PROPOSITION DE STAGE

Titre du stage : Optimization of joint searches for gravitational waves and gamma-ray bursts

Niveau (L3, M1, M2)	L3 ou M1
Si stage M2, poursuite possible sur thèse ? (indiquer l'intitulé de la thèse)	
Période / durée du stage (préciser l'année)	2026, any dates during May-July
Encadrant(e)	Tito DAL CANTON, Thomas JACQUOT
Équipe/Service	OG
Pôle	A2C
Téléphone	01 69 15 64 19
Courrier électronique	tito.dalcanton@ijclab.in2p3.fr

IJCLab - Laboratoire de Physique des 2 Infinis **Irène Joliot-Curie**
UMR 9012, CNRS, Université Paris-Saclay, Université de Paris
Bâtiment 100 - 15 rue Georges Clémenceau - 91405 Orsay cedex - France

Description of the internship

After their initial discovery in 2015 (LIGO, Virgo 2016), gravitational waves from coalescing black holes and neutron stars are nowadays routinely observed with the LIGO, Virgo and KAGRA interferometric network (LIGO, Virgo, KAGRA 2025). The vast majority of these events are observable only in gravitational waves, with the notable exception of GW170817: the merger of two neutron stars observed both in gravitational waves and in the entire electromagnetic spectrum (LIGO, Virgo 2017). Given the rarity of such events, and the amount of information that can be extracted from the source thanks to such multimessenger observations, searching for neutron star mergers by combining gravitational-wave and electromagnetic data remains one of the most active fields of multimessenger astronomy.

One of the search methods aimed at this uses the facts that neutron star mergers are expected to produce gamma-ray bursts, that we observe many gamma-ray bursts per year, and that we can model very precisely the gravitational waveform from a neutron star merger. The information about a gamma-ray burst (arrival time and sky location) produced by satellites like Fermi, Swift and SVOM is used as a prior to search for a corresponding weak signal from a compact binary coalescence in the gravitational-wave data (LIGO, Virgo, KAGRA 2022).

The aim of the internship will be to optimize this search algorithm, in particular the method that defines at which sky locations we need to search for a gravitational-wave signal once we have the gamma-ray-burst information. The project will involve digital signal processing, statistics, astronomy, data visualization, and scientific programming with Python. Prior knowledge of general relativity, astrophysics, Python, Numpy and Matplotlib is beneficial but not required.

Description of the team/service

IJCLab's gravitational-wave team is currently composed of several permanent researchers and lecturers, a few postdocs and PhD students. Research within this group comprises hardware development for the Virgo and Einstein Telescope interferometers, development of methods to analyze existing and future gravitational-wave data, scientific operations for the LIGO/Virgo/KAGRA network and the SVOM mission, and operations of the GRANDMA network of optical telescopes.

IJCLab - Laboratoire de Physique des 2 Infinis **Irène Joliot-Curie**
UMR 9012, CNRS, Université Paris-Saclay, Université de Paris
Bâtiment 100 - 15 rue Georges Clémenceau - 91405 Orsay cedex - France