# Germanium Detector Research at MPP

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Sino-German GDT Symposium, Oct. 20th, 2015

# GeDet Project at MPP

- Activities:
  - HPGe Detector Research - Focus:
    Segmented Detectors, Volume and Surface Effects
  - Ton-scale HPGe experiment studies

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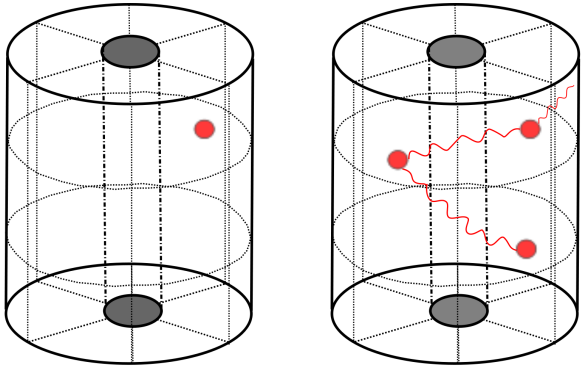
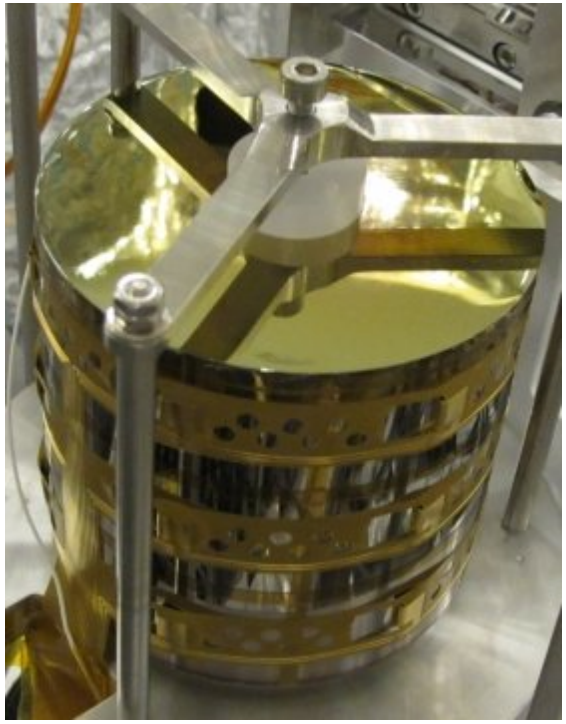
  - HPGe Detector Research - Focus:
    Segmented Detectors, Volume and Surface Effects
  - Ton-scale HPGe experiment studies
- People:
  - Director: Allen Caldwell
  - Group leader: Iris Abt
  - Staff: Bela Majorivits, Xiang Liu, Oliver Schulz
  - PostDocs: Dimitris Palioselitis, N.N.
  - PhD Students: Lucia Garbini, Raphael Kneissl, Heng-Ye Liao, Matteo Palermo, Laura Vanhoefer
  - Engineers / Technicians: Christopher Gooch, Hans Seitz

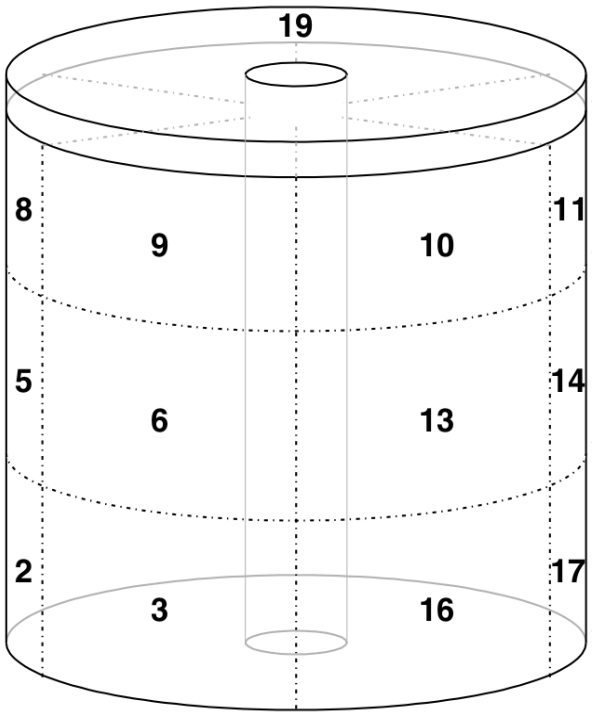
# Segmented HPGe Detectors




- Interesting both as:
  - Possible technology for a ton-scale experiment - complex, but high background suppression
  - Valuable tool to to study Ge-detector properties, both for volume and surface effects
- Years of experience with segmented coax detectors at MPP
- Since 2014 also a segmented BEGe detector

