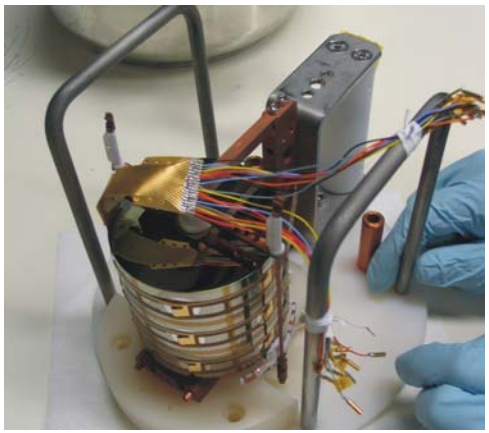
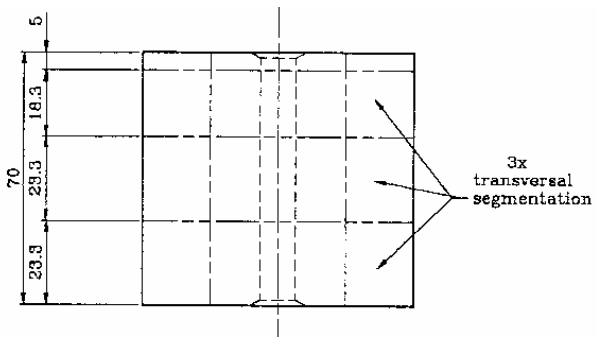
GERDA Phase-II Prototype Detectors

Xiang Liu for MPI Munich

First 18-fold segmented prototype:
operated in vacuum
(reported at Colla. Meeting Nov 2006)

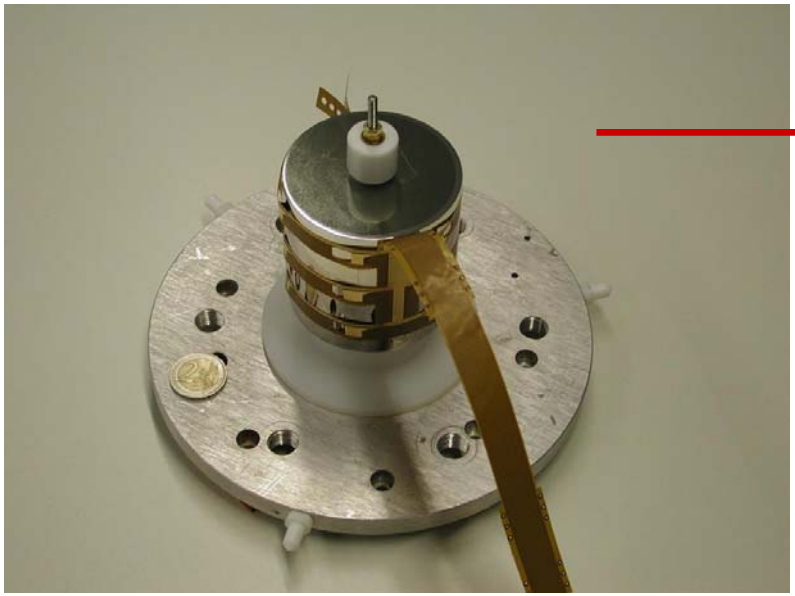


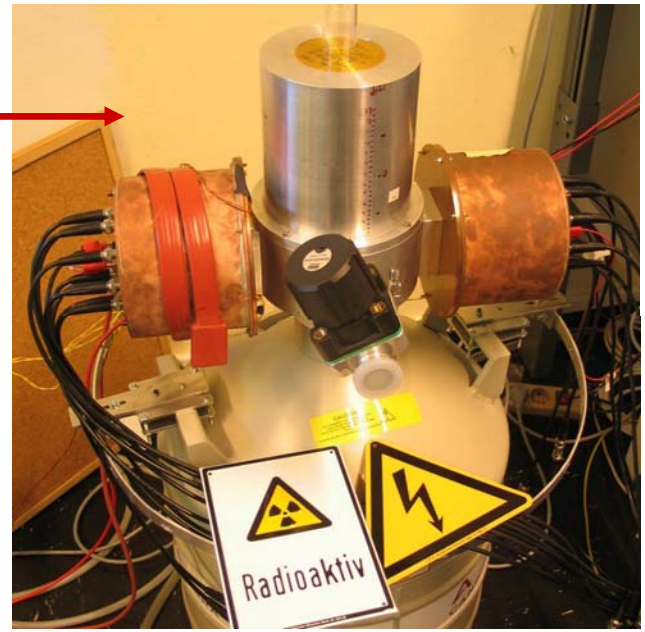
Second 18-fold prototype:
operated in liquid N2.



19-fold segmented detector:
operated in vacuum

First 18-fold segmented Phase-II prototype detector





Operated in vacuum.

