Symposium of the Sino-German GDT Cooperation
Tübingen

The GALATEA Test Facility

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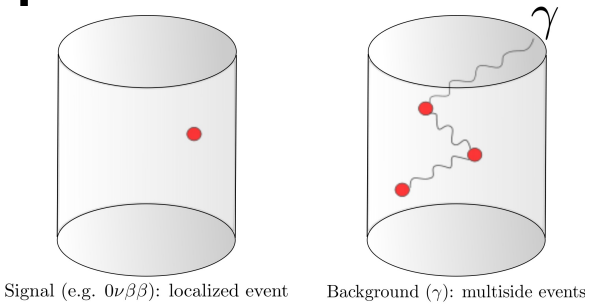
Outline

1. What are we interested in?
2. ”SuperSiegfried”
3. What Information can we extract?
4. Experimental Scanning of the Detector
5. The Test Stand GALATEA
6. First Results of the Commissioning Phase
7. Assembly and Upgrade
8. Pressure and Temperature Monitoring
9. Summary and Outlook

Characterisation of HPGe Detectors

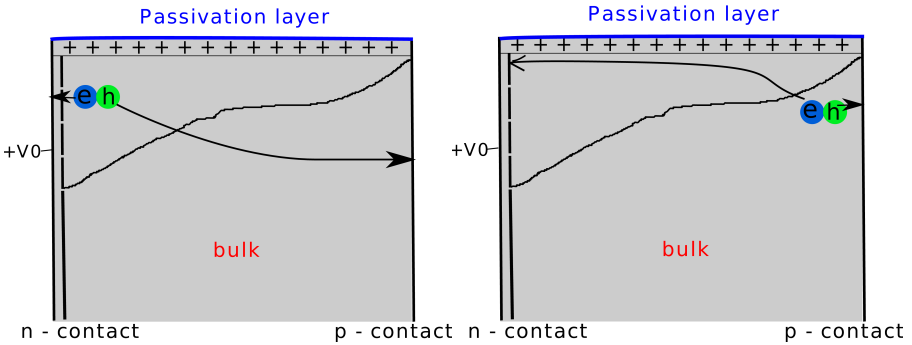
...for low-BG experiments

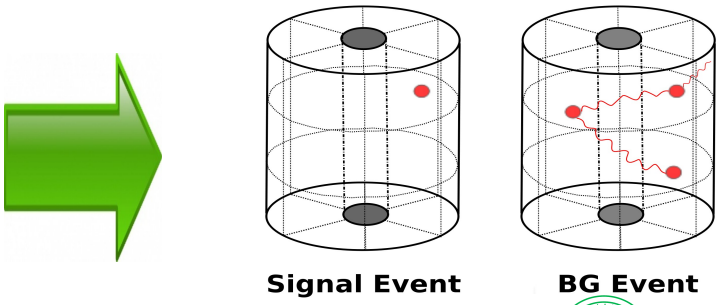
- BG reduction through event recognition
  - $0\nu\beta\beta$: localized event
  - γ: multiside events
- Segmentation



...further Detector Studies

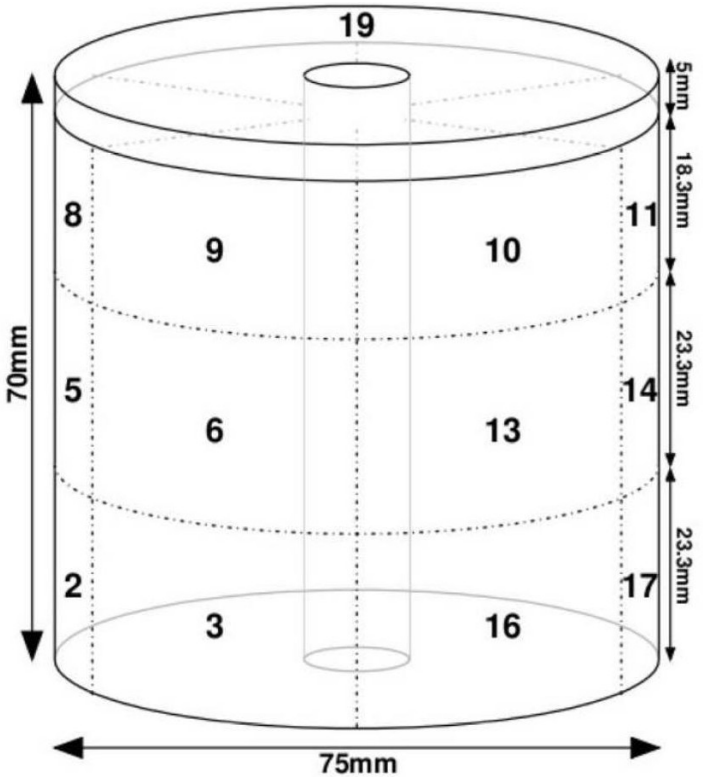
- Charge Trapping
- Surface Channel Effect





