Performance of the beamline cryostat for the Cryogenic Current Comparator for CRYRING

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The **beamline cryostat** for the operation of a Cryogenic Current Comparator (CCC) in the low-energy storage ring **CRYRING** is assembled and first results of the performance are available. The bath cryostat can be fully incorporated into the **UHV-beamline** and is designed with a **closed helium cycle** enabled by a helium liquefier.

While we are satisfied with the vacuum properties, the interaction between the cryostat and the liquefier needs to be optimized. Later this year, the **FAIR-CCC-XD** or other new detector models can be operated and tested with particles beams.

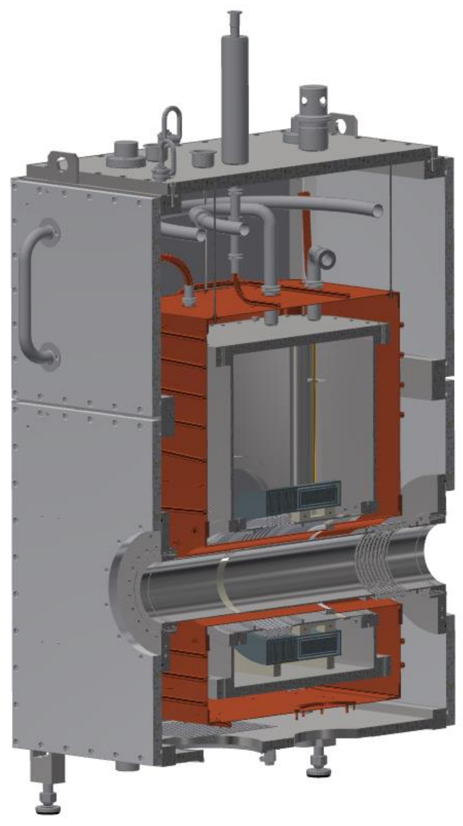


Figure 1: Final design for CRYRING@FAIR. Constructed in close cooperation with *ILK Dresden*.

