M2 Internship Subject (2026-2027) at Institut Pluridisciplinaire Hubert Curien (IPHC)
Department of Subatomic Research (DRS)

OGMA Team :

Cross-calibration of Gravitational Wave detectors with Astrophysical events

The OGMA Team (**O***bservations with* **G***ravitational waves &* **Mu***ltimessenger* **A***stronomy*) is involved in Gravitational Wave (GW) Astronomy, with technical contributions to the Virgo interferometer plus the analysis of the LIGO, Virgo and KAGRA data.

The GW astronomy is a new field started with the first observation of GW in 2015. It has been followed two years later by the first observation of GW plus electromagnetic signals (GRB, optical, radio). Since then, this field is rapidly evolving, thanks to the improvement of the detectors and new data taking, with more than 450 events observed so far (Oct. 2026). Last observing run ("O4") ended in 2025. A period of detector improvements and tuning followed to prepare the next observing run "IR1" scheduled to start in January 2027. The LIGO and Virgo detectors will be jointly operated for this new observing run, with an expected GW detection rate of a few events per week.

The OGMA Virgo group is involved in the search for GW events from the merger of compact objects (black holes and/or neutron stars), for realtime analyses and for the production of signal catalogues, through the development of the analysis pipeline MBTA. This pipeline is providing candidate events to a common LIGO/Virgo infrastructure which publicly broadcast the most significant candidates. The team is also involved in the validation and release of these public alerts.

In addition, as calibration is essential for accurate source localization and correct astrophysical interpretation of observed gravitational waves, the group is also dedicated to improving the calibration accuracy of the Virgo interferometer and has developed a Newtonian Calibrator (NCal) that enables the injection of a calibration signal in the Virgo detector with a sub-percent precision. Today, this reference signal, developed and succesfully deployed by the OGMA team is the base for the whole calibration chain.

The **proposed internship** will build on these fundamental activities and focus on the GW detector cross-calibration using data from the O4 observing campaign. The aim is to study with a much larger statistic an independant cross-calibration method between the GW detectors, based on astrophysical event data and tested during the previous O3 run. The result will be compared with individual calibration methods of each detector.

In parallel, during IR1, the group will continue to improve the NCal device and aims to deploy an additional NCal version for the LIGO detector to further improve the cross calibration accuracy, with the goal of defining calibration designs for future GW detectors. For these developments, the group has submitted a funding application to the ANR, which, if approved, could lead to the extension of the internship into a PhD thesis.

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Virgo members of OGMA team as of October 1st, 2026 : F. Aubin (CNRS Staff), C. Gostiaux (PhD), B. Mours (CNRS Staff), T. Pradier (University Staff), P. Van Hove (CNRS Staff), plus technical staff for the detector developments