”SuperSiegfried”

- Cylindrical true-coaxial n-type HPGe detector
- 18 + 1 fold segmentation (3z and 3φ)
- Additional top segment
- Dimensions
  - Height h = 70 mm
  - Inner bore hole r_{inner} = 5.05 mm
  - Outer radius r_{outer} = 37.5 mm



What Information can we extract?

- Segmentation for extraction of event topologies and event positions
- Pulse shapes including mirror pulses give information about
  - The energy deposited
  - The position of an event
    - RT & polarity of mirror pulses → position in r
    - Relative strength of mirror pulses → position in φ
- Proximity to end plates: long pulses → surface channel effect

How can we study these features experimentally?

Experimental Scanning of the Detector

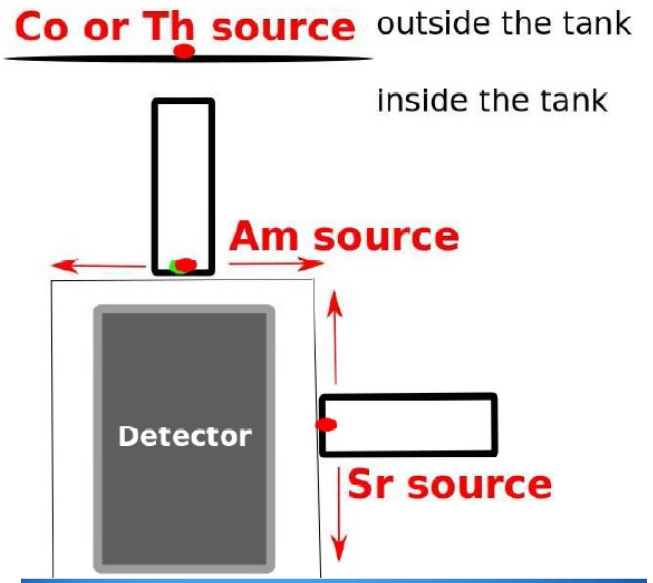
- Radioactive sources close to detector for scanning
- Sources inside vacuum tank

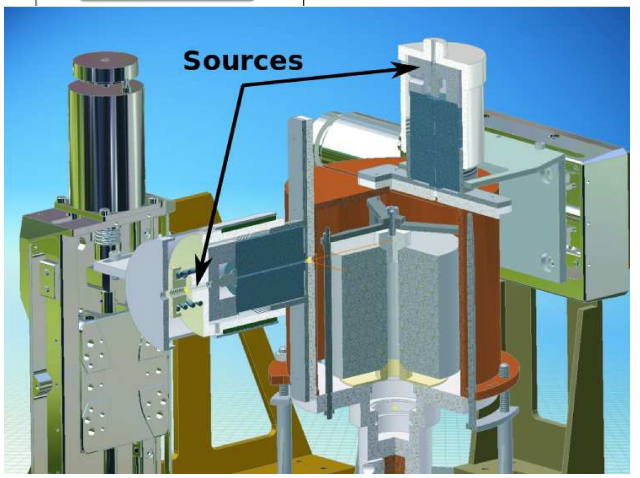
  → looking for events which relate to α and β

  → surface effects
- Using α particles and electrons, e to study the surface

  → penetration depth: $\delta_p(e)$ ~ 1mm (1 MeV)

  → penetration depth: $\delta_p(\alpha)$ ~ 10µm (5 MeV)
- Effective inactive layers can be measured