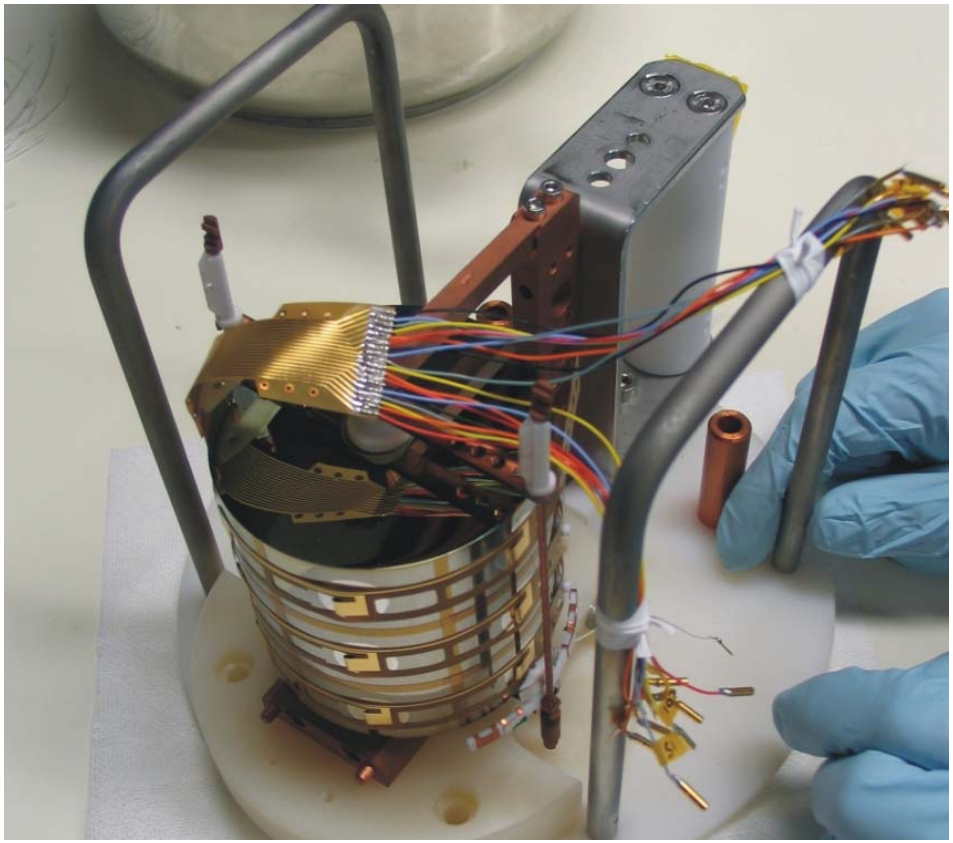
Exposed to Co60, Eu152, Th282 and AmBe sources.

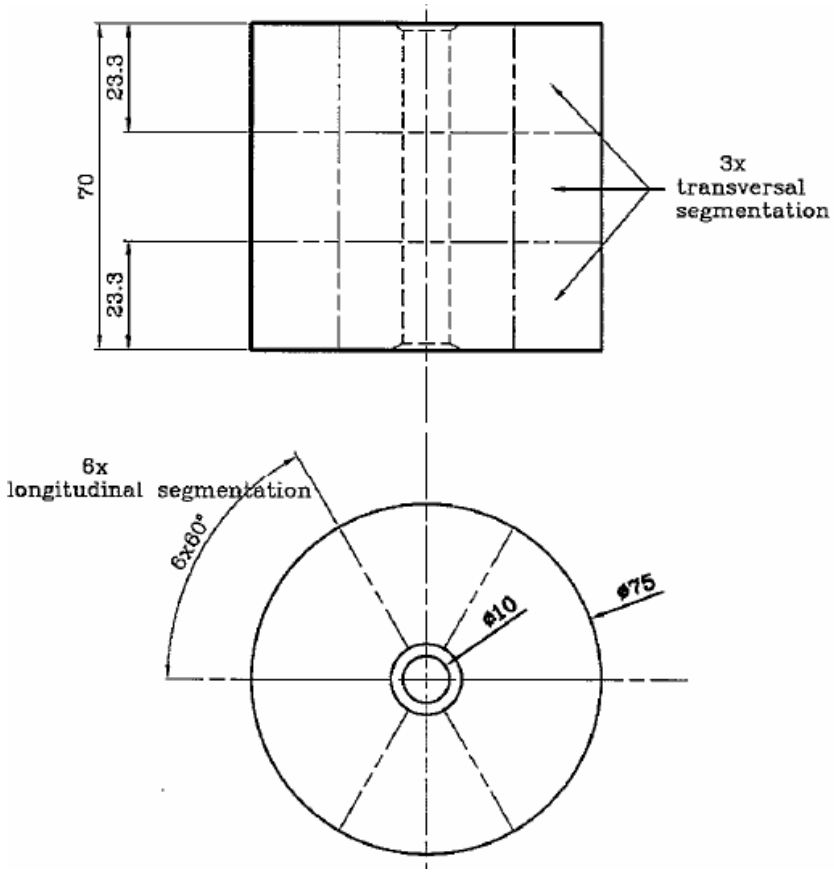
Studied segment anti-coincidence, pulse and neutron interactions.

→ confirmed segmentation technique & MC simulation

(Publications: see EB webpage or *wwwgerda.mppmu.mpg.de*)

second 18-fold segmented prototype detector





Outer Φ 75mm, inner Φ 10mm, H 70mm, W 1.58kg.

Operating voltage: +2000V

Operate in liquid Nitrogen.

Test stand for operating in liquid N2

Used non-segmented detector for cooling & operating tests.

Mounting

Mounting and lowering

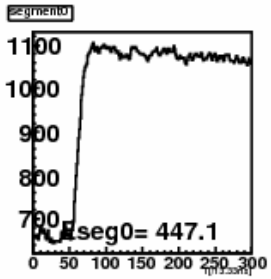
Inserted into liquid Nitrogen on April 23rd, 2008.
Detector and contacts work in liquid Nitrogen since then!
Will operate in liquid Argon afterwards.

What we learned again and again

PCB replaced by Cu board.

All preamps must be properly grounded.

Event display



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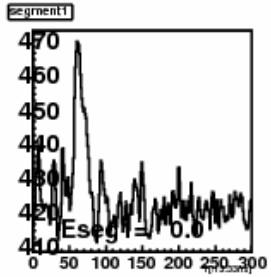
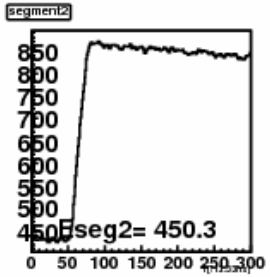
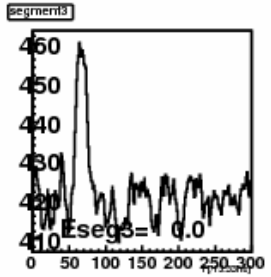
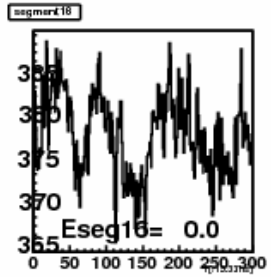
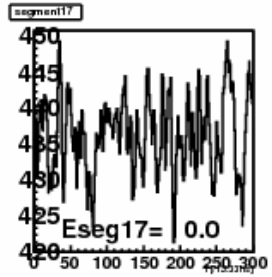
Eseg2= 450.3
Eseg3= 0.0
Eseg4= 0.0
Eseg5= 0.0
Eseg6= 0.0
Eseg7= 0.0
Eseg8= 0.0
Eseg9= 0.0
Eseg10= 0.0
Eseg11= 0.0
Eseg12= 0.0
Eseg13= 0.0
Eseg14= 0.0
Eseg15= 0.0
Eseg16= 0.0
Eseg17= 0.0
Eseg18= 0.0

