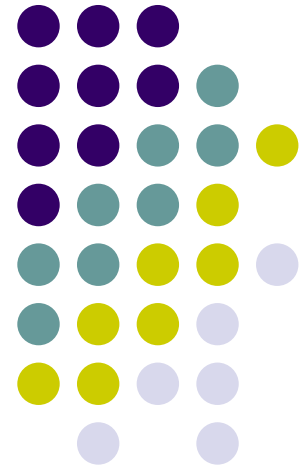


TG11 overview

Material screening

Hardy Simgen

Max-Planck-Institut für Kernphysik / Heidelberg





Outline

- New hardware development
- Gamma-ray screening results
 - Circuit components
 - Others
- ICP-MS measurements
 - PEN (Teonex) and Kapton
- ^{222}Rn emanation measurements

Rn monitor installation



Sep 09



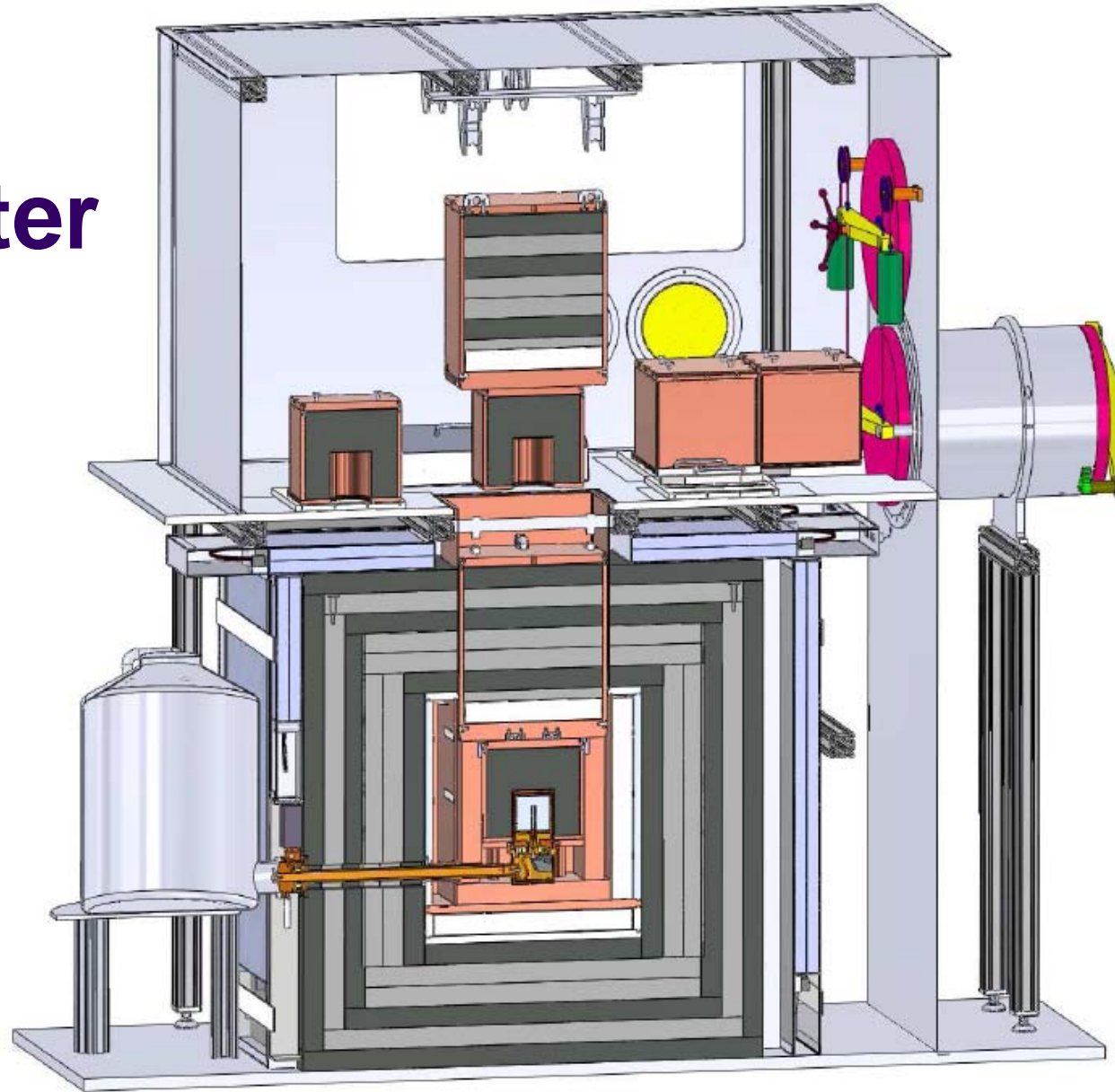
Rn monitor parameters

- Measurement of
 - Air: 40 kV: 76% collection efficiency
 - Ar: 8 kV: 95% collection efficiency
- ^{222}Rn emanation rate:
 - ~ 0.3 mBq (i.e. $5 \mu\text{Bq}/\text{m}^3$ @ 6 l/min flow-rate)
- Background: 0.2 – 2 cpd (double amplifier technique, PSA)
- Sensitivity down to $\sim 100 \mu\text{Bq}/\text{m}^3$
- Minor things missing (Network, connection tube)

