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Development of a 3D highly granular scintillator neutrino detector for the T2K experiment

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The long baseline neutrino experiment T2K has launched the upgrade project of its near detector ND280, crucial to reduce the systematic uncertainty in the prediction of number of events at the far detector to less than 4%. An essential component of this upgrade is a highly segmented scintillator detector, acting as a fully active target for the neutrino interactions.
The baseline concept for it is a novel device, called SuperFGD (arXiv:1707.01785, 2018_JINST_13_P02006), with dimensions of ˜200x180x60 cm3 and a total mass of about 2 tons. It consists of about 2x106 small scintillator cubes each of 1 cm3. The signal readout from each cube is provided by wavelength shifting fibers inserted in these holes and connected to micro-pixel avalanche photodiodes MPPCs. The total number of channels will be ˜60,000. We have demonstrated that this detector, providing three 2D projections, has excellent tracking performance, including a 4π angular acceptance, especially important for short proton and pion tracks.
Prototypes of this detector have been tested in a beam of charged particles at CERN in 2017-2018. The detector response of these prototypes, including the light yield, the cross-talk, and the time resolution has been measured.
In November 2018 we will release the detailed TDR describing all the components of this device (the installation is planned in 2021). The progress in the R&D of this detector, future plans and results of simulations will be also reported.

Author: PARSA, Saba (Universite de Geneve (CH))

Presenter: PARSA, Saba (Universite de Geneve (CH))

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