Shutdown Activities from 2020-2021

QIANG (ALAN) YE
SEPTEMBER, 2021

List of activities

- **Safety/Lifting documents**
  - Big Blue cryostat
  - CT dewar
  - SD55
  - Oxford Dil
  - All five superconducting magnets (3T, 7T, 9T, 10T, 11T, 15T)
- **Cross training with other staff member**
  - 10T training with Yegor and Tanya in 2020
  - Working with Cedric on LIPPS and PMI
- **Maintenance of equipments**
  - Hiden Analytical Mass Spectrometer
  - 9T silicon sample well, power supply, loose Al foil, bent LN2 shie10T demagnetization of DCS
  - 15T VTI installed and leak tested
  - Replace all 18+ computers in SE group

List of activities - continued

- **Procurements**
  - New compressors for HFBS and NSE TLCCR
  - 4-channel potentiostat for electro-chemistry users
- **Specialty projects**
  - Neutron Spin Echo Vacuum box
  - Carbon Fiber Sample Stick Testing at HFBS and in OC
  - ICE dil fridge Silicon IVC for SANS experiment
- **Future projects**
  - Design and make new silicon tail for Candor CCR
  - Design more carbon fiber sample sticks for different systems
  - New lighter 9T LN2 shield
  - Combine OC with Titan magnet
  - Remote control of compressors at PBR (with Tanya Dax)
  - Oxford dil fridge insert test with SANS 50mm OC and make a Silicon IVC for it
  - Make a new cart for the Hiden Analytical mass spectrometer
  - 3-syringe-pump system

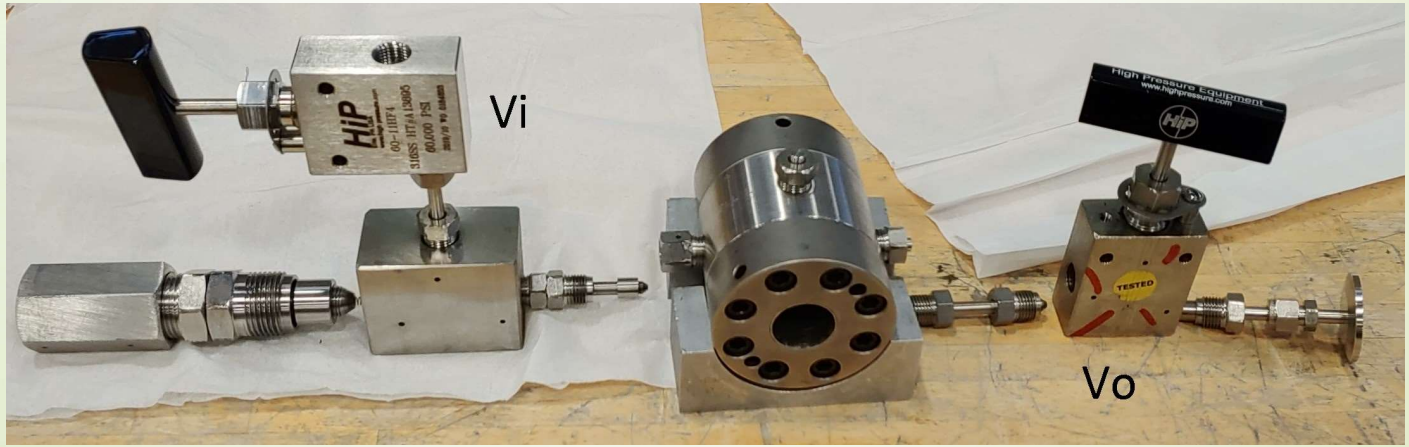
Safety/Lifting documents

- Big Blue cryostat
- CT dewar
- SD55
- Oxford Dil
- All six superconducting magnets (3T, 7T, 9T, 10T, 11T, 15T)

- Most lifting documents have been submitted for initial review and we are waiting from the lifting committee. 3T magnet's cart is being designed by Yegor and lifting documents will be submitted once the design is completed.