# Research Detector "Super-Siegfried"

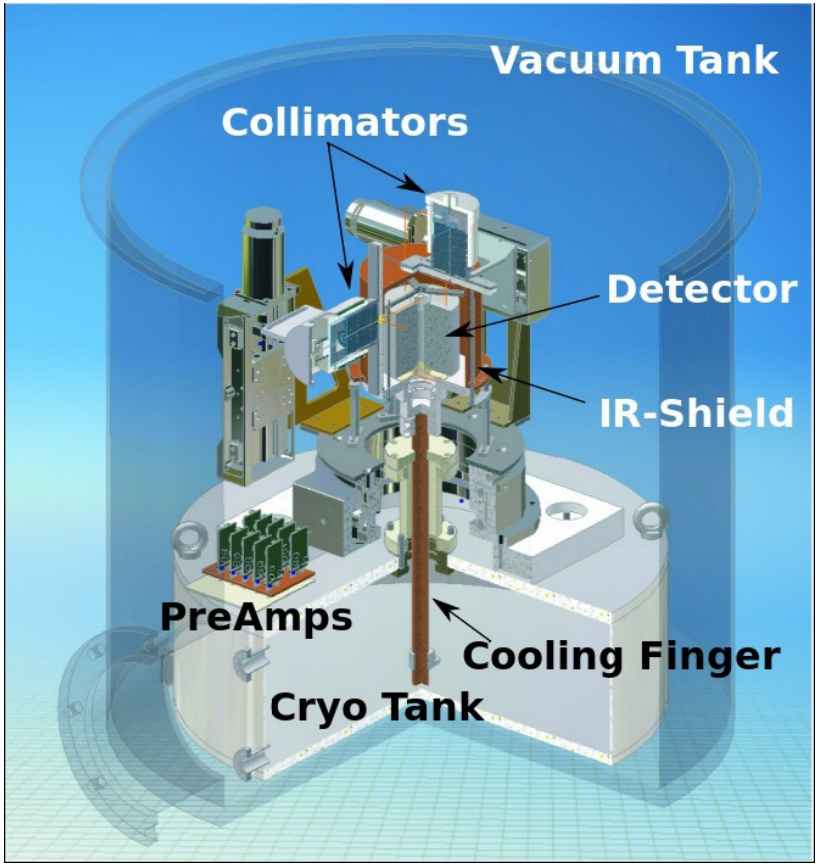





- 18-fold lateral segmentation plus top-slice segment
- Designed for study of segmentation and surface effects

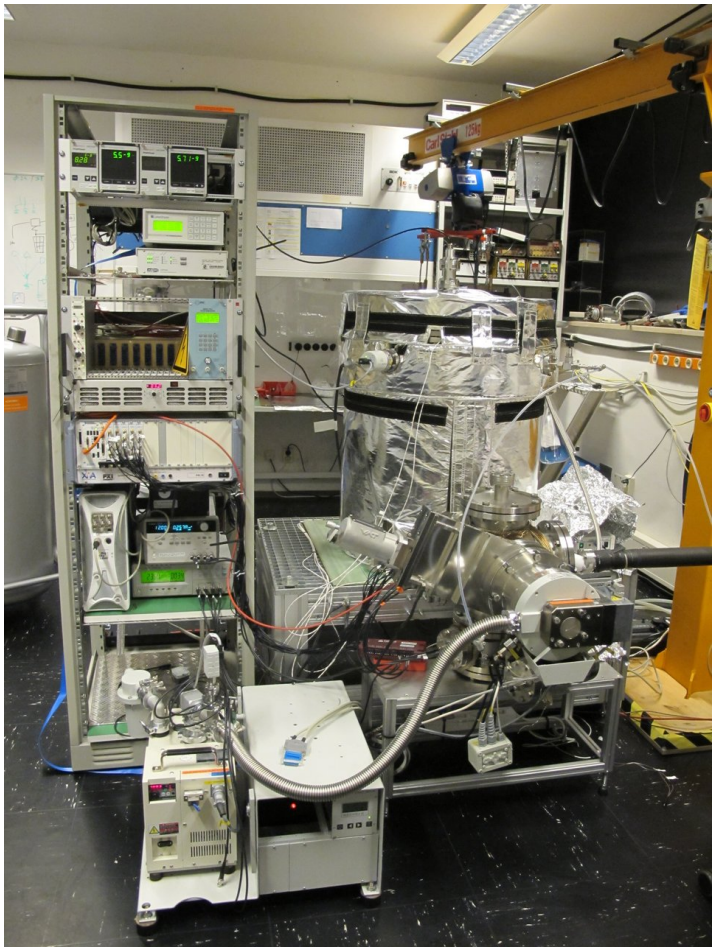
→ Talks of Lucia Garbini and Matteo Palermo (this session)

