Summary on TG11 activities

W. Hampel (MPIK Heidelberg)

for Task Group 11

- Gamma-ray screening measurements
- ICPMS measurements (Axel Gerdes, Univ. Frankfurt)
- Future new counting equipment for GERDA

Not covered (separate contributions):

- Recent results with GeMPI (M. Laubenstein)
- Ar, Kr and Rn in Liquid Nitrogen and Argon (G. Zuzel)

γ-ray screening measurements

MPIK Heidelberg - detector D

Start of Counting	Sample description	Sample mass	Useful counting time
10.07.05	Acrylic plates (thick)	9.55 kg	17.0 d
05.08.05	Acrylic plates (thin)	9.30 kg	19.0 d
25.08.05	Background measurement *)	empty chamber	32.2 d
12.10.05	Polyethylen	8.72 kg	11.3 d
08.11.05	Eroding wire (brass)	6.00 kg	still counting

*) to study Rn diffusion into sample chamber

Results

Specific activity [mBq/kg]	^{226}Ra	^{228}Th	^{228}Ra	^{40}K
Acrylic plates (thick)	< 4.6	< 6.2	2.4 ± 0.9	< 14.1
Acrylic plates (thin)	< 5.3	< 6.0	< 5.8	15.0 ± 5.4
Polyethylen	< 5.6	< 7.6	11.2 ± 3.2	10.8 ± 6.7

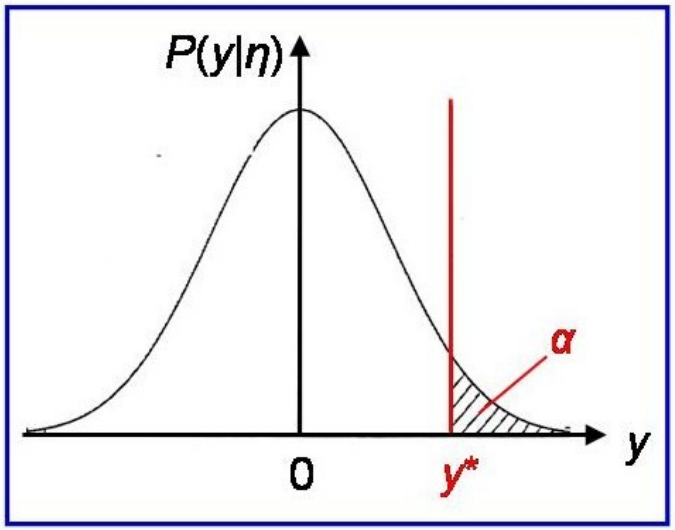
EC-JRC-IRMM Geel (HADES)

15 pieces Capton (20cm x 58cm x 50μm each) 129 g
3 pieces Capton + Cu (58cm x 20cm x 35 μm each) 112 g

} preliminary results → M.Hult

What limit is given in case there are (almost) no excess counts in the region of interest ?

→ in most cases the so-called “decision threshold“ is given:



Decision threshold $y^* = k \cdot \sigma_0$

DIN 25482-5
ISO 11929-3

= critical value to test the null hypothesis that there is no sample contribution to the measured signal. The probability that this hypothesis is rejected even though there is no sample contribution is α.

σ_0 : standard deviation for $y = 0$
(no excess counts in the region of interest)
k : coverage factor

k	confidence level (1-α)
1	84.1 %
1.645	95.0 %
2	97.7 %

When giving decision thresholds:
different coverage factors k have been used

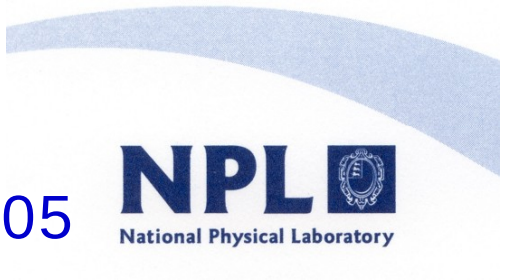
Important: The value for the decision threshold cannot be directly translated into a conventional upper limit !
→ Discussion at the separate TG 11 session this afternoon

At the TG11 Session in Dubna

desire to have an intercomparsion exercise between the four Low-Level Counting Labs participating in material screening for GERDA

→ it has been proposed to join the

NPL (National Physics Laboratory, UK)
Environmental Radioactivity Comparison 2005



