



SQMS Center 2022 Engineering Accomplishments

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Engineer's Week Plenary Session

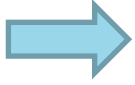
February 23rd, 2023

About the SQMS Center

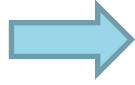


SQMS S&T Innovation Chain: from material discovery to quantum advantage

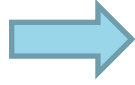
Materials
Discovery



High Coherence
Devices



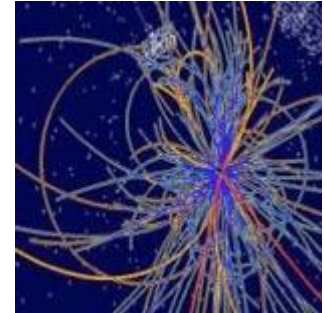
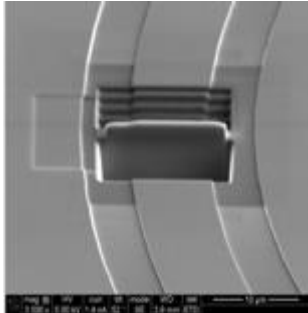
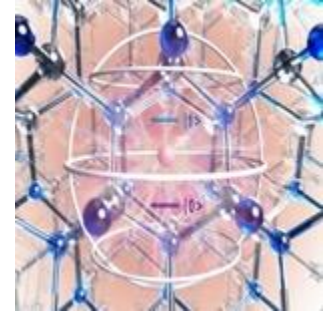
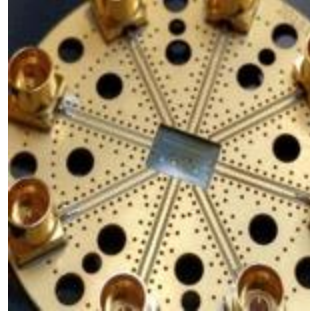
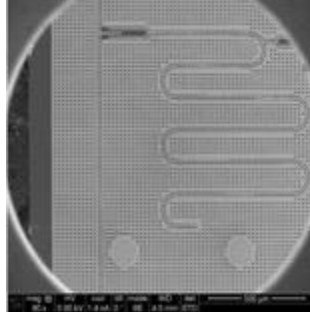
Systems
Integration