# Surface Studies: Test-Stand Galatea



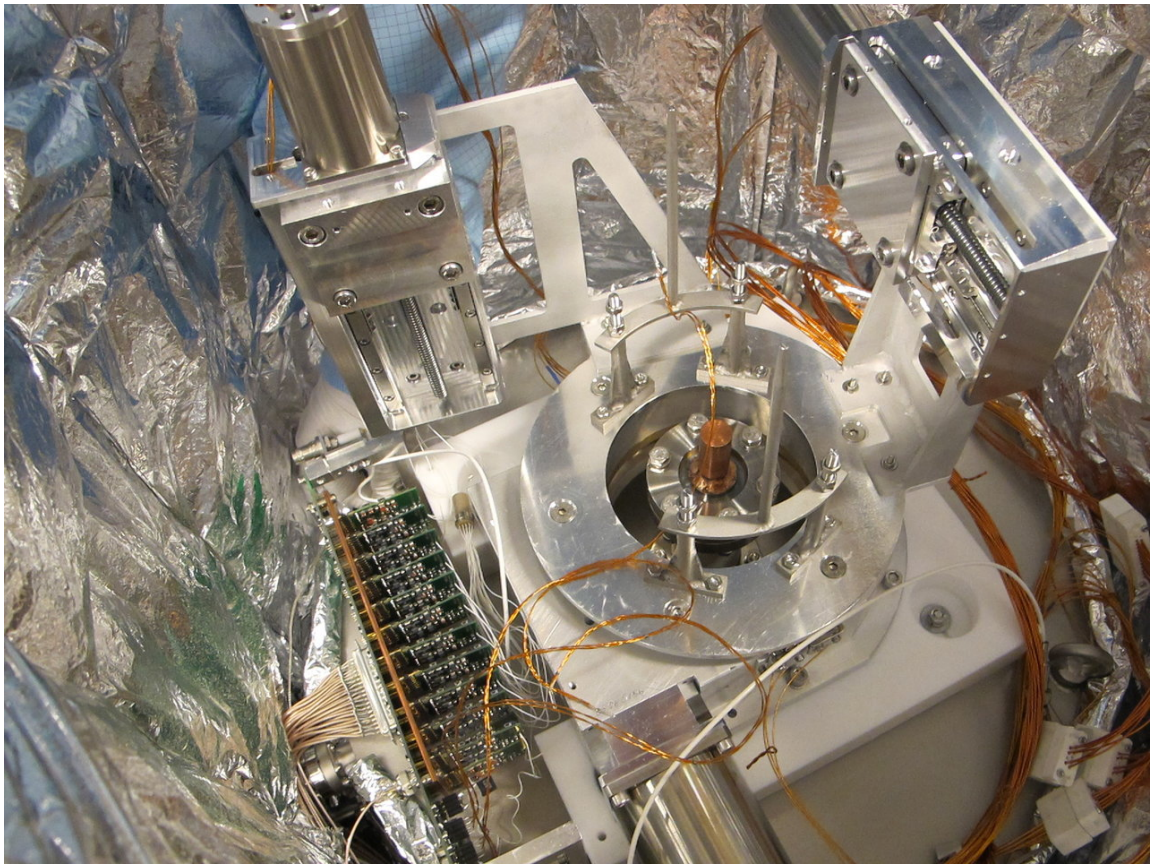

- Study of surface effects requires direct scan of detector in vacuum
- Test-Stand Galatea: Built for automated scan of side & top surface with alphas, betas and laser

