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The LEGEND experiment to search for neutrinoless double beta decay

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The observation of a hypothesized, extremely rare process, neutrinoless double beta decay ($0\nu\beta\beta$), would demonstrate that neutrinos are Majorana particles, i.e., their own antiparticles, and would establish lepton-number violation. Furthermore, it would provide hints of the neutrino absolute mass scale and the neutrino mass ordering, as well as information about the matter-antimatter imbalance of the Universe.

LEGEND (Large Enriched Germanium Experiment for Neutrinoless double beta Decay) will search for $0\nu\beta\beta$ with high-purity germanium detectors enriched in ^{76}Ge and operated in a liquid-argon cryostat, which serves as a coolant, a passive shield, and an active veto system. The first phase of the experiment (LEGEND-200) will deploy around 200 kg of germanium diodes and reach a discovery sensitivity of $> 10^{27}$y (3σ) for the half-life of $0\nu\beta\beta$ with an experimental live-time of five years. The first physics run has started with an initial 142 kg of germanium diodes (101 detectors). The other 50 kg of detectors will be characterized and installed in late 2023 to reach its full mass. The second phase of the experiment (LEGEND-1000) aims to improve the discovery sensitivity by another order of magnitude with 1 tonne of large-mass, high-purity, enriched germanium detectors operated for ten years. By reducing the background levels with several hardware approaches and improved analysis techniques, as well as operating with detectors of the best energy resolution in the field, LEGEND will perform a quasi-background-free search, where an unambiguous signature can be distinguished at the $0\nu\beta\beta$ decay Q-value of 2039 keV.

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