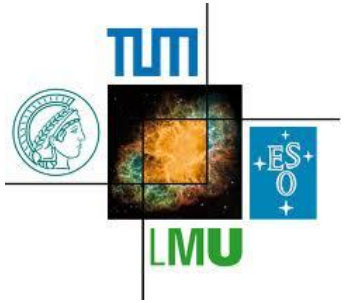
BEGe detector response to α-radiation near its p^+ electrode

Matteo Agostini, Marik Barnabé-Heider, Tobias Bode, Dušan Budjáš, Andrea Lazzaro and Stefan Schönert

for the GERDA collaboration

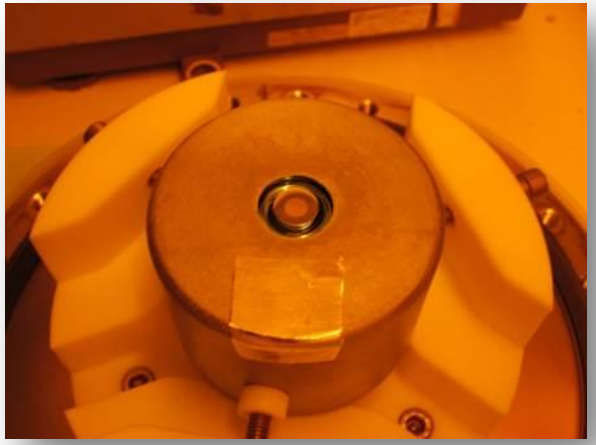


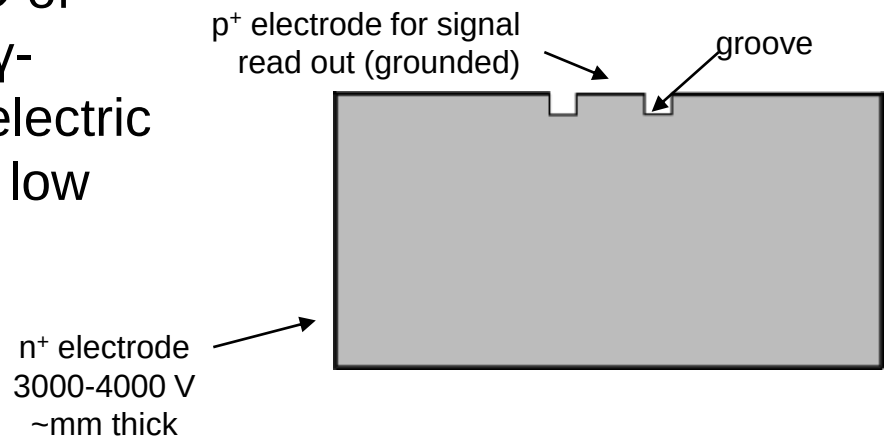
Outline

- Introduction to Broad Energy Germanium (BEGe) detectors and radioactive backgrounds
- The α-scanning setup TUBE
- First results
- Conclusion

