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Improving the sensitivity to effective Majorana mass with combined analysis of multiple 0νββ transitions in large xenon detectors

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Large xenon time projection chambers (TPCs) have become important tools in underground physics. Next-generation PandaX-xT and XLZD TPCs will contain 4-7 tons of Xe-136 in their active volumes. We propose a combined analysis of neutrinoless double beta decay (0νββ) to the ground state and excited states (0νββ-ES) of the daughter nucleus to enhance the search sensitivity. The improved signal identification and background suppression achieved through the characteristic beta+gamma coincidence signature of 0νββ-ES allows us to utilize a larger fiducial volume while maintaining low background rates. Stronger constraints on the effective neutrino mass can be obtained by this approach, despite the fact that the half-life for decays to excited states is typically one to three orders of magnitude longer than that for decays to the ground state. These results demonstrate the importance of simultaneously probing multiple decay channels in future 0νββ experiments, while highlighting the unique advantages offered by large xenon TPCs.

Collaboration you are representing

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