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Reliability of calculated nuclear matrix element of two-neutrino double-β decay

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The nuclear matrix element (NME) of neutrinoless double-β (0νββ) decay is an essential theoretical input for determining the neutrino effective mass, if the half-life of this decay is measured. The NME is also necessary for the detector design for the next generation of the 0νββ decay search. Reliable calculation of this NME has been a long-standing problem because of the diversity of the predicted values of the NME, which depends on the calculation method. A problem of the NME of the two-neutrino double-β (2νββ) decay of Xe-136 has been reported four years ago. The running sum for this NME of the shell model and the quasiparticle random-phase approximation (QRPA) were quite different. This means that the components of the NME are quite different depending on the calculations, and this problem affects the reliability of the predicted 0νββ NME.

In my poster presentation, first, I clarify that the cause of the problem is not the theoretical differences of the shell model and the QRPA; this is seen from available examples. Second, I clarify that the cause is in the interaction strengths; this is shown by my calculations and analytical discussion. In particular, it is seen that a decreasing behavior of the running sum at the energy of the Gamow-Teller giant resonance indicates a larger interaction strength than that of other calculations with less or no decreasing behavior. It is also shown that my interaction strength is appropriate by comparisons with experimental data related to the double-β decay.

Poster prize

No

Given name

Jun

Surname

Terasaki

First affiliation

Czech Technical University in Prague

Second affiliation

Institutional email

jun.terasaki@cvut.cz

Gender

Male

Collaboration (if any)

Primary author: TERASAKI, Jun (Czech Technical University in Prague)

Presenter: TERASAKI, Jun (Czech Technical University in Prague)

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