TG11 overview Material screening

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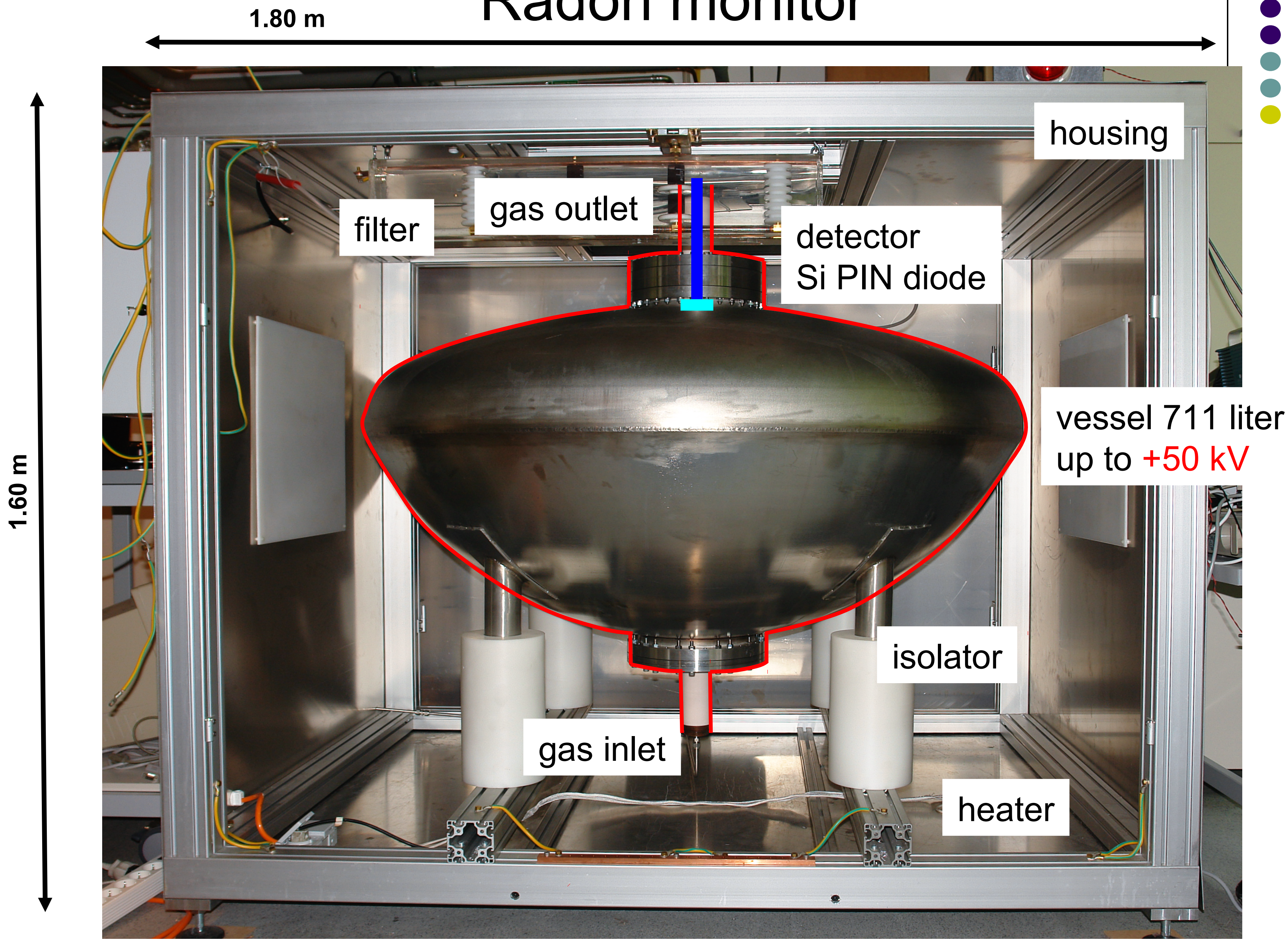
GERDA

