GERDA Test Stands for Segmented Germanium Detectors

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Outline

- Motivation
- Test Stands with Detectors on Cold Finger
- Test Stands with Detectors in Cryo-Liquid
- Conclusions

Motivation

GERDA is looking for 0νββ–decay

→ ν Dirac or Majorana

ticle?

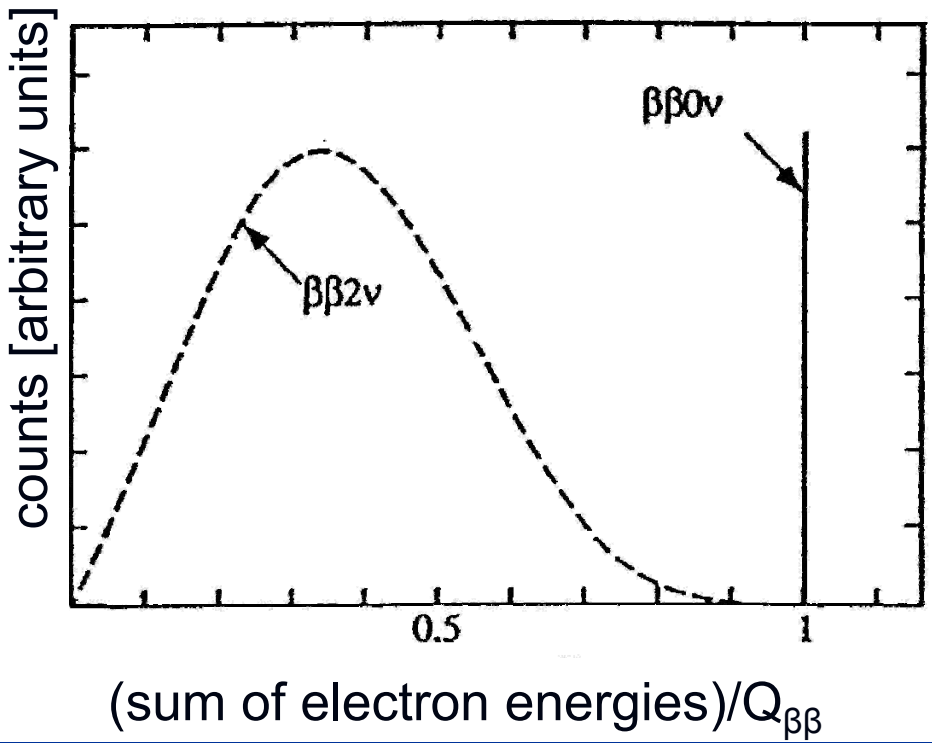
l mass

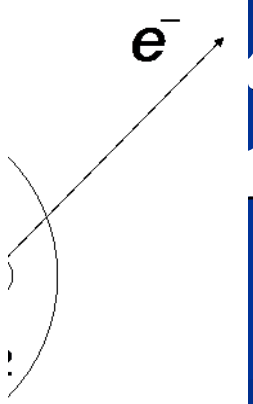
limit if no discovery)

