Pancake

Commissioning of Freiburg's large scale R&D platform

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XeSAT 5 - 8 June 2023, NANTES

universität freiburg

The DARWIN observatory

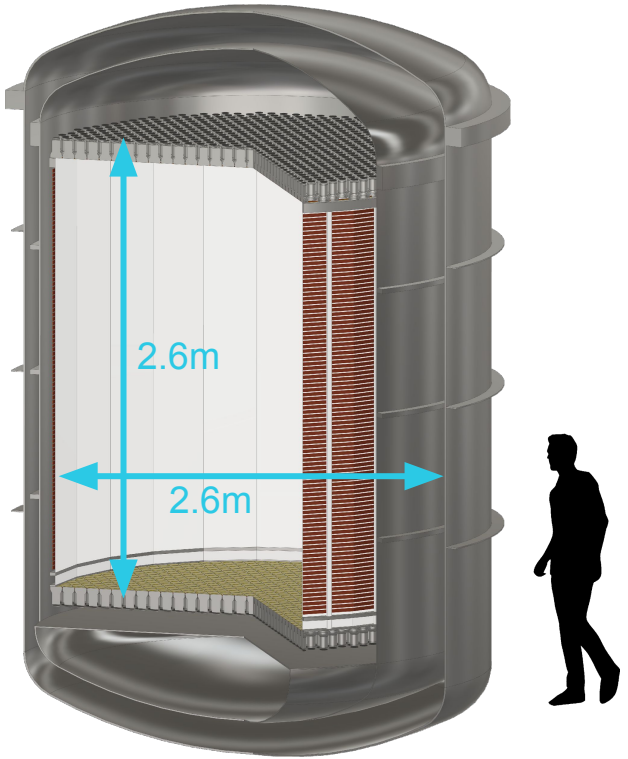
→ Talks by Laura Baudis and Ranny Budnik

- **next generation LXe TPC**
- **WIMP dark matter search**
- **sensitivity reaching the neutrino fog**

DARWIN baseline design:

LXe based TPC with 2.6m — **enormous size**
total xenon mass 50t @ -100°C — **low temperature**
ultra-low background — **radiopurity level**

minimal material budget plus huge size and temperature range
→ **technical realization will be challenging!!**



