

# Master1 Internship proposal at CPT, year 2020-2021

**Research team:**

Cosmology

**Supervisor:**

Julien Bel

**e-mail:**

jbel@cpt.univ-mrs.fr

**Project title:**

From the galaxy distribution to the neutrino mass and the dark energy equation of state

**Description:**

Both the late time acceleration of the universe and massive neutrinos leave a specific imprint on the formation of large-scale structures. On one hand, it is well established, that galaxies, clusters and super-clusters of galaxies are organized in a different way according to the supposed mechanism responsible for the acceleration and on the other hand massive neutrinos slow down the growth of structures [1] which affects in an alternative way the large scale galaxy clustering.

During the proposed internship, the goal will be to study the impact of the modelling of the galaxy distribution in the universe on the constraints that will be potentially achievable from future large scale galaxy surveys such as Euclid and LSST.

It consists first, in understanding from a theoretical point of view how galaxies follow the underlying dark matter distribution. With this project, the student will learn standard approximate methods allowing to explain the cosmological structure formation in order to be able to generalize them for the purpose of the internship. The second step will be to use simulated data coming from the high resolution simulation DEMNUnii [2] including dark energy and massive neutrinos and check the reliability of the developed models.

Finally, the student could develop his own numerical Monte Carlo Markov Chain code in order to forecast the constraints on parameters such as the dark energy equation of state and the neutrino mass.

**References:**

- [1] Julien Lesgourgues and Sergio Pastor, 2006, *Massive neutrinos and cosmology*
- [2] Castorina, Carbone, Bel, Sefusatti and Dolag, 2015, *DEMNUi: The clustering of large-scale structures in the presence of massive neutrinos*