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Physics modeling improvements in the MARLEY neutrino event generator

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Large liquid argon time projection chamber (LArTPC) neutrino detectors, such as those planned for the Deep Underground Neutrino Experiment (DUNE), show considerable promise as a platform for next-generation measurements of supernova neutrinos. Thanks to the neutron excess in 40Ar as well as the detailed tracking possible with LArTPCs, these detectors are expected to be uniquely capable of measuring supernova electron neutrinos with high statistics and minimal backgrounds. However, these technological advantages come at the price of complexities in data interpretation; reconstruction of the incident energies of supernova neutrinos in a future LArTPC-based analysis will be subject to a variety of systematic uncertainties related to nuclear interaction modeling. In this talk, we present recent improvements to the interaction model implemented in the MARLEY event generator used by DUNE and other LArTPC neutrino experiments. These include the addition of forbidden nuclear transitions under a Continuum Random Phase Approximation (CRPA) approach, as well as a first evaluation of optical potential uncertainties for exclusive neutrino-nucleus cross sections at tens-of-MeV energies. The talk will examine the impact of these simulation enhancements on observables of interest for DUNE and preview a new major release of the MARLEY code.

Working Group

WG 2: Neutrino Scattering Physics

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