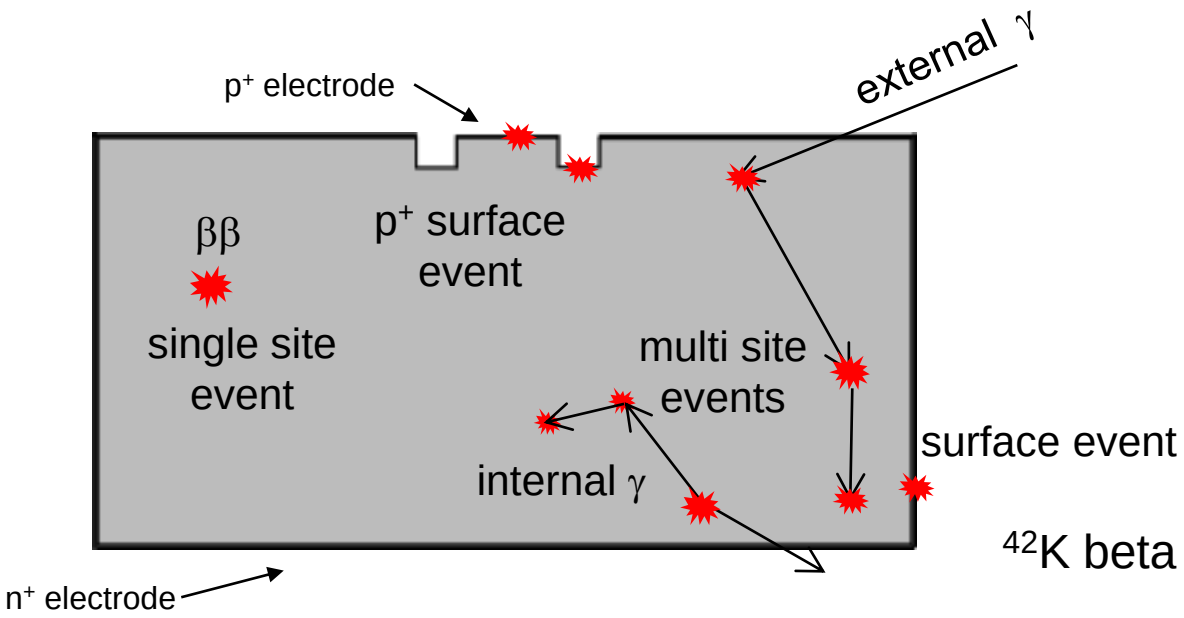
GERDA phase II

- Background index aim:
  < 0.001 cts/(keV·kg·y)
- Employ PID
- Broad Energy Germanium detectors well suited for PID of possible backgrounds (α,β,γ-radiation) due to favorable electric field configuration (shape & low electrically active impurity concentration)





Pulse shapes of different event topologies



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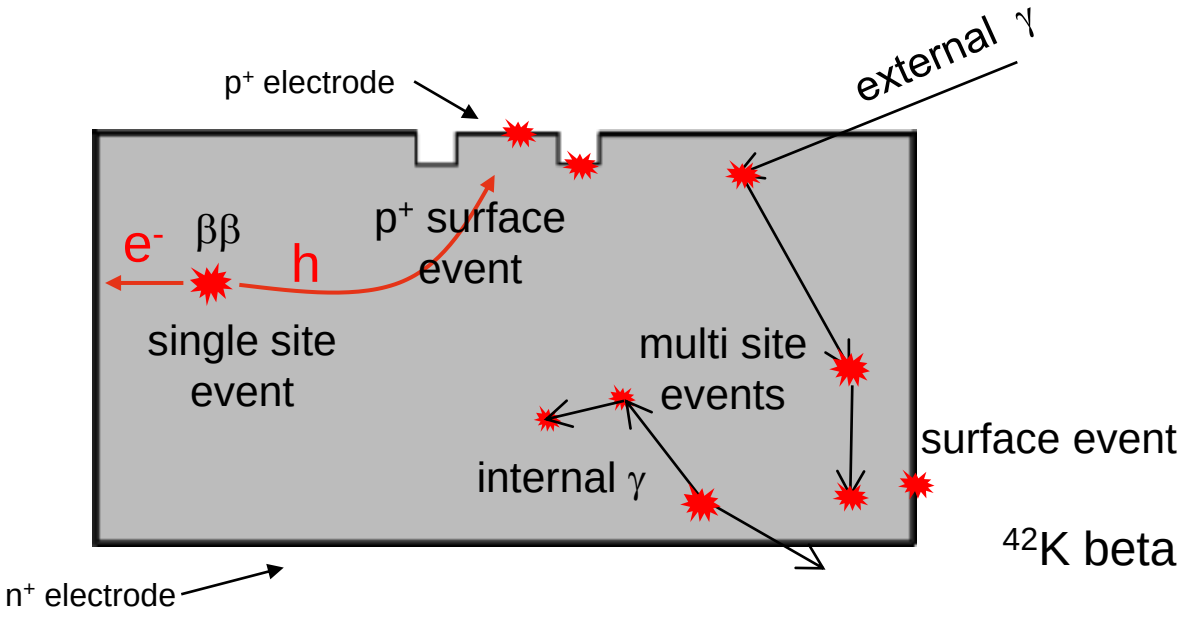

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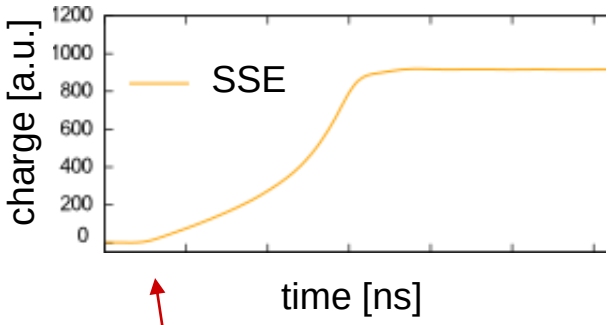

