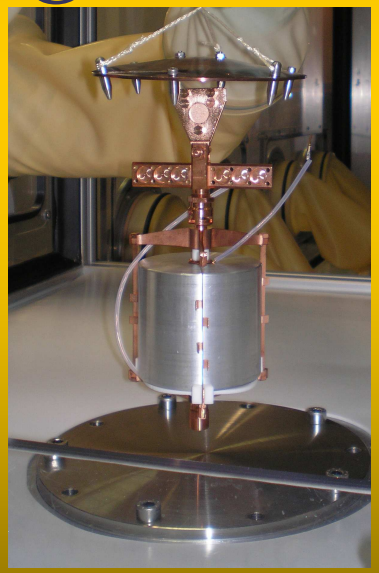
Operation of a GERDA phase I prototype detector in liquid argon and nitrogen



Marik Barnabé Heider, Max-Planck für Kernphysik

March 2007, DPG, Heidelberg

Outline

- GERDA phase I
- Enriched detectors
- Testing with prototype diode
- Low mass Cu holder
- GERDA Detector Laboratory
- Summary of 1 year measurement with Phase I detector prototype

GERmanium Detector Array for the search of neutrinoless $\beta\beta$ decays of ^{76}Ge

- PHASE I
  - Enriched ^{76}Ge (86%)
    - HEIDELBERG-MOSCOW (5) and IGEX (3) detectors → 17.9 kg
  - Non enriched Ge
    - Genius detectors (6) → 15 kg
  - 1 year data taking
  - Bkg = 0.01 cts/keV/kg/year

GERDA PHASE I detectors mounted vertically into strings in low-mass Cu support operated in LAr/LN_2

Enriched diodes

- In GERDA Detector Laboratory, LNGS …

Energy resolution measured in their cryostats

Opening and dimensions measurement

Keep under vacuum in transportation container

Refurbishment at Canberra Semiconductor, Olen, Belgium

GERDA phase I prototype diode

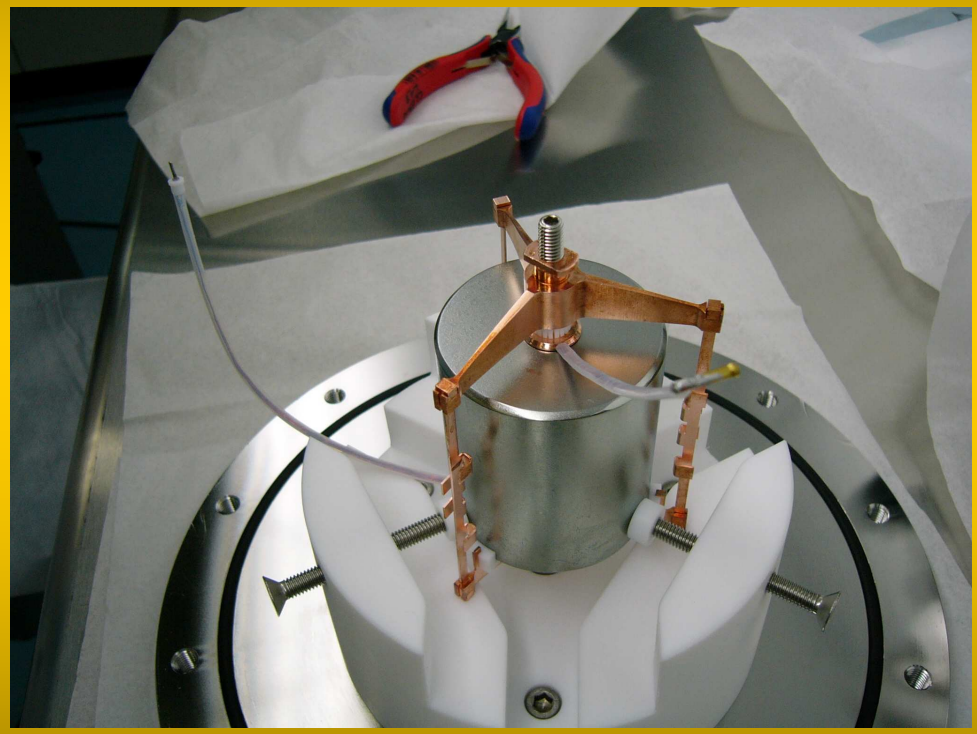
- Non-enriched HP p-type Ge diode to test
  - GERDA phase I low mass support
  - Cooling/warming cycles
  - Test bench facility of the GERDA Detector Lab
  - Detector stability in LAr/LN_2
  - Refurbishment procedure