Cross training

- 10T training with Yegor and Tanya in 2020 but the experiment cancelled
- Working with Cedric on LIPPS and PMI
  - Test the complete LIPPS & PMI system with Cedric Gagnon
  - Improve the stability of the labview control programs
  - Will have dedicated computers for LIPPS and PMI system separately
  - Making the system more user-friendly
  - Wrote a manual with more details



Maintenance of equipments

- Hiden Analytical Mass Spectrometer
- 9T silicon sample well, power supply, loose Al foil, bent LN2 shie10T demagnetization of DCS
- 10T maintenance
- 15T VTI installed and leak tested
- Replace all 18+ computers in SE group

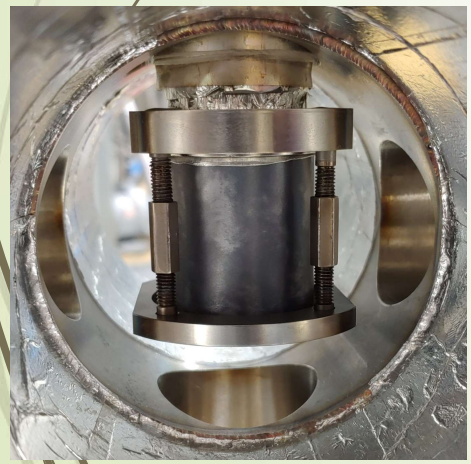
Hiden Analytical Mass Spectrometer

- Fix the Hiden Mass Spectrometer
- Can detect mass from 1 to 100
- Four detection modes
  - Profile Mode: Scan thru different masses, including the masses between the integer masses, like 4.1,4.2,4.3…5,5.1,5.2…..
  - Bar Mode: Scan thru only integer masses. Like from 2,3,4,…
  - MID Mode: Can detect a number of masses as a function of time
  - Leak Detect Mode: Can detect one mass as a function of time, usually used with helium for leak testing.
- Operation manual completed
- Wei Zhou and Jamie were using it for the last few months
  - Jamie: Develop new low ppm H in Ti standards for the aeronautics industry
  - Wei Zhou: Measure the gas composition leaving the dynamic column breakthrough apparatus for CO_2 capture. NIST Direct Air Capture (DAC) - Carbon Capture, Utilization, and Storage (CCUS) project: https://inet.nist.gov/adlp/nist-direct-air-capture-dac-carbon-capture-utilization-storage-ccus-working-group
- Making a cart for it and its computer to move around easier

9T Magnet performance before

- Small leak in the sample well
- Base T was 2K at sample position
- Helium evaporation rate was ~6mm/hr (max 240mm, min 40mm) when not ramping
- Power supply has a non-zero offset of about 1.6A
- Helium level couldn't be read remotely due to the analog helium level meter
- Quench happened in early 2021

9T magnet new sample well



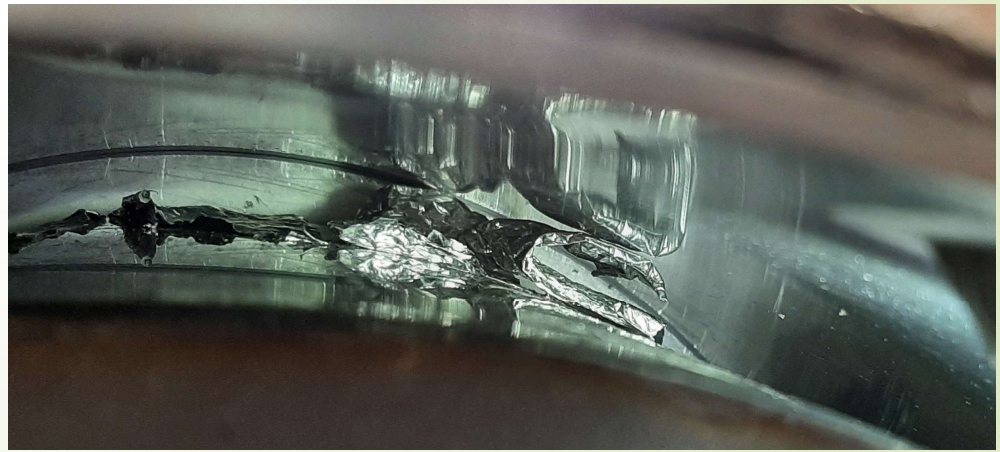
- Old quartz cell has cracks
- Replaced by Silicon cell
- No more leak from the sample well

