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Current status of the novel 3D SuperFGD detector for the T2K experiment

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T2K (Tokai to Kamioka) is the first long-baseline neutrino experiment with the concept of an off-axis neutrino beam generated by a 30 GeV proton synchrotron (PS) based on the Japan Proton Accelerator Research Complex (J-PARC). This project is aimed at finding a new source of violation of charge-conjugation parity-reversal CP-symmetry in the neutrino sector - a necessary element for explaining physical phenomena beyond the Standard Model, namely the baryon asymmetry of the Universe (the matter-antimatter disparity) and leptogenesis. Currently, the T2K experiment excludes the CP-conservation ($\delta_{CP} = 0, \pi$) at the level of 90% CL [1]. In order to increase its sensitivity to CP-violation, it is necessary to reduce systematic uncertainties in predicting the number of events at the far water Cherenkov detector Super-Kamiokande up to 3-4% from the current level of 6-7%. Thus, an intensive upgrade program of the ND280 off-axis detector was launched [2]. As a part of this upgrade, a new fully segmented 3D neutrino scintillation detector SuperFGD was proposed and designed. It will allow precision measurements of neutrino cross-sections and significantly increase the sensitivity to CP-violation in long-baseline experiments. SuperFGD with a total weight of about two tons, consisting of two million optically isolated cubes, each of them with a volume of 1 cm^3 and with three holes for inserting wavelength shifting fibers (a total of 60,000 channels for signal readout), was produced in Russia and will be a key element of the new upgraded near detector of the T2K experiment. All active 56 layers of the SuperFGD and the assembly platform have been shipped to Japan in June 2022. The assembly of the SuperFGD was started at J-PARC in October 2022. Such important components of the SuperFGD detector as electronics, mechanics, photosensors, LED calibration system, DAQ are also being actively prepared and will be discussed. The current status and upcoming plans for the SFGD as a part of the ND280 upgrade will be presented at the conference.

References

- [1] K. Abe, et al., Constraint on the matter-antimatter symmetry-violating phase in neutrino oscillations, Nature 580 (2020) 7803, 339-344. arXiv:1910.03887.
- [2] K. Abe, et al., T2K ND280 Upgrade - Technical Design Report. arXiv:1901.03750 [physics.ins-det].

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