^{222}Rn emanation measurements of the GERDA cryostat

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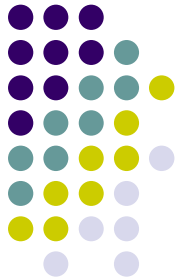
The procedure

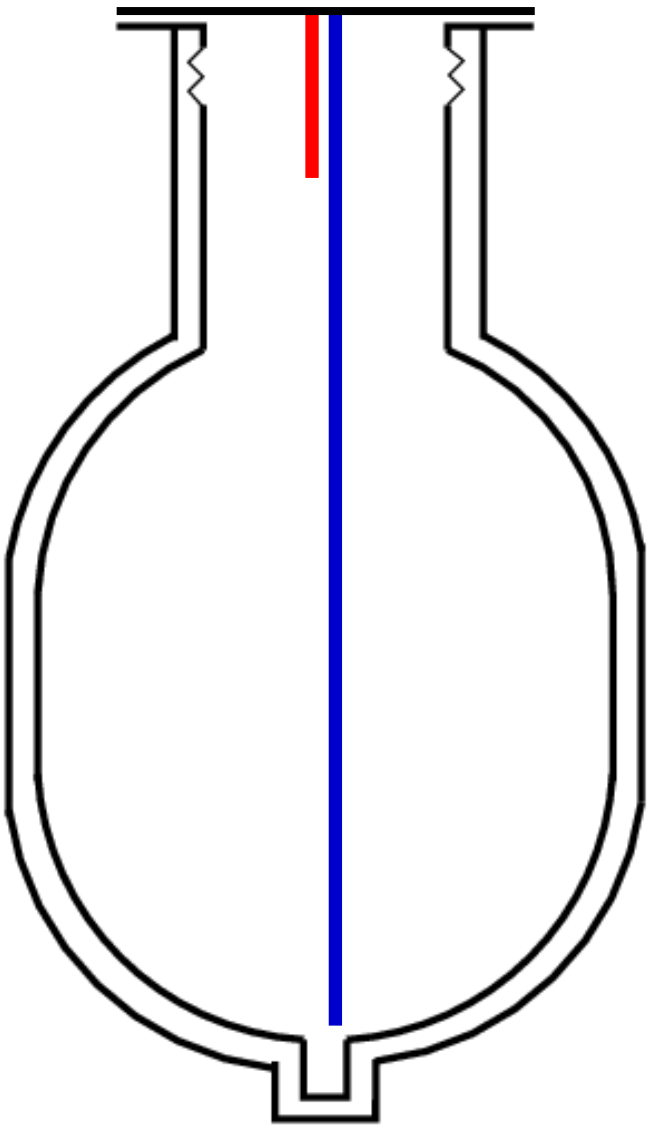


1. Remove air-borne ^{222}Rn (Evacuating cryostat twice to ~1 mbar)
2. Fill with ^{222}Rn-free N_2 (purified with MoREx)
3. Wait for ≥1 week to let grow-in emanating ^{222}Rn
4. Mix N_2 in order to guarantee homogeneuos ^{222}Rn distribution in the N_2 (Adding ^{222}Rn-free N_2 in a turbulent way right before the extraction)
5. Extract small fraction of N_2 from cryostat and determine its ^{222}Rn concentration
6. Scale to entire cryostat to find total emanation rate

Previous results

No.	Date	Description	Single results [mBq]	Average [mBq]
1	Nov 07	After construction and cleaning, no N_2 mixing	$16.9 \pm 1.6_{stat} \pm 3.0_{sys}$ $29.8 \pm 2.4_{stat} \pm 5.8_{sys}$	23.3 ± 3.6
2	Mar 08	After additional cleaning	$13.6 \pm 0.7_{stat} \pm 2.4_{sys}$ $13.7 \pm 0.7_{stat} \pm 2.7_{sys}$	13.7 ± 1.9
3	Jun 08	After Cu mounting	$33.0 \pm 2.8_{stat} \pm 7.0_{sys}$ $35.7 \pm 2.9_{stat} \pm 8.8_{sys}$	34.4 ± 6.0
4	Nov 08	After wiping of Cu / steel surfaces.	$33.2 \pm 3.5_{stat} \pm 1.9_{sys}$ $31.3 \pm 4.6_{stat} \pm 3.4_{sys}$ $27.3 \pm 2.4_{stat} \pm 0.7_{sys}$	30.6 ± 2.4