# Test-Stand Galatea



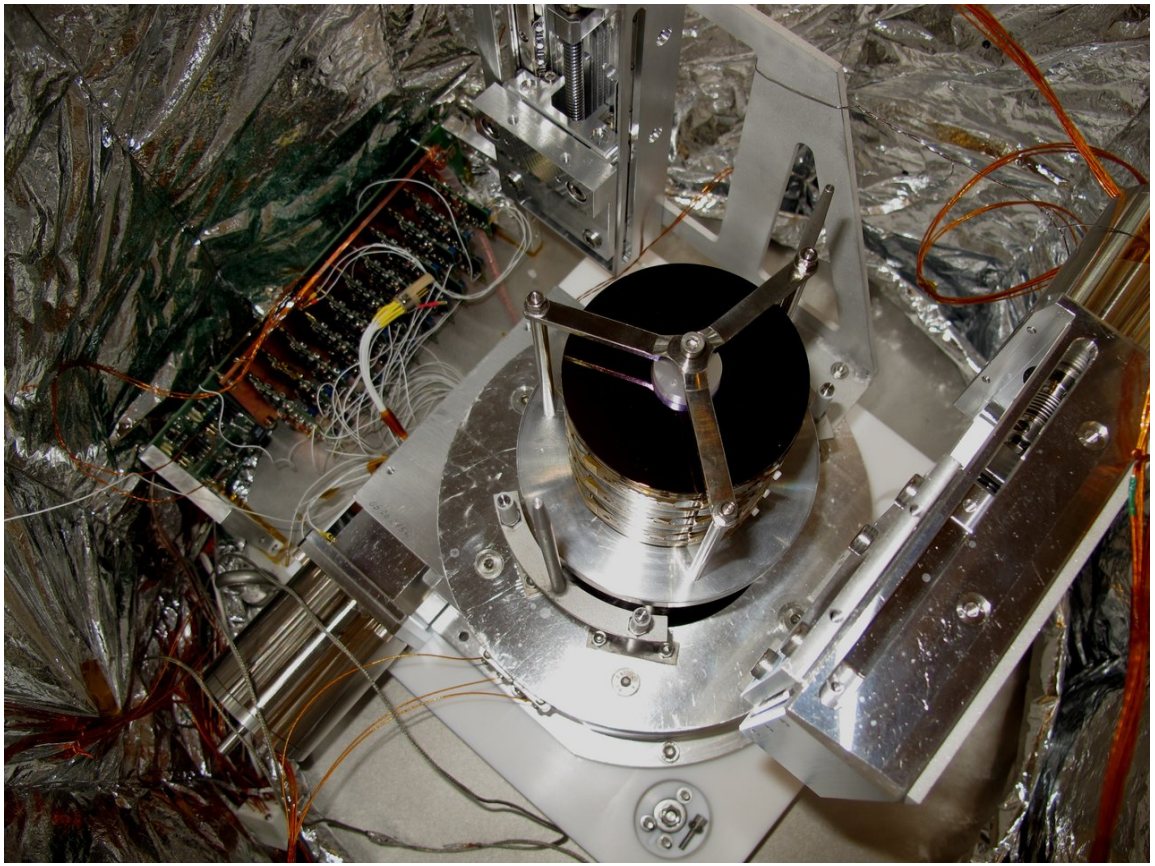
- High-power turbo pump
- Bake-out system
- Continuous monitoring of all operational parameters
- Excellent vacuum quality:
  $10^{-}7$ mbar warm,
  $10^{-}9$ mbar cold,
  $10^{-}6$ mbar cold *stable with pumps off*
  $\rightarrow$ no microphonics problems
- Laminar-flow box for detector handling

