Quantitative H and K band spectroscopy of Galactic OB-stars at medium resolution

T. Repolust(1), J. Puls(1), M.M. Hanson(2,3),
R.-P. Kudritzki(4), M.R. Mokiem(5)

1 - Universitäts-Sternwarte München, Scheinerstr. 1, D-81679 München, Germany
2 - Department of Physics, The University of Cincinnati, Cincinnati, OH 45221-0011
3 - Visiting Astronomer, Subaru Observatory at Mauna Kea, Hawaii
4 - Institute for Astronomy, University of Hawaii at Manoa, 2680 Woodlawn Drive, Honolulu, HI 96822
5 - Astronomical Institute ``Anton Pannekoek'', Kruislaan 403, NL-1098 SJ Amsterdam

In this paper we have analyzed 25 Galactic O and early B-stars by means of {\it H} and {\it K} band spectroscopy, with the primary goal to investigate to what extent a lone near-IR spectroscopy is able to recover stellar and wind parameters derived in the optical. Most of the spectra have been taken with {\sc subaru-ircs}, at an intermediate resolution of 12,000, and with a very high S/N, mostly on the order of 200 or better. In order to synthesize the strategic H/He lines, we have used our recent, line-blanketed version of {\sc fastwind} (Puls et al. 2005). In total, seven lines have been investigated, where for two stars we could make additional use of the HeI2.05 singlet which has been observed with {\sc irtf-cshell}. Apart from Br-gamma and HeII2.18, the other lines are predominately formed in the stellar photosphere, and thus remain fairly uncontaminated from more complex physical processes, particularly clumping.

First we investigated the predicted behaviour of the strategic lines. In contradiction to what one expects from the optical in the O-star regime, almost all photospheric H/HeI/HeII\ {\it H/K} band lines {\it become stronger if the gravity decreases}. Concerning H and HeII, this finding is related to the behaviour of Stark broadening as a function of electron density, which in the line cores is different for members of lower (optical) and higher (IR) series. Regarding HeI, the predicted behaviour is due to some subtle NLTE effects resulting in a stronger overpopulation of the lower level when the gravity decreases.

We have compared our calculations with results from the alternative NLTE model atmosphere code {\sc cmfgen} (Hillier & Miller 1998). In most cases, we found reasonable or nearly perfect agreement. Only the HeI2.05 singlet for mid O-types suffers from some discrepancy, analogous with findings for the optical HeI singlets.

For most of our objects, we obtained good fits, except for the line cores of Br-gamma in early O-stars with significant mass-loss. Whereas the observations show Br-gamma mostly as rather symmetric emission lines, the models predict a P~Cygni type profile with strong absorption. This discrepancy (which also appears in lines synthesized by {\sc cmfgen}) might be an indirect effect of clumping.

After having derived the stellar and wind parameters from the IR, we have compared them to results from previous optical analyses. Overall, the IR results coincide in most cases with the optical ones within the typical errors usually quoted for the corresponding parameters, i.e, an uncertainty in Teff of 5%, in log g of 0.1 dex and in Mdot of 0.2 dex, with lower errors at higher wind densities. Outliers above the 1-sigma level where found in four cases with respect to log g and in two cases for Mdot.

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Weblink: http://www.usm.uni-muenchen.de/people/puls/Puls.html

Comments:

Email: uh101aw@usm.uni-muenchen.de