

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 : Analysis of the latest LIGO–Virgo–KAGRA gravitational-wave catalog with advanced population models

Description: The LIGO–Virgo–KAGRA collaboration is continuously expanding our knowledge of the population of merging black holes and neutron stars through gravitational-wave observations. The increasing number of detections offers new opportunities to investigate the astrophysical origin of compact binaries and their use as probes of cosmology.

This internship will focus on the analysis of the latest gravitational-wave transient catalog, including the data release expected in December 2026, using advanced population inference methods recently developed within our research group.

The project will address two main scientific questions: Is there evidence that the binary black hole mass distribution evolves with redshift? Can we identify characteristic mass scales in the binary mass distribution that could be used to constrain cosmological parameters, such as the Hubble constant?

The student will become familiar with gravitational-wave population inference and Bayesian statistical methods, and will apply and extend existing numerical tools developed by the group. The analysis will build on recent studies of redshift-dependent mass distributions and flexible models of the joint binary mass spectrum.

The internship will involve numerical data analysis, scientific programming in Python, and interpretation of astrophysical and cosmological results. Depending on progress, the student may contribute to ongoing research and scientific publications within the 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>

