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Event Generators for Theory and Experiment

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The sensitivity of future neutrino experiments to oscillation parameters and BSM physics is highly dependent on the reduction of theoretical nuclear modeling systematics within the quasielastic regime. The usage of highly phenomenological or even classical nuclear models of Fermi motion, as well as nontrivial and inconsistent reweighting schemes, only adds to these woes. Also, many neutrino generators lack robust validation schemes on widely available electron scattering data to (partially) confirm their models of neutrino-nucleus interactions. Using GENIE, we have begun the interpolation and implementation of a new quantum-mechanically derived, inherently two-body, total inclusive quasielastic lepton scattering cross section. This model makes available much of the two-body semifinal state kinematics information at the scattering vertex via nuclear responses and two-body response densities. Currently, the electron—He-4 cross section has been validated across the available world quasielastic data and shows excellent agreement. Work is continuing on a GENIE generator module for this cross section and will soon output full final state topologies for study within detector geometries. The nature of this generator will make comparative study of two-body final states in past and current lepton scattering experiments fully realizable. The framework created for this generator can be utilized by similar future cross section calculations for larger nuclei such as C-12 and Ar-40.

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