New quantum
computing and
sensing platforms



Quantum
Advantage



...but potential for discovery lays at every step of the journey

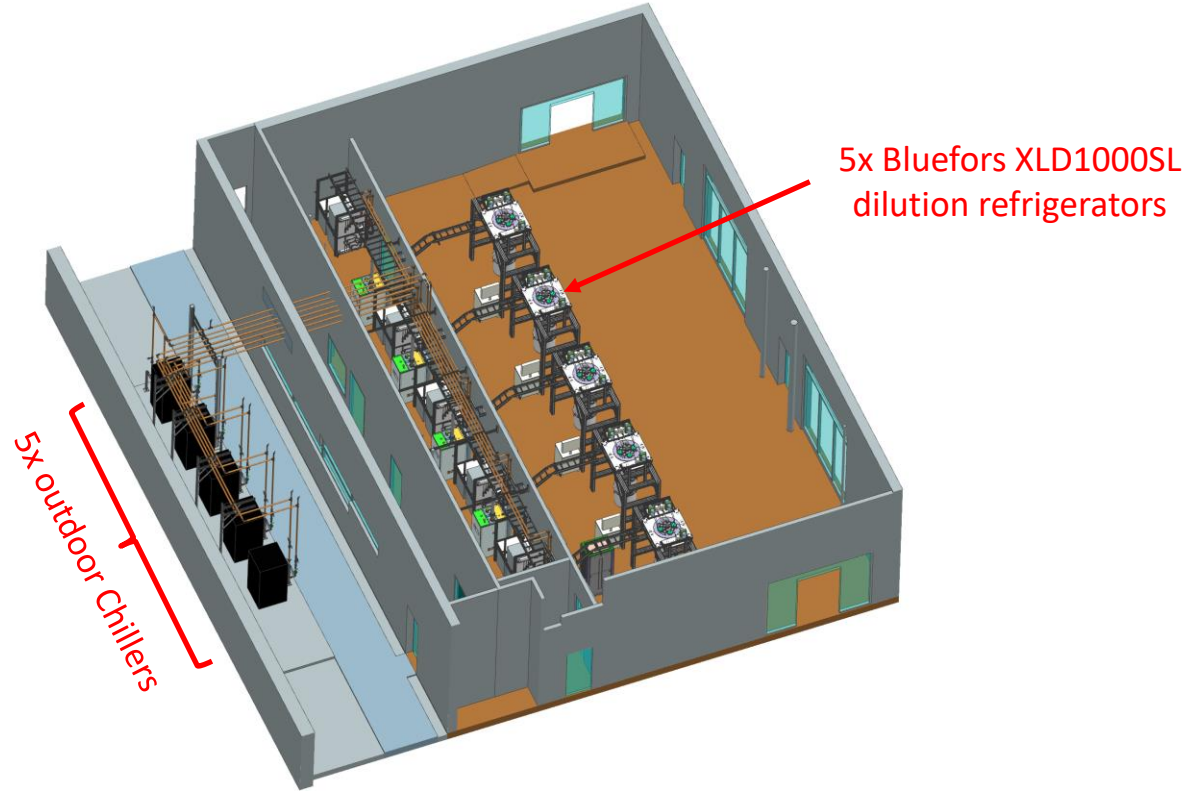
Discussion Topics

- Quantum Computing Lab 3 (QCL3)
- Colossus milli-Kelvin platform

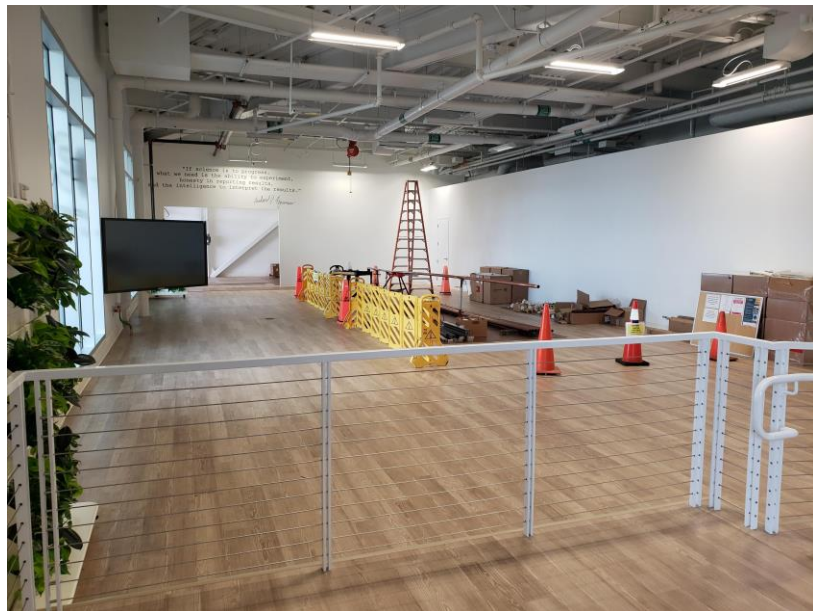


Quantum Computing Lab 3

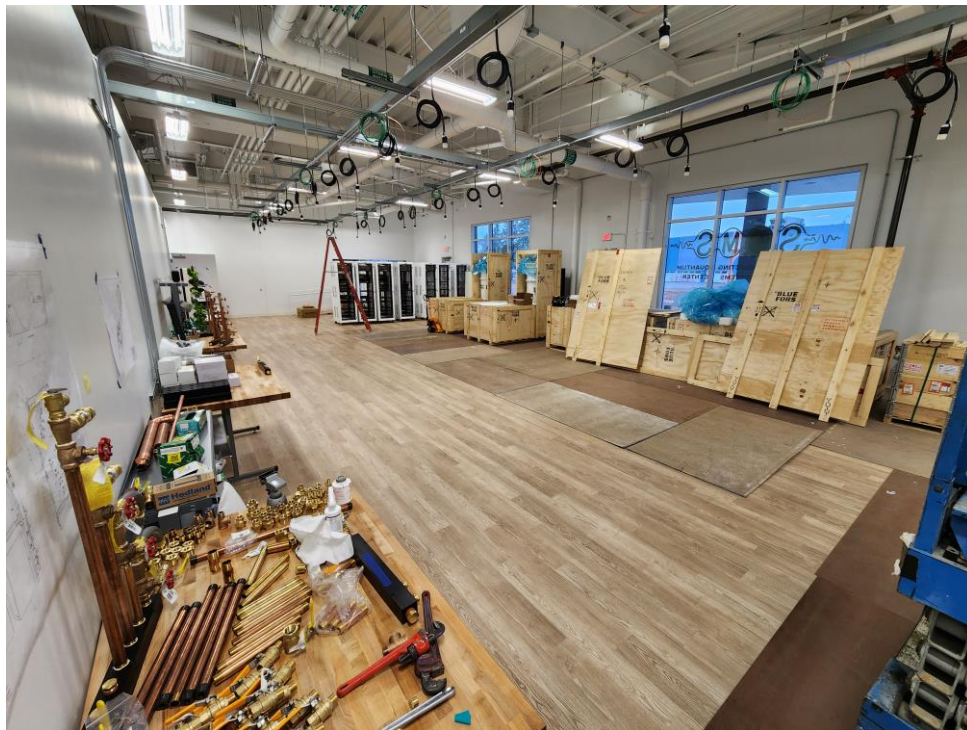
- Former garage space in OTE building (IARC).
- Undergoing renovation to house 5x new dilution refrigerators.
 - 30 μ W of cooling power at 20 mK for each fridge.
 - Refrigerators require cooling water, liquid nitrogen and compressed air.
- Installation begins next month!