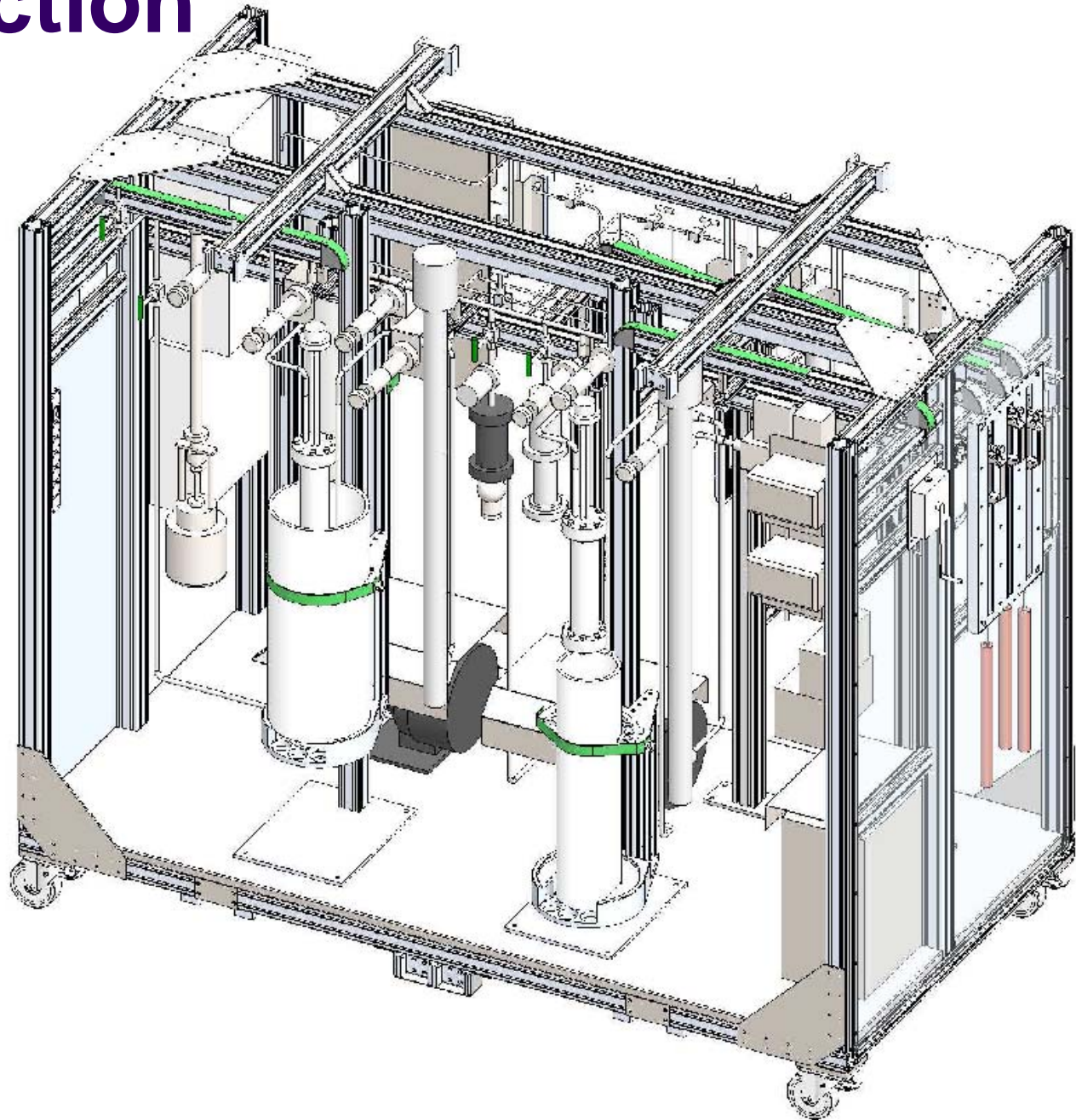
GIOVE: A new Ge- spectrometer @ MPIK

- Reduction of neutron background at shallow depth (15 m w.e.)

