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Simulating low-energy charged-current electron neutrino interactions on argon in the CCM experiment

Content

The Coherent CAPTAIN-Mills (CCM) experiment at Los Alamos National Laboratory employs a 10-ton liquid argon detector instrumented with 200 PMTs to detect scintillation light. The experiment is designed to investigate neutrino interactions, search for dark matter signals, and explore new physics scenarios. This work focuses on the modeling of charged-current (CC) interactions of electron neutrinos with argon nuclei at energies on the order of tens of MeV, a process that has not yet been measured experimentally in this regime. The lack of data on this interaction poses a limitation for future experiments aiming to detect supernova neutrinos, such as DUNE. We present the implementation of a full simulation framework that incorporates neutrino-argon interactions using the MARLEY event generator, event injection via the SIREN software package, and propagation through the detector using Geant4. Event reconstruction is performed using the CCMAnalysis framework. Preliminary simulation results are discussed, including observables related to energy deposition and scintillation photon production. This study lays the groundwork for an eventual measurement of this important low-energy cross section.

Summary

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