Wolf-Rayet Phenomena in Massive Stars and Starburst Galaxies
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Optical spectroscopic variability of possible Wolf-Rayet binaries

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1. Introduction

There are a number of Wolf-Rayet stars which, based on their emission line profile variations, were proposed to be WR+cc systems (Firmani *et al.* 1980; Cherepashchuk & Aslanov 1984). However, recent intensive monitoring with different observational techniques, has given rise to alternative explanations for the variability in these WR stars including the presence of a disk , rotating jet-like structures (Vreux *et al.* 1992), and corotating interaction regions (St-Louis *et al.* 1995).

In order to resolve whether or not binary interaction effects can be responsible for the line profile variability being observed, numerical simulations generated under the assumption of this interaction must be generated and compared with the observations. In this paper we present a comparison between the line profiles computed assuming orbital motion and atmospheric eclipses with observations of HD 50896 (WR 6) and HD 191765 (WR 134).

The effect on the line profiles due to orbital motion and atmospheric eclipses is computed as in Auer & Koenigsberger (1994). The companion is assumed to have an associate Gaussian emission line which follows its orbital motion. The calculated profiles are produced on a trial-and-error basis, by systematically modifying the input parameters until a reasonably good fit to a reference observed profile is obtained. Because the basic assumption is that the variations are due to the presence of a companion, an assumption must be made regarding which of the observed line profiles most resembles one which we could assign to a specific orbital phase. Once this reference spectrum is identified, and the input parameters of the code are defined, synthetic spectra are generated for the other orbital phases, corresponding to the available observational data for comparison (as shown in Figure 1). Differences between the observed and the computed line profiles can be attributed to effects which are not considered in the computer code, such as line formation in a shock cone, non-spherically symmetric mass loss from the WR star, and intrinsic variability (including clumping) in the WR wind.

The observations were obtained at the 2.1m Guillermo Haro Observatory (*OGH*) in Cananea Sonora, Mexico, in various observing runs during 1996–1998. The high S/N (≈ 300) and reciprocal dispersion (0.31 Å/pix) at He II 4686 Å allow a good comparison with the computed models.

2. Results

(1) The line profiles in WR 6 and WR 134 are very similar and the pattern of variability also shows great similarities. Thus, it appears that in both stars the phenomena producing the variations are similar

(2) The simple model of a binary system in which both components have associated emission arising in spherically symmetric line-forming regions is capable of reproducing some of the observed profiles, but not all. In particular, it is unable to reproduce the pattern of variability observed in WR 6, the star with the best determined period. The differences between the observed and predicted line profiles indicate that:

(2a) line emission arising in a shock cone surrounding the companion needs to be incorporated;

(2b) non-spherically symmetric line forming regions are required; and

(2c) wind instabilities play a major role in the shape of the upper portion of the line He II λ4686 profile and are not the result of the presence of a possible binary companion.

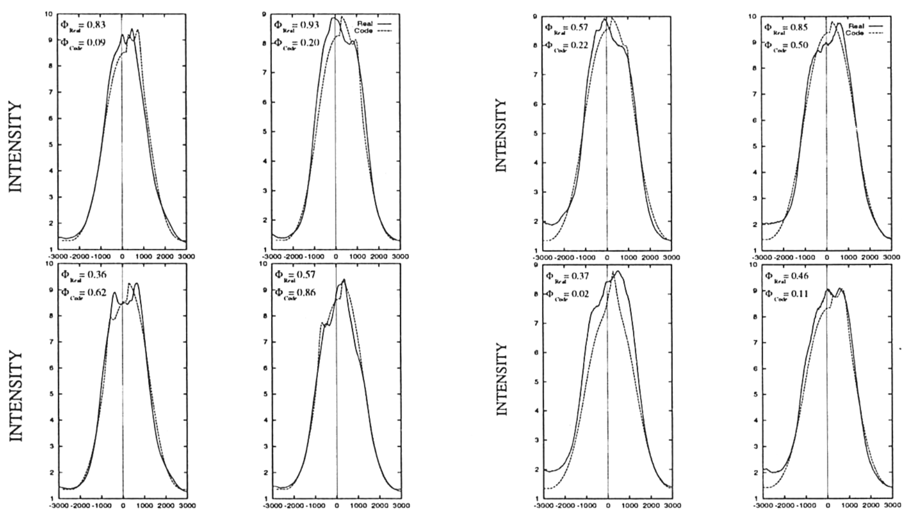

Figure 1. Phase-dependent synthetic line-profiles superposed on the He II λ4686 line of the WR+cc candidates WR 6 (*left*), and WR 134 (*right*).

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