

## LATE O GIANTS AND THE WEAK WIND PROBLEM

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**We analysed O giants through UV and optical spectroscopy using the code CMFGEN. We conclude that these stars show weak winds and are at the transition region in luminosity for such issue.**

We performed a spectroscopic modelling of 9 Galactic late O giants (O8-9.5III). We used high resolution UV data from the IUE telescope and optical data from the FEROS and NARVAL instruments. We derived the principal stellar winds physical parameters of the sample, i.e., the  $\dot{M}$  and  $v_\infty$ . For this, we analysed sophisticated non-LTE atmosphere models computed by the code CMFGEN (Hillier & Miller 1998). We are interested about these stars because of their luminosity region at  $\log(L_\star/L_\odot) \approx 5.2$ , which seems to define the beginning of the called weak wind problem (e.g., Martins et al. 2005; Marcolino et al. 2009), where the  $\dot{M}$  derived by atmospheric modelling are orders of magnitude lower than the hydrodynamical predicted values (Vink et al. 2000) for late O dwarfs (O8-9.5V). In order to obtain the stellar and wind parameters, we used the following line diagnostics: (i) UV: Fe III-IV-V ( $T_{\text{eff}}$ ), P-Cygni profiles of C IV  $\lambda\lambda 1548, 1551$  ( $\dot{M}$  and  $v_\infty$ ), and Si IV  $\lambda\lambda 1394, 1403$  ( $\dot{M}$ ); (ii) optical: He I-II ( $T_{\text{eff}}$ ), Balmer series ( $\log g$ ), weak metal lines and He I ( $v \sin i$ ), and H $\alpha$  ( $\dot{M}$ ). We developed a detailed analysis of possible relevant degeneracies between the  $\dot{M}$  and stellar parameters (such as  $T_{\text{eff}}$ , CNO abundances, and microturbulence field) and found that the determined limits for  $\dot{M}$  are robust to uncertainties on the stellar properties. There is an overall agreement between the UV and optical analyses. However, for 3 stars we do not find agreement between the modelling of H $\alpha$  and UV. In the Fig. 1, we show the comparison between the determined  $\dot{M}$  and the predicted values  $\dot{M}_{\text{Vink}}$  for different types of OB stars. The dwarfs with weak winds are below  $\log(L/L_\odot) \approx 5.2$  (balls). Note the overall agreement between the predicted and the derived  $\dot{M}$  for the most luminous OB stars. Our results for O giants are shown in red squares. We

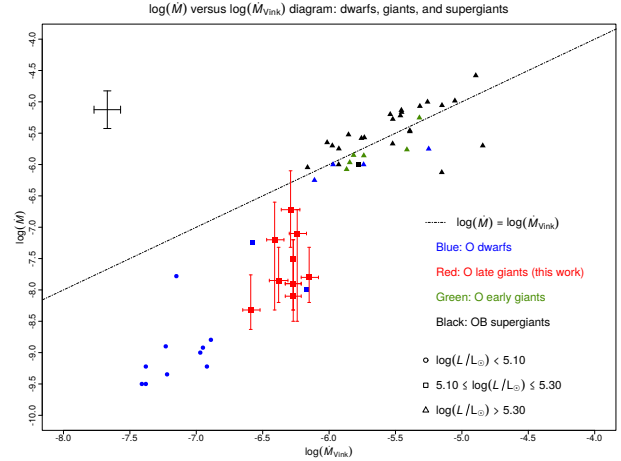


Fig. 1. Representative error bars for the literature results: O dwarfs (Martins et al. 2005; Marcolino et al. 2009), O early giants and OB supergiants (references within Mokiem et al. 2007).

conclude that O8-9.5III also exhibit the weak wind problem and confirm the region of  $\log(L_\star/L_\odot) \approx 5.2$  as critical for the weak winds. These results are the first to show this issue besides the types O8-9.5V. We analysed our sample in the HR diagram together to literature results for O dwarfs and supergiants and we verified the more evolved status of the former in comparison with the late dwarfs. Therefore, we attest that the weak winds are not due to evolutionary effects.

### REFERENCES

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