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General Audience Abstract

Neutrinos are highly pertinent particles in the search for potential new physics beyond the Standard Model. Quite uniquely, these leptons come in three different “flavour” states: the electron-, muon-, and tau-neutrino. Neutrinos are able to oscillate from one flavour state to another given some mathematically described probability which is proportional to (disregarding the mixing parameters involved) the distance traveled and neutrino energy; importance being, these oscillation parameters are extremely valuable in determining the structure and function of these particles and subsequently answering many open questions in physics and cosmology. One can reduce the expected neutrino interaction rate to a relationship that can be predicted, in part, given a proper handle on the lepton-nucleus cross-section. Let's rewind for a minute: a neutrino cross section (in our case) is used to characterize the probability that a neutrino scattering event will occur. Typically, this can be thought of as a “characteristic area” in which a larger area implies a higher probability of interaction. This cross-section varies greatly in contribution due to reaction mechanisms that dominate in certain energy regimes. Specifically, we are interested in Deep Inelastic Scattering (DIS) contributions to the lepton-nucleus cross-section at high neutrino energies, relevant in the interpretation of signals for ongoing and future experiments as we probe higher and higher GeV scales. A Spectral Function formalism recently applied to all other regimes of this cross-section has yet to encompass DIS effects: using this mathematical framework, we wish to utilize different sets of parton distribution functions (PDFs) in conjunction with the LHAPDF library to better describe each elementary structure function, soon joining them together to simulate deuteron scattering and, finally, neutrino scattering.