are process

→ low background required

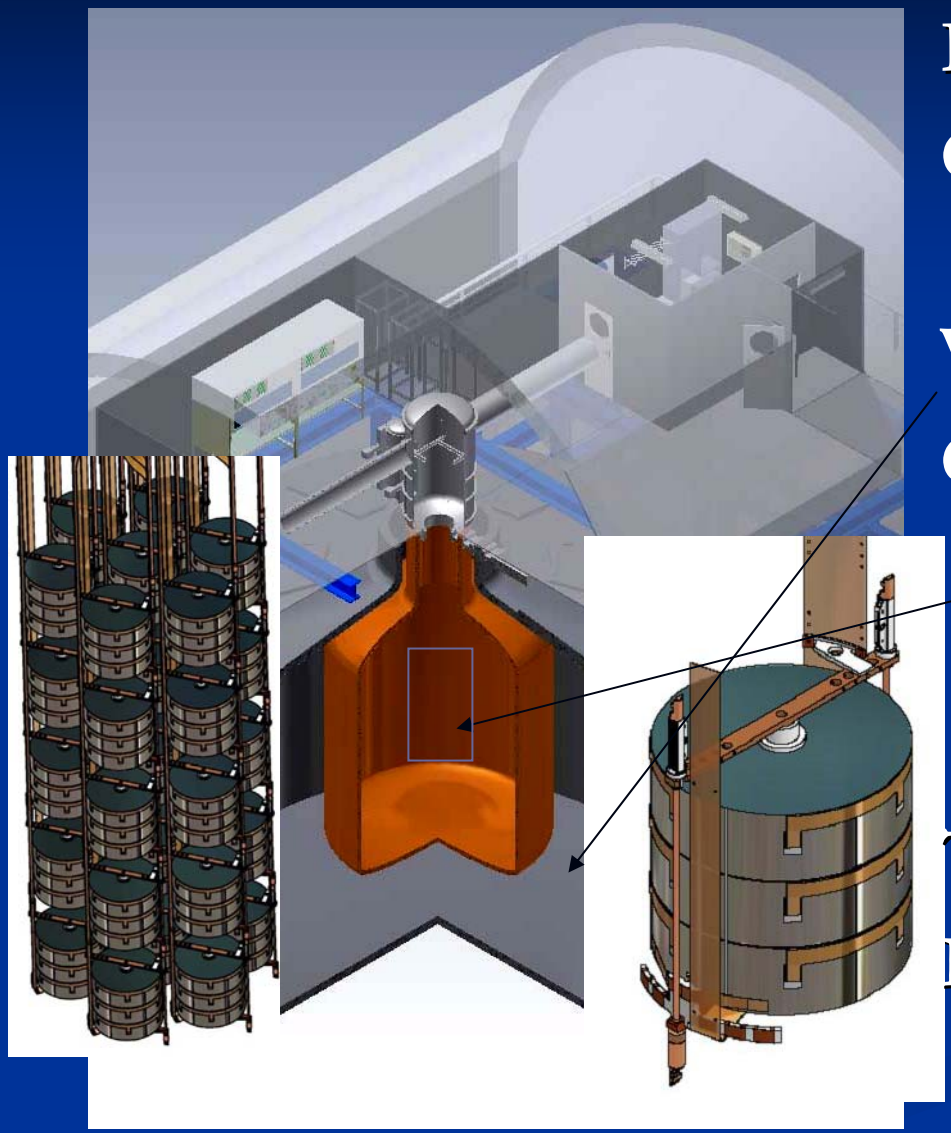
(<10^{-3} cnts/kg/y/keV)





Ge: good energy resolution → background reduction

Motivation



Background reduction:

GERDA in underground lab (cosmic rays)

Water Tank (neutrons)

GERDA Detectors operated directly in LAr (γ-background)

Test Stands in Munich:

LN_2/LAr and Cold Finger

Segmented Germanium Detectors

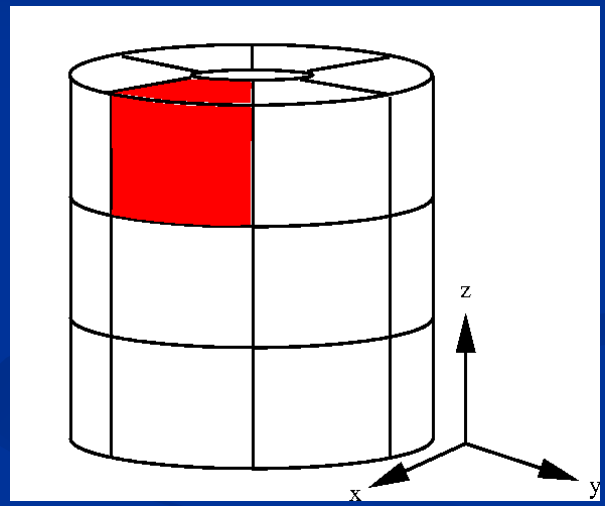
detector material: high purity Germanium

