	10	20.1	34.2

The third body lines behave independently of the eclipsing binary lines. The most pronounced spectral features of the third component are He I lines. Their FWHM should not be correlated with the binary orbital phase, but the measured depths of the third component line depend on phase; they are larger around minima. According to our measurements, the depths of the lines 5411 and 5876 Å would be 0.151 and 0.287 if the contribution of the eclipsing binary was negligible. The corresponding FWHMs are 3.1 and 3.3 Å, and the EWs 0.47 and 0.95 Å, respectively. Such values agree with spectral type O8 I (according to OSTAR synthetic spectra by Lanz & Hubeny 2003 and O-star parameters by Martins *et al.* 2005).

Leitherer *et al.* (1987) measured the radial velocity of the He II 5411 Å line of the third component as +21 km/s in the year 1986. According to our RVs for the years 2006 to 2009 the velocity is smaller (close to zero) in the years 2008–2009. The decreasing velocity of the third body is confirmed by the C III emission line (Fig. 1). In the year 2006, its velocity was $\sim$ 20 km/s more positive than in 2008. The correctness of the wavelength scale can be checked by the unchanged position of the 5905.1 Å DIB.

To show the eclipsing component line profiles, lines of the third star were subtracted. The 5411 Å profiles look as expected at phases 0 to 0.5, i.e., the primary line is stronger than the secondary; however, at phases 0.5 to 1, the primary line is weaker. The 5876 Å line has an asymmetric shape with a stronger blue wing around both conjunctions; at other phases, these lines behave similarly as 5411 Å, but at phases 0.5 to 1, the primary is yet weaker. Given the weakness of the primary lines and their enhancement at the blue side one has to assume that circumbinary matter causes these effects.

Radial velocities are presented in Fig. 1. In spite of deviations from the expected RV curve around conjunctions, the velocities at quadratures should represent the orbital motion; different gamma velocities provide a better fit than does a common velocity.

With $i = 83.6°$, the masses are 37.4 and 34.8 $M_\odot$, radii are 16.5 and 15.4 $R_\odot$. According to Martins *et al.* (2005), such parameters correspond to a spectral type O6 III.

The He II 4686 Å and Hα lines are in emission. Superpositions of these line profiles as measured in all analyzed spectra suggest that the third body contribution to the 4686 Å line is small. A stronger emission is present in Hα and is similar to the emission in other early-type supergiants.

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