Cryogen-free cryostat with sample changer for fast automatic data collection

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Motivation

Improvement of the sample exchange process:

- Shorter exchange time
- Automatisation of the exchange process

⇒ Two separate ideas:

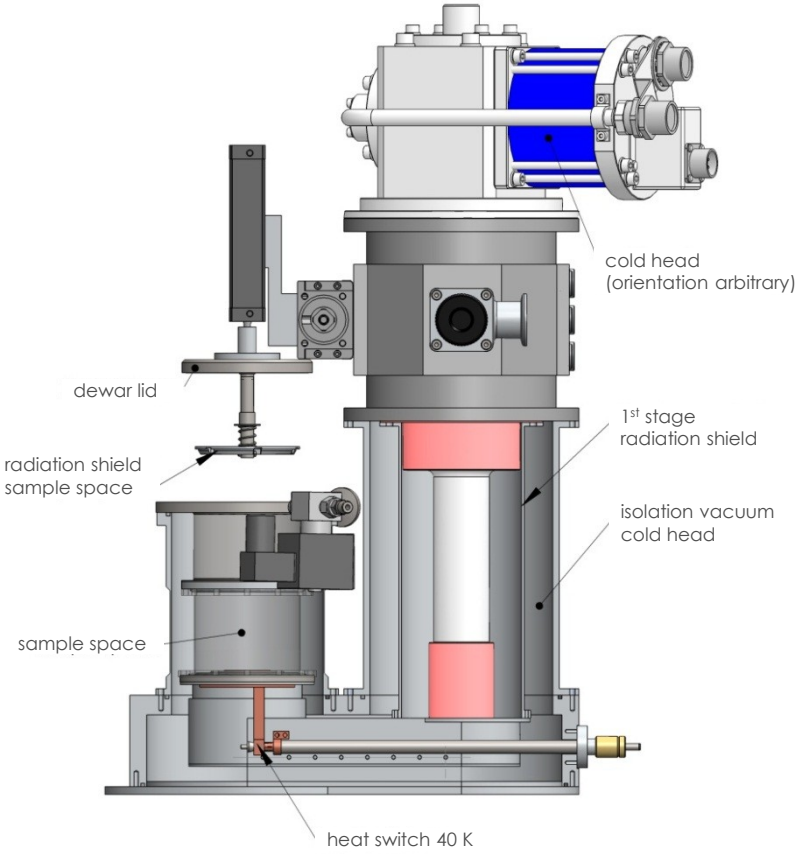
- Precooled samples (ILL)
- Compact cryostat: Minimised cold mass (MLZ)

Compact cryostat: objectives

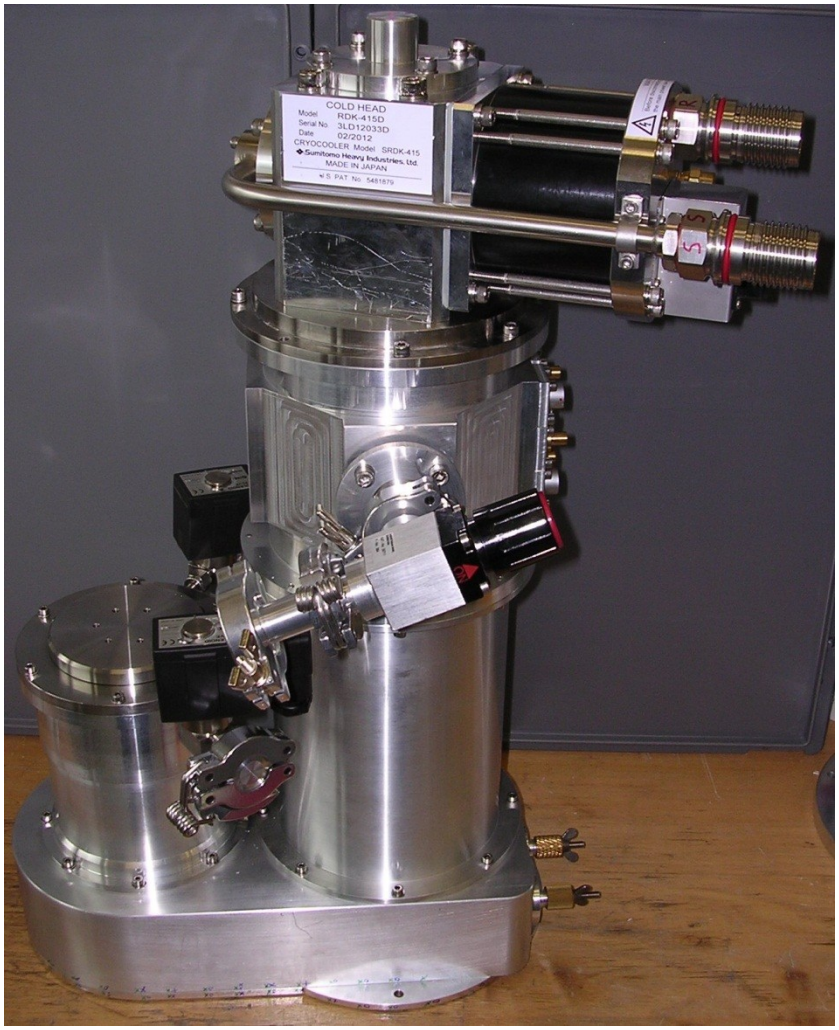
- Compact design (limited space at instrument)
- Fast remote controlled sample change
- Broad temperature range
- Sample storage and robot at RT
- Modular setup
- Top and bottom loader possible (arbitrary)

