THE RADIAL VELOCITY VARIATIONS OF WR46 (WN3P)

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Abstract. Spectral observations of the WN3p star WR46 (HD 104994) obtained during June 1993 and January/February 1994 display large amplitude radial velocity variations of the strong emission lines N V 4603-19Å and He II 4686Å, on a time scale of a fraction of a day. The most probable period found is 0.311 d, similar to the photometric period found by previous authors. The amplitude of the radial velocity variations of N V emission is almost twice that of He II. Noting the similarity of WR46 with low mass X-ray binaries, we suggest that the emission line spectrum corresponds to that of a luminous accretion disk in an evolved binary system.

Key words: stars: Wolf-Rayet – binaries – accretion disk – individual: WR46

1. Introduction and observations

WR46 (HD 104994) is a WN3 type star with relatively strong O VI 3811-34Å emission lines in its spectrum. The star exhibits visual light variations of 0.1 mag on a time-scale of few hours with a period of 6.8 hr presumably due to binary motion (van Genderen *et al.* 1990, 1991). Such a period is more suggestive of evolved lower mass binaries than the massive Population I WR+O systems. In this paper we present a radial-velocity study of the strongest emission lines in the spectrum of WR46, to clarify the origin of the light variations. Digital spectra were obtained at the *CASLEO* 2.1m and *CTIO* 1m telescopes in June 1993 and January/February 1994.

2. Results and discussion

The spectra observed in June 1993 show a relatively large motion of the strong N V 4603-19Å and He II 4686Å emission lines in successive spectra obtained during the same night, indicating a time-scale of a fraction of a day for the radial-velocity variations. A period-search routine applied to all our 1993-1994 radial-velocity data of He II and N V emission lines yields as the best period $0^d.31$. This value is similar, but not equal, to the photometric period of $0^d.28$ found by van Genderen *et al.* (1991). We note that the radial-velocity data folded in the $0^d.31$ show a considerable scatter, when compared with the observations from a single night. Assuming that the

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TABLE I
Circular orbital elements of WR46 (HD 104994, WN3p)

	He II λ4686Å emission	N V λλ4603 – 19Å emission
P (d)	0.311274	
v_0 (km/s)	+4	(+204)
K (km/s)	173	320
T_0(2440000+)	9143.7	9143.7
$f(M)$ ($M_\odot$)	0.17	1.06

period of $0^d.31$ is due to the orbital motion in a binary system, a sine fit with this period to the radial velocity of He II and N V emission gives the orbital elements as in Table 1. The radial velocities and the orbital fits from Table 1 for the He II and N V emissions are shown in Figure 1. Figure 2 shows a combined échelle spectrum of WR46, where the main emission lines are identified. Note the presence of O VI emissions in the otherwise early WN type spectrum. O VI emission is also observed in the optical spectra of "supersoft" X-ray sources (*cf.* Cowley *et al.* 1993), which are thought to represent a class of low mass X-ray binaries whose optical spectra are dominated by luminous accretion disks. In particular, the optical spectra published by Cowley *et al.* (1993) greatly resemble WN stars. WR46 was detected as a faint source in the *Einstein* X-ray survey (Pollock 1987). In view of the short binary period, the spectrum of WR46 may be due to an accretion disk in an evolved binary system. In this context the larger radial-velocity amplitude of the N V emission may due to higher velocities in the

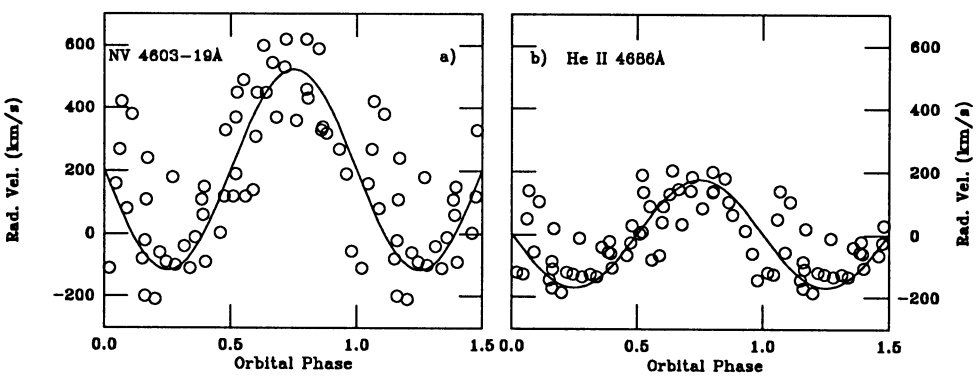

Fig. 1. Observed radial velocities of WR46 folded with $P = 0.311274$ d; a) N V 4603-19Å emission, b) He II 4686Å emission. The curves represent the orbital fits from Table 1.

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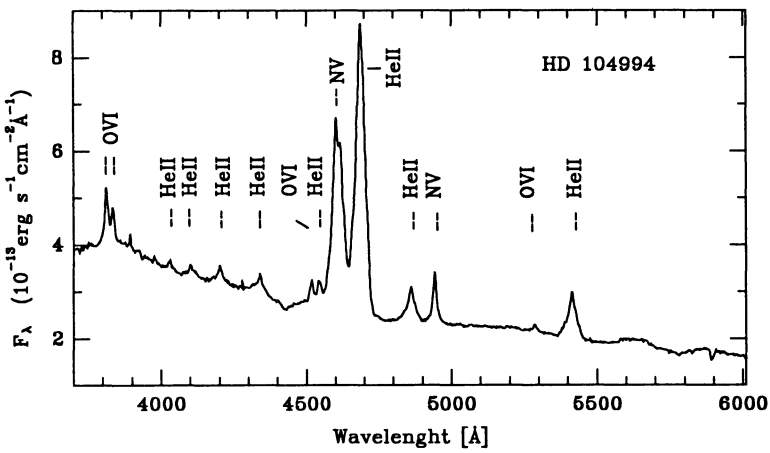

Fig. 2. The optical spectrum of WR46

inner accretion disk.

WR46 is not known to be a member of a cluster or stellar association. The distances available in the literature are based on the assumption of equal absolute magnitudes for all WN3 type stars. We have attempted an independent estimate of the distance based on polarimetric observations of WR46. The mean linear polarization of WR46 from V filter observations performed with the Vatican polarimeter at the 2.1m telescope at *CASLEO* is $P(\%) = 1.016$, $\theta = 89°$. A comparison of these values with the published polarization observed in stars at the same region of the sky (Mathewson & Ford 1970), yields an estimated distance of about 2 kpc and A_v about 1 mag, which would imply an absolute magnitude $M_v = -1.6$ for WR46. This value is equal to estimated absolute magnitude of the supersoft X-ray source RXJ 0513.9–6951 in the LMC (Cowley *et al.* 1993).

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