MASS LOSS EFFECTS IN THE SPECTRUM OF THE O 6.5f BINARY HD 153919

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Abstract. Apart from the known P-Cygni profiles of Hβ, HeI 5876, 4471 in the spectrum of HD 153919, also HeII 3923 and a line at 3759 A which is tentatively identified as OIII show an emission component. These lines indicate that the Of star is losing mass at a high rate. A detailed analysis of the radial velocities obtained from 76 spectrograms indicates that the outflow of the wind is not spherically symmetric: at the side where the Of star faces its companion the velocity of the wind has increased.

The extreme Of star HD 153919 has been identified as the optical counterpart of the X-ray binary 4U1700-37 (Jones et al., 1973; Jones and Liller, 1973; van den Heuvel, 1973). In this paper we will discuss the spectrum of the Of star and its mass loss. The visible spectrum of this star shows many characteristics of a high mass loss rate: several P-Cygni profiles, Hα, HeII 4686 and NIII, CIII 4650 in emission (cf. Hensberge et al., 1973; Conti and Cowley, 1975).

During the last few years we collected 76 blue plates of this star, all obtained with the 1.52 m telescope of the ESO in Chile. An inspection of the intensity tracings of these plates reveals that also some other lines show emission, which was previously undetected. The HeII line at 3923 A shows a broad -though weak- emission component on top of the CaII interstellar line. Fig. 1 shows also another P-Cygni profile which was detected at 3759 A. It is present on all plates. The only possible identification seems to be OIII, although this line appears in absorption in ζPup, an O5f star.

A detailed radial velocity study of the spectral lines on the 76 spectrograms shows that the stellar wind is not spherically symmetric. The assymmetry seems to be due to the deformation of the shape of the Of star by the presence of the compact companion. The mean velocity curve derived for all lines is shown in fig. 2. Each point represents the average radial velocity for one plate. The curve drawn through the points represents the best-fit solution to the data (cf. also

P. S. Conti and C. W. H. de Loore (eds.), Mass Loss and Evolution of O-Type Stars, 31-34.

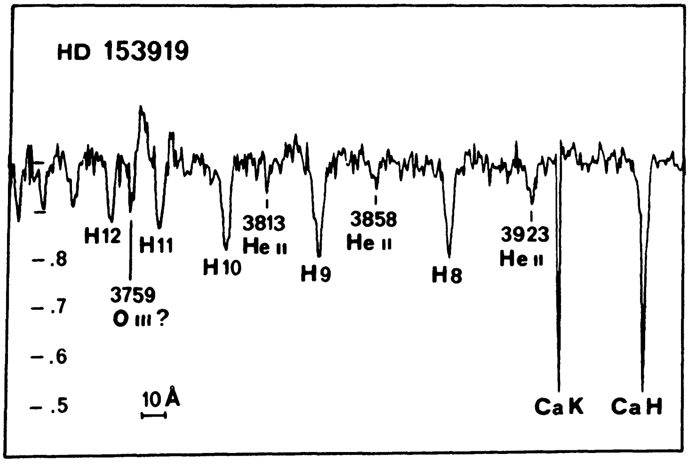

Figure 1. Part of the spectrum of HD 153919.

Hammerschlag-Hensberge, 1978 for more details). For a star with an out-streaming atmosphere as is the case here, one knows that the lines which are formed more outwards in the atmosphere have higher negative velocities than those formed more inwards. There is good evidence that even lines of HeII are formed in a region which is moving outwards. Before calculating the velocity curve, I corrected the velocities of

