

MULTI-MESSENGER ASTROPHYSICS WITH THE FIRST LINES OF THE KM3NET NEUTRINO TELESCOPES

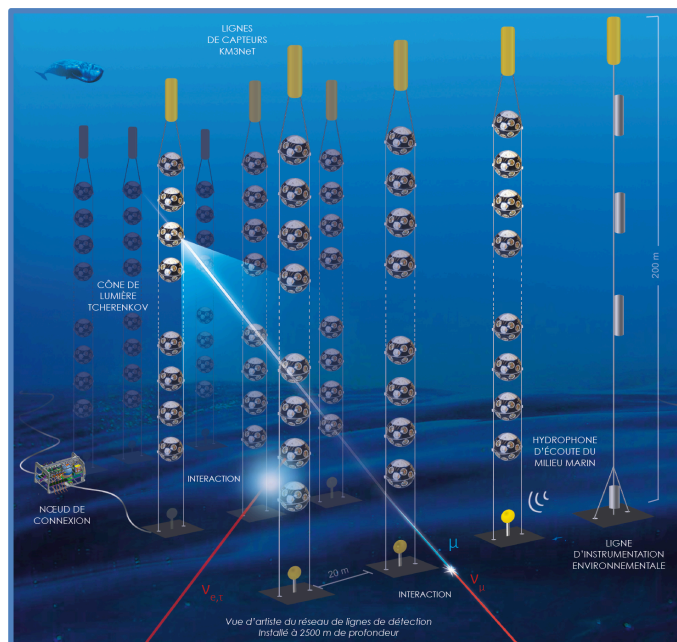
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The proposed PhD thesis will be performed in the framework of the european collaborations [KM3NeT](#), which use underwater « neutrino telescopes » in the Mediterranean Sea, to detect and study GeV to PeV atmospheric/cosmic neutrinos.

[IceCube has revealed in 2013](#) the existence of cosmic neutrinos, yielding information on the origin of cosmic rays. In July 2018, a possible connection of these [cosmic neutrinos with astrophysical sources such as blazars](#) was revealed. Moreover, the observation of gravitational waves and electromagnetic radiations from the [merger of two neutron stars in 2017](#), and the search for coincident neutrinos, has opened the field of multi-messenger astrophysics : the combination of photons from all wavelengths, neutrinos, cosmic-rays and gravitational waves to improve our knowledge of astrophysical sources and discover new sources, in which IPHC has taken an active part.

In 2019, the next-generation neutrino telescopes built by the KM3NeT collaboration will begin their deployment and data taking, with more than 300 lines on 2 sites to be deployed over a few years. The french site in Toulon will be dedicated to low energy GeV neutrinos, to determine the unknown neutrino mass hierarchy, with [ORCA](#) (Oscillation Research with Cosmics in the Abyss). The italian site, in Sicily, will host [ARCA](#) (Astroparticle Research with Cosmics in the Abyss), dedicated, like ANTARES, to TeV-PeV neutrino astronomy. Both telescopes can be used jointly to study astrophysical neutrino sources from GeV to PeV energies.



The IPHC Neutrino group has a long standing experience in multi-messenger astronomy in [ANTARES](#), through in particular the GWHEN program, devoted to the search for [Gravitational Waves - High Energy Neutrinos correlation](#). The PhD student will take an active part in the data analysis of the final data set of ANTARES, concomitant with the O3 data taking period of the GW detectors Advanced LIGO/Virgo starting in early 2019.

He/She will also devote part of the PhD to the multi-messenger analyses that will be performed with the KM3NeT telescopes, in particular the combination of ORCA/ARCA results for the search for GeV-PeV neutrinos from, e.g., gamma-ray bursts, or other potential GW emitters, in coincidence with GW data. He/She will also contribute to the calibration of the telescope(s) in their early data taking phases. The expertise of IPHC with the [Digital Optical Modules produced in the lab](#) will be a great asset in this regard.