The Test Stand GALATEA

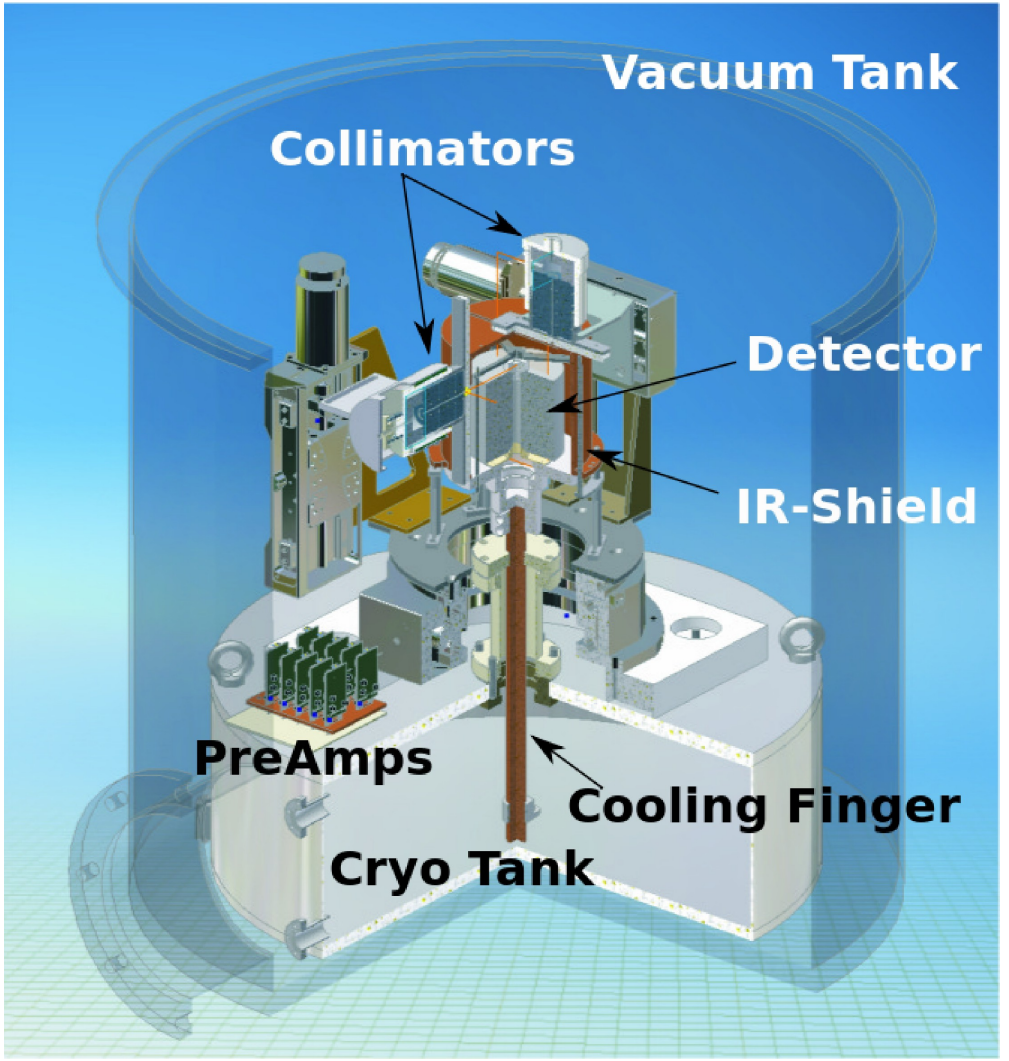
Technical Implementation

- Vacuum
- LN_2 Cooling
- Adjustable sources

  → moved via an UHV stage
- Electronics

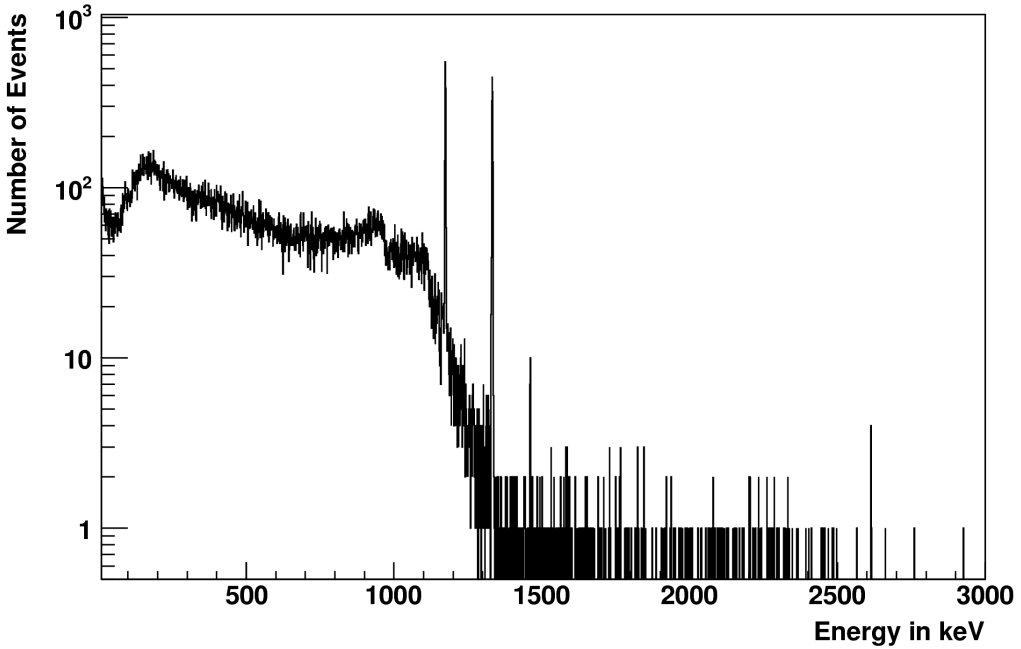
  → inside the vacuum tank

