Muon veto integration and analysis on its performances on the cosmogenic background reduction for the JUNO neutrino experiment

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The JUNO (Jiangmen Underground Neutrino Observatory) experiment has as main subject the measurement of the neutrino mass hierarchy. Neutrino oscillation experiments measured so far the mass splitting between the different neutrino mass eigenstates but two scenarios are still possible: m_1 is the lightest neutrino (i.e. normal hierarchy) or m_3 (inverted hierarchy). Such a measurement will help disentangling matter effects from the searched CP violation for the future long baseline neutrino project, which could contribute to the explanation of the matter–antimatter asymmetry in the universe. The JUNO goal is a sensitivity of at least 3σ on the mass hierarchy in 6 years of data taking. In addition, JUNO will allow to measure with high precision several parameters of the neutrino mixing matrix. Geo-neutrinos will be detected with unprecedented statistics, as well as solar, atmospheric and possibly supernovae neutrinos. The laboratory construction in the south of China has started and the detector construction should start in 2018 for a beginning of data taking foreseen in 2020.

JUNO is an international collaboration of 34 institutes from Asia and 32 from Europe and America. The experiment will measure the neutrinos produced by several nuclear reactor plants, for a total power of 36 GW. The detector will be located 53 km from the reactor cores and the target will be made of liquid scintillator to measure the electron antineutrinos produced by the inverse beta decay reaction. The light emitted by the scintillator will be measured by 15000 20” photomultipliers which will instrument the central detector. The central detector will be placed in a large water pool which will allow to identify the cosmic muons, thanks to the emitted Cherenkov light. In addition, a plastic scintillator detector will be located on top of the water pool (Top Tracker) to further reduce and understand the cosmic muon induced background.

The Strasbourg group will bring the OPERA Target Tracker (TT) to China to use it as Top Tracker for JUNO. This OPERA sub-detector was under the Strasbourg group responsibility (construction, installation and data analysis). This contribution allows the Strasbourg group to play an important role in the JUNO collaboration. Some modifications are required before its installation. On top of the different geometry, the electronics and the data acquisition system have to be replaced by a more performant system in order to cope with the significantly higher counting rate expected in JUNO underground laboratory, mainly due to the high level of radioactivity of the Chinese rock. The needed modifications will be done by the Strasbourg group in collaboration with other laboratories. The group is already in charge of the TT analysis in terms of Monte Carlo simulation, muon track reconstruction and background estimation.

The goal of the thesis will be the optimization of the TT configuration before its installation in 2019, the development and optimization of the simulation and reconstruction codes and the evaluation of the detector performance in terms of cosmogenic background reduction. In parallel to the analysis, the successful candidate will actively participate to the tests of the newly developed electronics.