

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 : Calibrating gravitational-wave simulators to assess the scientific performance of next-generation observatories

Description: The European gravitational-wave community is preparing for the next generation of ground-based observatories, with the Einstein Telescope (ET) as a flagship project. With a sensitivity significantly exceeding that of current detectors, ET is expected to observe a much larger population of compact binary mergers, opening new opportunities for studying black hole astrophysics and precision cosmology.

Accurately forecasting the scientific capabilities of these future observatories requires realistic simulations of gravitational-wave detections, including observational uncertainties and detector selection effects. Developing fast and reliable simulation tools is therefore an important challenge for the design and scientific preparation of next-generation experiments.

The goal of this internship is to develop and calibrate a computationally efficient gravitational-wave catalog simulator for the Einstein Telescope, capable of reproducing realistic measurement uncertainties and selection effects for different astrophysical populations.

The student will build on existing approaches for generating mock gravitational-wave catalogs and calibrate the simulator using more detailed ET-specific simulations. The resulting framework will be validated against reference simulations and used to explore the potential of Einstein Telescope observations to constrain compact binary populations and cosmological parameters.

Prerequisites:

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

References:

<https://einstein Telescope.eu/>

<https://arxiv.org/abs/2301.00834>