Outline

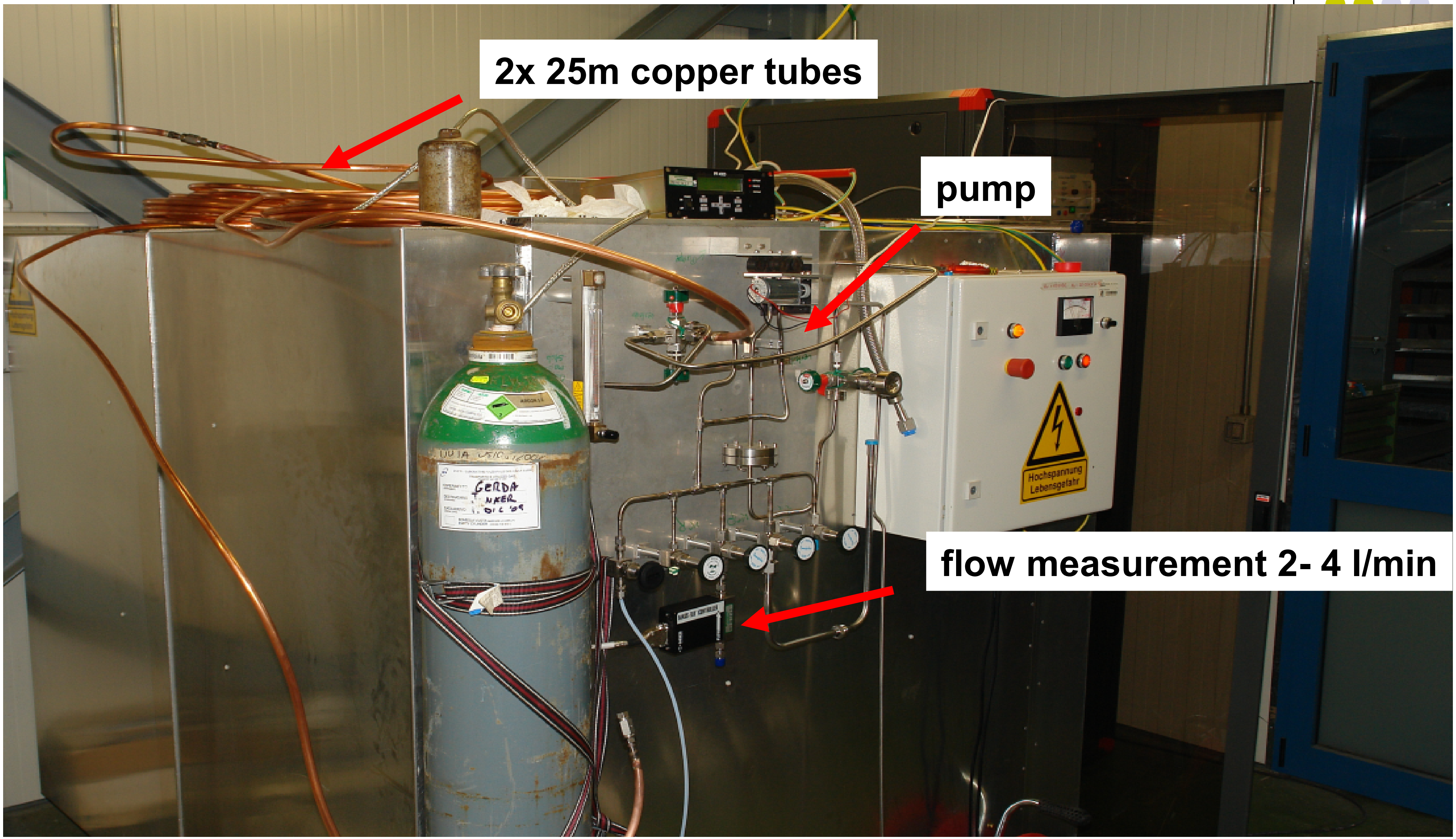
- News from
  - the ^{222}Rn monitor
  - ^{222}Rn emanation tests
  - gamma-ray screening
  - Rn daughters → Talk by Grzegorz Zuzel

- Thanks to Alfredo Ferella, Mikael Hult, Matthias Laubenstein and Jochen Schreiner for providing input and slides.