- EC-JRC-IRMM Geel
- MPIK Heidelberg

} samples have been received

- ? LNGS
- ? Baksan

ICPMS measurements on GERDA samples

Axel Gerdes, Department of Mineralogy, University of Frankfurt

- offered to perform ICPMS measurements for GERDA on about 15 samples
- U and Th results: reported in Dubna (H. Simgen)

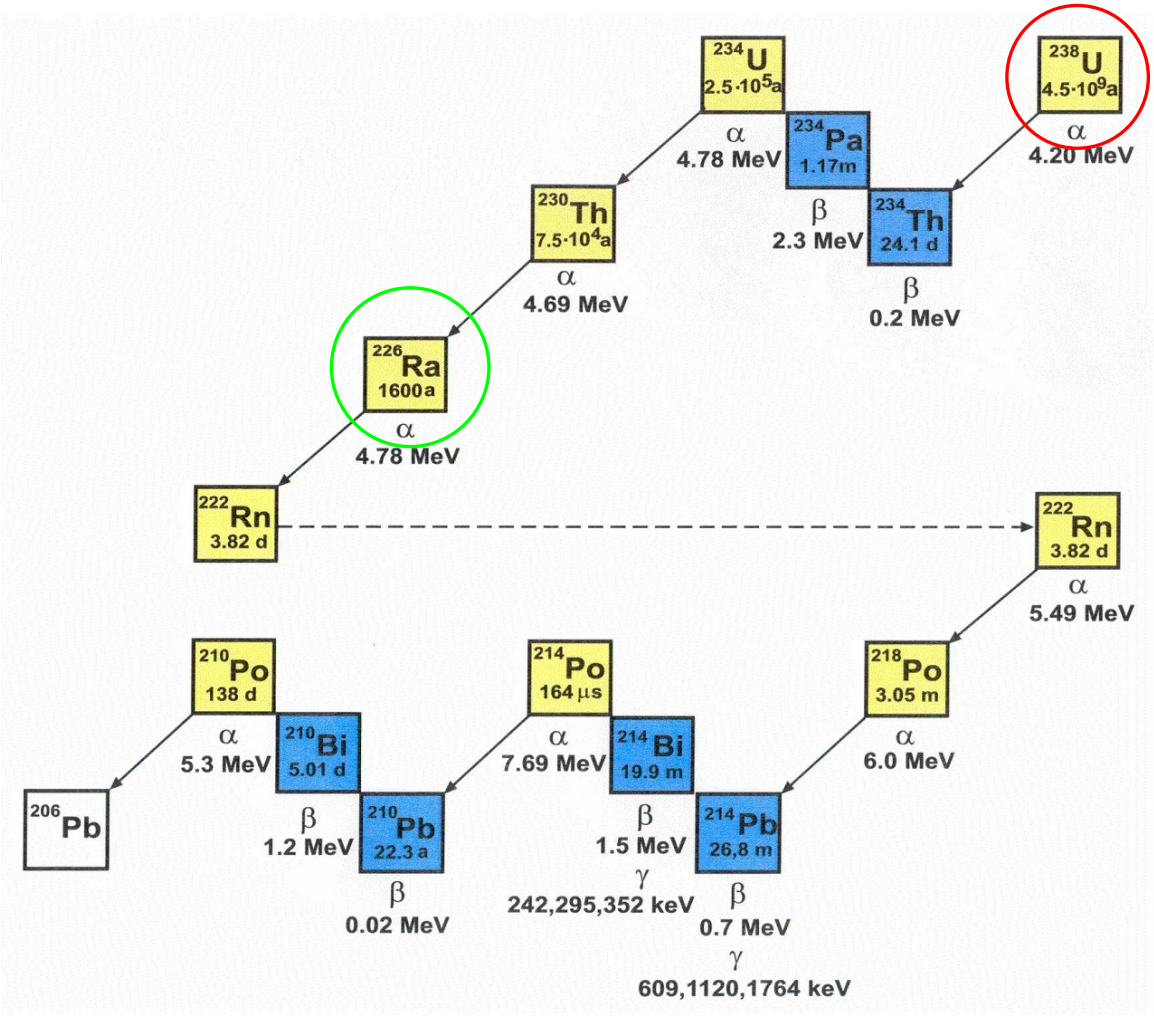
  U/Th sensitivities in the range of 10 μBq/kg

  Problem: in quite a few cases (where γ spectrometric data are available)

  → secular equilibrium is broken !
- K measurements: difficult

  → see below !

