“Bayesian pipelines for cosmic shear analyses with the Vera Rubin Observatory LSST”

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Source et détails sur le financement : ANR AstroDeep

Mots-clés : Weak lensing, blending, machine learning bayesien, probabilistic pipelines, photo-z

Compétences nécessaires : Cosmologie OU machine learning.

Sujet scientifique de la thèse :

During the last decade, cosmology has entered a precision era, leading to the prevalence of the standard cosmological model, ΛCDM. Nevertheless, the main ingredient of this model, the so-called dark energy, remains mysterious while dominating the energy budget of the Universe. Its comprehension is therefore one of the main goals in this domain. Current and upcoming cosmological surveys, including that of the Euclid satellite, launched two years ago, and the ground-based Legacy Survey of Space and Time (LSST) of the Vera Rubin Observatory starting in 2026, are specifically designed to address this objective. These surveys, when combined, will map thousands of square degrees of sky in a multiwavelength manner with sub-arcsec resolution. This will result in the detection of several tens of billions of sources, enabling a wide range of astrophysical investigations and providing unprecedented constraints on the nature of dark energy and dark matter. The scope of the PhD topic, based in the LSST dark energy science collaboration and LSST Informatics and Statistics Science Collaboration context, will aim to bring new developments for the treatment of cosmic shear. More precisely, the PhD topic discussed here (and the preceding internship) will focus on the detection of sources and treatment of so-called unrecognized blends. We will use machine learning approaches that we want to build into Bayesian pipelines. This is the context of our “AstroDeep” ANR funding, and the direction taken by our research team for the past few years. This PhD topic will be funded as well by this grant The goal of this PhD project is to bring a new approach of detection to account for the probability of misdetected galaxies, keeping the number of detected objects itself as a random variable, leading to a probabilistic treatment of sources. This will be integrated with other elements formerly developed by our group or the DESC collaboration to bring a proof of principle of a pure Bayesian pipeline for the probabilistic determination of the cosmic shear on a patch of sky. The principle here is not new as hierarchical Bayesian approaches have been thought of for shear analyses, although they have never been implemented. They moreover currently raise much attention in the DESC collaboration, as a working group dedicated to Bayesian pipelines has been formed.

Informations complémentaires :

More details available on https://astrodeep.net/jobs/thesis-apc-2026/