

Neutrinoless double beta decay in multiple isotopes for fingerprints identification of operators and models

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Neutrinoless double beta ($0\nu\beta\beta$) decay is the most promising way to determine whether neutrinos are Majorana particles. There are many experiments based on different isotopes searching for $0\nu\beta\beta$ decay. Combining the searches of $0\nu\beta\beta$ decay in multiple isotopes provides a possible method to distinguish operators and different models. The contributions to $0\nu\beta\beta$ decay come from standard, long-range, and short-range mechanisms. We analyze the scenario in which the standard and short-range operators exist simultaneously within the framework of low-energy effective field theory. Five specific models are considered, which can realize neutrino mass and can contribute to $0\nu\beta\beta$ decay via multiple mechanisms. A criterion to evaluate the possibilities of future experiments to discriminate operators and models is built. We find that the complementary searches for $0\nu\beta\beta$ decay in different isotopes can distinguish the cases that contain the low-energy effective operators $O_{1,2,5}$ and R-parity violating supersymmetry model. For other cases and models, the experimental searches within multiple isotopes can also more effectively constrain the parameter region than with only one isotope.

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