

## OBSERVATIONS OF WOLF-RAYET BINARIES

Virpi S. Niemela<sup>1</sup>

51 esq. 11, Villa Elisa, Buenos Aires, Argentina

In many recent papers dealing with computations of evolutionary sequences for massive stars with mass loss, the evolutionary status of Wolf-Rayet stars has been discussed. When one wishes to compare these theoretical computations with observations, it is of great importance to know the masses of Wolf-Rayet stars, which unfortunately are well determined only in a few cases. Estimates of the masses are provided by binaries with WR type components. I will report here preliminary results of spectrographic observations for 4 WN+OB systems, with new information about the masses of their components.

The observations of the southern binaries, namely HD 90657, HD 94546 and HDE 311884 (=MR 42), were obtained during 12 consecutive nights in February 1979 with the Cassegrain spectrograph with IT attached to the 1.0m reflector of the Cerro Tololo Interamerican Observatory. These spectra have dispersion 42 Å/mm and are on Kodak IIIaJ plates. The spectrograms (15 and 30 Å/mm on IIaO plates) of the northern WN+OB binary HD 214419 (=CQ Cep) were obtained at the Dominion Astrophysical Observatory by Dr. A. Batten and myself.

Radial velocity curves have been derived for all 4 binary systems from the NIV  $\lambda$ 4058 emission line, assumed to represent the motion of the WN star; and from the Balmer series, HeII and HeI absorption lines of the OB companion. Preliminary orbital elements, listed in Table 1, were obtained by graphical solution from these velocity curves. I have chosen the NIV  $\lambda$ 4058 emission for the WN components, because this line was shown to represent closely the stellar radial velocity in WN stars of subclasses WN7/WN8 (Moffat and Seggewiss 1979). However, for the present WN stars of earlier types this may

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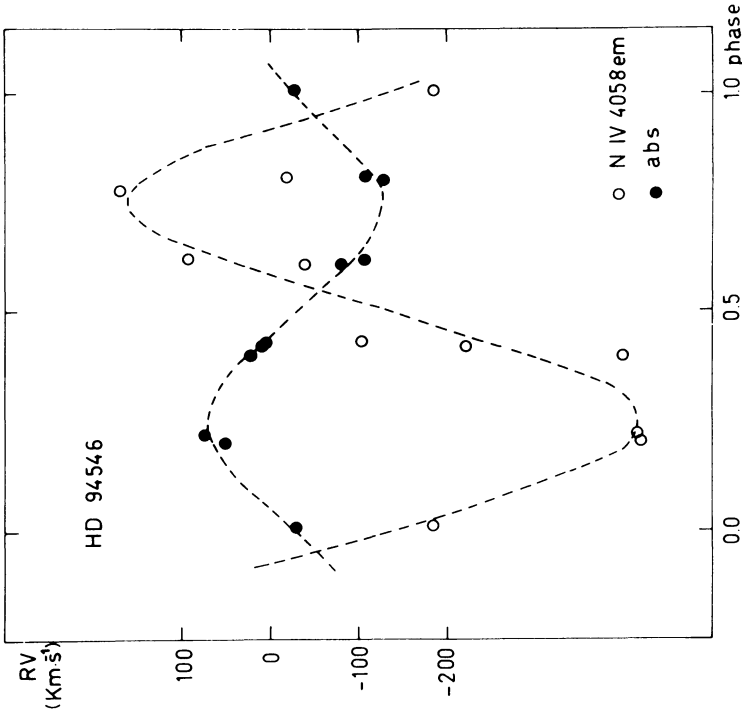


Fig. 2. Radial velocities for HD 94546. The symbols as in Fig. 1.

