

NCNR Sample Environment Projects

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Procurement and Development: Helium Recovery Project

Helium Recovery System - is a system to collect, store, purify, liquify and re-use Helium gas boil-off from wet cryostats / magnets, Helium pumps and transport Dewars

- Weekly meetings with NCNR team (SE, RFO, ROE, OFPM, AMD, Safety, etc.) (Fall 2019 – Present)
- Preparation and submission of procurement paperwork (Fall 2019 – Summer 2020)
- Bids evaluation, choosing the Contractor (September 2020)
- Bi-weekly meetings with the Contractor on system design, etc. (Fall 2020 – Present)

IN PROGRESS

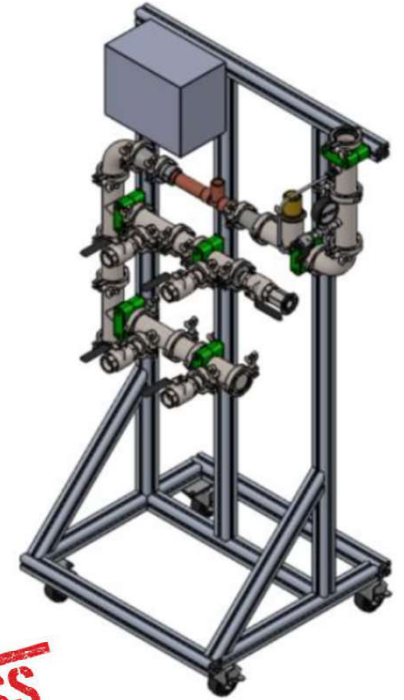
Procurement and Development: Helium Recovery Project

End-User Station (EUS) - 29 pcs and Helium Monitor Station (HMS) - 8 pcs

- Working with the Contractor on EUS and HMS conceptual designs – finished in April 2021
- Designing interfaces between SE equipment (cryostats, He dewars, pumps) and EUS
- Testing EUS and HMS prototypes - August 2021
- Working with NCNR staff to determine EUS locations at neutron instruments (G100: April – May 2021; C100 – June 2021). EUS locations are approved by Team Leaders.
- After EUS prototype test is performed, measure and order all hoses/connectors between SE equipment (cryostats, He dewars, pumps) and EUS – next FY

Preliminary EUS test results:

- unit arrived to NCNR is malfunction; the contractor will come to fix it at NCNR



IN PROGRESS

Maintenance and development: ILL cryostats

Maintenance

- All operational cryostats have undergone thorough maintenance (**thanks Sergiy Gladchenko for his help**):
 - Needle valve cleaning and re-sealing
 - Vacuum jacket valve cleaning
 - Cold tests, etc.

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Safety

- All cryostats and their carts have been certified for crane lifting according to new NCNR safety policy

Developments

- All cryostats now have wide range pressure transducer on Helium pumping line, makes Needle Valve adjustment more convenient and robust
- All cryostats now have LN2 level sensors
- Most cryostats now have new cryogen level meter, Allows to measure both levels: LHe and LN2 and to refill automatically
- User and Tech manuals for ILL cryostats have been updated (**thanks Tanya Dax for editorial assistance**)