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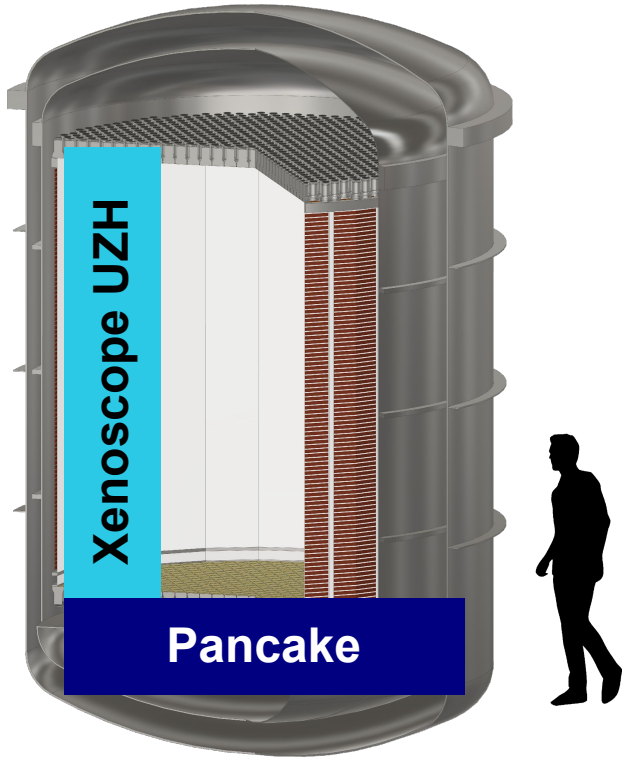
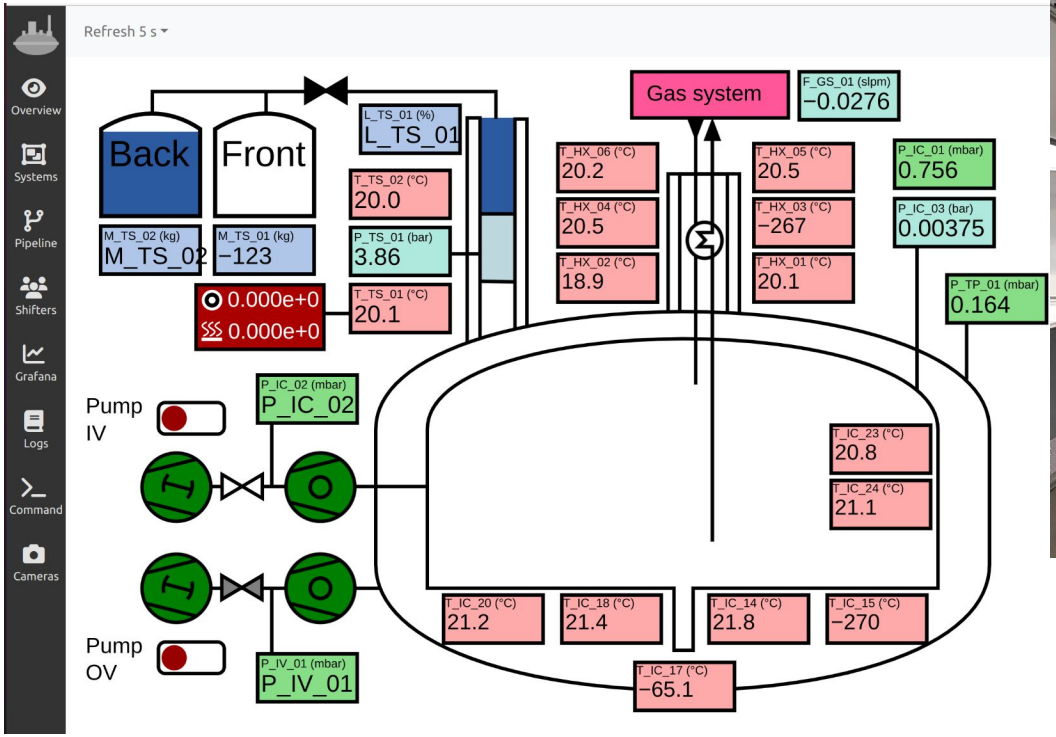
test full-scale components and new concepts
under real conditions: in LXe, in cold xenon gas, under HV
→ **Pancake**



Test Platform: Pancake

→ thoroughly test detector components (e.g. electrodes) for