detectors segmented 6-fold in φ and 3-fold in height

segmentation helps with background rejection

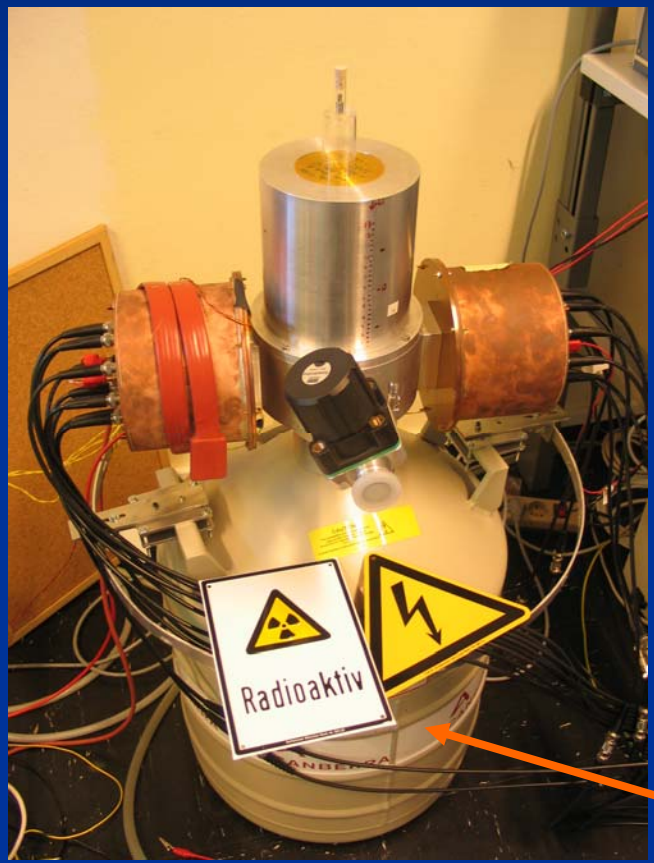
signal: 1 segment hit