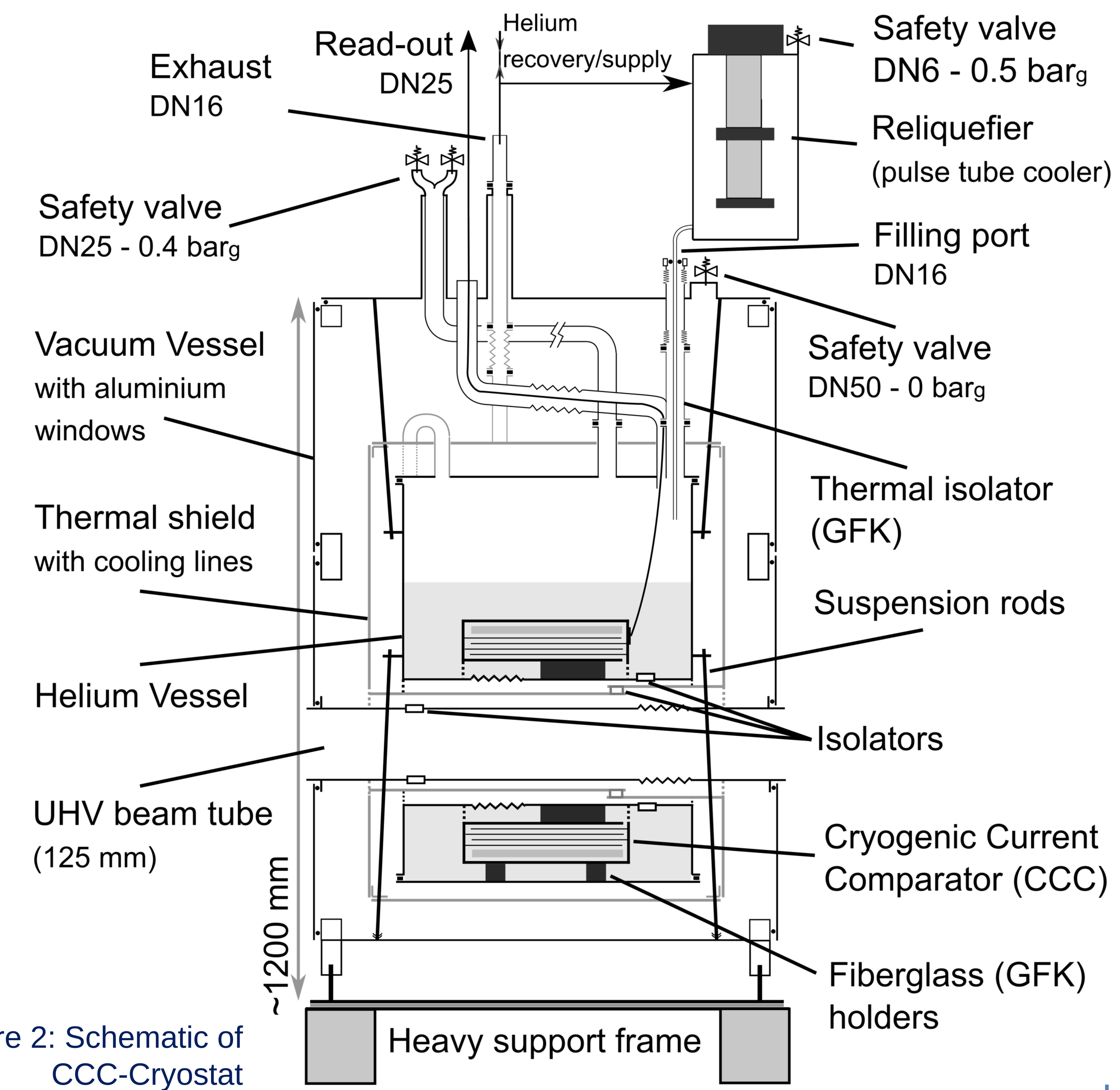


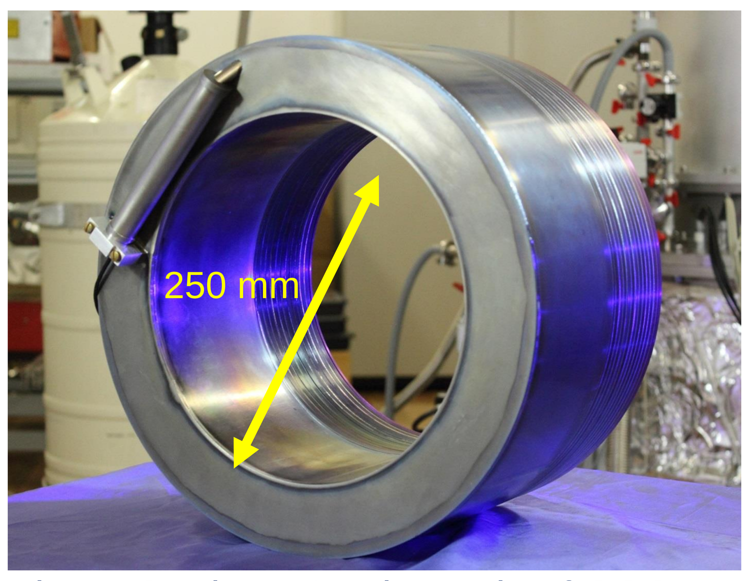
Figure 2: Schematic of CCC-Cryostat

ILK Dresden

Design goals

- **Non-stop & independent cryogenic operation at 4.2 K w/o refilling**
- **Compatible with a UHV accelerator beamline**
- **Stable temperature and pressure (Δ < mK, mbar)**
- **Limit vibrations that reach detector**