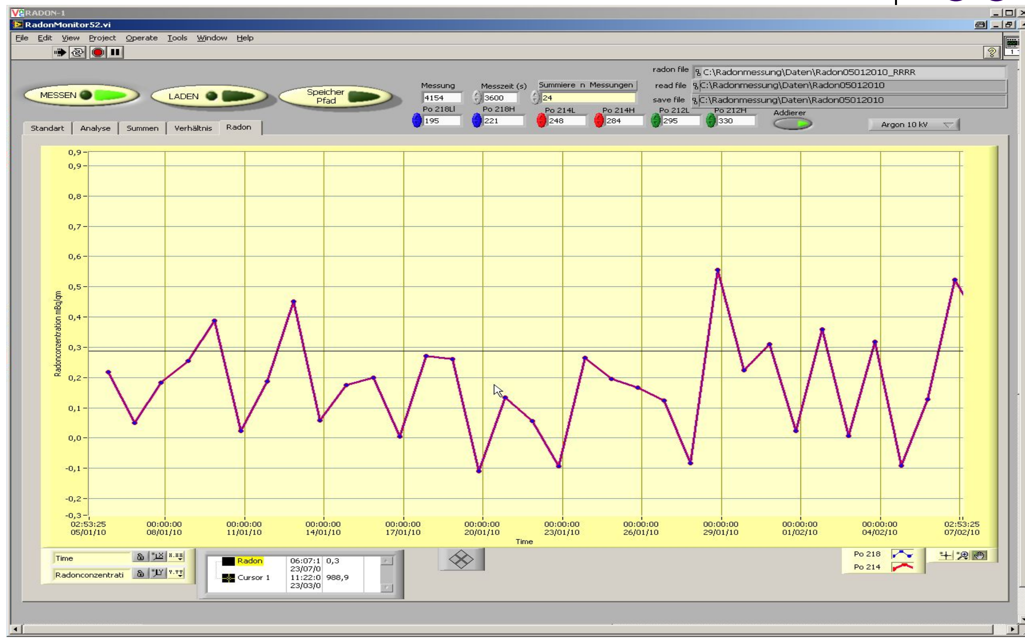
Radon monitor



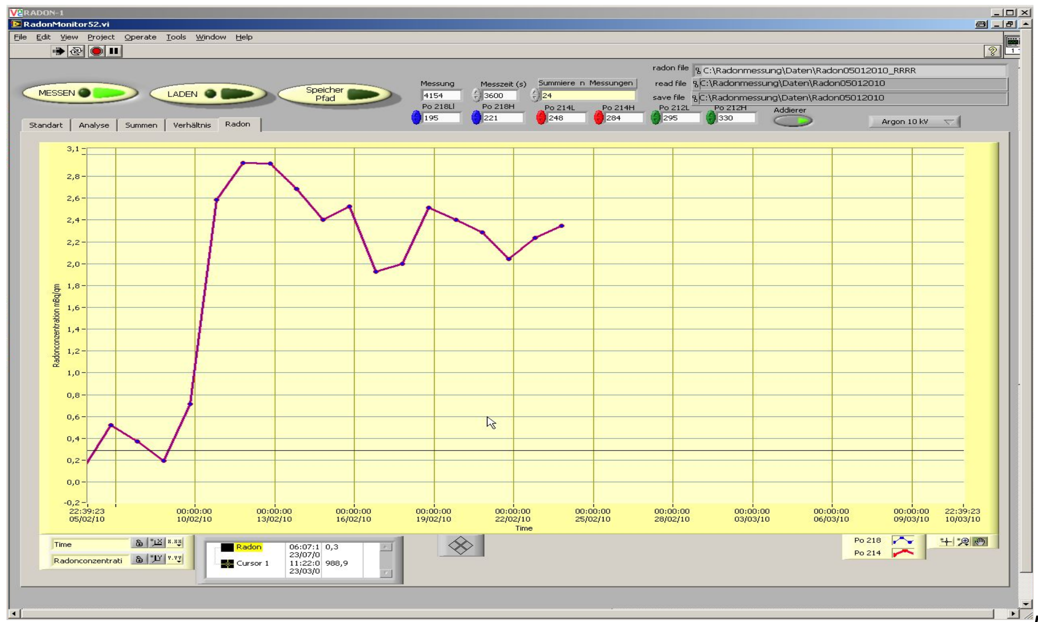
