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End-to-End, Machine-Learning-Based Michel Electron Reconstruction in ICARUS

The ICARUS detector, a LArTPC (Liquid Argon Time Projection Chamber) of 476 tons fiducial volume, serves as the Far Detector of the SBN (Short Baseline Neutrino) program. ICARUS is situated on-axis with respect to the BNB and off-axis to the NuMI neutrino beams at Fermilab. LArTPC is a powerful detector technology for achieving precise neutrino interaction imaging and reconstruction in 3D, thanks to its mm-scale spatial resolution. An end-to-end, scalable reconstruction chain referred to as “SPINE” (Scalable Particle Imaging with Neural Embeddings) makes use of Sparse Convolutional Neural Networks for voxel-level information extraction and Graph Neural Networks for particle-level structure clustering in a hierarchical framework to analyze data. This talk presents the reconstruction performance of SPINE on Michel electrons in ICARUS. Michel electrons, the daughter particles of muons decaying at rest, have well-defined energy spectra, making them ideal targets for detector energy scale calibration below 100 MeV. Understanding Michel electrons in ICARUS is key to the successful application of machine learning techniques toward SBN neutrino oscillation physics.

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