MicroPirani MKS910



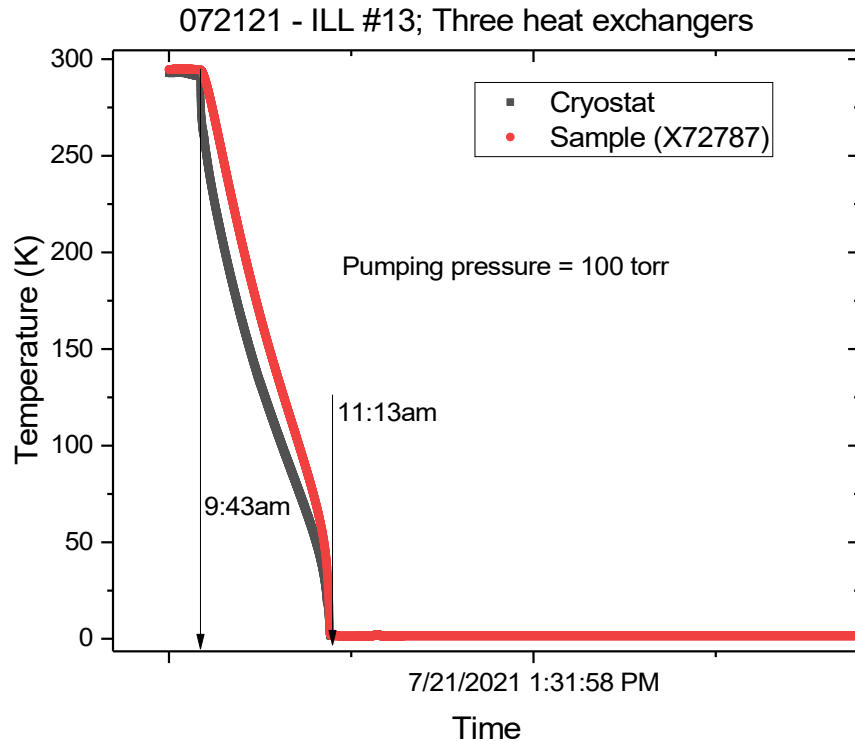
Model 1700

Procurements: ILL cryostats

- 100mm MACS ILL #4 cryostat: new needle valve has been ordered, installed, tested - **Completed**
- 3He MACS ILL cryostat #14: needle valve refurbishment has been ordered – **In progress**
- Upgrade of ILL cryostat #13 to three heat exchangers: more cooling power, faster prep and sample change times.
Commissioned - **Completed**

Procurements: ILL cryostats

- Upgrade of ILL cryostat #13 to three heat exchangers: more cooling power, faster prep and sample change times.



Cryostat performance before and after upgrade Cooling from 300K to 2K

1 heat exchanger (standard)	3 heat exchangers (upgraded)
4-5 hours	90 min

If funding approved, more cryostats would need this type of upgrade

Procurement: Custom Rotation System for 100mm ILL Cryostat

Funded by NSF

- Collecting the requirements from NCNR scientists
- Market research
 - Talking to other neutron facilities
 - Talking to manufacturers and engineering companies
- Preparing procurement paperwork
- Submission to AMD: June 2021
- Award: September 2021



The rotation system consist of

- Computer controlled rotation stage to be mounted on top flange of the 100mm ILL cryostat
- Rotatable sample stick to be inserted in 100mm sample well
- Interface mounting flange adapter between rotation stage and cryostat flange
- Interface mounting flange adapter between rotation stage and rotatable sample stick
- Controller, cables, software



IN PROGRESS

Maintenance: CCRs

CCR5 – Has an issue with base temp while running in horizontal position. It drifts up after reaching normal 6K base temp. What was done: cold head got changed and CCR tested in vertical position. No positive outcome. Needs further attention

IN PROGRESS

CCR19 – sensor upgrade, cold test. Works fine.

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CANDOR CCR – leak checks

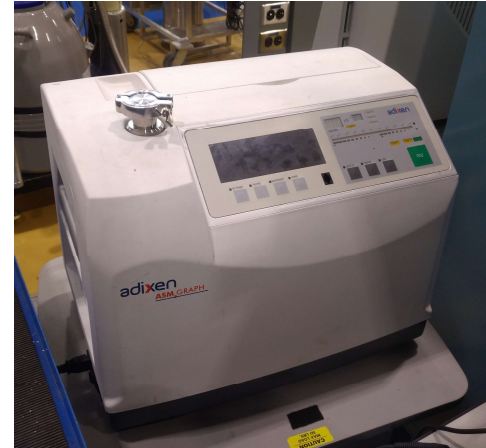
Maintenance: Other equipment

Maintenance/repair:

- Two leak detectors at user stations
- CCR compressor

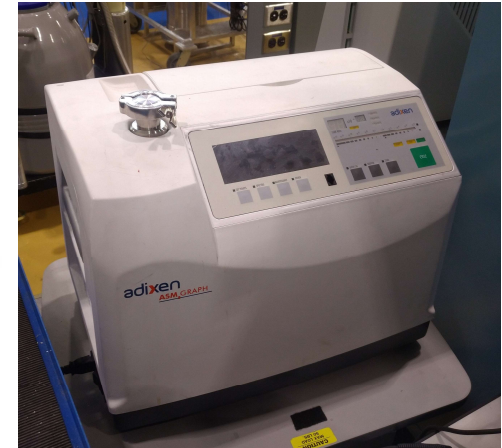
- Sent out
- Received
- Commissioned

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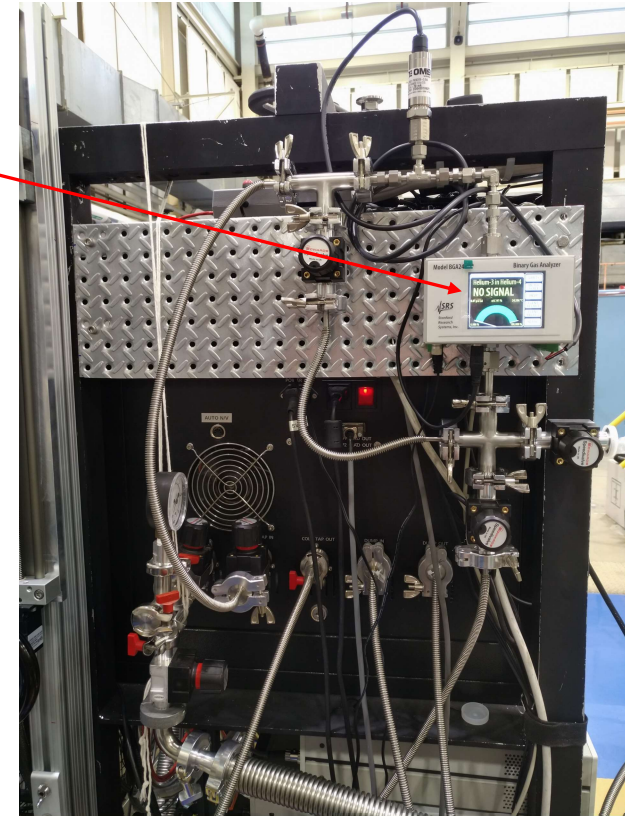
Development: ICE Dil Fridge

➤ Binary Gas Analyzer

Fully integrated into dil fridge gas handling system, this diagnostics and troubleshooting tool allows *in situ* ^3He - ^4He mixture analysis.

Suggestion: implement this approach to all NCNR dil fridges

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Development: ICE Dil Fridge

➤ **User and tech manuals updated.**

Thanks to Tanya Dax for editorial assistance

Thanks to Jonathan Gaudet for the help with manuals tests (**cross-training opportunity**)

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➤ **New sample holder for SANS dil fridge experiments**

Collaboration with Jonathan Gaudet

- Design
- Thermal conductivity test
- Neutron background test

IN PROGRESS

Development: Needle Valve Automatic Control for ILL Cryostats

- Market research: Oak Ridge, ISIS UK, HZB – **thanks Sergiy Gladchenko for help**
- ISIS UK is sharing all the details on their system (drawings, diagrams, BOM)
- Oak Ridge has sent their system to test (drawings, diagrams, BOM)
- HZB: general consultations

Next:

