IRFU : Institut de recherche sur les lois fondamentales de l'univers

Saclay

DAp/LCS

L'effet de lentille gravitationnelle faible et la mission spatiale Euclid

Spécialité Astrophysique

Niveau d'étude Bac+5

Formation Master 2

Unité d'accueil DAp/LCS

Candidature avant le 15/03/2023

Durée 5 mois

Poursuite possible en thèse oui

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Résumé

Le but de ce stage sera la validation des algorithmes de corrélation à l'aide des simulations dédiée dans le cadre d'Euclid. Les données de sortie seront communiquées aux modules de vraisemblance pour l'inférence des paramètres cosmologiques.

Sujet détaillé

Weak gravitational lensing, the distortion of the images of high-redshift galaxies due to foreground matter structures on large scales is one of the most promising tools of cosmology to probe the dark sector of the Universe. The statistical analysis of lensing distortions can measure the dark-matter distribution on large scales, constrain the properties of dark matter and dark energy, and limit models of modified gravity.

The upcoming European space mission Euclid will measure cosmological parameters to unprecedented accuracy. To achieve this ambitious goal, Euclid will measure the shapes of 1.5 billion high-redshift galaxies, and compute their spatial correlations. To carry out these very large number of correlations is challenging, and dedicated algorithms are being developed in our group. These correlation statistics are the base data ingredients to the Euclid likelihood, which is evaluated and sampled to obtain constraints on cosmological parameters.

The goal of this M2 stage is to validate the correlation algorithms using dedicated Euclid simulations. The output will then be interfaced to the Euclid likelihood modules to infer cosmological parameters. The codes developed in this internship will be tested on existing ground-based weak-lensing data available in the CosmoStat lab.

The Euclid simulations contain realistic effects based on the expected performance of galaxyshape measurement, the Euclid point spread function (PSF), CCD degradations by cosmic rays and more. Astrophysical systematics are included such as correlations between galaxy shapes and the tidal field of their dark-matter halos (intrinsic galaxy alignment). The student will assess the influence of those different effects on the weak-lensing correlations. The interface between the correlation output data and the likelihood is a crucial part in the Euclid pipeline. The student will help to develop tools to manipulate this output, perform sanity checks, and transform the data into a suitable format for

further processing. The output on simulated Euclid data will be used by the student to test the proper functioning of the likelihood modules. Cosmological parameter inference can be performed to assess whether the simulated input model can
be recovered.

Mots clés

cosmologie, lentile gravitationnelle faible, informatique

Compétences

Traitement de données

Logiciels

python, C++

Weak gravitational lensing statistics for the Euclid space mission

Summary

The goal of this M2 stage is to validate the correlation algorithms using dedicated Euclid simulations. The output will then be interfaced to the Euclid likelihood modules to infer cosmological parameters.

Full description

Weak gravitational lensing, the distortion of the images of high-redshift galaxies due to foreground matter structures on large scales is one of the most promising tools of cosmology to probe the dark sector of the Universe. The statistical analysis of lensing distortions can measure the dark-matter distribution on large scales, constrain the properties of dark matter and dark energy, and limit models of modified gravity.

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Keywords

cosmology, weak gravitational lensing, computer science

Skills

Data analysis

Softwares

python, C++