background event: more segments hit

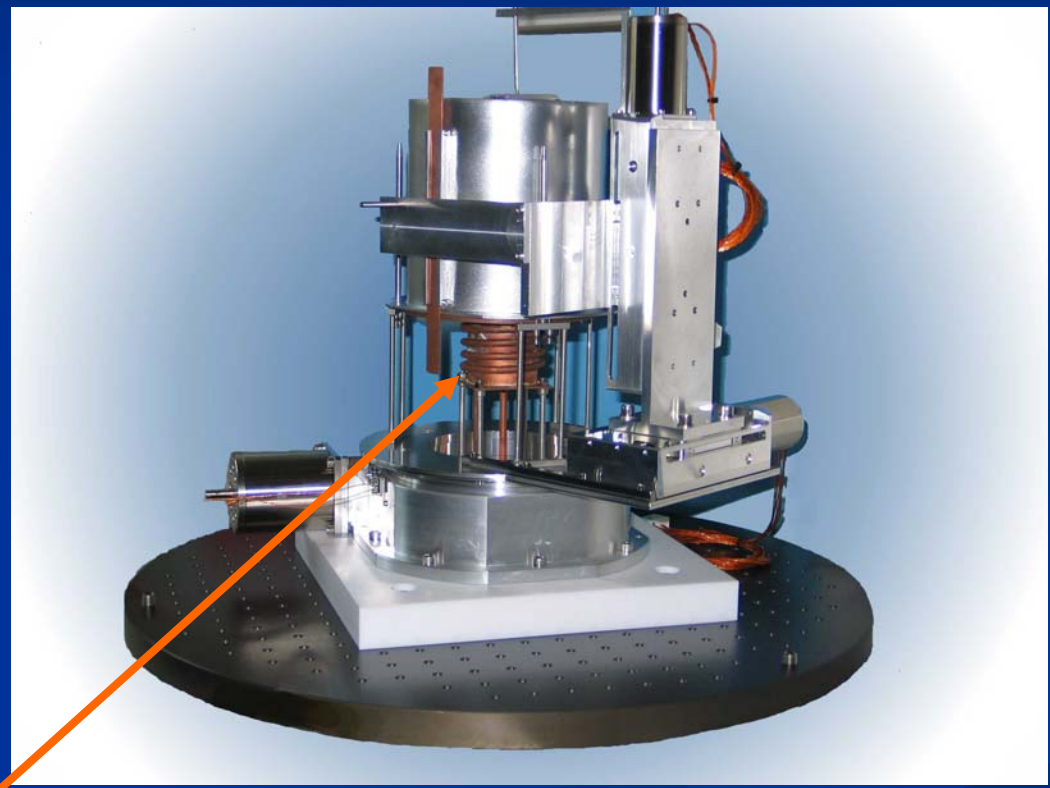


Test Stands with Detectors on Cold Finger

classical cryostat



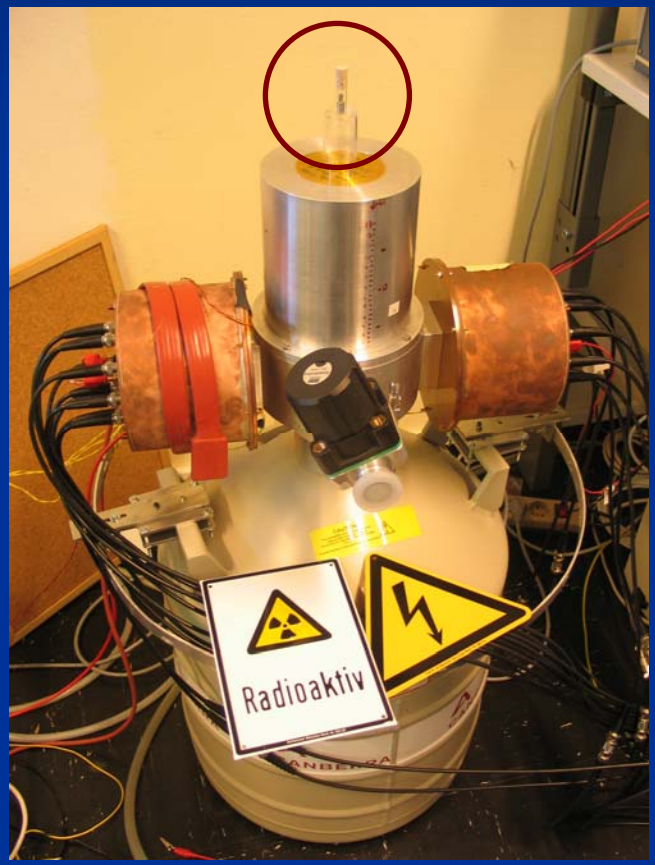
'Galatea'



