^{222}Rn emanation measurement of the GERDA cryostat

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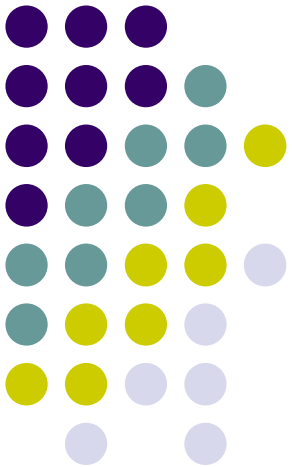


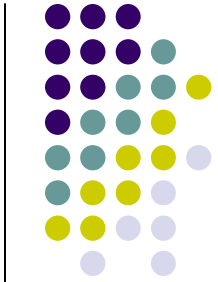
^{222}Rn emanation of the GERDA inner detector

- All ^{222}Rn emanated from inner detector (lock + cryostat) can create background.
- Check of
  - Individual components (Grzegorz's talk on Wednesday)
  - Fully assembled lock (Future)
  - Inner vessel of cryostat (this talk)
- Tolerable ^{222}Rn emanation rate (GSTR-07-020): 10^{-4} cts/(kg·keV·y) ↔ ~8 mBq
  - Assumption: Homogeneous ^{222}Rn distribution in LAr

Homogenous distribution and convection

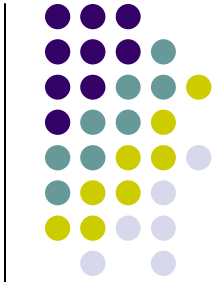
- Little convection in detectors with large amounts of liquids (BOREXINO, CTF, KamLAND)
  - ^{222}Rn emanated close to surfaces stays there (until it decays).
- Situation is different for cryogenic liquids
  - Non-perfect insulation $\Rightarrow$ permanent heat input
  - Permanent convection expected!
- Homogeneous distribution is not conservative

