The Large Enriched Germanium Experiment for Neutrinoless Double Beta Decay(LEGEND)

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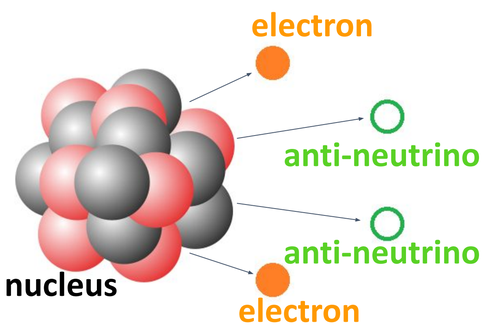
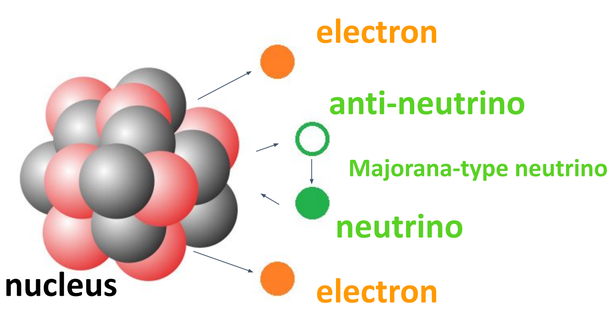
Large Enriched Germanium Experiment for Neutrinoless ββ Decay

Neutrinoless Double Beta Decay

Neutrino Double Beta Decay



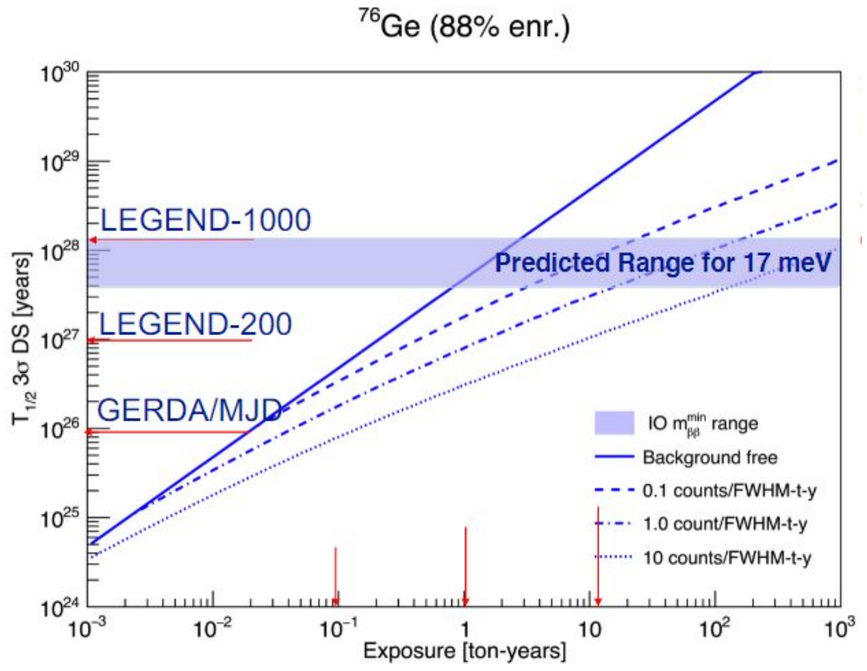
Neutrinoless Double Beta Decay



For a Majorana particle, the particle is its own antiparticle.