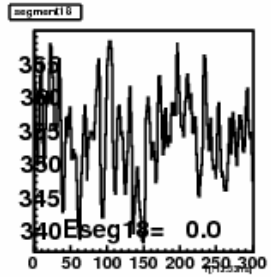


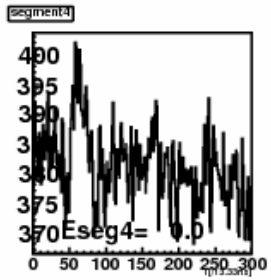


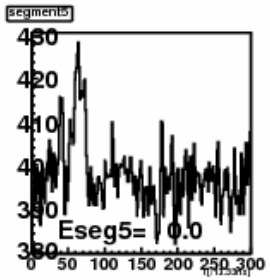


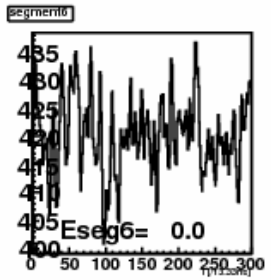


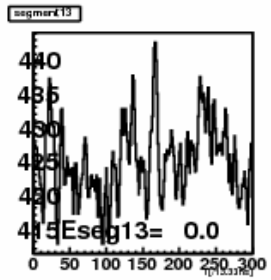


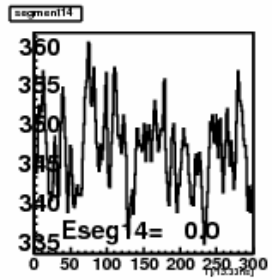


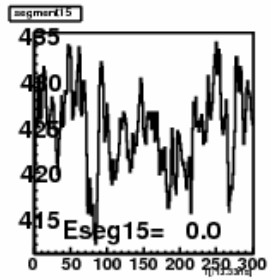


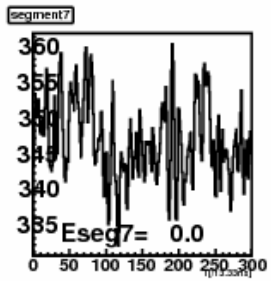


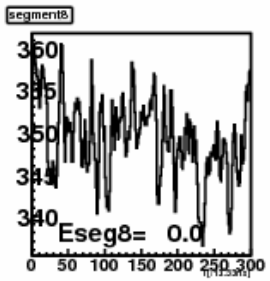


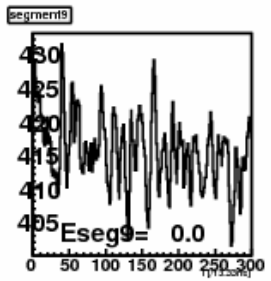


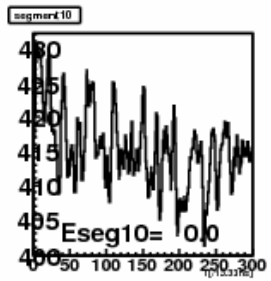


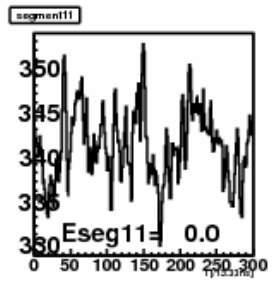


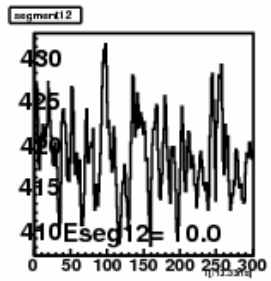