# Test-Stand Galatea



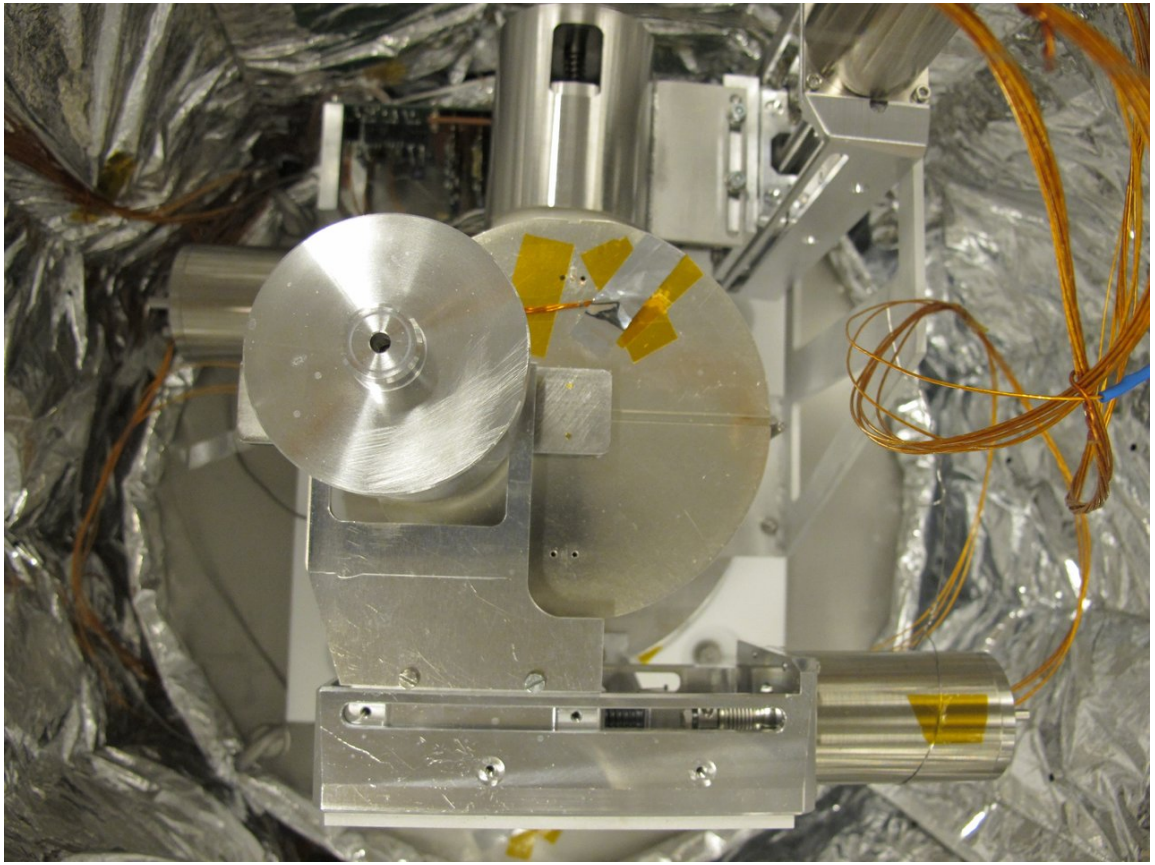
- Cooling finger and scanning stage designed to accept different types of detectors

# Test-Stand Galatea



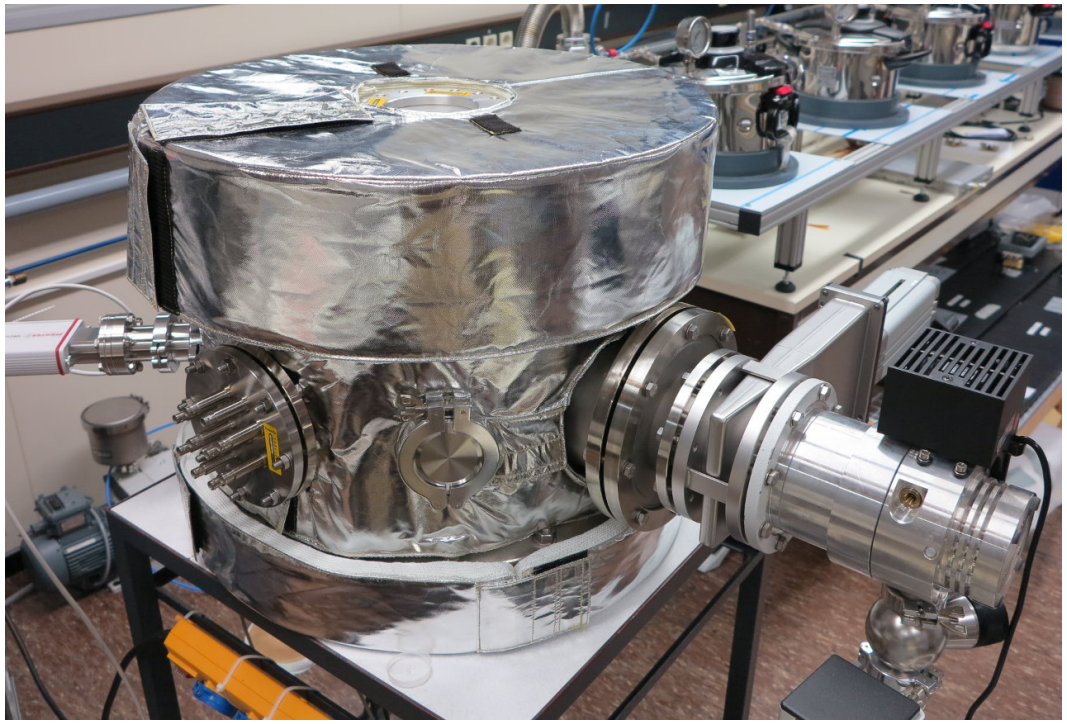
- Example: Segmented coax detector mounted in Galatea

