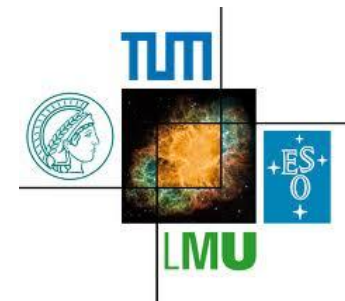


BEGe detector response to α -radiation near its p^+ electrode

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

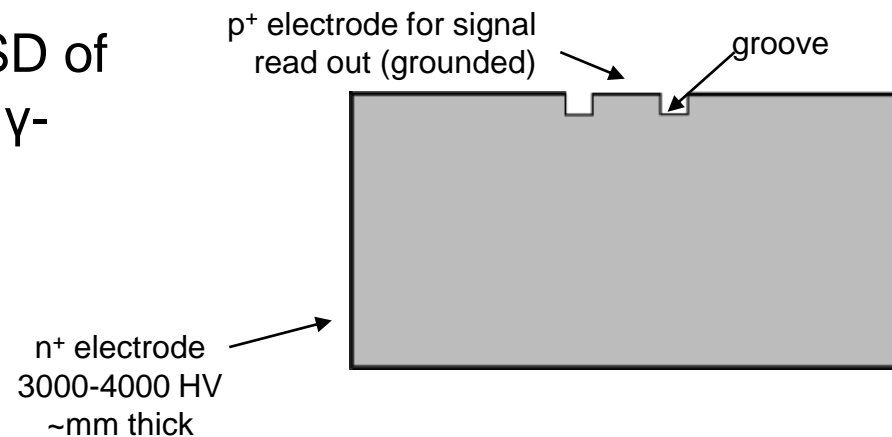
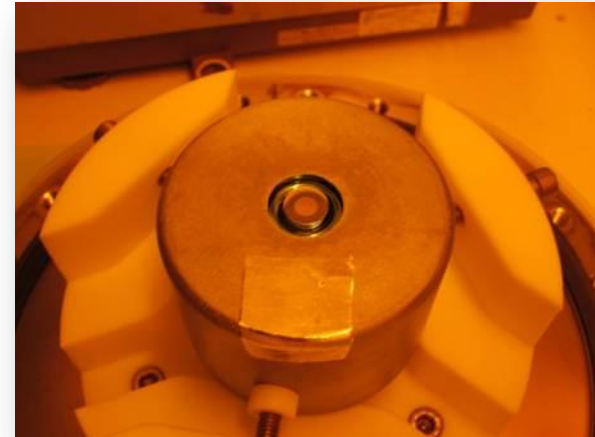


Outline

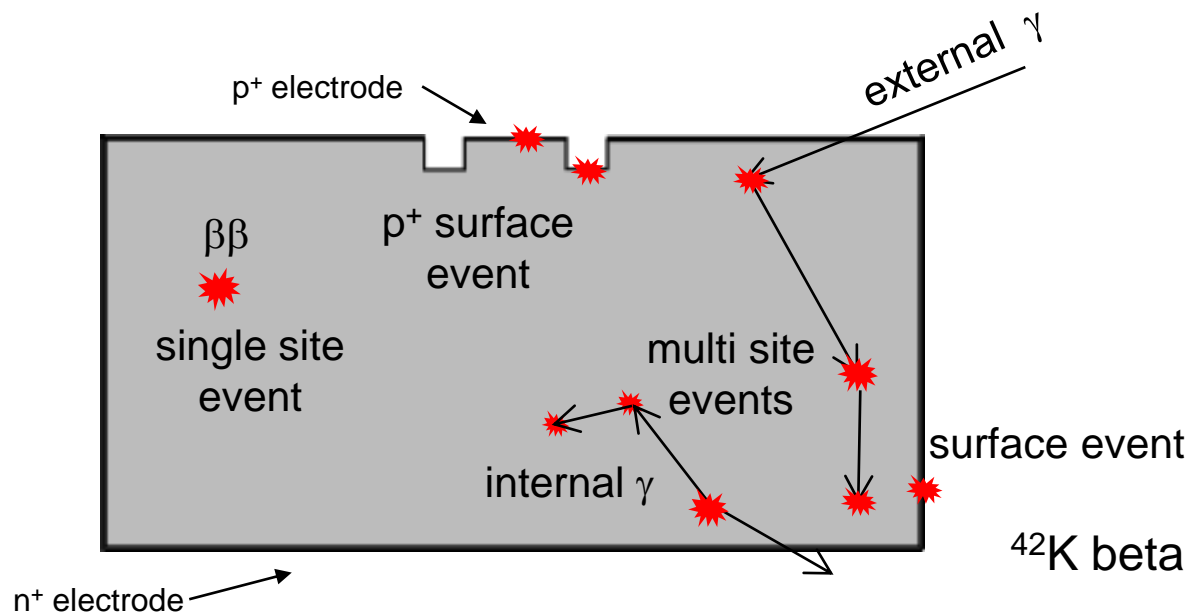
- Introduction to Broad Energy Germanium (BEGe) detectors and radioactive backgrounds
- The α -scanning setup TUBE
- First results
- Conclusion

