Bridging stellar and extragalactic astrophysics : modeling and observing globular clusters in the era of Euclid

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Context:

Modern telescopes have opened up new insights into Globular Clusters (GCs) both at high redshift in deep pointed observations (e.g. JWST or HST observations) and in the relatively local universe over vast areas of the sky (e.g. observations by Euclid and collaborating ground-based optical surveys). Globular Clusters serve as bright tracers of galaxy evolution and interactions as well as galaxy dynamics and the underlying dark matter. We also are only starting to understand their formation and properties such as the very unusual abundance patterns of their multiple quasi-coeval stellar populations.

The study of GCs both in photometry and spectroscopy requires accurate stellar populations models of GCs to disentangle their properties. Even today it remains difficult to simultaneously reproduce the energy distributions and the absorption line spectra of stars with theoretical models across the HR-diagram. The low metallicity regime is particularly important for the study of GCs, and is among the most difficult to model (Lançon et al. 2021, Mucciarelli & Bonifacio 2020).

Thesis project:

The proposed thesis work is at the interface between stellar and extragalactic astrophysics. The first project of this thesis would be in improving the prediction of stellar population models for low metallicity GCs. This is especially crucial as we rely on good infrared predicted colors for selecting and analyzing GCs in the Euclid survey. A dataset of low metallicity stellar spectra has been observed with X-Shooter (ESO/VLT) for this purpose. Its reduction needs to be finalized and validated. Then these spectra will be confronted with theoretical spectra to discuss any discrepancies, and they will be used to improve the predictions for stellar population models of low-metallicity globular clusters.

A second project is planned within the Euclid collaboration where we use the knowledge from these stellar population models on the color of GCs in the infrared within the Euclid survey. With the data release of Euclid DR1 coming up this year in fall, we will have a large dataset from which we aim to select the most likely globular clusters. The second project is thus focused on applying our understanding of stellar population in GCs to the Euclid results, and to place the Euclid GCs in the context of modern galaxy evolution scenarii. The focus will be on one of the following: the fraction of metal-rich GCs in the outer halos, the search for very massive GCs that could be remnant dwarf galaxy nuclei, the globular cluster population of spiral galaxy halos.