

# Modeling Backgrounds in the MAJORANA DEMONSTRATOR

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The MAJORANA DEMONSTRATOR was a neutrinoless double-beta decay ( $0\nu\beta\beta$ ) experiment containing ~44 kg of p-type point contact germanium detectors, of which ~30 kg were enriched to 88% in  $^{76}\text{Ge}$ . The DEMONSTRATOR's low background rate and excellent energy resolution of 2.52 keV at the  $0\nu\beta\beta$  Q-value allowed it to set a lower limit of  $8.3 \times 10^{25}$  yrs on the  $0\nu\beta\beta$  half-life. Through the use of a multi-layer passive shield, radiopure materials, and analysis-based background rejection techniques, the DEMONSTRATOR achieved one of the lowest background rates of all  $0\nu\beta\beta$  experiments at the  $0\nu\beta\beta$  Q-value,  $6.23 \times 10^{-3}$  cnts/(keV kg yr). However, the observed background rate exhibited significant tension with the assay-based projection of  $1.17 \times 10^{-3}$  cnts/(keV kg yr). Spectral fits and supplementary background studies indicate that this discrepancy primarily arose from an excess of events from the  $^{232}\text{Th}$  decay chain, which were non-uniformly distributed between the DEMONSTRATOR's two modules and which did not originate in a near-detector component. This poster presents the results of background model fits, their implications for the next-generation experiment LEGEND-200, and a measurement of the half-life of two-neutrino double-beta decay, incorporating studies of multiple sources of systematic uncertainty.

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## Poster prize

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