Top Tracker Prototype of the JUNO Experiment

The observation of neutrino oscillations is a fundamental result in particle physics. It demonstrates that the neutrino has a non zero mass, and currently is the only sign of physics beyond the Standard Model. This discovery awarded the 2015 Nobel prize in Physics to Takaaki Kajita and Arthur B. McDonald for their role in the Super-Kamiokande and SNO experiments, where neutrino oscillations were clearly shown.

The three neutrino oscillation is described by the PMNS mixing matrix via three mixing angles and a CP violating phase. Neutrino oscillations experiments at nuclear power plants have been fundamental to completing measurements of these mixing angles, however the CP violating phase and the neutrino mass ordering are still unknown to this day. A new experiment, JUNO (Jiangmen Underground Neutrino Observatory), in China is currently being prepared. In JUNO, neutrinos will be detected in a 20 kt spherical liquid scintillator target at about 53 km from the Jiangmen province's nuclear power plants. JUNO is expected to measure the neutrino mass ordering, that is which of the neutrinos ν_1 (composed of mostly ν_e) or ν_3 (composed of a mix of ν_μ and ν_τ) is the lightest.

In JUNO, an important background comes from atmospheric muons traversing the detector. To reduce the atmospheric muon rate the detectors are built underground, however the surrounding rock thickness is not always sufficient to sufficiently shield the detector. To account for the remaining atmospheric muon background, JUNO is equipped with an external veto, made of crossing planes of plastic scintillator bars, that have a high muon detection efficiency to identify and reconstruct these muon tracks.

The external veto of JUNO was elaborated from OPERA's Target Tracker. Our laboratory will build a top tracker prototype from OPERA's Target Tracker plans, as will be done for JUNO, in a reduced scale. This prototype will make it possible to start preparing and testing reconstruction algorithms to be used in JUNO's external veto. The top tracker prototype will be composed of four XY plastic scintillator planes that will be read by a total of eight multi-anode photomultiplier tubes and the associated electronic cards. There will also be an acquisition system that will store the data on tape and provide online monitoring information.

The goal of this internship will be for the student to take part in testing and simulating the top tracker prototype. The student is expected to learn the usual computer tools used in high energy physics (C++, ROOT, Geant4).

Name of the internship contact persons: **Eric Baussan and João Pedro A. M. de André**
Phone: **+33 3 88 10 65 82**, **+33 3 88 10 68 90**
Fax: **+33 3 88 10 62 34**
Email: **eric.baussan@iphc.cnrs.fr**, **jpandre@iphc.cnrs.fr**
JUNO team at IPHC: **J. P. A. M. de André, E. Baussan, M. Dracos (PI), P. Poussot, J. Wurtz**

IPHC director: **Rémi Barillon**
Address: **Institut Pluridisciplinaire Huber Curien (IPHC)**
23 rue du Loess, BP 28 – 67037 Strasbourg cedex 2