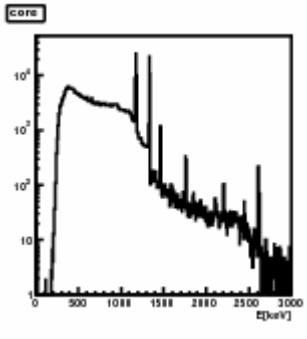








Leakage current and resolution



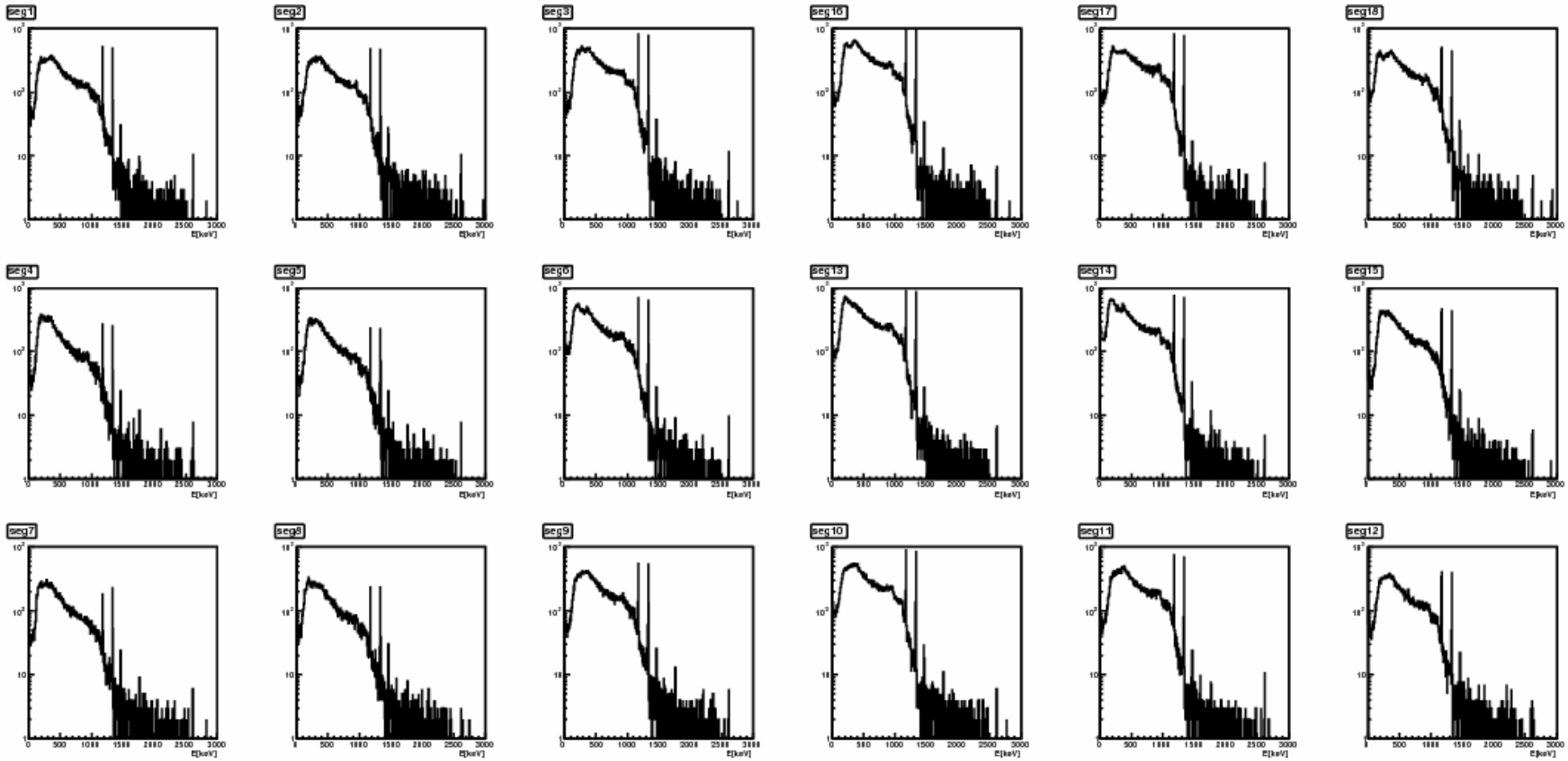
Leakage current at 2kV: 30pA

FWHM at 1332keV:

core 4.7 keV

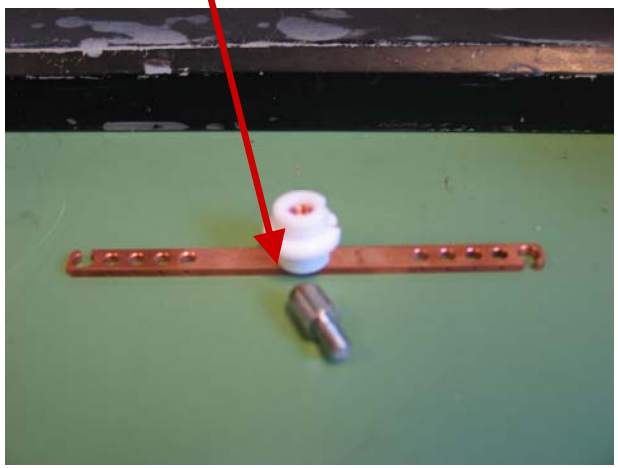
segments 3.6-5.7 keV

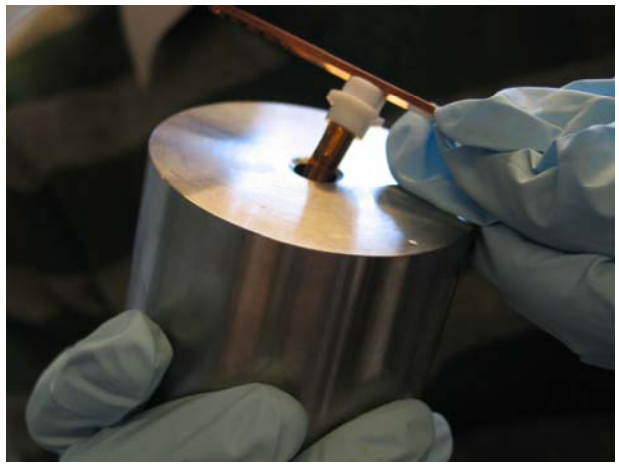
Improvement expected (preamp settings etc.)



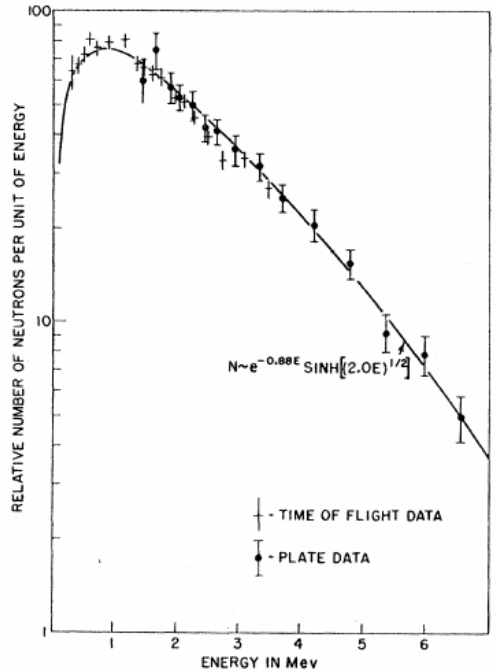
Physics program

- ✓γ sources: detector performance in liquid N2.
- ✓Cf252: neutron interaction.
- ✓Cd109: measure hole drift velocity.