^{238}U decay chain



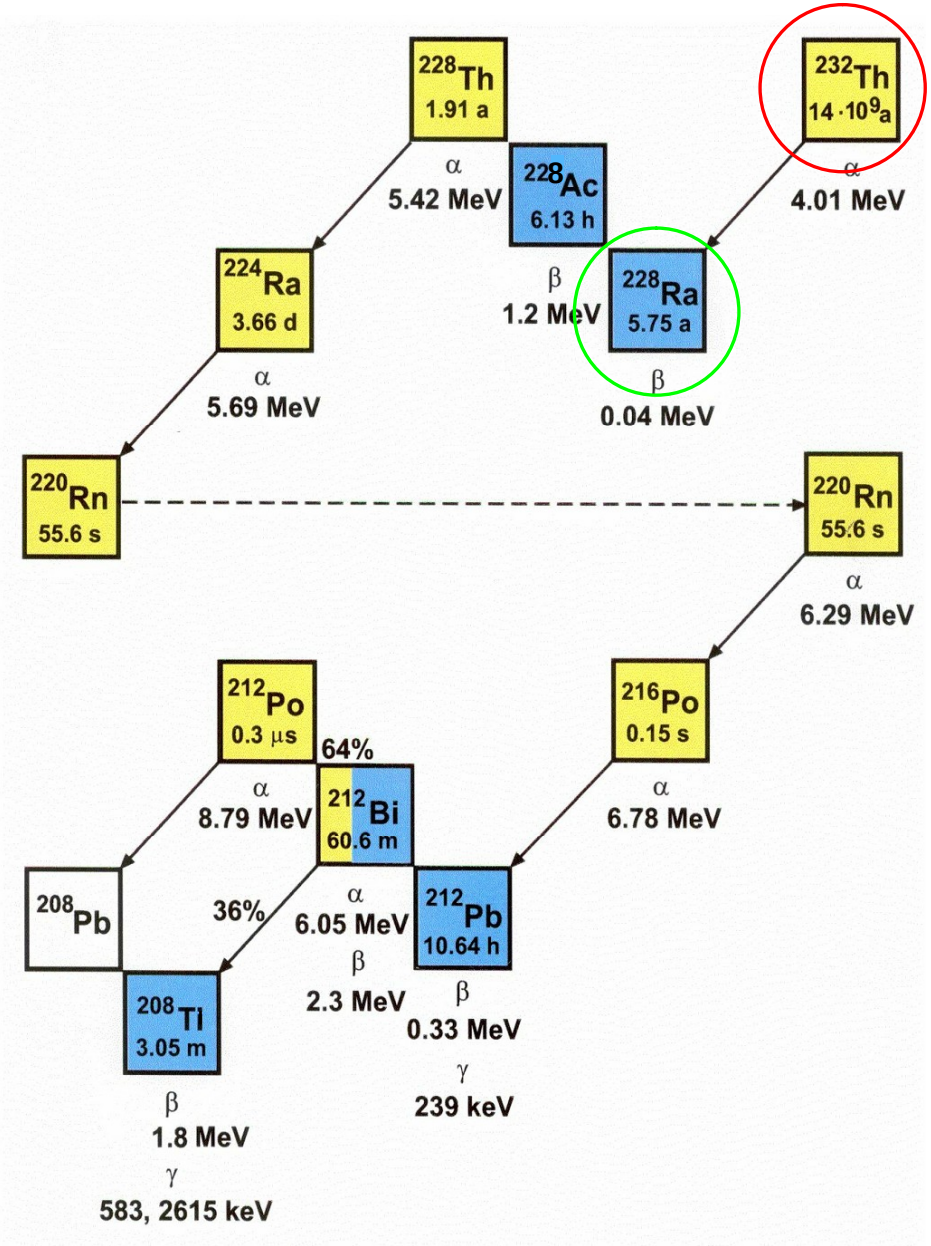
PMT glass

Activity measured by	ICPMS [mBq/kg]	Ge spectrometry [mBq/kg]
uranium chain (^{238}U/^{226}Ra)	175	1950 (HADES) 2100 (MPIK)
thorium chain (^{232}Th/^{228}Th)	15	170 (HADES) 220 (MPIK)

