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Procurement, production and testing of the Broad Energy Germanium (BEGe) detectors depleted in 76Ge

The GERDA experiment employs isotopically enriched Ge detectors
to search for neutrinoless double beta decay of Ge-76. In addition to the detectors deployed in Phase I, the Phase II of the experiment will use new detectors from 37.5 kg of enriched germanium with additional rejection capabilities. Possible candidates are p-type Broad Energy Germanium detectors (BEGe) or 18-fold segmented n-type diodes. The capability of pulse shape discrimination of Canberra commercial BEGe have been already tested and verified two groups of the collaboration. This project is aiming to demonstrate that working BEGe detectors can be produced, while maximizing the production-chain yield from the isotopically enriched material. Such production chain consisting of

• procurement of the isotopically modified material (both depletion and enrichment from ECP, Zelenogorsk, Krasnoyarsk Region, Russia),
• reduction to metal,
• chemical purification,
• crystal pulling and
• diode fabrication

is tested with material of the same history, i.e. depleted Germanium in 76Ge to 0.6%. 34 kg of depleted material (from ECP, Zelenogorsk, Krasnoyarsk Region, Russia) has been purchased by GERDA collaboration, the quality has been fourfold checked via ICPMS (LNGS, Italy and RAS, Moscow) and NAA (in Geel and Munich). Then the material underwent the reduction and purification to 6N at PPM (Pure Metals GmbH), Langelsheim, Germany. 17 zone refined bars received in June 2009, with a yield for reduction process of 91% (21.4 kg) has been sent to Canberra in Oak Ridge for crystal pulling and first crystal suitable for diode production was ready at the end of September 2009. Finally the diode fabrication is ongoing at Canberra, Olen, Belgium. GERDA collaboration aims for 5 diodes of BEGe type to evaluate the achievable mass of detectors that can be produced from 37.5 kg of enriched material.

Two depleted BEGe detectors have been produced by Canberra, they are undergoing all the Canberra internal acceptance tests and then they will be shipped to LNGS. The arrival is foreseen within March 2010. BEGe detectors will be tested and characterized in terms of energy resolution, active volume and pulse shape discrimination capabilities. Experimental results will be compared to a modelling developed and optimized for the purpose and already validated on the basis of the extensive measurements campaign of commercial BEGe detectors of two different dimensions. The modelling consists on the numerical calculation of the internal electric field and simulation of shape of pulses generated as a consequence of energy deposition at different positions.

The results of the characterization measurements and the comparison with output of the modelling will be presented in the poster.

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