# Test-Stand Galatea



- Collimators slide in groves of infrared shield

# Vacuum Conditioning

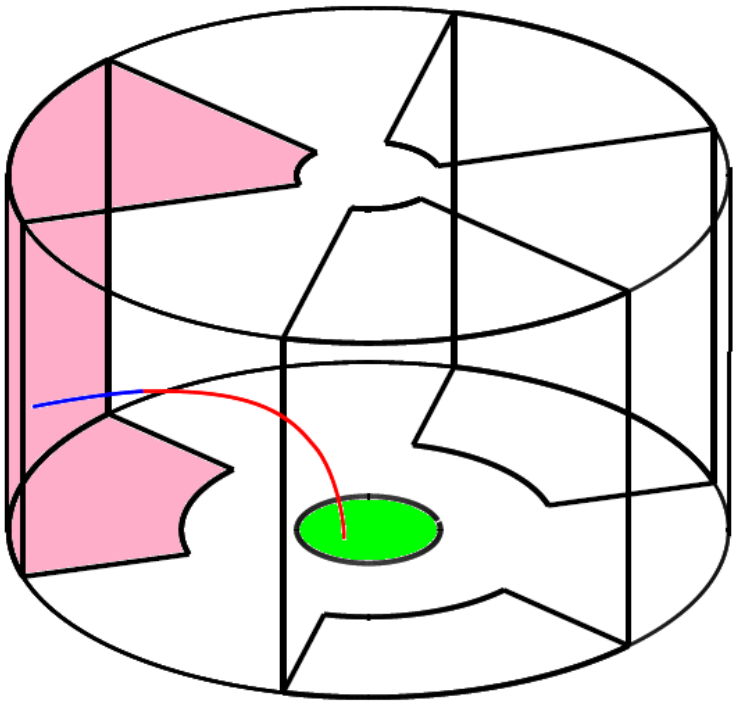


- Excellent vacuum quality in setups like Galatea requires thorough conditioning of new components
- Large vacuum tank with bake-out system (max. 150 °C), turbo-pump, shutter and vacuum quality monitoring

# Detector Storage

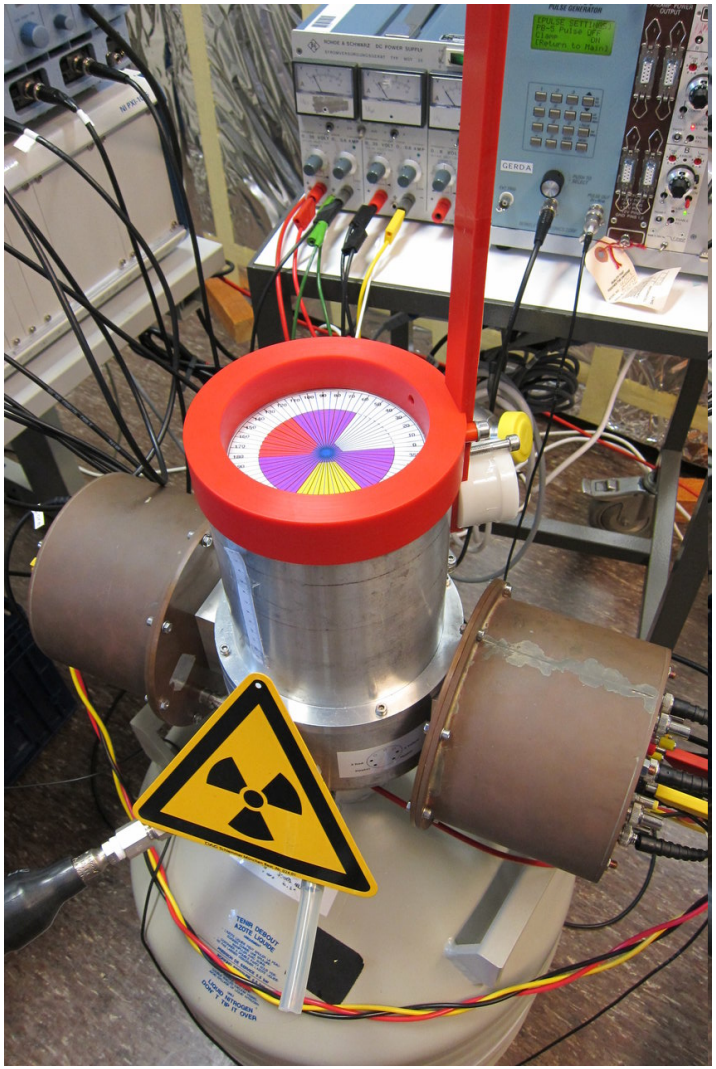
- Working with multiple bare detectors requires dedicated storage and transport solution
- Storage containers: Converted pressure cookers
  $\rightarrow$ pressure tight, fast access, car transport holder
- Detectors stored in vacuum, emergency $LN_2$ flushing

