



Internship at APC (Université de Paris)

Observing the next Galactic core-collapse supernova with neutrinos and photons: optimization of the observational strategies in the framework of the GRANDMA – SNEWS collaboration

Level M1 – M2 – 4ème – 5ème année école d'ingénieur

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Keywords: Data Analysis – Monte-Carlo Simulations – Astrophysics – open source Python

In the context of the GRANDMA (Global Rapid Advanced Network Devoted to the Multi-messenger Addicts, <https://grandma.lal.in2p3.fr/>) project, we would like to propose **an internship from February/March to August 2021** (or a subset of this period) to a student with strong skills on computing (Python and/or C/C++) and interested in astronomy and astroparticle physics.

The GRANDMA project is an international network of 25 telescopes of different sizes distributed in 20 observatories located on both hemispheres. By covering a large number of time zones, this network aims to rapidly monitor any multi-messenger alert from gravitational wave and neutrino detectors, to find a potential electromagnetic counterpart to these cataclysmic events. In addition, the SNEWS Early Warning System (<https://snews.bnl.gov>) is a network of neutrino detectors designed to give an early warning of a core-collapse supernova (CCSN) in the Milky Way to astronomers. Even if these detectors do not allow for a precise reconstruction of the position of the supernova in the sky, we recently showed that the triangulation of the neutrino signal could help to constrain this position to an error box of about 100 square degrees on the sky (Coleiro et al., 2020¹).

In this context, the GRANDMA network could be particularly suited to a low-latency follow-up of a **future CCSN** in the Milky Way, by probing the localization error box resulting from the early detection of MeV neutrinos.

By taking advantage of the expertise acquired on the search for electromagnetic counterparts to the sources of gravitational waves, we would like, as part of this internship, 1) to assess the possibility of detecting the electromagnetic signature of a future CCSN in our galaxy with the GRANDMA network; and 2) to optimize the observational strategy in synergy between neutrino detectors and the GRANDMA network.

This work will consist in developing and making use of simulations of multi-messenger observations (neutrinos and optical / infrared) together with a CCSN population synthesis model that will be implemented in Python.

The student will also participate to the conversion of the alert stream into the observational strategy and telescope scheduling based on his simulation results with the public code gwemopt (<https://github.com/mcoughlin/gwemopt>).

The internship student will join an international team. He/she will have the opportunity to improve his/her computing skills, to develop a rigorous scientific approach and to improve his/her English skills in written as well as spoken communications.

¹ <https://arxiv.org/pdf/2003.04864.pdf>