

Investigation of neutrino interactions and neutrino oscillations with the T2K (Tokai-to-Kamioka) accelerator experiment in Japan

Research Project / Research Group Description:

The discovery and further studies of neutrino oscillations (transitions between electron, muon and tau neutrino flavours) during the last 20 years triggered a review of the Standard Model of particle physics. Neutrinos were proved to be massive and to possess an ability to change their flavour. Recently, neutrino oscillation physics has entered a new era of precision. It is expected that in the next decade it will be possible to use neutrinos to probe such important questions as the dark matter and the baryon asymmetry of the Universe. For the latter, the main focus is the search for CP violation effects. This is challenging and requires the combined efforts of various experiments, with the long baseline accelerator-based ones, such as T2K (Japan) and NOVA (USA), playing the most important role.

From 2010, T2K has been producing world-leading results in neutrino oscillation physics and is approved to further collect data. The IFIC group (Valencia, Spain) has been involved in T2K starting from near detector (ND280) hardware R&D and up to software development for calibration, tracking and analysis. The group members are in charge of the ND280 analysis framework and coordinate several activities in ND280, such as the software, muon neutrino analysis (with inputs to oscillation analysis) and “new physics” groups.

The general aim of the proposed project is the study of neutrino oscillations in T2K. One of the goals is to further enhance the T2K sensitivity to neutrino oscillation parameters by inclusion of new ND280 data samples, which will be used to reduce the overall systematic error, and to constraint neutrino interaction models. Another important goal is to combine T2K data with other experiments, namely reactor ones (as Daya Bay in China and Double CHOOZ in France) and also the atmospheric data from the T2K far detector Super-Kamiokande, inside one general analysis, so to profit from the sensitivity to different parameters of the neutrino oscillation model.

Job position description:

The candidate would be responsible of the inclusion of new T2K data samples into the analysis as more neutrino data is being accumulated, including development of new methods for the selection of signal events and evaluation of the corresponding uncertainties. This task will be primarily carried out by means of the official ND280 analysis framework, developed by the IFIC group. It consists of a set of general analysis tools (adopted and accepted by projects beyond T2K, such as e.g. DUNE experiment and T2K-II upgrade developments) extensively used for the analysis of neutrino oscillations and for neutrino cross section studies. During the project the candidate is also expected to participate the ND280 analysis framework maintenance in the light of its possible usage in future neutrino experiments.

Other activities will include combining the T2K data with other experiments in the field, such as Double CHOOZ, Daya Bay and NOVA. The candidate will contribute to the extension and further development of the currently available algorithms and software for neutrino oscillation analysis in T2K.



The position will require frequent travels to Japan, namely 2-3 per year. Participation in the T2K near detector maintenance/operation (including both remote and on-site shifts) is expected. It is also considered that the applicant will be involved in the regular checks (basically operating the relevant software and being in charge of regular reports on the status) of the quality of the data collected by the ND280 Time-Projection Chambers (a key element for ND280 particle tracking).

A high level of motivation is expected. The attitude for teamwork and good communication skills are also very desirable. Some initial knowledge of C++/PYTHON coding, computing, particle physics data analysis and/or detector hardware experience is highly appreciated for the position.

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