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First Results of the LEGEND-200 experiment: Searching for Neutrinoless Double Beta Decay with High-Purity Germanium Detectors

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The LEGEND experiment is designed to search for the neutrinoless double beta ($0\nu\beta\beta$) decay of the germanium isotope Ge-76. This decay, if observed, would establish the Majorana nature of neutrinos and reveal lepton number non-conservation. The first stage of the experiment, LEGEND-200, has recently completed its commissioning phase and transitioned to physics data taking in March 2023. LEGEND-200, situated within the underground facility of INFN Laboratori Nazionali del Gran Sasso in Italy, can accommodate approximately 200 kg of enriched high-purity germanium detectors. The experiment offers a discovery sensitivity for the half-life of the $0\nu\beta\beta$ decay surpassing 10^{27} years within five years of data taking. The germanium detectors are immersed in an instrumented liquid argon (LAr) cryostat that shields against gamma radiation and operates as an active veto system. Additionally, the cryostat is surrounded by a water tank, providing an extra layer of neutron shielding and muon veto capabilities. In my talk, I will present the initial results of the LEGEND-200 experiment. I will discuss the performance of the germanium detectors and the LAr instrumentation and about the effectiveness of the techniques for background mitigation, such as the LAr veto and the pulse shape discrimination. I will show the actual background levels in the region of interest for searching for the $0\nu\beta\beta$ decay during the first months of data taking. Finally, I will also describe plans of ongoing preparations for the second stage of the experiment, LEGEND-1000, which aims to scale the detector mass up to 1 tonne. This ambitious endeavor is driven by the objective to increase the experimental sensitivity to discover the $0\nu\beta\beta$ decay at the level of 10^{28} years.

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