

Muons and neutrinos flux modelization of the the KM3NeT experiment

Research Internship / Master 2
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Neutrino is one of the most elusive constituents of the standard model of particle physics. It is the most abundant massive particle of the universe but it is also the one that interacts the least. As a result, and despite experimental progress, its nature and fundamental properties remain mostly unknown: Dirac or Majorana nature, CP violation, absolute mass scale, other flavors. Nevertheless, the neutrino is already used as a new astrophysical probe. Given their very small cross-section, neutrinos travel cosmological distances without being deviated and therefore are excellent messengers. In particular, the detection of high-energy cosmic neutrinos from cataclysmic events in the Universe allows to reconstruct the place and the origin of their production.

KM3NeT (Cubic Kilometer Neutrino Telescope) is a neutrino observatory to be installed in the Mediterranean Sea [1]. The objective is the study of the neutrino properties exploiting neutrinos generated in the Earth's atmosphere (ARCA telescope) and the mapping of high energy cosmic neutrino sources, such as supernovae, gamma ray burster or collidng stars (ORCA telescope). It includes a network of several hundred vertical detection units submerged more than 2,000 m deep. Each chain contains 18 light sensor modules also spaced along its entire length and which records Cherenkov light, coming from the interaction of neutrinos with seawater.

We propose to the candidate(s) to modelize the cosmic particles flux at sea level, in particular atmospheric muons and neutrinos. It will then consist on propagating both particles in earth and water by using home-made model and/or event generator and simulation softwares. The candidate(s), with an M2 level in subatomic physics, should have received training in nuclear physics, particle physics and radiation-matter interactions. He (she) must be interested in programming (C ++ / python), in physical simulation and data manipulation (root). He (she) should also possess a good editorial level and master English.

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[1] <https://www.km3net.org/>