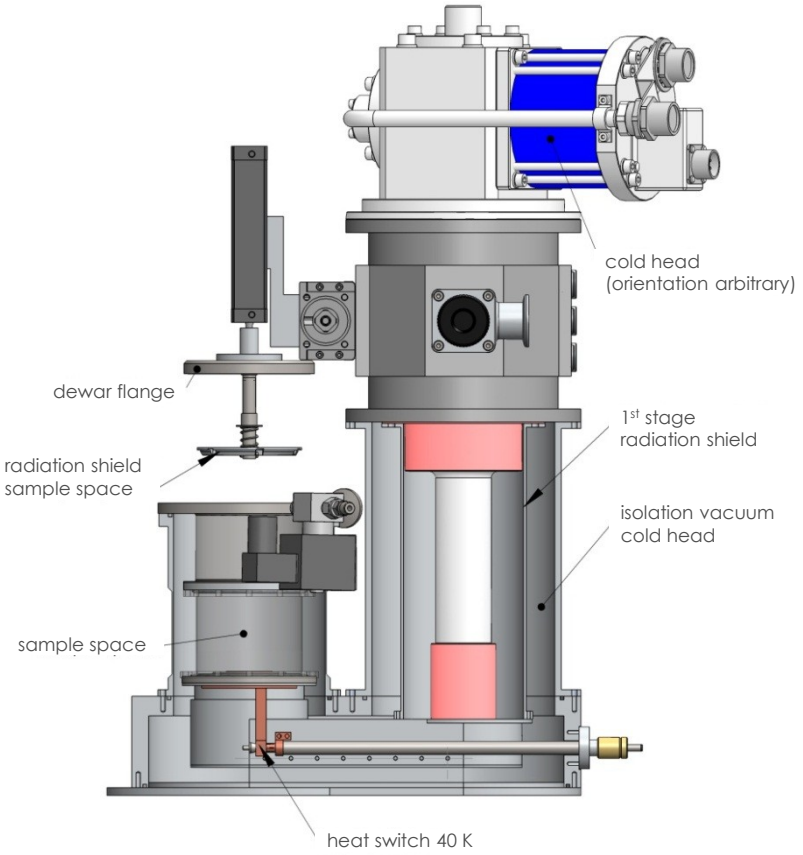
Compact Cryostat: Concept study

- Separate sample space vacuum and cold head isolation vacuum
- Minimised cold mass
- Remote controlled reload
- Standardised sample holder
- Sample in exchange gas via sample container

