Hunting Na-rich stars through the jungle of N-rich stars in the Galactic halo

Globular clusters (GCs) provide stars to the halo of galaxies as a result of two-body interactions and tidal forces exerted by the galactic gravitational field. Therefore, to understand how the halo of the Milky Way formed, we need to estimate what fraction of the halo field stars are GC escapees. Identifying characteristic chemical signatures in halo stars is a promising approach, because GCs have unique chemical fingerprints, i.e. the majority of GC stars is enriched in N and Na.
Large existing surveys (e.g. APOGEE and SEGUE-1/2) used N enrichment to identify GC escapees. However, N enrichment is a necessary but insufficient condition to this purpose, because red giant stars can modify their surface abundances of N via mixing processes. On the other hand, Na abundances are not affected by mixing and thus represent a better probe to identify chemically peculiar stars formed in GCs.

We will report here the Na abundance measurements of a sample of ~50 Galactic halo stars selected to be N-rich from the SEGUE surveys. Our Na survey will reveal the nature of the N-strong stars in the halo, thus separating N-rich stars, due to mixing, from real GC escapee stars. Moreover, thanks to the unprecedented precision reached by Gaia DR3 astrometric measurements, we are able to combine a detailed abundance analysis with parallaxes and proper motions. This allows us to trace back the orbits of our candidate stars and associate them with GCs and additional potential escapees with normal light-element abundances. This study will then provide a crucial validation of the commonly-used N-based identification of GC escapees and open up a new way to probe the formation history of the Galactic halo.