THE BINARY ORBIT OF HD 92740

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HD 92740 is a star located in the Carina nebula showing a Wolf-Rayet spectrum of type WN7.Faint absorption lines of the upper Balmer series of hydrogen,and also of the Pickering series of HeII are present in the spectrum,in addition to the WN emissions.Although absorption lines present in a Wolf-Rayet spectrum are generally assumed to arise in a companion OB star,a previous study (Niemelä 1973) of the radial velocities of HD 92740 showed that the absorption and emission lines followed the same orbital motion.Subsequent spectral observations of this star have been carried out at the Cerro Tololo Inter-American Observatory,Chile,and at the Córdoba Observatory,Argentina,during four years;the observational data are listed in Conti,Niemelä and Walborn (1978).These observations showed that the true period is 8 times longer than the initially derived period of 10 days,and that doubtlessly the absorption lines belong to the WN star.

A new orbital solution has been derived for HD 92740 with the program based on the method of Lehmann-Filhés,published by Bertiau and Grobben (1968).The mean radial velocities of the narrow emission lines of NIII,NIV and SiIV define the best orbit,i.e.that with smaller probable error.The mean radial velocities of the hydrogen upper Balmer series and HeII Pickering series absorption lines yield a similar orbital solution with slightly higher probable error,which may be partly due to that not all the mean values included the same number of lines,or that the steep velocity gradient present on these lines is somewhat variable. Both orbital solutions are given in Table 1.

The observed mean radial velocities of the narrow emissions and the absorption lines are plotted in Figure 1,which shows clearly the same orbital motion of the absorption and emission lines.The dashed

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curve represents the orbital solution of Table 1 corresponding to the narrow emissions.

Table 1

Orbital elements of HD 92740		
	narrow emission	absorption
P (days)	80.34 ± 0.01	
e	0.61 ± 0.02	0.64 ± 0.02
K (km/s)	74 ± 2	79 ± 3
γ (km/s)	-28 ± 1	-152 ± 2
w	276° ± 3°	248° ± 4°
T_o(2440000+)	728.9 ± 0.2	726.6 ± 0.4

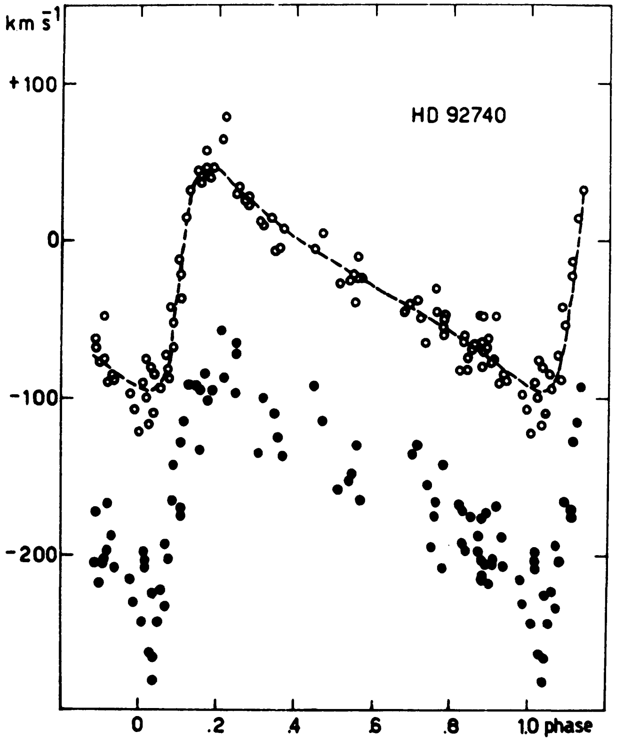

Figure 1. Velocity curves of HD 92740 from the narrow emissions (open circles) and upper Balmer and HeII Pickering absorption lines (filled circles).

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On spectrograms obtained in 1977 using the III aJ emulsion, when the WN star has the highest positive radial velocity most absorption lines appear double. This may happen due to a contribution of the secondary component of the binary system with the highest negative velocity to the blueshifted WN absorptions. Some very faint features on other spectrograms also suggest they may be absorption lines from an O type companion. Figure 2 shows a plot of the radial velocities of these faint absorptions with respect to the orbit derived from the narrow emission lines.

