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Direct Measurement of Nuclear Effects in QE-like Neutrino Scattering at MINERvA

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The MINERvA experiment at Fermilab presents results from several analyses of quasielastic-like (QE-like) ν_μ interactions on a variety of nuclear targets in the NuMI neutrino beams. In the low energy ($<E_\nu>\sim$3 GeV) beam, components of the muon-proton momentum imbalance, \tkidptx ˜and \tkidpty, are used to probe Fermi motion, binding energy, and non-QE contributions in scintillator. In the medium energy ($<E_\nu>\sim$6 GeV) beam, the statistical power of the sample is apparent as QE-like 2-d cross section results on C, CH, H_2O, Fe, and Pb targets are presented in bins of muon longitudinal and transverse momentum. Cross section ratios of each target relative to scintillator are also shown. In a subset of these medium energy events where protons are cleanly reconstructed, cross section and cross section ratio results on each of the five nuclear targets are presented as a function of muon, proton, and transverse kinematic imbalance variables. The results from each of the three presented analyses are sensitive to nuclear effects. All of the presented observations are compared to predictions from a series of widely used neutrino event generators with different options and tunes. Qualitatively, the spread of simulated results tends to cover the data. However, none of the simulations consistently describe the data. While some of the trends and comparisons will be discussed, an important aim of this talk is to demonstrate for the neutrino community the breadth of these results and their potential utility for constraining models.

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