→ Talk by
Marc Weber



Construction of new MoREx

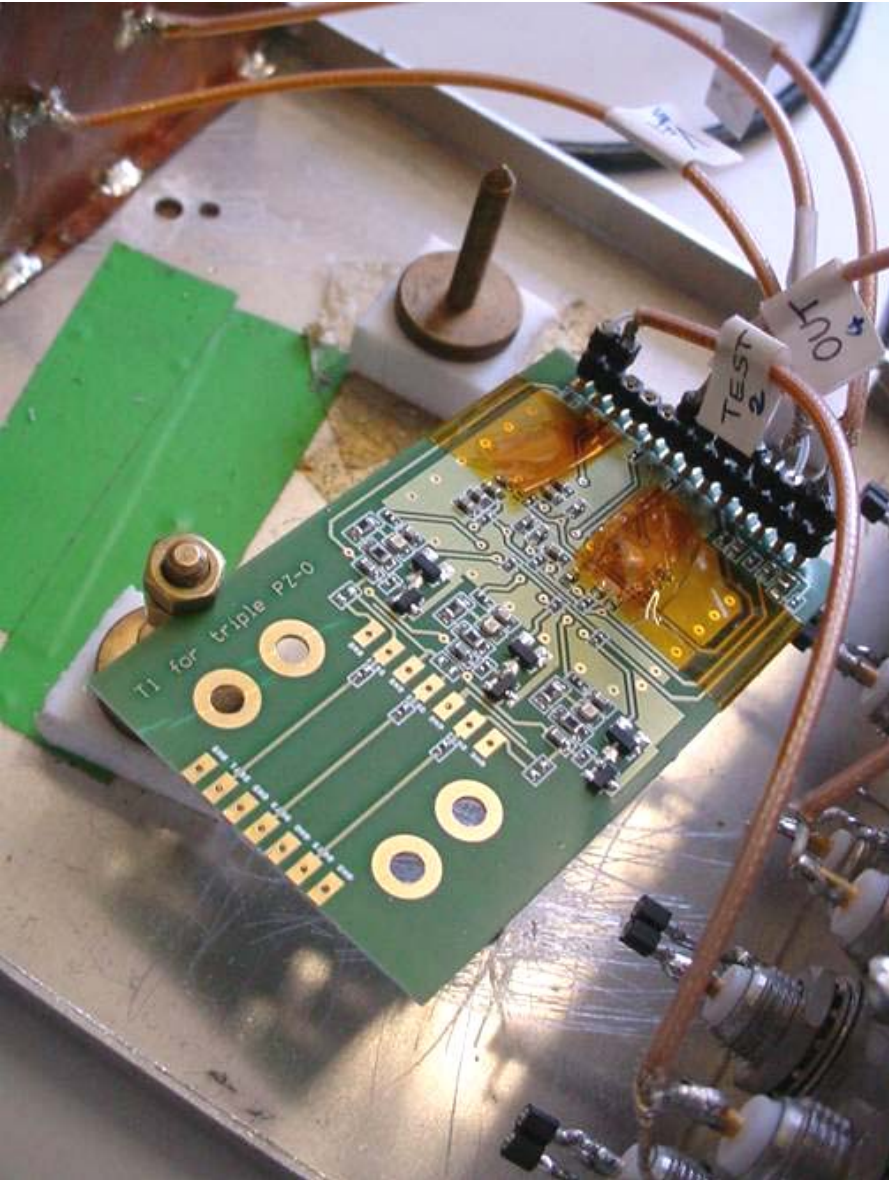
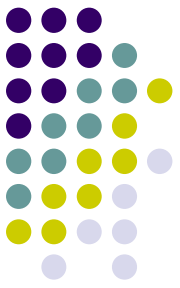