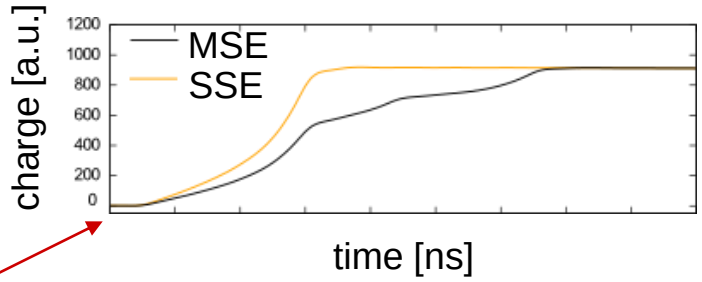

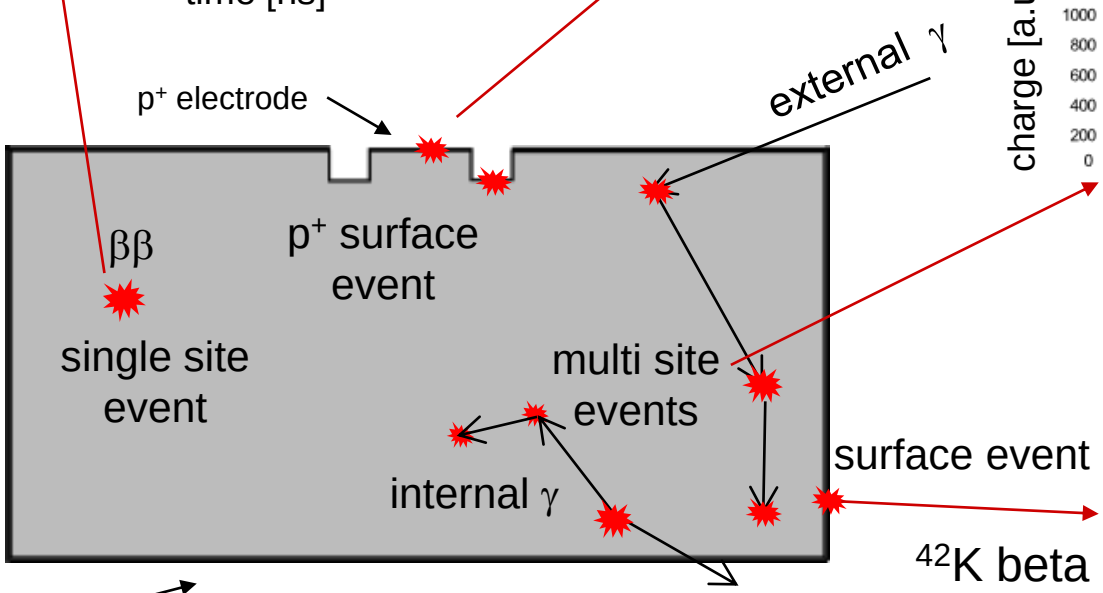

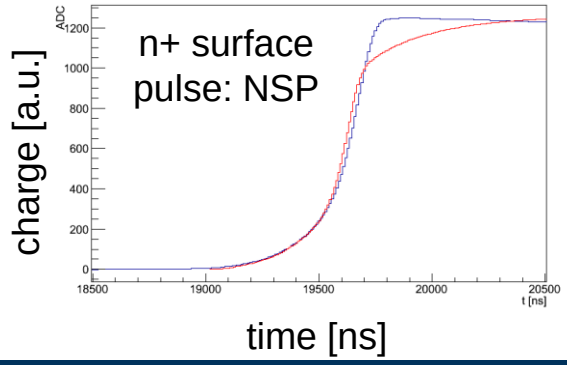

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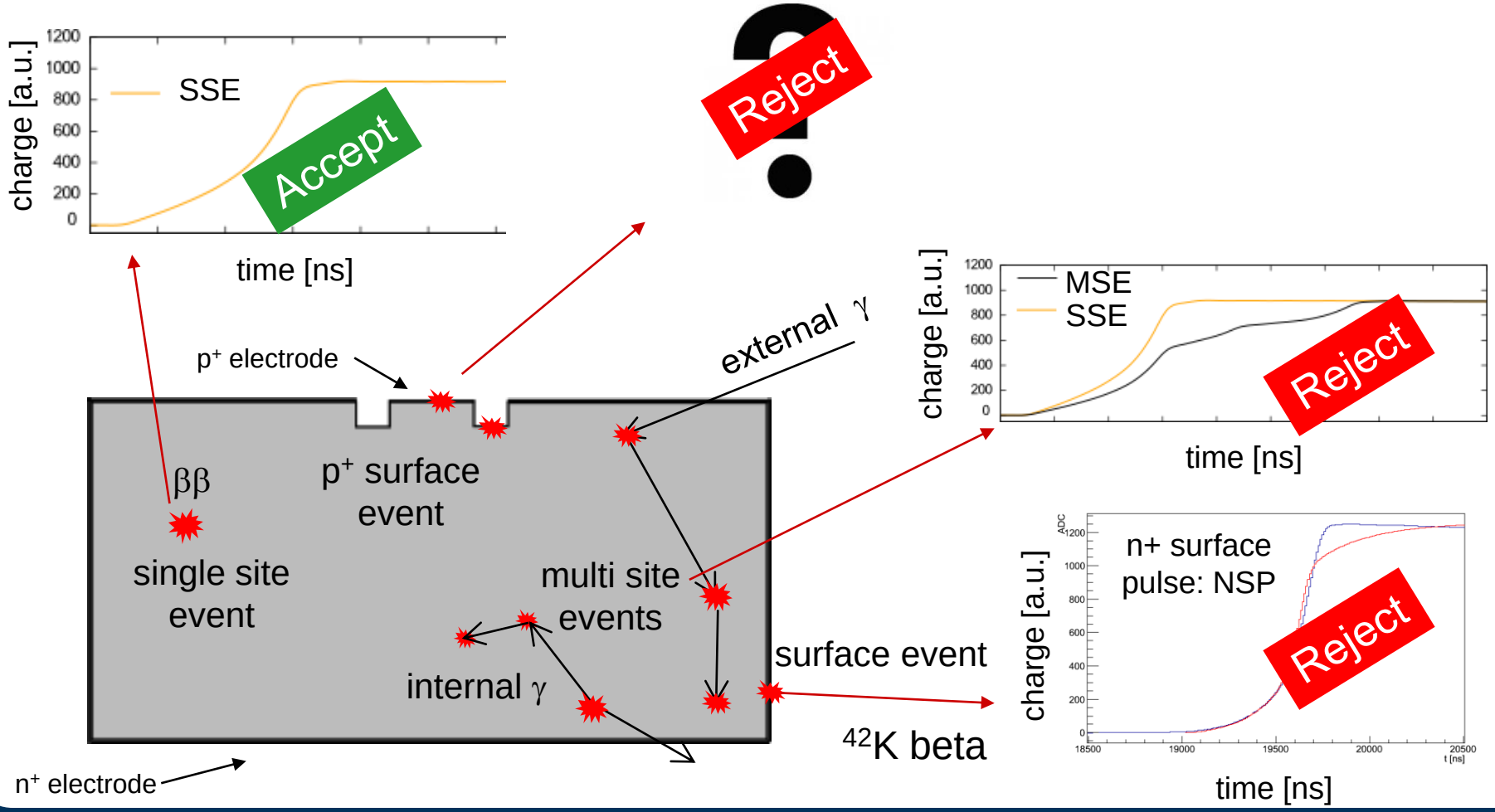

Pulse shape disrcimination work so far

- Multiple site events treated by D. Budjaš et. al (JINST, 4 (2009) P10007) & M. Agostini et. al (JINST, 6 (2011) P03005
- n^+ surface events
- Study of p^+ and groove events: this talk