# New Detector Design: Segmented BEGe



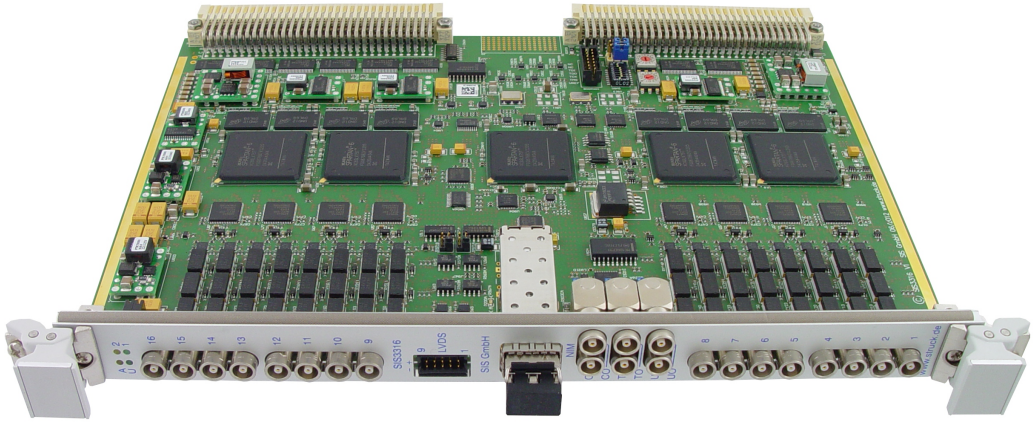
- Designed new segmented BEGe detector (with Canberra France)
- Detector delivered in 2014, very promising results
  → Talks of Heng-Ye Liao and Xiang Liu (tomorrow)

# Detector Volume Studies: Test-Stand K1



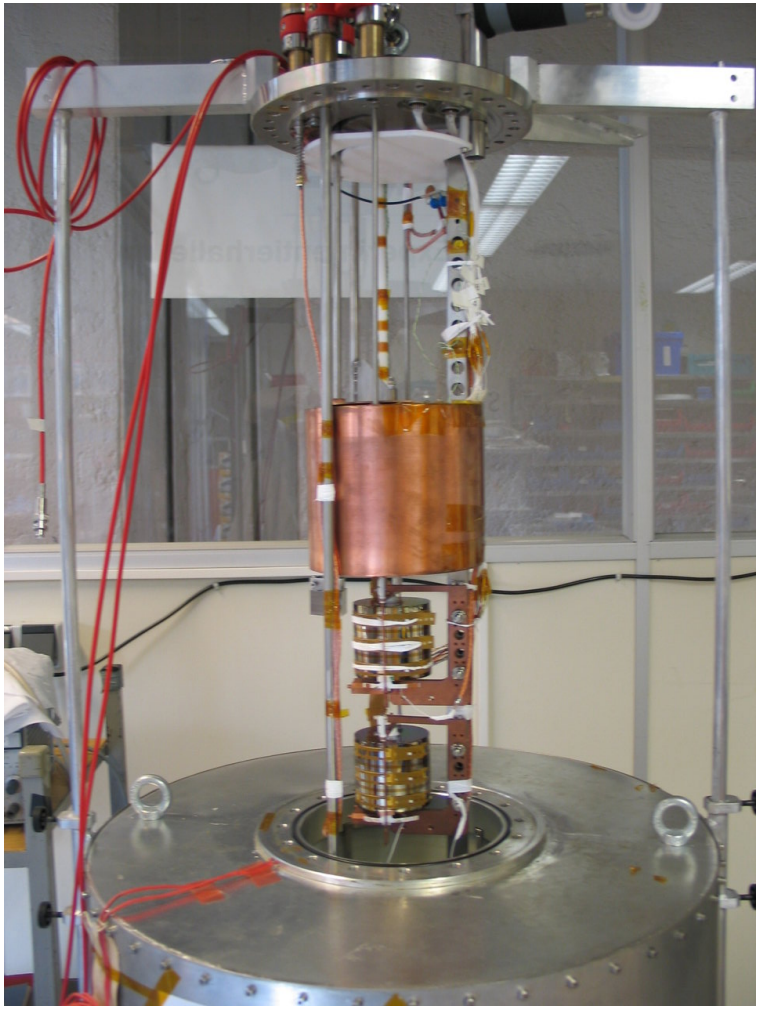
- Test-Cryostat K1 can accept different types of multi-channel HPGe detectors
- Scans with radioactive sources from top and sides (manual, but precise)
- Currently used to study pulse shapes of segmented BEGe detector