→ To be ready for the enriched diodes

Prototype diode (total mass: 1.6 kg) refurbished by CANBERRA using the same technology as for the enriched diodes. The FWHM in a test cryostat is 2.2 keV at 1.332 MeV.

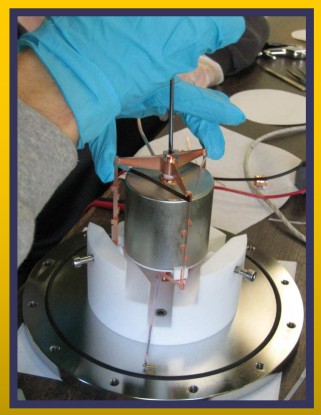
GERDA phase I detector assembly

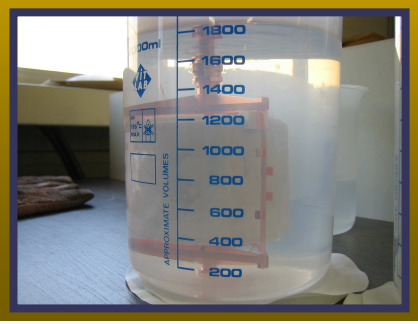
- Low mass Cu holder
  - Low activity Cu (80 g)
  - PTFE
  - Silicon

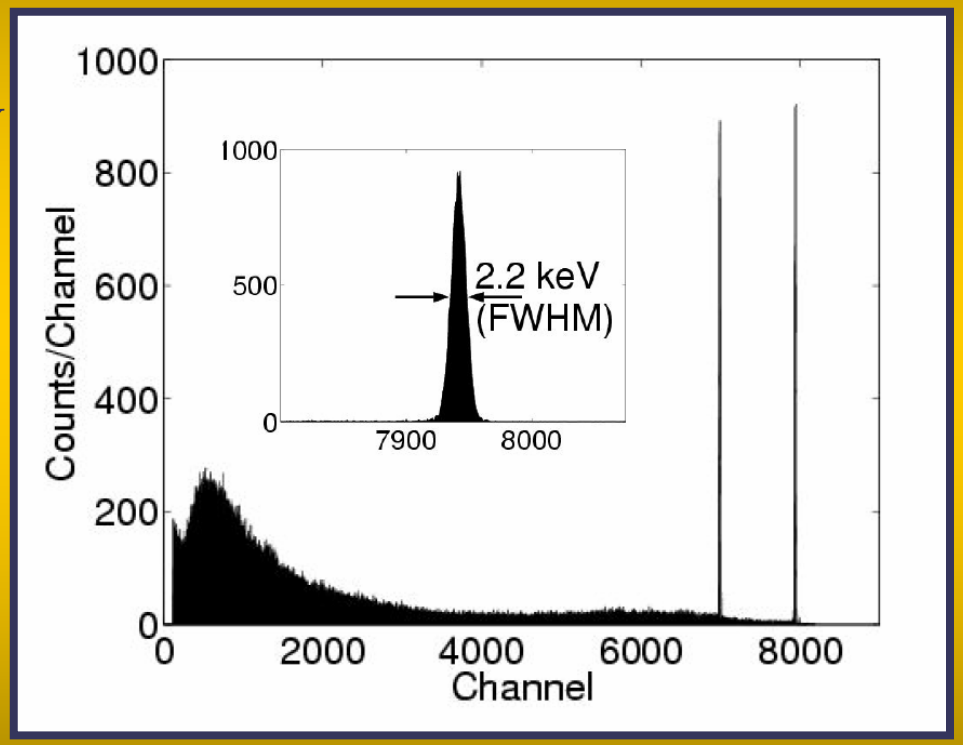


GERDA phase I detector assembly

- Testing at Canberra
  - Mounting procedure
  - Signal and central HV contact quality
  - Mechanical stability
  - Spectroscopy performance





