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Neutrino-induced reactions on ^{13}C and ^{16}O at supernova neutrino energies

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Neutrino-nucleus reactions on ^{13}C and ^{16}O at supernova (SN) energies are investigated by shell-model calculations with the use of new Hamiltonian, which can describe spin responses of nuclei quite well. Cabon-based scintillators and water-Cerenkov scintillators relevent to SN observation and experiments at the spallation neutron sources are now available. Cross sections for various particle and γ emission channels are evaluated by the statistical Hauser-Feshbach method.
For ^{13}C, total reaction cross sections at reactor and solar neutrino energies were studied [1]. Here, we extend our study to SN neutrino energies up to $\approx$50 MeV, and evaluations of partial cross sections for proton and neutron emission channels within the Standard Model [2]. Among them, a reaction channel ^{13}C ($\bar{\nu}$, $\bar{\nu}$'n) ^{12}C (2^+, 4.44 MeV) followed by prompt 4.44 MeV γ emission is discussed in relation to the shape distortion in the 5-7 MeV range in the measured neutrino spectrum in the short-baseline reactor neutrino experiments [3]. The cross section is too small to explain the extra enhancement in the spectrum.
Coherent elastic scattering cross section is obtained for 13C, and compared with that for ^{12}C. Nuclear structure effects in the cross sections are pointed out [2]. Possible merit of large recoil momenta in light nuclei for the study of neutron distributions in nuclei is discussed.
For ^{16}O, spin-dipole strength, which are the dominant contributions to the cross sections, and neutrino-induced reaction cross sections on ^{16}O are investigated [4]. Charged-current cross sections induced by SN neutrinos and their dependence on Mikheyev-Smirnov-Wolfenstein neutrino oscillations are discussed for a future SN burst [5].

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