- Test Oak Ridge system
- Develop the NCNR system based on the market research

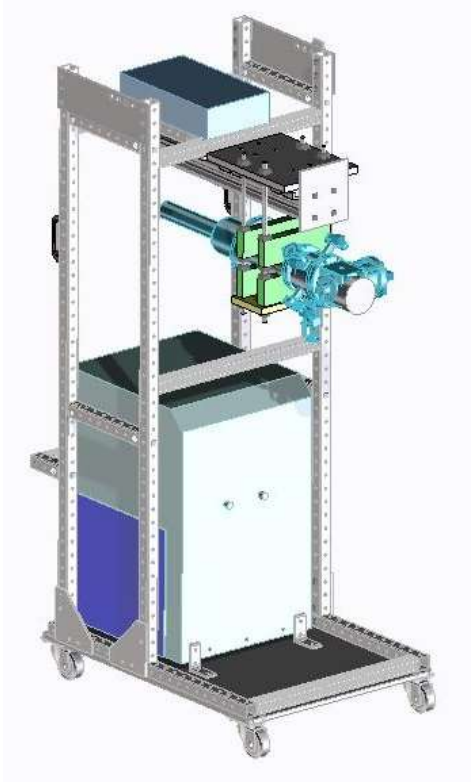


IN PROGRESS



Development: Lifiable carts

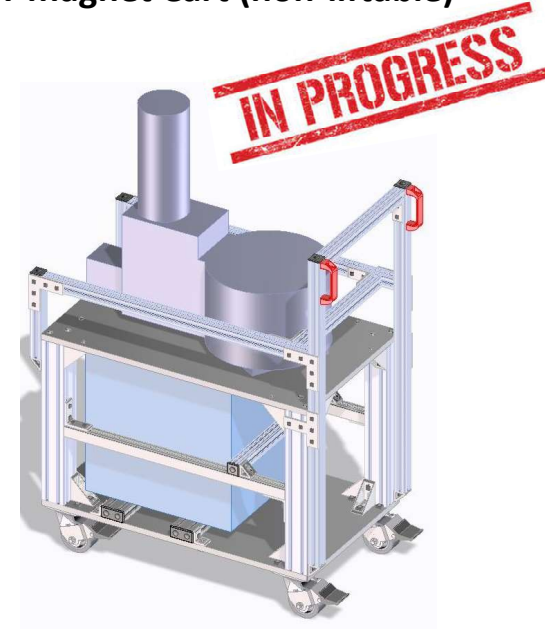
New CANDOR CCR cart (lifiable)



- Designed – Jan - Feb 2021
- Hazard Review approved – March 2021
- All parts ordered – April 2021
- Cart assembled – June - July 2021
- Test – September 2021

IN PROGRESS

Cylon 3T magnet Cart (non-lifiable)

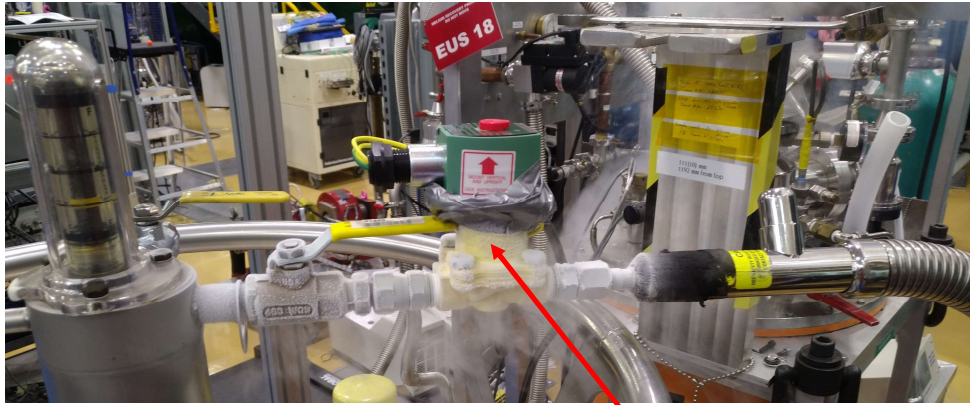


- Made in 2018
- New requirements: Needs to be lifiable
- Design – Fall 2021

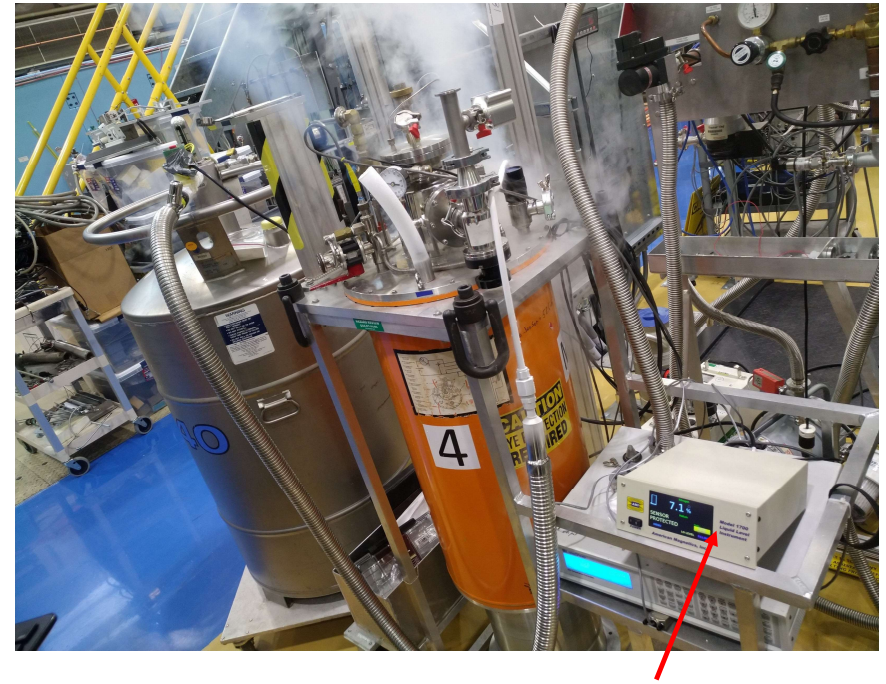
Delayed due to lack of engineering support

