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Progress in Developing a Spiral Fiber Tracker for the J-PARC E36 Experiment

This paper presents recent progress in developing a spiral fiber tracker for use in the E36 experiment scheduled to be performed at J-PARC, Japan. This positive kaon decay experiment using the stopped kaon method will search for physics beyond the standard model of particle physics through precision measurements of lepton flavor universality, heavy sterile neutrino search, and dark photon search. For this experiment, we plan to upgrade the TREK detector system based on the super-conducting toroidal spectrometer previously used at KEK, Japan. Tracking and identification of charged decaying particles (positive muon and positron) is of importance to achieve high precision measurements. As one of the tracking devices, the spiral fiber tracker, under development, will consist of ribbons containing 1-mm-diameter double-clad plastic scintillating fibers in two helicities wrapped around the kaon stopping target in the TREK detector. Scintillation photons are read out by multipixel photon counters connected to the scintillating fibers with clear fibers. We use the tracker to measure the momentum of the charged decaying particles in combination with the exiting three layers of multiwire proportional chambers. Moreover, we introduce, as particle identification devices, aerogel Cherenkov counters with a refractive index of approximately 1.08, time-of-flight counters, and lead glass Cherenkov counters. In the engineering runs, these particle tracking and identification detectors will be calibrated to each other by using redundant devices. Here, we report the design and results of efficiency bench measurements of the spiral fiber tracker.

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