GERDA phase II

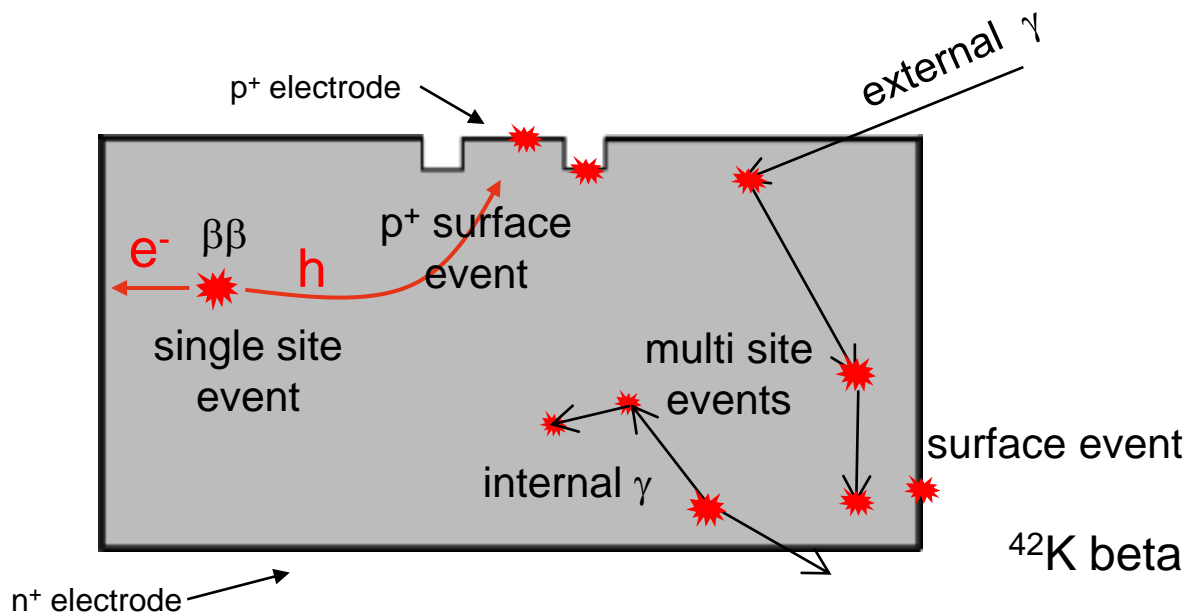
- Background index aim:
 $< 0.001 \text{ cts}/(\text{keV}\cdot\text{kg}\cdot\text{y})$
- Employ Pulse Shape Discrimination (PSD)
- Broad Energy Germanium detectors well suited for PSD of possible backgrounds (α, β, γ -radiation)



