
Searching for Multimessenger Gravitational Wave Events

DIRECTEUR DE THESE : BENOIT MOURS

INSTITUT PLURIDISCIPLINAIRE HUBERT CURIEN, DEPARTEMENT RECHERCHES SUBATOMIQUES, IPHC/DRS, 23 RUE DU LOESS 67037 STRASBOURG

TEL : 03 88 0 6209 ; E-MAIL : BENOIT.MOURS@IPHC.CNRS.FR

In August 2017, the first joint observation of gravitational waves (GW) from the coalescence of a binary system of neutron stars with a gamma-ray burst, followed by an optical counterpart, has opened a new chapter of astronomy. Beside the confirmation of the origin of short gamma-ray bursts, new measurements have been made, from general relativity tests to independent Hubble constant measurement, highlighting the discovery power of these events. Nevertheless, this event remains the only GW multimessenger event observed so far.

The last data taking run (O3) of the Virgo and LIGO detectors brought the number of observed gravitational waves events to about 95, all but one visible only with GW. The next run, O4, schedule to start end of 2022, should increase this number by a factor 3. This exponential growth should continue with the following runs and will lead to new observations of multimessenger event.

The proposed PhD is to participate to the developments needed to maximize the number of multimessenger observations as well as their interpretation.

IPHC is involved in the search of GW compact binary coalescing events (with neutron stars or black holes), either online that lead to public alerts in quasi real time for electromagnetic followup, or offline with the production of catalogues of sources. This search, carried on with the so-called MBTA pipeline, is done without prior on the source localization or time of arrival. However, in the case of a multimessenger event with a gamma -ray burst and/or a high energy neutrino, these additional informations are available. Their use during the GW event search will increase the sensitivity of the analysis, and therefore increase the number of multimessenger events.

The proposed PhD work is to adapt the MBTA search pipeline for this kind of events, participate to its use during the next join LIGO-Virgo data taking that will start at the end of 2022. The PhD 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 and Virgo fully share their data and data analysis teams and publications, the PhD student will be fully integrated in this join effort and will work both on LIGO and Virgo data.

Composition of the research team DRS/OGMA (Observations with Gravitational Waves & Multimessenger Astronomy) : Responsible [T. Pradier](#) (Assoc. Prof. Unistra), A. Albert (Assoc. Prof. UHA), D. Drouhin (Assoc. Prof UHA), D. Estevez (Postdoc CNRS), V. Juste (PhD CNRS), B. Mours (Res. Dir. CNRS), A. Syx (PhD ANR)