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First results of the LEGEND experiment in the quest for Neutrinoless Double-Beta Decay

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The search for neutrinoless double beta ($0\nu\beta\beta$) decay is considered as the most promising way to prove the Majorana nature of neutrinos as well as to give an indication on the mass hierarchy and on the absolute mass scale. The discovery of $0\nu\beta\beta$ decay would moreover open the way for theories predicting the observed matter anti-matter asymmetry of the Universe being a consequence of lepton number violation through leptogenesis.

Building upon the success of GERDA and MAJORANA experiments, the LEGEND (Large Enriched Germanium Detector for Neutrinoless $\beta\beta$ Decay) Collaboration aims at building a ^{76}Ge-based $0\nu\beta\beta$ experiment to fully span the inverted neutrino mass ordering region.
The LEGEND project will proceed in two steps. The first phase, LEGEND-200, began operations at Gran Sasso National Laboratory in Italy in the spring of 2023, employing 142 kg of high-purity, enriched germanium detectors. Plans are in place to install additional mass in the coming months. By combining an initial exposure of 76.1 kg·yr with data from GERDA and MAJORANA experiments, the highest half-life sensitivity to date in the search for $0\nu\beta\beta$ decay in ^{76}Ge has been achieved.
In the second phase, the enriched germanium mass will be increased up to 1000 kg in a new experimental setup. With a background index of $\sim 10^{-5}$ cts/(keV·kg·year) and with an exposure of 10 t·yr, LEGEND-1000 will be able to reach a 3σ half-life discovery sensitivity of 1.3×10^{28}yr.

This talk will highlight the performance of the experiment and present the first $0\nu\beta\beta$ decay results obtained from the initial year of data collected by LEGEND-200. Lastly, an update on the status of the future LEGEND-1000 phase will be provided.

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