DARWIN under real conditions in easily accessible Freiburg lab → Pancake is a unique system worldwide

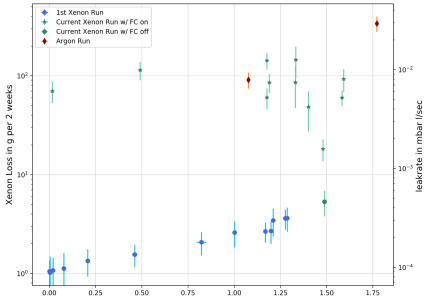


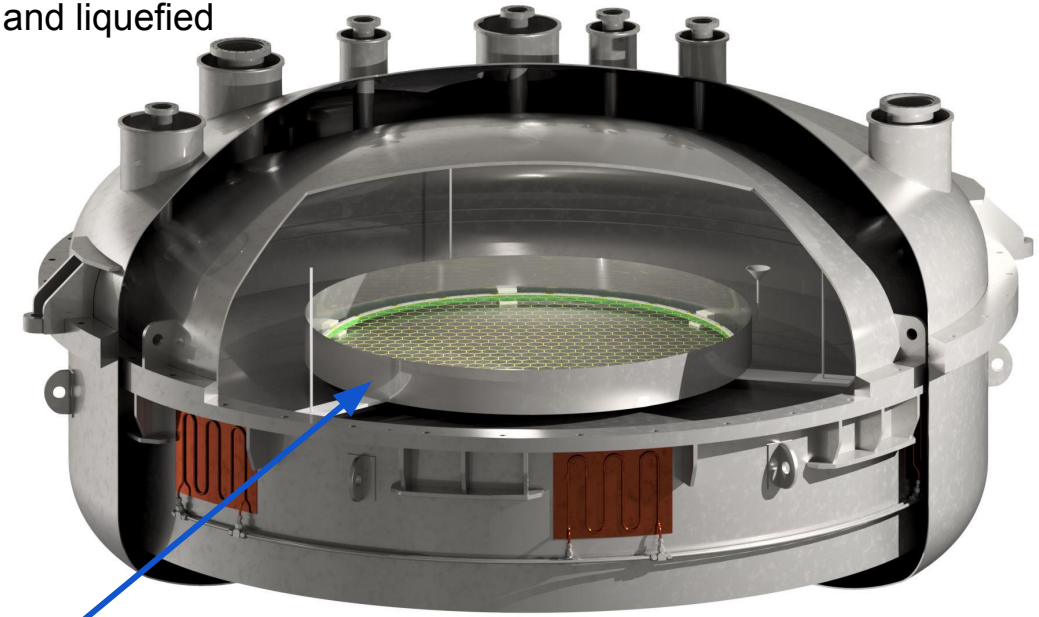
- 5t stainless steel
- double-walled cryostat
- 380kg xenon (inventory)
- flat-floor design → save xenon
- liquid level of 2cm on 2.7m width

