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3D segmented plastic scintillator neutrino detector for T2K experiment

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The T2K neutrino experiment in Japan started data taking in 2010 and obtained a first indication of CP violation in neutrino oscillations. To obtain better sensitivity, T2K will accumulate more statistics with a higher intensity beam and an upgraded near detector. The upgraded off-axis near detector (ND280) will allow us to reduce systematic uncertainties in the number of predicted events at Super-Kamiokande and to constrain the neutrino interaction cross section models. The upgraded detector will have the full polar angle coverage for muons produced in neutrino charged current interactions, a low threshold for proton detection and will be able to measure neutrons using time-of-flight due to a good timing performance. Thanks to these new capabilities, the upgrade of ND280 will measure the energy spectra of muon neutrinos and antineutrinos with an unprecedented level of accuracy, and the near-to-far detector extrapolation of systematics constrains will be much less model dependent and therefore more reliable.
A novel 3D highly granular scintillator detector called SuperFGD of a mass of about 2 tons was adopted as an upgraded ND280 fully-active neutrino target and a 4\pi detector of charged particles from neutrino interactions. It will consist of about two millions of small optically-isolated plastic scintillator cubes with a 1 cm side. Each cube is read out in the three orthogonal directions with wave-length shifting fibers coupled to compact photosensors, micro pixel photon counters. Several SuperFGD prototypes tested in beams with charged particles and neutrons demonstrated good performance. It is planned that SuperFGD installed into the ND280 magnet will be ready to accept the beam in December 2022. In this talk, the results of the beam tests of the SuperFGD prototypes, obtained parameters and current status of the detector construction will be reported. The physics program of SuperFGD and its ability for further reduction of largest systematic uncertainties in oscillation analysis based on realistic assumptions extracted from the present T2K results will be described.

Collaboration name

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