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First demonstration for a LArTPC-based search for intranuclear neutron-antineutron transitions and annihilation in 40Ar using the MicroBooNE detector

Wednesday, May 15, 2024 2:00 PM (30 minutes)

Massive and deep underground detectors such as the future Deep Underground Neutrino Experiment (DUNE) will offer a great opportunity to search for rare, beyond-the-Standard-Model (BSM) physics signals including baryon number violating (BNV) processes. One such BNV process is nucleus-bound neutron-antineutron transition, followed by antineutron annihilation on a nearby neutron/proton that produces multiple final state pions, characterized by a unique, star-like topological signature. This signature should be easily recognizable within a fully active liquid argon time projection chamber (LArTPC) detector. While the future DUNE LArTPC can search for this signature with high sensitivity, existing data from the much-smaller MicroBooNE LArTPC can be used to demonstrate and validate the methodologies applicable in the DUNE search. This talk presents a deep learning-based analysis of MicroBooNE data, making use of a sparse convolutional neural network (CNN) and event topology information to search for argon-bound neutron-antineutron transition-like signals in MicroBooNE. This analysis demonstrates LArTPCs' capability, combined with deep-learning techniques, to search for such rare processes with high signal efficiency and strong background rejection.

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