Update on ^{222}Rn emanation measurements

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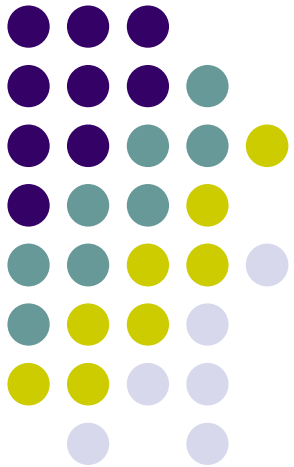
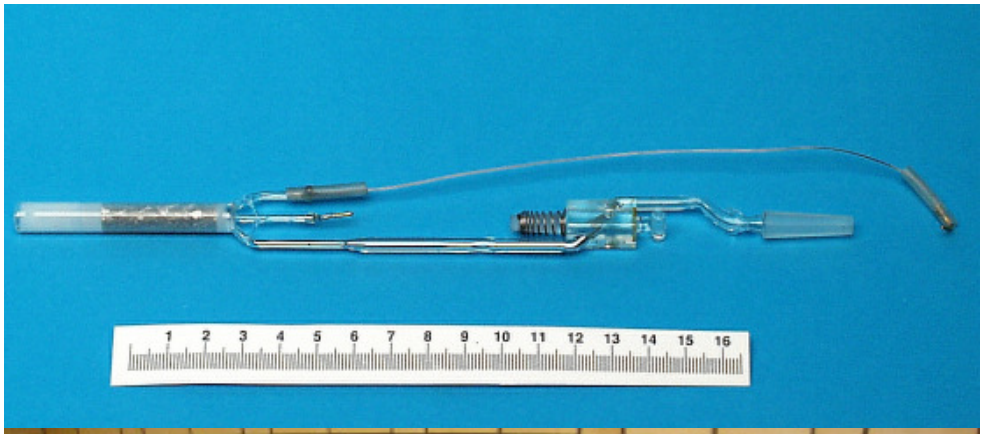
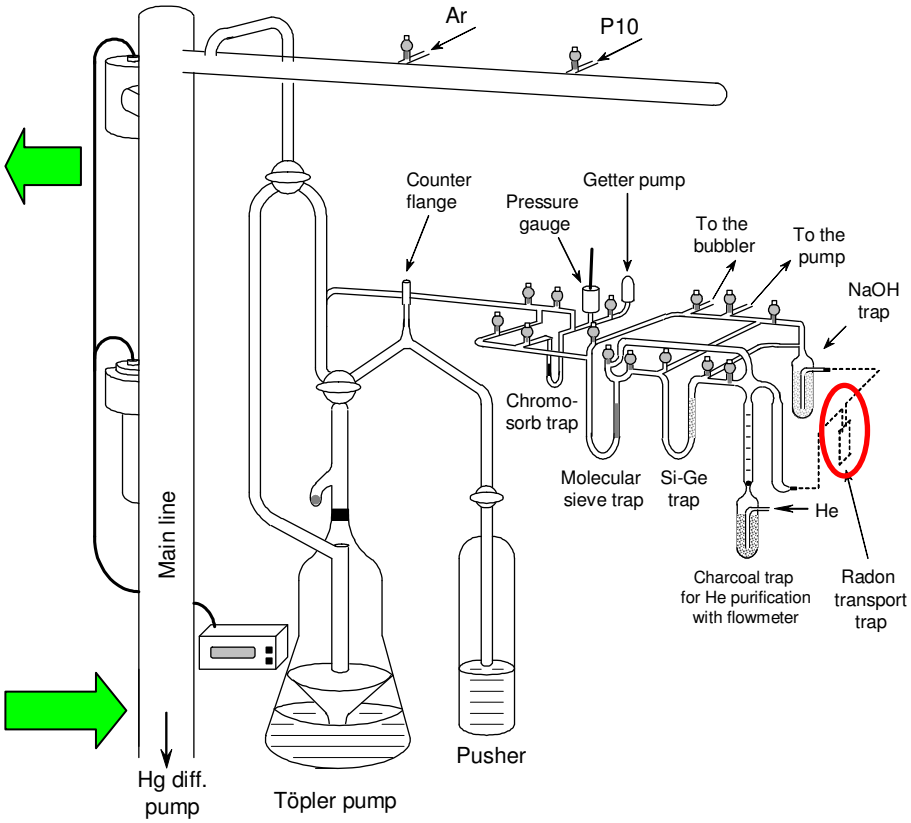


