New windows on massive stars: asteroseismology, interferometry, and spectropolarimetry
Proceedings IAU Symposium No. 307, 2014
G. Meynet, C. Georgy, J. H. Groh & Ph. Stee, eds.

doi:10.1017/S1743921314006334

Non-LTE Abundances in OB stars: Preliminary Results for 5 Stars in the Outer Galactic Disk

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Abstract. The aim of this study is to analyse and determine elemental abundances for a large sample of distant B stars in the outer Galactic disk in order to constrain the chemical distribution of the Galactic disk and models of chemical evolution of the Galaxy. Here, we present preliminary results on a few stars along with the adopted methodology based on securing simultaneous O and Si ionization equilibria with consistent NLTE model atmospheres.

Keywords. stars: early-type, stars: fundamental parameters, stars: abundances, Galaxy: disk, Galaxy: abundances, Galaxy: evolution

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The chemical distribution of B stars in the outer Galactic disk is presently poorly probed, based on only a few abundance results for distant B stars (e.g., Daflon *et al.* 2004). In order to enlarge the number of studied stars and to better represent the chemical distribution of the outer Galactic disk, we obtained high-resolution echelle spectra for a sample of 136 OB stars located towards the Galactic anti-center using the MIKE spectrograph on the 6.5m Magellan Clay telescope. A subsample of 50 sharp-lined B stars has been selected for the abundance analysis. High resolution, high signal-to-noise spectra of 3 well studied main-sequence B stars (HD 61068, HD 63922 and HD 74575) were added to the sample in order to test our adopted methodology.

We use an iterative method to obtain simultaneously the stellar parameters (effective temperature ($T_{\rm eff}$), surface gravity ($\log g$), microturbulence, and abundances of Si and O) based on non-LTE synthesis of H, He, Si, and O profiles. The synthetic spectra are computed using `SYNSPEC` (Hubeny & Lanz 2011), which interpolates in a grid of non-LTE model atmospheres computed with `TLUSTY` (Hubeny & Lanz 1995) and detailed atomic models of O (69, 219 and 41 levels for O I, II and III, respectively) and Si (70, 122 and 53 levels for Si II, III and IV, respectively). The adopted method, based on Hunter *et al.* (2007), consists of the following steps:

(*a*) Initial values for the stellar parameters are set from the stellar spectral type.

(*b*) Ionization balance of Si II/III/IV and/or O I/II/III provides $T_{\rm eff}$ and abundances of Si and O.

(*c*) $\log g$ is obtained from fits of the pressure broadened wings of the Balmer lines Hα, Hβ and Hγ.

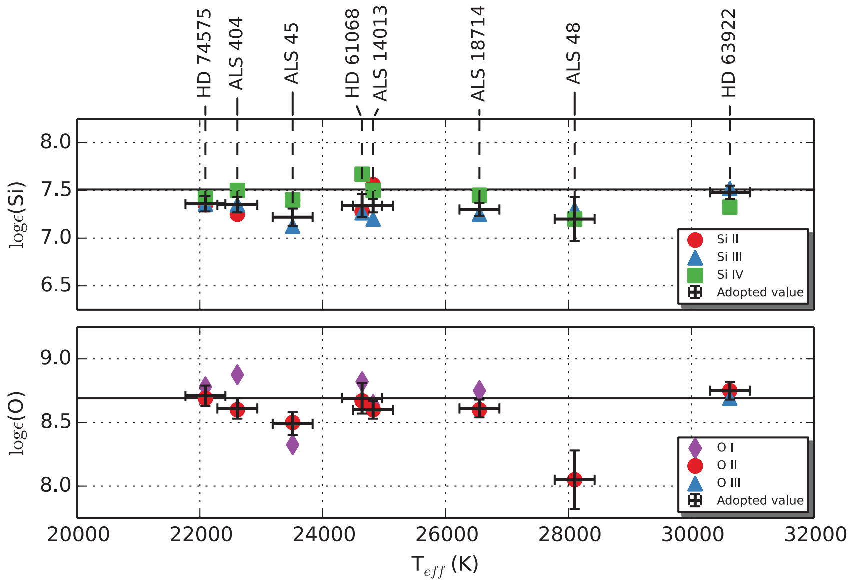

Figure 1. Chemical abundances of Si and O as a function of $T_{\rm eff}$. The black crosses represent the adopted abundances for Si and O with the respective dispersion. The colored symbols show the abundance obtained for each species (see legend) and the solid lines represent the solar value obtained by Asplund *et al.* (2009).

(*d*) Microturbulence is defined by requiring that the SiIII line abundances are independent of the line strength (equivalent width).

(*e*) We check for convergence of the basic stellar parameters: $T_{\rm eff}$, $\log g$ and microturbulence. If not, the previous steps are repeated.

(*f*) If converged, we fit the Si and O lines to obtain the adopted abundance values. The parameters $T_{\rm eff}$, $\log g$, microturbulence and Si and O abundances (in the $\log \epsilon_{\rm X} = \log(N_{\rm X}/N_{\rm H}) + 12$ notation) are obtained with uncertainties of 325 K, 0.07 dex, 3 km/s, 0.08 dex and 0.11 dex, respectively.

Our preliminary abundance results and effective temperatures for 5 ALS sample stars and 3 reference HD stars are shown in Fig. 1. The derived abundances show no trends with effective temperature, indicating the non-LTE calculations are free of systematics. This iterative method will be applied to the whole sub-sample of 50 sharp-lined, distant B stars in order to probe the chemical distribution of the outer Galactic disk.

Acknowledgements

We acknowledge financial support of National Science Foundation (NSF, AST-0448900), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the International Astronomomic Union (IAU).

References

Asplund, M., Grevesse, N., Sauval, A. J., & Scott, P. 2009, *ARA&A* 47, 481
Daflon, S., Cunha, K., & Butler, K. 2004, *ApJ* 606, 514
Hubeny, I. & Lanz, T. 1995, *ApJ* 439, 875
Hubeny, I. & Lanz, T. 2011, *Synspec: General Spectrum Synthesis Program*, Astrophysics Source Code Library
Hunter, I., Dufton, P. L., Smartt, S. J., *et al.* 2007, *A&A* 466, 277

https://doi.org/10.1017/S1743921314006334 Published online by Cambridge University Press