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

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Neutrinoless double beta (0νββ) decay is the most promising way to determine whether neutrinos are Majorana particles. There are many experiments based on different isotopes searching for 0νββ decay. Combining the searches of 0νββ decay in multiple isotopes provides a possible method to distinguish operators and different models. The contributions to 0νββ 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 0νββ 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 0νββ decay in different isotopes can distinguish the cases that contain the low-energy effective operators O1,2,5 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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