QCL3 Main Hall in Pictures

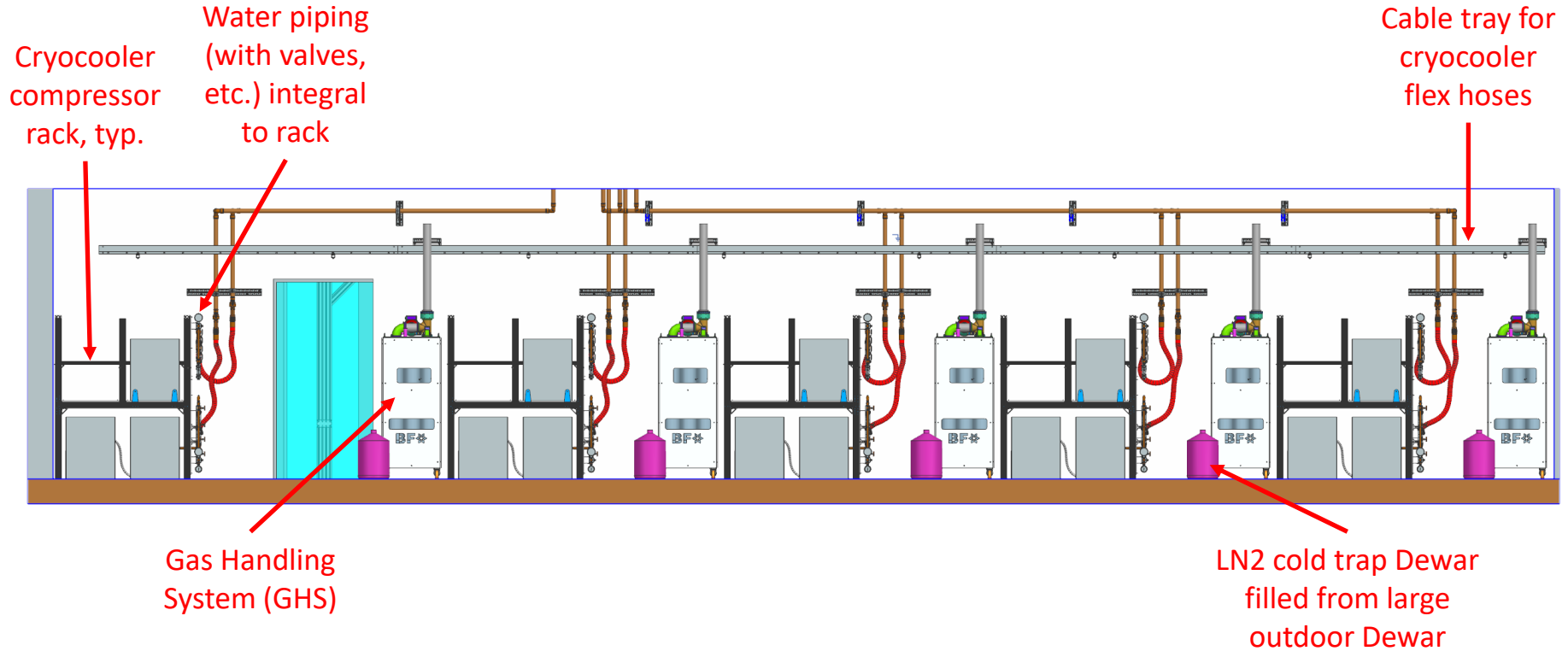


6 months ago



Today

Utility Room in 3D



Utilities Room in Pictures



6 months ago



Today

Other Pictures



Outdoor chillers



Only 2 of the 5 dilution refrigerators!