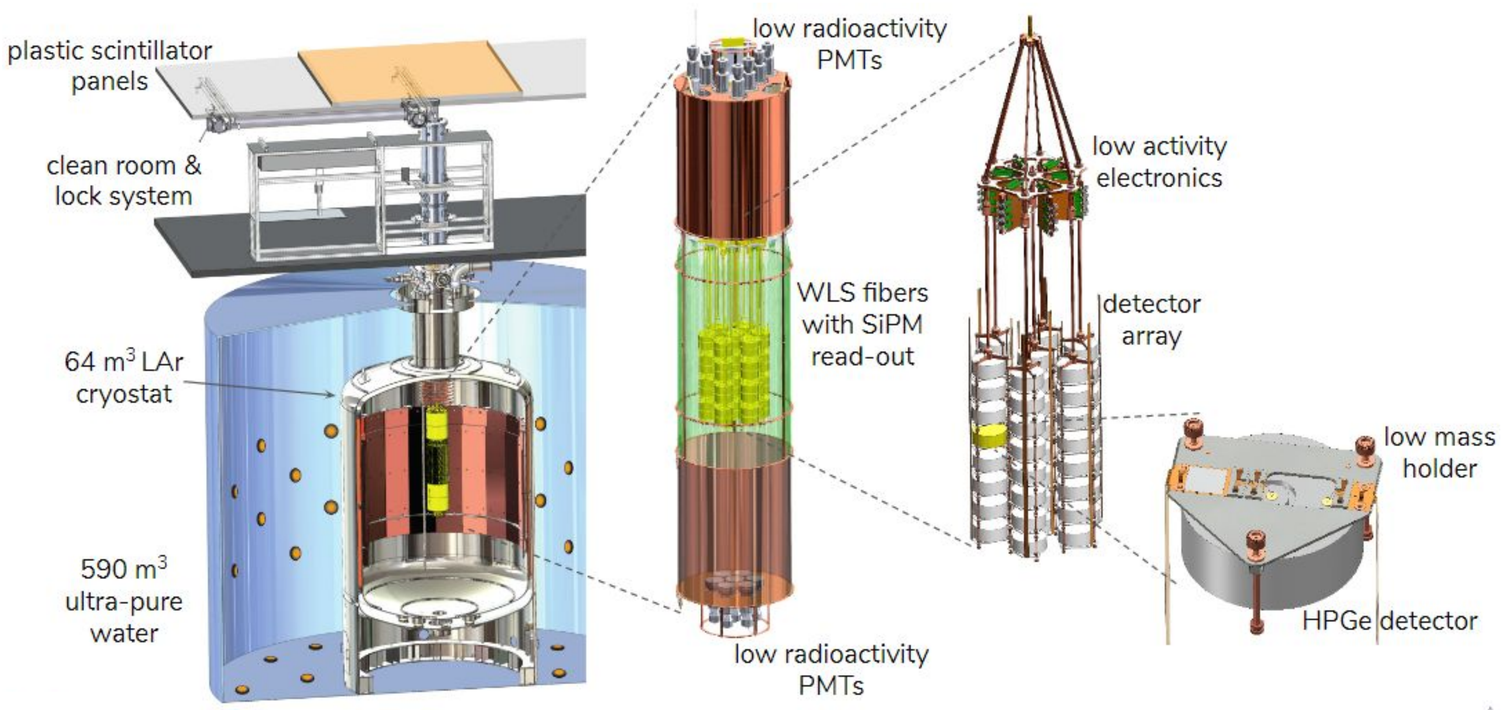
- Majorana-type neutrinos lead to a neutrinoless double beta decay with the emission of only two electrons.(Lepton Number Violation)
- LEGEND experiment is proposed to search for this transition from ^{76}Ge to ^{76}Se. **The goal is to reach the half-life sensitivity of about 10^{28} years in a 5 kton·year exposure of a detector with 1 ton of isotopic ^{76}Ge mass.**
- The LEGEND is located in the Laboratori Nazionali del Gran Sasso (LNGS) in Italy. Schematically, LEGEND follows the GERDA/MAJORANA experiment with an increase in the mass of the ^{76}Ge crystals and improvements of background suppression and signal events identification.

