Selection of short gamma-ray bursts for GeV neutrino searches

Contacts : Gwenhaël de Wasseige
gdewasse@apc.in2p3.fr
Véronique Van Elewyck
elewyck@apc.univ-paris7.fr, 01 57 27 69 56

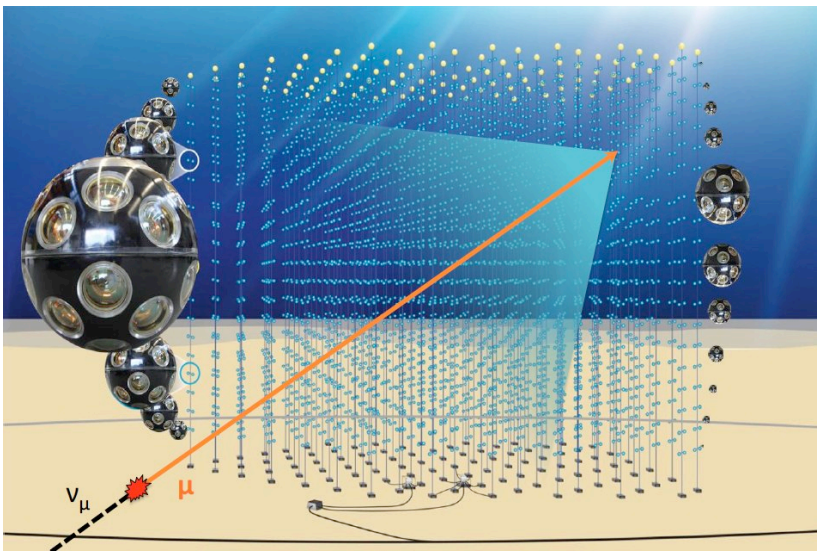
Master internship project proposed by the KM3NeT group at Laboratoire Astroparticules et Cosmologie (APC)

Since 2013 and the first observation of high-energy astrophysical neutrinos in the IceCube Neutrino Observatory[1], neutrinos constitute a new messenger to study the extreme Universe, and large neutrino telescopes have been working towards the identification of sources. While recent multi-messenger observations suggest that blazars may be the first identifiable sources of this observed neutrino flux[2], other source populations emitting neutrinos remain unidentified. Among promising candidates are short gamma-ray bursts (SGRBs) resulting from the merger of two neutron stars. As recently announced, these astrophysical events can now be detected using electromagnetic and gravitational wave emissions, being therefore the first multi-messenger source population observed.

Bearing in mind the decreasing character of the astrophysical neutrino flux with the increasing energy, we propose to lower down the energy range to the GeV level in view of probing a larger neutrino flux and thus allowing to identify new astrophysical neutrino sources. Result of hadronic acceleration similarly to the observed high-energy neutrinos, GeV neutrinos are expected to be produced by proton-neutron collisions happening in dense astrophysical objects[3]. They offer, besides an evidence of hadronic acceleration mechanisms, a probe of the amount of matter surrounding the astrophysical object and may therefore allow a more complete understanding of its intrinsic nature.

We propose a master internship (M1 or M2, adaptable to the level of the candidate) to perform a selection of the most promising SGRBs for low energy neutrino searches. The candidate will use electromagnetic observations of SGRBs, based on Fermi and Swift catalogs, to study the distribution (distance, luminosity, position in the sky,...) of the observed population. He/she will also have the possibility to include the mergers detected during the new observation run of the LIGO and Virgo interferometers.

The candidate will be in charge of optimizing the values of each parameter to maximize the low energy neutrino flux and the considered population. He/she will be able to work in collaboration with the KM3NeT group at APC and will be asked to present the progress made along the weeks. Through this work, he/she will become familiar with state-of-the-art questions in neutrino astronomy as well as multi-messenger astronomy, while acquiring some experience in programming (python, C++,…).



[1] The IceCube Collaboration, Science 22 Nov 2013:Vol. 342, Issue 6161, 1242856.
[2] The IceCube Collaboration et al., Science 12 Jul 2018:eaat1378, The IceCube Collaboration, Science 12 Jul 2018: eaat2890
[3] K. Asano, K. Murase, Adv. Astron. 2015, 568516 (2015), J. Bahcall, P. Mészáros, Phys. Rev. Lett. 85, 1362 (2000)