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# Study of 2- states in atomic nuclei and connection with double beta decay

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Neutrino nuclear responses for double beta decays (DBDs) are crucial for studies of fundamental properties of neutrinos and neutrino nuclear interactions. Nuclear matrix elements (NMEs) for charged current (CC) Gamow Teller GT(1 + ) and spin dipole SD(2 - ) β ± 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 τσ 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 Aeff /g A ~ 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-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.

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