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FASTWIND reloaded: Complete comoving frame transfer for "all" contributing lines

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Abstract. FASTWIND is a unified NLTE atmosphere/spectrum synthesis code originally designed (and frequently used) for the optical/IR spectroscopic analysis of massive stars with winds. Until the previous version (v10), the line transfer for background elements (mostly from the iron-group) was performed in an approximate way, by calculating the individual line-transitions in a single-line Sobolev or comoving frame approach, and by adding up the individual opacities and source functions to quasi-continuum quantities that are used to determine the radiation field for the complete spectrum (see Puls *et al.* 2005, A&A 435, 669, and updates).

We have now updated this approach (v11) and calculate, for *all* contributing lines (from elements H to Zn), the radiative transfer in the comoving frame, thus also accounting for line-overlap effects in an "exact" way. Related quantities such as temperature, radiative acceleration and formal integral have been improved in parallel. For a typical massive star atmospheric model, the computation times (from scratch, and for a modern desktop computer) are 1.5 h for the atmosphere/NLTE part, and 30 to 45 minutes (when not parallelized) for the formal integral (i.e., SED and normalized flux) in the ranges 900 to 2000 and 3800 to 7000 Å($\Delta\lambda = 0.03$ Å).

We compare our new with analogous results from the alternative code CMFGEN (Hillier & Miller 1998, ApJ 496, 407, and updates), for a grid consisting of 5 O-dwarf and 5 O-supergiant models of different spectral subtype. In most cases, the agreement is very good or even excellent (i.e., for the radiative acceleration), though also certain differences can be spotted. A comparison with results from the previous, approximate method shows equally good agreement, though also here some differences become obvious. Besides the possibility to calculate the (total) radiative acceleration, the new FASTWIND version will allow us to investigate the UV-part of the spectrum in parallel with the optical/IR domain.

Keywords. methods: numerical, stars: atmospheres, stars: early-type, stars: mass loss

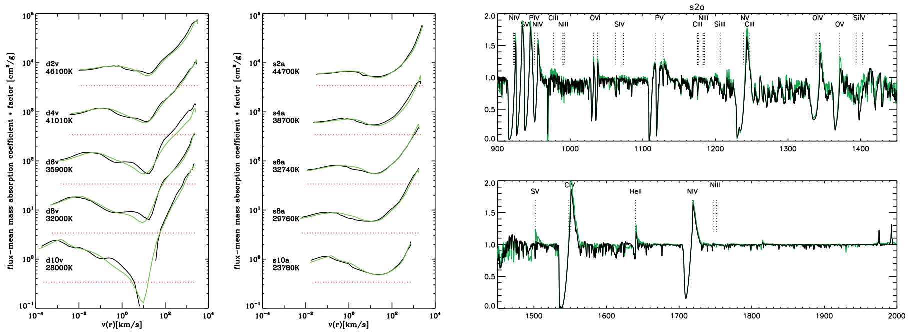

Figure 1. Left: Flux-mean mass absorption coefficient, a quantity directly proportional to the total radiative acceleration, for dwarf (left) and supergiant models (right) from FW v11 (black) and CMFGEN (green). The red lines indicate the corresponding "acceleration" by pure Thomson scattering. All curves (but the lowest ones) have been shifted by multiples of 1 dex. **Right:** Predicted UV spectrum ($v \sin i = 80 \mathrm{km\,s}^{-1}$) in the range between 900 and 2000 Å, for a supergiant model at $T_{\rm eff} = 44{,}700$ K, as synthesized by FW v11 (black) and CMFGEN (green).

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