https://github.com/AG-Schumann/Doberman

Commissioning

- validate seal tightness → **copper-wire seal**
- FC- ,TS-cooling and liquefaction ability
- cameras, lights, T-sensors, etc.
- test bathtub principle and liquid level
- successful Argon run with 80 kg filled and liquefied

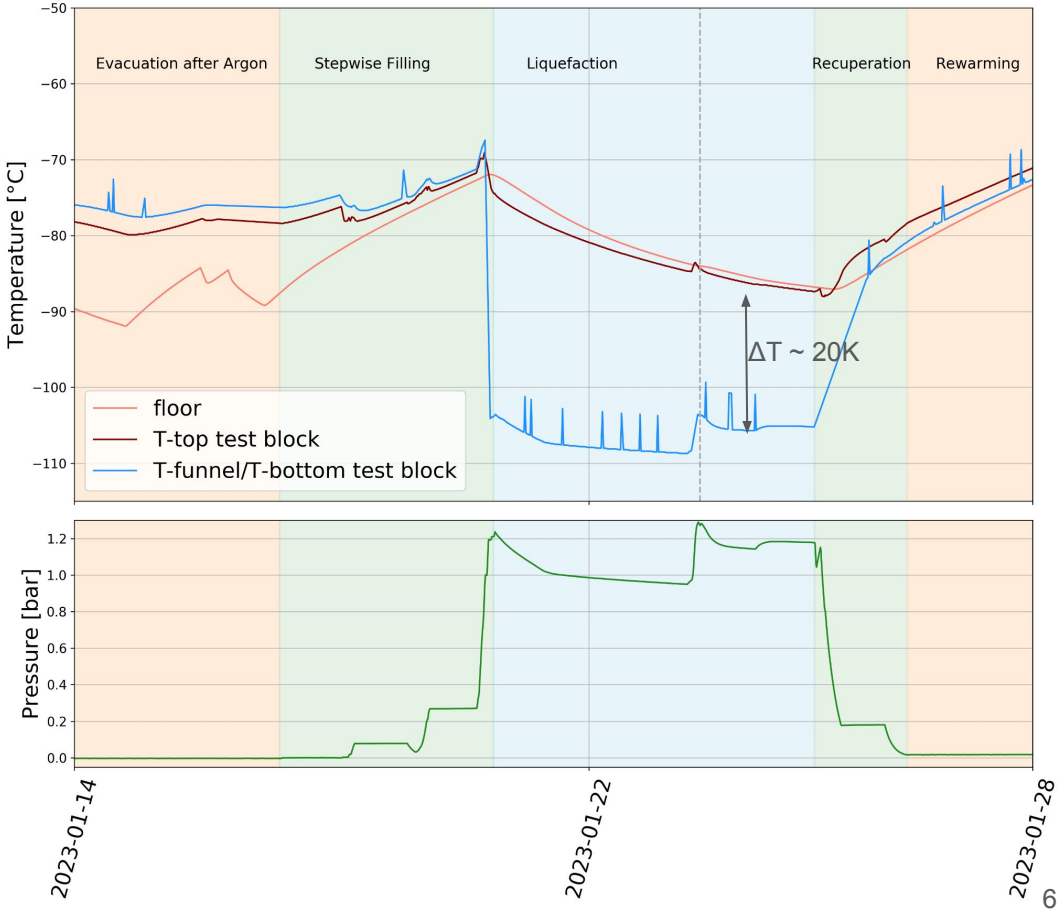




bathtub ⌀ = 1.5m → reach higher liquid level,necessary to submerge test components in LXe