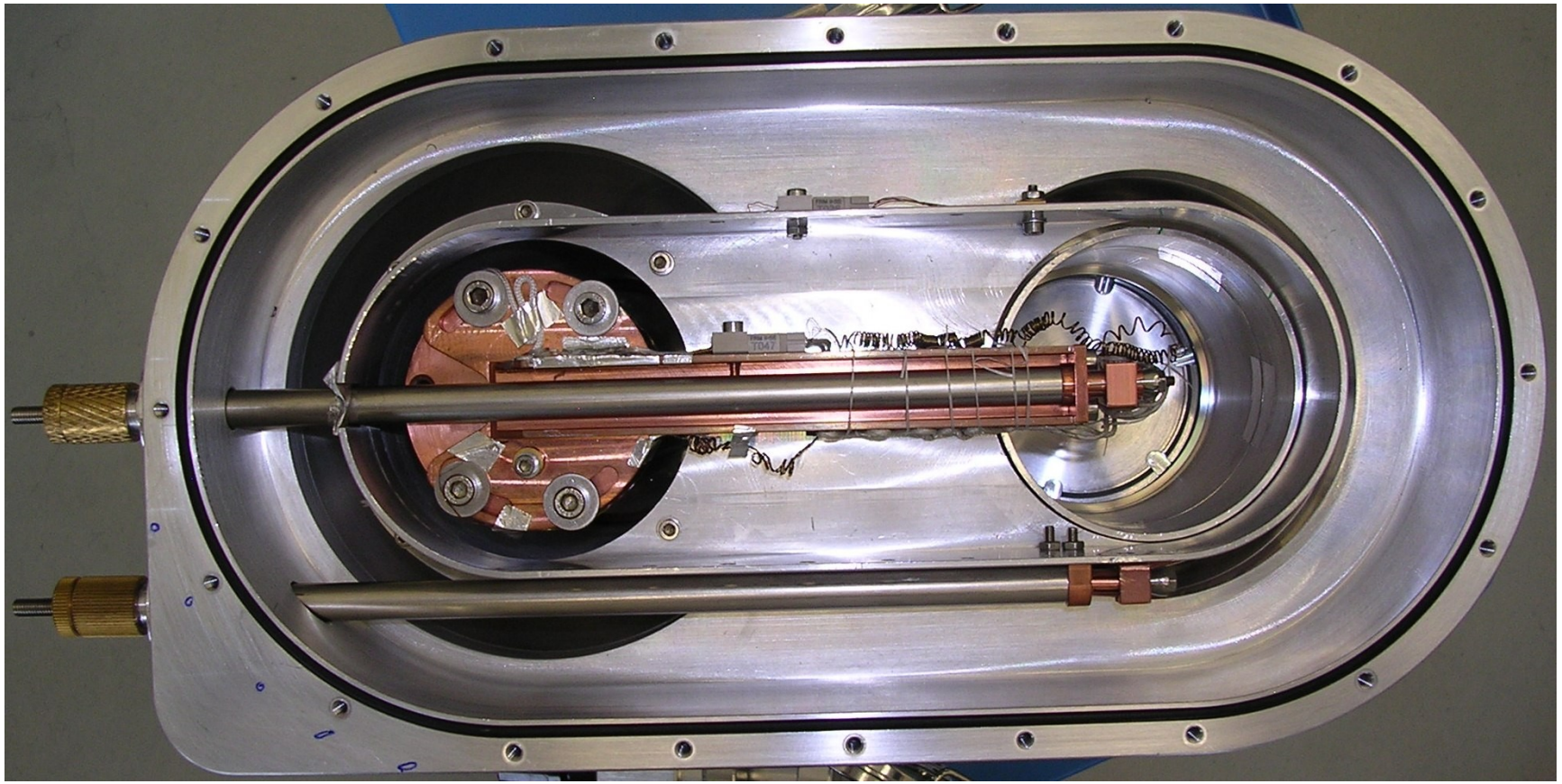


Compact Cryostat

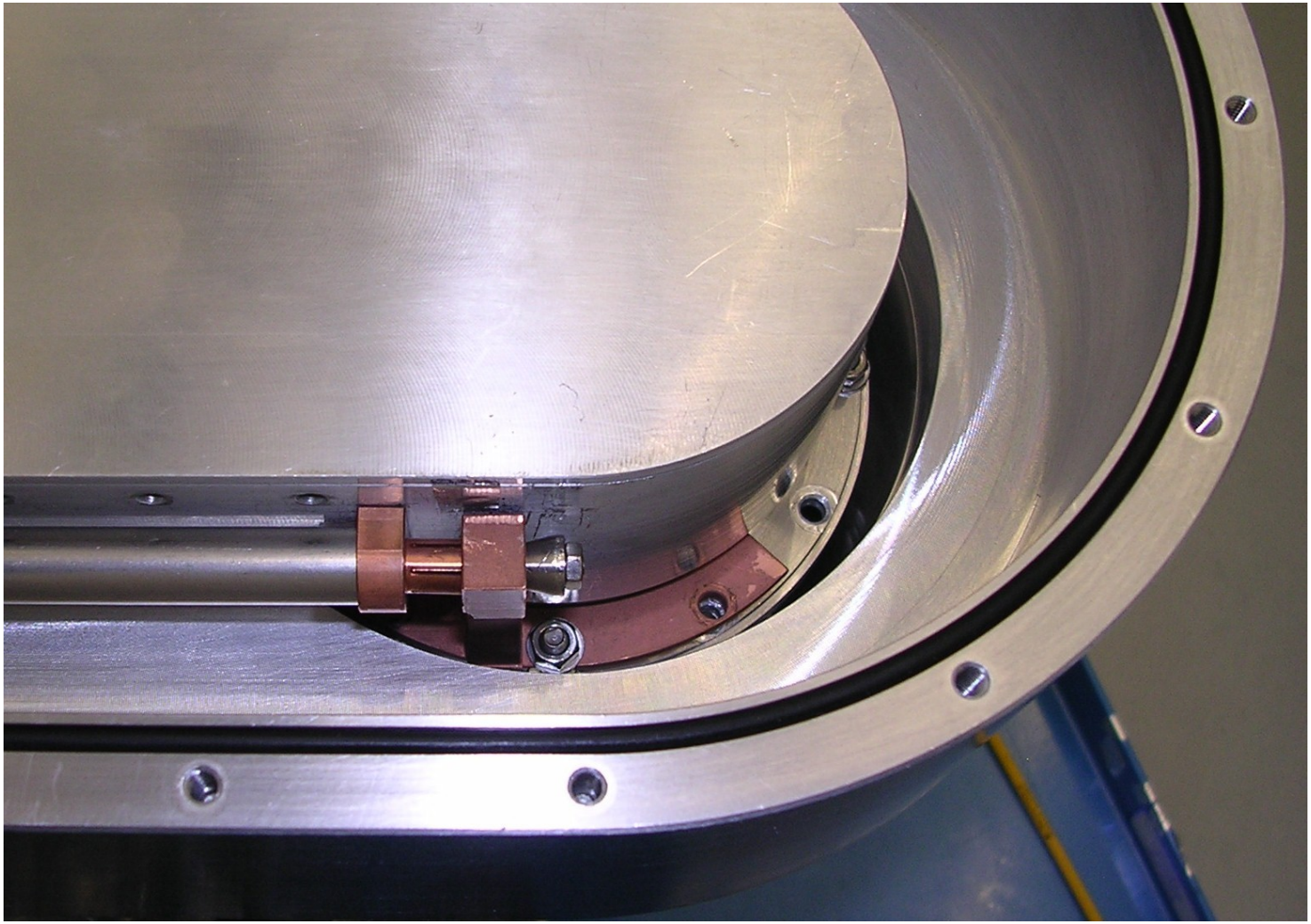




Compact Cryostat: Heat switch

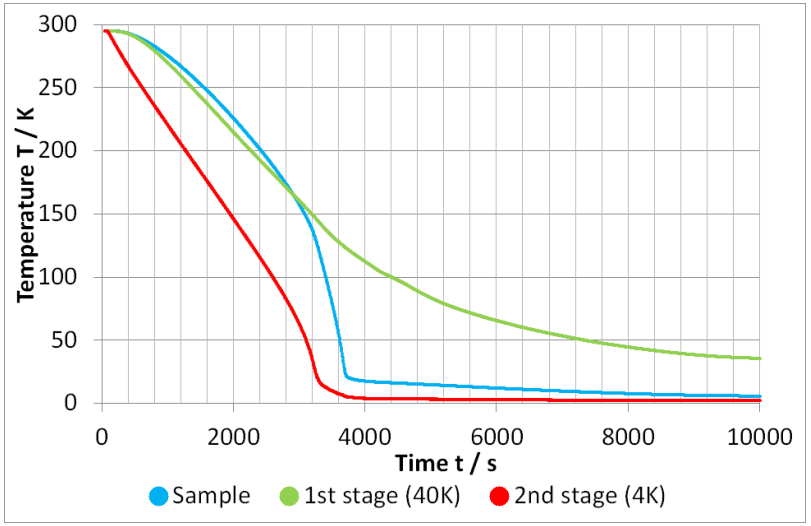


Compact Cryostat: Heat switch