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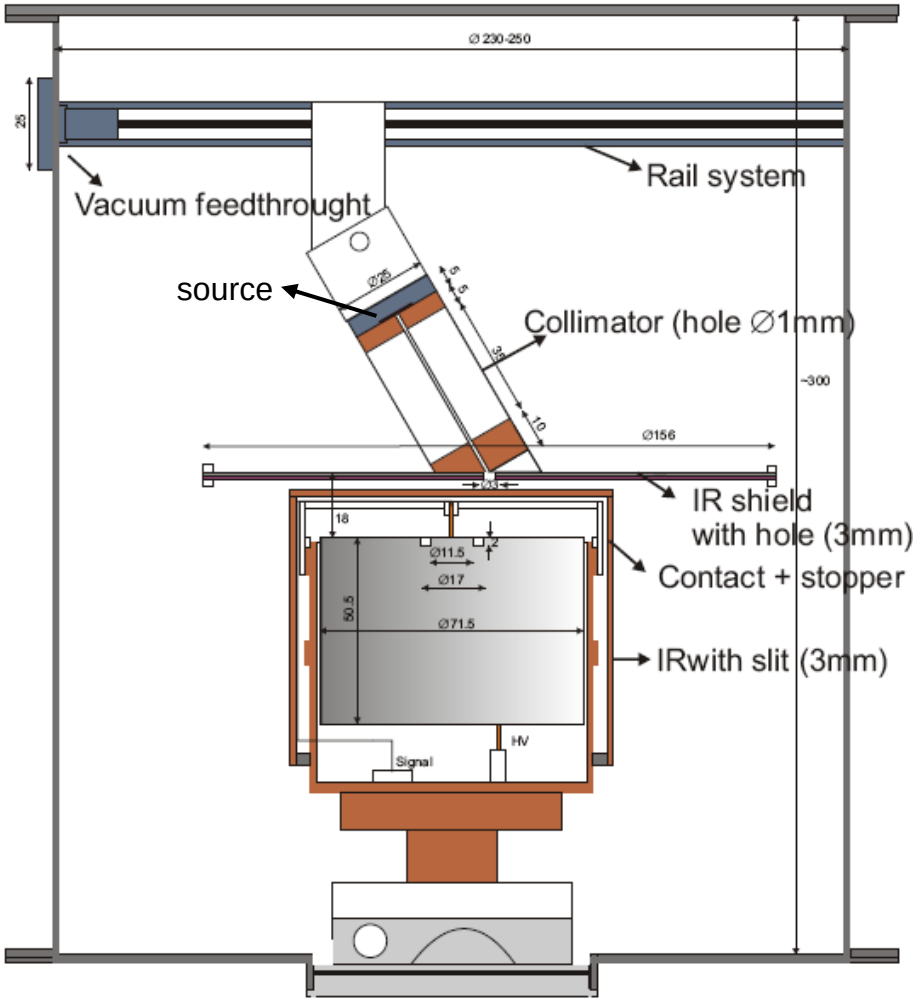
- Study of p^+ and groove events: this talk
- Critical surface events only by α- and β-particles
- Phase I α-background index: 10^{-3} cts/(keV kg y)
- Potentially harmful for aim of phase II
- Behaviour of α-particles incident on p^+ and groove region not studied before

Dedicated setup for scanning the p^+ & groove region

Scanning setup TUBE (TUM Up-side down BEGe)

- Study needs data sample rich in p^+ & groove events
- → collimated beam of α-particles (Am-241)



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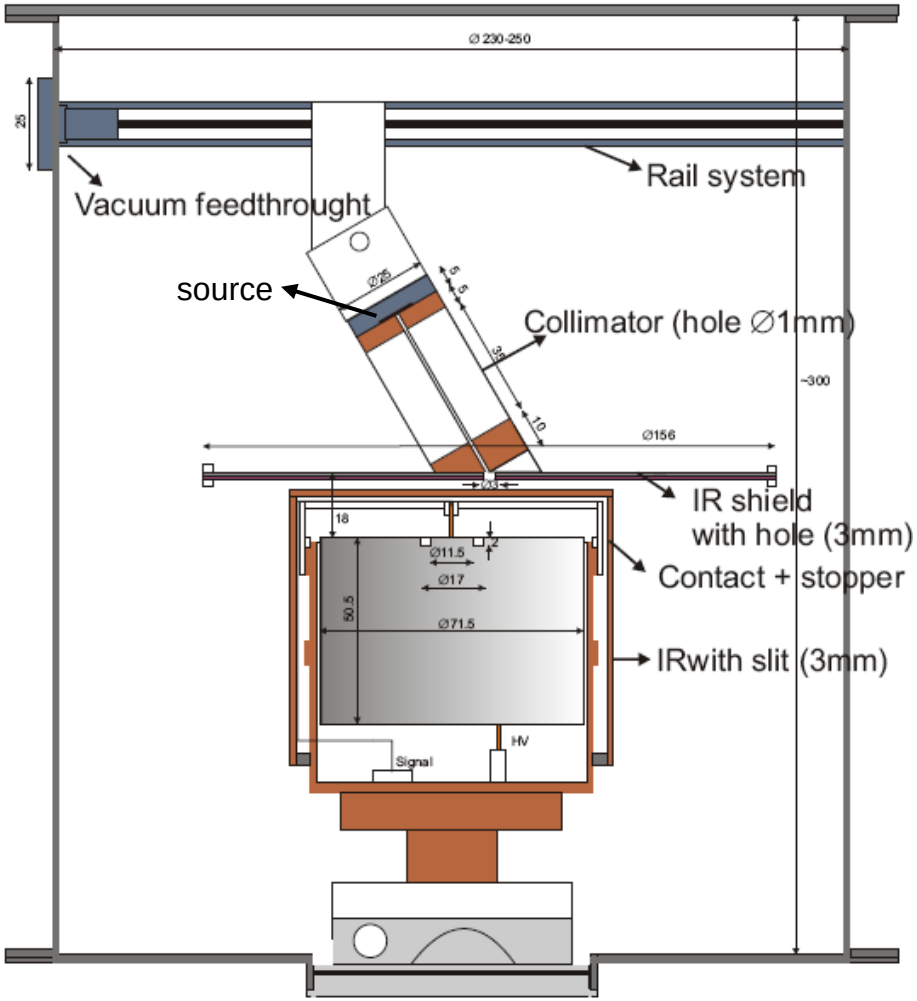
- In common vacuum cryostat p^+ contact shielded by holder
- For movable collimator large vacuum tube neccessary