LN_2

Test Stands with Detectors on Cold Finger

classical cryostat



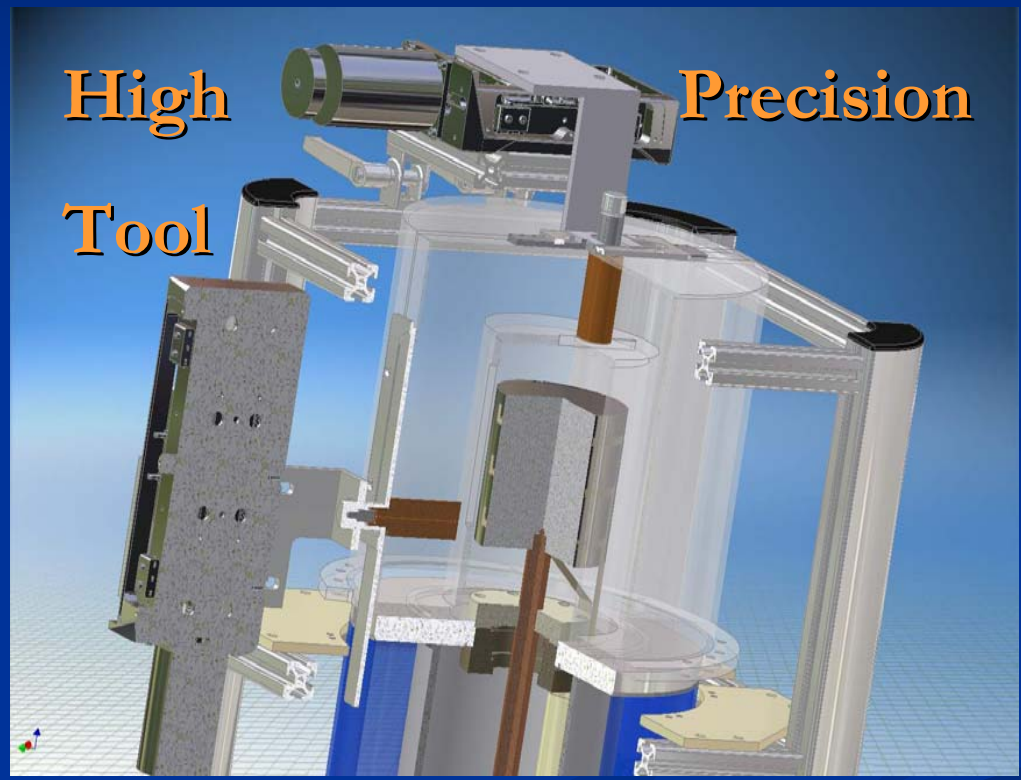
cryostat for first n-type 18-fold segmented detector

detector cooled indirectly via copper cold finger

sources put outside aluminum vacuum tank

Test Stands with Detectors on Cold Finger – Galatea

Sources movable 360° in φ- and whole range in z-and r-direction
→ 3-D scan; surface and bulk properties, dead layers
no material between source and detector
→ ideal for α-/β-sources/laser



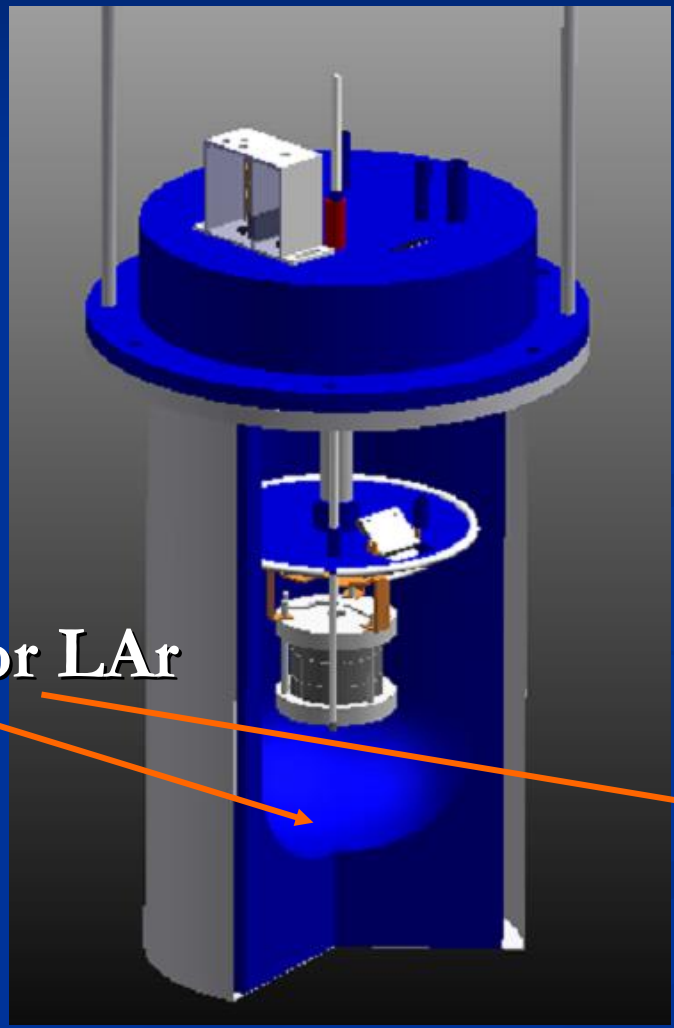
Segment resolution, segment boundaries and cross-talk
→ pulse shape studies and background suppression