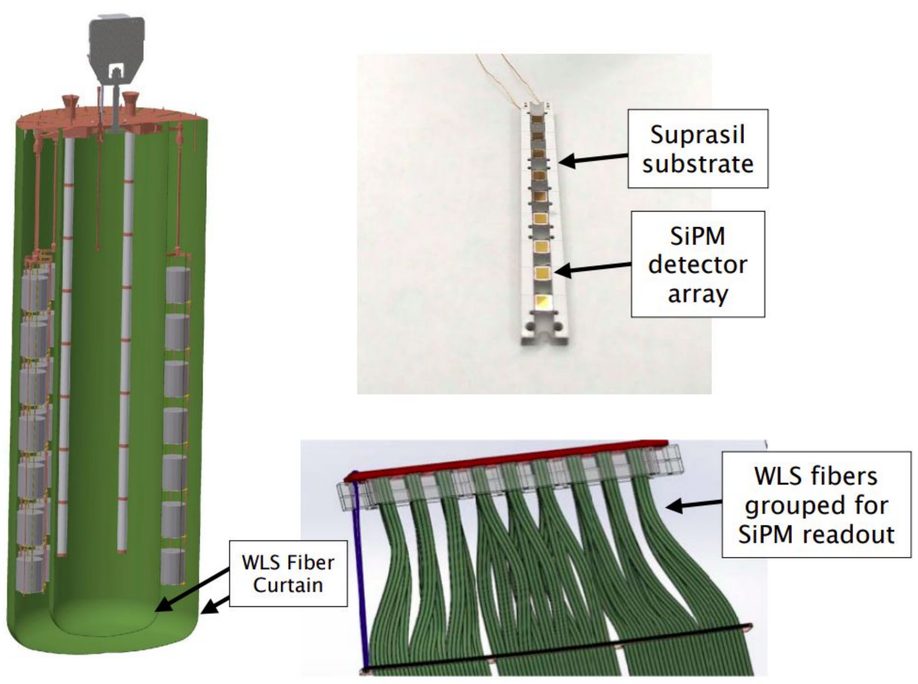
Expected Performance



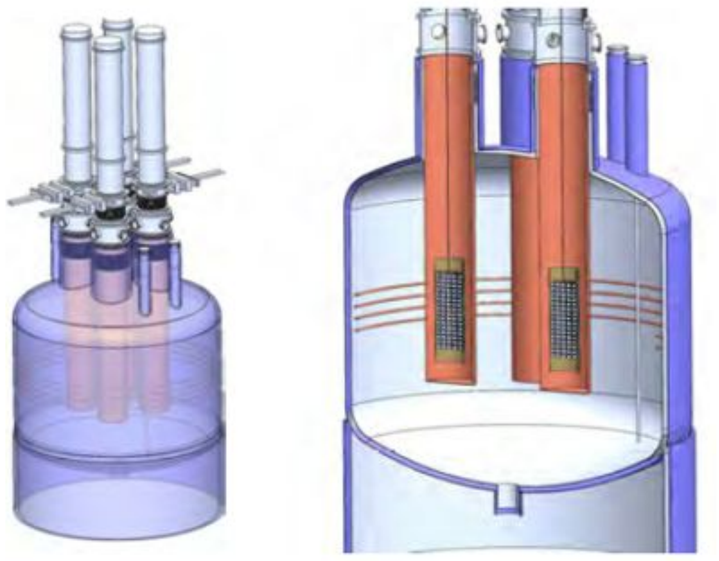
- LEGEND-200 experiment is to operate with ~200 kg of ^{76}Ge crystals to achieve about 0.6 counts/(FWHM·ton·year) to reach half life sensitivity of 10^{27} year in a 1 ton·year exposure.
- LEGEND-1000 is to operate with ~1000 kg of ^{76}Ge crystals achieving 0.1 lower cts/(FWHM·ton·year) in a 10 tyr exposure, reaching a sensitivity of 10^{28} years. **This would probe $m_{\beta\beta}$ in the 10-20 meV range, or the bottom part of the Inverted Ordering of the neutrino masses**, which is one of best performances among the many neutrinoless double beta decay experiments in the world.

Detector configuration



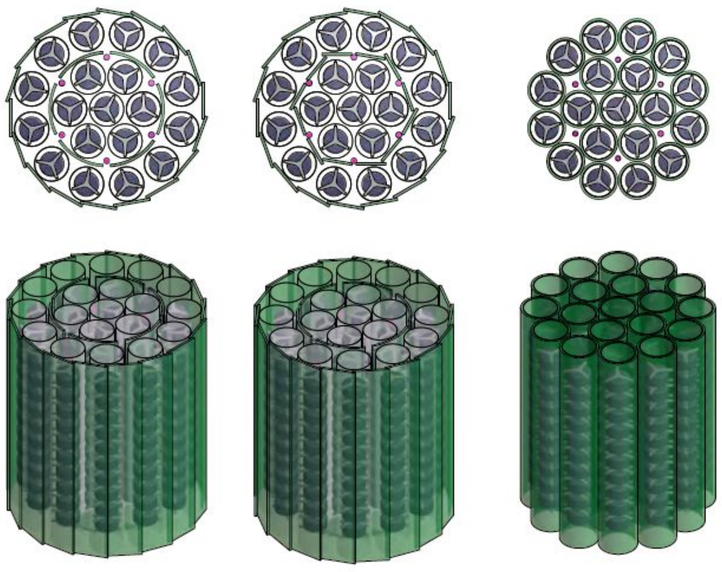


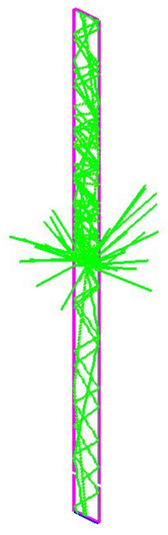
GERDA/LEGEND-200 features a water tank with a cryogenic tank of liquid argon (LAr), both acting as an external shield and an active veto system. The LAr tank holds strings of ^{76}Ge detector crystals, which are surrounded by fiber shrouds. These shrouds provide further suppression of background.



Conceptual design of the LEGEND-1000 experiment. It would consist of several groups of detector strings.

The current fiber shrouds model of the LAr active veto system.





UT Austin's plate model

- TPB coated(3um) EJ280 rectangular plate.
- Two photodetectors positioned on opposite edges of the plate.
- Size
  length: 1.5 m
  width: 2-10 cm
  thickness: 3 mm

UT Austin group is contributing to the extensive R&D of the LAr active veto system. To achieve higher radio-purity and better background detection efficiency, we are devising wavelength-shifting plates for LEGEND-1000 instead of using fiber shrouds. In a Monte Carlo simulation developed using Geant4, UT Austin's plate model has about **40% better light collection efficiency** than the current fiber shrouds of equivalent size.