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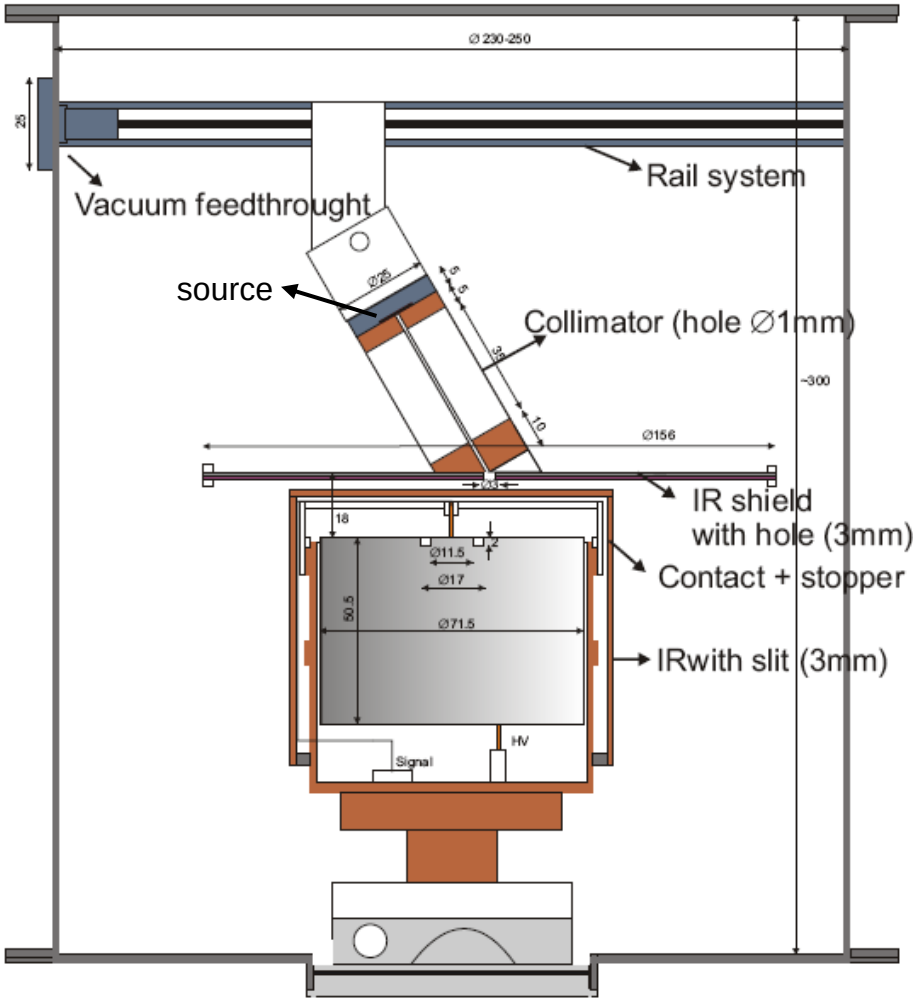
- Read out via commercial electronics
- Offline analysis of raw data from FADC