Test Stands with Detectors in Cryo-Liquid

'Milchkanne'

'GERDAlinchen'

'GERDAlinchen II'



LN_2 or LAr

Test Stands with Detectors in Cryo-Liquid

>30 coa

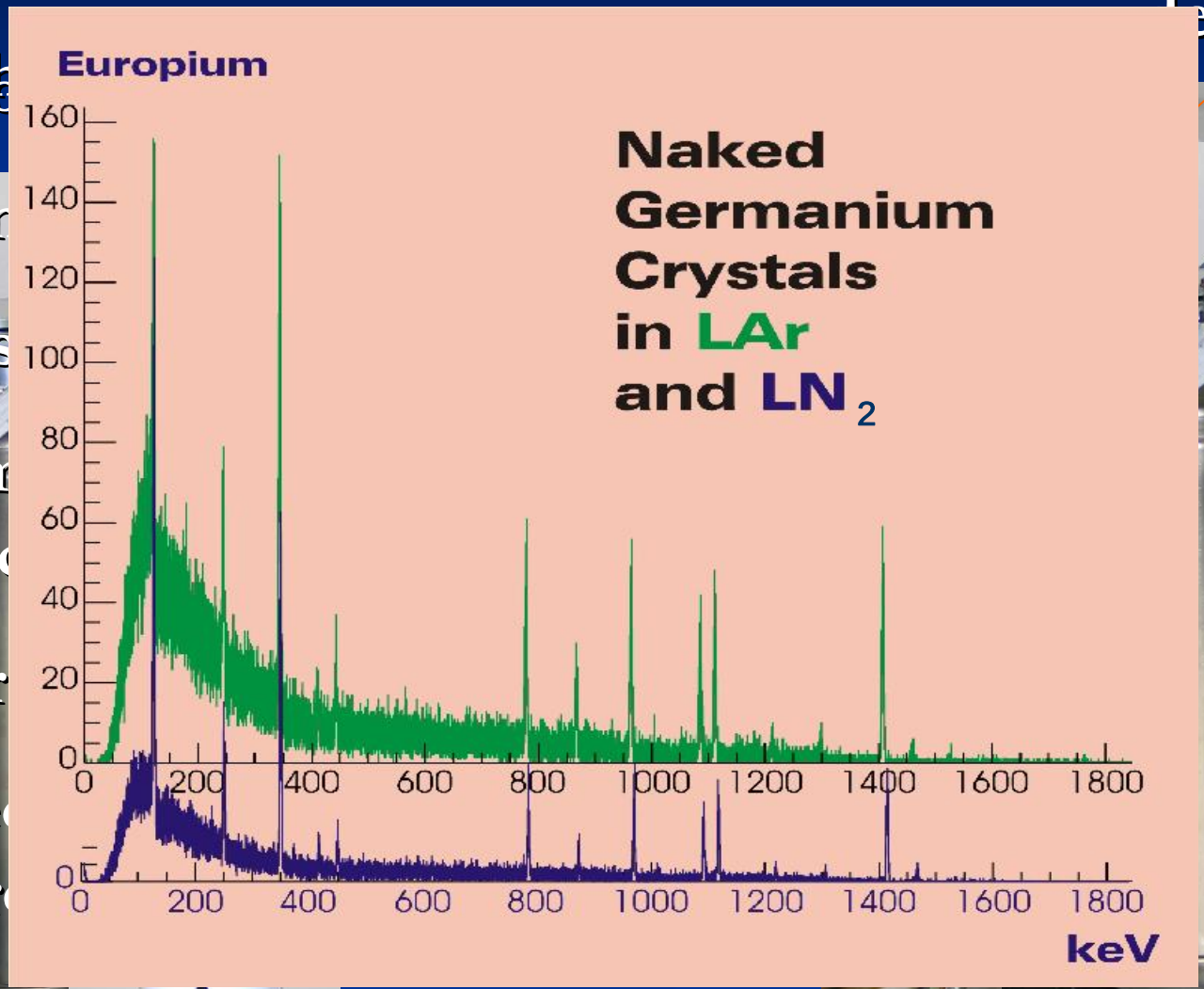
1) subm

2) meas

3) warm
in vac

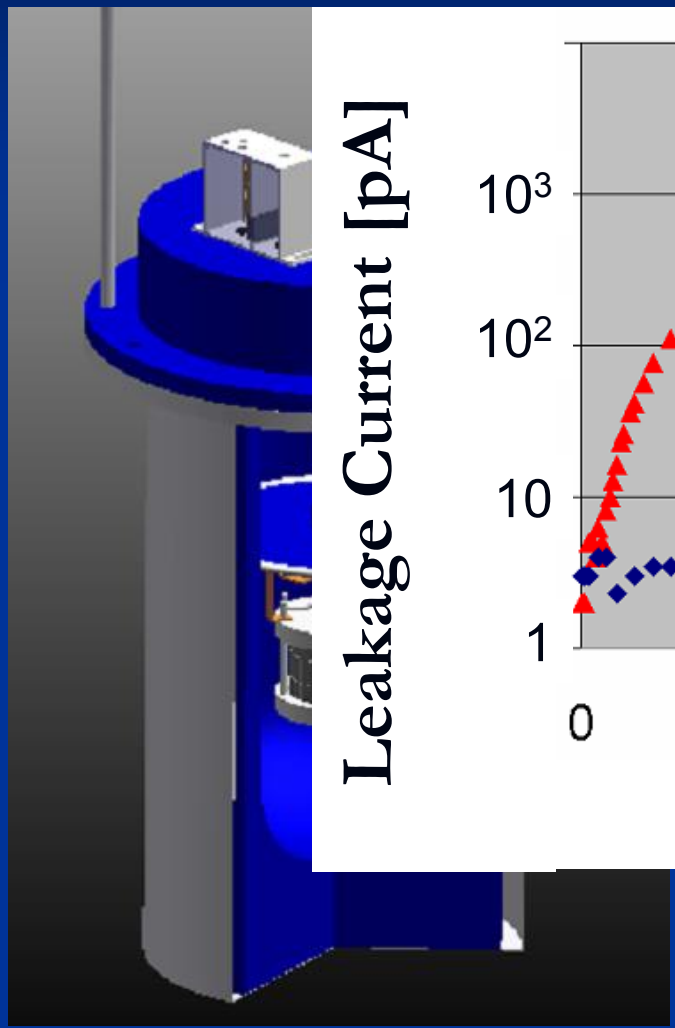
→ oper

→ dete