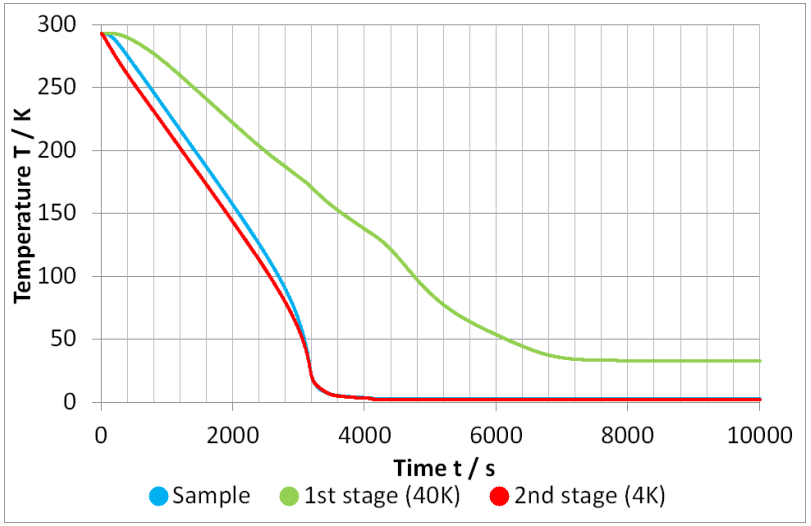
Compact Cryostat: Cooling

Sample holder thermally coupled



2:45 h: 2nd stage at ~2,6 K
3:20 h: Sample at ~5,9 K
ΔT ≈ 3,3 K