Radon Monitor at LNGS



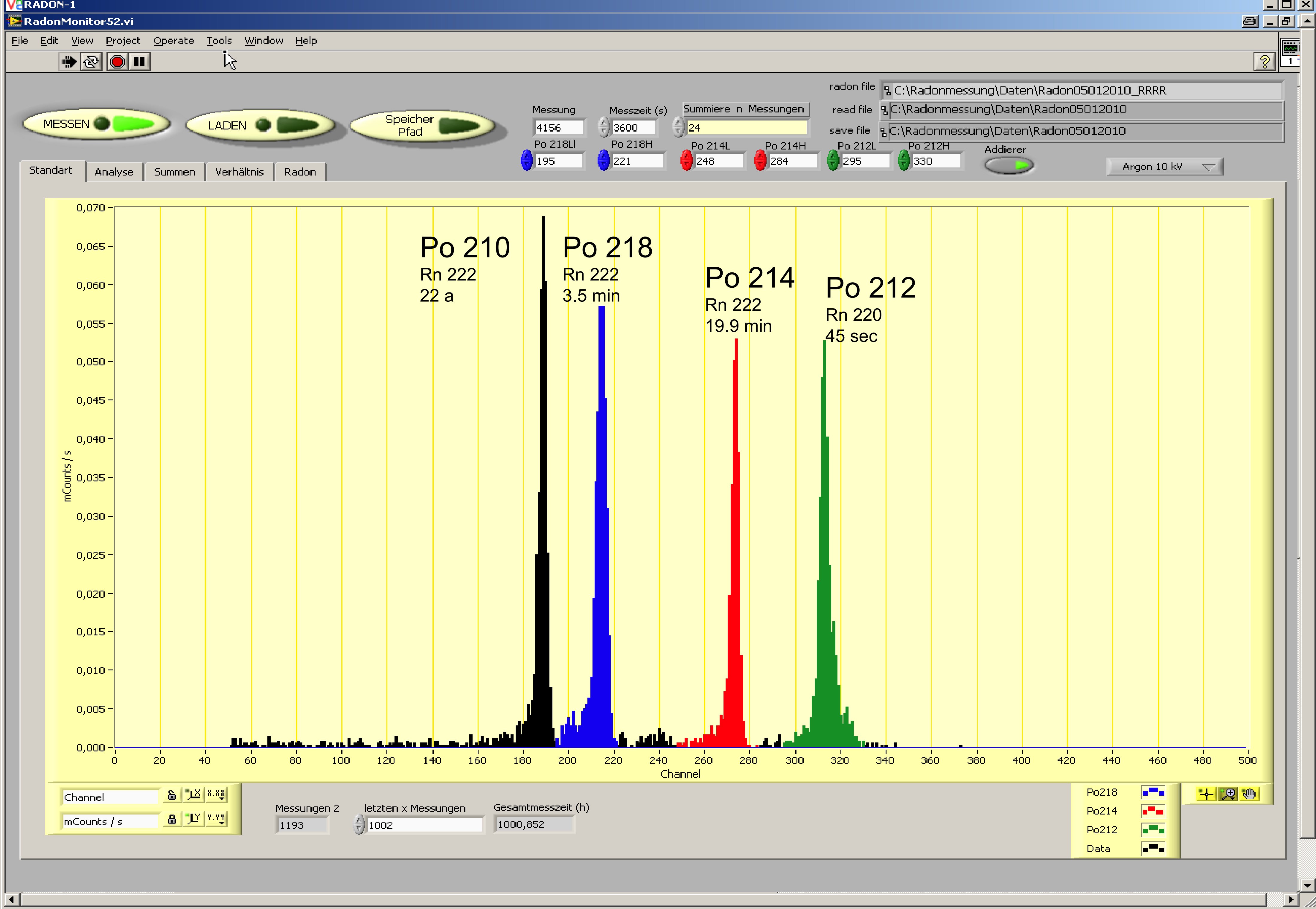
Radon Monitor emanation
0.3 +- 0.1 mBq/m³