9T Magnet new 4G-150 Power supply from Cryomagnetics

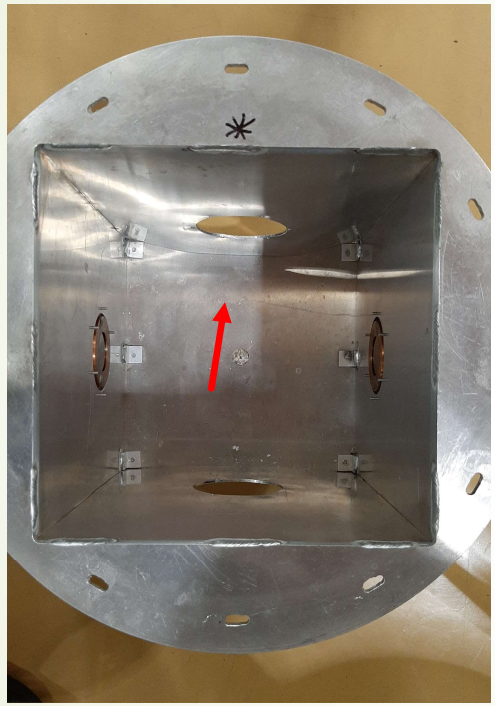
- Old IPS120-10 power supply has strange zero B field offsets
- Replace with 4G-150 PS from Cryomagnetics.
- Replaced the 120A current leads with new ones

9T Loose Al Foil between Liquid N2 and Helium Shield

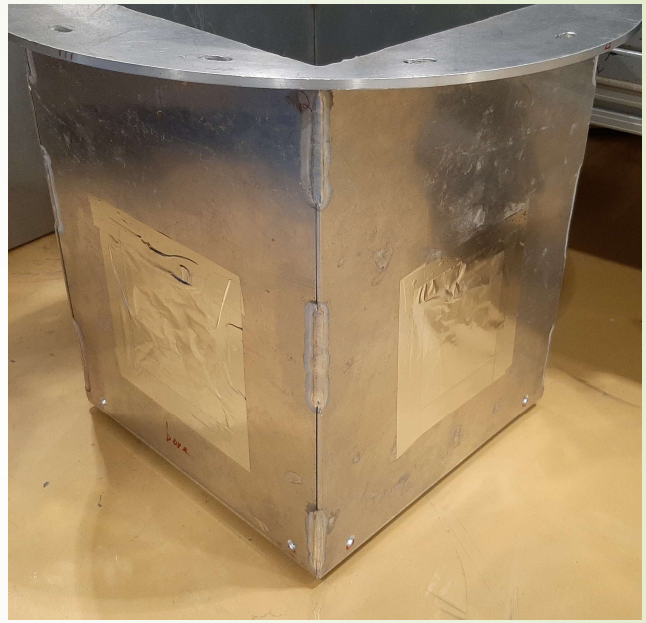
- Since last quench, we opened up 9T with the help of Donna to check the physical conditions of different components.
- Cleaned up a lot of loose Al tape between liquid N2 and helium shields.
- Those are the reasons why helium evaporation rate was not stable over the last few years.



9T LN_2 shield bent



Fixed by Doug's group



New liquid helium level sensor and readout

9T low T test with new liquid helium level sensor and power supply

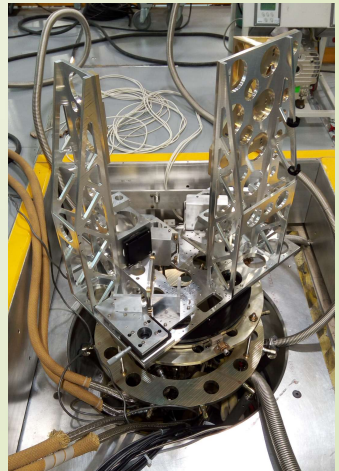
- Base T 1.55K@0T and 1.6K@9T (-9T)
- Helium consumption
  - -4.7mm/hour when not ramping
  - ~14mm mm from 0T to 9T
  - ~8 mm from 9T to 0T
- The temperature is much lower than before (~2K). Same level as the OC. Entire system is much more stable.

