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Performance Study of Orthogonal-Strip Planar HPGe Detectors for 76Ge Neutrinoless Double-Beta Decay Searching

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Searching for neutrinoless double-beta ($0\nu\beta\beta$) decay is considered a promising approach for proving the Majorana nature of neutrinos. Background suppression is particularly important in $0\nu\beta\beta$ decay searches, which are considered rare-event searches. For traditional single-electrode high-purity germanium (HPGe) detectors, pulse shape analysis methods such as A/E are effective in distinguishing between single-site and multi-site events. However, they are inadequate for separating single- and double-electron events because of insufficient position resolution. Orthogonal-strip planar HPGe detectors, which offer excellent energy resolution, low background, high detection efficiency, and, most importantly, three-dimensional position sensitivity, are ideal for $0\nu\beta\beta$ searches. In this work, we developed a waveform simulation platform for orthogonal-strip planar HPGe detectors to systematically study their response to single- and multi-site events, as well as to single- and double-electron events. Furthermore, key detector parameters, such as electrode configuration and crystal thickness, were optimized to improve performance in 76Ge $0\nu\beta\beta$ detection. Our results demonstrate the feasibility and advantages of applying orthogonal-strip planar HPGe detectors for $0\nu\beta\beta$ detection, providing valuable guidance for future detector design.

Collaboration you are representing

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