NEUTRINO NUCLEAR RESPONSES FOR DOUBLE BETA DECAYS AND SUPERNOVA NEUTRINOS

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Neutrino nuclear responses for double beta decays (DBDs) and astro-neutrinos are crucial for studies of fundamental properties of neutrinos and astro-neutrino nuclear interactions. Nuclear matrix elements (NMEs) for charged current (CC) Gamow Teller GT(1^+) and spin dipole SD(2-) $\beta^{\pm}$ NMEs and neutral current (NC) M4(4^-) γ NMEs in medium heavy nuclei are shown by one of the present authors (H.E), J. Suhonen and others to be reduced with respect to quasi-particle (QP), QRPA and MQPM models. They suggest reduction of such CC and NC NMEs due to nucleonic, non-nucleonic $\tau\sigma$ correlations and nuclear medium effects. Non-nucleonic and nuclear medium effects around the reduction rate of k = 0.6 may be expressed by using effective $g_A^{eff}/g_A \sim 0.6$. The CC neutrino nuclear responses for DBD nuclei have extensively been studied by high energy-resolution charge exchange reactions (CERs) of (^{3}He,t) at RCNP. It is shown for the first time that the CER SD cross sections are proportional to SD strength (B(SD)), and thus CERs are used to study SD NMEs relevant to neutrino-less DBDs and super nova neutrinos. The RCNP E425 collaboration has measured the SD strengths in near DBD nuclei by means of the high energy resolution CER (^{3}He,t) reactions at RCNP. Impact of the reduction of CC and NC NMEs and the CER experiments for GT and SD NMEs on neutrino studies in nuclei is discussed.