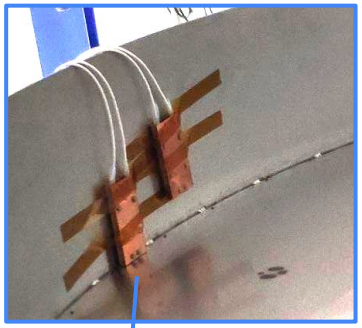
Commissioning with Xenon: ‘Small’ Filling

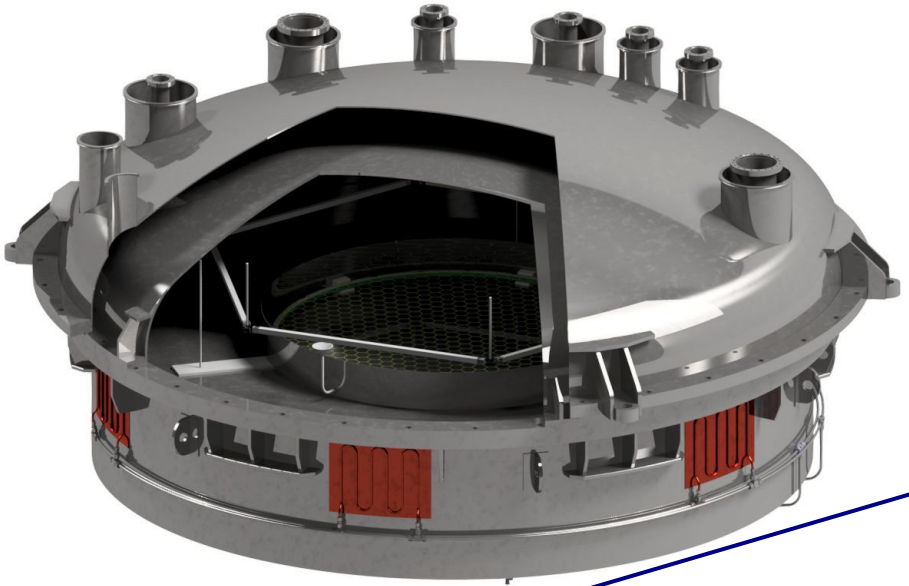
- filling of 50kg of xenon
- proof liquefaction of xenon
- commissioning of recuperation system
- leak rate: < 4.0×10^{-4} mbar l/sec
- usage of cameras inside → monitor
- ΔT ~ 20K
- stable operation (7 days filled)
- gas recuperation via an emergency line → 50 slpm
- freeze-in of xenon → video



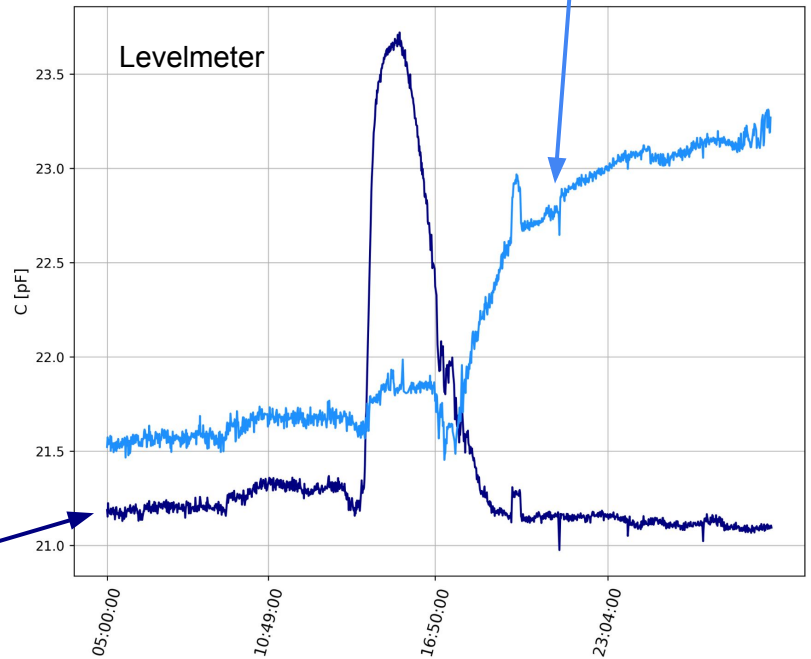
Commissioning with Xenon: 300kg-Run

- started run with pre-cooling inner vessel → minimize ΔT inside
- started filling once floor at -100°C
- @1.6 bar pressure → liquefied into cold bottom feedthrough of inner vessel
- change to thermosyphon cooling → fill bathtub