Colossus

- Currently in design, Colossus is slated to be the largest and most powerful $^3\text{He}/^4\text{He}$ dilution-cooled cryogenic system constructed to-date.
 - Fully-upgraded, it is designed to provide up to 350 μW @ 20 mK of cooling power.
- Important design features:
 - Liquid nitrogen, liquid helium and pumped helium cooling stages down to 2 K.
 - This is typically accomplished with pulse tube cryocoolers on commercially-available “dry” dilution refrigerators, which is not very efficient as you scale up.
 - Large payload capacity around 40,000 kg.
 - Large experimental volume (2-meter diameter mixing chamber plate).
 - Use of commercially-available dilution units.
 - Possible future integration with existing commercially-available dilution refrigerators.
- Planning on completing the design phase by the end of 2023, begin purchasing items in mid to late 2023.

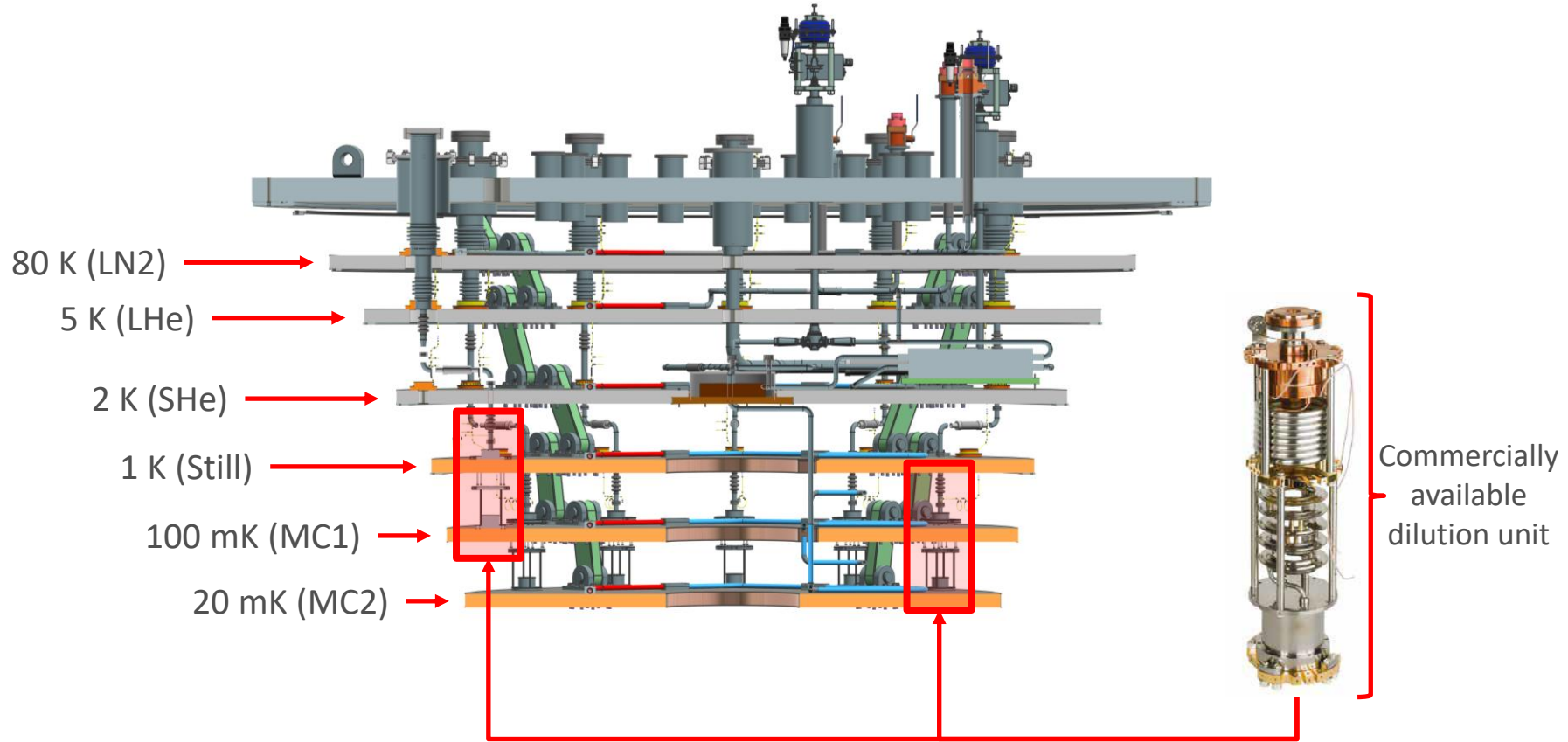
Facility

- Colossus will be located at HAB.
 - Former site of Mu2e's Solenoid Test Facility.
- Future upgrades to:
 - Cryogenics plant control systems.
 - Cryogenic transfer line.
 - Vacuum vessel (replacement).
 - Building cooling water.

