A Massive Star Odyssey, from Main Sequence to Supernova
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A flatter metallicity gradient in the Galactic disk: non-LTE abundance calculations of OB stars

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Abstract. We present non-LTE abundances of carbon, nitrogen, oxygen, magnesium, aluminum, silicon and sulfur, derived for a sample of 70 O9-B2 main sequence stars of the Galactic disk and analyze the distribution of the chemical abundances in terms of radial gradients within 4.4 - 12.9 kpc from the center of the Galaxy. The derived gradients are flatter than those presented by the most recent studies about the radial gradients of stellar abundances.

One very important observational constraint for the chemical evolution models is the distribution of the abundances in the Galactic disk as a function of galactocentric distance: the radial metallicity gradients. In our Galaxy, such gradients may be determined by the analysis of the chemical composition of ionized gas or stellar photospheres. The abundance results, in general, suggest that the radial gradients do exist in the Galactic disk; the exact values of these gradients, however, still remain somewhat uncertain. The stellar analyses, in particular, are based on non-homogeneous abundance data, usually derived with the assumption of LTE, which may introduce systematic errors in the abundance determination. In this work, we analyze the distribution of stellar abundances in the context of the Galactic disk, focusing on the radial gradients of metallicity. Our analysis is based on a sample of 70 OB main-sequence stars members of 25 open clusters, OB associations and H II regions, covering Galactocentric distances between 4.4 and 12.9 kpc, assuming $R_{\odot} = 7.6$ kpc.

A unique methodology was applied throughout the sample in order to produce a homogeneous and self-consistent set of abundance data (Daflon, Cunha & Becker 1999; Daflon *et al.* 2001a,b; Daflon 2002). The atmosphere parameters, effective temperature and surface gravity, were obtained from a photometric calibration for the reddening-free index Q, coupled to the fitting of Hγ profile. The model atmospheres are plane-parallel, LTE models calculated with the program ATLAS9. The chemical abundances are derived from the fitting of broadened non-LTE synthetic line profiles to high resolution observed spectra. The non-LTE calculations were done with programs DETAIL, which solves simultaneously the equations of statistical equilibrium and transfer, and SURFACE, which computes the line profiles. The fitting of synthetic profiles instead of equivalent width measurements makes it possible to determine the chemical composition of stars with high projected rotational velocities, which is very common among OB stars.

The radial gradients obtained from our abundance distributions are flatter than the most recent results listed in the literature. All the element gradients are similar and could be represented by a single slope of $\sim$–0.04 dex kpc^{-1}. The abundance ratios of C, N, Mg, Al, Si and S, relative to oxygen, are approximately independent of the galactocentric distance. Our sample stars have $7 < v \sin i < 190\,\mathrm{km\,s^{-1}}$; however, the inclusion of stars with $v \sin i < 60\,\mathrm{km\,s^{-1}}$ does not introduce any bias in our abundance analysis.

References

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The winner takes it all: semi-final Mundial 2002, Brasil - Turkey: 1 - 0. (A few days later Brasil would win the final against Germany: 2 - 0.) Celebrating: Mrs. Zinnecker, Hans Zinnecker, Katia Cunha, Lucimara Martins, Francisco de Araújo, João Leão, Marcelo Borges, Carolina Kehrig, Simone Daflon, and Duilia de Mello

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