

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 SII and SIII lines. The abundance distribution obtained for the Orion targets is homogeneous within the errors in the analysis: $A(S)=7.15\pm 0.05$. 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 SNI. In addition, sulfur is not expected to be 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_{eff} , $\log g$, and ξ) adopted in this analysis are from Cunha & Lambert (1994). Sulfur abundances were derived from non-LTE synthetic profiles

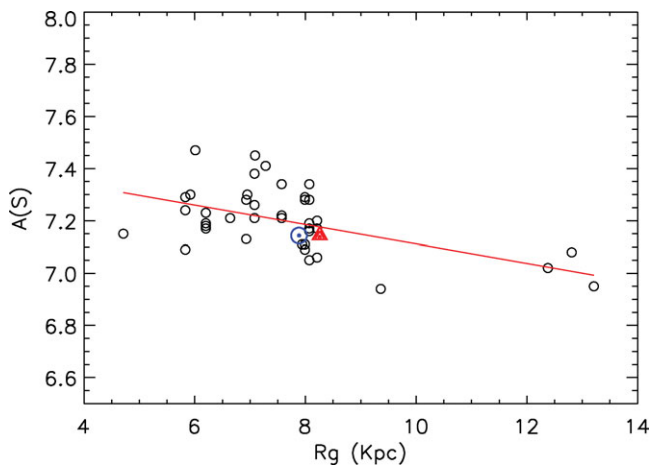


Figure 1. Radial gradient of sulfur abundances: the red triangle represents the average sulfur abundance for Orion B stars and the black open circles, the stellar abundances for the sample studied by Daflon & Cunha (2004).

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_{eff} range.

4. Results

The average sulfur abundance for our sample is $A(\text{S}) = 7.15 \pm 0.05$ and it is found to be in perfect agreement with the Solar System value $A(\text{S}) = 7.14 \pm 0.05$ (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

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