# Radioactive Sources and DAQ

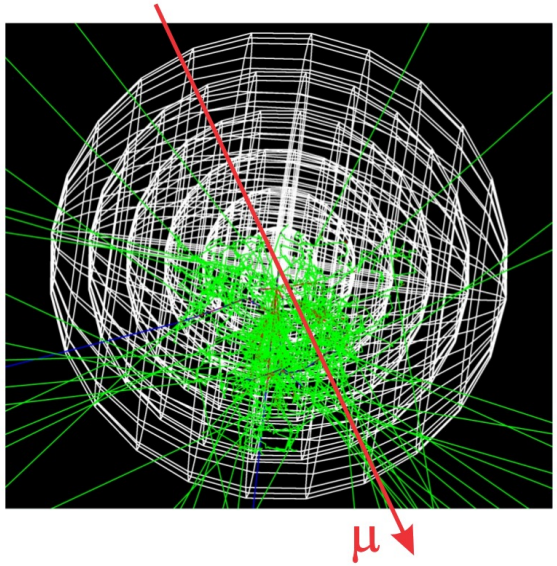
- Broad range of radioactive sources at MPP
- AmBe neutron source available on site
- New DAQ systems: Struck SIS3316 (250 MHz, 14 bit, 16 channels per device, Ethernet), can record very long traces

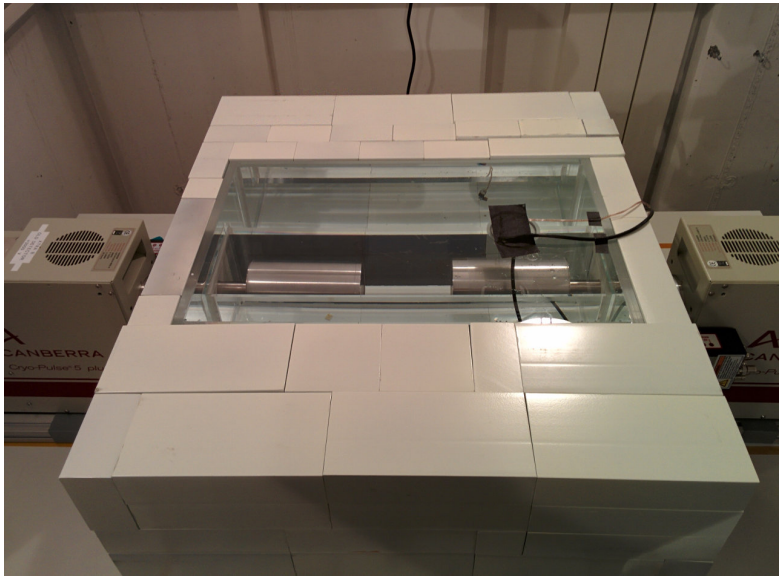
# Detector Operation in Cryo-Liquids



- Test-stand Gerdalinchen-II: Simultaneous operation of up to three segmented detectors in $\mathrm{LAr}$ or $\mathrm{LN}_2$

# Cosmic Background Studies



- $\mu$ and $\nu$ induced backgrounds very important at ton-scale, even at deepest locations
- Monte-Carlo studies of $\mu/\nu$-induced showers in rock and shielding materials
- Neutron production measurements: MINIDEX Experiment $\rightarrow$ Talk of Matteo Palermo (tomorrow)

# Summary

- Study of HPGe detector properties, volume and surface
- Detector design, recently segmented BEGe (with Canberra)
- Simulations and measurements for ton-scale experiments
- Detailed talks (in order):
  Lucia Garbini and Matteo Palermo (this session),
  Heng-Ye Liao, Xiang Liu and Matteo Palermo (tomorrow)