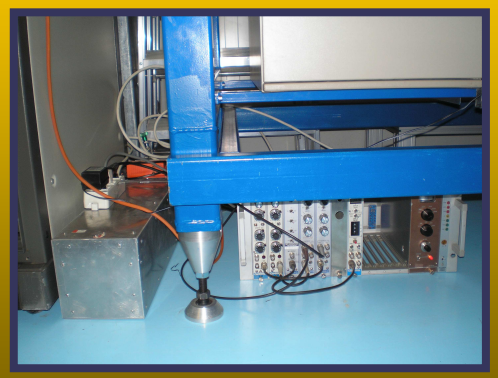


Same resolution as obtained in a test cryostat!

GERDA Detector underground Laboratory, LNGS

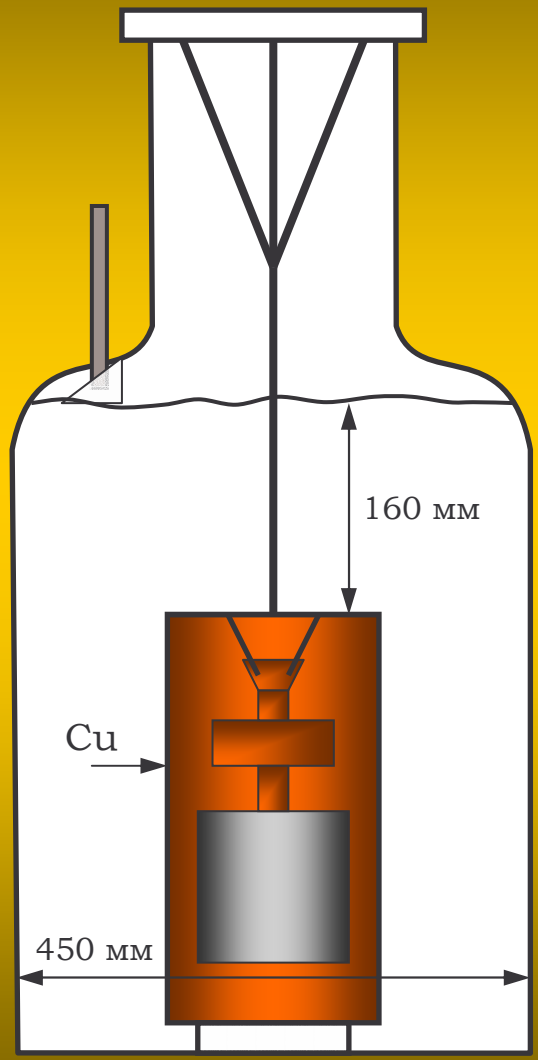
Detector test bench, Rn 'free bench' and clean bench. Ar level is monitored by weighting cells, Rn by Lucas cell (10 Bq/m^3) and humidity is kept low(30%).

