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THE WINDS OF O-TYPE STARS: IONIZATION STRUCTURE AND REVISED STELLAR PARAMETERS FROM FAR-UV SPECTRA

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We derived consistent photospheric and wind parameters of O-type stars, by analyzing high-resolution spectra in the range 905 to 3250 Å with line-blanketed, hydrodynamic, non-LTE spherical models. We find significantly lower $T_{\rm eff}$ and luminosities than previously assigned to these spectral types.

We show sample results from a comprehensive program to study hot massive stars in the Milky Way (MW) and Local Group galaxies. Stellar parameters are derived by a consistent analysis of multiwavelength spectra, with non-LTE, hydrodynamic, line-blanketed models. We combine *FUSE* spectra (905 to 1187 Å) and *IUE/HST* archive spectra (1150 to 3250 Å). Synthetic spectra for the analysis are computed with the WMBASIC code (Pauldrach, Hoffman, & Lennon 2001), and with Hillier & Miller's (1998) CMFGEN code for comparison.

Effective temperatures derived from our analysis are significantly lower (≈ 15 to 20%) than values previously published for our sample stars, and than canonical values assigned to their spectral types by different compilations (Figure 1). The luminosities are consequently lower. This result has great implications for our understanding of massive star evolution and energy balance calculations of H II regions.

Lines in the *FUSE* range, including high ionization stages and lower abundance non-CNO elements (e.g., O VI, S VI, S IV, P V), when analyzed consistently with N IV, N V, C IV and Si IV lines in the *IUE/HST* range, can uniquely constrain the stellar photospheric and wind parameters, and provide the first quantitative assessment of the effect of soft X-rays (from shocks) on the wind ionization.

Bianchi & Garcia (2002) found that all the lines observed in the far-UV to UV range (high and low ionization species) could be consistently modeled, once shocks are properly taken into account, for stars of luminosity class V, with the WMBASIC code. For supergiant stars, however, the WMBASIC calculations fail to explain the observed S IV/S VI ratio, while all other features can again be modeled consistently. These findings and other considerations

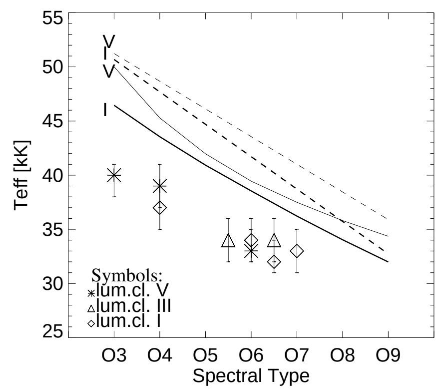

Fig. 1. $T_{\rm eff}$ values from our consistent analysis of wind and photospheric lines for a sample of MW stars (symbols) are compared to previous calibrations (Vacca, Garmany, & Shull 1996: dashed lines; de Jager & Nieuwenhuijzen 1987: solid lines). Results for mid-O type stars are from Bianchi & Garcia (2002). Results for early-O types are preliminary (Garcia & Bianchi 2003).

prompted us to undertake a systematic comparison of different codes, WMBASIC and CMFGEN. We find that synthetic spectra calculated with these two codes for equivalent sets of stellar parameters, predict very similar ionization fractions (once all relevant ions are treated with the same detail) for most ions, except for S IV.

A first comparison among far-UV spectra of similar objects in the MW, Large Magellanic Cloud, and M 33 was presented by Bianchi et al. (2002). The analysis is being extended to the optical lines, and to more stars in the MW and in the Local Group.

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