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Modeling neutrino-nucleus interaction for neutrino-oscillation experiments

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Neutrino properties have been investigated for more than 80 years. It has been firmly established that neutrinos oscillate and hence are massive particles. The oscillation parameters have been measured, but still one needs to determine the neutrino-mass hierarchy, the neutrino-mass absolute scale, and whether the neutrino is a Dirac or a Majorana particle. Also, investigation of charge-parity (CP) violation in the leptonic sector of the Standard Model is of fundamental importance for the construction of cosmological models. Today, huge efforts in both theoretical and experimental sides are made to achieve these goals. Inevitably, this ambitious scientific program meets challenges that slow down the process. The underlying problem is that the energy of the incident neutrino, which is a necessary input for the oscillation analyses, is unknown. The neutrino energy is reconstructed using the available experimental information and theoretical models. What complicates the reconstruction of the neutrino energy, and brings theoretical nuclear physics to the stage, is the fact that all present and future generations of neutrino-oscillation experiments use complex nuclei as target/detector material. I will present an overview of some theoretical approaches employed for the modeling of the main reaction mechanisms involved in the neutrino-nucleus interaction.

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