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The LEGEND Program to Search for Neutrinoless Double Beta Decay

The observation of neutrinoless double beta ($0\nu\beta\beta$) decay would have profound implications on the field of neutrino physics, giving key insights into multiple questions simultaneously. It would prove the existence of a lepton number violating process, determining if neutrinos are Majorana particles as well as constraining the overall mass hierarchy and the absolute mass scale of the neutrino. The multiphase LEGEND (Large Enriched Germanium Detector for Neutrinoless $\beta\beta$ Decay) suite of experiments seeks to build upon the previous successes of the GERDA and MAJORANA $0\nu\beta\beta$ search experiments to fully span the inverted neutrino mass ordering region. In the first phase, LEGEND-200, has already deployed 142 kg of enriched germanium detectors working towards deploying 200 kg with a total exposure of 1 tonne year and a background index of $\approx 10^{-4}$ cts/(keVkgyear) with the aim of reaching a $0\nu\beta\beta$ half-life sensitivity of 10^{27} years at 90% CL. In the following phase, LEGEND-1000, the enriched germanium mass will be increased to 1000 kg, with a background index of $\approx 10^{-5}$ cts/(keVkgyear) and an exposure of 10 tonne-years, allowing for a projected 3σ half-life discovery sensitivity of $1.3*10^{28}$ years. In this talk, we will present the current operation status and an overview of the ongoing LEGEND-200 $0\nu\beta\beta$ search results as well discussing the road ahead for the LEGEND-1000 $0\nu\beta\beta$ experiment.

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