Procedure for the ^{222}Rn test

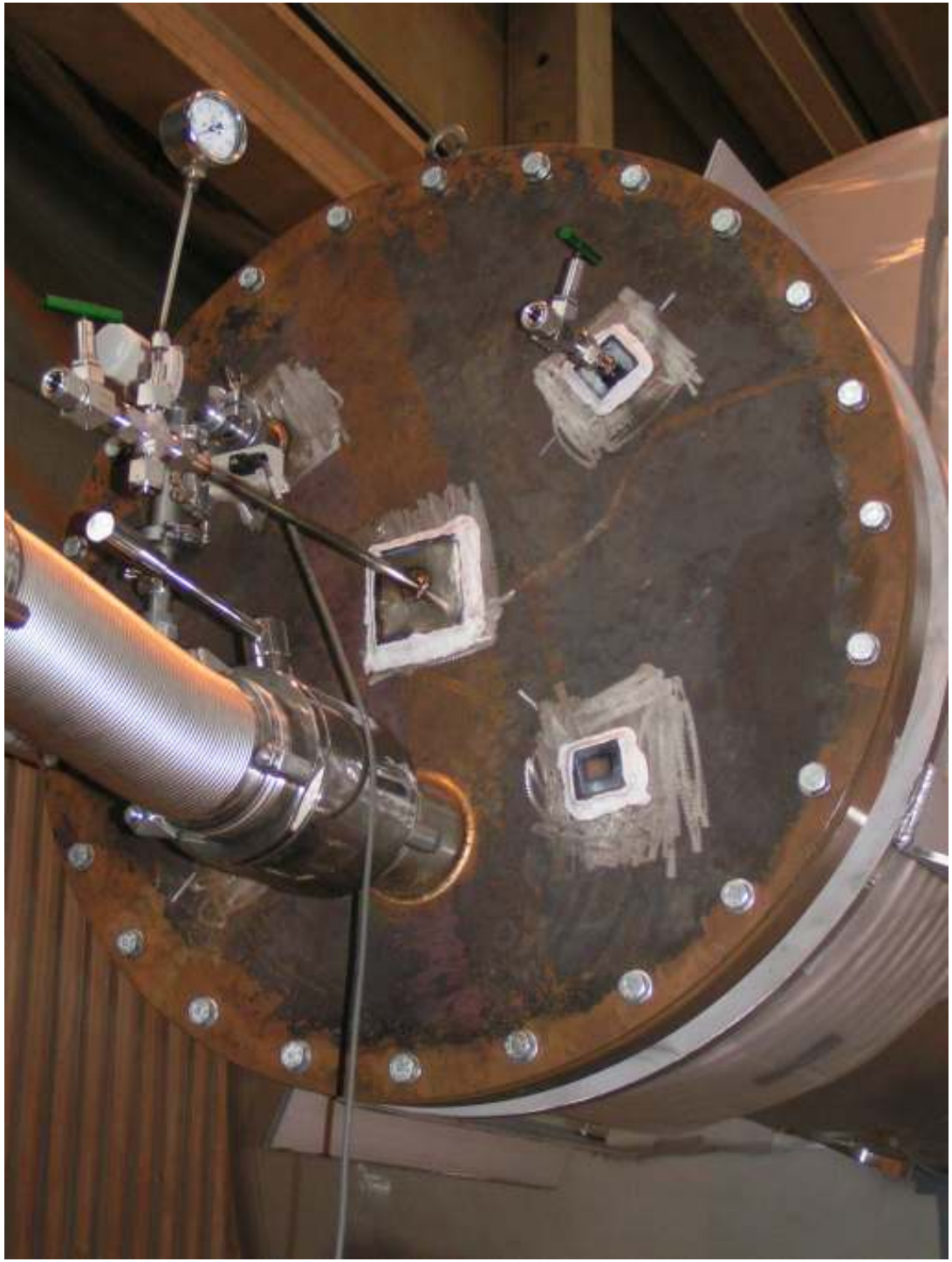


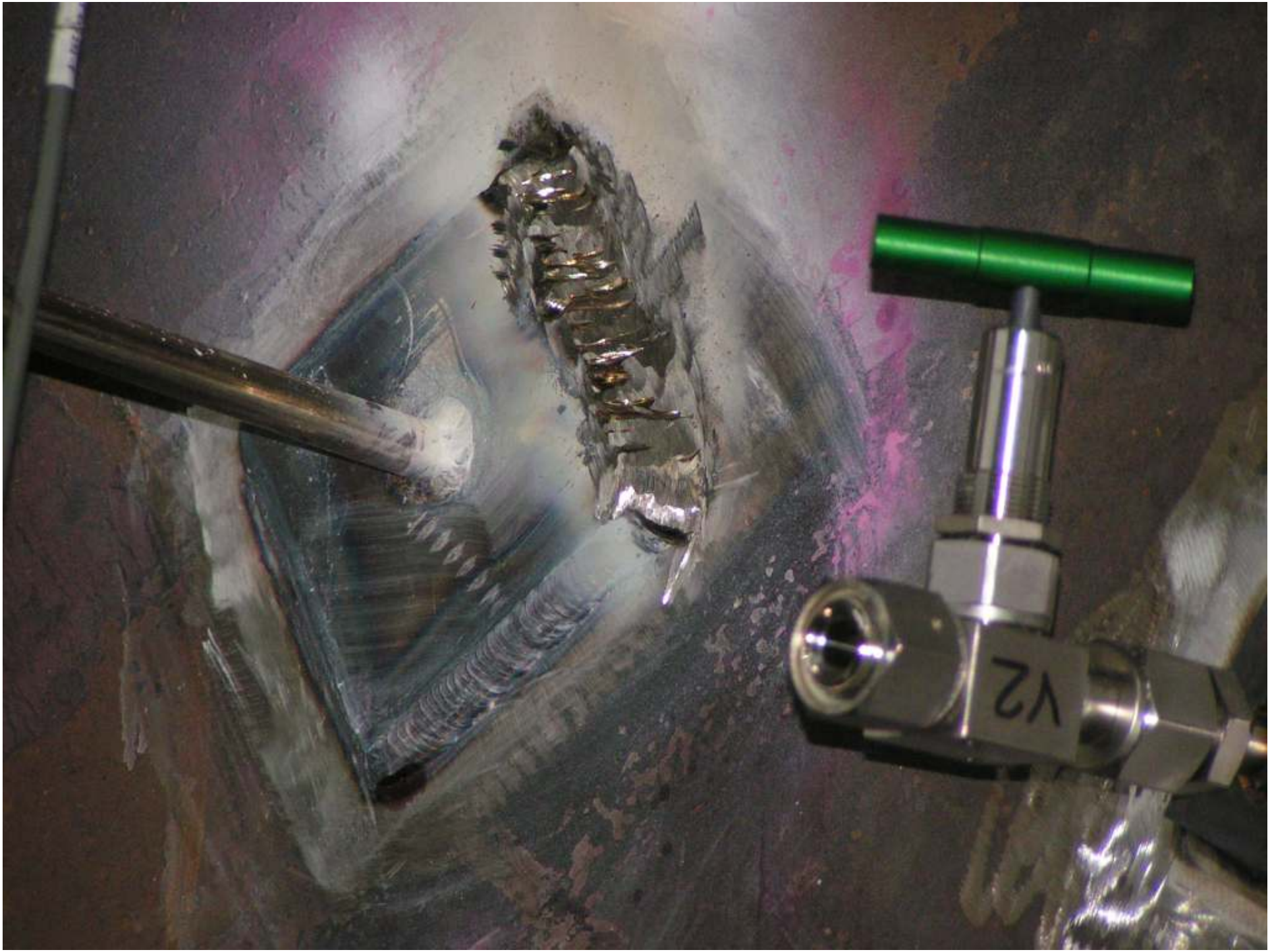
1. Evacuating to ≤ 1mbar
2. Filling with ^{222}Rn-free nitrogen to ~1 bara
3. Evacuating again to ≤ 1mbar
4. Filling with ^{222}Rn-free nitrogen to ~2.6 bara
5. Waiting few days for ^{222}Rn accumulation
6. Extraction of 2 samples (few 10 m^3 (STP) each)
7. Scaling to entire volume

