Double beta decay phase space factor calculation using Coulomb potential determined by mean-field theory

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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.

The phase space factors include the information on the emitted electron wave functions. They have been calculated by solving the Dirac equation for the emitted electrons by including the finite-size effect (the nuclear charge distribution assuming a uniform charge distribution or Woods-Saxon potential) and the electron screening effect based on the Thomas-Fermi equation [1,2].

We plan to perform a precise calculation of the phase space factor based on the nuclear and electron density functional theory (DFT); nuclear charge distribution based on the nuclear DFT and the electron screening effect based on the electron DFT.

In this presentation, I will show the current status of the phase space factor calculation for double-beta decaying nuclei based on the nuclear/electron DFT.

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