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Nuclear Effects in Neutrino Scattering at MINERvA[1]

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MINERvA is a neutrino cross section experiment in the NuMI beamline at Fermilab. The MINERvA detector employs fine-grained plastic scintillator (CH) for tracking and calorimetry, and is capable of reconstructing exclusive final states. The detector includes nuclear targets of carbon, iron, lead, liquid helium, and water, with which MINERvA can measure the nuclear dependence of neutrino interactions. Neutrino scattering measurements complement those done with charged leptons, because neutrino scattering directly probes axial structure and is sensitive to the deep inelastic structure function F_3. In addition, precise neutrino-nucleus measurements will reduce the significant nuclear model uncertainties incurred by using heavy nuclear targets to obtain high statistics in neutrino experiments. Such nuclear effects include both changes to the interaction cross section and alterations to the final state products through their interactions in the target nucleus. These uncertainties have implications for the utilization of neutrino deep inelastic scattering data in fitting parton distribution functions and for the extraction of neutrino oscillation parameters. We present three recent results from MINERvA that address this need for better knowledge of nuclear effects in neutrino scattering. First, measurements of ν_μ and $\bar{\nu}_\mu$ quasielastic cross sections. Then, a measurement of charged pion production from inclusive ν_μ interactions. Lastly, the first measurements of inclusive ν_μ cross section ratios of carbon, iron, and lead to scintillator as functions of neutrino energy and Bjorken-x.

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