Preparation of the cryostat

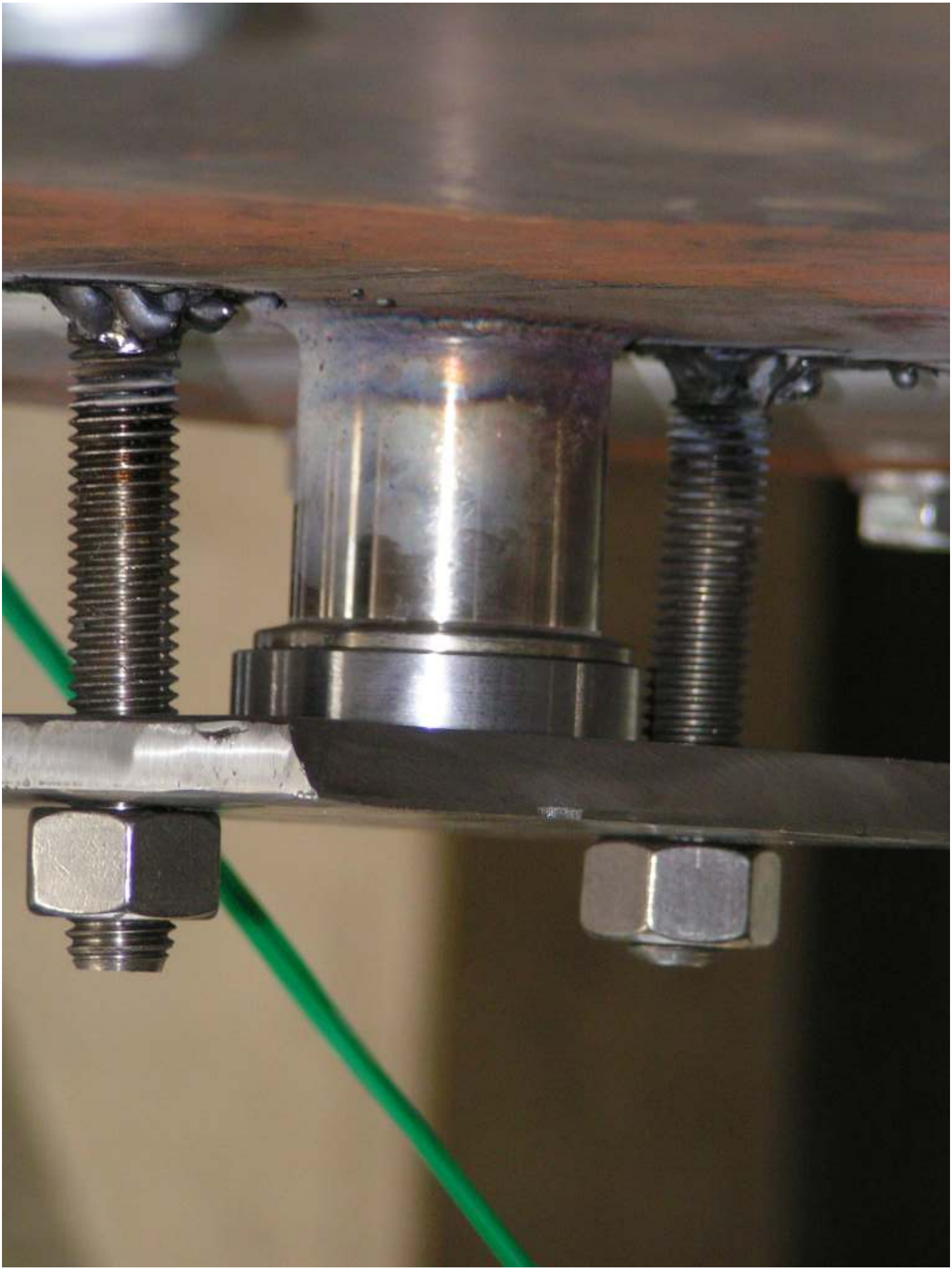


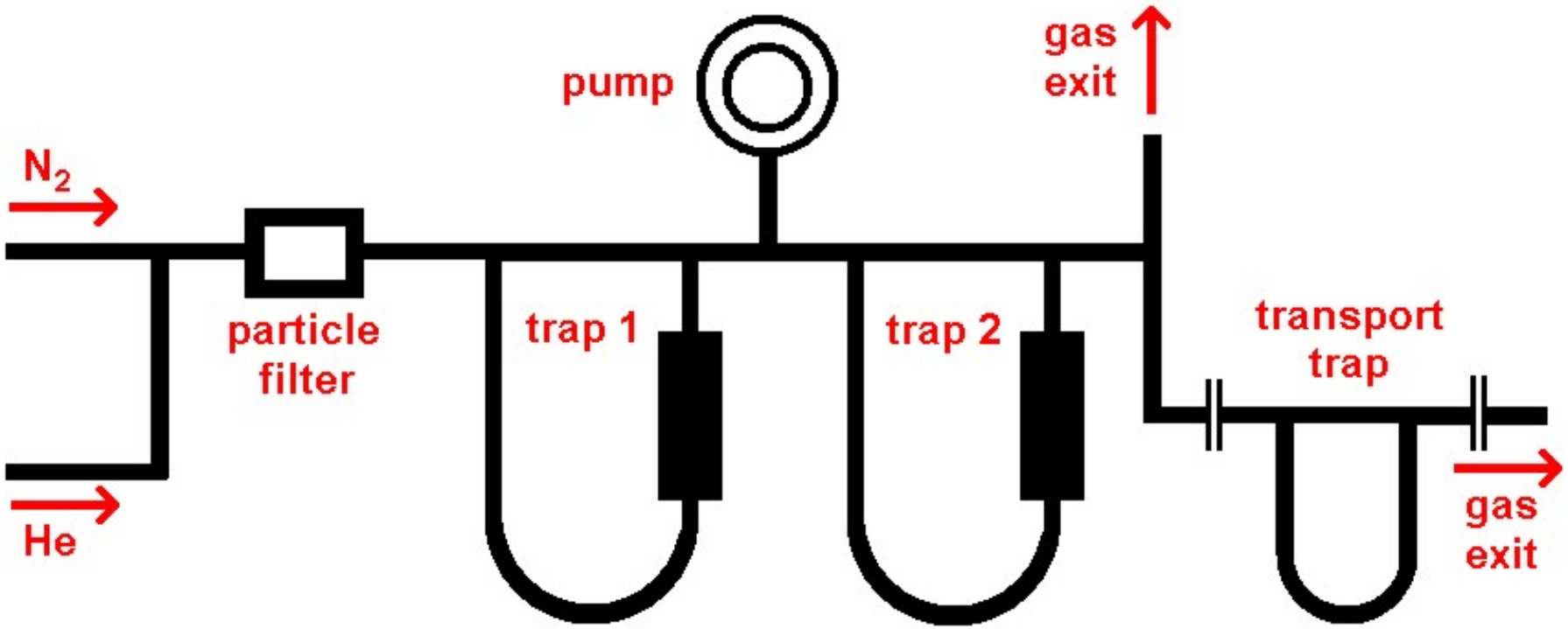
- Construction of inner vessel finished including
  - Pressure test
  - Cleaning (pickling and passivation)
- Temporary carbon steel flange equipped with
  - Helicoflex gasket
  - VCR ports for MoREx / pressure gauge
  - ~2m tube inside
- Helium-leak test performed
  - Vessel left in evacuated state