Radon Monitor, pump and copper tubes emanation
2.2 +- 0.3 mBq/m³




RADON-1
RadonMonitor52.vi
File Edit View Project Operate Tools Window Help
MESSEN
LADEN
Speicher Pfad
Messung
4156
Messzeit (s)
3600
Summiere n Messungen
24
radon file
C:\Radonmessung\Daten\Radon05012010_RRRR
read file
C:\Radonmessung\Daten\Radon05012010
save file
C:\Radonmessung\Daten\Radon05012010
Po 218LI
195
Po 218H
221
Po 214L
248
Po 214H
284
Po 212L
295
Po 212H
330
Addierer
Argon 10 kV
Standart
Analyse
Summen
Verhältnis
Radon
Po 214
Rn 222
19.9 min
Po 218
Rn 222
3.5 min
Po 210
Rn 222
22 a
Po 212
Rn 220
mCounts / s
Channel
Messungen 2
1193
letzten x Messungen
2
Gesamtmesszeit (h)
1,999
Po218
Po214
Po212
Data


RADON-1
RadonMonitor52.vi
File Edit View Project Operate Tools Window Help
MESSEN
LADEN
Speicher Pfad
Messung
4156
Messzeit (s)
3600
Summiere n Messungen
24
radon file
C:\Radonmessung\Daten\Radon05012010_RRRR
read file
C:\Radonmessung\Daten\Radon05012010
save file
C:\Radonmessung\Daten\Radon05012010
Po 218LI
195
Po 218H
221
Po 214L
248
Po 214H
284
Po 212L
295
Po 212H
330
Addierer
Argon 10 kV
Standart
Analyse
Summen
Verhältnis
Radon
Po 210
Rn 222
22 a
Po 218
Rn 222
3.5 min
Po 214
Rn 222
19.9 min
Po 212
Rn 220
45 sec
mCounts / s
Channel
Channel
mCounts / s
Messungen 2
1193
letzten x Messungen
1002
Gesamtmesszeit (h)
1000,852
Po218
Po214
Po212
Data