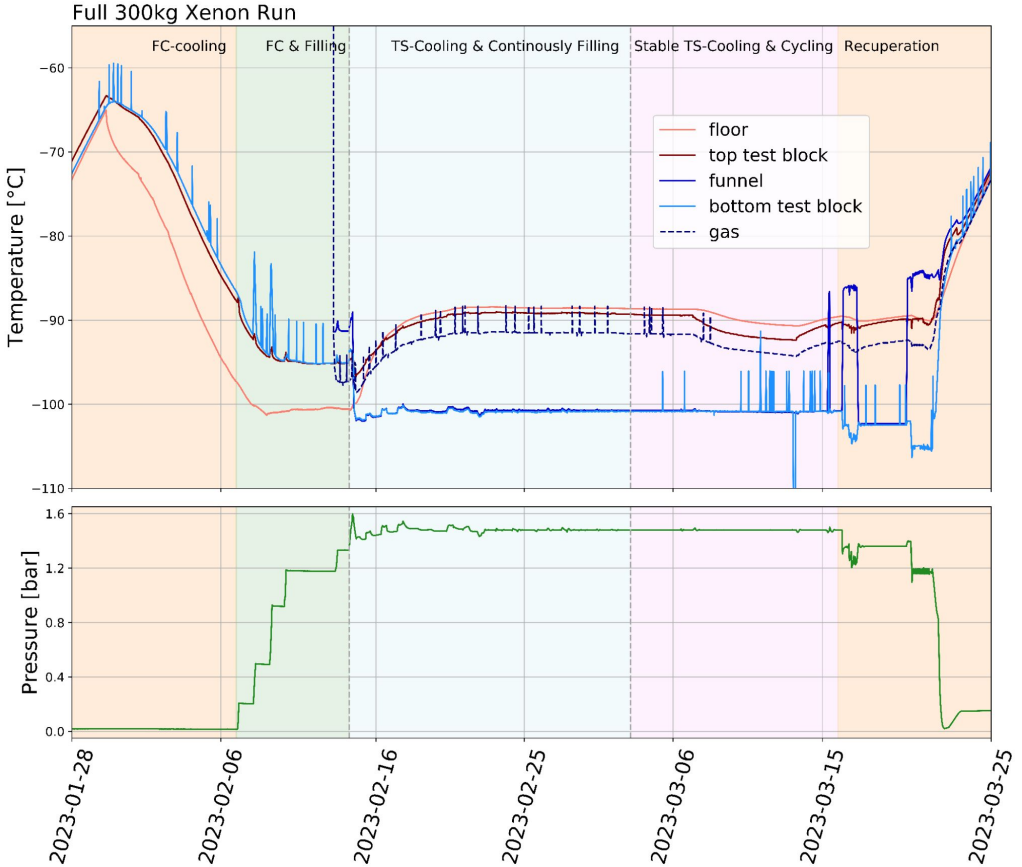


bottom feedthrough



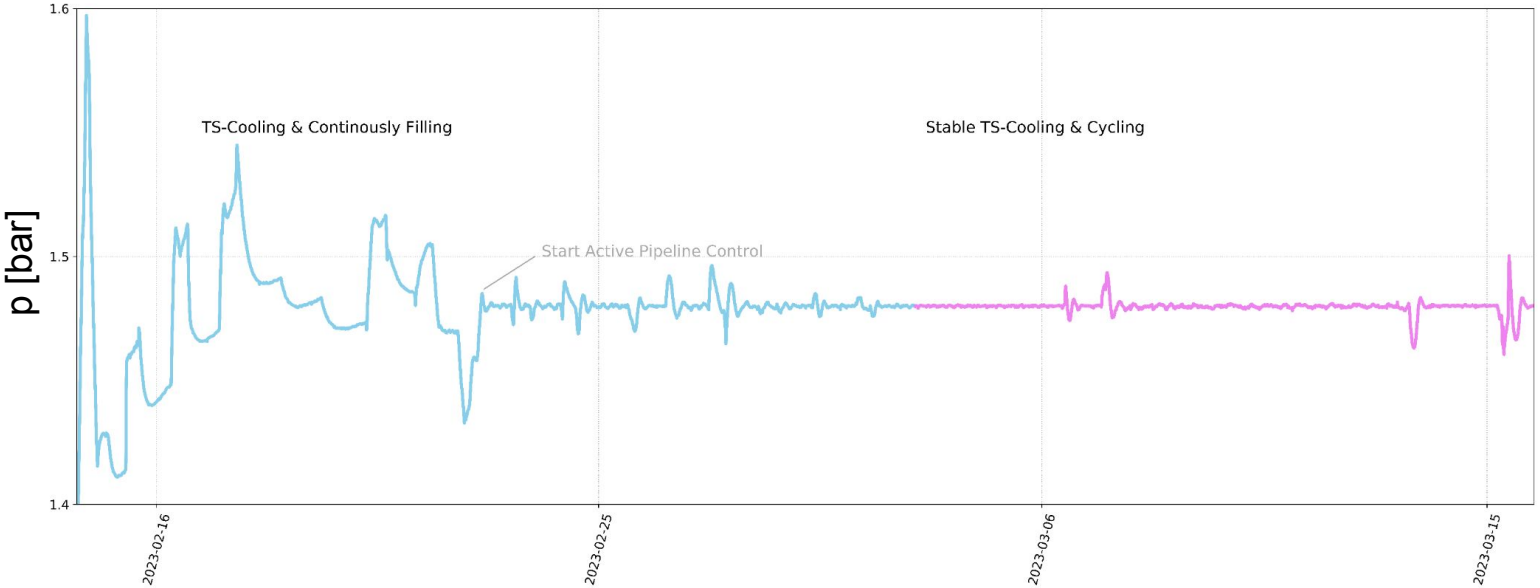
Commissioning with Xenon: 300kg-Run

- filling over 4 weeks at final flow rate of 4.7slpm and pressure 1.48bar
- limit in cooling power due to surface area of copper cold head
- leak rate: < 4.0×10^{-4} mbar l/sec
- <u>bottom test block ↔ gas:</u>
  ΔT~ 10K while gas is actually warmer



