Thesis subject

Name of the laboratory: Laboratoire d'Astrophysique de Marseille LAM (UMR7326)

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Subject's title: Bridging the gap between weak and strong lensing regimes to shed light on the galaxy - dark matter halo relation

Subject description:

The dark matter drives the cosmic evolution of structure in the universe and its distribution can reflect some of its fundamental properties but also it has a strong impact of the formation and evolution of galaxies and the visible baryonic matter therein. Gravitational lensing plays a key role in modern observational cosmology and wide field imaging surveys because of its ability to trace the mass. By combining the so-called strong and weak lensing regimes of distortions of faint background sources, we propose to uniquely investigate the light – matter relation and in particular the stellar to halo mass relation as a function of environment, by distinguishing sub-halos (ie treating differently central and satellite galaxies), and by relating the lensing signal within the large scale filamentary structure.

The project is perfectly timely with the launch of the Euclid Satellite in July 2023 in which we occupy leading responsibilities. Much attention will be put on the details of the shape measurements in the inner parts of halos, where shear, convergence and magnification can be large (>0.1) and where the so-called flexion signal must be accounted for in order to propose a fully consistent modeling framework, also able to incorporate more local constraints like Einstein radii coming from the strong lensing regime.

The PhD student will incorporate the Euclid consortium (as well as CFIS/UNIONS for short term warm up studies) and explore some extensions of machine-learning and parametric model fitting methods which are proved to work efficiently in the regime of small distortions. Building on the large experience at LAM in strong and weak lensing signal extraction and modeling, the student will improve, test and incorporate those tools into the advanced newly refurbished Sourcextractor++ morphometry code.

Bibliography:

Kuemmel et al 2022 # Martinet et al. 2021 # Euclid Preparation XXVI # Euclid Preparation IV # Great3 results