10T maintenance

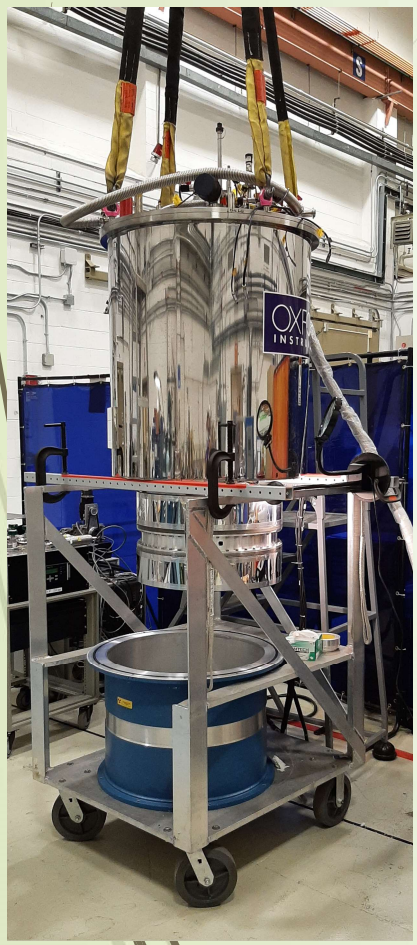
- Add aluminum sheets around 10T cart to prevent things from falling off the cart
- Change the computer and all software
- Temperature sensor cables make fischer connection extension cables so now all cables are much longer and easier to reach anywhere

- Testing with Tim Reeder, Collin Broholm's microwave setup. We cooled down the microwave setup to below 2K and did EPR measurements by applying microwave pulses and watch the decay of signals from the sample at different magnetic fileds.

- Demagnetization of 10T at DCS and it works for the 3He group
  - Change B fields -10 T -> 9 T -> -8 T -> 7 T -> -6 T -> 5 T -> -4 T-> 3 T -> -2 T -> 1 T-> -0.5 T -> 0.2 T -> -0.1 T -> 0.05 T -> -0.02 T -> 0.01 T -> 0 T

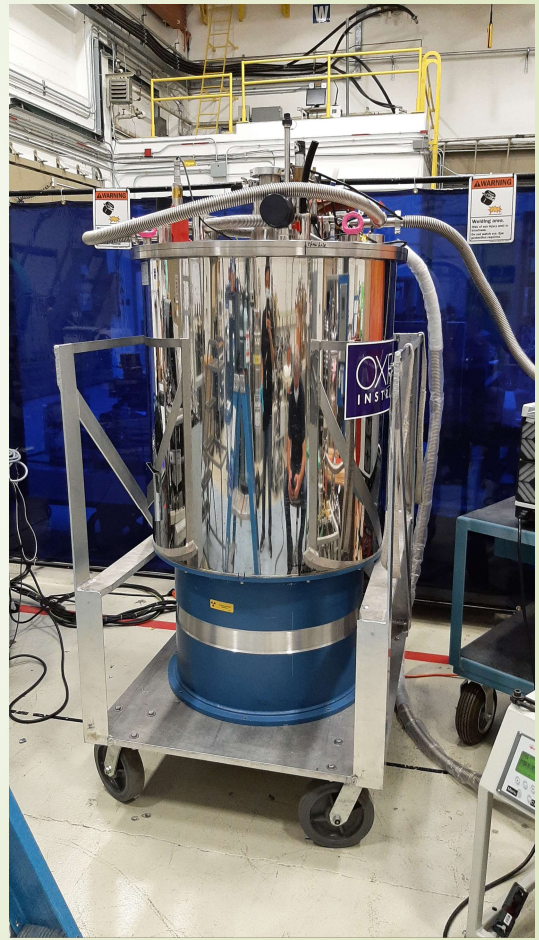


15T magnet VTI installed



- VTI had a leak which caused a quench in 2019.
- Oxford sent engineer to NCNR to help us take out the VTI from 15T and sent it back to Oxford in early 2020
- VTI fixed and sent back to NIST in late 2020
- Engineer came to install VTI back into 15T. Donna, Sergiy and I helped him with the entire process
- Leak tested at room T and no leak was found
- Will perform low T test on VTI and lambda fridge
- Need new current leads for field test

- 15T will be sent back for a full refurbishment in 2023 for the new SPINS and BT7.