envir

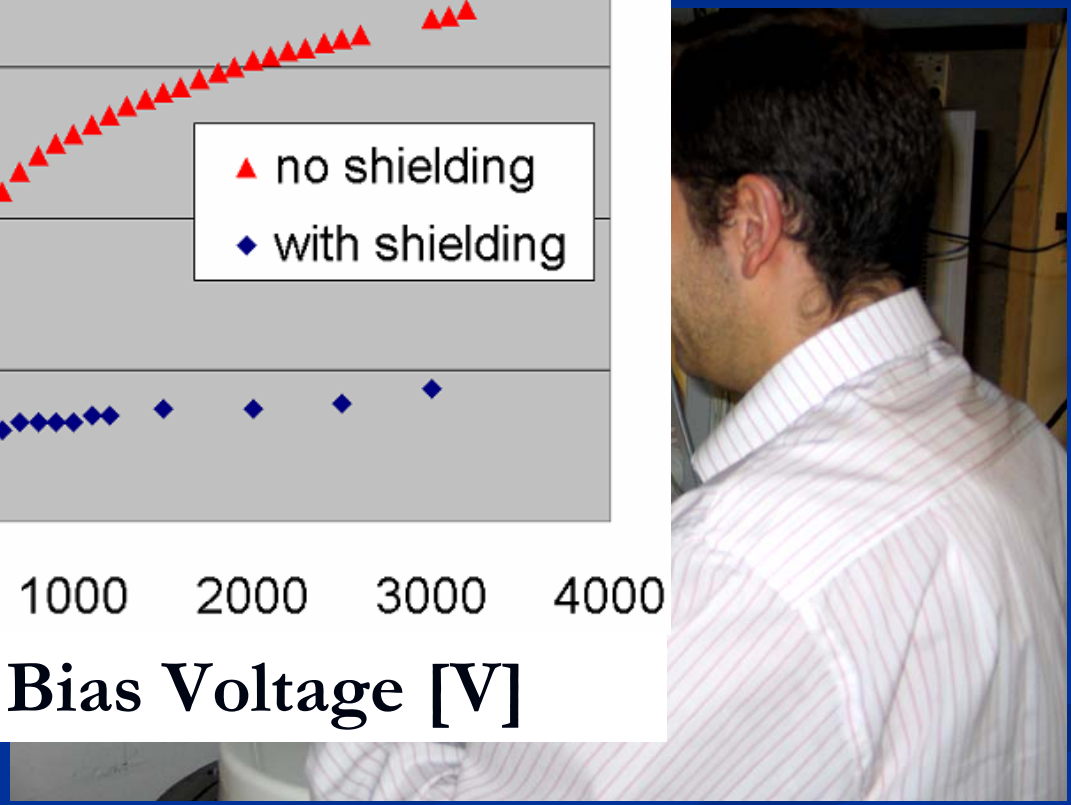


Test Stands with Detectors in Cryo-Liquid

'GERDAlinchen'

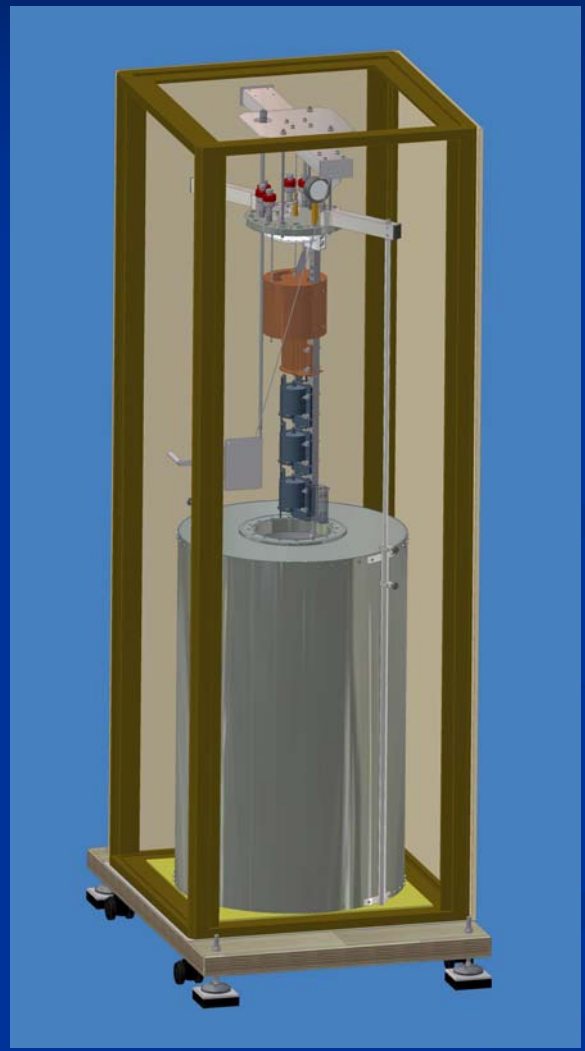


Mounting of a 6-fold segmented p-type detector



Test Stands with Detectors in Cryo-Liquid

'GERDAlinchen II'



Conclusions

- Detectors can be operated in vacuum or in cryogenic liquids, LN_2 or LAr
- Stable operation of Ge detectors in LN_2/LAr
- New vacuum test stand 'Galatea': precision tool to scan crystal in 3-D
- New test stand with naked crystal in LN_2 : 'GERDAlinchen II' → test for GERDA setup of detector strings