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The new Time Projection Chambers for Upgraded Near Detector of the T2K experiment

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In order to accurately establish leptonic CP-violation the T2K collaboration planned to upgrade both the neutrino beam line, by doubling its intensity and the ND280 Near Detector, for collecting neutrino interactions within full phase-space acceptance. The innovative concept of this neutrino detection system consists in combining a fine-grained fully active target (Super-Fine-Grained Detector) with 2 large volume Time Projection Chambers, rectangular in shape (High Angle TPC, HATPC) and 6 TOF planes. The sub-detectors are being assembled and commissioned at CERN and J-PARC and will be installed within ND280 by March 2023.

This talk will focus on the HATPCs which will be used for 3D track reconstruction, momentum measurement and identification of final state particles from neutrino interactions in the SFGD.

The HATPCs operate with the “T2K gas” mixture Ar:CF₄:isoC₄H₁₀ (95%:3%:2%) at atmospheric pressure in a thin walled Field Cage (3cm thickness, 4% rad-length, 2×1.8×0.8 m³ volume) with a central cathode (-30kV) and fully instrumented anodes at the opposite end-plates.

Each end-plate is instrumented with 8 “Encapsulated Resistive Anode bulk Micromegas” sensors (ERAM) covering the full transverse surface (1.8×0.8 m²). ERAMs provide primary charge amplification and use a Diamond-Like-Carbon (DLC) resistive anode to “spread” the charge over several pads with several advantages including enhanced spatial resolution.

In this talk I will report about the construction of the new HATPCs, focusing on the innovative developments and discussing our results concerning the following:

- 1) Mechanical and electrical characterization of the Field Cages, including assessment of mechanical properties, E-field uniformity, HV insulation limits and studies about inner surfaces characteristics;
- 2) Performance characterization of the ERAM detectors including studies about electrical response, X-ray Test-Bench results for series production validation, Test-Beam results including assessment of track reconstruction in magnetic fields;
- 3) Commissioning by exploiting Cosmic-Rays and a Test-Beam of the first TPC module at CERN (April'22)

Collaboration

T2K - ND280 Upgrade

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