

Internship 2026/2027

Year: M2

Laboratory : Centre de Physique Théorique (CPT)

Research Team : Cosmology and Gravitational Waves

Supervisor: Michele MANCARELLA (michele.mancarella@univ-amu.fr),
with contributions from other members of the research group

Project Title : Investigating emerging cosmological rulers in the gravitational-wave compact binary mass spectrum

Description: Gravitational-wave observations provide a new way to study the expansion of the Universe. In particular, characteristic features in the mass distribution of merging compact binaries can act as statistical cosmological rulers, allowing us to extract information about the redshift of gravitational-wave sources and constrain cosmological parameters.

Recent population studies suggest the presence of previously unresolved structures in the joint mass distribution of binary black holes, including a possible excess involving black holes with masses around 20 solar masses. Understanding the origin and statistical significance of such features, and their potential use for cosmology, is an important open problem.

The goal of this internship is to develop and test an analytical population model capable of describing these emerging mass features, and to compare its performance with more flexible, data-driven approaches.

The student will investigate the statistical significance of the proposed structures using gravitational-wave observations and assess their impact on measurements of the Hubble constant. The project will combine analytical modelling, Bayesian inference, and numerical data analysis, building on an extension of the software developed within the research group.

Prerequisites:

- Strong proficiency in Python programming.
- Good knowledge of General Relativity and cosmology.
- Basic understanding of gravitational-wave emission.

References:

- <https://arxiv.org/abs/2610.10535>
- <https://arxiv.org/abs/2605.20112>

- <https://github.com/CosmoStatGW/pymcpop-gw>