Cu(90%) / P(10%) pellets

Activity measured by	ICPMS [mBq/kg]	Ge spectrometry [mBq/kg]
uranium chain (^{238}U/^{226}Ra)	0.9	< 5 (MPIK) < 1.8 (HADES)
thorium chain (^{232}Th/^{228}Th)	0.05	< 6 (MPIK) < 1.5 (HADES) 0.9 (Baksan)

^{232}Th decay chain



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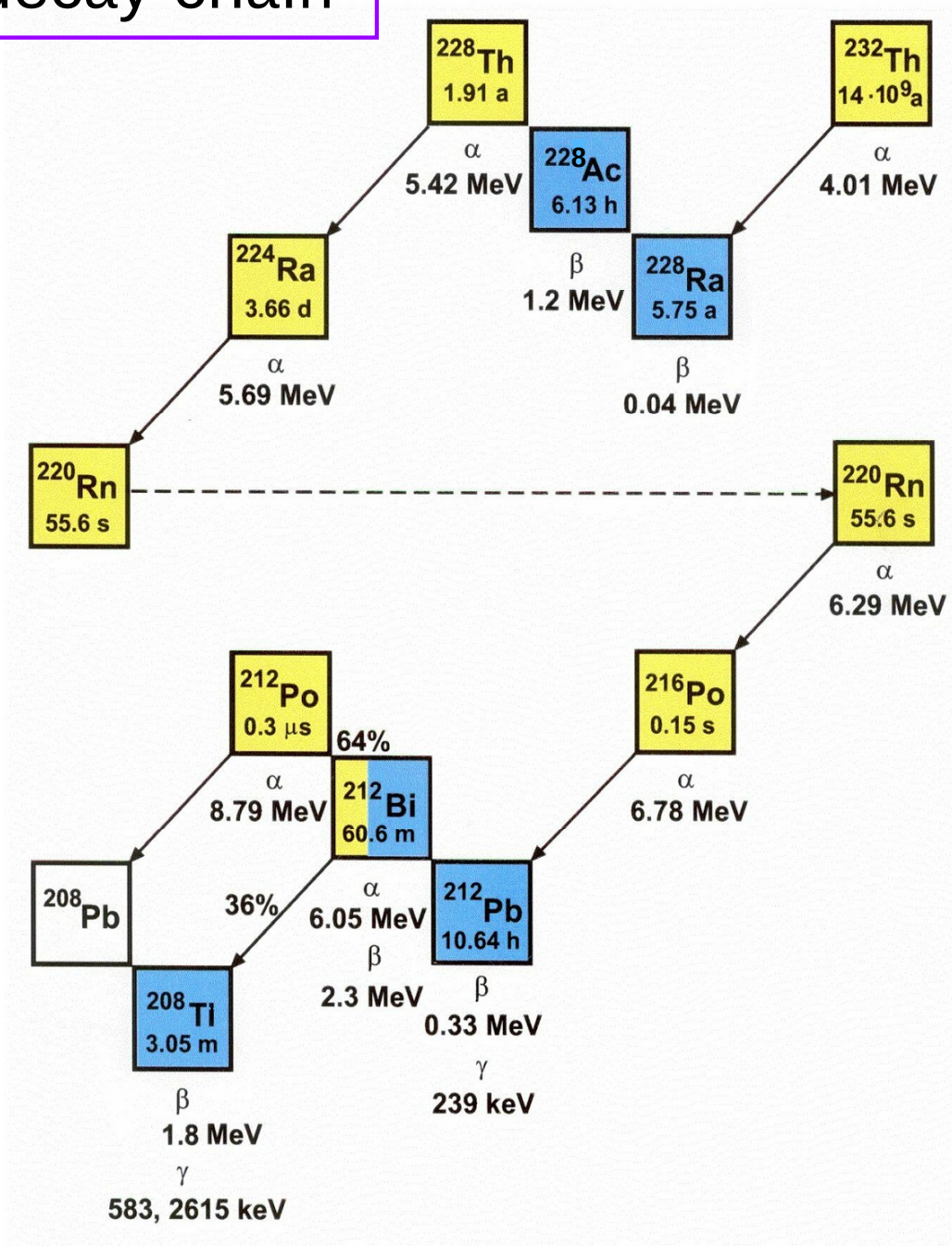
^{232}Th ⟶ ICPMS