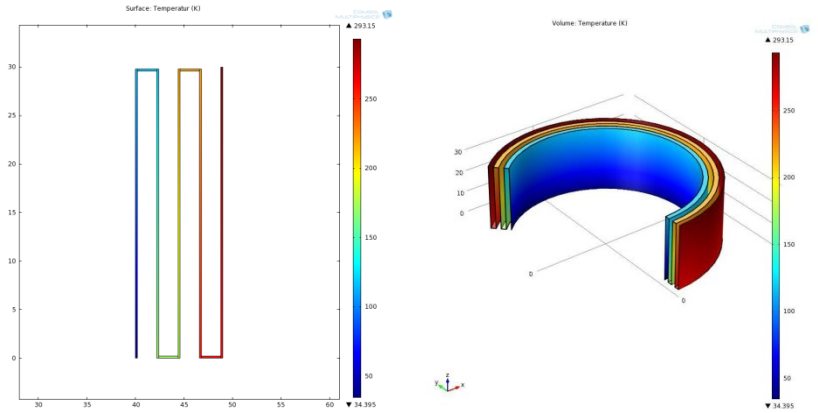
Sample holder thermally decoupled

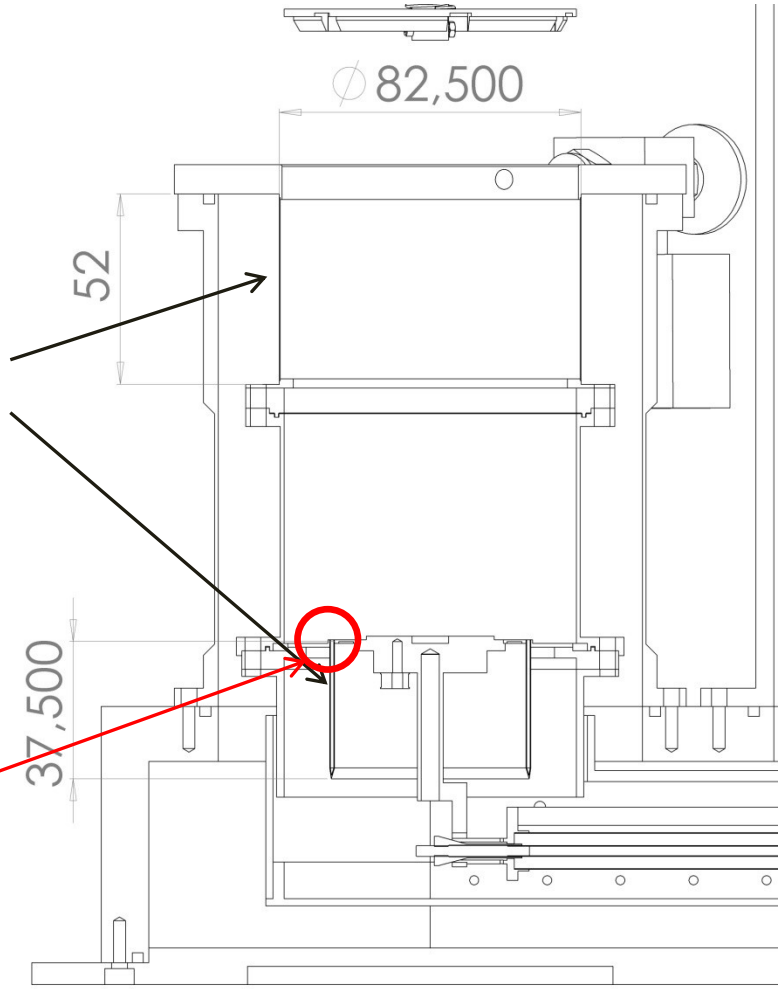


1:25 h: 2nd stage at ~2,4K
2:40 h: Sample at ~2,8 K
(1:30 h: Sample at ~2,9 K)
ΔT ≈ 0,4 K