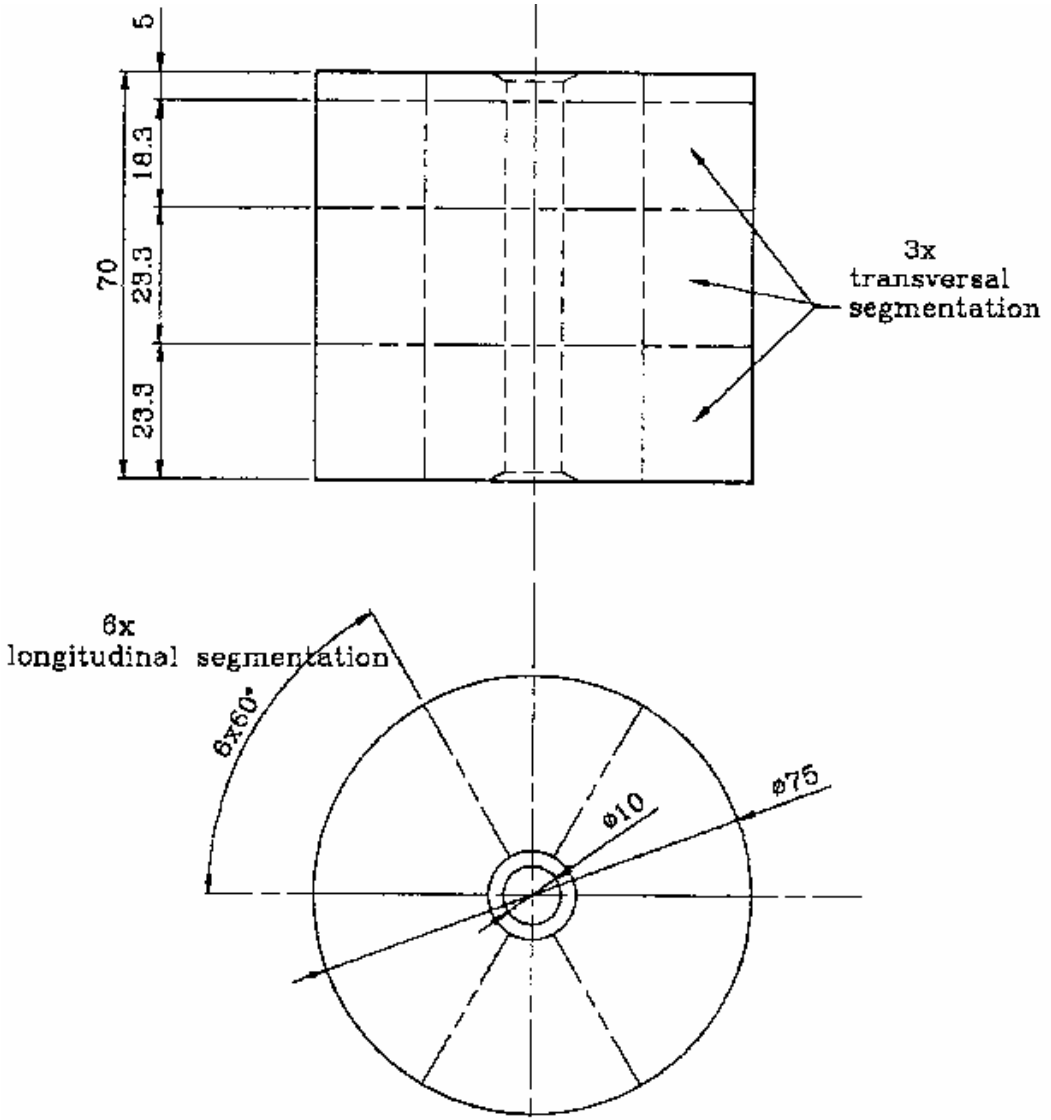


Cf252 n-spectrum



- ✓Search for cosmogenically produced Ge68:
  Ge68→Ga68 (EC Q=106keV)
  Ga68→Zn68 (e+ decay, Q=2921.1keV)
  signal: 3 segments registered, 2 have 511keV.
  (first 18-fold detector sees no bg, statistics limited)

19-fold segmented detector



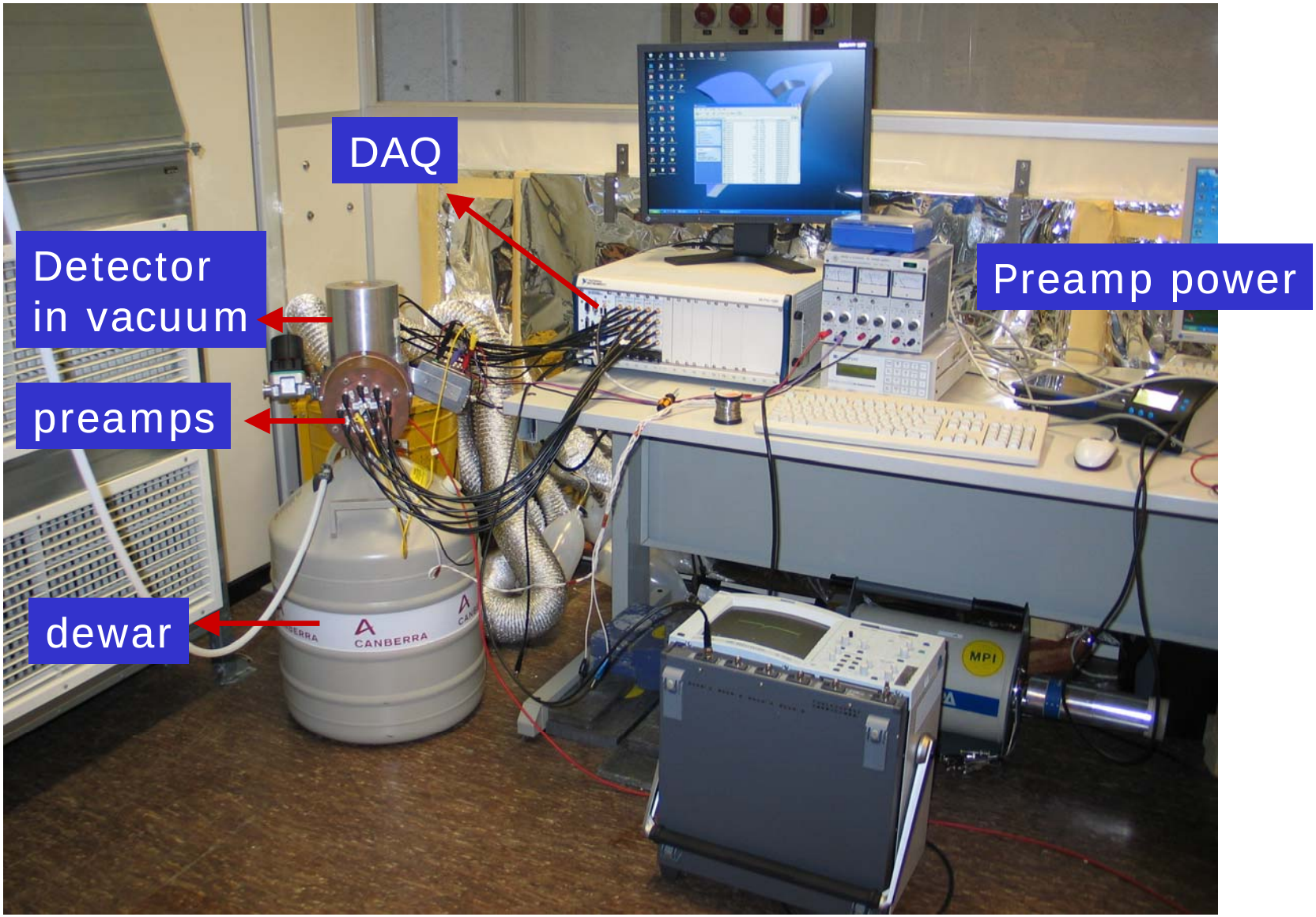
Same size:
Outer Φ 75mm,
inner Φ 10mm,
H 70mm