^{222}Rn emanation results

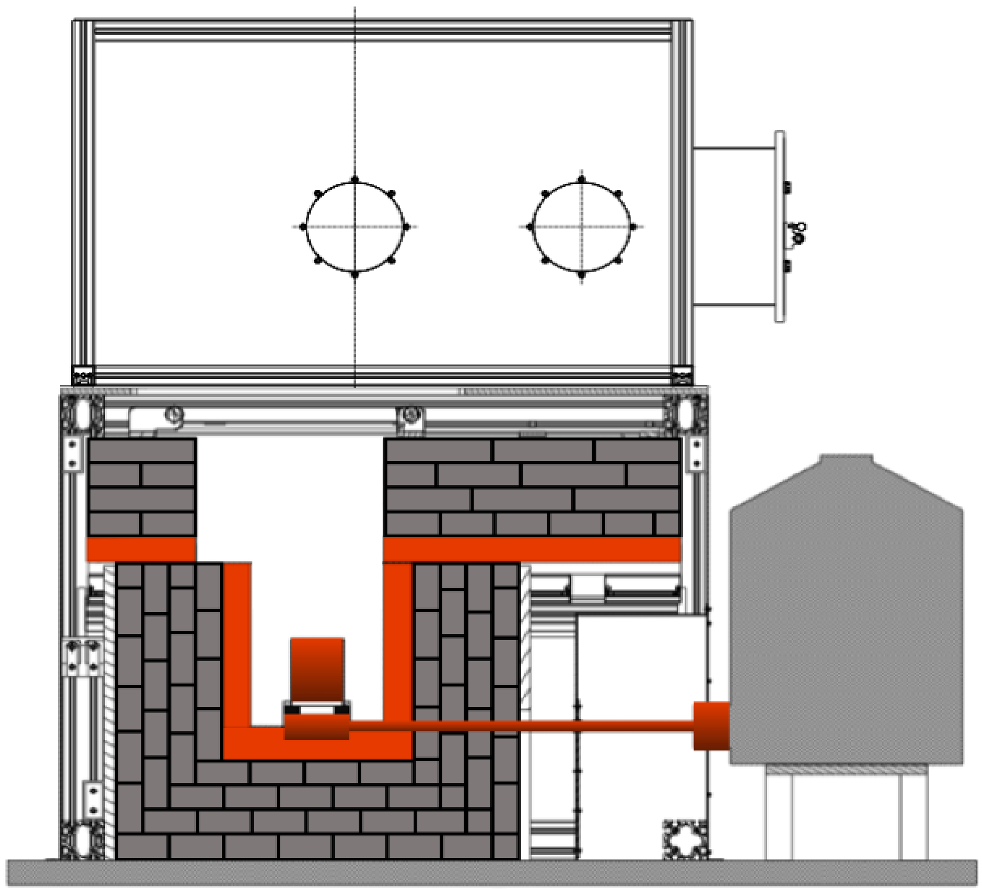
- As usual all numbers are saturation emanation rates

- „Actual position“ measurement device:
  - Controller: (0.43 ± 0.09) mBq
  - Plug: (0.20 ± 0.09) mBq
  - Cable: (1.5 ± 0.17) mBq