CCC-XD (eXtended-Dimensions) for FAIR



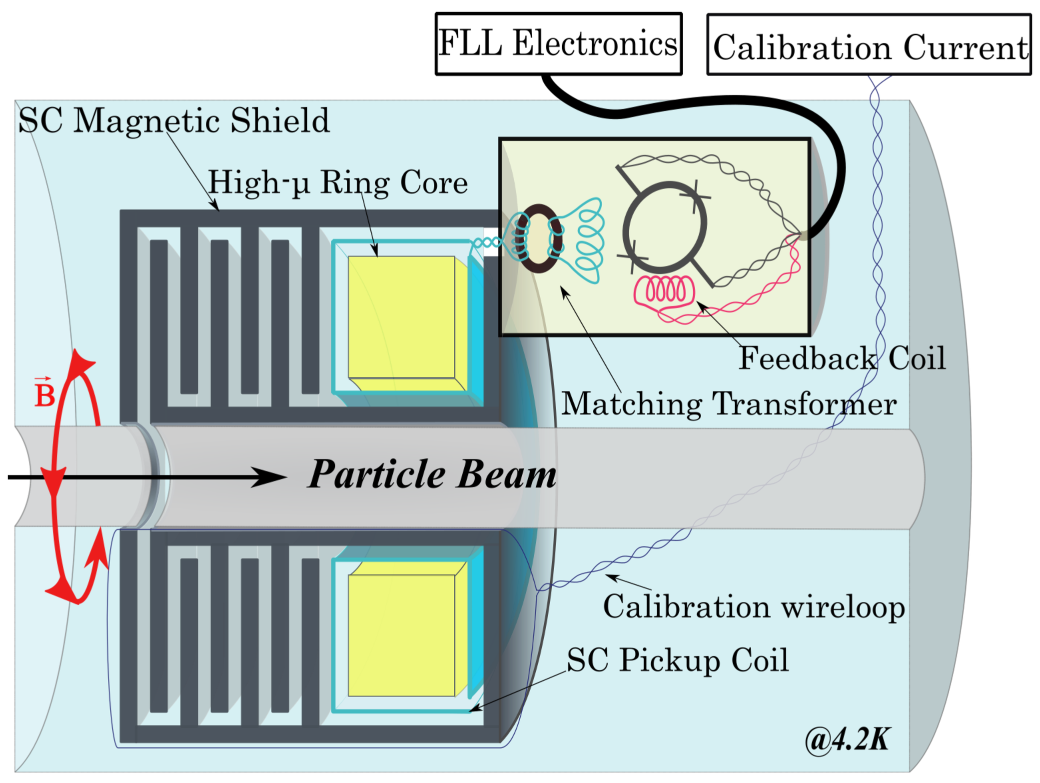


Figure 3: Photo & schematic of CCC-XD

Principle

- **Superconducting magnetic shield –** Field selection
- **Superconducting pick-up coil –** Signal transfer
- **DC-SQUID –** Measurement **(Superconducting Quantum Interference Device)**

Properties

- **Non-destructive**
- **Independent of energy, position and particle species**
- **Detection threshold < 1.3 nA (@ 10 kHz bandwidth)**
- **Slew rates of up to 0.16 µA/µs (@ 200 kHz bandwidth)**

Uses

- **Transfer lines** (SIS18/SIS100 at GSI/FAIR)
- **Storage rings** (AD at CERN, TARN II at KEK, CR at FAIR)
- **SC cavities characterization** (dark currents at DESY)

Figure 5: Reliquefier from *CRYOMECH*

Production and cryo-test stand

Figure 6: Documentation of the production and testing of the cryostat.

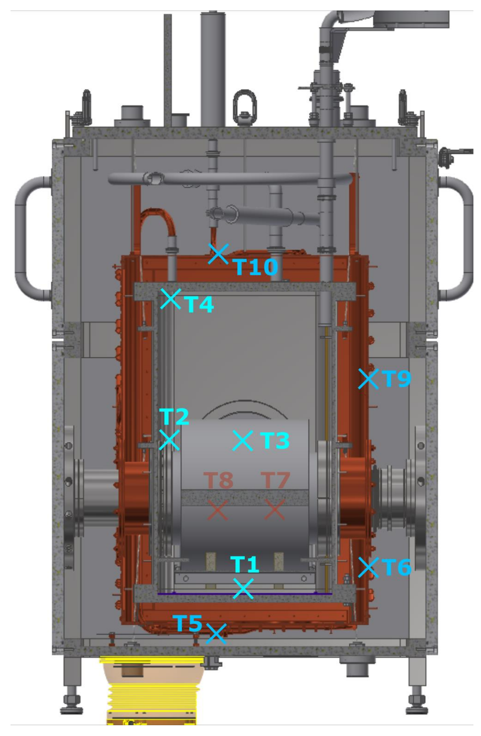
Cold test results

+ Excellent isolation **vacuum** and **mechanical** properties
+ Detailed temperature **monitoring**
+ Good mechanical **decoupling** from liquefier
+ **Evaporation rate** at design value of 15 l/day

