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The upgrade project of the T2K near detector

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The T2K neutrino oscillation experiment established the $\nu_\mu \rightarrow \nu_e$ appearance with only 10% of the original beam request of 7.8×10^{21} 30 GeV protons on target (p.o.t.). In view of the J-PARC program of upgrades of the beam intensity, the T2K-II proposal requires to run up to 20×10^{21} p.o.t., i.e. an increase of the exposure by more than a factor 10 aimed at establishing CP violation at 3σ level for a significant fraction of the possible δ_{CP} values. The Hyper-K proposal consists in a further increase by a factor 10 of the far detector mass. Facing the potential increase of statistics by two orders of magnitude, it is of great importance to undertake a vigorous program of near detector upgrades, with the aim of reducing the overall statistical and systematic uncertainties at the appropriate level of better than 4%.

Time Projection Chambers equipped with MPGD have been used with success for the T2K ND280 near detector and are proposed for the upgrade of the T2K near detector together with fine-grained scintillator-based targets and TOF detectors. The requirements of TPCs for neutrino detectors are quite specific. We envisage to use a very thin field cage, resistive Micromegas detectors for the charge readout and state-of-the-art electronics.

A project (CERN-SPSC-2017-002 and SPSC-EOI-015) combining the upgrade of the T2K near detector and the R&D for a High Pressure TPC has been recently launched. A High Pressure TPC would be a very sensitive detector for the detailed study of neutrino-nucleus interactions, a limiting factor for extracting the ultimate precision in long baseline experiments. High pressure TPCs are also being considered for future long-baseline experiments like Hyper-Kamiokande and DUNE.

We will report on the goals of this project and its development program including prototypes, beam tests, and projected performances.

Experimental Collaboration

T2K

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