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New Solutions to Line-Driven Winds of Hot Massive Stars

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Abstract. In the frame of radiation driven wind theory (Castor *et al.*1975), we present self-consistent hydrodynamical solutions to the line-force parameters (k, α, δ) under LTE conditions. Hydrodynamic models are provided by HydWind (Curé 2004). We evaluate these results with those ones previously found in literature, focusing in different regions of the optical depth to be used to perform the calculations. The values for mass-loss rate and terminal velocity obtained from our calculations are also presented.

We also examine the line-force parameters for the case when large changes in ionization throughout the wind occurs (δ-slow solutions, Curé *et al.*2011).

Keywords. Radiative transfer – Hydrodynamics – Stars: winds, outflows – Stars: mass-loss

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We use the CAK formalism (Castor *et al.*, 1975; Abbott, 1982) to calculate the force multiplier $\mathcal{M}(t)$ by means of the sum of all the spectral lines ($\sim$ 900 thousand) contributing to the radiative-driven processes. Parameters (k, α, δ) are obtained fitting the force multiplier, i.e., $\mathcal{M}(t) = k\,t^{-\alpha}(N_{e,11}/W)^{\delta}$. These calculations are complemented with the solution of the equation of motion by HydWind (Curé, 2004). With the new velocity profile we calculate new line-force parameters and iterate with the hydrodynamic solution until convergence, obtaining therefore a self-consistent wind solution.

Results for fast and δ-slow regimes (Curé *et al.*, 2011) are presented in the Table. Bottom rows corresponds to δ-slow solutions ($\delta > 0.25$) Optical depth t ranges where solutions have been calculated are also displayed.

$T_{\rm eff}$	$\log g$	k	α	δ	$\dot{M}$ $[M_\odot/{\rm yr}]$	v_∞ [km/s]	$\log t_{\rm min}$	$\log t_{\rm max}$
50 000	4.5	0.895	0.572	0.049	1.1×10^{-5}	4 486	−5.305	−0.593
40 000	4.0	0.312	0.585	0.084	2.8×10^{-6}	2 780	−5.732	−1.305
20 000	2.5	0.069	0.601	0.163	4.2×10^{-7}	683	−6.097	−2.392
19 500	2.1	0.07	0.551	0.272	6.18×10^{-6}	204.1	−2.194	−3.259
16 000	2.7	0.05	0.61	0.28	1.15×10^{-9}	477.3	−2.086	−3.974

Present results have been able not only to reproduce previous calculations (Abbott, 1982; Noebauer & Sim, 2015), but also have given values for mass-loss rate in the expected range. A more exhaustive work to properly determine how accurate are our new $\dot{M}$ and v_∞ compared with those measured observationally is ongoing.

References

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