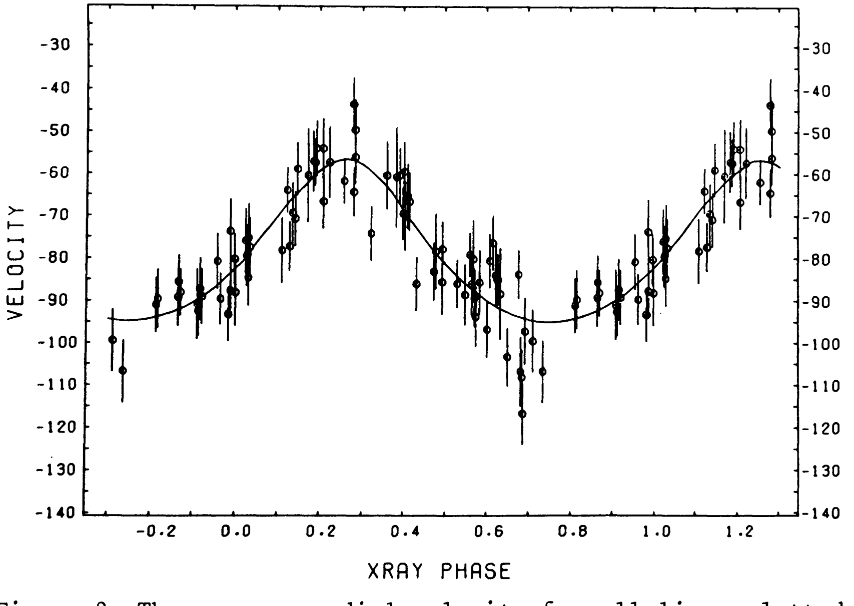

Figure 2. The average radial velocity for all lines plotted against X-ray phase. Phase zero corresponds to mid X-ray eclipse time.

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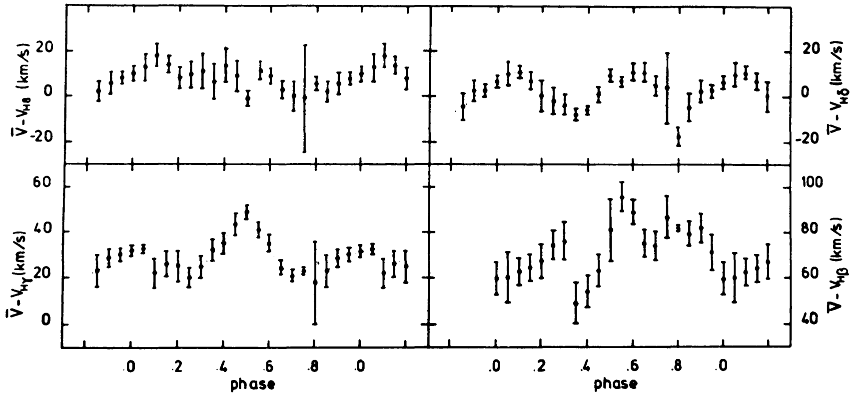

Figure 3. Radial velocity deviations from the mean for some Balmer lines, plotted against X-ray phase.

all lines for this systematic deviation from the mean velocity. For a spherically symmetric wind one would expect that this deviation would be independent of binary phase. But a plot of the deviations gives for some lines clear evidence for a phase dependence, as fig. 3 shows. For instance, Hγ shows a clear deviation at phase 0.5, and to a lesser extent also at phase zero, where phase 0.5 is the phase at which the X-ray source is in front of the Of star. Near phase 0.5 the velocity of Hγ is systematically more negative. Comparison of the Hγ profile near phase 0.5 with the profile at other phases shows no difference in intensity or shape. As a consequence the deviation must be due to a velocity difference in the wind.

The effect can also have implications for the determination of the binary parameters, e.g. the mass of the binary system. It clearly influences the eccentricity: we have corrected the Hγ-radial velocities for the just mentioned deviation and after the correction the eccentricity obtained in the orbital solution was reduced from 0.36 to 0.06 (Hammerschlag-Hensberge, 1978). The deviation also influences the velocity amplitude and as a consequence the mass.

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DISCUSSION FOLLOWING G. HAMMERSCHLAG-HENSBERGE

Seggewiss: Could you please quote the errors of the eccentricities in your last table? It might be possible that the error of the eccentricity for the corrected RV curve is of the order of the value of 0.06 itself.

Hammerschlag-Hensberge: The error on the eccentricity of the velocity curve for Hγ is rather large: $e \simeq 0.2$, because the scatter in the velocity curve is also large for this system. The intrinsic scatter in the velocity values is as large as the velocity amplitude of the orbit.

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