  → close to the detector

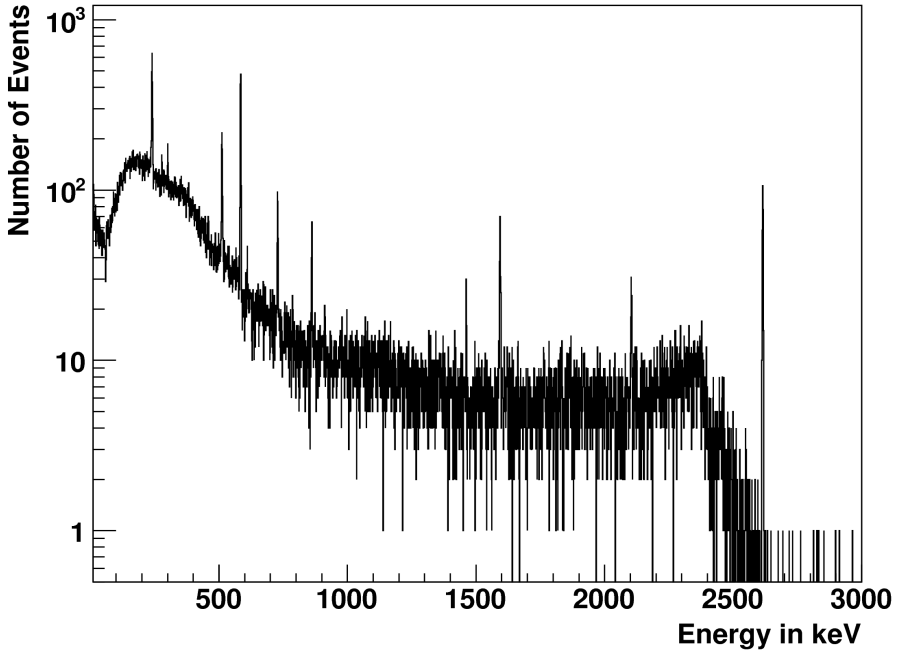


First Results of Commissioning Phase I

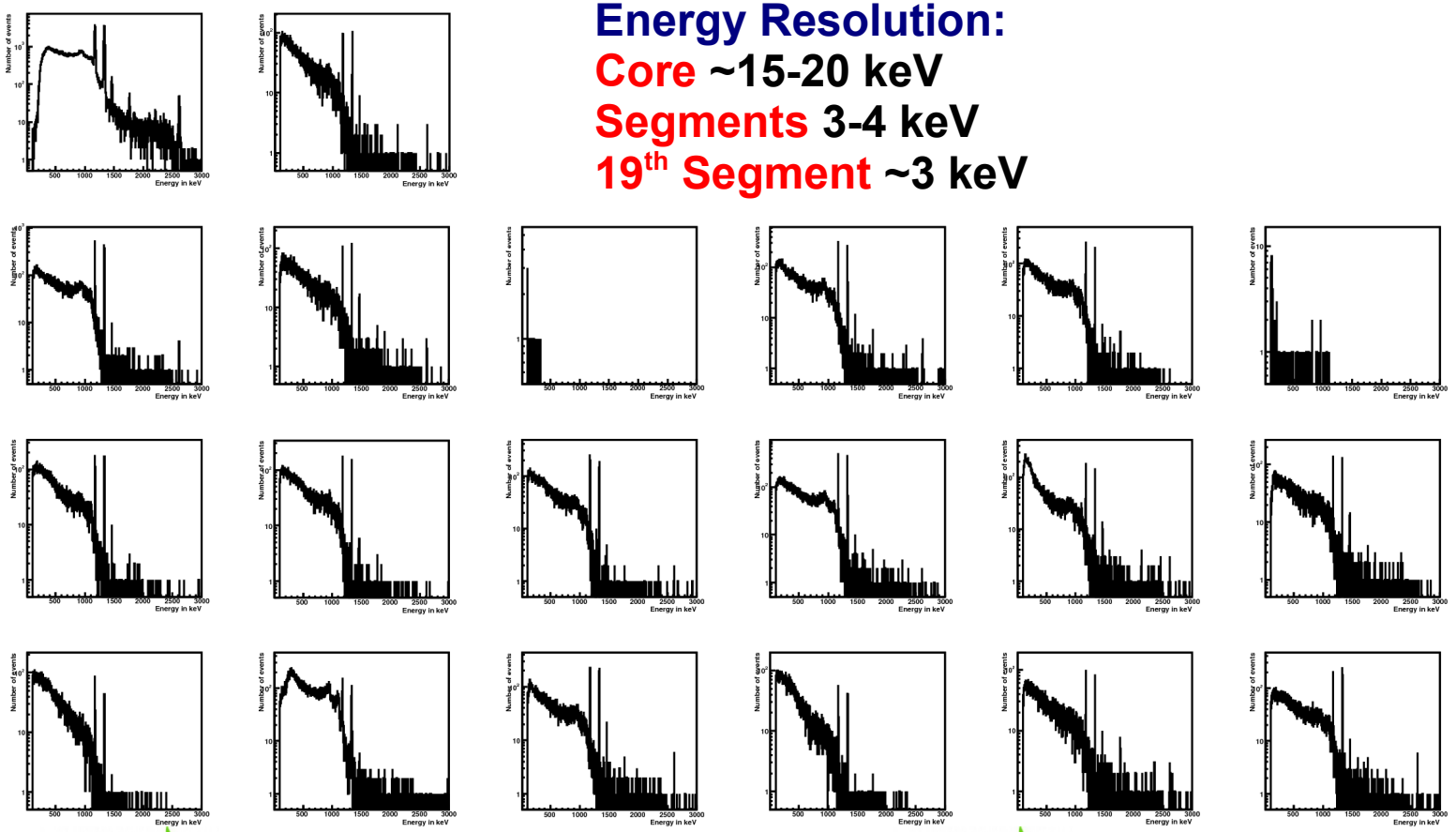
^{60}Co Spectrum (Segment 7)



^{228}Th Spectrum (Segment 7)