Outline

- ^{222}Rn measurements with proportional counters
- Samples not related to the cryostat ^{222}Rn problem
  - Cast steel valve
  - Abrasive paper
  - Gloves
  - Others
- Samples related to the cryostat ^{222}Rn problem
  - Permanent marker
  - Silvered stainless steel screws
  - Flexible stainless steel tube
  - Copper eccentric disks
  - Dust

^{222}Rn measurements with proportional counters





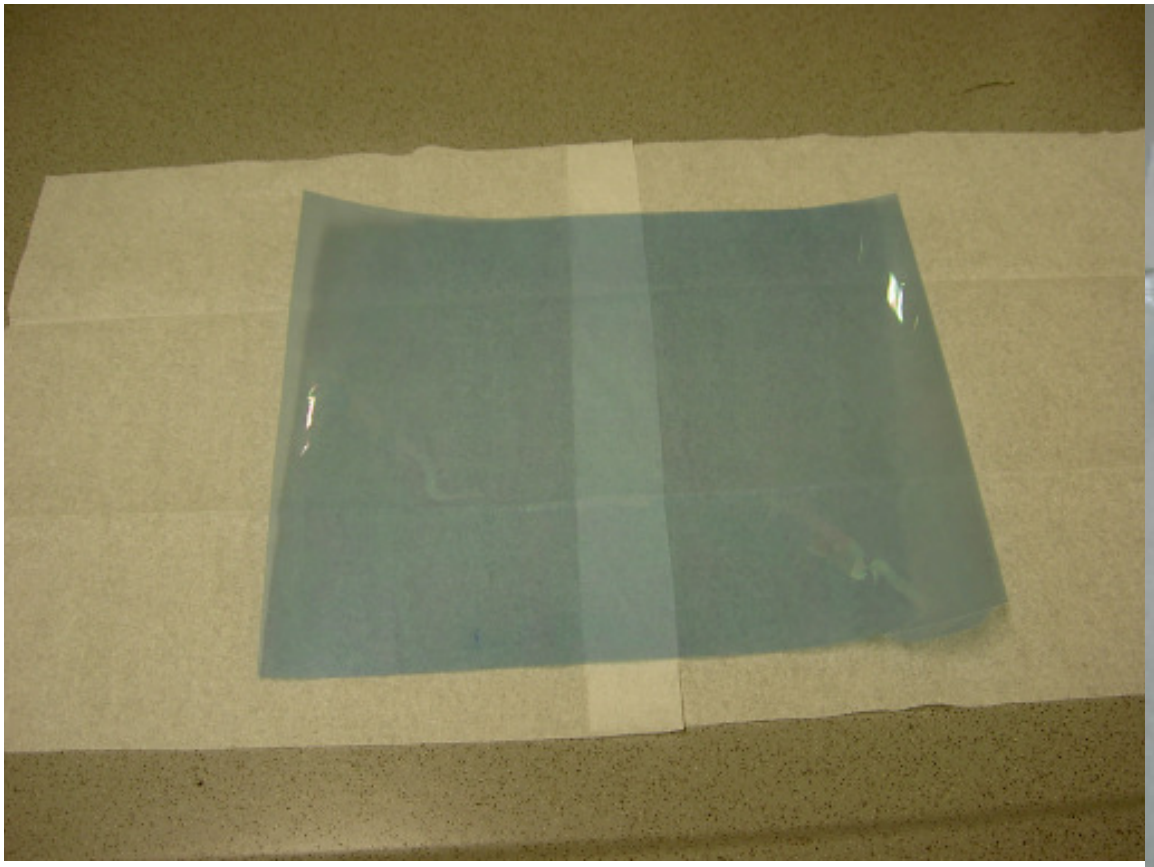
Absolute detection limit 30–100 μBq (15–50 atoms)

