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Final Results of the MAJORANA DEMONSTRATOR and Improvements in its Background Model

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The MAJORANA DEMONSTRATOR is a neutrinoless double beta decay ($0\nu\beta\beta$) experiment consisting of ~ 30 kg of germanium detectors enriched to 88% in ^{76}Ge and ~ 14 kg of natural germanium detectors. The detectors are divided between two cryostats and surrounded by a graded passive shield. The DEMONSTRATOR concluded in March 2021 and set a $0\nu\beta\beta$ half-life limit of $T_{1/2} > 8.3 \times 10^{25}$ yrs based on its full exposure. The experiment achieved one of the lowest background rates in the region of the $0\nu\beta\beta$ Q-value, 15.7 cnts/(FWHM t y). This background rate, however, was higher than the rate of 2.9 cnts/(FWHM t y) projected by material assays and simulations. This discrepancy arises from an excess of events from the ^{232}Th decay chain. Background model fits aim to understand the observed ^{232}Th excess and other deviations from assay-based projections, as well as allow a precision measurement of the $2\nu\beta\beta$ half-life. Comparisons of the data with simulations indicate the ^{232}Th excess cannot arise from near-detector components. This is an important finding related to the design and implementation of the LEGEND-200 experiment. The final results of the DEMONSTRATOR are presented along with its latest background model.

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Submitted on behalf of a Collaboration?

Yes

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