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The Pristine Survey: High-resolution spectroscopy and kinematics of new extremely metal-poor stars

Extremely metal-poor stars (EMPs, [Fe/H] < -3) are excellent tools for Galactic archaeologists to study the first stars and the early formation history of the Milky Way. A great diversity has been seen in the EMP stars, both in the medley of their chemical abundance ratios, as well as in their kinematics; a diversity suggestive of the variety of their nucleosynthetic origins and formation sites.
Here we present the first results from the high-resolution spectroscopic follow-up of 21 new EMP stars found in the Pristine survey. We observed these stars with the Gemini Remote Access to CFHT ESPaDOnS Spectrograph (GRACES) at Gemini-N and have determined precision chemical abundances for key elements including the alpha (Mg, Ca), odd- Z (Na, Al, Sc, Mn, Zn), and the neutron capture elements (Y, Sr, Ba, Eu). These element abundances are necessary to identify rare classes of chemically peculiar stars, such as CEMP-no, alpha-challenged, and r-process rich stars, and also enable new constraints on supernova yields with respect to progenitor mass, rotation rates, explosion energies, mixing/fallback models, explosion symmetries, and progenitor binarity. Furthermore, we infer distances, kinematics, and orbits for our sample by combining Gaia DR2 astrometric and photometric data with isochrones and radial velocities measured from the GRACES spectra. We find a majority of our stars are confined to the Galactic halo, however we additionally identify a group of stars with prograde "disk-like" orbits ($z_{max} < 3$ kpc, $J_z < 100$km s−1 kpc). The unique kinematics of these "disk-like" stars have an assortment of possible explanations, most notably the ancient accretion event(s) responsible for the formation of the proto-Milky Way disk. These data are part on an ongoing Gemini Large and Long Program which aims to increase the number of known EMP stars with detailed abundance analyses by ˜30%.

Author: KIELTY, Collin (University of Victoria)

Co-authors: Prof. VENN, Kim; SESTITO, Federico (Observatoire Astronomique de Strasbourg); Dr STARKENBURG, Else; Dr MARTIN, Nicolas (Observatoire Astronomique de Strasbourg); YOUAKIM, Kris; BONIFACIO, Piercarlo (Observatoire de Paris); Dr CAFFAU, elisabetta; LARDO, Carmela; ARENTSEN, Anke; GONZALES-HERNANDEZ, Jonay

Presenter: KIELTY, Collin (University of Victoria)

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