WTA cast steel cryogenic valve

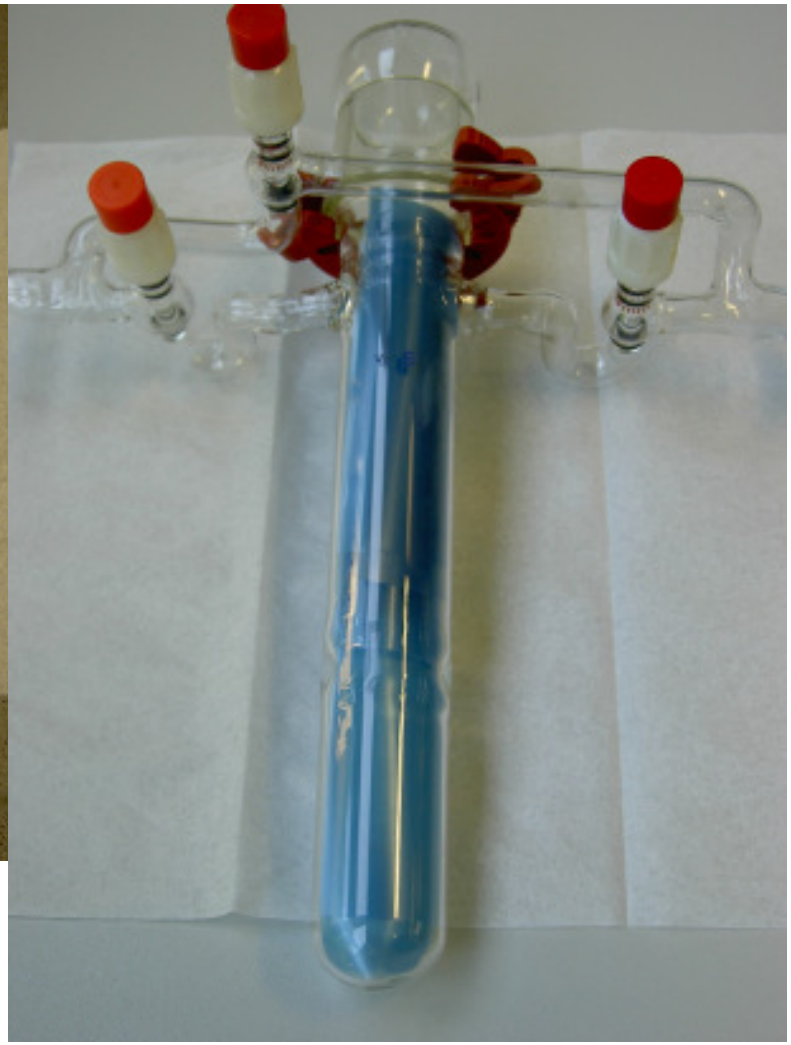
Sample / Condition	Emanation rate [mBq]
Valve 1 open	2.0 ± 0.2
Valve 1 closed	0.7 ± 0.2
Valve 1 open + Indium	2.3 ± 0.4
Valve 1 closed + Indium	0.7 ± 0.1
Body (of valve) 1 only	1.8 ± 0.2
Body 1 after 1st etching	0.21 ± 0.06
Body 1 after 2nd etching	0.14 ± 0.04
Valve 2 open	7.0 ± 0.8

Abrasive paper

- Used for Ge-diode lapping (for HV-contact).
- 7.15 g sample (9 micron granularity) measured.



<130 μBq



Gloves

Sample	Emanation rate per glove [mBq]
Nitrile #1 (one-way)	2.1 ± 0.2
Nitrile #2 (one-way)	2.7 ± 0.1
Nitrile #3 (multiple use)	75 ± 5
Viton (multipe use)	prepared for measurement

Other samples (not related to cryostat ^{222}Rn problem)