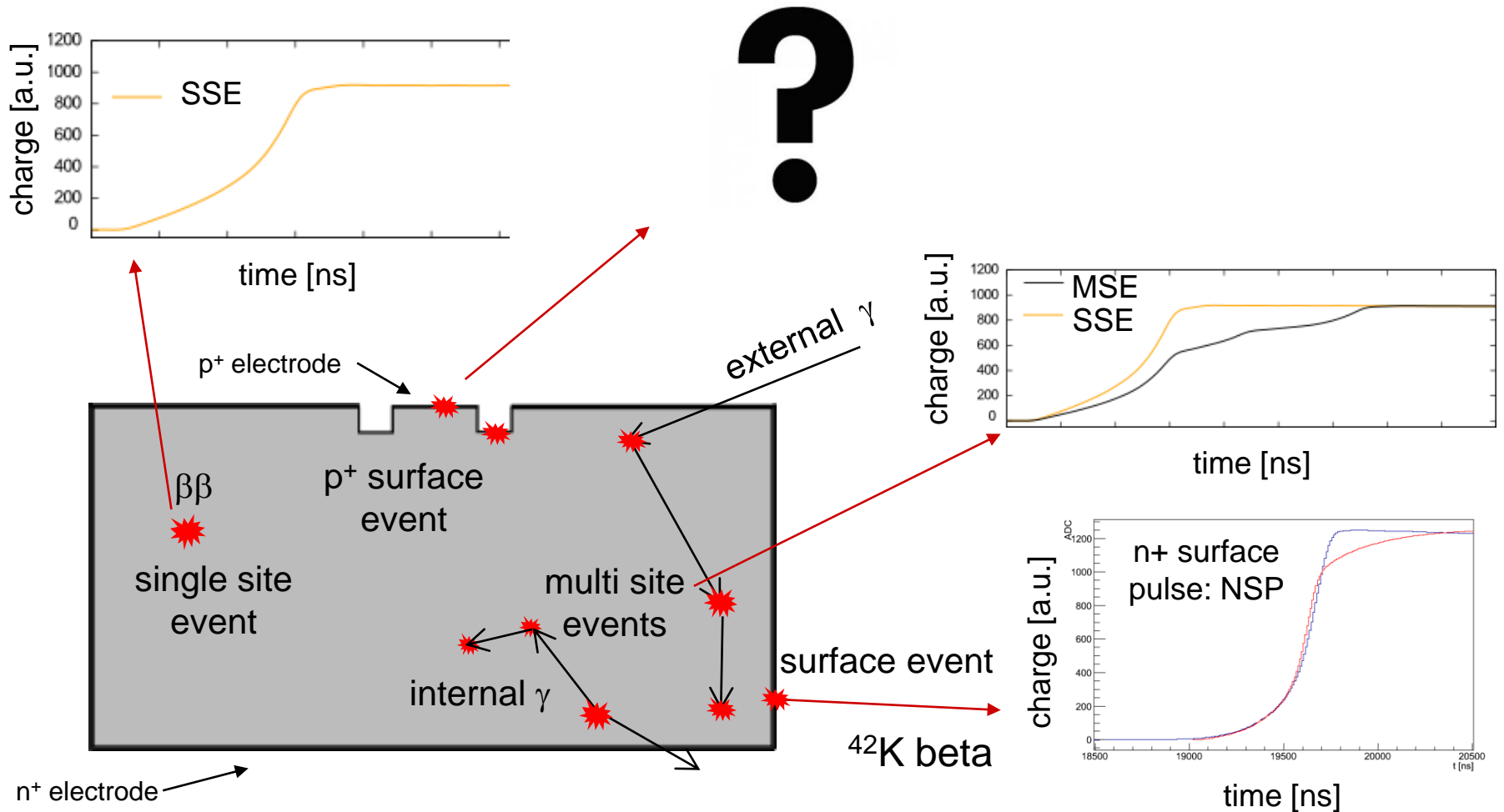
Pulse shapes of different event topologies



