Research investigates chemical composition of globular cluster Terzan 6

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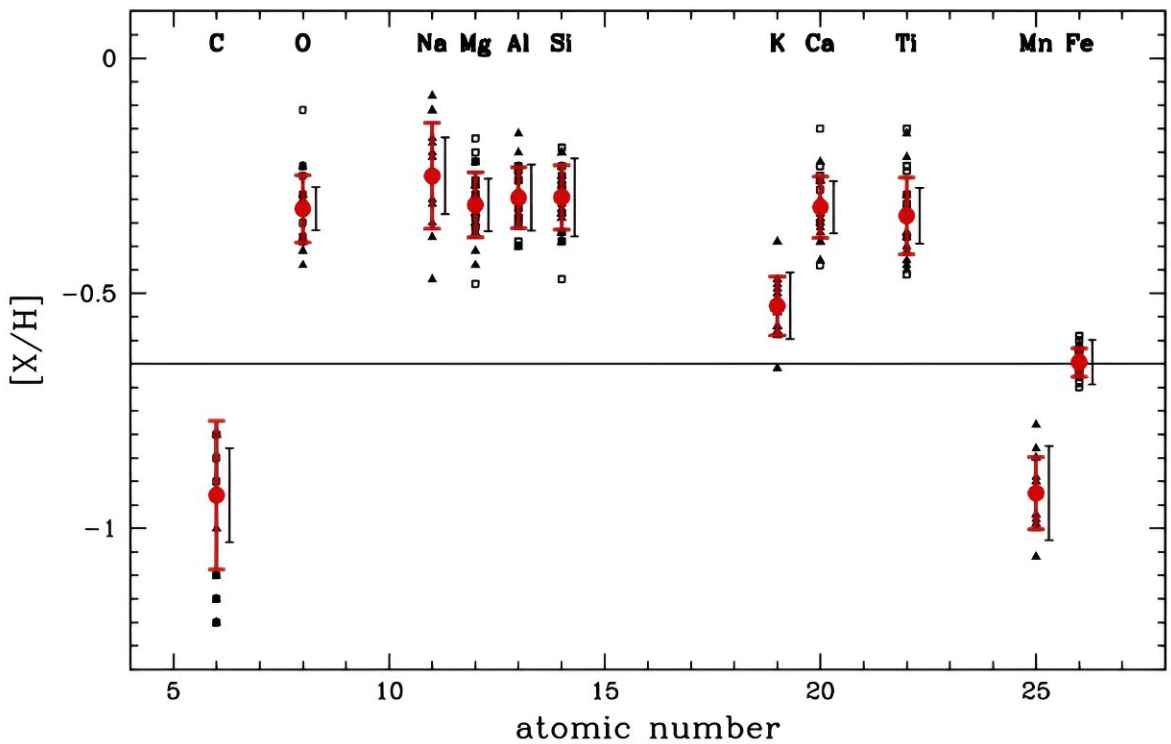

Chemical abundances for the Terzan 6 stars observed with X-shooter (filled triangles) and NIRSpec (open squares). Credit: Fanelli et al., 2024.

Astronomers have performed a comprehensive chemical study of a Galactic globular cluster known as Terzan 6. Results of the study, presented in a research paper published June 11 on the pre-print server *arXiv*, could advance our knowledge about the properties and nature of

this cluster.

Globular clusters (GCs) are collections of tightly bound stars orbiting galaxies. Astronomers perceive them as natural laboratories enabling studies on the evolution of stars and galaxies. In particular, globular clusters could help researchers to better understand the formation history and evolution of early-type galaxies, as the origin of GCs seems to be closely linked to periods of intense star formation.

Discovered in 1968, Terzan 6 is a highly reddened GC located in the Milky Way's inner bulge, about 23,000 light years away from the Earth. It has an intermediate luminosity, metallicity at a level of -0.62 dex, and its total mass is estimated to be some 100,000 solar masses.

Although Terzan 6 has been known for decades, its chemical composition is poorly studied. That is why a team of astronomers led by Cristiano Fanelli of the Astrophysics and Space Science Observatory of Bologna in Italy, decided to investigate the cluster's chemistry.

The observations were conducted using the Hubble Space Telescope (HST), the Keck II telescope and the Very Large Telescope (VLT), as part of a long-term, ongoing project aimed at studying stellar populations of Galactic bulge GCs.

Fanelli's team has conducted medium-high resolution near-infrared spectroscopy of a representative sample of 27 giant stars, likely members of Terzan 6. All of the investigated stars are within 80 arcseconds from the cluster center, have an average heliocentric velocity of 143.3 km/s and their effective temperatures are between 3,500 and 4,250 K.

Based on this sample of stars, the astronomers found that Terzan 6 has a metallicity of approximately -0.65 dex and does not exhibit any

appreciable intrinsic spread in iron. It turned out that calcium, silicon, magnesium, titanium, oxygen, aluminum and sodium have abundance ratios enhanced with respect to the corresponding solar values by about 0.3–0.4 dex. However, the abundance ratio of potassium is only mildly enhanced by an average of 0.11 dex, while carbon and manganese are depleted.

The researchers noted that the inferred chemical abundances indicate that Terzan 6 is a genuine GC of the Galactic bulge. They added that the enhancement in alpha elements like silicon, magnesium or titanium, suggest an old age of the cluster's stellar population, which likely formed at early epochs from a gas mainly enriched by Type II supernovae. Moreover, the spread in the light element abundances points to the presence of first-generation and intermediate second-generation stars in Terzan 6.

"Some scatter in the light element abundances is consistent with the possible self-enrichment of Terzan 6 in these elements during its early lifetime, as is typically observed in Galactic GCs and interpreted as a signature of multiple stellar populations," the authors of the paper concluded.

More information: C. Fanelli et al, Detailed chemical abundances of the globular cluster Terzan 6 in the inner bulge, *arXiv* (2024). DOI: 10.48550/arxiv.2406.07180