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Convolution Neural networks in nucleon Decay Searches in Liquid Argon time projection Chambers

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Liquid argon time projection chambers (LArTPCs) are an innovative technology used in neutrino physics measurements that can also be utilized in establishing lifetimes on several partial lifetimes for proton and neutron decay. Current analyses suffer from low efficiencies and purities that arise from the misidentification of nucleon decay final states as background processes and vice-versa. One solution is to utilize convolutional neural networks (CNNs) to identify decay topologies in LArTPC data. In this study, CNNs are trained on Monte Carlo simulated data, labeled by truth, and then assessed by out-of-sample simulation. Currently running LArTPCs play an instrumental role in establishing the capabilities of this technology. Simultaneously, the next generation tens-of-kilotons flagship LArTPC experiment – one of whose main charges is to search for nucleon decay – is planning on using this technology in the future. We discuss analysis possibilities and further, a potential application of proton decay-sensitive CNN-enabled data acquisition.

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