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Sensitivity expectations for the next-gen neutrinoless double beta decay experiments

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Probing the inverted mass ordering region and venturing into the normal mass ordering region of neutrinos is a crucial goal for the next generation of neutrinoless double beta decay ($0\nu\beta\beta$) experiments. The absence of definitive signatures, the quest for heightened sensitivity, background minimization, statistical significance, and exploration of multiple isotopes collectively drive the move towards tonne-scale $0\nu\beta\beta$ experiments. Assessing the experimental requirements and their cost-efficiency is vital, considering the tonne-scale enriched isotopes and the years of effort these experiments necessitate. We undertake a comprehensive quantitative assessment of projected experimental sensitivities, placing specific emphasis on the discovery potentials anticipated prior to conducting the experiments. We investigate the sensitivity of the counting analysis using full Poisson statistics [1], its continuous approximation [2], and compare both with those based on maximum likelihood analysis, which integrates additional measurable signatures such as energy [3]. This study emphasizes the typical hurdle faced in making sensitivity projections for proposed projects and contends that counting-only analyses with Poisson or continuous approximations, currently employed by several experiments, are no longer sufficient. Incorporating energy information into sensitivity estimation is essential for optimizing cost-effectiveness assessments.

References
[1] M. K. Singh, H. T. Wong et al., "Exposure-background duality in the searches of neutrinoless double beta decay", Phys. Rev. D 101, 013006 (2020).
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[3] M. K. Singh, H. T. Wong et al., "Projections of discovery potentials from expected background", Phys. Rev. D 109, 032001 (2024).

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