COSMOLOGY AND STRUCTURE FORMATION

AT THE EPOCH OF DEEP LARGE SCALE SURVEYS

Prof. Simona Mei

11-14 May- four days – 9AM-12PM30; 2PM-6PM – 30 hours

In the next decade, deep large scale surveys, such as the space mission Euclid and the ground based surveys LSST and DESI, have the goal to constrain dark energy and our standard cosmology model. The main probes used by these surveys are: weak lensing, the baryonic acoustic oscillations and the statistics of galaxy clusters.

Those of you who are working in research areas different from cosmology and galaxy evolution will be submerged from the results of these surveys from all media. For those of you who do work in cosmology and galaxy formation and evolution, these results will revolutionize your field of research. This class will permit you to decipher these results, and understand their impact.

During your master classes, you could not go deep in the understanding of the three cosmological probes - weak lensing, BAO, galaxy clusters - neither had the time to place them in the largest context of the formation and evolution of large scale structures. This class will permit you to do both: (1) on one hand you will learn how to measure weak lensing and BAO, and how to obtain cosmological constraints from the statistics of galaxy clusters; (2) on the other hand you will be able to understand these measurements in the largest context of the formation and evolution of large scale structures, from the dark matter spherical collapse to galaxy and galaxy cluster formation.

Students attending this class need an introductory background in cosmology, and basics of statistics.

The class will be given in English if there will be participants who do not speak French or if the participants request the class in English. The professor will speak both English and French in the afternoon, depending on the participant's preferred language.

The class will be organized as follows:

<u>Monday</u>

Morning Class: Presentation of the large-scale surveys of the next decade and of the first of three probes that will permit us to understand dark energy: weak lensing

Afternoon TP: Weak lensing measurements in a specific case using simple codes. The students will be organized in groups, and perform the measurements. Plot and interpretation.

Tuesday

Morning Class on the collapse of dark matter haloes and their distribution and evolution to explain why weak lensing measurements are key to constrain dark energy

Afternoon TP: Discussion on the weak lensing measurements performed on Monday. Comparison between ground-based and space-based weak lensing measurements.

Wendsday

Morning Class Presentation of the second probe that will permit us to understand dark energy in the context of the collapse of dark matter haloes: BAO

Afternoon TP BAO measurements from a given galaxy catalog. Plot and interpretation.

Thrusday

Morning Class Presentation of the third probe that will permit us to understand dark energy: the distribution of galaxy clusters

Afternoon TP Galaxy cluster statistics measurements from a given galaxy cluster catalog. Plot and interpretation.

Friday

Morning Class Discussion of the systematics in the measurements performed with the three probes. Elements of galaxy formation and baryonic physics that can bias cosmology and large scale structure measurements.

Afternoon TP Weak lensing, BAO and galaxy cluster measurements are performed again on the TPs of the past days, but this time we will introduce systematics and discuss their effect on the final results.