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Sulfur Abundances in Orion B Stars

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Abstract. Sulfur abundances are derived for a sample of ten B MS star members of the Orion association. The analysis is based on LTE model atmospheres and non-LTE line formation theory by means of spectrum synthesis analysis of S II and S III lines. The abundance distribution obtained for the Orion targets is homogeneous within the errors in the analysis: A(S)=7.15±0.05. This abundance result is in agreement with the solar value and with results for the Orion nebula. The sulfur abundances for Orion combined with previous results for other OB-type stars produce a relatively shallow sulfur abundance gradient with a slope of -0.037 ± 0.012 dex Kpc^{-1}.

Keywords. stars: early-type, stars: abundances, (Galaxy:) open clusters and associations: individual (Ori OB1)

1. Introduction

The α-element sulfur is of great astrophysical interest: it is among the ten most abundant elements in the universe and its production occurs both during hydrostatic and explosive oxygen-burning phases in massive star evolution and SN II. In addition, sulfur is not expected to locked-up significantly into grains. Thus, a comparison between nebular and stellar sulfur abundances may involve relatively small corrections for grain depletion; if true, sulfur then would provide a direct connection between the stellar and gas-phase abundances in the ISM, as well as nebular abundances in galactic and extra-galactic environments.

This work aims to define the present-day stellar sulfur abundance in a sample of young B-star members of the Orion association. These abundances can be used to help define the present-day sulfur abundance in the solar neighborhood, as well as constrain sulfur depletions onto grains.

2. Observations

The targets are 10 MS early B-type star members of the Ori OB1 association, selected from the sample of Cunha & Lambert (1994). The data are high resolution (R$\sim$ 35 000) spectra obtained with the ARCES on the 3.5m telescope at the APO. The spectra cover the wavelength range between 3480-10260Å and have SNR > 100.

3. Analysis

The stellar parameters ($T_{\rm eff}$, $\log g$, and ξ) adopted in this analysis are from Cunha & Lambert (1994). Sulfur abundances were derived from non-LTE synthetic profiles

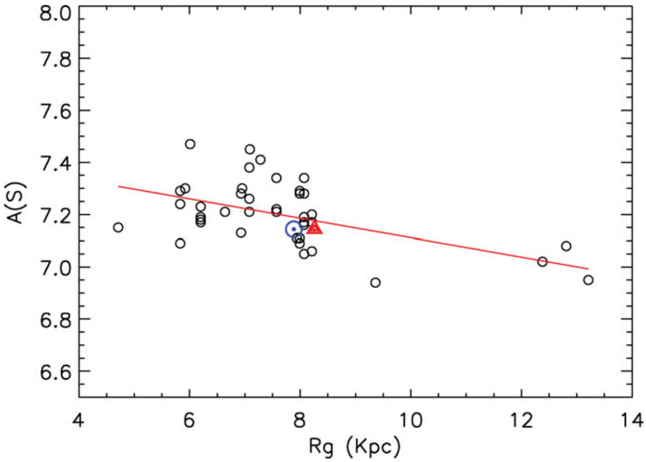

Figure 1. Radial gradient of sulfur abundances: the red triangle represents the average sulfur abundance for Orion B stars and the black open circles, the stellar abundances for the sample studied by Daflon & Cunha (2004).

computed for 16 S II and 3 S III lines. The non-LTE calculations were done with programs DETAIL/SURFACE, using LTE model atmospheres (Kurucz 1993) plus a sulfur model atom from Vrancken *et al.* (1996). The abundances and $V \sin i$ of the synthetic profiles were varied until they matched the observed S II and S III lines. For most stars in our sample, sulfur abundances derived from S II and S III lines were found to agree within 0.10 dex. The total errors in the derived S II and S III abundances are 0.11 dex and 0.10 dex, respectively. The sulfur abundances show no trend with effective temperature, suggesting that these results are probably free of major systematics within this $T_{\rm eff}$ range.

4. Results

The average sulfur abundance for our sample is A(S)= 7.15±0.05 and it is found to be in perfect agreement with the Solar System value A(S)=7.14 ± 0.05 (Asplund *et al.* 2006), suggesting that little, if any, chemical evolution of sulfur has taken place in the Solar vicinity in the last ∼4.5 Gyrs. The abundances of main-sequence B stars overlap with the nebular abundance derived by Esteban *et al.* (2004) for Orion. The similarity between these abundances indicates that sulfur is undepleted in the Orion Nebula.

The sulfur abundance results for Orion are added to a database of abundances previously published for OB main sequence stars along the Galactic Disk (Daflon & Cunha 2004), producing a gradient of sulfur abundance of -0.037 ± 0.012 dex Kpc^{-1} (Fig. 1).

References

Asplund, M., Grevesse, N., & Sauval, A. J. 2006, *Nuclear Physics A*, 777, 1
Cunha, K. & Lambert, D. 1994, *ApJ*, 426, 170
Daflon, S. & Cunha, K. 2004, *ApJ*, 617, 1115
Esteban, C. *et al.* 2004, *MNRAS*, 355, 229
Kurucz, R. 1993, CD-ROM No. 13. Cambridge, Mass.: SAO
Vrancken, M., Butler, K., & Becker, S. R. 1996, *A&AS*, 311, 661