± **Two operating modes** with helium loss (figure 7)

a. Oscillations of gas flow and temperature (fig. 8)

b. Stable flow



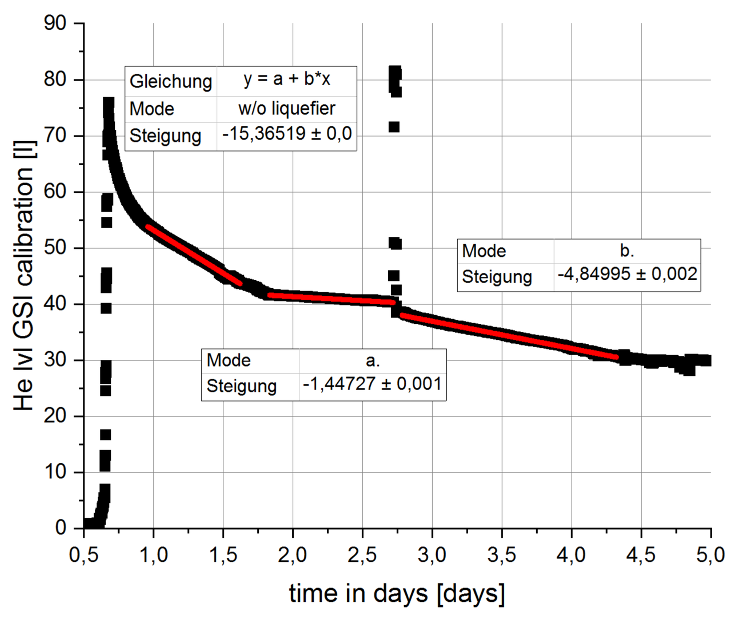


Figure 7: Change of helium level in different operating modes.

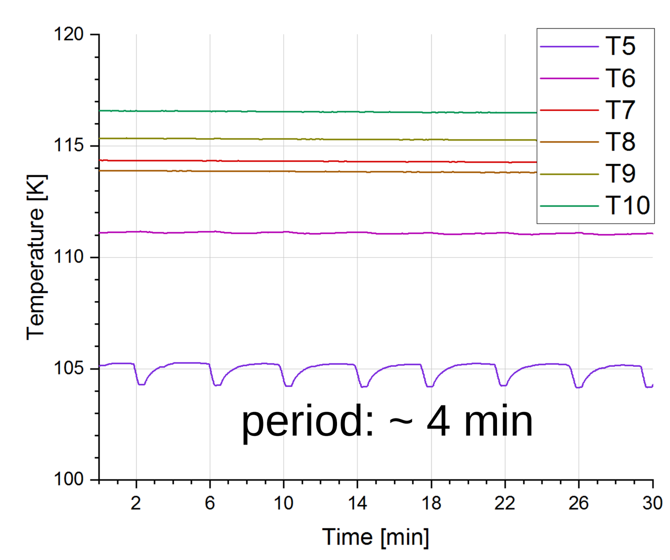
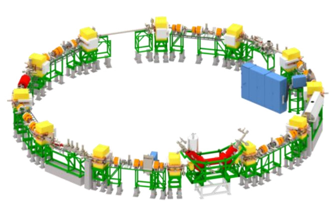


Figure 8: Temperature oscillations of radiation shield in operating mode a.

Outlook

- The CCC will be added to **CRYRING** in summer 2020.
- Develop methods to **stabilize thermal equilibrium**.
- Probe **detector performance** in accelerator environment.



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Further information at: https://www-bd.gsi.de/dokuwiki/doku.php?id=instruments:overview:ccc

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