QUASIELASTIC NEUTRINO–ARGON CROSS SECTIONS IN A CRPA APPROACH*

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We present calculations for inclusive charged current quasielastic neutrino–argon cross sections. These have been performed using the Continuum Random Phase Approximation (CRPA).

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The need for a detailed understanding of neutrino–nucleus interactions has led to many experiments in recent years. Despite the merits and successes of carbon as detection material, its potential for precision studies of neutrino–nucleus interactions is limited. An alternative that has seen a lot of interest recently is offered by Liquid Argon Time Projection Chambers (LArTPC) that combine a high precision in particle identification and energy resolution with efficient background rejection. In the light of the need for theoretical studies of the neutrino–argon cross section, we present first results on inclusive quasielastic (QE) neutrino–argon double differential cross section calculations.

We briefly summarize the most important aspects of the CRPA approach [1–3]:

— The nucleus is initially described as a Slater determinant, with single-particle wave functions generated through a self-consistent HF calculation with a Skyrme potential.

— The continuum random phase approximation is based on a Green's function formalism which introduces long-range correlations in the nuclear many-body system. These are crucial to model processes with low-energy transfer.

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— Relativistic effects are taken into account in an effective way.

— The model was benchmarked against inclusive QE electron–nucleus scattering data [2,3].

Folding these results with the NUMI beam flux [4], one gets the results shown in figure 1.

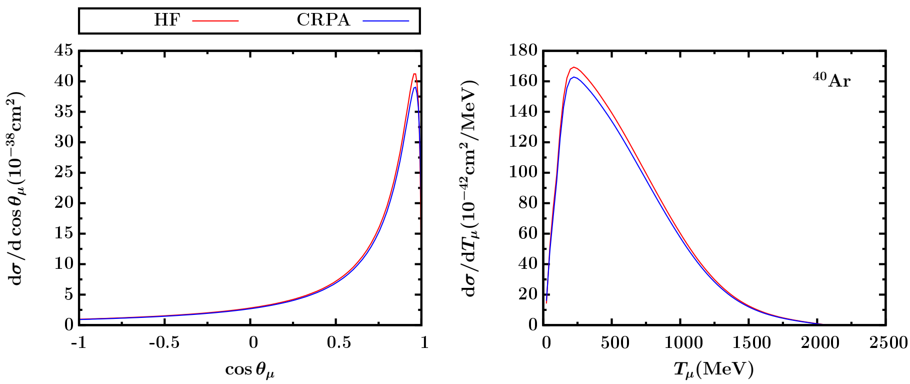

Fig. 1. Single-differential QE neutrino–argon cross section as a function of the angle of the outgoing muon and the kinetic energy of the muon, respectively.

The dominance of forward scattering is clear, with the folded differential cross section peaking around $\cos\theta_\mu = 0.96$. The CRPA approach also causes a reduction in the reaction strength compared to the results where no correlations are taken into account. Further research is in progress [5].

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