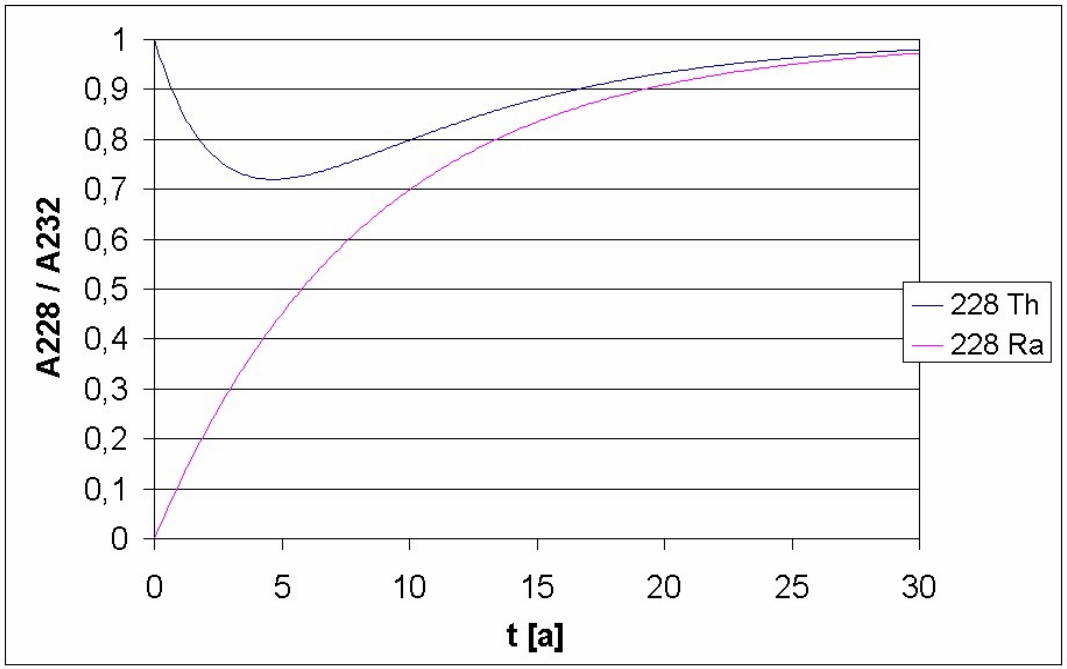
^{228}Th ⟶ γ spectrometry

^{232}Th decay chain



Even if the ^{228}Th/^{232}Th activity ratio is disturbed by chemical treatment (removal or addition of ^{228}Ra) this ratio can never drop below 0.7

→ the ^{228}Th activity must always be greater than 70% of the ^{232}Th activity



K concentration measurements on a variety of GERDA samples with ICPMS

Axel Gerdes
Univ. Frankfurt

Sample #	Sample description	K concentrations in ppm	
		before blank subtraction	after blank subtraction
L1	Ax-CuSn welding wire	3,8	< 2
L2	Ax-CuSn welding wire	3,5	< 2
L3	PM glass powder (bulb)	98,2	83,9
L4	PM glass powder (bulb)	134	91,2
L5	Capton foil (Cu layer, Krempel)	15	< 4
L6	Capton foil (Cu layer, Krempel)	12	< 4
L7	Cu-P pellets (90% Cu, 10% P)	114	99,6
L8	Cu-P pellets (90% Cu, 10% P)	110	95,7
L11	AlSi 1%, Faden	0,51	0,25
L12	Electrical contact (Ingun, case)	28,8	28,2
L13	Steel (044310 sample 3285T)	0,23	< 0.2
L14	Steel (044310 sample 3285T)	0,81	< 0.2
L16	Electrical contact (Ingun, spring)		< 0.2
L17	Cu-Be wire, MPI München		16
L19	Torlon	1	0,85
L20	Superisolation foil (HERA Cryo Tech.)	8,8	< 1
L21	Superisolation foil (HERA Cryo Tech.)	9,9	< 1
L22	#25 Alloy (Little Falls Alloy)	7,5	< 3
L24	#25 Alloy (Little Falls Alloy)	4,4	< 1
L23	Cu-Be wire (Good Fellow)	2,7	< 3
L25	Ge (nat. composition, from Russia)	0,32	< 0.1