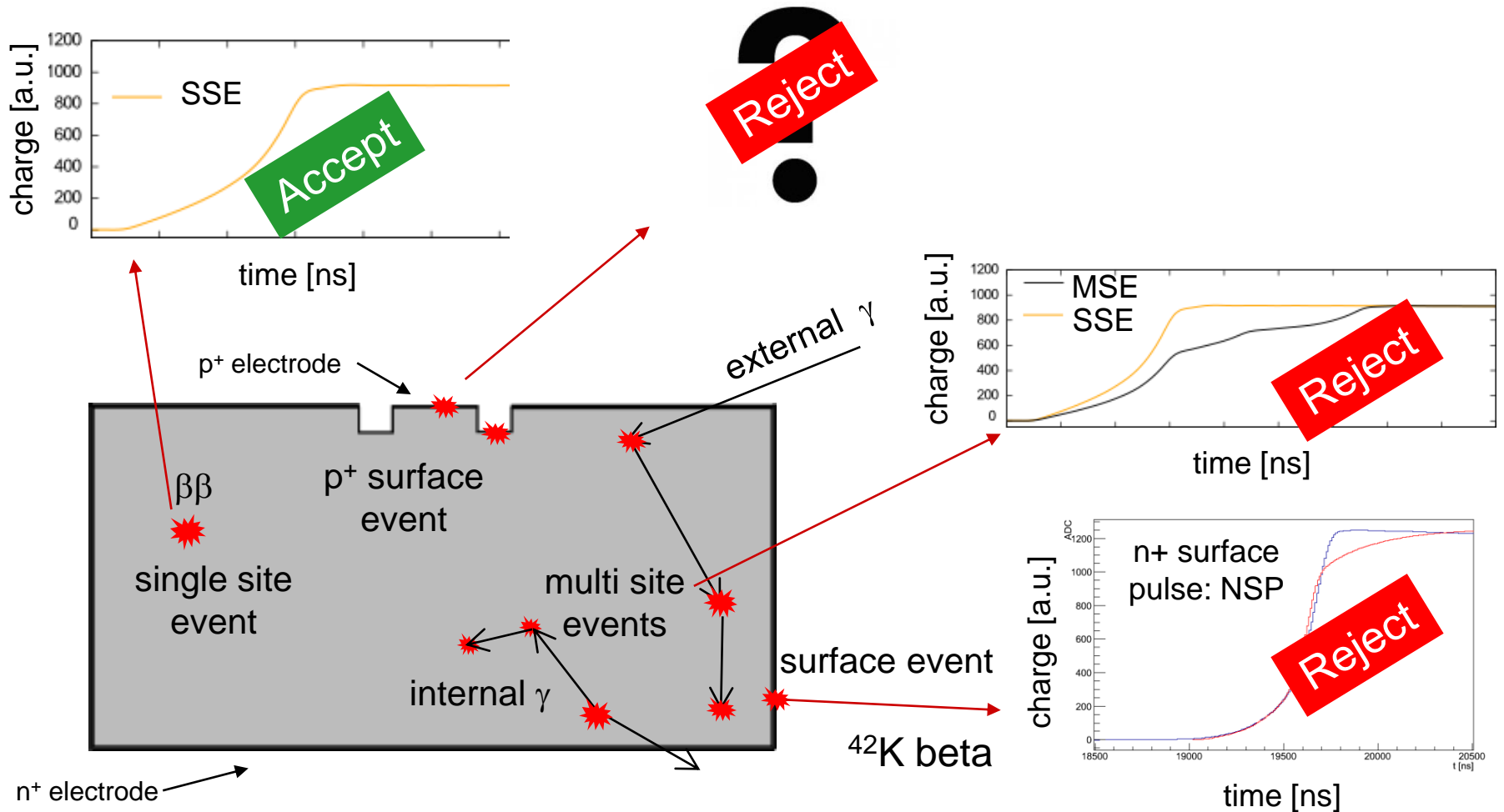
Pulse shapes of different event topologies



Pulse shapes of different event topologies



Pulse shapes of different event topologies



Pulse shape discrimination 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: talk by A. Lazzaro T113.2
- Study of p^+ and groove events: this talk

