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Ancestor Particle Clustering in MicroBooNE using Deep Learning Neural Networks

The MicroBooNE Experiment uses Liquid Argon Time Projection Chamber (LArTPC) detector chambers. This detector is located about 460 meters away from the Booster Neutrino Beam at Fermilab. One of the challenges of identifying neutrino events among the dataset is the high frequency of cosmic ray muons that leave long tracks slicing through our event displays. In order to maintain high purity and efficiency neutrino event sample it becomes important to cluster and remove these cosmic ray muon tracks leaving the neutrino event intact. These tracks often cross in two-dimensional detector images, which creates a challenge for traditional clustering algorithms. In order to reduce the effect of this cosmic ray background a Convolutional Neural Network is trained to identify regions of interest within an image, classify those regions, then cluster hits within the region. This network is modeled after the structure and implementation of Facebook AI Research's Detectron, an image recognition network. The network's output clusters can then be rejected based on metrics such as geometric location, timing with respect to the beam pulse, and more in order to reduce the cosmic ray background.

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