19th segment: 5mm thick

Operating voltage: 3kV

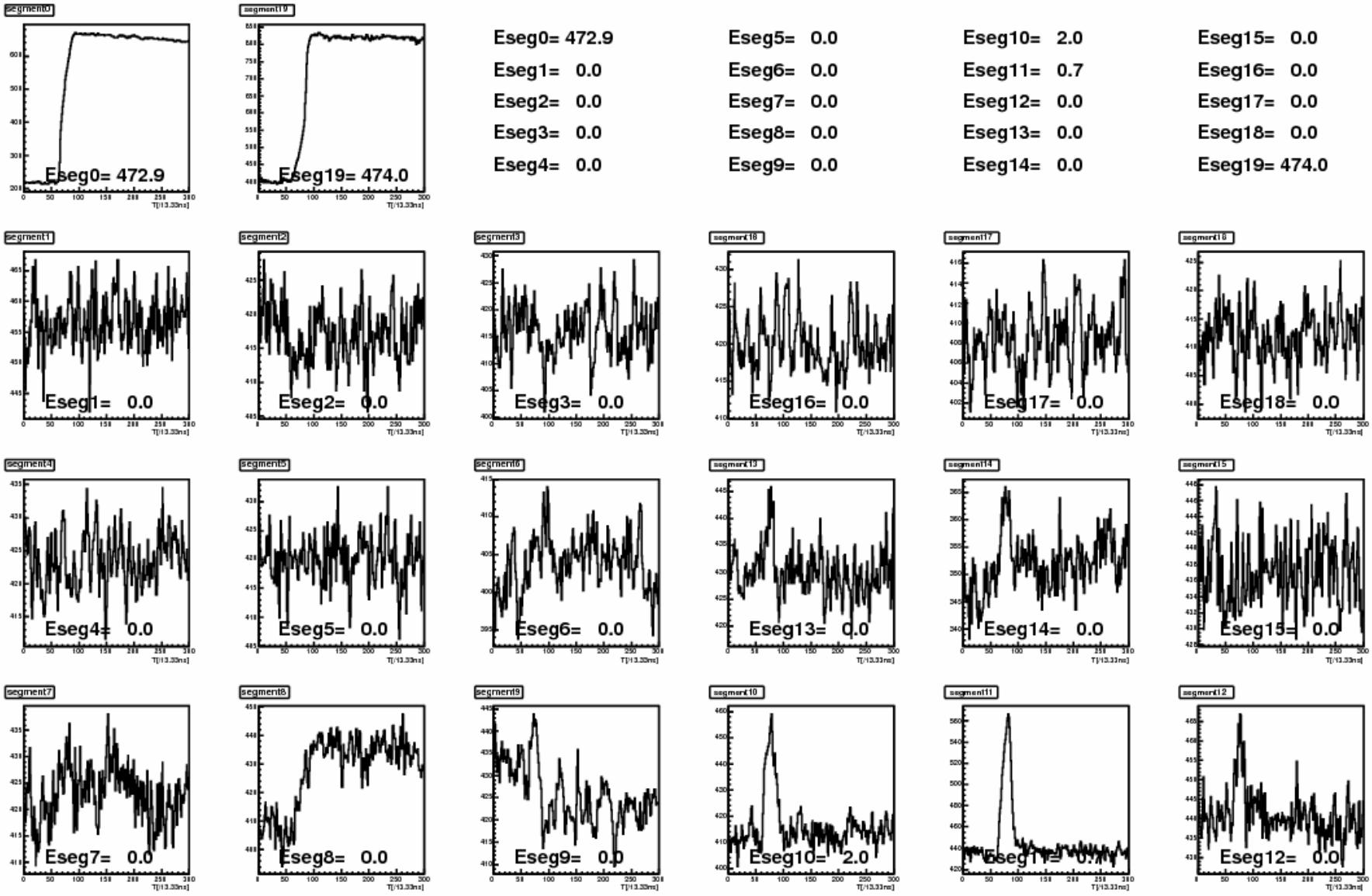
Operate in vacuum in conventional cryostat.

19-fold segmented detector

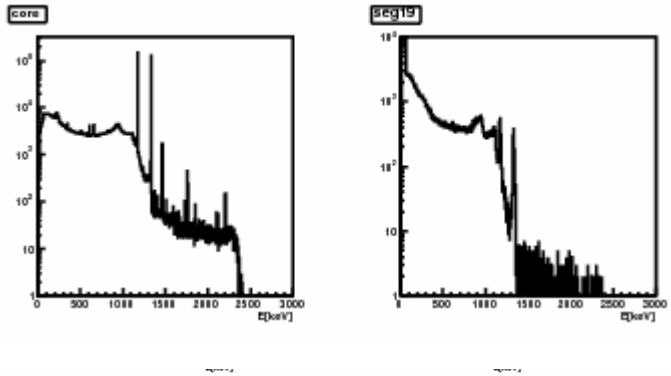


Same cryotank setup as used for the first 18-fold segmented.

