
Contributions to the Early-Warning Gravitational Wave Search

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Team « *Observations with Gravitational waves & Multimessenger Astronomy* » (OGMA) - *IPHC/DRS*

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The [OGMA](#) Team is involved in High Energy Neutrino Astronomy ([KM3NeT](#) neutrino telescopes) and Gravitational Wave (GW) Astronomy, with technical contributions to the [Virgo](#) interferometer (see also in [Wikipedia](#)) plus the analysis of the [LIGO](#), [Virgo](#) and [KAGRA](#) data. The team is also involved in the low latency operations, leading to public alerts and enabling MultiMessenger astronomy.

The GW astronomy is a new field started a few years ago with the [first observation of GW in 2015](#). It has been followed two years later by GW170817, 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 about 400 events observed as of October 2025. The LIGO and Virgo detectors are jointly operated as part of the fourth observing run (O4) detecting GW events at a typical rate of few events per week. The O4 run will stop in November to allow for detector upgrades before restarting observations in early 2028 with improved detection capability (see run schedule [here](#)).

The Virgo OGMA group is involved in the search for GW events from the coalescence and merger of binary systems of compact objects (black holes BH and/or neutron stars NS). It is focusing its data analysis effort on the development and deployment of the [MBTA](#) analysis pipeline. This includes real-time analyses to provide candidate events which are publicly broadcasted and the production of signal catalogues. During O5, the detection rate is expected to increase by at least a factor of three compared to O4, offering new opportunities for discovery as well as challenges for data analysis.

For nearby events like GW170817, enough GW signal could be collected before the merger to enable so-called [early-warning alerts](#). Such alerts could be used as triggers for electromagnetic (EM) and neutrino follow-up searches. Since the O4 run, the MBTA pipeline has operated an early-warning search. The proposed internship aims to contribute to this effort by conducting a retrospective study of the O4 early-warning search and exploring strategies to improve its sensitivity for O5.

The student will become a member of the Virgo collaboration, in charge of the Virgo gravitational wave detector located close to Pisa in Italy. Since LIGO, Virgo and KAGRA share their data and have common data analysis teams and publications, the student will be fully integrated in this joint effort and will work on LIGO, Virgo and KAGRA data.

This work could be extended and enlarged during a PhD Thesis.

Virgo members of the OGMA team as of October 1st, 2025 : 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