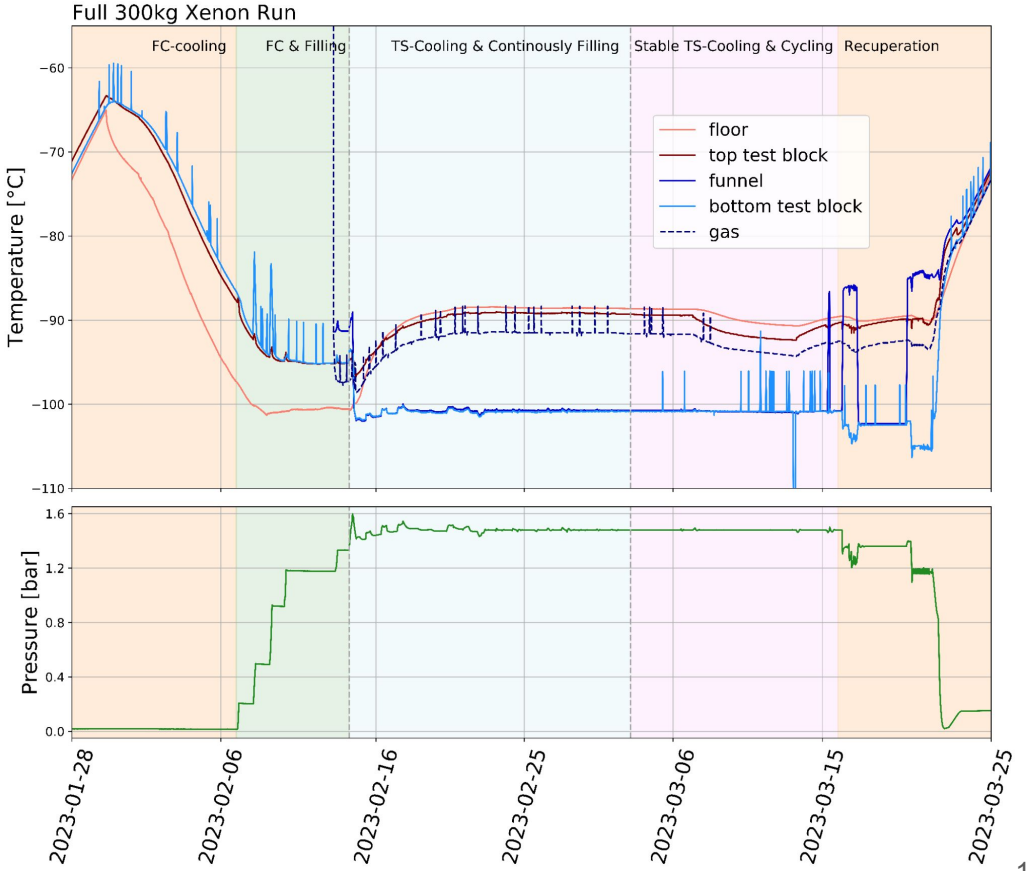
Commissioning with Xenon: 300kg-Run

- maximal purification flow achieved: 15slpm
- **extremely stable while filling and cycling**
- active pipeline control Δp ~ ***O***(mbar)



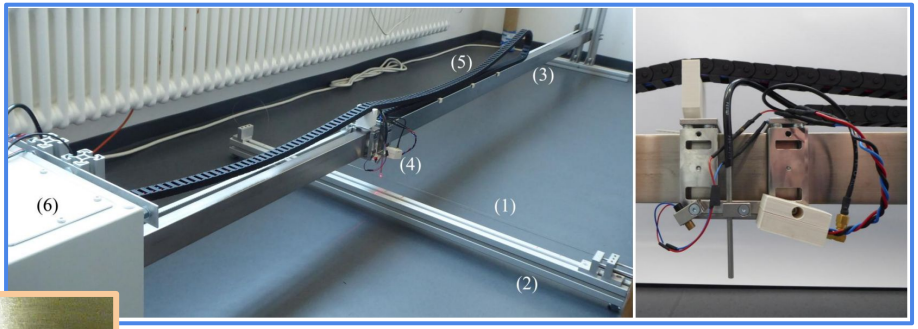
Commissioning with Xenon: 300kg-Run

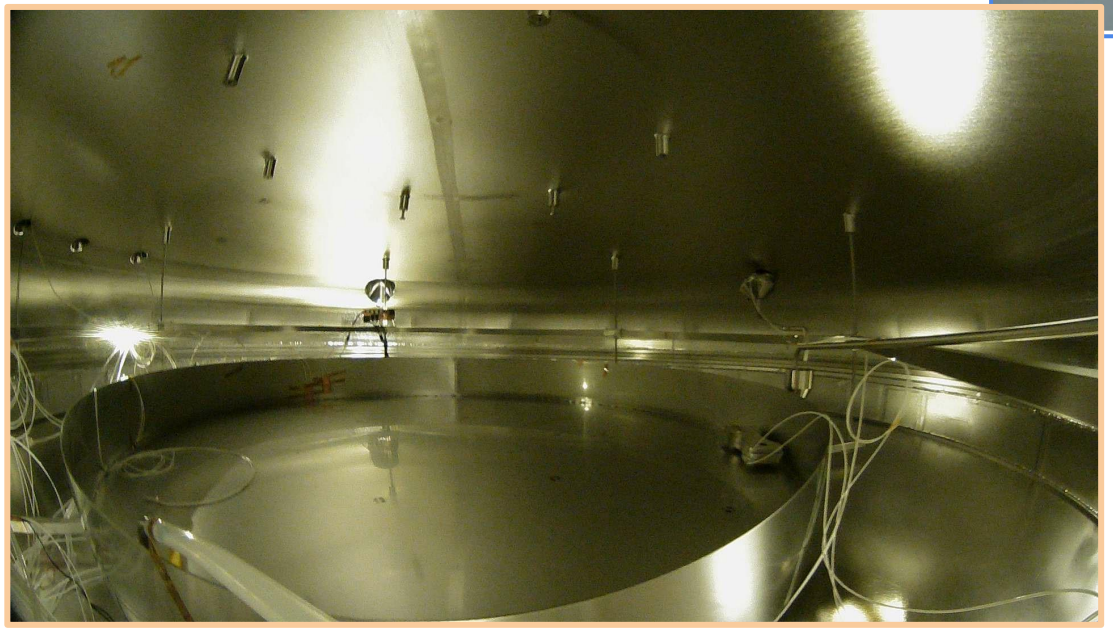
- recuperation ~7days
- 6 aluminum bottles frozen-in by LN2



Next Step: Testing Electrodes

- test stack of electrodes in Pancake
- wire tension measurement device
- cameras and PMTs for observation





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