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Bound and scattering states of the electron wavefunctions calculated with the Dirac equation for 0νββ

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In some nuclei, a phenomenon called double beta decay, in which two nucleons simultaneously undergo beta decay, is known to occur rarely. In this case, two neutrinos are emitted. Neutrinos may be Majorana particles, which do not distinguish between particles and antiparticles among Fermi particles. In that case, double beta decay without neutrino emission ($0\nu\beta\beta$) may occur. If the half-life of this decay can be measured experimentally and quantities called the phase space factor and nuclear matrix element can be calculated theoretically, the effective neutrino mass can be obtained. In this study, in preparation for the phase space factor calculation, first I calculated the wavefunctions of electrons in the bound state for hydrogen atoms and compared with the exact solution of the Dirac equation, and then calculated the wavefunctions of electrons in the scattering state for several double-beta decaying nuclei including $^{48}\mathrm{Ca}$ and $^{150}\mathrm{Nd}$.

Presentation type

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