Internship/Stage 2020

TITLE: Non linear matter power spectrum and machine learning

Laboratoire : IRFU/DAp/CosmoStat

Supervisors: Valeria Pettorino, Santiago Casas, Jean-Luc Starck

Contact: valeria.pettorino@cea.fr, santiago.casas@cea.fr, jean-luc.starck@cea.fr
☏ : 01 69 08 42 75

Duration: 4-6 months

Keywords: cosmology, matter power spectrum, machine learning, non-linear regime

Topic:

Next to come experiments like the ESA Euclid satellite, to be launched in 2022, will observe one hundred billion galaxies over a large fraction of the sky in optical and infrared wavelengths, and will be able to map large-scale structures and weak-lensing distortions out to high redshifts. Weak gravitational lensing and galaxy clustering, combined, are very promising tools to test models in cosmology, and can help to shed light on the unknown origin of the accelerated expansion of the cosmos. Whether this acceleration is due to a simple cosmological constant, a yet to be discovered "dark-energy" fluid, or indicates that gravity and Einstein's theory of General Relativity have to be modified (Modified Gravity, MG) at very large scales, is one of the most important problems of modern physics.

One of the biggest challenges that needs to be addressed in order to profit at most of the large amount of data, is predicting the theoretical expected matter power spectrum at non-linear scales, both in a standard LCDM model and, in particular, within Dark Energy and Modified Gravity models.

This internship is meant to use and compare different machine learning methods in order to check which one better performs in the non-linear regime. Work builds on preliminary results and codes developed within the CosmoStat group.

The internship candidate within this project will be at the interface between theory and observations to get the best scientific return out of the big investment done in space missions like Euclid, in which CosmoStat is very much involved.

The scientific environment:

The thesis will take place within the research group CosmoStat, within the Astrophysics Department (DAp) under the supervision of Valeria Pettorino, Santiago Casas, and Jean-Luc Starck. The team is strongly involved in the Euclid project and in particular in theory, weak lensing, probe combination as well as the inter science task-force to develop the Euclid

Likelihood. The internship student will be able to work at the interface between theory and observations, learn about Modified Gravity as well as state-of-the-art statistical methods and machine-learning applications. This will allow the student to learn a variety of different skills, both in the interpretation of data and in the analysis of the data, with a concrete impact on future surveys. The student will be able to attend seminars and group meetings and will develop skills that can be useful both for a future career in academia or in the industrial domain.