Djorgovski 2 hosts multiple stellar populations, study suggests

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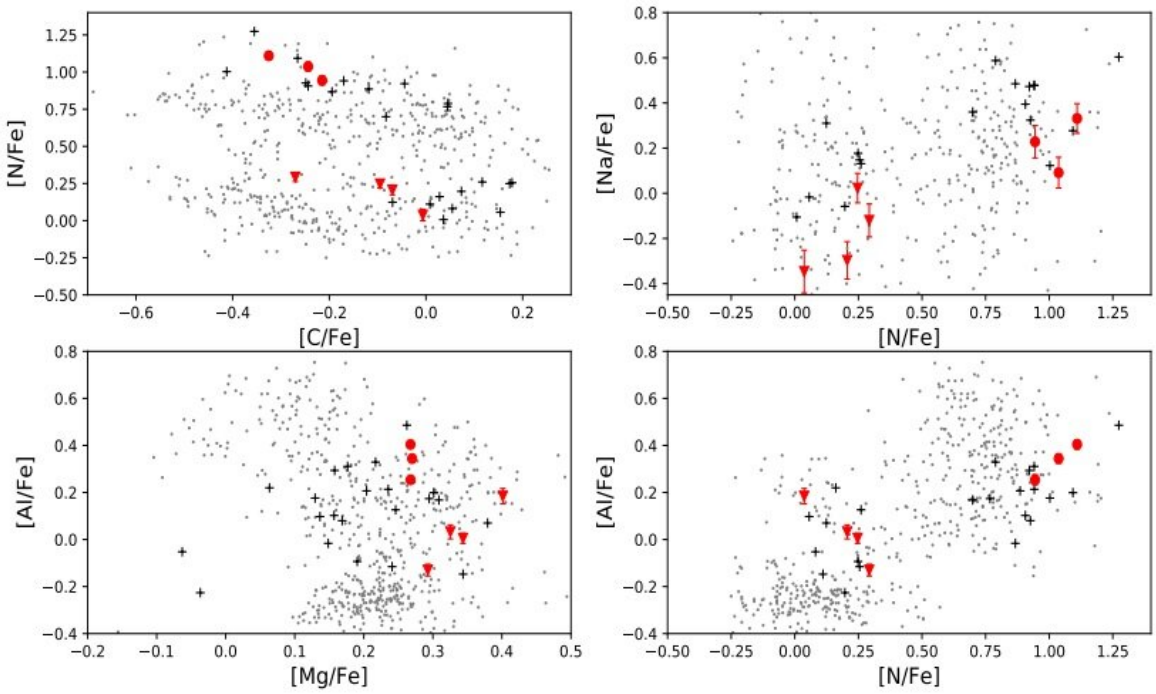

The abundance ratios [N/Fe], [Na/Fe], [Al/Fe], [Mg/Fe] and [C/Fe] for member ESO 456-SC38 stars highlighted in red. Credit: Butler et al., 2020.

Astronomers have performed spectroscopic observations of a globular cluster (GC) known as Djorgovski 2 and obtained chemical abundances of the cluster's seven stars. The results suggest that Djorgovski 2

contains multiple stellar populations. The finding was detailed in a paper published October 8 on the arXiv pre-print repository.

Discovered in 1978, Djorgovski 2 (also known as ESO 456-SC38) is a globular cluster located in the galactic bulge, one of the closest globular clusters to the center of the Milky Way. Given their location, such clusters as Djorgovski 2 are among the oldest known to date. This could mean that they might have witnessed the entire history of the Milky Way, and could therefore be crucial in advancing the knowledge about our home galaxy.

Previous observations have found that Djorgovski 2, with a metallicity of -1.11, is a moderately metal-poor cluster located at a distance of approximately 28,500 light years and is some 12.7 billion years old. However, Djorgovski 2 remains a poorly studied cluster and elemental abundances for its stars are largely unknown.

Andrea Kunder and Evan Butler from the Saint Martin's University in Olympia, Washington, performed spectroscopic observations of Djorgovski 2 in order to get more insight into the chemical composition of its stars. The data for the study were collected as part of the Apache Point Observatory Galactic Evolution Experiment (APOGEE) and Sloan Digital Sky Survey (SDSS).

The researchers managed to isolate seven stars in Djorgovski 2 with robust metallicities, elemental abundances, radial velocities and proper motions from ESA's Gaia satellite (its second data release known as DR2). This doubled the sample of stars with spectroscopic measurements in this cluster.

The new study found that Djorgovski 2 has a metallicity of approximately -1.05, which is slightly higher than the value reported by previous observations. A significant spread in the abundances of

nitrogen, carbon, sodium and aluminum was detected in these stars. The values obtained are indicative of multiple stellar populations in this cluster.

"Multiple populations in all globular clusters are evident in the spread of C, N, O and Na in cluster stars, and here a bimodality is the most clearly seen within [N/Fe] (...) From their [C/Fe], [N/Fe], [Na/Fe], [Mg/Fe], and [Al/Fe] abundances, we detect the presence of multiple stellar populations in this cluster," the astronomers explained.

Moreover, the observations found that the average silicon to iron abundance ratio is at a level of about 25 dex, which is typical for in situ bulge clusters. The study also confirmed that some RR Lyrae stars, previously thought to be field stars, are the members of Djorgovski 2. The distance to the cluster was calculated to be approximately 28,134 light years, which is in accordance with previous estimates.

More information: Kunder et al., Spectroscopic analysis of the bulge Globular Cluster ESO 456-SC38, arXiv:2010.04255 [astro-ph.SR] arxiv.org/abs/2010.04255

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