Reminder: Homogeneity test



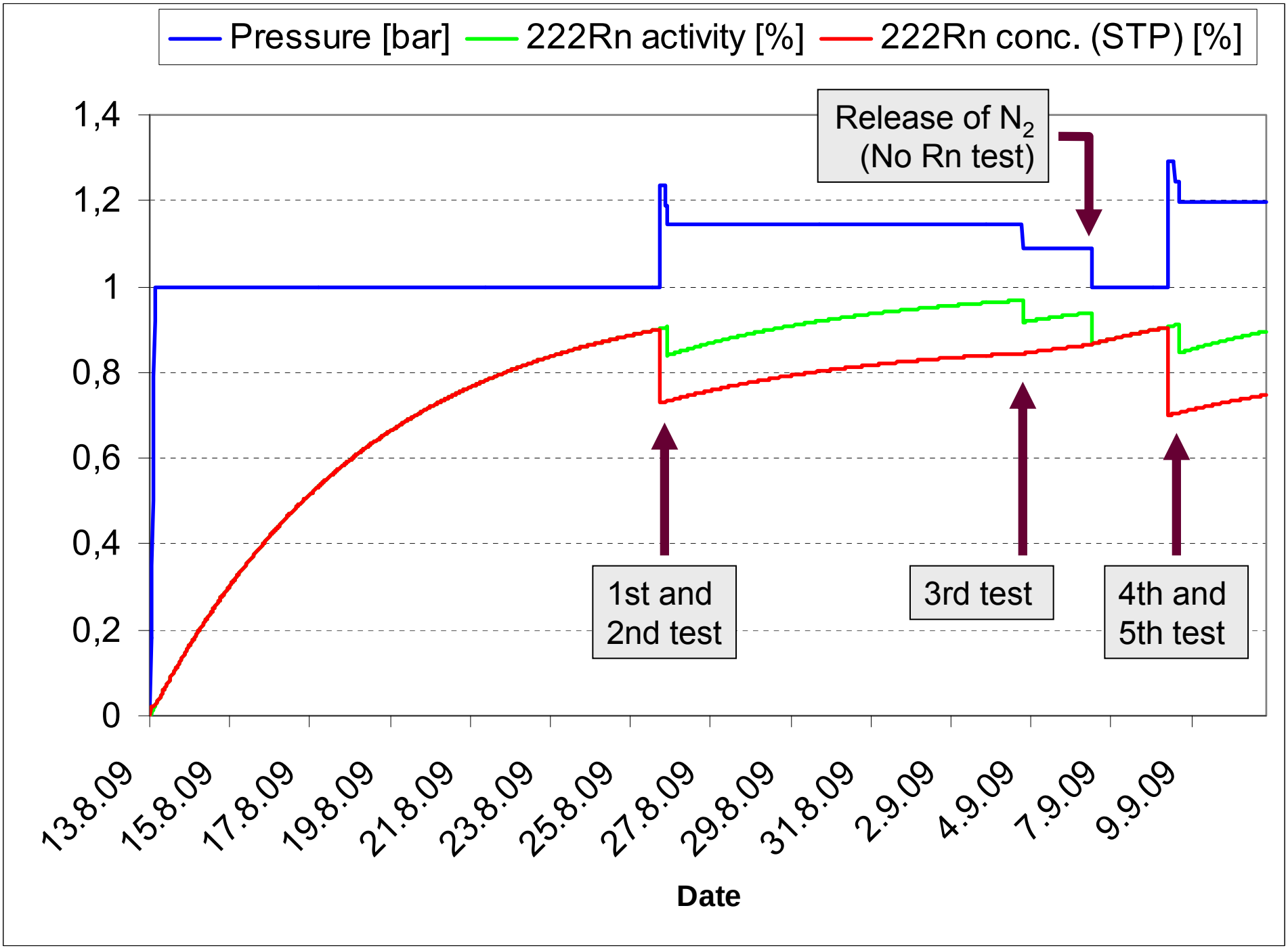
Before mixing:

- $c_{bot} = (0.28 \pm 0.03)$ mBq/m^3 (STP)
- $c_{top} = (0.42 \pm 0.05)$ mBq/m^3 (STP)

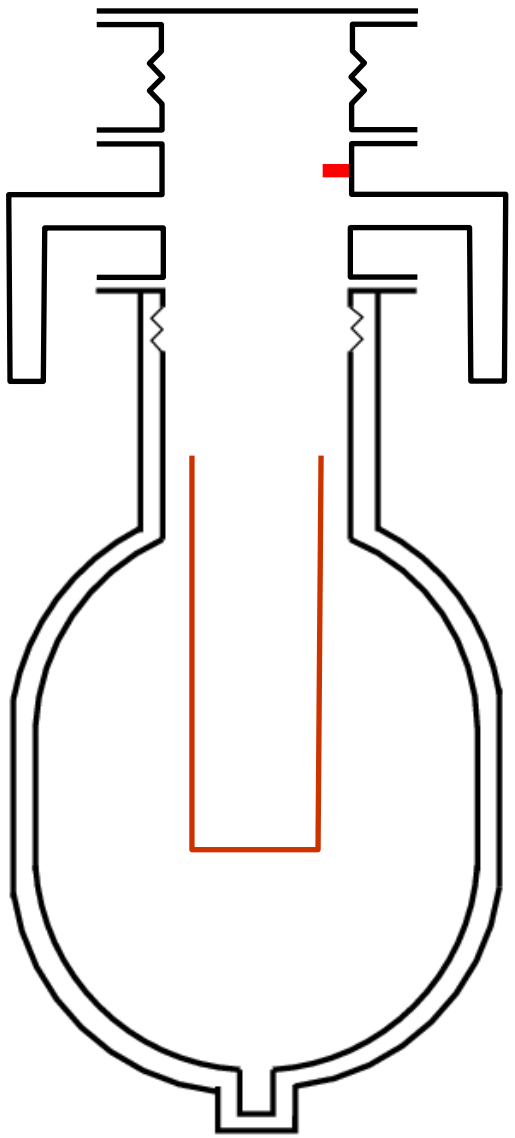
After mixing:

- $c_{bot} = (0.27 \pm 0.05)$ mBq/m^3 (STP)
- $c_{top} = (0.23 \pm 0.03)$ mBq/m^3 (STP)

- If system is untouched ^{222}Rn is NOT homogeneously distributed
- Mixing technique by N_2-adding is working!


Pressure [bar]
222Rn activity [%]
222Rn conc. (STP) [%]
Release of N2
(No Rn test)
1st and
2nd test
3rd test
4th and
5th test
1,4
1,2
1
0,8
0,6
0,4
0,2
0
13.8.09
15.8.09
17.8.09
19.8.09
21.8.09
23.8.09
25.8.09
27.8.09
29.8.09
31.8.09
2.9.09
4.9.09
7.9.09
9.9.09
Date

Latest cryostat ^{222}Rn tests



1st + 2nd test (with mixing):

- c = (0.77 ± 0.06) mBq/m^3 (STP)
- c = (0.98 ± 0.08) mBq/m^3 (STP)

3rd test (without mixing):

- c = (1.50 ± 0.10) mBq/m^3 (STP)

4th + 5th test (with mixing):

- c = (0.86 ± 0.07) mBq/m^3 (STP)
- c = (0.76 ± 0.06) mBq/m^3 (STP)

- Stronger ^{222}Rn source in the upper part than in the lower part of the cryostat.

Summary of latest cryostat ^{222}Rn emanation tests

Date	Sample size [m³ (STP)]	Mixed before sampling ?	Fraction of satura-tion	Measured Rn concentration in saturation [mBq/m³]	Total cryostat emanation [mBq]
26.8.09	3.1	yes	73 %	$0.77 \pm 0.05_{stat} \pm 0.03_{sys}$	$49.9 \pm 3.3_{stat} \pm 2.1_{sys}$
26.8.09	2.7	yes	73 %	$0.98 \pm 0.06_{stat} \pm 0.05_{sys}$	$63.8 \pm 4.1_{stat} \pm 3.1_{sys}$
4.9.09	3.9	no	84 %	$1.50 \pm 0.09_{stat} \pm 0.05_{sys}$	$(97.2 \pm 5.5_{stat} \pm 3.3_{sys})$
8.9.09	2.7	yes	71 %	$0.86 \pm 0.06_{stat} \pm 0.04_{sys}$	$56.2 \pm 3.7_{stat} \pm 2.7_{sys}$
8.9.09	2.9	yes	71 %	$0.76 \pm 0.05_{stat} \pm 0.03_{sys}$	$49.1 \pm 3.3_{stat} \pm 2.2_{sys}$

Average (without non-mixed sample):

(54.7 ± 3.5) mBq

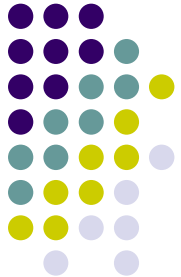
Assumes homogeneous ^{222}Rn distribution

Conclusions

- Sampling procedure well understood
- Emanation rate is now (54.7 ± 3.5) mBq
  - about 25 mBq more than before
- More ^{222}Rn sources in upper part than in lower part
  - Might be favourable due to the planned temperature gradient (No convection).
- All data obtained at room temperature!

  → talk of Sebastian Lindemann tomorrow
- Next: Sampling of LAr after filling!?

Extra sildes



Cryostat emanation overview

No.	Date	Description	Single results [mBq]	Average [mBq]
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5	Sep 09	After mounting of shroud, manifold, compensator, and cryogenic tubing	$49.9 \pm 3.3_{stat} \pm 2.1_{sys}$ $63.8 \pm 4.1_{stat} \pm 3.1_{sys}$ $56.2 \pm 3.7_{stat} \pm 2.7_{sys}$ $49.1 \pm 3.3_{stat} \pm 2.2_{sys}$	54.7 ± 3.5