Title : From star/galaxy separation to the detection of stellar streams for the search for dark matter, preparation for the early observations from Rubin/LSST

Advisor : Johann Cohen-Tanugi

Subject :

If its nature still remains an enigma, dark matter seems to make its presence felt at all gravitational scales, from the large-scale structuring of the cosmos (10^{23} solar masses, Msol, for the observable universe) to the smallest galaxies (~$10^{8\text{-}9}$ M_{sol}). As most cosmological models, including the standard "LCDM" model, predict structuring at all scales, the detection of structures at smaller scales, say down to 10^{6} M_{sol}, represents a frontier of utmost importance, as these small scales open up new ways to discriminate between different phenomenological models of dark matter.

To reach this frontier, one of the most promising recent probes turns out to be stellar streams. These are extended structures in the sky, seen by Gaia for example, coming from the tidal effect created by a host galaxy, in our case the Milky Way, on stable stellar systems such as globular clusters. The dark matter substructures, a priori present in the halo of such a host galaxy, then impact the structure of these stellar trails in a potentially observable manner.

The Vera C. Rubin Observatory will begin taking science data in the second half of 2025, and promises to bring new impetus to this research topic by detecting fainter members of existing streams as well as new fainter streams, potentially more distant from the Galactic center and therefore less disturbed by the presence of baryonic matter. The aim of the internship will be to prepare Rubin's early observations, which will probably already be of scientific interest for this research, by following two axes: simulations of stellar trails in the sky and of stars in the focal plane of Rubin's camera, and star/galaxy discrimination as part of the use of LePHARE, a code developed in part at LPCA and dedicated to the estimation of photometric redshift and physical parameters of galaxies, but which is also capable of adjusting stellar spectra to the data.

If budgeted, continuation of this work will also be proposed as a thesis subject.