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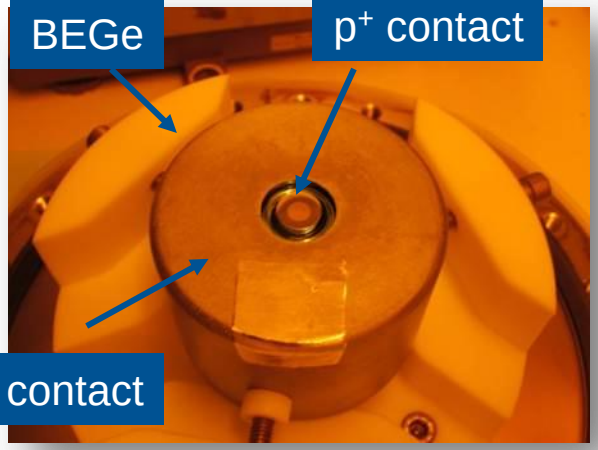
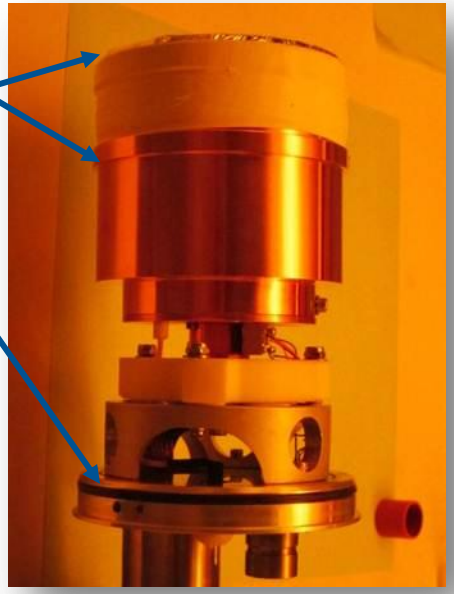
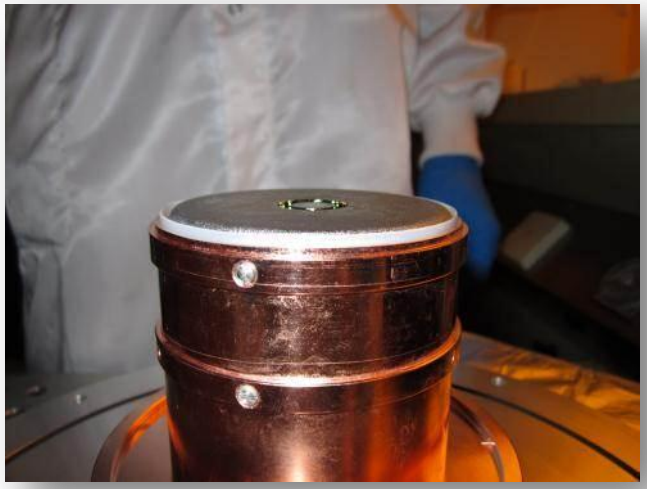
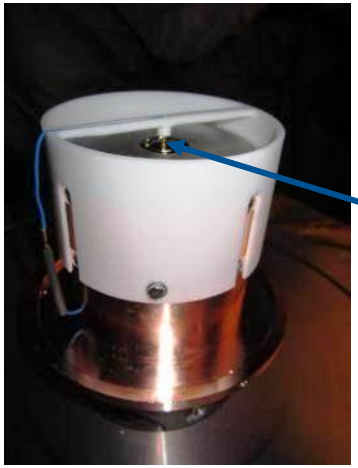