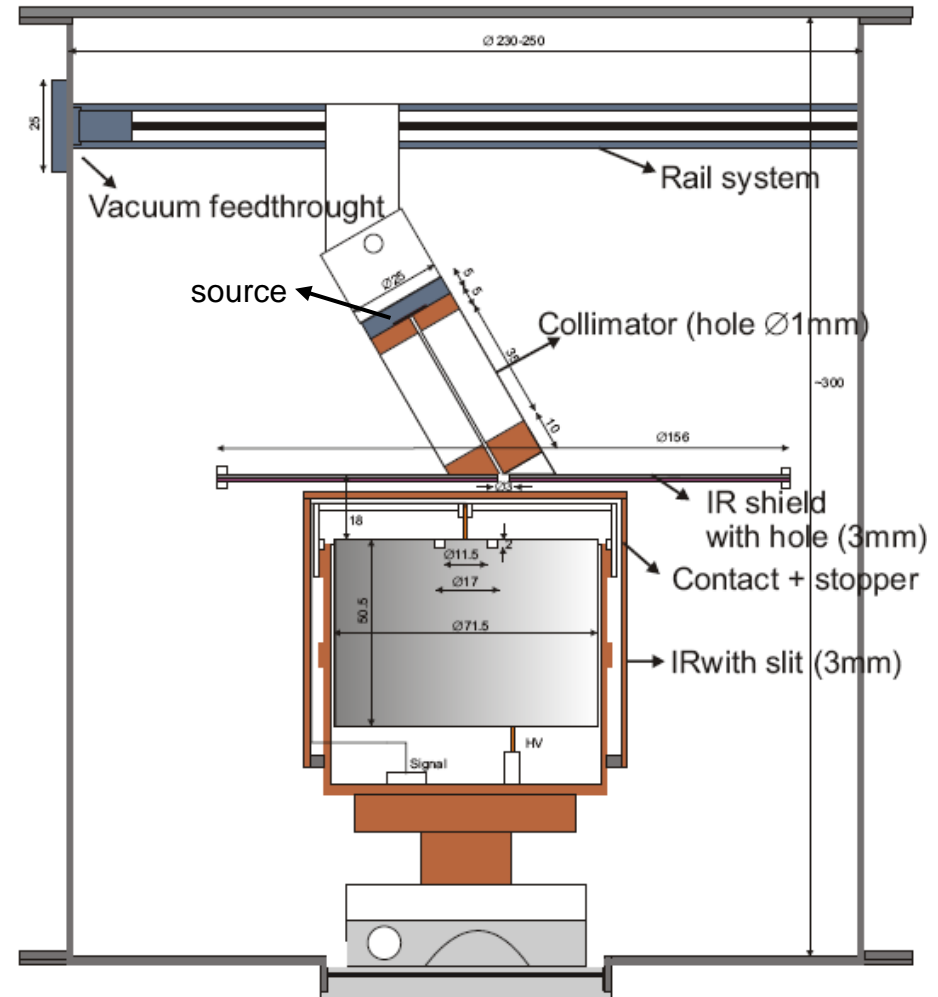
Pulse shape discrimination work so far

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- n^+ surface events: talk by A. Lazzaro T113.2
- 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) (T 109.3)
- Potentially harmful for aim of phase II
- Behaviour of α -particles not studied before

Dedicated setup for scanning the p^+ & groove region

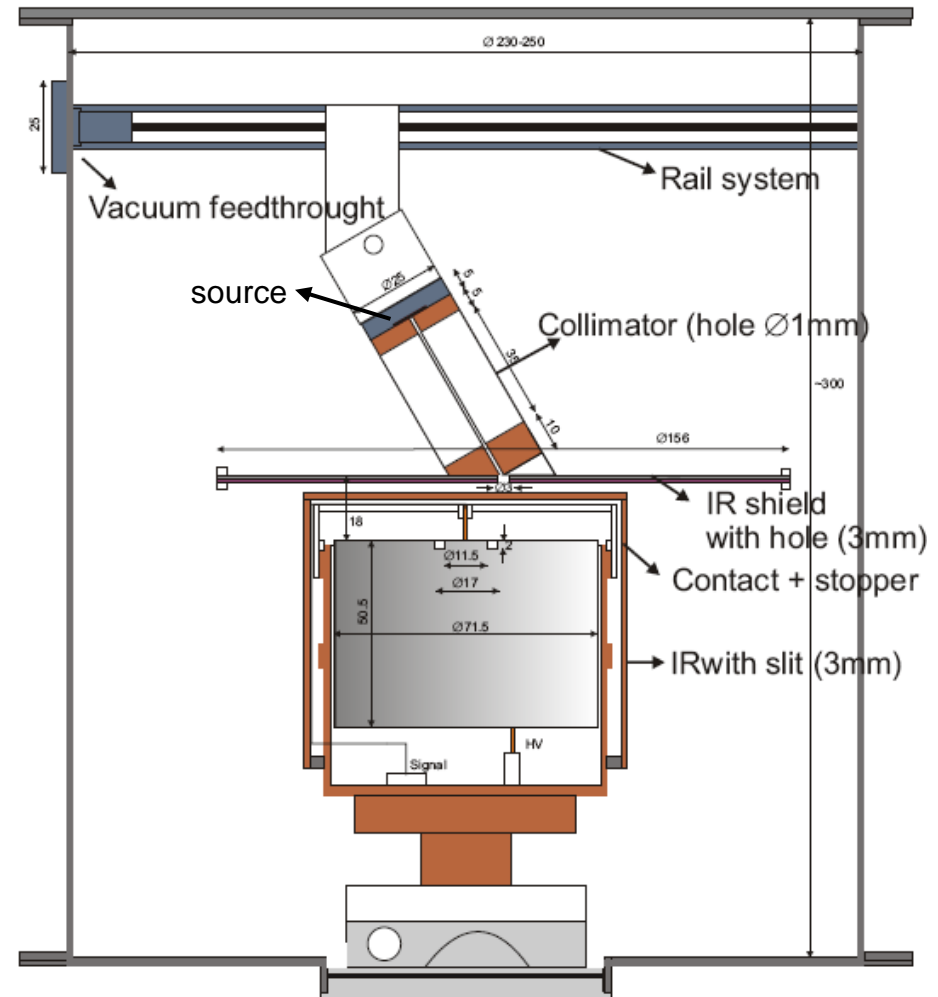
Scanning setup TUBE (TUM Up-side down BEGe)

