

Abundances of Wolf-Rayet stars as metallicity tracers

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Abstract. We present here the first results of a grid of helium-carbon-oxygen models for Wolf-Rayet stars of the carbon sequence (WC). The models were calculated with a numerical code that assumes the basic considerations of the standard model.

1. Introduction

We developed a numerical code to analyze stellar winds of massive stars, using non-LTE techniques (Machado 1998). We consider radial expansion, spherical symmetry and a monotonic law of velocity. Line radiative transfer is calculated using Sobolev's approximation for supersonic winds and atomic models including all ions of H, He, C, and O. We fit the profiles of the lines O III 5590 Å, C III 5696 Å and C IV 5806 Å, and observed the main effects produced by the variation of the stellar parameters.

2. The model grid

The WC models are specified by the following basic parameters: photospheric temperature T_* , photospheric radius R_* , terminal velocity of the wind v_∞ , mass loss rate (\dot{M}), chemical abundances of carbon and oxygen A_C and A_O (by number), respectively, and the free parameter β of the velocity profile. To analyze the effects produced by the variation of parameters, we fixed a test model and changed each parameter in turn. The test model has the following parameters: $T_* = 67\,000$ K, $R_* = 5 R_\odot$, $v_\infty = 2800$ km s⁻¹, $\dot{M} = 3 \times 10^{-5} M_\odot \text{yr}^{-1}$, $\frac{C}{He} = 0.5$, $\frac{O}{He} = 0.1$ and $\beta = 3$.

3. Discussion

We observed from this grid that the line at $\lambda 5590$ Å is due to O III. The most important point was the variation in the lines caused by a change in free parameter of the velocity profile. In a second step we fit the line profiles of O III 5590 Å, C III 5696 Å and C IV 5806 Å lines for five WC stars (WC5 to WC9 subtypes) (Machado 1998). The results show a correlation between the subtypes and the abundances ratio (C+O)/He. This result is in accordance with the results of Smith & Hummer (1988) and can be used for the investigation in order to distinguish the metallicities for different galaxies (Smith & Maeder 1991).

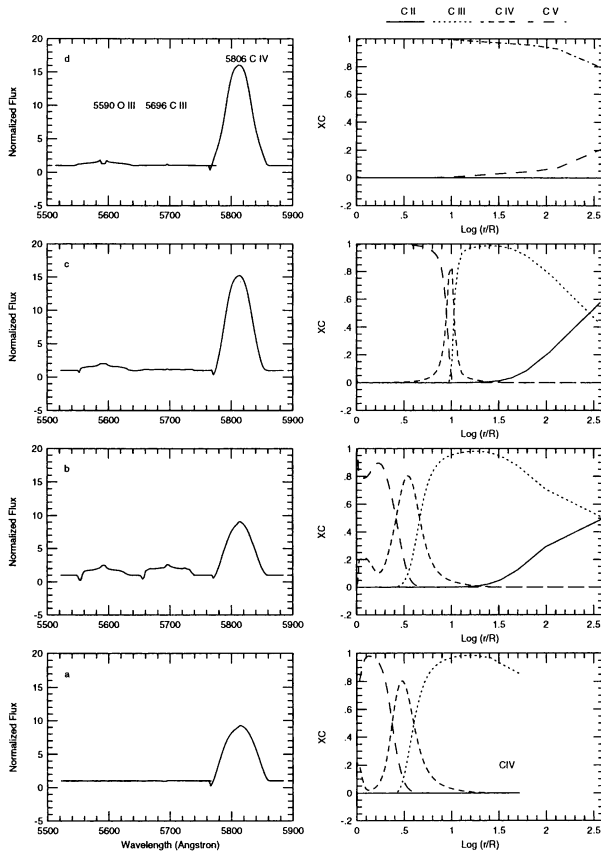


Figure 1. Observed variations of O III λ 5590, C III λ 5696 and of C IV λ 5806 lines (*left*) and in the carbon ionization curves (*right*) for different values of the free parameter of the velocity profile: $\beta = 1$ (Fig. 1a), $\beta = 2$ (Fig. 1b), $\beta = 3$ (Fig. 1c), and $\beta = 4$ (Fig. 1d).

References

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