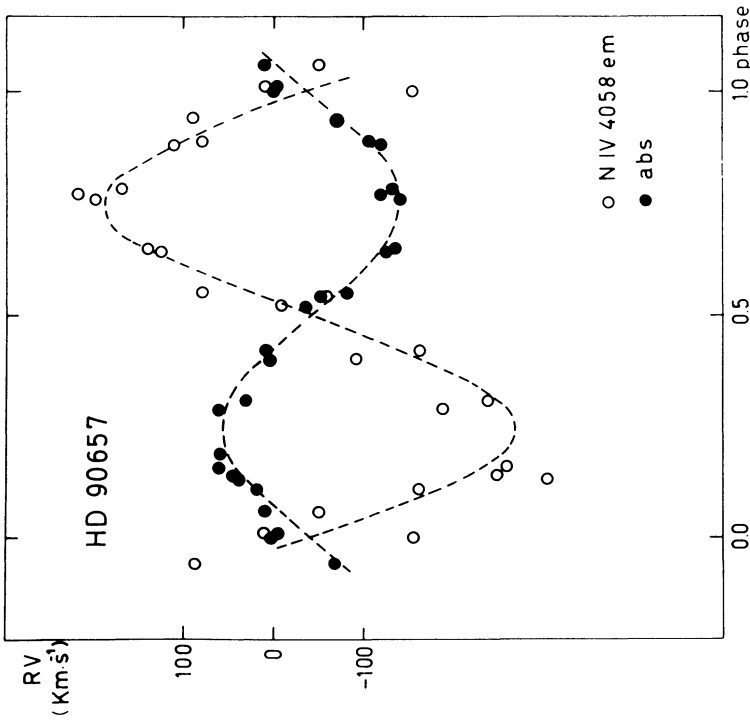


Fig. 1. Radial velocities for HD 90657. Filled circles: mean absorption. Open circles: N IV  $\lambda$ 4058 emission. Dashed curves: theoretical velocities defined by orbital elements in Table 1.

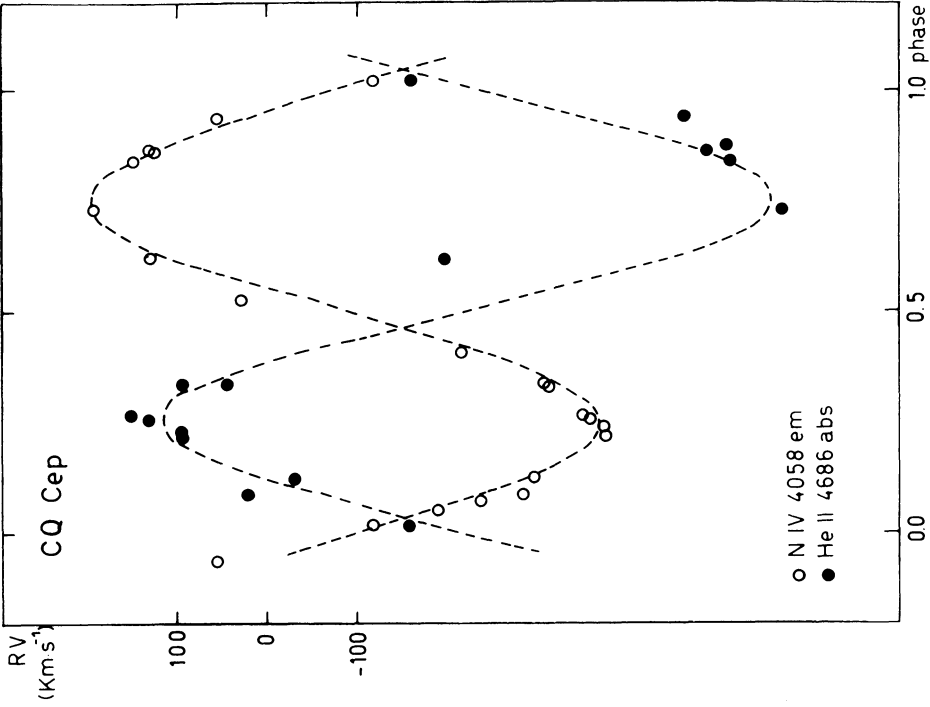


Fig.4. Radial velocities for CQ Cep. Filled circles:HeII 4686 abs. Other symbols are as in Fig.1.

