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A Prototype Combination TPC Cherenkov Detector with GEM Readout for Tracking and Particle Identification and its Potential Use at an Electron Ion Collider

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A prototype detector is being developed which combines the functions of a Time Projection Chamber for charged particle tracking and a Cherenkov detector for particle identification. The TPC consists of a 10x10x10 cm3 drift volume where the charge is drifted to a 10x10 cm2 triple GEM detector. The charge is measured on a readout plane consisting of 2x10 mm2 chevron pads which provide a spatial resolution ~ 100 microns per point in the chevron direction along with dE/dx information. The Cherenkov portion of the detector consists of a second 10x10 cm2 triple GEM with a photosensitive CsI photocathode on the top layer. This detector measures Cherenkov light produced in the drift gas of the TPC by high velocity particles which are above threshold. CF4 is used as the drift gas which is highly transparent to UV light and provides excellent efficiency for detecting Cherenkov photons. The drift gas is also used as the operating gas for both GEM detectors. The prototype detector has been fully constructed and is currently being tested in the lab with sources and cosmic rays, and additional tests are planned in the future to study the detector in a test beam. This contribution will describe the current status of the prototype and results from these tests.
This work is part of the Detector R&D Program for a future Electron Ion Collider that is being planned to be built at either Brookhaven National Lab or Thomas Jefferson National Lab. EIC would collide beams of electrons with protons and heavy ions at high energies in order to study nucleon structure and QCD over a broad range of x and Q2. A large multipurpose spectrometer would be used to measure deep inelastic electron scattering over a wide range of rapidity and solid angle, and the tracking system for the central detector would consist of a TPC and a precision vertex detector. The combined TPC-Cherenkov detector described here could be used to provide both tracking and particle id information for measuring the scattered electron and hadrons produced in the central region. A description of the envisioned EIC spectrometer and how this type of detector could be used to improve its physics capabilities will also be discussed in this talk.

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