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First results from the LEGEND Experiment

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Neutrinoless double beta decay (0νββ) is a hypothetical process that, if observed, would establish that neutrinos are Majorana particles. The LEGEND (Large Enriched Germanium Experiment for Neutrinoless ββ decay) Experiment is designed to search for the 0νββ decay ⁷⁶Ge → ⁷⁶Se + 2e-, with high-purity germanium (HPGe) detectors enriched in ⁷⁶Ge. The experimental signature of 0νββ is a monoenergetic peak at the decay Q-value (Q_{ββ}), which for ⁷⁶Ge is 2039 keV.

The LEGEND Experiment builds on the success of the GERDA and MAJORANA DEMONSTRATOR experiments to search for 0νββ in ⁷⁶Ge. The HPGe detectors serve both as the source of the decaying isotope and as sensors for the emitted electrons and are operated in liquid argon (LAr) to suppress backgrounds. The first phase of the experiment, LEGEND-200, is currently collecting physics data at the Gran Sasso National Laboratories, aiming to probe the effective Majorana mass down to ~35 meV.

LEGEND employs advanced background suppression techniques, including pulse shape discrimination in the semiconducting diodes and active vetoes using both a muon veto and a liquid argon veto. The next phase, LEGEND-1000, will further advance the sensitivity frontier aiming for half-lives beyond 10²⁸ years and probing Majorana masses down to ~10 meV.

In this presentation, we will provide an overview of LEGEND, detailing its experimental strategy, background mitigation techniques, and the latest results from LEGEND-200, as well as prospects for LEGEND-1000.

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