K concentrations [ppm] resulting from γ ray screening

54 ± 5

4.2 ± 1.0

0.32 ± 0.06 **?**

0.050 ± 0.013

2.6 ± 0.6

K concentration measurements on a variety of GERDA samples with ICPMS

Axel Gerdes
Univ. Frankfurt

- Problems (no experience with K)
  - No isotope tracer used
  - Interference from ^{38}Ar-H and ^{40}Ar-H ions (Ar plasma)
  - Rather high blank values
- Improvements possible
  - Use isotope tracer (^{41}K) -> chemical separation possible
  - Use different plasma gas (Ne, Xe ?)
  - Reduce blank values (measure K contents of all chemicals used in sample preparation)
- What can in principle be achieved ?

ICPMS measurements in Borexino (P.R. Trincherini, ISPRA)

DMP quencher 0.2 ppb ⟶ 6 μBq/kg ^{40}K

Water ~ 0.1 ppb

Radon monitor for GERDA

Stainless steel vessel, inner surface electropolished, volume 710 l

Status:
Mechanical parts ready

Currently:
HV tests (up to 60 kV)

Expected count rate:
45 cpd for ^{214}Po and ^{218}Po (for a ^{222}Rn concentration in air of 1mBq/m^3)

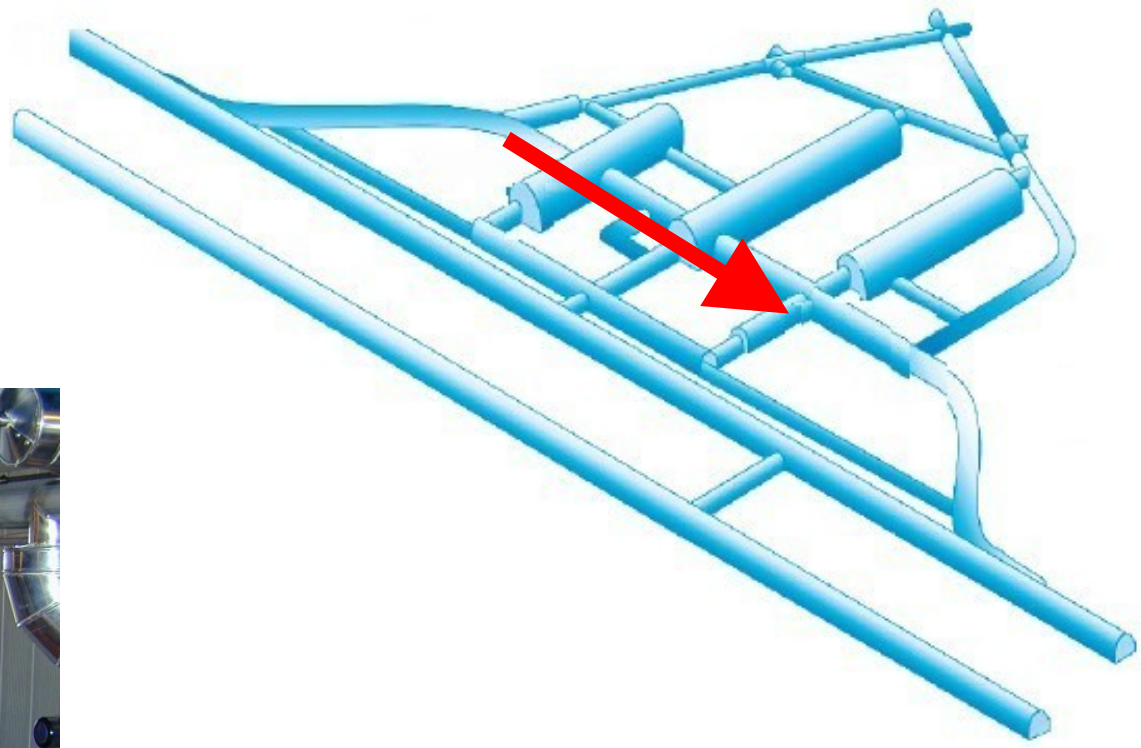
Ready for use at LNGS:
Spring/summer 2006

GeMPI-2 detector

If needed: detector is almost ready for use in material screening

Still missing:

- Efficiency calibration
- Some mechanical parts



For comparison:

Background rate 40 – 2700 keV (with empty sample chamber)