Development: LN2 automatic transfer system

Allows to maintain LN2 level within preset limits



Solenoid cryo valve



Cryogen level controller

Next steps:

- Instrument scientists to test the system and return the feedback
- For BT7 and MACS: discuss system setup challenges
- Order parts for several LN2 refill sets (FY 2022) and get system ready during 2023 shutdown

Research: Ultra-low temperature thermometry

Several different RuO₂ sensors have been studied at dil fridge base temperature within 0 – 10T magnetic field.

Experimental setup:

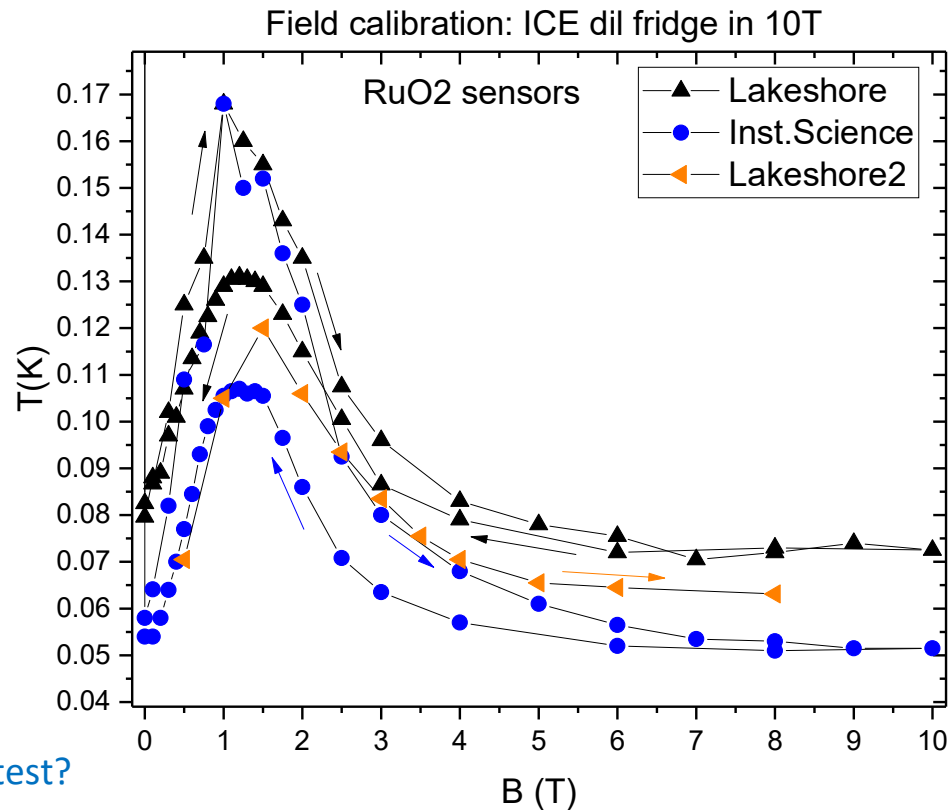
- ICE dil fridge
- 10T dry magnet

Sensors studied:

- Lakeshore RX202A – has two chips
- Lakeshore RX102A (original and new one)
- Scientific Instruments RO-600