First Results of Commissioning Phase I

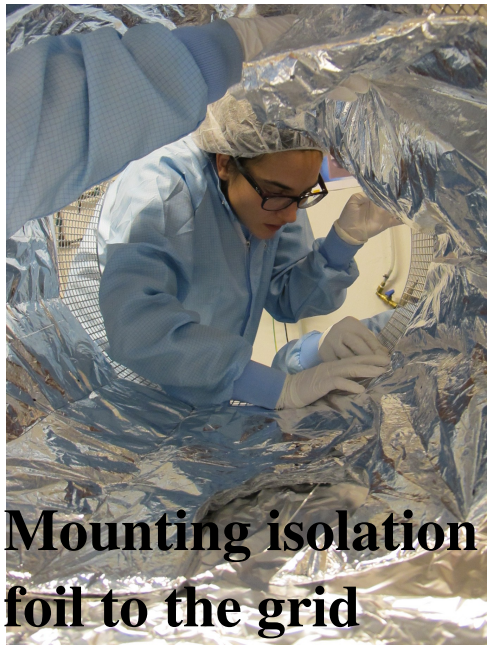


Energy Resolution:
Core ~15-20 keV
Segments 3-4 keV
19th Segment ~3 keV

- ✗ bad resolution
- ✗ grounding problem
- ✗ bad vacuum → only short measurements possible