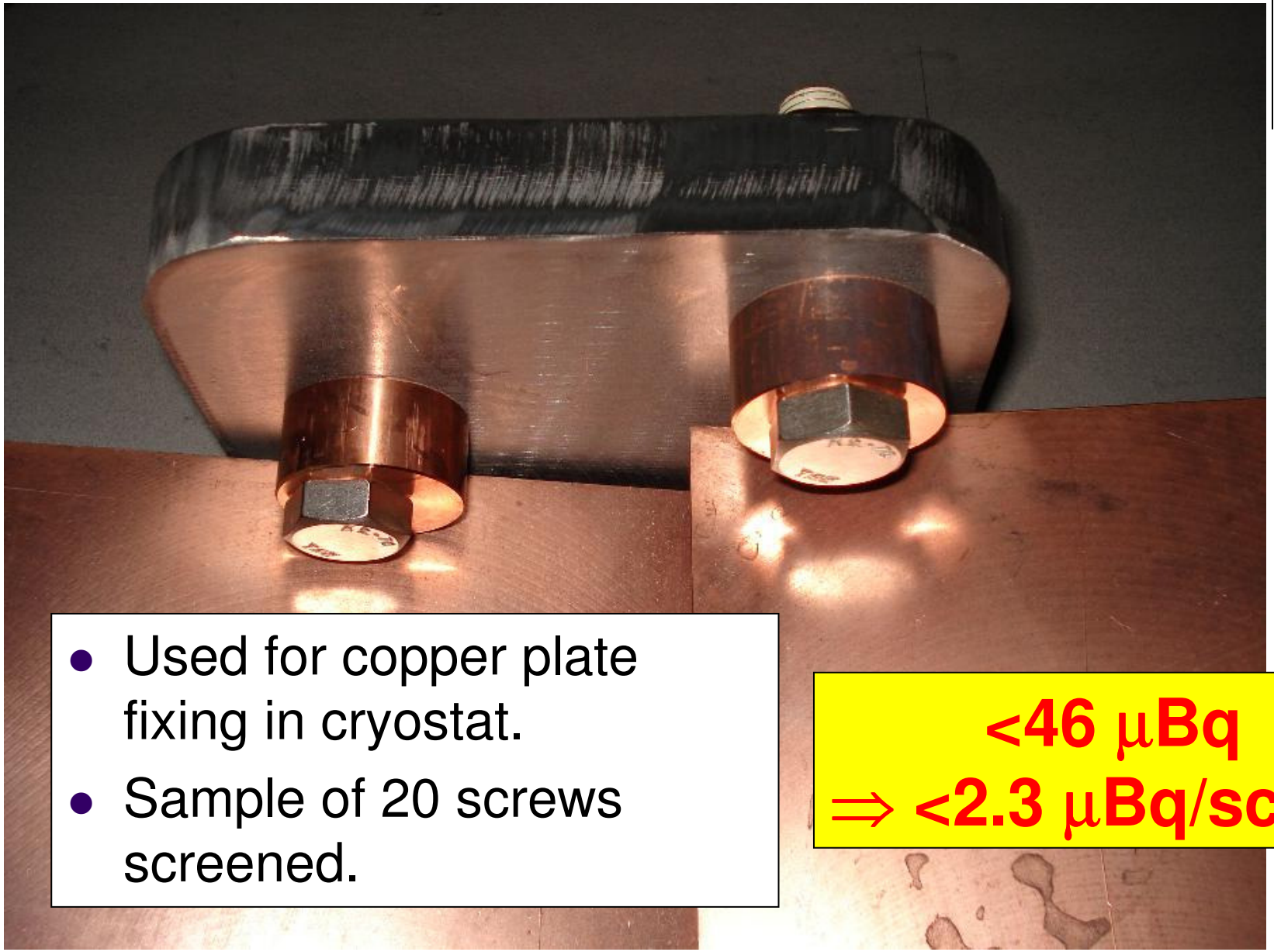
Sample	Emanation rate
Pure water from Millipore ELIX system (rev.-osmosis + electro-deionization)	(11 ± 3) mBq/m^3 *before: (16 ± 2) mBq/m^3*
Ultrapure water from Millipore MILLI-Q ADVANTAGE system (fed with ELIX water + ion exchange + TOC removal)	<4.9 mBq/m^3
Multi-wire flat cable for temperature sensors (Bürklin)	<0.17 mBq/m
PVC-tube (outer diameter 12 mm, wall thickness 2 mm)	(0.20 ± 0.03) mBq/m

Black permanent marker

- Residuals of permanent marker discovered on copper plates.
- For measurement painted on both sides of a 785 cm^2 copper-foil.

<70 μBq ⇒ <0.45 mBq/m²

Silvered stainless steel screws



- Used for copper plate fixing in cryostat.
- Sample of 20 screws screened.

