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Hybrid model for single-pion production incorporated in the NuWro event generator nuclear framework

Precise modeling of GeV neutrino interactions with nuclei underpins our understanding of data from atmospheric and accelerator neutrino experiments. Single pion production, a critical channel in these interactions, demands accurate representation as required by future experiments like DUNE and Hyper-K. The current NuWro single pion production model, while valuable, relies on a single Delta resonance and a non-resonant background obtained from Pythia. While Pythia excels in describing interactions with very high W values, its effectiveness diminishes at both lower and intermediate W values, leading to limitations in capturing single pion production accurately. To address these limitations, we propose a new single pion production model in NuWro. This model incorporates additional resonances and utilizes the Chiral Perturbation Theory (ChPT) method for a more comprehensive description of the non-resonant background, specifically focusing on the lower and intermediate W region. This refined approach demonstrably improves agreement with MINERvA transverse kinematic imbalance data compared to the previous model, paving the way for a more nuanced understanding of neutrino interactions.

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