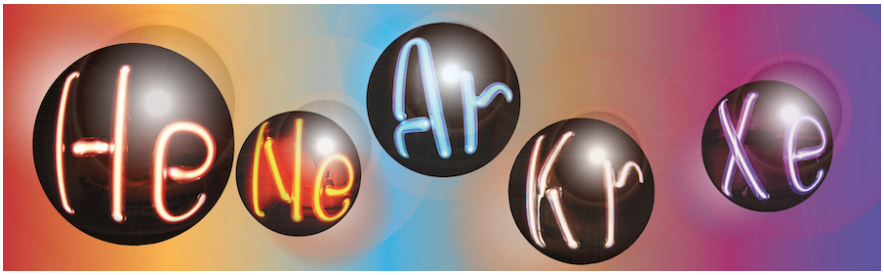

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Particle Identification in ProtoDUNE Detectors Using Scintillation Light

Characterized by prime 3D imaging precision, low energy thresholds, and robust particle identification tracking, Liquid Argon Time-Projection Chambers (LArTPCs) stand at the forefront of modern neutrino and dark matter detection. These capabilities — fundamental for reconstructing final-state interactions and conducting precise physics measurements — are currently being demonstrated at CERN's ProtoDUNE facilities through a combination of beam tests and cosmic ray atmospheric data for comprehensive performance verification. While LArTPCs collect both ionization charge and scintillation light that provide complementary information, standard interaction reconstruction relies primarily on charge data, utilizing the scintillation photon signal chiefly to determine the interaction time of non-beam particles. This work demonstrates how the scintillation light signal can be further exploited. Specifically, we present how the photon detection systems in the latest iterations of the ProtoDUNE detectors — ProtoDUNE Horizontal Drift and Vertical Drift — can successfully identify some primary beam particles. Notably, this approach enables, independently of the ionization charge data, the differentiation between muons and pions with good efficiency and purity, a task where traditional beam instrumentation, combining Time-of-Flight and Cherenkov detectors, falls short.

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