

# The LEGEND Experiment

### Particle Physics Annual Meeting May 2025

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Large Enriched Germanium Experiment for Neutrinoless ββ Decay

Brunel University London, King's College London, Lancaster University, UKRI STFC Boulby Underground Laboratory, UKRI STFC Daresbury Laboratory, University College London, University of Edinburgh, University of Liverpool, University of Sheffield, University of Warwick, University of York

## Introduction to LEGEND

- The LEGEND collaboration proposes a 0vββ decay search experiment, using a 1 tonne of <sup>76</sup>Ge enriched detectors
- The programme follows a staged approach:
  - LEGEND-200: a 200 kg mass experiment, installed in the LAr cryostat at LNGS, Gran Sasso. Data taking in progress
  - LEGEND-1000: a 1T experiment will require a new underground infrastructure and additional R&D to further reduce backgrounds
  - LEGEND-1000 project to start construction later this decade



## LEGEND 200 Status

- 200 kg of enriched HPGe at LNGS
- Data taking continues....
- First LEGEND physics paper submitted to PRL May 2025
- Liverpool significantly contributing to detector characterisation and background rejection – a key part of the analysis pipeline
- Designs of optimised HPGe crystal configurations being developed in collaboration with UCL and Mirion Technologies



Installation at LNGS



Characterisation in Liverpool

### LEGEND-1000 Baseline Design: Underground Site

- A deep-underground site is needed to shield the experiment from backgrounds generated by cosmic rays
- Baseline site: LNGS (Italy)
  - 3500m water equivalent depth
  - Lower overburden somewhat increases background
  - Horizontal access reduces cost/schedule risk
- Alternative site: The SNOLAB "Cryopit"
  - 2 km underground (6000m water equivalent)
  - In an active nickel mine in Sudbury, Ontario
  - Vertical access through mine shaft
- Staff at both sites are actively involved in planning
- We are currently assuming that we need to carry both sites forward through CD-1 in Nov 2025



## LEGEND 1000 UK

- A joint effort of nuclear and particle community along with industrial partners for:
  - Contributing to enriched Ge and detector production
  - HPGe Detector Development & Characterisation
  - Material Screening & Assays Boulby Underground Laboratory
  - Active Veto Liquid Argon Detectors
  - Software & Analysis including theory support
  - Design, test and build large hardware items
- Industrial requirements for improved gamma-ray detector performance
- The UK has the opportunity to play a leading role in a global next generation experiment
- Ambition for an equal UK, Italian and German contribution.



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