IMPROVE IT!

Assembly and Upgrade

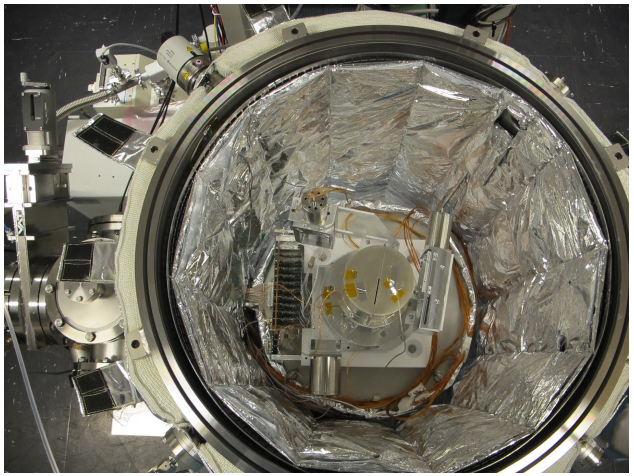


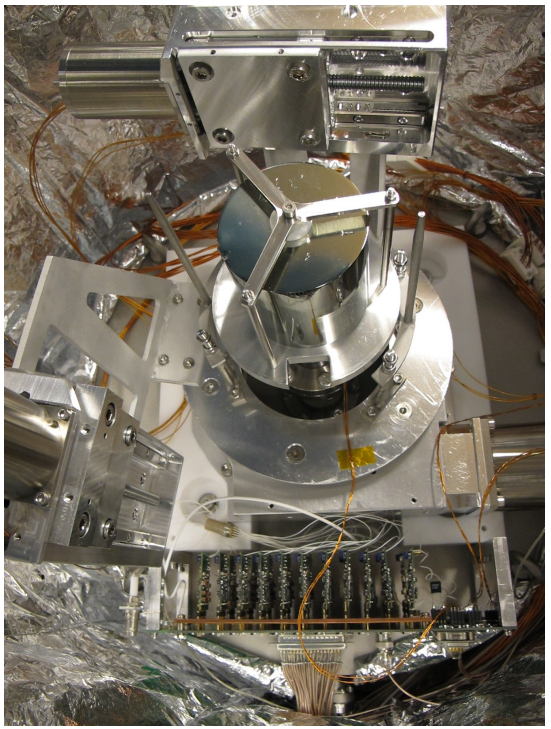
Mounting isolation foil to the grid

- ✔ additional ports
- ✔ rework of the whole vacuum tank
- ✔ new heating system
- ✔ new electronic concept
  → grounding shema

- ✔ rework of the moving stage
- ✔ new cableing
- ✔ ...

