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Neutrino-induced Single Pion Production with Light Nuclei

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Single pion production datasets from the Argonne (ANL) and Brookhaven (BNL) Bubble Chamber neutrino experiments are heavily used to test and tune pion production models. Measurements as a function of the true neutrino energy (E_ν) and four-momentum transfer (Q^2) are typically used for this purpose, so our objective is to investigate and utilize other observables that are also available from these experiments. We simulate neutrino-deuterium scattering events using the ANL/BNL fluxes and digitize histograms of the previously unexplored nucleon-pion, nucleon-muon and muon-pion invariant mass (W) distributions. The NUISANCE framework is used to compare the theoretical predictions of four event generators to the data that ANL and BNL published in the 1980s. For the NEUT simulation package, we use event-reweighting to make variations in the non-resonant background scaling factor $I_{1/2}$ and two other parameters appearing in the Graczyk-Sobczyk resonance model's axial form factor, namely the axial mass M_A^{RES} and the resonant normalization factor ${C_A}^5(0)$. We investigate fitting these parameters to various combinations of the E_ν and W datasets. A study of the resulting set of post-fit parameter values could help in addressing the systematic uncertainties encountered in neutrino oscillation experiments.

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