Characterization of BEGe detectors in the HADES underground laboratory

Development of a test facility for the fast screening of BEGe detectors assuring minimal exposure to cosmic radiation

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Broad Energy Germanium detectors (BEGe)
BEGe detectors are p-type HPGe’s with a n’ contact covering the whole outer surface and a small p’ contact located on the bottom. Main properties:
- enhanced Pulse Shape Discrimination properties, which can be exploited for background reduction purposes [1].
- excellent energy resolution (~0.1%).

The GERDA BEGe’s are being produced from 35 kg of enriched germanium by Canberra:
- crystal pulling in Canberra Oak Ridge (USA)
- diode production in Canberra Olen (Belgium)

A complete characterization of the BEGe’s is carried out in the HADES underground laboratory prior to their installation in the GERDA experimental set-up at Laboratori Nazionali del Gran Sasso (LNGS), Assergi (Italy).

HADES
Located 223 m underground (~500 m w.e.) in a Boom Clay layer [3].
Muon flux reduced by ~10³.
In Mol at ~30 km from Olen.

January 2012 - first batch of 7 BEGe’s deployed: Argo, Andromeda, Achilles, Agamemnon, Archimedes, Aristoteles, Anubis. FWHM by Canberra: 1.64-1.79 keV @ 1.3 MeV.

Radiopurity
Strategy to minimize exposure to cosmic radiation:
1. Diodes always stored in underground locations in the vicinity of the plants during production and characterization phases.
2. Transport from USA to Belgium by sea in a container equipped with shielding layers of steel and water.

The test protocol
- Energy resolution and high voltage scan up to the operational value (54 kV) with 60Co.
- Average top surface dead layer determination using 241Am and 43Ba.
- Active volume determination using 60Co: count rate under the peaks @ 1273.2 keV and 1332 5 keV is compared to the simulated one.
- Pulse Shape Discrimination performance [1].

References:

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