

GERDA – Germanium Detector Array

searching for the
Neutrinoless Double Beta Decay



Procurement of enriched germanium for Phase II

The GERDA experiment is built for the search for $0\nu 2\beta$ decay in ^{76}Ge . In the natural Ge the content of the ^{76}Ge isotope is only 7.6%. Increasing the abundance of ^{76}Ge not only increases the target mass but also reduces the background from the cosmogenic activation of other isotopes. Natural Ge was enriched to contain 86% ^{76}Ge at the ECP in Zelenogorsk (Russia). It was delivered as GeO_2 powder. This has to be reduced to metal bars and purified.

Full production chain test for Phase II BEGe detectors

34 kg of depleted germanium left over after the ^{76}Ge enrichment was used to test the whole production chain from the Ge procurement through crystal pulling at Canberra, Oak Ridge, USA to the manufacture of working detectors. Five detectors were produced, implementing various improvements to increase the detector mass yield. Comprehensive acceptance testing is currently underway – the detectors tested so far perform as good as BEGe detectors from standard production.



This test demonstrated that the enriched germanium procured for GERDA Phase II is suited for BEGe-type detectors, and provides input for defining and maximizing the achievable mass yield for Phase II enriched detectors.

Enriched Germanium procurement

Processing of the Ge

In total 53.3 kg enriched GeO_2 have been produced in the plant ECP in Siberia. The powder has been transported in a shielded container to Munich.

The material has been reduced to germanium metal and purified at PPM Pure Metals with a yield of 94%. 35.4 kg $6\text{N } ^{enr}\text{Ge}$ in form of metal bars are available. To protect it from cosmic radiation it is stored underground in the mining museum in Rammelsberg.

Enrichment Facilities at ECP, Russia



Shielded container to protect the germanium from cosmic radiation during transport



The zone refined germanium bars are stored underground in the Rammelsberg mining museum

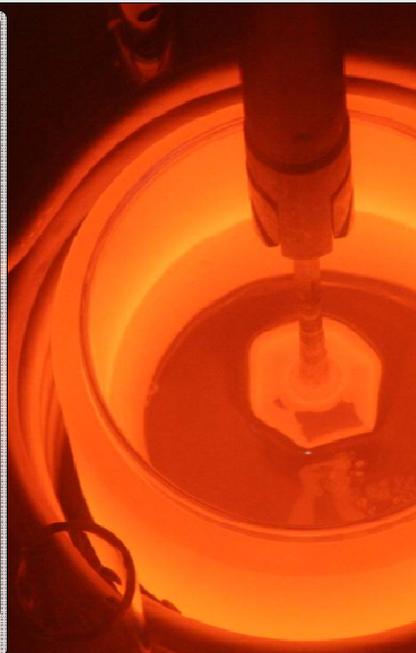


The GeO_2 powder is delivered in 1kg bags

Crystal pulling R&D



EKZ 2000, LEYBOLD
Czochozrski puller



Germanium detectors are made of high purity crystals. The concentration of impurities in the crystal should not be more than $10^{10}/\text{cm}^3$ (99.9999999999% purity).

A R&D project with Institute für Kristallzüchtung (Berlin) to produce the high purity crystals has been started in 2007.

A dedicated Czochozrski puller was set up for High Purity Germanium at IKZ (Berlin)

Many test crystals produced had Impurity levels around $10^{11}/\text{cm}^3$

The Impurity concentration are measured with Hall-effect measurement at very low temperature (7K)

The chemical composition is analyzed with Photo-Thermal Ionization Spectroscopy (PTIS).



Crystal grown at IKZ

