Elaboration of the Top Tracker and cosmogenic background analysis of the JUNO Experiment

PHD SUPERVISOR: MARCOS DRACOS
IPHC, 23 RUE DU LOESS, BP 28 67037 STRASBOURG CEDEX 2
TEL: 03 88 10 63 70 ; E-MAIL : MARCOS.DRACOS@IN2P3.FR

The main goal of the JUNO experiment (Jiangmen Underground Neutrino Observatory) is to solve the neutrino mass hierarchy problem. Up to now, the neutrino oscillation experiments have measured the mass difference between propagation states but the real pattern remains unknown. In the three flavor states, two patterns are avalaible in which m_1 is the lightest (Normal Hierarchy) or m_3 is the the lightest (Inverted Hierarchy). This measurement is fundamental for the research of the CP violation in the leptonic sector and in our understanding of the matter/antimatter in the Universe.

The goal of JUNO experiment is to reach a 3σ sensitivity on the mass hierarchy after 6 years of data taking. JUNO will precisely measure the paramaters of the neutrino oscillation mixing matrix and will allow to start unitary tests. JUNO will be able to perform measurements on geoneutrinos, solar neutrinos, atmospheric and supernovae neutrino. The underground laboratory is under excavation in the south of China and the detector construction is foreseen to start in 2018 with a data taking by the end of 2020.

JUNO is an international collaboration of 34 asian instituts and 32 american and european instituts. The experiment will use neutrino coming from several nuclear power plant with a total power of 36 GW. The detector will be located at 53 km far away from the reactor core, the target consists of liquid scintillators allowing to detect electronic antineutrino emitted by the reactor. The scintllation light will be collected by 17000 photomultipliers (20'' PMT) and 34000 photomultipliers (3'' PMT). The liquid scintillator and the PMT is the central part of the detector and will be surround by a water pool equipped using Cherenkov light to identifiy cosmic muons crossing the detector. A additional detector, called Top Tracker, will be installed on the top of the detector and will improve the muon reconstruction.

The neutrino group will reuse the Target Tracker of the OPERA experiment as the Top Tracker (TT) of JUNO. This is detector was under the responsibility of the IPHC institut (construction, installation and data taking) and allow us to have a good visibility and important responsibility inside the JUNO Collaboration. The OPERA Target Tracker, is dismounted and ready to be shipped to China near the JUNO site. Due to a higher counting rate than in the OPERA experiment, a new electronic and acquisition system has to be redesigned. This work will be realised by the Strasbourg Group in collaboration with other instituts. The group is also responsible for the analysis of the TT events (simulation, track reconstruction and background evaluation).

The goals of the Phd Thesis will be to optimize the performances of the Top Tracker before its installation in 2019 and to optimise the track reconstruction algorithms in term of cosmogenic background reductions and to evaluate the impact of the systematic uncertainties. In parallel, the student will participate to the tests of the new electronics.