V2


Marklift

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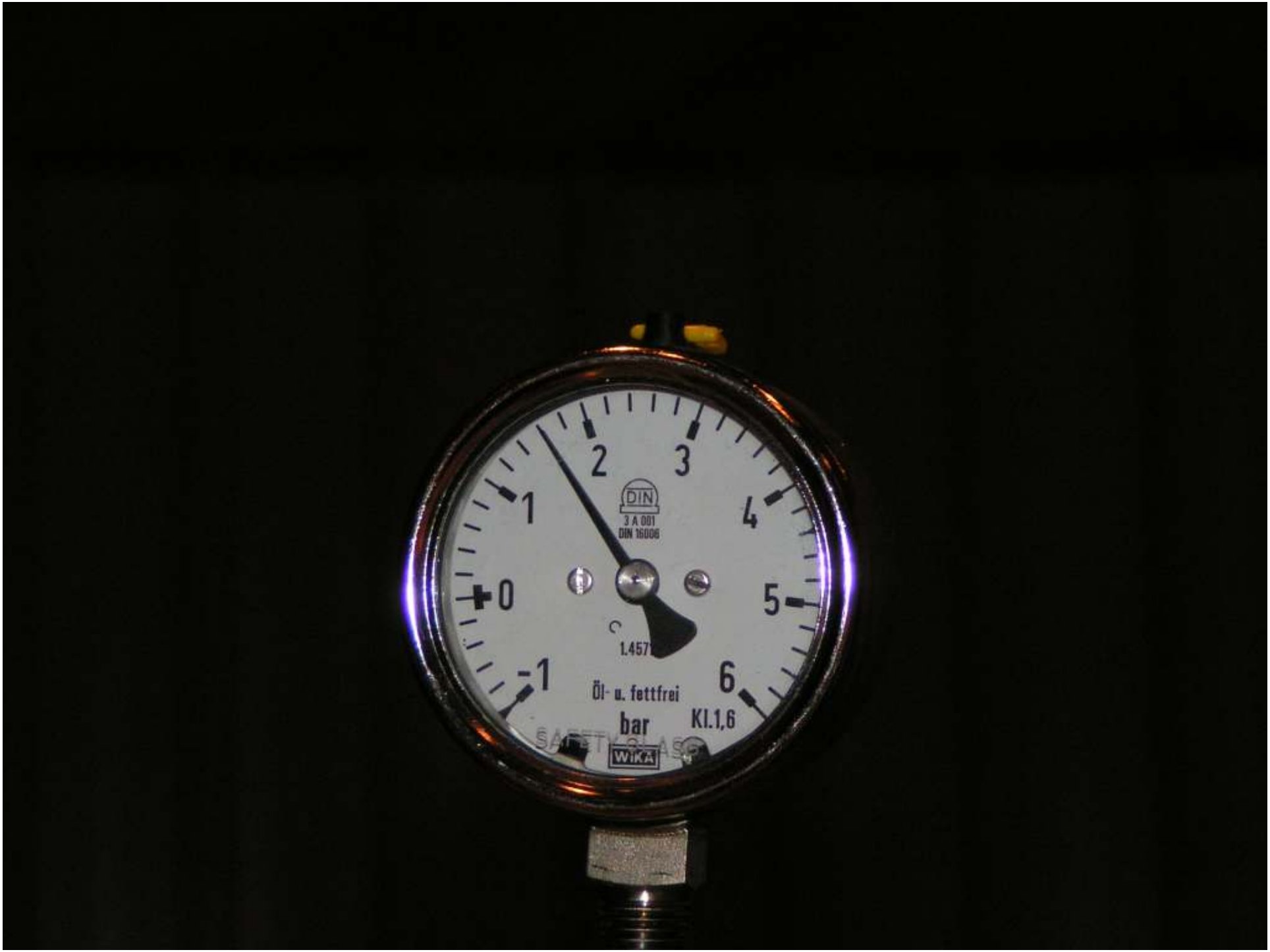
genics


NITROGEN
REFRIGERATED
LIQUID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Marklift


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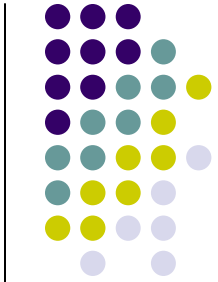
WIKA

Results

- 1st test (23 m^3 (STP) of 169 m^3 (STP)):
  ^{222}Rn activity scaled to entire cryostat in saturation = (16.9 ± 1.6) mBq

- 2nd test (45 m^3 (STP) of 146 m^3 (STP)):
  ^{222}Rn activity scaled to entire cryostat in saturation = (29.8 ± 2.4) mBq

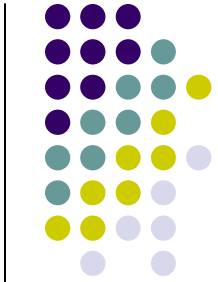
Discussion



- Results not in agreement
  - Problem with measurement procedure?
  - Inhomogeneous ^{222}Rn distribution?
- But ^{222}Rn activity definitely >8 mBq
- Possible reasons:
  - Cleaning was not sufficient
  - Some dirt left in cryostat
  - It's normal for a tank of this size

    Welds! → see Grzegorz's talk on Wednesday

Status / Outlook



- Work done after ^{222}Rn-test:
  - Cu-mounting test
  - Evaporation test
  - Another cleaning (using spray-ball)
- Future:
  - 2nd ^{222}Rn emanation test planned
  - Accumulation during transport to Gran Sasso (?)
- Improvements:
  - Mixing immediately before extraction