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Neutrinoless double beta decay searches with the LEGEND experiment

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Neutrinoless double beta ($0\nu\beta\beta$) decay is an ultra-rare process which could take place only if neutrinos were Majorana fermions, namely if neutrinos were their own antiparticle: if observed, this decay would shed light on neutrinos'nature and would be an unambiguous evidence for the existence of some Beyond Standard Model Physics, as it entails a violation of the lepton number by two units. Also, from the study of this decay it would be possible to give an explanation of the matter-antimatter asymmetry observed in the Universe and to extract information about neutrino masses.

The LEGEND Experiment is designed to search for the neutrinoless double beta decay of 76Ge employing active 76Ge-enriched HPGe detectors; these detectors are operated bare in Liquid Argon (LAr), serving both as a refrigerant and as a veto for background events; the LAr cryostat itself is immersed in a large volume of water, serving as muon veto.

The first phase of the experiment, LEGEND-200, started taking data in March 2023 at Laboratori Nazionali del Gran Sasso (LNGS) in Italy and is now running in a stable physics data taking regime. With an exposure of 1 ton yr and a target background index of 2 ·10−4 cts/(keV kg yr) at $Q_{\beta\beta}$ = 2039 keV, LEGEND-200 is planned to reach a 3σ discovery sensitivity of 1027 yr. The second phase, LEGEND-1000, will operate 1000 kg of Germanium and is planned to achieve a 3σ discovery sensitivity beyond 1028 yr with its target background index of 1 ·10−5 cts/(keV kg yr) at $Q_{\beta\beta}$. LEGEND-1000 sensitivity will allow to cover the full inverted mass ordering region.

In this contribution LEGEND's physics program will be presented, with a focus on the current status and results of the ongoing experimental campaign.

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