Replace all 18+ computers in SE group

Location	IP	Property #	Form factor
Top of HFBS	129.6.227.134, 229.218	PG906394	small
3He Dipper for OC	129.6.225.108	G906395	small wireless
Gas loading cart	129.6.123.27	931980	small
highbay Paul Neves (hard to get)	129.6.123.95	859372	small
MUZAC, PMI, LIPPS	129.6.123.211	859369	small
7T 3He Dipper	129.6.252.220	G906396	small
9T	129.6.122.144	862189	small
ICE DR	129.6.121.197	PG901070	small wireless
Oxford DR	129.6.227.64	PG901071	small wireless
CCR area new guide hall	129.6.225.88	PG906399	small with 90W PS, wireless
SE area with 425 Gauss Meter	129.6.226.96	PG906398	small
11T	129.6.121.125	PG904040	small with 90W PS
10T	129.6.120.198	PG905773	small
syringe pump	129.6.122.171	859366	small
SE area, moving	129.6.230.127	PG906401	small
SE area, moving	129.6.120.59	PG901810	desktop 8700
	129.6.224.80	PG906397	
	129.6.225.126	PG906400	

Procurement - New compressors for HFBS and NSE TLCCR

- New compressors for HFBS and NSE TLCCR
  - CNA-31C Compressors getting old and no longer being serviced by manufacturers
  - Sent out paperwork to purchase new FA-40L compressors to work with the current RDK-305D cold heads on HFBS and NSE TLCCR
  - Two FA-40L compressors are on the way

4-channel potentiostat for electro-chemistry experiments

- Market research of different types of potentiostats

VSP300 from Biologic

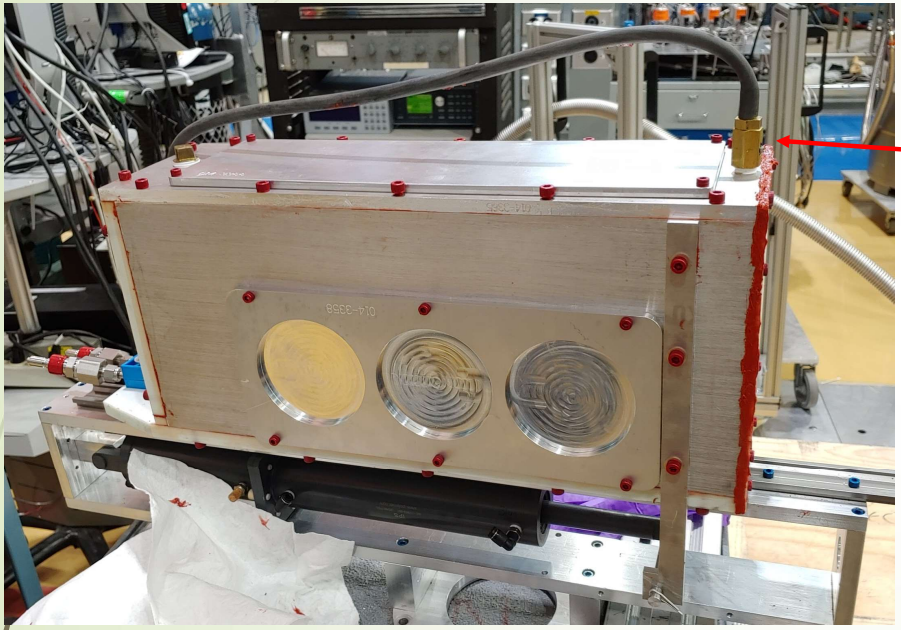
Interface 1010E Galvanostat/ZRA from Gamry

Ivium-n-Stat with 4 channels

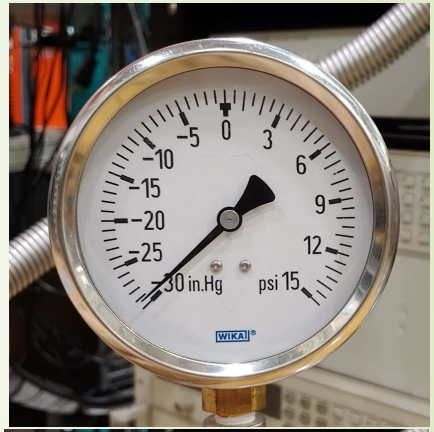
MultiPalmSens4

- Refresh myself with the electrochemistry and how it works with batteries so that we can support the users better once the new potentiostat arrives.

