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Research on the Application of GEM Detectors in Neutrino Elastic Scattering Measurements

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This poster presents the developmental progress of a time projection chamber (TPC) detector based on gas electron multipliers (GEMs) as the key amplification component. The detector is designed to enable high-precision measurements of the reactor neutrino energy spectrum below the inverse beta decay (IBD) threshold, and to facilitate studies of physics topics such as the neutrino anomalous magnetic moment, mixing angles, and sterile neutrinos. Its operational principle relies on detecting the recoil electron tracks and energies resulting from neutrino scattering off target nuclei, thereby allowing a precise reconstruction of the neutrino energy. To meet these objectives, the detector must simultaneously achieve excellent three-dimensional position resolution and energy resolution, with the capability to record both positional and energy information of scattering events. For signal readout, this work proposes a hybrid detection scheme employing GEMs in conjunction with silicon photomultipliers (SiPMs): the GEMs provide the high electric field strength required for electron multiplication, while the SiPM array enables the reconstruction of both energy and position by detecting the scintillation photons generated during the GEM multiplication process. This poster reports the preliminary test results of this hybrid scheme, including the energy response measurements using a ^{55}Fe radioactive source, as well as a comparative analysis of the detector's energy resolution performance under various configurations.

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