Tests with optical crystal

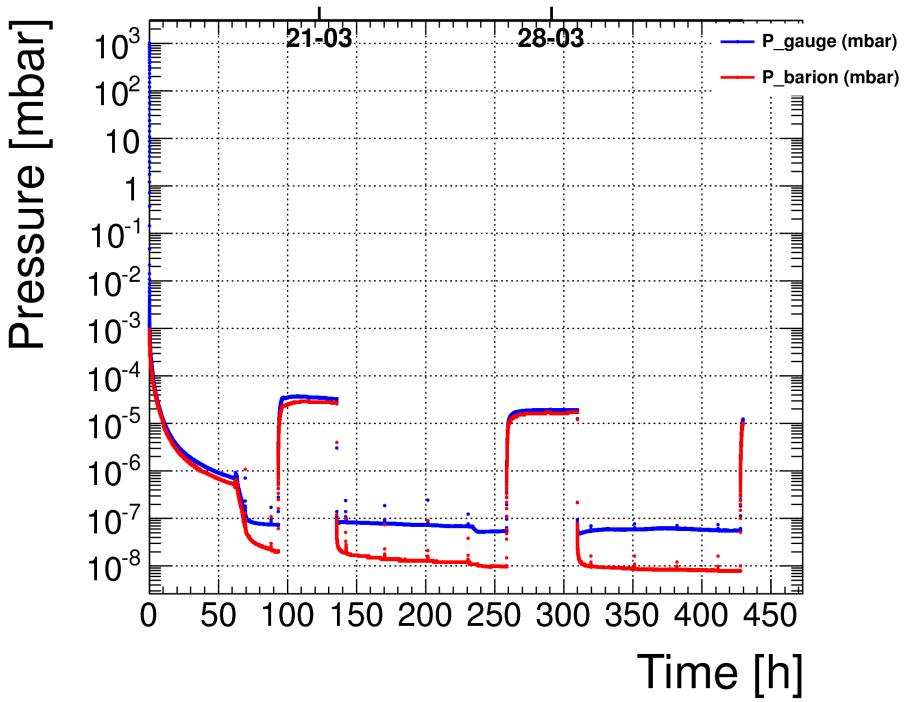


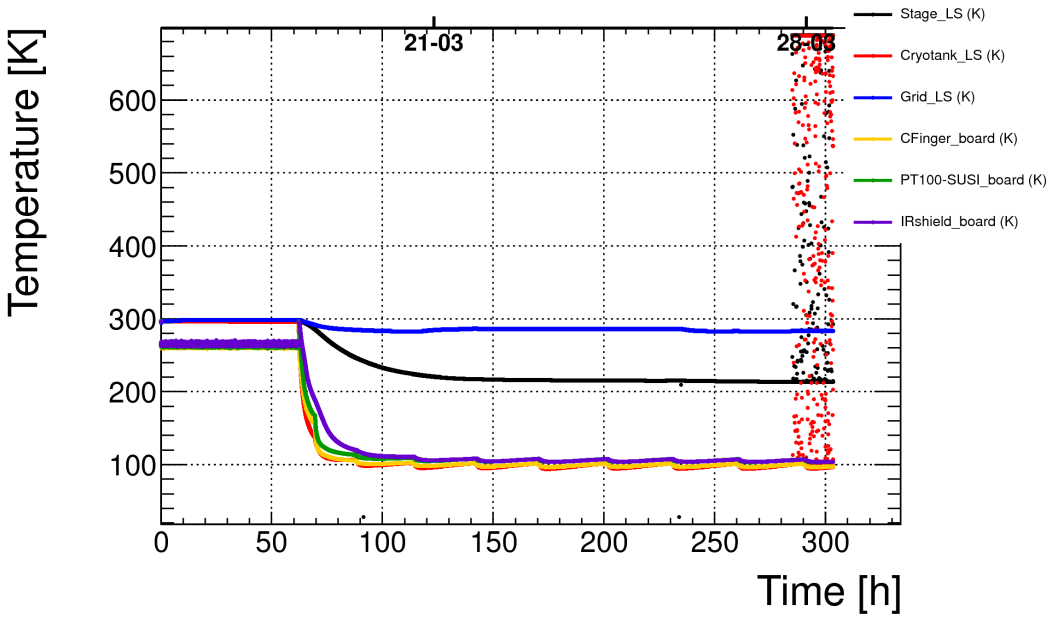


Mounting grid

Pressure and Temperature Monitoring

Long term pressure and temperature monitoring including shutter test and refilling cycles





Holds vacuum of p = 10^{-5} mbar for more then one week } with closed shutter
Temperature stability on the crystal: ΔT ~2 K

Summary & Outlook

What is our plan?

- Study surface effects in segmented true-coaxial HPGe detectors
- Identify and characterize surface events and further study on segmented HPGe detectors

What do we need?

- Scan of a special 19-fold segmented Ge detector with α and β sources
- A test stand which allows a fully scan of the detector → GALATEA

What is the status of GALATEA?

✔ Rework of the vacuum tank & all components finished

✔ New heating and cooling system installed & tested → long term measurements!!!

✔ SuSie mounted

Comissioning read out chain!