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Correlation Between 2νββ and 0νββ Decays in 48Ca and 76Ge via Higher-Order IMSRG Many-Body Truncations

Neutrinoless double beta decay ($0\nu\beta\beta$) is a primary search channel for lepton number violation and the Majorana nature of neutrinos beyond the Standard Model. Extracting the effective neutrino mass from experimental decay limits relies heavily on accurate $0\nu\beta\beta$ nuclear matrix elements (NMEs), which are thought to be correlated with two-neutrino double beta decay ($2\nu\beta\beta$) NMEs. In this work, we compute $2\nu\beta\beta$ NMEs for key candidate isotopes ^{48}Ca and ^{76}Ge using ab initio Valence Space In-Medium Similarity Renormalization Group (VS-IMSRG) methods. We systematically evaluate the convergence of the observables by comparing standard two-body truncations (IMSRG(2)) against higher-order three-body force inclusions (IMSRG(3f2)). Our analysis focuses on how these advanced truncations impact agreement with experimental $2\nu\beta\beta$ half-lives and whether higher-order many-body interactions modify the theoretical correlation between $2\nu\beta\beta$ and $0\nu\beta\beta$ matrix elements. These results provide refined theoretical benchmarks to reduce systematic nuclear uncertainties in interpreting next-generation $0\nu\beta\beta$ experimental searches.

Academic position of the presenting author

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