Researchers determine chemical composition of the stellar cluster Gaia1

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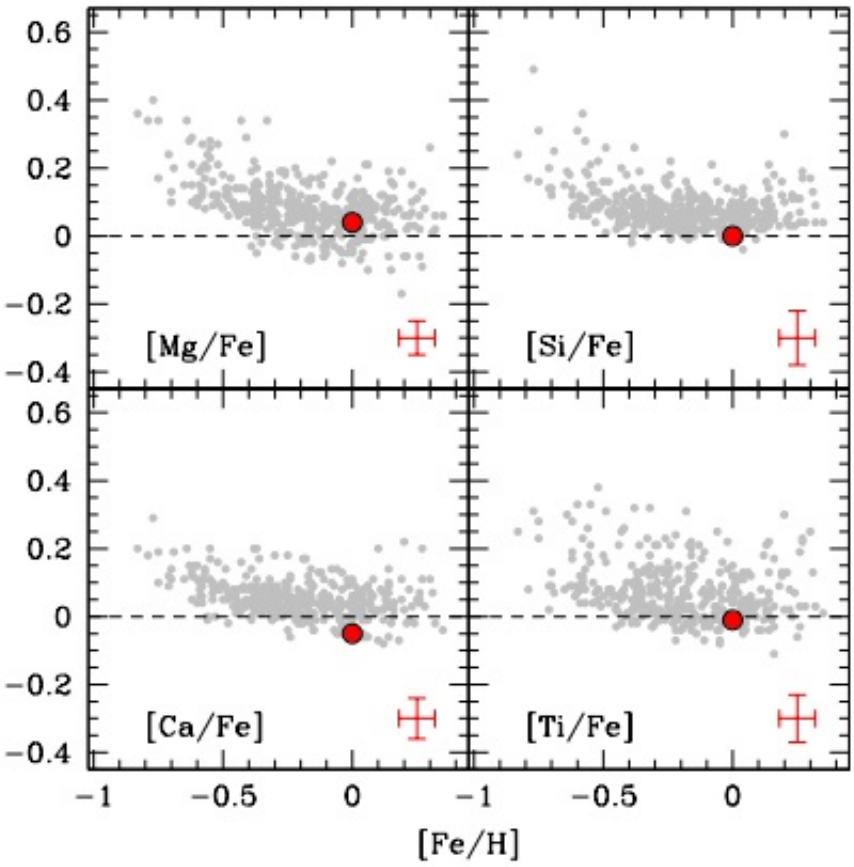

The behavior of the average [Mg/Fe], [Si/Fe], [Ca/Fe] and [Ti/Fe] abundance ratios of Gaia1 as a function of [Fe/H] (red point), in comparison with Galactic thin disk stars (grey points, Soubiran & Girard 2005). Credit: Mucciarelli et al., 2017.

(Phys.org)—Astronomers have determined chemical abundances of several elements for six giant stars of a recently discovered stellar cluster known as Gaia1. The results, available in a paper published June 5 on arXiv.org, reveal chemical composition of the cluster, providing important hints about its nature and origin.

Located some 15,000 light years away from the Earth (10 arcmin from Sirius), Gaia1 is an intermediate-age stellar cluster of about 22,000 solar masses. The discovery of the cluster, based on Data Release 1 (DR1) from ESA's Gaia satellite, was reported in May 2017. DR1 and follow-up spectroscopic observations suggested extragalactic origin of Gaia1, however, more studies were needed in order to confirm this assumption.

So a team of researchers led by Alessio Mucciarelli of the University of Bologna in Italy analyzed the spectroscopic data from the Magellan Inamori Kyocera Echelle (MIKE) spectrograph mounted on the Magellan II Telescope at Las Campanas Observatory in Chile. The spectra derived by Mucciarelli's team included helium-clump stars of the Gaia1 cluster. The researchers obtained chemical abundances of iron (Fe), sodium (Na), magnesium (Mg), aluminium (Al), silicon (Si), calcium (Ca), titanium (Ti), barium (Ba) and europium (Eu) for six giant stars observed with the Magellan II Telescope.

"We observed six He-clump stars of the intermediate-age stellar cluster Gaia1 with the MIKE/MAGELLAN spectrograph. (...) Abundances for Fe, Na, Al, Si, Ca and Ti have been derived from the equivalent widths of unblended transitions. (...) Abundances for Mg, Ba and Eu have been derived from spectral synthesis," the astronomers wrote in the paper.

The study reveals that Gaia1's iron abundance is similar to that of our sun. Other abundance ratios are solar-scaled, comparable to our galaxy's thin disk stars and open clusters of similar metallicity.

According to the authors of the paper, the chemical composition of Gaia1 indicates that it formed from a gas that underwent chemical enrichment similar to that of the Milky Way's thin disk. Thus, the results do not support the hypothesis that this cluster has an extragalactic origin.

"A possible extragalactic origin of Gaia1 is not supported by the comparison between its chemical composition and that of other stellar systems. The galaxies currently populating the Local Group are more metal-poor than Gaia1 and they do not reach solar metallicity," the researchers concluded.

Therefore, the team classified Gaia1 as an unremarkable standard galactic open cluster. The researchers noted that the cluster's position could suggest that it formed in the inner disk, progressively migrating toward higher galactocentric distance, which explains its possible peculiar orbit with respect to other open clusters.

While the chemical composition of Gaia1 has been determined by Mucciarelli and his colleagues, there are still uncertainties about its orbital parameters. The researchers hope that the second Gaia data release will change this situation.

More information: The chemical composition of the stellar cluster Gaia1: no surprise behind Sirius, arXiv:1706.01504 [astro-ph.SR] arxiv.org/abs/1706.01504

Abstract
We observed 6 He-clump stars of the intermediate-age stellar cluster Gaia1 with the MIKE/MAGELLAN spectrograph. A possible extra-galactic origin of this cluster, recently discovered thanks to the first data release of the ESA Gaia mission, has been suggested, based on its orbital parameters. Abundances for Fe, alpha, proton- and neutron-capture elements have been obtained. We find no evidence of intrinsic

abundance spreads. The iron abundance is solar ([FeI/H]=+0.00 +-0.01; sigma = 0.03 dex). All the other abundance ratios are, by and large, solar-scaled, similar to the Galactic thin disk and open clusters stars of similar metallicity. The chemical composition of Gaia1 does not support an extra-galactic origin for this stellar cluster, that can be considered as a standard Galactic open cluster.