Padrikojo spiečiaus IC 4756 raudonųjų milžinių sekos žvaigždžių cheminė sudėtis

Chemical composition of giant stars in the open cluster IC 4756

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Stars of open clusters (OC) are born from the same molecular cloud, they have the same primordial chemical composition, age and distance. These reasons give for the OCs stars a significant advantage over the field stars, as former ones provide much better statistical evaluations and allow us to construct the Galaxy's chemical enrichment models more precisely.

Since the origin of *α*- and iron-peak-elements are different – former ones are mainly produced via the Type II supernovae explosions, latter – via Type Ia supernovae explosions – the interstellar medium enrichement timescales for these elements are different as well. Thus, *α*- and iron-peak chemical elements are important galactic evolution indicators as their abundances vary in different parts of the Galaxy.

The *s*- and *r*-process elements are created via the neutron capture processes at different stages of stellar evolution. However, a contribution of the asymptotic giant branch (AGB) stars to the production of *s*-process elements was underestimated, especially from old, low-mass stars. This effect is visible in young open clusters as they exhibit the overabundance of *s*-process elements compared to the older clusters [1] or the field stars.

In this work, we performed a high-resolution spectral analysis for thirteen red giant branch stars of the open cluster IC 4756. We determined their main atmospheric parameters as well as abundances of *α*-, iron-peak, *s*-, and *r*-process chemical elements.

IC 4756 (Galactic coordinates l = 36.381, b = 5.242) is a relatively young open cluster (0.79 – 0.89 Gyr [2]). It is located in the inner part of the Galactic disk at the galactocentric distance of around 8.1 kpc. As established in several studies, cluster's metallicity [Fe/H] is close to Solar (varies from –0.22 to 0.08 dex). Even though this cluster has multiple studies, in this work we carried out a detailed chemical analysis of 13 its stars.

High resolution spectra (R ≈ 48 000) were obtained using a bench-mounted, high-resolution astronomical eschelle spectrograph FEROS [3] at the 2.2 m MPG/ESO Telescope in La Silla. FEROS covers the whole visible range of 350–920 nm over 39 orders. The FEROS DRS pipeline within MIDAS was used for spectral reductions. A differential analysis technique was used for the spectra analysis as in [4]. All calculations were carried out in relation to the Sun. Main atmospheric parameters ($T_{\rm eff}$, log g, Fe/H and $v_{\rm t}$) for our programme stars were derived using excitation-ionization equilibrium principles. For the determination of chemical element abundances, we used the EQWIDTH and BSYN program packages, developed at the Uppsala Observatory. A set of plane-parallel, one dimensional, hydrostatic, constant flux LTE model atmospheres from MARCS were used as well.

In this work, for 10 of our programme stars we derived similar atmospheric parameters – the average $T_{\rm eff}$ = 5124 ± 55 K, log g = 2.73 ± 0.1, [Fe/H] = –0.02 ± 0.01, $v_{\rm t}$ = 1.37 ± 0.11 km/s. The remaining stars (ID: 14, 28 and 52) have slightly lower $T_{\rm eff}$'s and slightly higher log g's. The determined combined average cluster metallicity for all stars is [Fe/H] = –0.03 ± 0.04.

α- and iron-peak-elements average abundances relative to iron for all programme stars are Solar or slightly above Solar. *s*-process elements show higher abundances compared to the Sun confirming the significance of AGB stars in producing them (Figure 1).

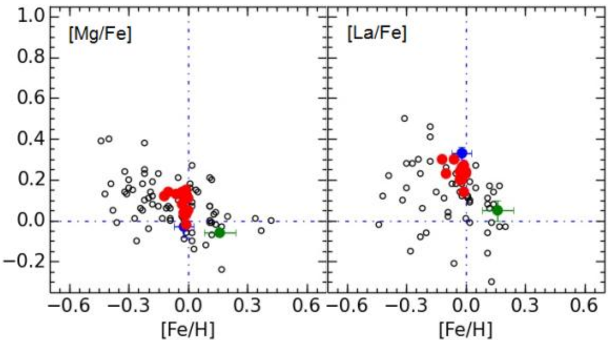

Figure 1. Mg and La abundance-to-Fe ratios in stars of IC 4756 compared to other clusters' studies. Stars investigated in this work are indicated as red dots. The green and blue dots indicate clusters from another our study [4], black circles – clusters from [5].

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Key words: open cluster, chemical element abundances

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