<46 μBq
⇒ <2.3 μBq/screw

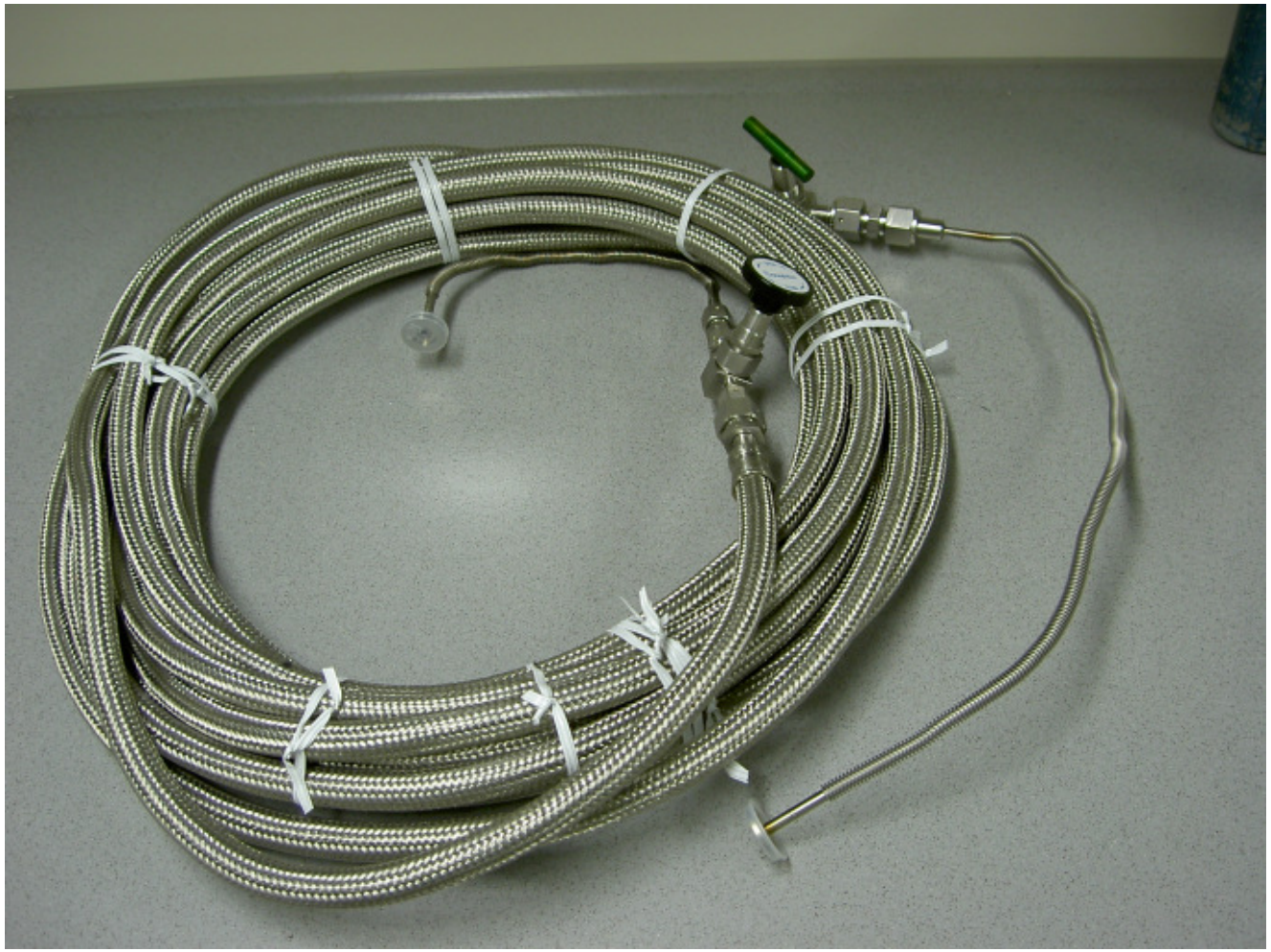
15 m ½” stainless steel tube

- Top of cryostat difficult to reach during water tank construction.

⇒ 15 meter 1/2” flexible stainless steel tube connected to top of cryostat and closed at bottom.

⇒ Part of tested volume.

