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IS THERE WIND-WIND COLLISION IN WR 141 (HD 193928)?

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RESUMEN

Obtuvimos series de espectros ópticos del sistema binario WR 141 (WN6+O) en el Observatorio Astronómico Nacional en San Pedro Mártir en 1992 y 1993. Comparando con datos anteriores, podemos mejorar la estimación del período orbital. Las variaciones observadas en los perfiles de las líneas, especialmente He II λ4686 Å sugieren la presencia de efectos de colision de vientos.

ABSTRACT

Series of optical spectra of the binary system WR 141 (WN6+O) have been obtained at the Observatorio Astronómico Nacional at San Pedro Mártir in 1992 and 1993. Comparison with previous data leads to a refined estimate of the orbital period. The observed variations of the line profiles, especially of He II λ4686 Å suggests the presence of wind-wind collision effects.

Key words: **LINE: PROFILES — BINARIES: CLOSE — STARS: WOLF-RAYET — STARS: INDIVIDUAL (HD 193928)**

1. INTRODUCTION

WR 141 (HD 193928) is a narrow-line WN6 in a binary system. According to Hiltner (1945), the orbital period is 21.64 days. The wind velocity, determined from the P Cygni profiles of infrared He I lines, is 1550 km s^{-1} (Eenens & Williams 1994). Grandchamps & Moffat (1991) estimated an orbital inclination of 71.7° and masses of the binary components of 23.8 $M_\odot$ (WR star) and 22.9 $M_\odot$ (O star).

2. THE DATA

Optical spectra of WR 141 were obtained at the Observatorio Astronómico Nacional at San Pedro Mártir in Baja California, México, during extended observing campaigns in 1992 and 1993. The spectra have a resolution between 0.5 Å (1992) and 1 Å (1993) per pixel and cover the wavelength ranges 4400 – 4800 Å (1992) or 4000 – 4800 Å (1993). Several consecutive spectra were taken each night to improve the signal to noise ratio without saturating the He II λ4686 Å line, and to increase our confidence in the observed line profiles.

3. THE BINARY PERIOD

Our data span a total of 24 nights and provide a good cover of all the phases of the binary system. Comparison with the data obtained by Hiltner (1945) enables us to refine the period to P = 21.635 ± 0.002 days. We can thus confirm the phase estimated by Eenens & Williams (1994) for their 1990 infrared spectrum (around phase ϕ=0.0), on which they based their suggestion that the 1.083 μm He I line may show progressive waves in displacement velocity.

4. THE LINE PROFILE CHANGES

Significant changes are observed in the profile of the He II λ4686 Å emission line. The clearest feature is an excess of emission in the blue wing of the line near the orbital phase ϕ=0.4, that is when the WR star is

receding and about to reach opposition. This cannot be explained in terms of absorption of the red wing by the companion, as it is then approaching. Moreover, the equivalent width of the line is measured to be higher, confirming that we are observing an increase in emission.

The observed profile changes of the WR He II emission line are consistent with a bow shock around the companion. Near phase ϕ=0.4, one of the arms of the bow shock would be pointing toward the observer, causing an excess of blue-shifted emission, due to increased emission in the shock front. The data analyzed so far suggest that the emission excess is seen red-shifted near phase ϕ=0.0 as expected. In the snapshot infrared spectrum published by Eenens & Williams (1994; their Fig. 2a), the He I line also exhibits a redshifted peak, in addtition to a smaller peak near the line center. More observations would tell us whether the changes in the line profiles are periodical.

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