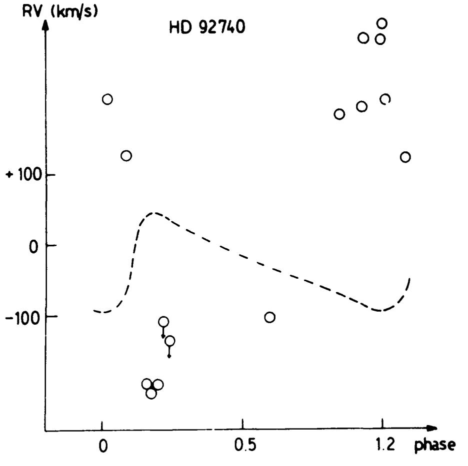

Figure 2. Distribution of the radial velocities of the fainter absorption lines. The dashed curve represents the orbital solution from the narrow emissions of the WN star.

If these absorption features actually exist and belong to the companion star, then from Figure 2 it is clear that the WN component would be the more massive of the system. The corresponding minimum masses would result aproximately

$$M_{WN7} \sin^3 i = 64\ M_\odot$$
$$M_O \sin^3 i = 24\ M_\odot$$

This would be the first case when in a binary system the Wolf-Rayet component is the more massive, since in all other cases the reverse is true (e.g. see tabulation in Kuhi 1973).

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DISCUSSION FOLLOWING NIEMELA

Morton: What period did you find for γ Vel? How does it compare with the value derived with Ganesh and Bappu?

Niemela: 78.5002 days, Ganesh and Bappu used 78.5 d.

Bolton: Dorothy Fraquelli of David Dunlap Observatory and Jiri Horn of Ondrejov Observatory have redone the orbit of the WN 4.5+O9I star HD 190918 using high dispersion spectra. They find a much larger period and velocity amplitude than previous investigators. They find an eccentricity of 0.4 and ω near 220°. There is evidence for large variations in the emission line intensities and for changes in absorption line profiles. These effects may be distorting the velocity curve, but their work on this problem is just beginning.

van den Heuvel: Both orbits seem to have very large eccentricities, and have ω near 270°. This seems rather strange to me, and seems to suggest that there is a strong distortion of the radial velocity curve of some sort. Do you have an explanation for this?

Niemela: No, it may be casual (but see the remark of Dr. Bolton).

Noerdlinger: At a previous Wolf-Rayet Conference you said that the He I 3888 emission was peaked in the violet when the O star is in front and to the red when it is behind. I had interpreted this to mean He I comes from the O star: when it is behind, the WR star cannot interfere with the outflow behind it, but when it is in front the WR star may ionize some of the He I behind the O star and also divert its flow to the side. Have the new observations given different results, or have you another interpretation?

Niemela: This is partly due to the orbital motion of the H8 absorption belonging to the O9I star. My interpretation of the violet emission peak was that it may arise in a gas stream from the WC towards the O star. It may also be due to the asymmetry of the WR envelope. We have no quantitative measures of this intensity change yet, but the radial velocity variations of the He I emission follow the WC orbit, therefore it probably comes from the envelope of this star.

Massey: For γ Vel, you said you got the W-R velocity curve from the carbon emission lines. Do you get the same amplitude curve when you look at He II λ4686?

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Niemela: Yes, but with different γ-velocity.

Conti: I would like to emphasize the very important result presented here that the absorption and the emission lines in this system are in phase and in the WN star. The detection of the secondary is not yet certain but of course would give a very important result for the WR mass.

Moffat: Moffat and Seggewiss (1978, A & A in press) have studied HD 92740 using 12 Å/mm Coudé spectrograms in the blue. The results here confirm ours except that we find the velocity amplitude of the Balmer absorption lines to be half that of the emission lines of the WR star, while He II and N V absorption lines are the same. This may be due to blending of a just unseen OB companion which may have quite wide, unresolvable photospheric absorption lines, the strongest being those of the Balmer series. Also we find no indication of the anti-phase, large amplitude absorption lines from a possible OB companion.

Niemela: If the lower amplitude you find were due to a companion, then it should be a quite peculiar object with all absorption lines shifted to a -150 km/s systemic velocity.

Moffat: Our mean (systemic) γ-velocity of the observed Balmer lines (H8,9,10) is -132 ± 10 km s^{-1} (not -150 km s^{-1}) while their width is over 400 km s^{-1}. Thus, there is sufficient margin to allow a normal companion OB star with Balmer lines varying in antiphase around a low γ-velocity.

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