Heat management

Nested thermal links



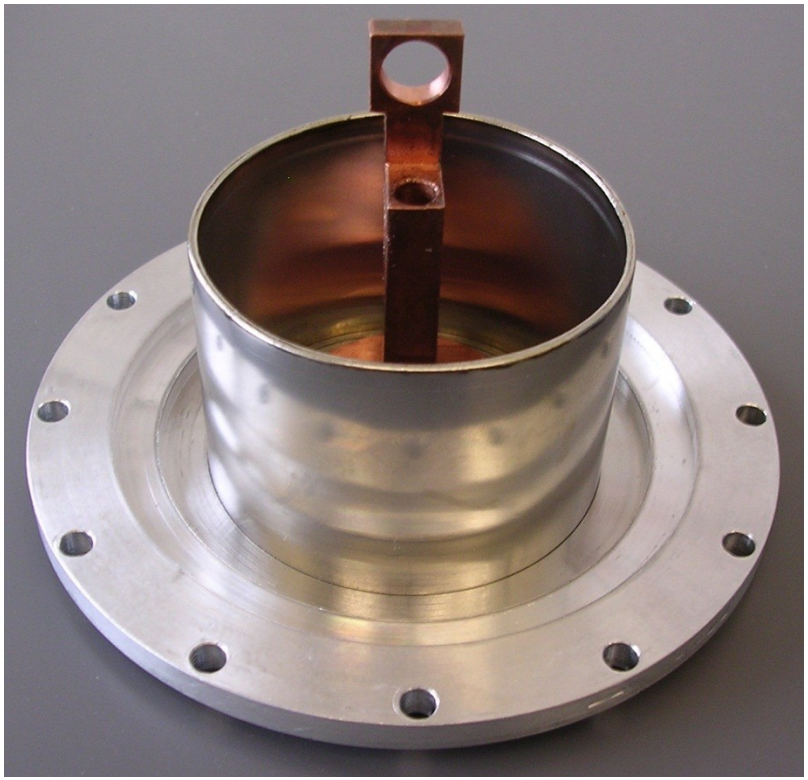


<u>Problem</u>:

Temperature difference between the two cylinders much higher

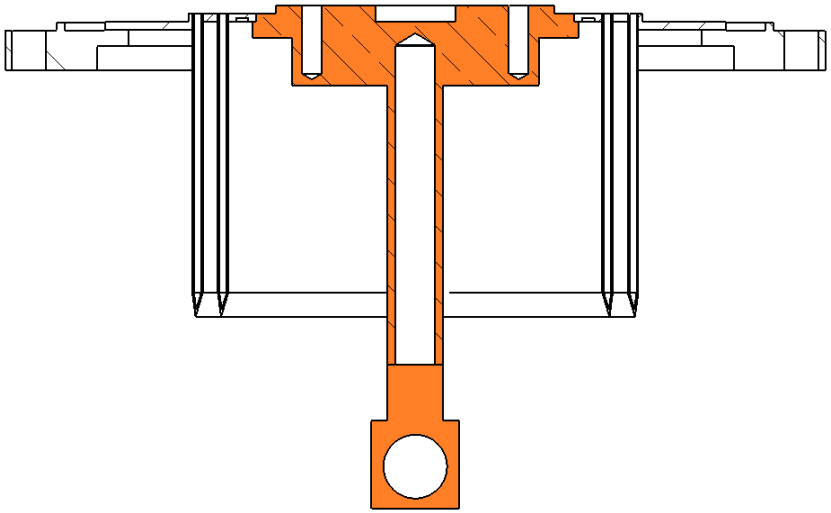
Heat management

First sample holder



Length = 75 mm

New sample holder



Length = 150 mm

Problems to be solved

- Thermally decoupling of sample holder
- Thermal connection of sample
  - Pin connection
  - Standardised sample cans (orbital laser welding)
- Automation of the sample exchange
  - Control of the heat switches
  - Robot arm

Thank you

for your attention