Event display



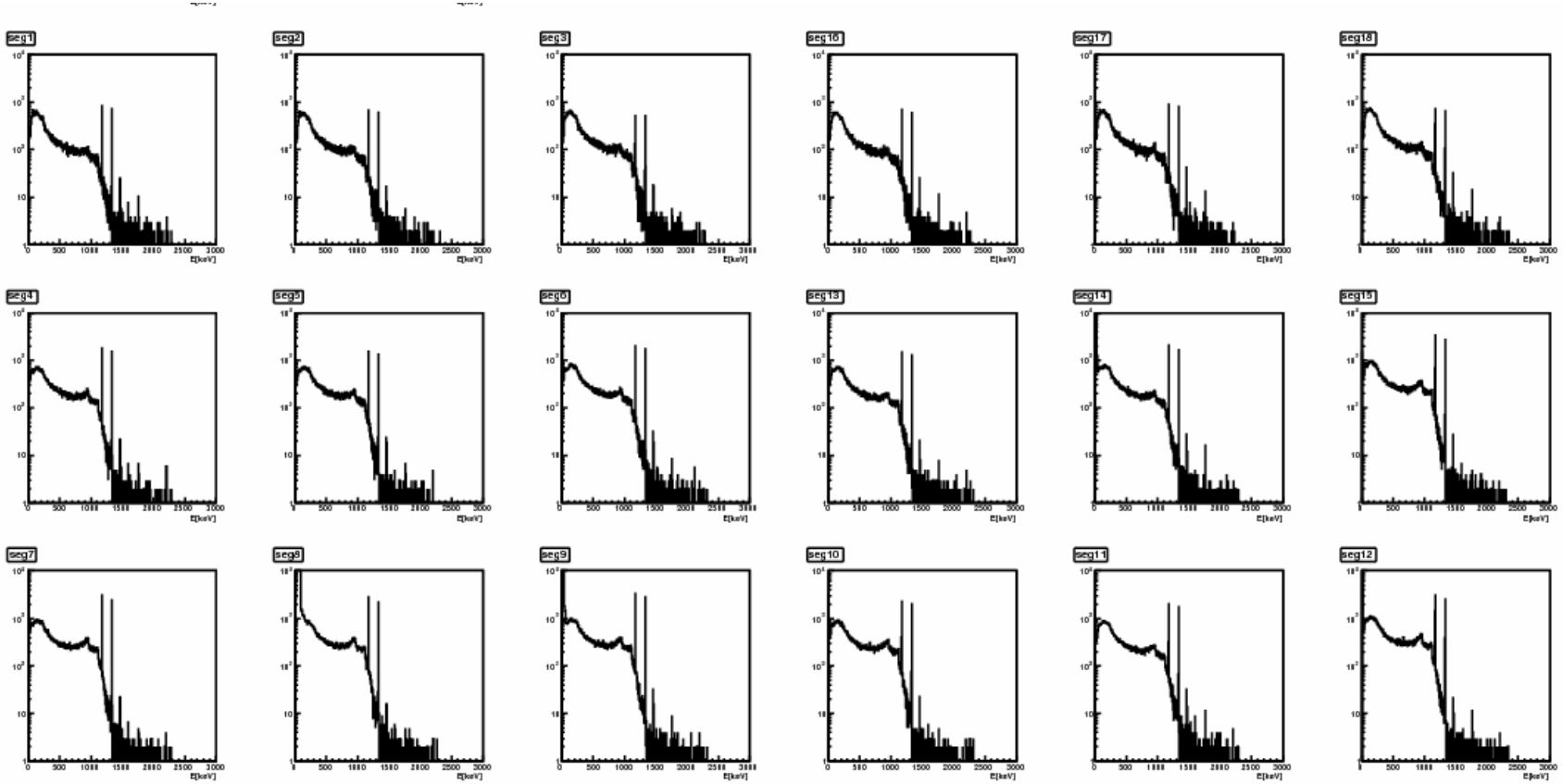
Leakage current and resolution



Leakage current at 3000V: <20pA

FWHM at 1332keV:

core	2.7 keV
segments 1-18:	2.4-2.9 keV
19th segment:	7.9 keV



Physics program for 19-fold segmented detector

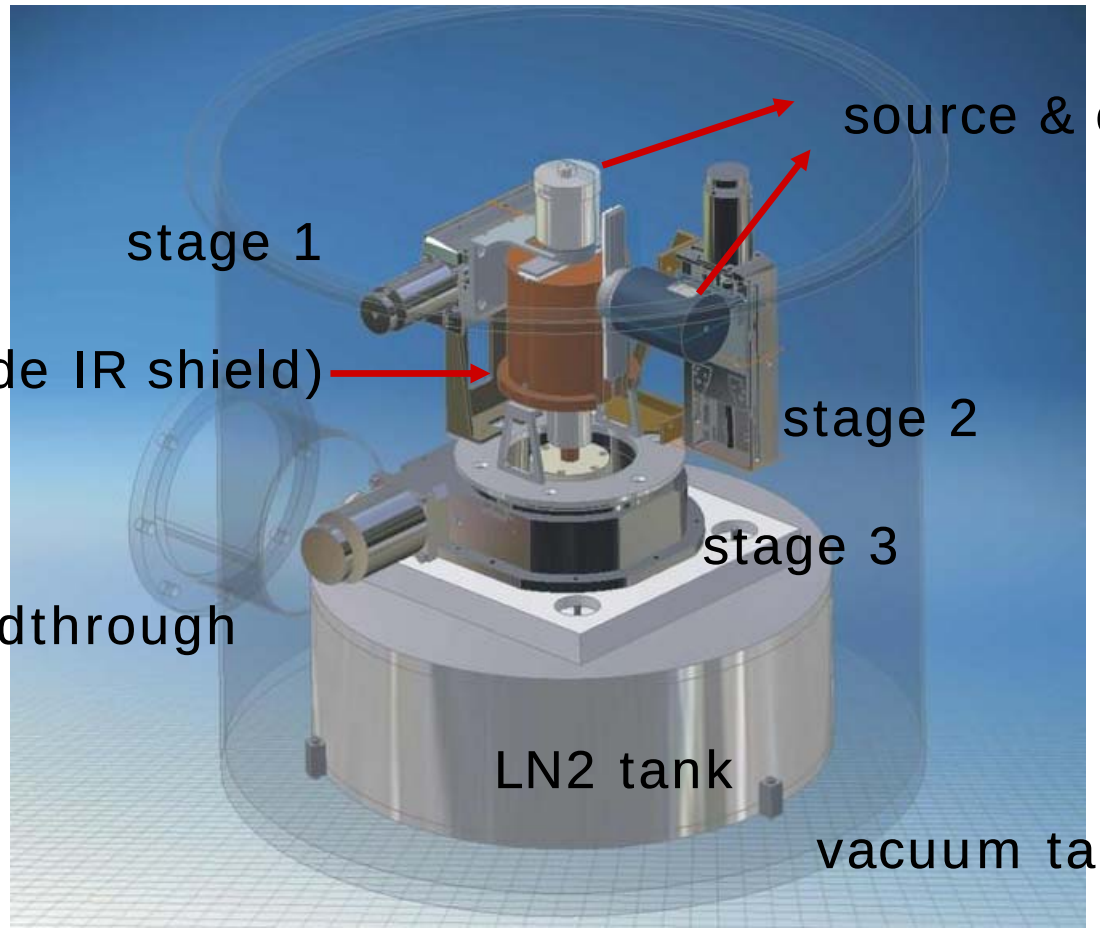
Characterization of the detector:
resolution, crystal axis, segment anti-coincidence etc.

