Neutrinoless Double Beta Decay with Left- and Right-Handed Currents Revisited

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The formalism of the Majorana neutrino mass mechanism of the neutrinoless double-beta decay is extended by considering $p_{1/2}$-states of emitted electrons and recoil corrections to nucleon currents. The derived decay rate of the process is a sum of products of kinematical phase space factors and various nuclear matrix elements. By using exact Dirac wave function with finite nuclear size and electron screening numerical computation of phase space integrals is performed. In order to conclude about the importance of additional contributions to decay rate values of nuclear matrix elements are estimated by a comparison of corresponding two-nucleon exchange potential for $r = 1$ and 2 fm. The obtained results allow to conclude that the effect of the $p_{1/2}$ electrons on the neutrinoless double-beta decay rate is not large.

The neutrinoless double-beta decay with the inclusion of the right-handed leptonic and hadronic currents and by assuming small neutrino masses is revisited. The $p_{1/2}$-states of emitted electrons and recoil corrections to nucleon currents are taken into account. Calculation of the phase space integrals and differential characteristics is performed by using exact Dirac wave function with finite nuclear size and electron screening. Analysis is respect of the effective lepton number violating parameters due to right-handed currents are updated in light of recent progress achieved by the GERDA, EXO and KamlandZen experiments.