Neutrino reaction in a few nucleon system

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Abstract

The neutrino reactions of two nucleon system in the core-collapse supernovae[1,2] and the construction of unified model of neutron nucleus reaction from a few hundred MeV to GeV region[3,4] have been reported.

The neutrino reactions play crucial role in the supernova explosion. We have studied role of the semi-leptonic reactions of the two nucleon system based on the standard nuclear physics approach[5]. We found the energy transfer cross section for the deuteron is considerably larger than those for ^{3}H, ^{3}He and ^{4}He for neutrino temperatures $T_\nu \sim 4$MeV relevant to the supernova core. The results suggests the contribution of the deuteron reaction for the heating mechanism[1]. We have also studied the neutrino emissivity due to the electron or positron capture on deuteron and nucleon-nucleon scattering leading to deuteron using the profile of supernova core[6]. It was found that those new processes may play important role for the cooling mechanism[2].

A precise knowledge of the lepton-nucleus interaction within a few percent accuracy is of increasing importance for the determination of the CP-phase δ and mass hierarchy of neutrino. As a first step towards the construction of the unified model, we studied neutrino induced meson production reaction in the resonance region[4]. The neutrino induced forward cross sections with the pion, eta and kaon, two-pion productions are obtained by using the dynamical coupled channel model of the pion and photon induced meson production reaction developed for investigating N^* and Δ resonances[7].

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