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



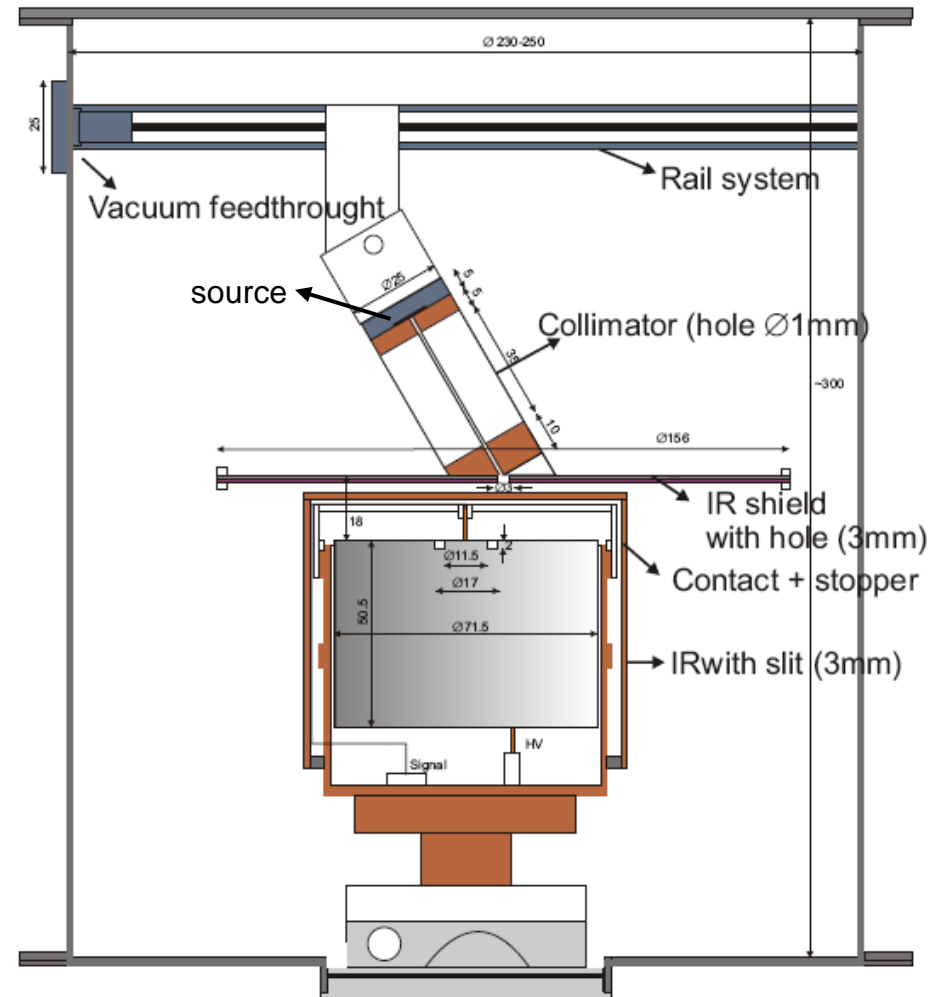
Scanning setup TUBE (TUM Up-side down BEGe)