$\Rightarrow$ ~2 mBq additional ^{222}Rn in inner detector

GATOR screening of GERDA samples

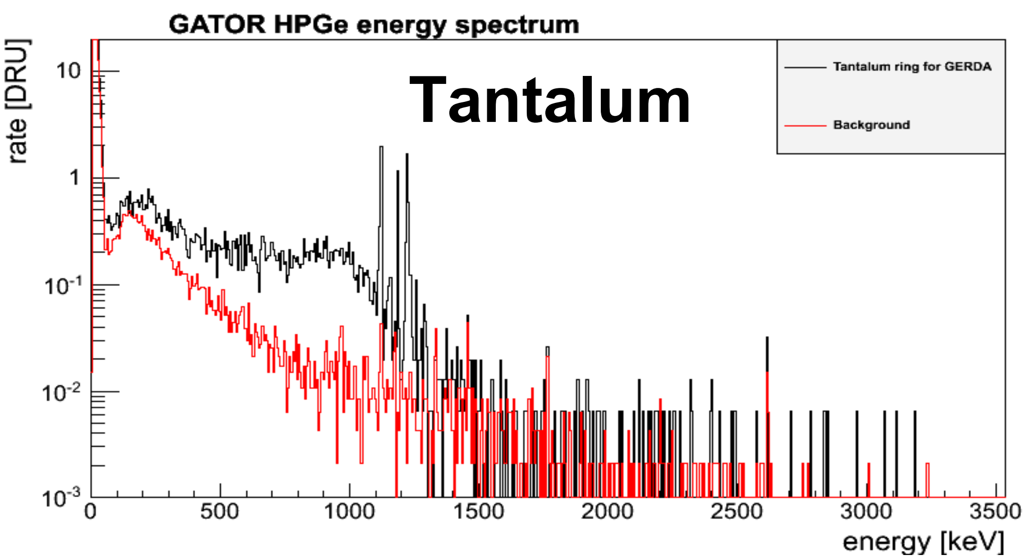
UZH group

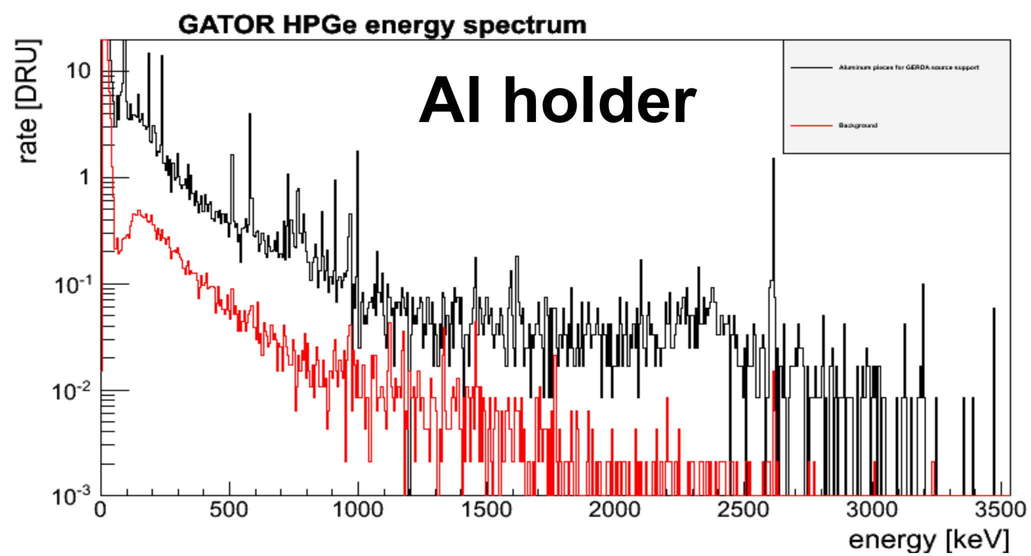


Results

- **Tantalum (source absorber) (8.758 kg)**
- **Aluminum pieces (absorber support) (125 g)**

Material	^{226}Ra [mBq/kg]	^{238}U [Bq/kg]	^{232}Th [mBq/kg]	^{60}Co [mBq/kg]	^{40}K [mBq/kg]	Other [mBq/kg]
Al support	< 13	8 ± 1	^{228}Ra 101 ± 25 ^{224}Ra 491 ± 56	< 5	< 65	310 ± 40 (^{235}U)
Absorber	< 2.3	< 120	^{228}Ra < 2.2 ^{224}Ra < 3.2	< 0.5	< 3.88	21.3 ± 2.8 (^{182}Ta)





Gamma-ray screening results from LNGS (Matthias L.)

Sample	^{226}Ra	^{228}Th	^{228}Ra	^{40}K	^{60}Co
	Unit: [Bq/kg]				
Resin for CR-floor	0.82 ± 0.06	0.08 ± 0.03	0.08 ± 0.03	< 0.7	---
Filler for CR-floor	8.9 ± 0.6	10 ± 1	8 ± 1	0.37 ± 0.04	---
Resin + filler	9.3 ± 0.4	9.9 ± 0.6	9.6 ± 0.5	0.34 ± 0.03	---
	Unit: [mBq/kg]				
36 steel bolts for LArGe	1.4 ± 0.3	3.6 ± 0.5	1.0 ± 0.5	6 ± 2	10.4 ± 0.7
Steel tape for meter drive	4 ± 1	3 ± 1	< 5	70 ± 20	1.6 ± 0.5
Raw Cu for PCB housing	< 1.8	< 2.2	< 1.3	< 22	< 0.76
Plastic scintillator slabs	1.0 ± 0.1	9.3 ± 0.3	9.2 0.4	2.2 ± 0.7	---

Gamma-ray screening results from LNGS (Matthias L.)