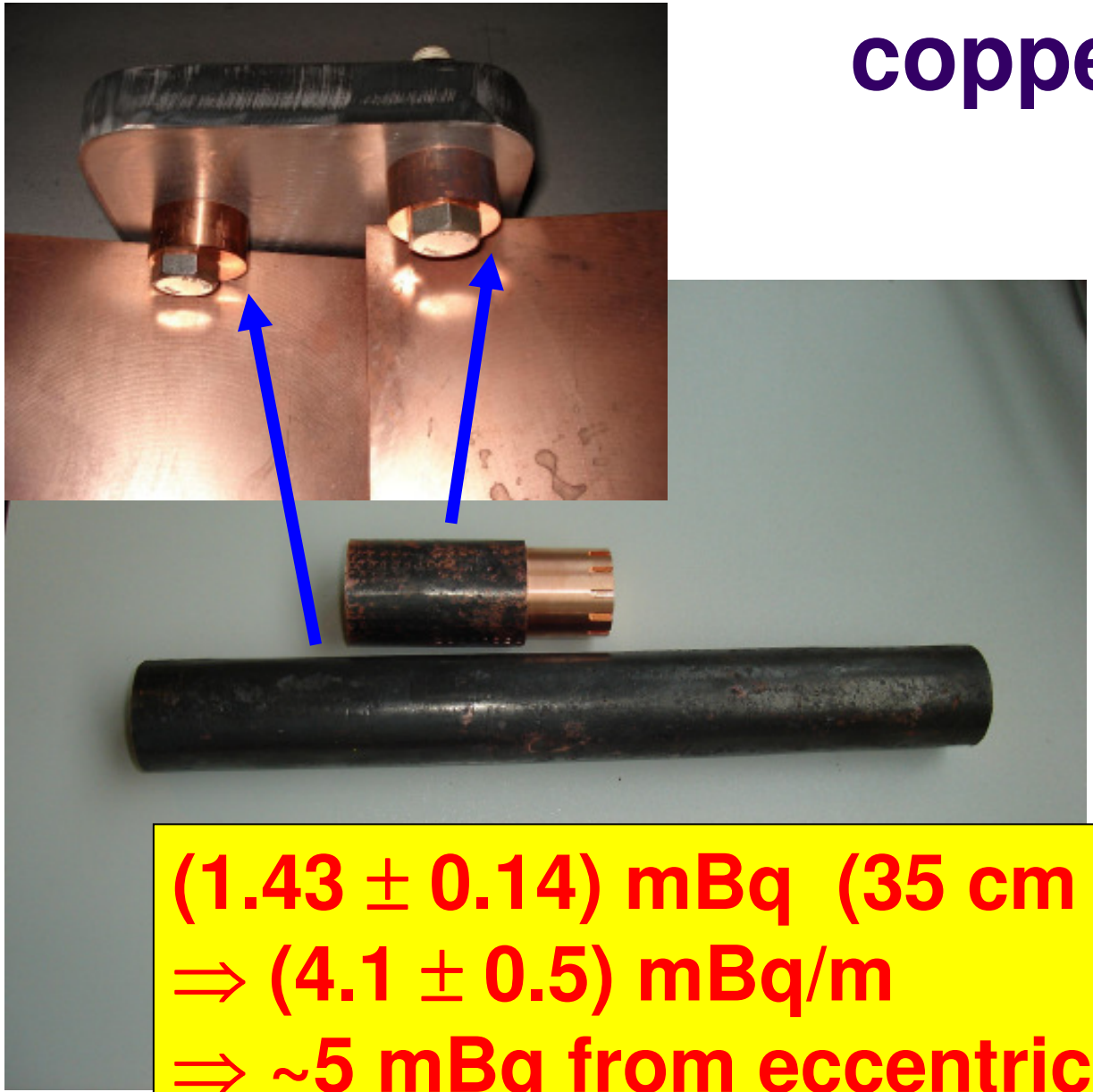
15 m ½" stainless steel tube



- Used tube is still connected.
- Same type of tube bought for ^{222}Rn emanation test.

(0.5 ± 0.1) mBq ⇒ ~30 μBq/m

Eccentric disks for fixing of copper plates



- 60 eccentric copper disks (2 cm thick).
- Made from a Cu-rod (see picture).
- Black surface (Cu-oxides?).

(1.43 ± 0.14) mBq (35 cm sample)
⇒ (4.1 ± 0.5) mBq/m
⇒ ~5 mBq from eccentric disks

Investigation of dust

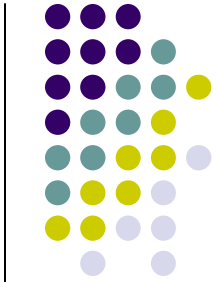
- 113 g dust collected in hall A on 6.5.08
- From Germanium spectroscopy: ^{226}Ra: ~20 Bq/kg
- Question: Which fraction is emanated?
- (Strongly?) depends on grain size.
- Broad distribution of grain size in the sample.

^{222}Rn emanation from dust

- Worries about contamination of our assay system
- Solution: Put dust in water (assuming same emanation rate for dry and wet dust)

(2.4 ± 0.2) Bq/kg
$\Rightarrow$ 12 % emanation rate

Is dust the main ^{222}Rn source in the cryostat?



- ~40 g of dust would explain 100 mBq.
- That's a lot $\Rightarrow$ Visual inspection didn't confirm.
- But *fine dust* fraction
  - may contain more ^{226}Ra
  - may emanate larger ^{222}Rn fraction
- A (small?) fraction of 40 g *fine dust* might be sufficient to explain 100 mBq.