

Understanding galaxy formation through the chemo-dynamics of Milky Way's stellar fossils

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Descrizione:

Galaxy formation and evolution is a key research area of modern Astrophysics. Galaxy formation can be explored by using a variety of theoretical and observational techniques in the nearby Universe or at very large distances (high redshift, z). In the local Universe, the Milky Way offers a unique perspective to test models of galaxy formation because stars can be individually observed and their properties, such as the motion within the Galaxy (kinematics, dynamics), and the chemical composition, can be accurately derived. Stellar populations that are member of the Galaxy's halo (the most ancient component) are metal-poor and particularly informative of the assembly process because they can retain memories of such mechanisms in their motion. Moreover, their chemical composition encodes crucial information on the environment in which they formed, on the nature of the first stars formed in the Universe, and on the properties of the galactic building blocks.

In this project the PhD student will learn to perform chemo-dynamical analysis of large samples of stars coming from public surveys (SDSS-IV and -V, Gaia-DR3,), and non-public surveys (Hamburg ESO Survey- HES). The faint stellar sample in the HES survey is a non-public data set of 5000 stars with low-resolution spectroscopy, covering the southern sky. The sample contains more than 2000 stars with metallicity $[Fe/H] < -2$, of which 400 have $[Fe/H] < -3$. She/He will also learn to extract the chemical abundances from high-resolution spectroscopy of HES and other data samples that will be obtained through ESO facilities. The PhD student will work on the chemical composition (alpha elements, neutron-capture elements) of these ancient stellar fossils, and on their dynamics, which contains information on the assembly process of the Galaxy. She/He will have the possibility to be involved in the 4MOST project (Milky Way Halo High Resolution Survey; PI: N. Christlieb).

The student will also use data coming from new chemo-dynamical cosmological simulation of Milky Way mass-sized galaxies in LCDM framework (for example Illustris TNG-50) to perform comparisons of the observed properties of the Milky Way halo system and its stellar populations, with those inferred from the analyses of simulated haloes. She/He will have the possibility to work at international facilities through an extended network of collaborators.