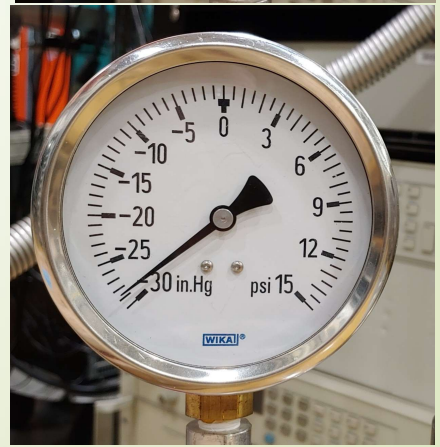
Specialty projects -
Neutron Spin Echo Vacuum box



base pressure with box's valve closed



base pressure with box's valve open

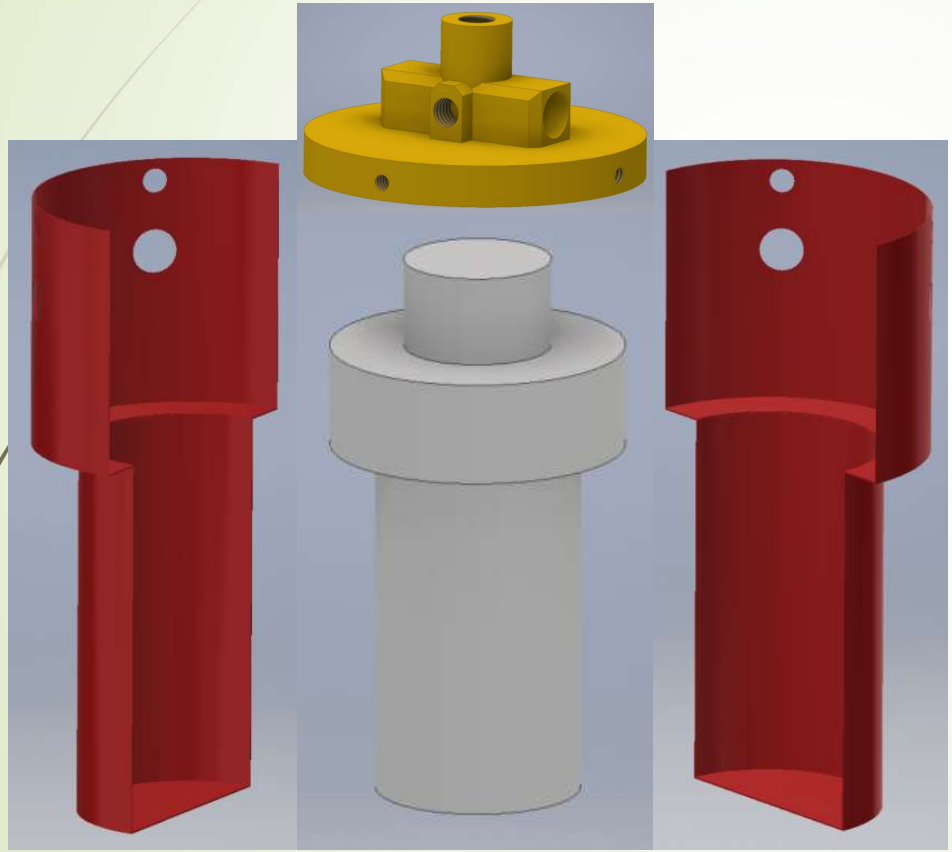


- Now users are able to perform neutron experiments with samples in vacuum or under inert gas atmosphere

Specialty projects - Carbon Fiber Sample Stick Testing

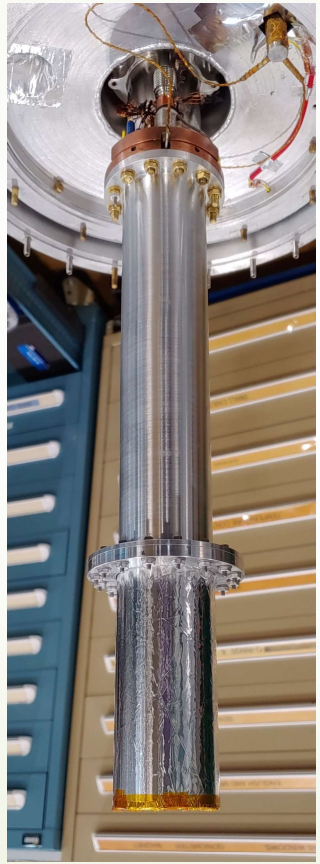
- Carbon fiber pros and cons:
  - Pros:
    - High Strength to Weight Ratio (also known as specific strength), very rigid measured by its Young Modulus
    - Low thermal conductivity in epoxy
    - Low Coefficient of Thermal Expansion
    - Corrosion Resistant and Chemically Stable, non-poisonous, biologically inert, X-ray permeable
    - Good fatigue resistance and tensile strength, Non-Flammable
  - Cons:
    - Electrically Conductive
    - Relatively Expensive
    - As brittle as supercars (light and strong enough to handle the weight of the sample stick)
- Significantly reduce the thermal mass inside the cryostat. Cooling time shortened greatly to save neutron beam time.
- For OC, cooling time from 300K to base T reduced from 30 minutes to 5 minutes
- For HFBS TLCCR, cooling time from 300K to base T reduced from 5.2 hrs to 4.8 hrs
- More sample sticks are being designed to fit in the HFBS TLCCR and orange cryostat for MACS and neutron spin echo TLCCR.