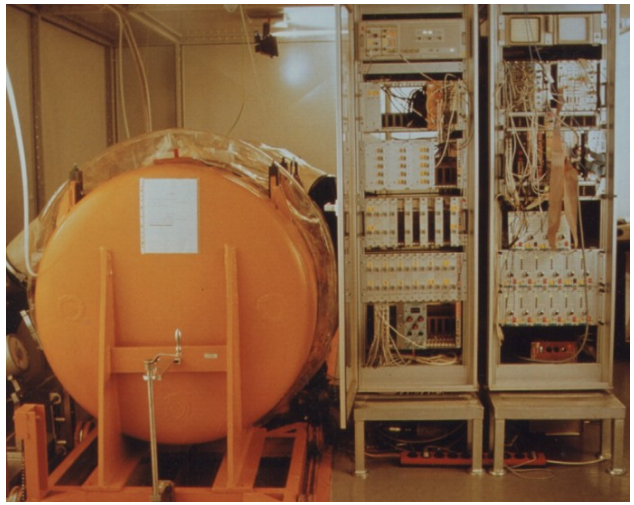
GeMPI: ~ 100 cpd/kg

GeMPI-2 ~ 63 cpd/kg

GALLEX/GNO Counting building in hall A

has recently been assigned to the general Low-Level facilities at LNGS
Responsible scientist: Matthias Laubenstein

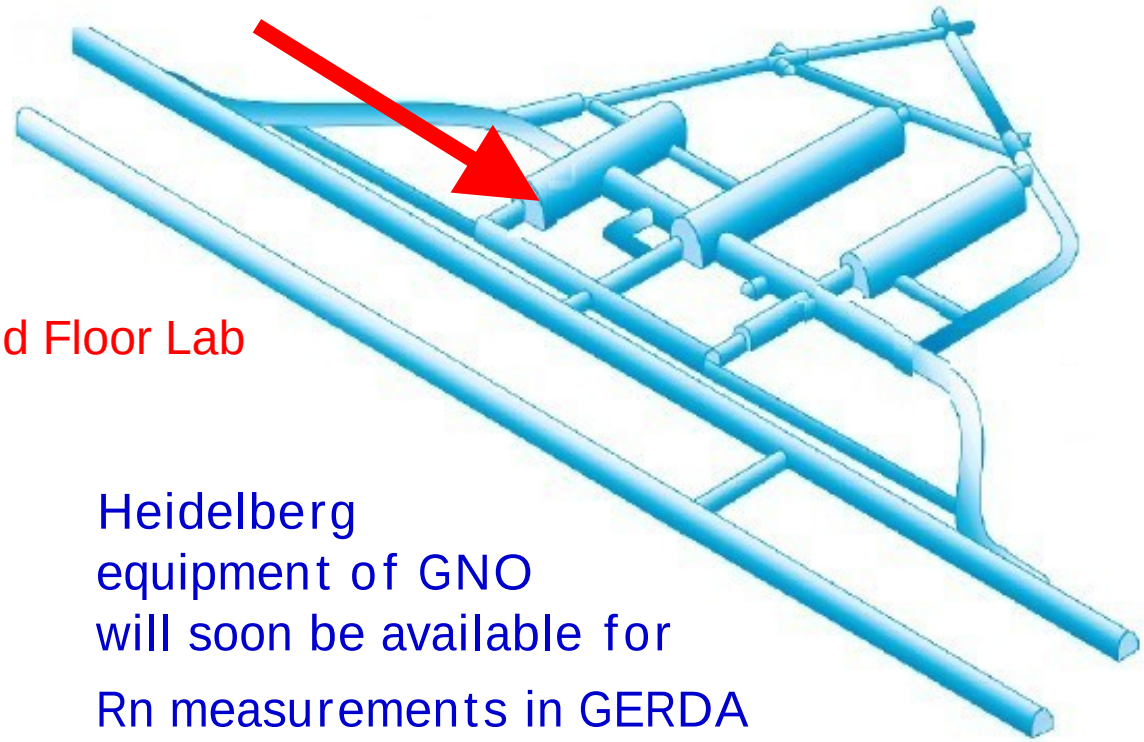
GNO counter filling line, now at Heidelberg, will be reinstalled at the FFL



GNO lead shield located in the Faraday cage of the GFL

First Floor Lab (FFL)

Ground Floor Lab (GFL)



Heidelberg equipment of GNO will soon be available for Rn measurements in GERDA