- To test the enriched detectors
  - Clean room level 10 000
  - Clean bench and Rn 'free bench' level 10



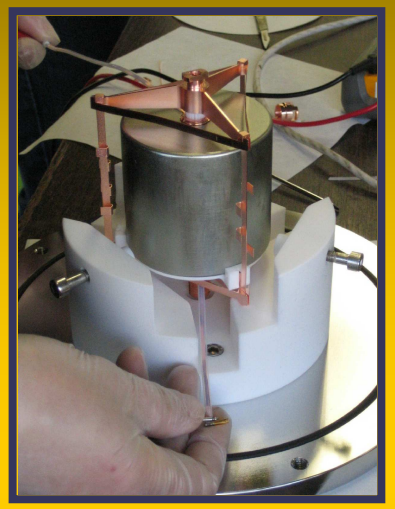
Detector test bench

- Infrared shield
- WarmFET
- 1 m cables
- LAr: 1 feeling/week

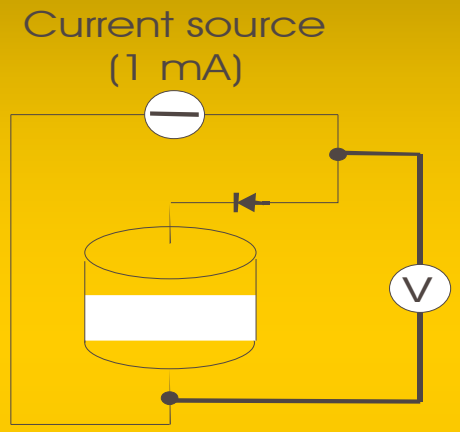


Detector 'health' monitoring

- Signal to HV resistivity measurement

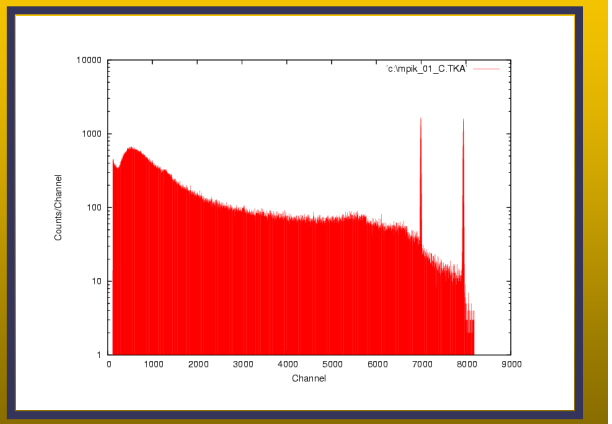


- Forward resistivity measurement while cooling



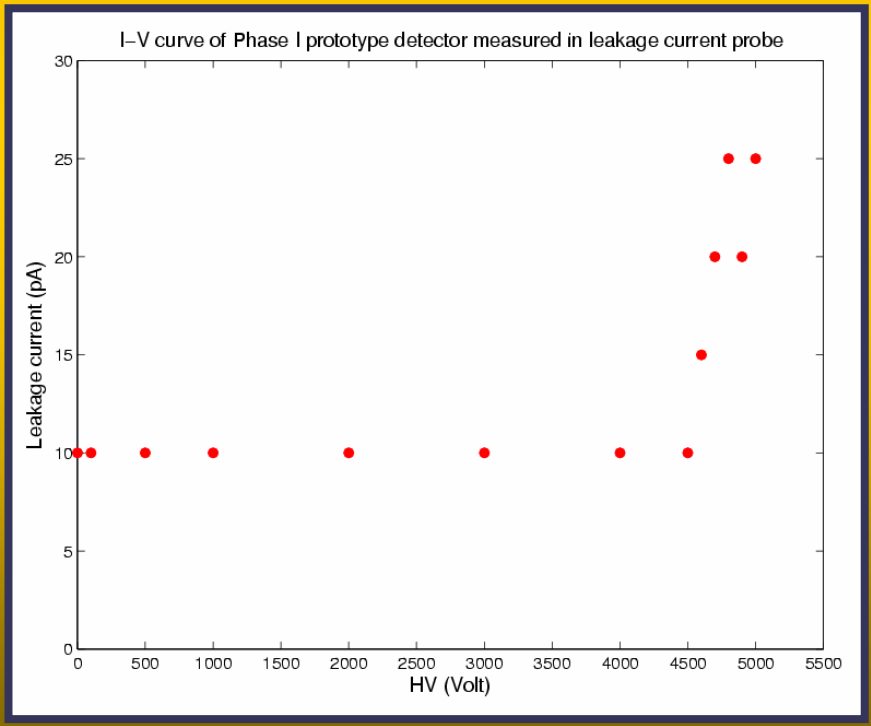
- Test point, picoammeter and noise level recorded