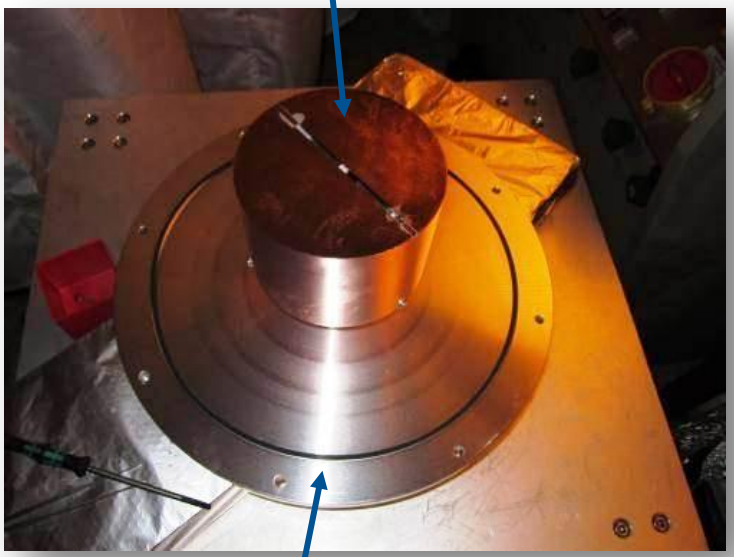






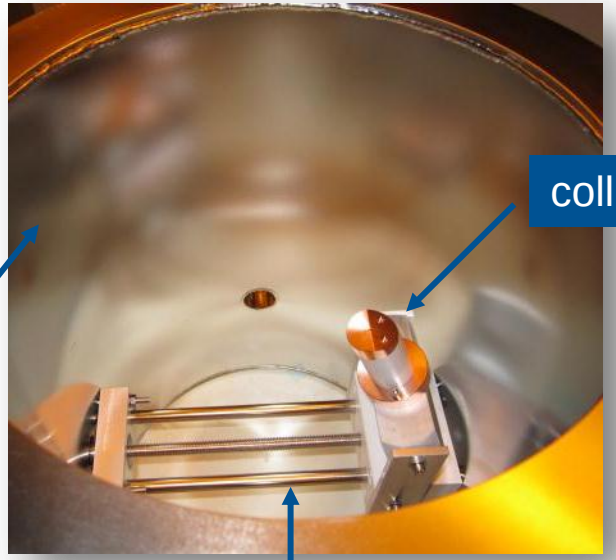
Scanning setup TUBE (TUM Up-side down BEGe)

„custom“ IR shield with slit



„new“ vacuum flange

vacuum tube



collimator

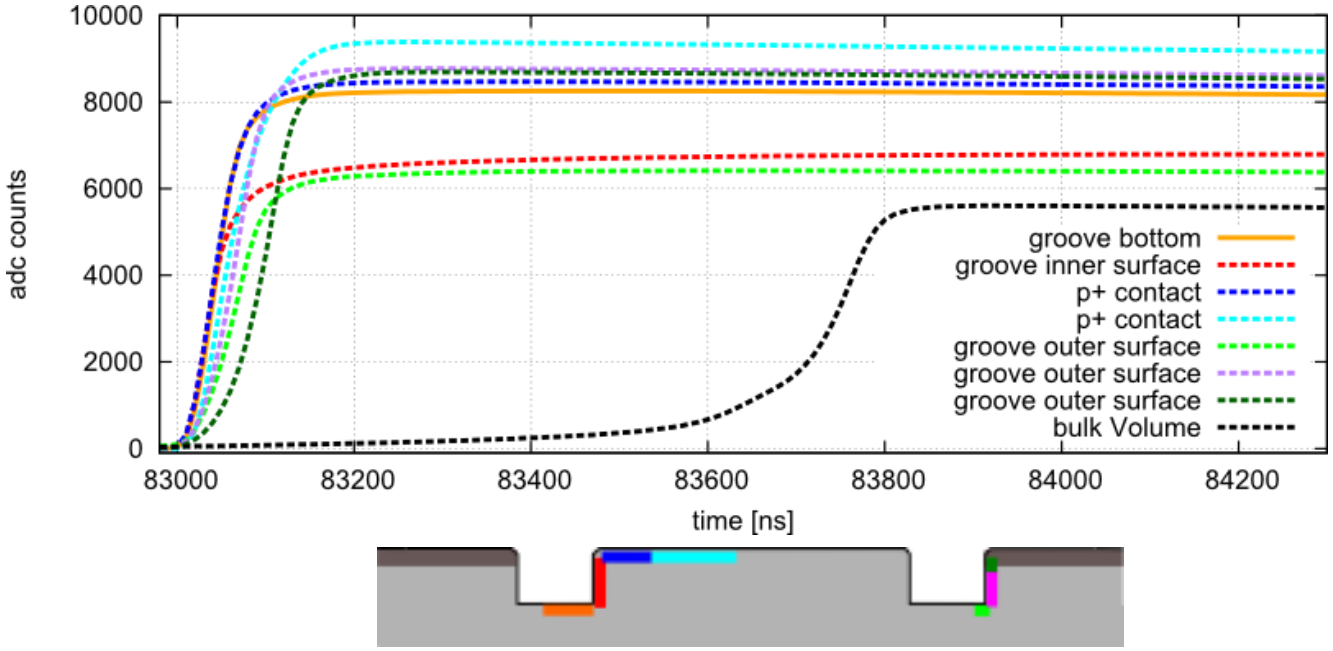
rail system

The TUBE build up in the Underground Laboratory at TUM

Complete setup with lead shield and muon veto panel

Results of scanning the p^+ & groove region

- With small collimated α-beam a very accurate scan of the p^+ & groove region was possible
- Signals can be easily discriminated (rise time etc..)
- Suppression factor of ≥ 10
- No unexpected behaviour seen



Conclusion and outlook

- Current α -background index of 10^{-3} cts/(keV kg y) potentially harmful for GERDA phase II
- Pulse shapes of α-particles in BEGe‘s never studied before
- Dedicated setup needed
- Model of signal formation (M.Agostini et.al) verified

- With achieved suppression factor > 10, α-backgrounds are within specifications of GERDA phase II
- Use another BEGe
- Use β-source