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Nuclei as Neutrino Detectors

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Neutrinos make reactions with nuclei by means of neutral current (NC) as well as charged current (CC). In nuclear physics, the reactions caused by the NC are called "inelastic scattering (IE scattering)." On the other hand, those caused by the CC are named "charge-exchange reaction (CE reaction)." Since leptons have small mass and cannot bring in (or carry out) large angular momentum, the so-called "allowed transitions" are caused by the operators with \Delta L =0 nature. They are the Fermi and Gamow-Teller transitions caused by the operators \tau [isospin operator: isovector (IV) current] and \sigma \tau [spin-isospin operator: axial-IV current], respectively.

The NC-type neutrino-induced reactions are caused by the axial-IV current, while CC-type reactions can be caused by the axial-IV current and also by the IV current.

We examine the properties of nuclear excitations caused by these currents for the p-shell (mass number A= 5-16) and also sd-shell nuclei (A= 17-40) with the z-component of isospin $T_{z} = 0$, pm 1/2, and also pm 1. We seek the possible use of some of these nuclei as neutrino detectors.

The high energy-resolution (3He,t) reaction at the intermediate incident enrgy of 140 MeV/nucleon played an important role in the study of Fermi and Gamow-Teller transitions.

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