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Reliability of QRPA approach to $\beta\beta$ and β decays

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We have proposed in a series of previous papers a method to determine the effective axial-vector current coupling and the strength of the isoscalar proton-neutron pairing interaction for calculating the nuclear matrix elements of the neutrinoless $\beta\beta$ decay by the quasiparticle random-phase approximation. The combination of these two parameters have had an uncertainty in this approach, but now this uncertainty is removed. In this presentation, we show the result of applying our method to the neutrinoless $\beta\beta$ decays of ^{136}Xe and ^{130}Te and predict the nuclear matrix elements and reduced half-lives. Our calculation is tested first by a self-check method using the two-neutrino $\beta\beta$ decay, and this test ensures the application of our method to ^{136}Xe . Comparison is made between the experimental data and our calculation for the spectrum of the intermediate nucleus, charge-change strength function, and a higher-order component of two-neutrino $\beta\beta$ decay recently proposed. Further test is made for our calculation of the β decay of ^{138}Xe , and a satisfactory result is obtained.

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