

Flux-Averaged Multi-Differential Semi-Inclusive Charged-Current Muon Neutrino Cross Sections on Helium-4 in MINERvA and the Helium-to-CH Target Cross Section Ratio

Monday, 16 September 2024 16:05 (1 hour)

A comprehensive international effort has been underway to elucidate the properties and behaviors of neutrinos. A major source of systematic uncertainties in studying neutrino-induced interactions comes from neutrino-nucleus cross-section models, highlighting the need for more precise statistical measurements. MINERvA, an on-axis neutrino-nucleus scattering experiment located at the Fermi National Accelerator Laboratory, was established to produce neutrino cross-section measurements with many different nuclei. The helium target is the lightest nucleus to be measured by MINERvA. Using the NuMI medium energy muon neutrino data set, we present preliminary results and summarize the extraction of the charged current (CC) muon neutrino - helium-4 semi-inclusive ($\nu_\mu + {}^4\text{He} \rightarrow \mu^- + N\pi + Mp$) multi-differential cross-section extraction as a function of transverse (P_T) and longitudinal (P_L) muon momentum with respect to the neutrino beamline. We define the final state topology as CC- $N\pi Mp$, with at least two reconstructed tracks: a muon and a combination of N protons and M pions, where $N + M > 0$. To probe the dependence on the size of the nucleus in neutrino-induced interaction phenomena we present a differential cross-section ratio of helium-4 to MINERvA's hydrocarbon target (CH) as a function of transverse muon momentum.

Working Group

WG 2: Neutrino Scattering Physics

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Session Classification: Poster session

Track Classification: WG2: Neutrino Scattering Physics