NEUTRINOLESS DOUBLE-BETA DECAY RATES AROUND MASS 80 IN THE NUCLEAR SHELL MODEL

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The double beta decay is a second order process of the weak interaction which converts two neutrons into two protons. There are possibly two modes of the double-beta decay. The 0ν mode (0νββ), in which no neutrinos and only two electrons are emitted, can only take place if the neutrino is a massive Majorana particle. It demands an extension of the Standard Model since it violates the lepton number conservation. Thus, the observation of the 0νββ decay is considered as one of the best probes for physics beyond the Standard Model. Despite intensive experimental efforts the 0νββ decay has not yet been observed. The 0νββ decay half-life is given by a phase-space factor, the effective mass of the electron neutrino, and the nuclear matrix element (NME). Our attention is focused on calculating the NMEs. Many theoretical attempts have been made to calculate the NMEs and the resulting half-lives. We carry out the nuclear shell model calculations for nuclei with mass 76 and 82. Energy levels and transition rates are compared with the experimental data. Using the wave functions thus obtained, nuclear matrix elements for the neutrinoless double-beta decay are estimated. In order to investigate the model dependence on the nuclear matrix elements, the pair-truncated shell model calculations are also performed. By comparing the results with those in other models, it turns out that the nuclear matrix elements are sensitive to the ground state correlations.