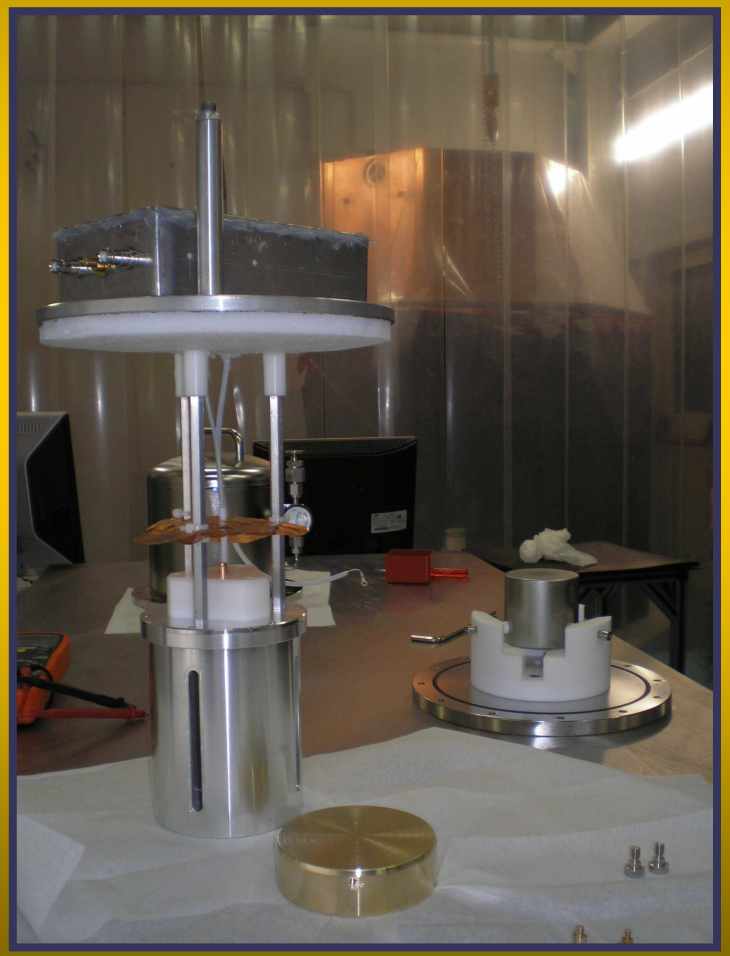
- Spectra collecting



Detector 'health' monitoring

- Leakage current probe
  - I-V curve of diodes





GERDA phase I prototype diode … 1 year testing

- LN_2 and LAr
- 43 cooling-warming cycles
  - To performed detector mounting and/or electronics modifications
- 2 refurbishments
  - New passivation layer evaporated
  - Total exposure to cosmic rays ~ 60 hours
- Detector parameters stable over long term measurement
  - 2 months
  - Physics results: Limit on the radiative 0v ECEC decay of ^{36}Ar, O.Chkvorets
- Spectroscopy performance: 3.4 keV FWHM at 1.332 MeV

Enriched detectors status

- Refurbishment procedure is on going
  - ANG 1 and RG 3 are refurbished and ready to be tested in GDL
  - ANG 2-5, RG 1-2, Genius 1-6 are being refurbished at Canberra Semiconductor, Olen, Belgium

Conclusion

- Gerda Detector underground Laboratory, LNGS, is operated for GERDA phase 1
- Enriched detectors are being refurbishment
- 1 year testing with prototype detector
  - Low mass holder
  - Cooling/warming cycles
  - Operation in LAr and LN_2
  - Refurbishment procedure
  - Long term measurement