The 19th segment:
understand resolution.
study dead layer with low energy gamma sources.
uniformity of segment thickness.
E field distribution.
→ Pulse rise time for the 19th segment.
(expect longer rise time due to weaker E field)
α-veto with the 19th segment.

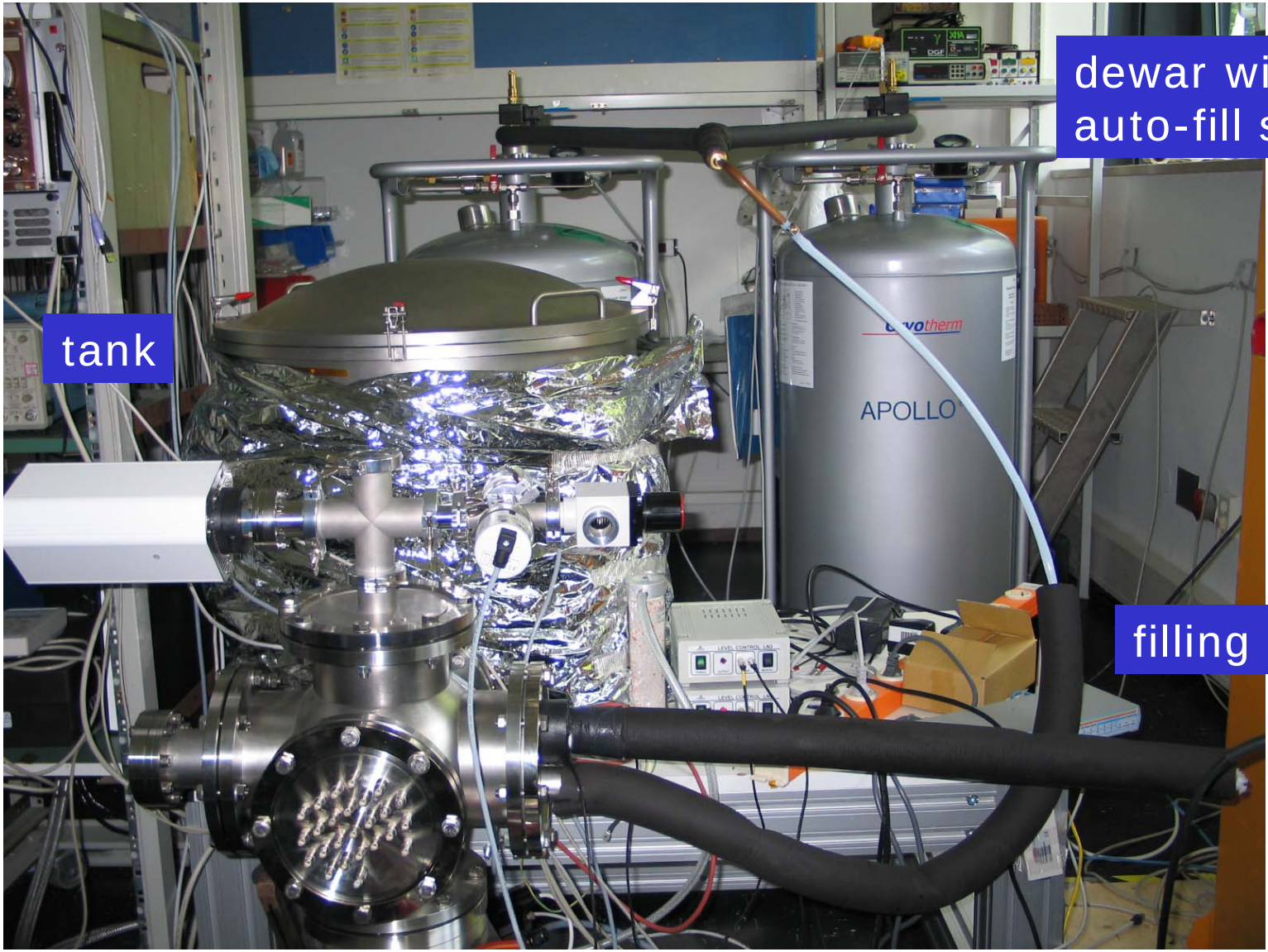
→more detailed study with the new test stand Galatea.

One more new test stand under construction

3D scan with γ, α and laser.



New test stand under test



Conclusion

One Phase-II prototype detector operated in LN2!
- leakage current: 30pA
- FWHM at 1332keV: core 4.7keV segments 3.6-5.7keV
- expect improvement (on preamp settings etc.)

One 19-fold segmented detectors works in vacuum.
- leakage current: <20pA
- FWHM at 1332keV: core 2.7keV, segments 2.4-2.9keV
  19^{th} segment 7.9 keV

Rich physics program for both detectors:
- characterization
- neutron interaction
- hole drifting velocity
- search for Ge68
- ……