

WR 148 and the not so compact companion

Melissa Munoz¹, Anthony J. Moffat¹, Grant M. Hill²,
Tomer Shenar³, Noel D. Richardson⁴, Herbert Pablo³,
Nicole St-Louis¹ and Tahina Ramiamananantsoa¹

¹Université de Montréal, ²W. M. Keck Observatory, ³Institut für Physik und Astronomie,
⁴University of Toledo

Abstract. The objective is to determine the nature of the unseen companion of the single-lined spectroscopic binary, WR 148 (= WN7h+?). The absence of companion lines supports a compact companion (cc) scenario. The lack of hard X-rays favours a non-compact companion scenario. Is WR 148 a commonplace WR+OB binary or a rare WR+cc binary?

Keywords. binaries: spectroscopic, stars: Wolf-Rayet, stars: individual (WR 148).

WR 148 (WN7h) is a single-lined spectroscopic binary with an established period of 4.3174 d suspected to harbour either a low mass B star or a black hole companion (Marchenko *et al.* 1996). We obtained two nights of spectra from the Keck Observatory at both quadratures complemented by additional other spectra from l'Observatoire du Mont-Mgantic (OMM) in the summers of 2014 and 2015.

The high resolution and high signal-to-noise ratio Keck spectra reveal absorption lines moving in anti-phase to the WR emission lines with similar velocity amplitude (see Table 1 for the orbital elements). Considering an orbital inclination of $\sim 67^\circ$, derived from previous polarimetry observations (Drissen *et al.* 1986), the systems total mass would be a mere 2-3 M_\odot ; an unprecedented result for suspected massive binary.

Table 1. Orbital solution for the WR star and companion.

Object	P [days]	E [HJD - 2,440,000]	γ [kms s ⁻¹]	K [kms s ⁻¹]
WR star	4.317336 ± 0.000026	4825.04 ± 0.03	88.1 ± 3.8	-131.4 ± 2.7
Companion			79.2 ± 3.1	-120.1 ± 1.2

We apply the shift-and-add technique to disentangle the spectra and obtain a companion spectrum compatible with an O5 spectral type. Assuming a typical mass for a O5 V type from Martins *et al.* 2003, we obtain a new orbital inclination of $\sim 20^\circ$. This discrepancy in inclination angle can be reconciled with a revised error assessment on the polarisation data. In fact, Wolinski & Dolan (1994) demonstrate that polarimetrically-derived inclination angles have a statistical bias towards higher angles.

To summarise, WR 148 is found to be a normal, massive, close WN7+O5 binary system. Though not discussed here, evidence of colliding winds has been discovered as well as thermal X-rays compatible with other WR+O colliding wind binaries.

References

- Drissen, L., Lamontagne, R., Moffat, A. F. J., Bastien, P., & Seguin, M., 1986, *ApJ*, 304, 188
Marchenko, S. V., Moffat, A. F. J., Lamontagne, R., & Tovmassian, G. H. 1996, *ApJ*, 461, 386
Martins, F., Schaerer, D., & Hillier, D. J. 2003, *A&A*, 436, 1049
Wolinski, K. G. & Dolan, J. F. 1994, *MNRAS*, 267, 5