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Time Projection Chambers with Integrated Pixels and their Application in Dark Matter Search, Fast Neutron Detection, and Beam Commissioning

We present our most recent work on the use of integrated silicon pixel electronics (pixels) to readout gas-filled Time Projection Chambers (TPCs). Employing Gas Electron Multipliers (GEMs) to amplify the signal we are able to detect single electrons produced from ionization with high efficiency. These technologies also allow ionization in the target gas to be detected with low noise and excellent position and time resolution. This type of detector has great promise to measure the direction and energy of neutral particles via nuclear recoils in the gas. We present data from cosmic muon, x-rays, alpha particles, and fast neutrons, using the FE-I3 pixel chip developed for the ATLAS detector at the LHC. We also discuss the technical issues relating to the upgrade of our detector to the FE-I4 pixel chip. This chip, also developed by the ATLAS collaboration, has several advantages, namely a larger active area, and simplified data acquisition system. We also report on ongoing simulation studies and refinement of the first prototype at the University of Hawaii (UH), and present several applications including: direction-sensitive searches for WIMP dark matter (D3/DMTPC), neutron detection of in the context of homeland security (DiNO), and beam background monitoring at the SuperKEKB accelerator.

quote your primary experiment

Dark Matter D3

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Track Classification: Gaseous Detectors