TG11 activities I won't talk about...



- Cryostat emanation tests: (54.7 ± 3.5) mBq
- Behaviour of Rn and Rn daughters in a cryogenic environment:
 - Talk by Sebastian Lindemann
 - Talk by Krzysztof Pelczar
- Neutron activation analysis of various materials
 - Talk by Alexander Domula

Gamma-ray screening: PZ0



Matthias' slide from Padova:

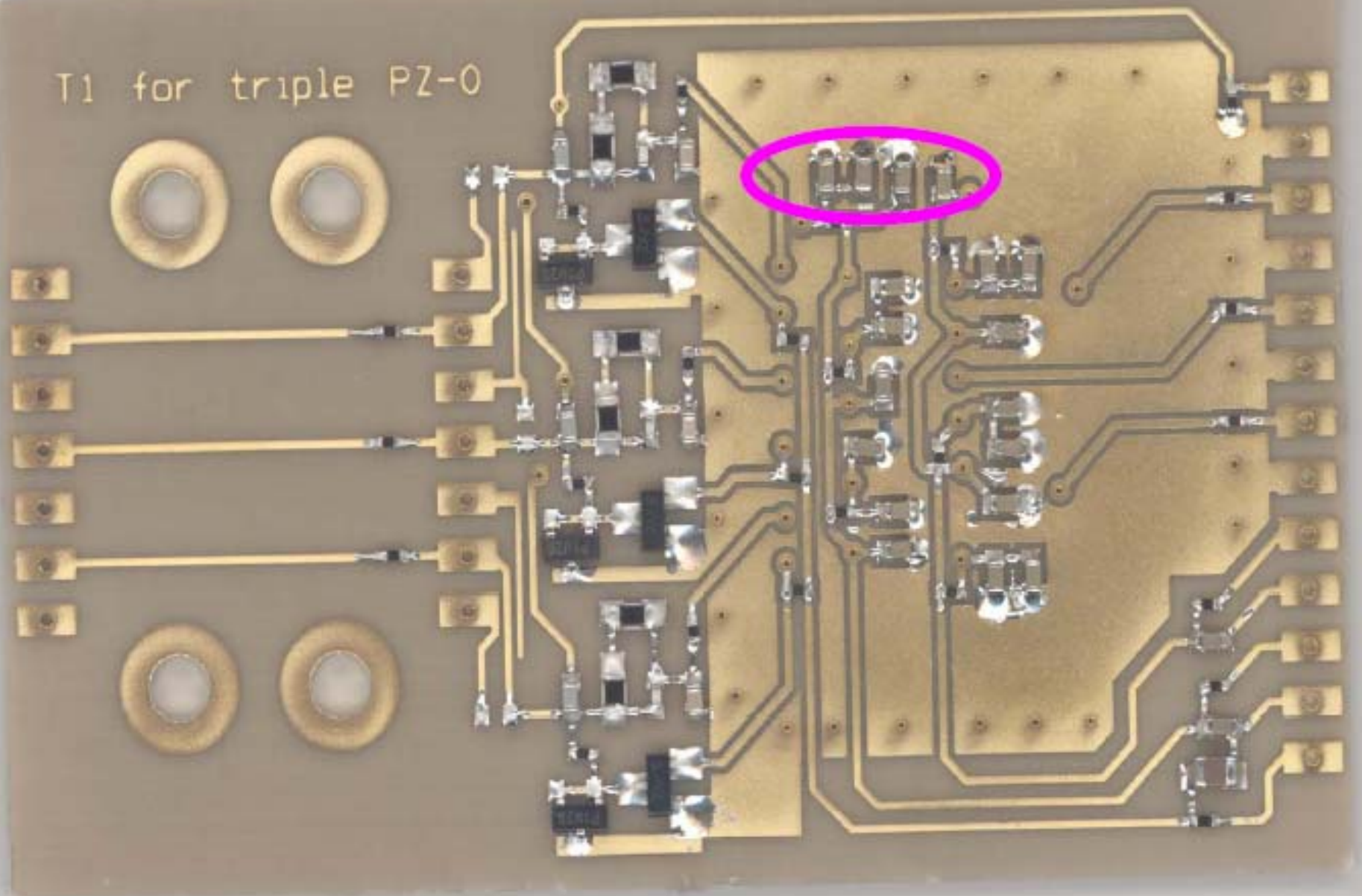
Radionuclide concentrations per PCB

item	mass	^{226}Ra	^{228}Ra	^{228}Th	^{40}K
PCB	6.5 g	6.3 ± 0.5	0.21 ± 0.13	0.19 ± 0.08	2.2 ± 0.7
Cuflon	4.4 g	$< 3.5 \text{ E-}3$	$< 12 \text{ E-}3$	$< 7.9 \text{ E-}3$	0.19 ± 0.06
solder	~2 g	$< 9.6 \text{ E-}3$	$< 9.2 \text{ E-}3$	$< 13 \text{ E-}3$	< 0.10
FET	0.05 g	$31 \pm 8 \text{ E-}3$	$< 26 \text{ E-}3$	$33 \pm 8 \text{ E-}3$	< 0.12
Big res.	0.03 g	$< 22 \text{ E-}3$	$< 20 \text{ E-}3$	$< 20 \text{ E-}3$	< 0.21

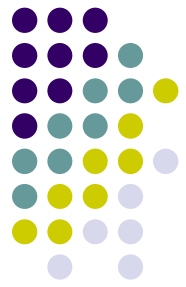
