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Parametrising CCQE uncertainties in the Spectral Function model for neutrino oscillation analyses

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A substantial fraction of systematic uncertainties in neutrino oscillation experiments stems from the lack of precision in modeling the nucleus when describing the neutrino-nucleus interactions. The Spectral Function (SF) model features a distribution of momenta and removal energies of nucleons inside the nucleus within the shell-model picture, and also accounts for short-range correlations between nucleons. These characteristics offer significant improvements with respect to the more commonly used Fermi gas-based models. Electron scattering experiments offer a precise probe of the structure of the nucleus and have been used to both construct and validate the SF model. SF is thus an interesting reference model for long baseline neutrino experiments.

Based on constraints from electron scattering data, we develop a set of parameters that can alter the occupancy of the nuclear shells and the distribution of the nucleon momentum within each shell. In addition, the contribution of short-range correlations and the effect of Pauli blocking can also be modified. In this talk, we will first present the impact these parameters have on several observables from quasi-elastic-like interactions, such as the transverse momentum imbalance or the muon momentum and direction. We then show fits of these parameters to available T2K and MINERvA cross-section data and discuss how they can be used to constrain the systematic uncertainties related to the SF model in neutrino oscillation analyses.

Working group

WG2

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