HFBS TLCCR 700K experiments



- HFBS TLCCR has problem reaching high T.
- Use Turbo to pump out the sample well.
- New Labview control program to open the valve intermittently to pump out the exchange gas
- Smaller sample stage
- Smaller heat shield
- Use carbon fiber stick
- Users can reach 700K every time on HFBS TLCCR
- Madhu is trying the entire process.

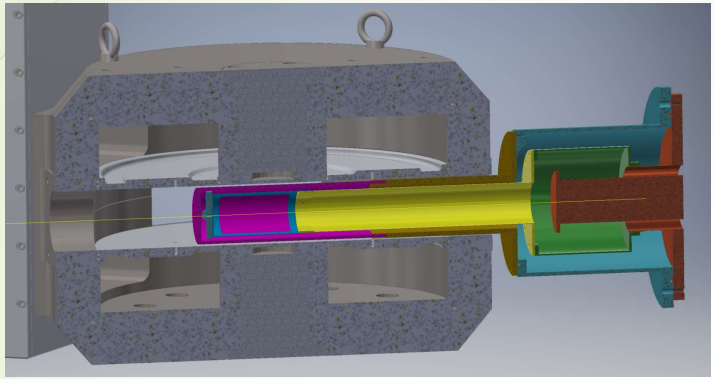
Specialty projects -
ICE dil fridge Silicon IVC for SANS experiment

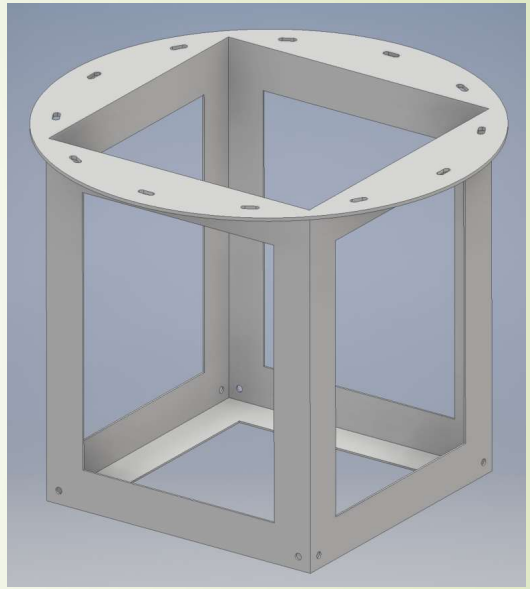


- Working with Jonanthan and Yegor to reach lower temperatures in SANS experiments
- Used with ICE dil fridge in SANS Orange Cryostat
- Reached base T below 80mK with Yegor running the ICE dil fridge
- Inner diameter 1.1”
- Designing holders for SANS experiment

