Contribution ID: **74** Type: **Poster**

Field Cages for the new HA-TPCs of T2K Near Detector Upgrade

Monday 1 September 2025 17:30 (20 minutes)

T2K (Tokai to Kamioka) is a long-baseline neutrino experiment based in Japan, designed to measure neutrino oscillation parameters, including θ_{13}, δ_{CP}, θ_{23}, and Δm^2_{32}. These parameters are determined by studying electron neutrino appearance probabilities and muon neutrino survival probabilities. In recent years, T2K has undergone significant upgrades to its beam-line and the magnetized Near Detector (ND280) to increase the neutrino flux and reduce systematic uncertainties. These improvements are critical not only for T2K but also for the next generation of neutrino oscillation experiments, as the beam-line and ND280 will play a key role in the long-baseline program of Hyper-Kamiokande, expected to be completed in 2027.
A key component of the ND280 upgrade is the installation of two High-Angle Time Projection Chambers (HA-TPCs), designed to identify charged particles at large angles relative to the beam direction. Both HA-TPCs were successfully installed at J-PARC by May 2024.

The HA-TPCs feature a gaseous active volume enclosed in a field cage constructed from lightweight composite materials, offering an optimal balance of mechanical and electrical properties while minimizing radiation length and dead volume. The readout is based on innovative Resistive Micromegas, which include a resistive layer for charge spreading to enhance spatial resolution and protect the electronics from sparks.

Field cages serve multiple functions: (i) providing mechanical support to the detector, (ii) shaping the electric field, and (iii) containing the gas mixture while preventing contamination. The cage walls are made from composite materials with low atomic numbers and minimal material budget to reduce particle interactions and scattering. Additionally, they must exhibit high structural integrity to withstand over-pressure and gravitational forces. Precise design, prototyping, and rigorous validation were essential to meet the stringent geometrical tolerances and electrical insulation requirements.

This contribution focuses on two main aspects of the Field Cages of HA-TPCs: (i) their design, production, and performance evaluation, (ii) and the study of their electric field properties.

[1.] **Field Cage Production and Validation:** The production process, quality assessment protocols, and the assembly and commissioning at CERN and J-PARC are presented. In addition, Field Cages design was improved thanks to detailed studies of electrical and mechanical performances with the development of mathematical modeling based on results obtained on small- and full-scale prototypes.

[2.] **Electric Field Characterization:** The uniformity of the electric drift field, which is critical for accurate track reconstruction was investigated. Deviations from ideal conditions can introduce systematic distortions in particle trajectories. Using finite element method (FEM) simulations and cosmic ray data, distortions in the electric field were evaluated and corrected using a 3D electric field map derived from the FEM simulation, significantly improving track reconstruction accuracy.

Author: FELTRE, Matteo (Universita e INFN, Padova (IT))

Presenter: FELTRE, Matteo (Universita e INFN, Padova (IT))

Session Classification: Poster Session

Track Classification: NuFACT 2025: WG6 - Detectors