unit in mBq

20 x X5R

T1 for triple PZ-0



γ -ray screening results of PZ0 and capacitors [mBq/PCB]

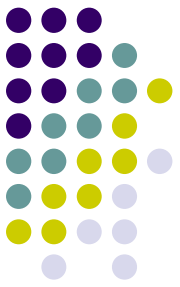


Sample		^{226}Ra	^{228}Th	^{228}Ra	^{40}K
PCB	1 piece / 6.5 g	6.3 ± 0.5	0.2 ± 0.1	0.2 ± 0.1	2.2 ± 0.7
Capacitors NP0	9 pc./PCB	0.6 ± 0.2	<0.4	0.7 ± 0.3	<3.2
Capacitors X7R	1 pc./PCB	1.0 ± 0.1	0.3 ± 0.1	<0.4	<0.7
Capacitors X5R	20 pc./PCB	3.8 ± 0.3	0.8 ± 0.2	<1.0	<2.9
Ta capacitors Farnell 165-8386 10 μF , 4 V	50 pieces (0.27 g)	<3 $\mu\text{Bq/pc.}$	8 ± 2 $\mu\text{Bq/pc.}$	<10 $\mu\text{Bq/pc.}$	70 ± 30 $\mu\text{Bq/pc.}$
Ta capacitors Farnell 165-8387 4.7 μF , 10 V	50 pieces (0.25 g)	<2 $\mu\text{Bq/pc.}$	2 ± 1 $\mu\text{Bq/pc.}$	<5 $\mu\text{Bq/pc.}$	80 ± 20 $\mu\text{Bq/pc.}$

see GERDA Wiki <http://www.mpi-hd.mpg.de/gerdawiki/index.php/Circuit>

Gamma-ray screening results

Activities in [mBq/kg]