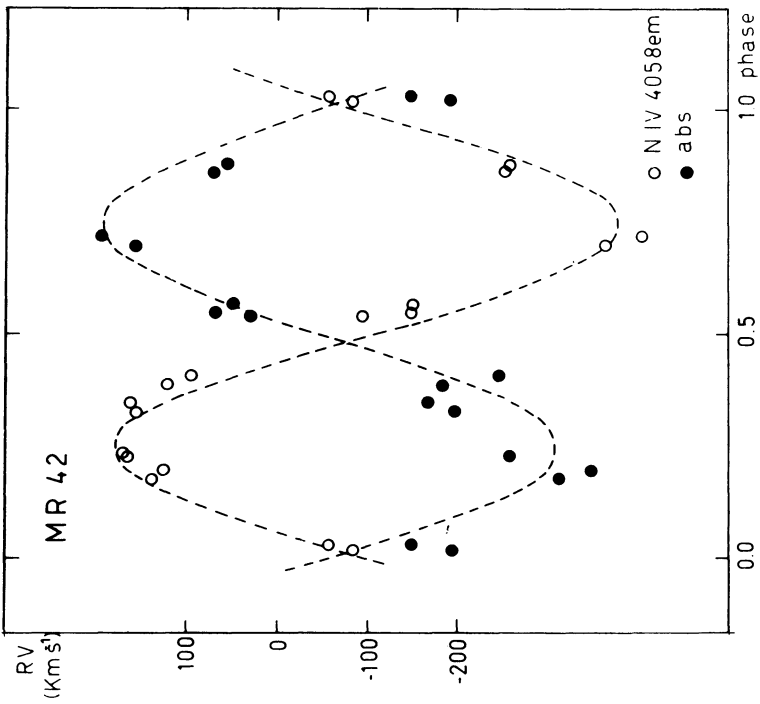


Fig.3. Radial velocities for MR 42. The symbols are as in Fig.1.

Table 1. Preliminary Orbital Elements for 4 WN+OB Systems

	HD 90657	HD 94546	MR 42	CQ Cep
Period (d)	8.2	4.9	6.3	1.6
$e=0$ (assumed)				
$K_{\text{NIV em.}}$ (km/s)	230	290	280	285
$K_{\text{abs.}}$ (km/s)	100	100	240	340
$\gamma_{\text{NIV em.}}$ (km/s)	-40	-130	-100	-85
$\gamma_{\text{abs.}}$ (km/s)	-40	-30	-50	-220
$M_{\text{OB}} \sin^3 i$ ( $M_{\odot}$ )	22	23	50	19
$M_{\text{WN}} \sin^3 i$ ( $M_{\odot}$ )	9.5	8	43	23
Spectral type	WN4+OB	WN4+OB	WN6+OB	WN7+O?

not be true, as the systemic velocities from the NIV emission do not always agree with that of the OB companion.

HD 90657: The velocity curves for this system from 25 spectra obtained in February 1979 are shown in Fig. 1. The ellipticity of a previous orbit (Niemela 1976) is found to be spurious by the present observations covering one and a half cycles of the binary. The values of the minimum masses for this system, with the WN star being the less massive, are very similar to those of the "classical" WN+O system V 444 Cygni (Munch 1950).

HD 94546: No previous radial velocity curves for this system are known. A radial velocity variation with a period of 4.9 days is shown from 10 spectra obtained in February 1979 (Fig. 2). Spectroscopically this binary resembles HD 90657 and also seems to have similar minimum masses.

MR 42: This star has not previously been known as double-lined spectroscopic binary. 17 spectra obtained in February 1979 show faint absorption lines from an OB companion to be present. Both components of this system seem to be quite massive (see Fig. 3 and Table 1), unlike most other WR binaries.

CQ Cep: The absorption lines previously attributed to the OB companion belong to the WN7 star. Only two absorption lines, the He II  $\lambda$  4686 superimposed to the WN emission, and one component of the violet shifted He I  $\lambda$  3888, seem to arise from the companion.

#### REFERENCES

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