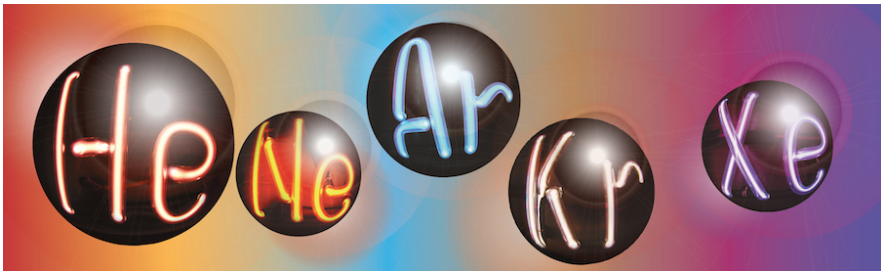

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Gamma Ray Detection in Liquid Argon Time Projection Chambers

The future Deep Underground Neutrino Experiment (DUNE) experiment will require unprecedented levels of precision to reach its physics goals. To this end, efficient reconstruction of photons produced in neutrino-nucleus scattering will be essential. This talk will present a new Compton scattering gamma-ray reconstruction tool that can associate blip-like energy depositions with a primary interaction vertex. This would improve the reconstruction of both accelerator and supernova neutrino interactions.

To this end, efficient reconstruction of photons produced in inelastic neutrino-argon interactions in excess of 250 keV will be essential. This new reconstruction was tested with data collected by placing various gamma-emitting isotopes, Cobalt-60, Sodium-22, and Fluorine-18, in proximity to the 2x2 Demonstrator and the Full Scale Demonstrator. These prototype detectors are pixelated liquid argon time projection chambers designed to demonstrate the capabilities of the DUNE Liquid Argon Near Detector (ND-LAr). These tests showed the ability to reconstruct the direction of MeV photons within a 10 percent error, and provided strong support for applying this method to neutrino-nucleus interactions. Additionally, it provided a simple accurate method for measuring various detector performance metrics which will become increasingly useful for Module Assembly of the DUNE ND-LAr.

We aim to utilize this method to associate each blip-like energy deposit to its interaction vertex, which would improve reconstructed energy resolution in the DUNE Near Detector. Using this work, we have also developed a design for a liquid argon-based Positron Emission Tomography (PET) scanner. PET scanners detect gamma rays emitted by a tracer chemical like fluorine-18 to help screen for diseases like cancer.

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