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Present and future of the most sensitive techniques for double beta decay searches: an overview

Content

Neutrinoless double beta decay (NDBD) is a never-observed, Standard Model-forbidden nuclear process where the lepton number is violated by two units. It's observation would be a groundbreaking achievement in particle physics, as it would imply that neutrino is a Majorana particle and at least one mechanism exists that can explain the matter-antimatter asymmetry that we observe in the modern universe. Inputs from nuclear physics, and in particular the nuclear matrix elements, are essential to convert an observation into physical parameters. Nowadays the search for NDBD is one of the most challenging experimentals endeavors in particle physics: tons of candidate nuclei are monitored, with various technologies, in ultra-low radioactivity setups hidden in deep underground laboratories. Few signals with the correct topological and energy signature could be enough to claim the discovery, if no background events are expected in the region of interest. In this contribution the current status of the experimental effort is presented, with particular focus on the experimental challenges related to the scalability of the technologies combined with their effectiveness in keeping the background under control. The importance of a multi-isotope program, necessary to overcome the impact of systematics and the limitations of theoretical predictions, will also be stressed. Finally, a critical comparison of the consolidated and proposed experimental approaches will be performed, taking into account economical and technological boundary conditions that can influence the present and future evolution of the field.

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