Sample	^{226}Ra	^{228}Th	^{228}Ra	^{40}K
10% borated PE	53 ± 2	9.3 ± 1.7	5.3 ± 2.3	34 ± 8
5% borated PE (Profilan)	130 ± 4	12 ± 2	14 ± 2	23 ± 7
unborated PE (Profilan)	<4	<4	<7	<17
Boron oxide	570 ± 20	50 ± 10	70 ± 10	70 ± 30
Viton O-rings for LArGe (fraction measured at IRMM)	440 ± 30	80 ± 15	67 ± 15	2700 ± 280
Viton O-rings for LArGe (fraction measured at MPIK)	310 ± 50	<190	<230	910 ± 360

ICP-MS measurements of PEN (Teonex) and Kapton



- Kapton is dirty in ^{226}Ra : ~ 9 mBq/kg
- Flat cable production with PEN proven (metal layer deposition possible)
- PEN is promising material, but contradicting results:
 - 1st sample : U <16 ppt (only ICP-MS)
 - 2nd sample: 1000 times worse (γ and ICP-MS)
 - 3rd sample: ^{226}Ra : <2 mBq/kg (γ)
- Cross check of 3rd sample with ICP-MS



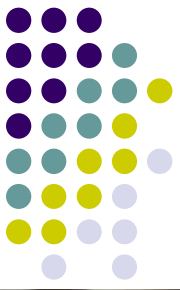
PEN (Teonex) and Kapton

- Two detailed reports from Stefano Nisi:
- Linked on GERDA Wiki:
http://www.mpi-hd.mpg.de/gerdawiki/index.php/TEONEX_and_Kapton

Summary:

Element / Isotope	PEN (Teonex)		Kapton	
	c [ppt]	A [mBq/kg]	c [ppt]	A [mBq/kg]
U / ^{226}Ra	30 - 80	0.4 - 1.0	800	10
Th / ^{228}Th	20 - 120	0.1 - 0.5	120	0.5
K / ^{40}K	$3 \cdot 10^5$	10	$<1.5 \cdot 10^6$	<50

Emanation measurements: Viton o-rings for LArGe



- 20 Viton o-rings (63.3 g, 3 mm x 75 mm)
- Results:
(1.04 ± 0.10) mBq
(28 ± 2) mBq/m²
- γ -ray screening:
²²⁶Ra: (440 ± 30) mBq/kg (IRMM)
²²⁶Ra: (310 ± 50) mBq/kg (MPIK)
 \Rightarrow 4 - 5 % of the ²²²Rn is emanated



^{222}Rn emanation results: Saturation activity in [mBq]



Sample	Description	Result
Cu foil for shroud	similar amount as used for shroud	$<71 \mu\text{Bq}$
Rn monitor	Cross-check with proportional counters	$\sim 0.3 \text{ mBq}$
Polyurethane o-rings (93° Sh)	26 pieces, thickness: 2 mm and 3 mm	$(1.3 \pm 0.1) \text{ mBq}$ $(40 \pm 3) \text{ mBq/m}^2$
Polyurethane o-rings (90° Sh)	15 pieces, thickness: 4 mm	$<66 \mu\text{Bq}$ $<1 \text{ mBq/m}^2$
10 % borated PE	4pc. (20 x 20 x 5) cm^3	$(0.20 \pm 0.05) \text{ mBq}$ $(0.4 \pm 0.1) \text{ mBq/m}^2$

Emanation measurements: LEDs

- 6 pieces with cables
- Total result:
 $(0.34 \pm 0.09) \text{ mBq}$
- Specific result:
 $(60 \pm 15) \mu\text{Bq/pc.}$
- Measurement is still ongoing