- Study needs data sample rich in p^+ & groove events
- → collimated beam of α -particles (Am-241)
- In common vacuum cryostat p^+ contact shielded by holder
- For movable collimator large vacuum tube necessary

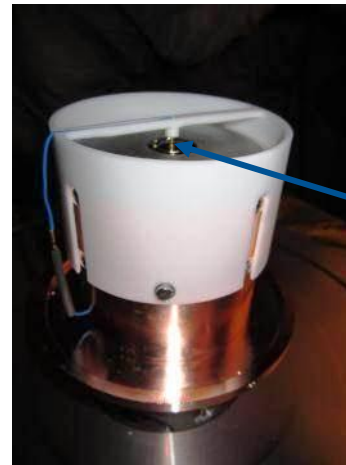
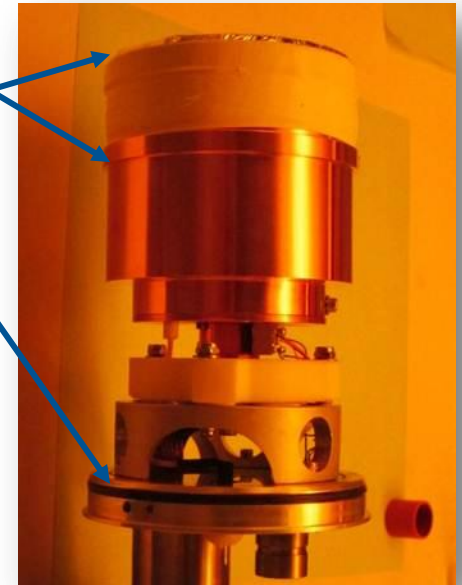
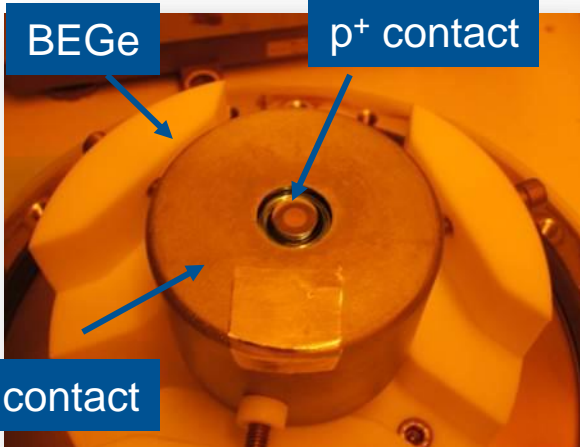


Scanning setup TUBE (TUM Up-side down BEGe)

- Study needs data sample rich in p^+ & groove events
- → collimated beam of α -particles (Am-241)
- In common vacuum cryostat p^+ contact shielded by holder
- For movable collimator large vacuum tube necessary
- Cooling power to be considered
- Two IR shields for reduction of radiative heat load

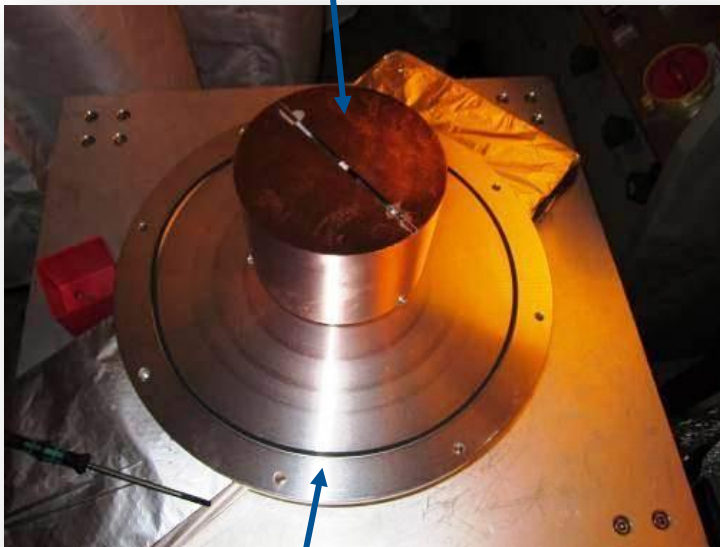


Scanning setup TUBE (TUM Up-side down BEGe)