Future projects

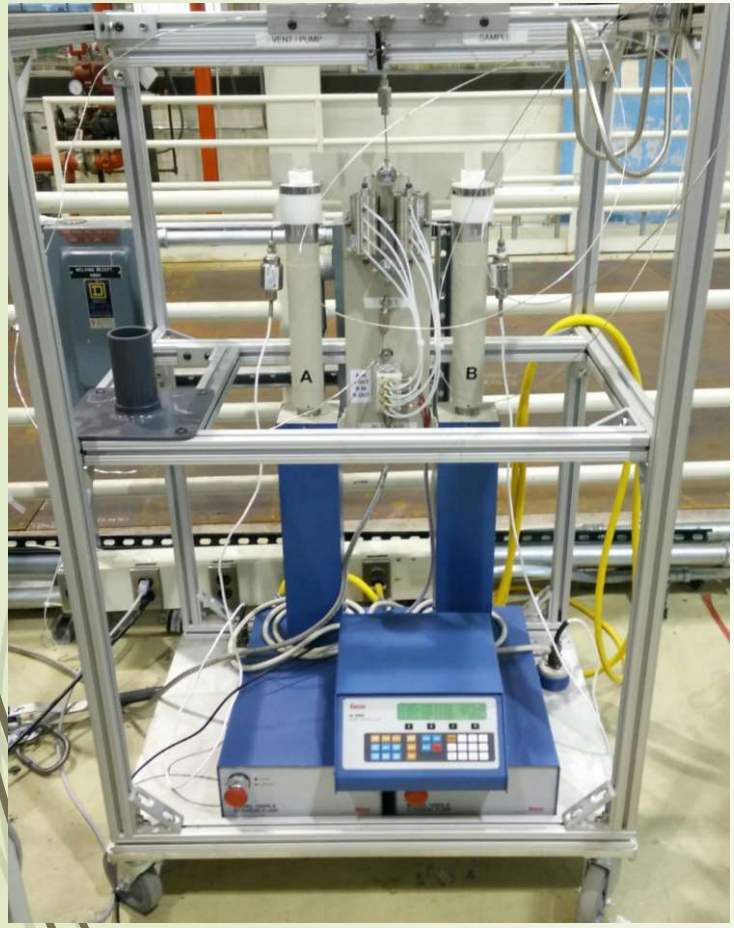
- Design and make new silicon tail for Candor CCR



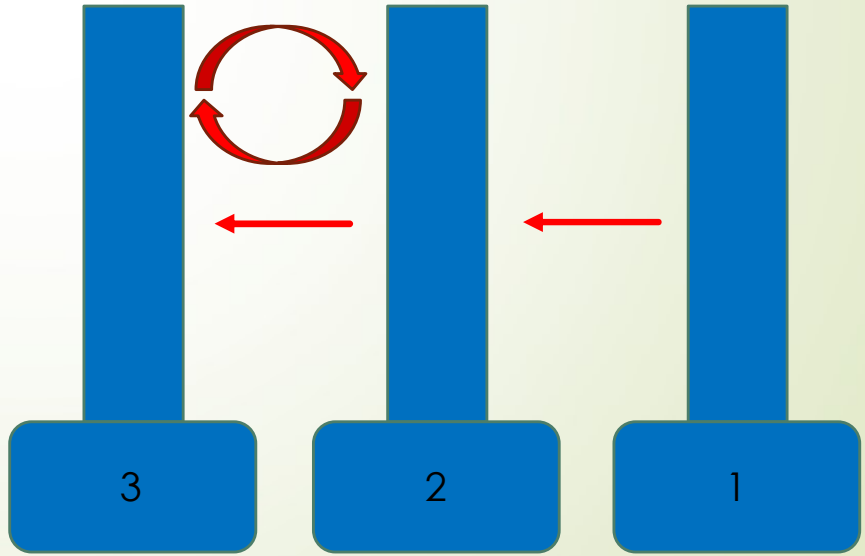


- Design more carbon fiber sample sticks for different systems
- New lighter 9T LN2 shield
- Combine OC with Titan magnet
- Remote control of compressors at PBR (with Tanya Dax)
- Oxford dil fridge insert test with SANS 50mm OC and make a Silicon IVC for it
- Make a new cart for the Hiden Analytical mass spectrometer

3-syringe-pump system



- Working with Juscelino and Yun Liu
- Part of the "NIST Direct Air Capture (DAC) - Carbon Capture, Utilization, and Storage (CCUS) Working Group"
- Make new programs for the 3-syringe-pump system for different working modes



Summary

- **Completed:**
  - Cross training with Cedric on LIPPS and PMI
  - Procurement: New compressors for HFBS and NSE TLCCR
  - Procurement: 4-channel potentiostat for electro-chemistry users
  - Neutron Spin Echo Vacuum box
  - ICE dil fridge Silicon IVC for SANS experiment
  - 10T magnet
- **In progress:**
  - Safety/Lifting documents
  - Maintenance: New cart for Hiden Analytical Mass Spectrometer
  - Maintenance: 9T new LN2 shield and cold test
  - Maintenance: 15T cold test
  - Maintenance: Replace computers in SE group
  - Oxford dil fridge Silicon IVC for SANS experiment
  - Design and make new silicon tail for Candor CCR
  - Design more carbon fiber sample sticks for different systems
  - Combine OC with Titan magnet
  - Remote control of compressors at PBR (with Tanya Dax)
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