

SERVICE DE METROLOGIE NUCLEAIRE

PARTICLES-MATTER INTERACTIONS: Particles physics

(in collaboration with IIHE - ULB particle physics department)

MASTER THESES

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Study of the characteristics of neutrinos with the JUNO detector 2

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JUNO is a large liquid scintillator detector whose purpose is the detection of anti-neutrinos emitted by nuclear reactors situated at a distance of 53 km. The detector is located 700 m below the rock and consists of 20 kilotons of liquid scintillator contained in a 35 m diameter acrylic sphere, instrumented by more than 18000 20-inch photomultiplier tubes (PMTs). The main objective of the experiment is to determine the mass hierarchy of neutrinos, but it has also other physical goals. In fact, it will also be useful for the detection of other natural sources of neutrinos, including the measurement of oscillations of atmospheric neutrinos produced during interactions of cosmic rays, or of neutrinos from supernova explosions. The international JUNO collaboration was established in 2014, construction of the site started in 2015 and the R&D and production phase for the detector is underway. The start of data collection is expected at the end of 2022.

Two thesis work subjects are proposed:

- Study of the energy spectrum of atmospheric neutrinos measured by the JUNO detector. The work will consist more particularly in defining the selection criteria of the physical events of interest for the analysis, which will have as final goal the determination of the parameters of the oscillations of these neutrinos and the combination with the measurements of the neutrinos of the reactors.
- Prospective study of the possibility of using JUNO data in the case of an analysis with multi-messengers (in particular JUNO - IceCube) with an alert system to trigger on signals coming from very violent astrophysical events. The work will focus on the feasibility of developing such an analysis (trigger system and threshold energy).