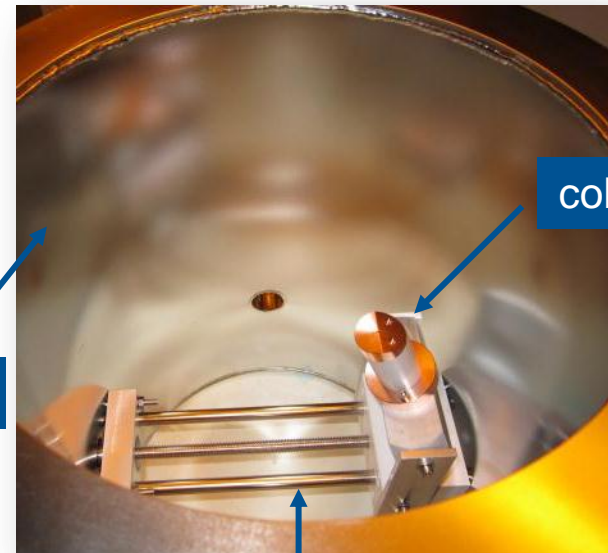
Scanning setup TUBE (TUM Up-side down BEGe)

„custom“ IR shield with slit



„new“ vacuum flange

vacuum tube



collimator

rail system

The TUBE build up in the Underground Laboratory at TUM



heater for outbaking

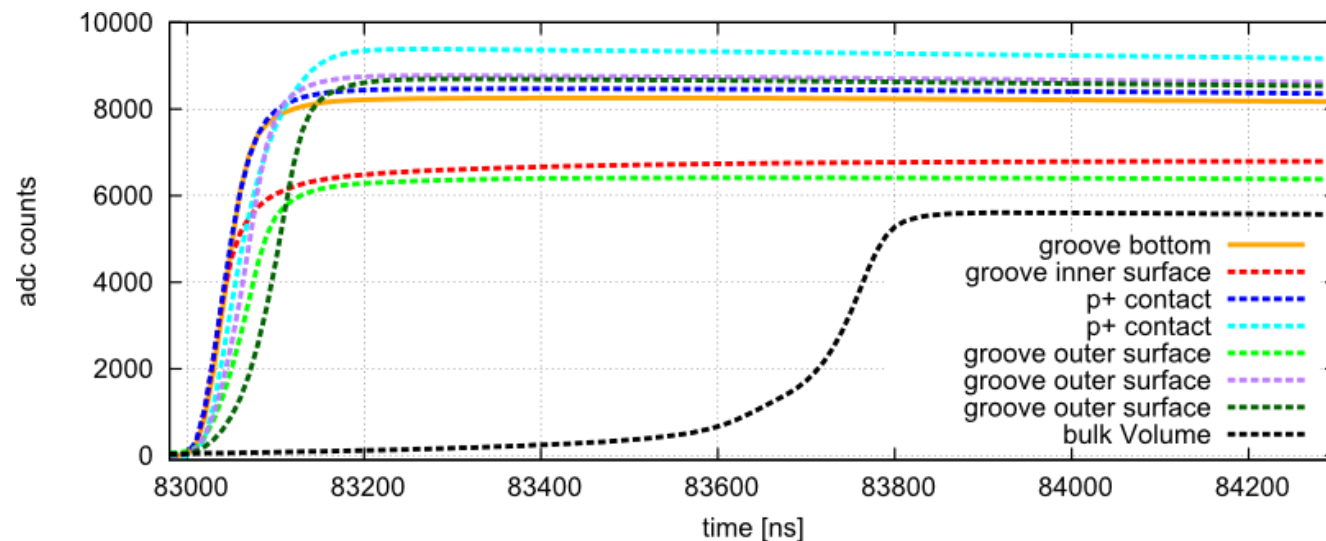
pumping system

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



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