Sample	^{226}Ra	^{228}Th	^{228}Ra	^{40}K
	Units: mBq/piece			
New pins for PCB	< 0.0038	0.003 ± 0.001	< 0.0062	0.02 ± 0.01
„Old“ PCB	6.3 ± 0.5	0.2 ± 0.1	0.2 ± 0.1	2.2 ± 0.7
Modified PCB with Ta cpacitors (2 independent measurements)	0.70 ± 0.15 0.49 ± 0.08	< 0.4 0.28 ± 0.08	< 0.28 0.25 ± 0.09	5.4 ± 1.9 2.6 ± 0.7
3 modified PCBs with Ta capacitors (including the upper one)	0.54 ± 0.08	0.29 ± 0.08	0.24 ± 0.09	3.2 ± 2.8

Clamp Rings for cable chain (Bela)

- Amount: 56000 (~1000 for Phase I, 10 000 for Phase II)
- Cleaning in ultrasonic bath, rinsing in deionised water
- Almost all rings (we didn’t count them) measured together in a Marinelli beaker
- m = 1.41 kg
- Measurement time: 24.5 days
- Detector: “Ge-4”, XtRa with 106% rel. eff.

Clamp Ring Results

Radionuclide	Detected radionuclide	Massic activity (mBq/kg)	Uncertainty (mBq/kg)	alpha=0.05 Decision threshold (mBq/kg)	Comment
U-238 U-235	Th-234 185.7 keV line	25 0.84	8 0.13		Ratio: 30 ± 11 Nat. isot. Abund.: 21
Ra-226	Pb-214+Bi-214	8.8	1.5		
Ra-228	Ac-228	9.6	1.1		
Th-228	Pb-212+Tl-208	7.7	0.9		
Pb-210	Pb-210			74	Quite high! But very low efficiency due to low gamma-energy
	K-40	32	3		
	Co-60	1.63	0.22		
	Mn-54	2.57	0.24		

Steel plates

Radio-nuclide	Detected radionuclide	Batch-0 (mBq/kg)	Batch-1 (mBq/kg)		Batch-1/ Batch-0	Half-life
Ra-226	Ra-226 (186 keV)	0.67 ±1.00	2.0 ±5.0	< DT	3.0 ±8.7	
Ra-226	Bi-214+Pb-214	0.55 ±0.13	1.6 ±0.4		2.9 ±0.9	
U-238	Th-234		15 ±6			
U-235	U-236 (186 keV)		0.54 ±0.20			
Pb-210		500 ±200.00	700 ±300.00		1.4 ±0.8	
Th-228	Pb-212+Tl-208	0.84 ±0.18	2.40 ±0.80		2.9 ±1.1	
Ra-228	Ac-228	0.55 ±0.23	< 2	<DT	<4	
K-40		1.55 ±0.50	1.30 ±1.04	<DT	0.8 ±0.7	
Cr-51		5.0 ±1.0	5.0 ±1.70		1.0 ±0.4	28 d
Mn-54		2.29 ±0.16	2.04 ±0.21		0.89 ±0.11	312 d
Co-58		0.43 ±0.07	<0.25	<DT	<0.6	71 d
Co-60		9.0 ±0.5	13.9 ±0.80		1.54 ±0.12	5.2 y

Batch-"0" Preferred

Extra task

- Select the most radiopure rings!
- … will keep all our detectors busy through Phase III and beyond.