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Neutrino-nucleus interactions at intermediate energies

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Present and future generations of accelerator-based neutrino-oscillation experiments use nuclei as targets, therefore, a good understanding of neutrino-nucleus processes is essential to reduce systematic errors in the oscillation analyses. In addition to that, since monoenergetic neutrino beams are not available, the theoretical models have to be able to describe all possible reaction channels in the wide energy region covered by the beam: quasielastic scattering, two-body current contributions, single-pion production, deep inelastic scattering, etc.

In recent years, the research activities of the Ghent group have focused on providing a consistent description of some of these mechanisms. We wish to present the current status of our investigations. We describe the low energy region with collective nuclear excitations and the quasielastic peak using a Hartree-Fock-CRPA (continuum random phase approximation) model that takes into account nuclear long-range correlations as well as hadronic final-state interactions. The two-body current mechanisms, which are especially important in the region between the quasielastic and the delta-resonance peak, are treated within the same mean-field based model. We consider the influence of nuclear short-range correlations on one- and two-nucleon knock-out channels. Our description of intermediate-energy neutrino-nucleus scattering is completed by modeling neutrino-induced single-pion production. For that, we consider resonance decays as well as other contributions required by chiral symmetry. This low-energy model is combined with a Regge approach, that allows us to extend our predictions beyond the resonance region.

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