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Development of tracker alignment software for the J-PARC E16 experiment

The J-PARC E16 experiment will be performed to measure the mass modification of vector mesons in nuclear matter at J-PARC in order to study the origin of hadron mass.
In the experiment, we will measure invariant mass spectra of vector mesons with the electron and positron decay channel.
We will use 30 GeV proton beam with an intensity of 1×10^{10} protons per pulse at High-momentum beam line, which is to be constructed at J-PARC Hadron Facility in early 2016.

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The design of the E16 spectrometer is shown as Figure 1.
It consists of several modules, and one module consists of three Gas Electron Multiplier Trackers (GTRs), a Hadron Blind Detector, which is a gas Cherenkov counter using CsI evaporated GEM, and Lead-Glass calorimeters. The sizes of GTRs are 100 mm $\times$ 100 mm, 200 mm $\times$ 200 mm, and 300 mm $\times$ 300 mm, respectively. A full spectrometer consists of 26 modules. Nuclear targets such as CH_2, C, Cu, and Pb, are placed at the center of the spectrometer. The magnitude of magnetic field is about 1.8 T at the center.

The E16 experiment aims for the mass resolution of 5 MeV/c^2 around ϕ meson peak. In order to achieve this, the position resolution of 100 μm is required.
So we should align GTRs with the accuracy of better than 100 μm.

Detector R&D has been well performed by the J-PARC E16 collaboration.
Our GTR consists of a drift cathode, a triple GEM, and a readout strip board.
We chose a strip pitch of 350 μm to achieve the required position resolution.
By several beam tests, the requirement is shown to be satisfied.

The photogrammetry system using a CCD camera will be conducted when detectors are installed, while the aimed precision will be finally achieved by using charged particle track-based software alignment.
We are developing its algorithm.
We will acquire calibration run data in which no magnetic field will be present and two additional wire targets will be used.
In the algorithm, we move tracking detectors to arrange wire target position and three hit positions of GTRs on a straight line.
We evaluate this algorithm using a Monte Carlo simulation.
In the simulation, tracks are generated from wire targets after misaligning detectors in random directions from designed places.
For example, distances between simulation true and corrected positions of detector centers are estimated.

We will report the R&D progress of the alignment software for the J-PARC E16 experiment.

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