

Demonstrating Calorimetry and Particle Discrimination at MeV Energy Scales with Ambient Backgrounds in the MicroBooNE LArTPC

MicroBooNE is an 85 tonne liquid argon time projection chamber (LArTPC) detector situated at Fermilab exposed to both the Fermilab neutrino beams. It collected data from 2015 until 2021, which have been used for a plethora of physics analyses. Using MC samples of single electrons, photons, and protons that produce low-energy blips of ionization activity spanning the energy range 0-8 MeVee, we have developed a particle-ID (PID) metric related to the ratio of a blip's total charge to its size. This metric is able to provide substantial electron-proton and photon-proton separation above roughly 3 MeVee in reconstructed blip energy (roughly 15 MeV true proton energy). MicroBooNE's lower-energy ambient blip population contains specific radiogenic spectral features that can be used to calibrate the energy scale and energy resolution of MicroBooNE's MeV-scale reconstruction, while the higher-energy blip population contains cosmogenically-produced electron- and proton-generated blips useful for calibrating MeV-scale particle discrimination metrics. To validate the PID metrics at the MeV scale, a calibration was performed in this regime by measuring the energy spectrum of blips at hotspots in the detector, identifying the Compton edge in this spectrum, and matching this edge to that in an MC sample of 2.614 MeV gammas from Tl-208 radioactive decay.

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