DETERMINATION OF EFFECTIVE NEUTRINO MASS BASED ON DOUBLE BETA DECAY EXPERIMENTS

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Neutrinoless double beta decay provides a way to determine the effective mass of neutrinos. If the half-life of neutrino ($T_{1/2}$) is measured, the effective mass (m_n) of neutrino is determined by

$$[T_{1/2}]^{-1} = G\,|M|^2\,(m_n/m_e)^2$$

where the values of phase space factor (G), and the electron mass (m_e) are precisely known, while the value of nuclear matrix element (NME) denoted by M is not well determined and still includes almost a factor three difference depending on the theoretical methods. In this sense it is desirable to arrange a large-scale calculation giving rise to the most precise value of M so far.

In this report a new value of nuclear matrix element for neutrinoless double beta decay of ^{48}Ca based on large-scale shell model calculations is shown, and compared to the existing theoretical data. For the purpose of examining the reliability of our shell-model calculations, calculated nuclear matrix element for two-neutrino double beta decay is also presented, and compared to the experimental data.

The obtained result suggests that the half-life is almost halved relative to those calculated by existing NME values. Among several conclusions, importance of pairing correlation is noticed. According to the comparison between new-type two major shell calculation and old- type one major shell calculations, a certain kind of pairing correlation is identified to play a role in the cancellation leading to the reduction of the absolute NME value. Much attention is paid to clarify the mechanism of neutrinoless double beta decay. Consequently a constraint for effective neutrino mass is suggested based on the latest NME value. Furthermore the impact of sterile neutrino on the life-time of double beta decay is presented for the double beta decay of ^{48}Ca.