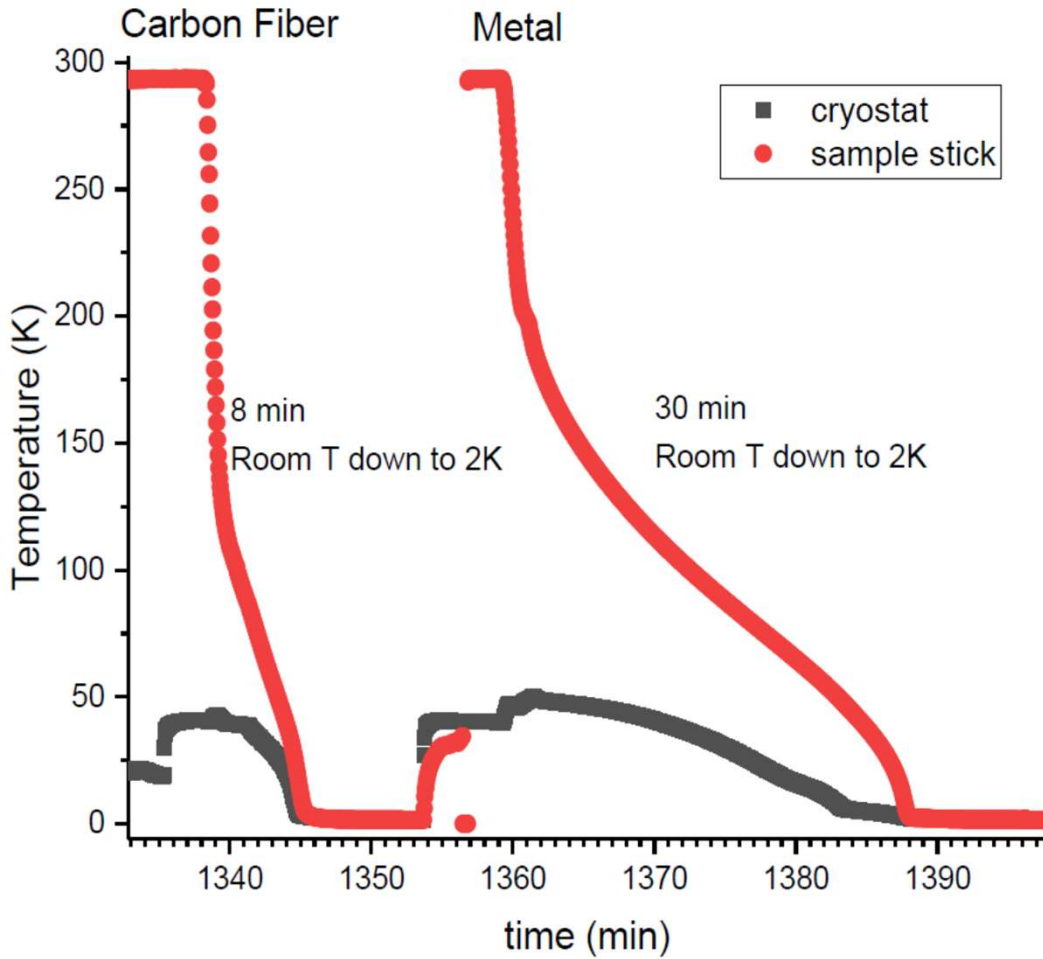
Results: All studied sensors showed magneto-resistance maximum at around 1.5T

Other resistance sensors to test?



Test: Carbon Fiber sample stick

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Carbon Fiber sample stick made by ICEOxford showed excellent performance: much faster sample change time than Metal sample stick

Next to order: Sample stick for 100mm MACS ILL Cryostat

Thanks Alan Ye for ordering the stick

Users support during cycles

- ILL cryostats: 15 experiments
- Dil fridge: 4 experiments



Any suggestions for 2023 Shutdown?

- New sample holders
- New low temperature capabilities
- New automation ideas
- New temperature sensors to study at 50mK in magnetic field



Summary

Completed projects:

- ILL cryostats: maintenance, improvements, procurements
- CCR maintenance
- Two leak detectors maintenance
- CCR compressor maintenance
- ICE dil fridge improvements: *in situ* 3He-4He mixture measurement system, updated manuals
- New CANDOR CCR liftable cart
- New LN2 auto refill system
- Carbon Fiber sample stick for ILL cryostat: cold tests
- User support: dil fridge, ILL cryostats

In progress:

- Helium Recovery System
- Custom Rotation System for 100mm ILL cryostat
- CCR #5 maintenance
- Needle Valve Automatic Control for ILL cryostats
- New Cylon 3T magnet liftable cart
- Ultra-low temperature thermometry (research)
- New sample holder for SANS dil fridge experiments