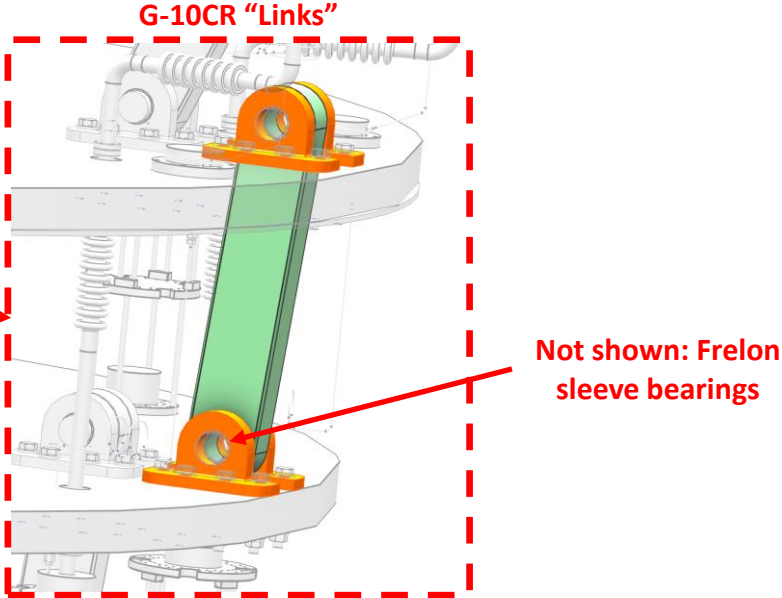
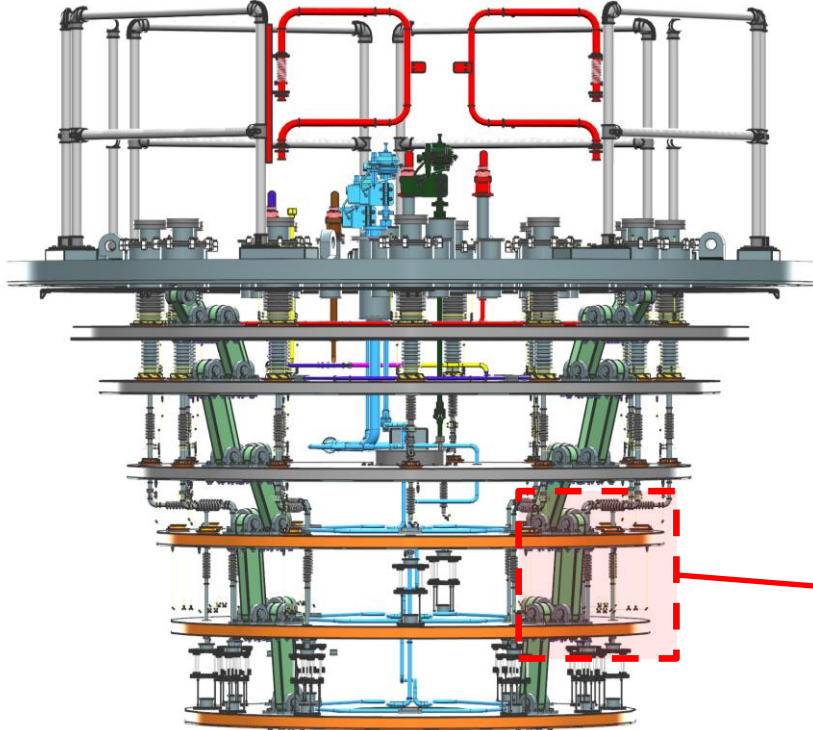


Mu2e's Solenoid Test Facility at HAB

Thermal Architecture



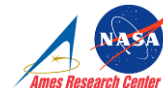
Structural Architecture





A DOE National Quantum Information Science Research Center

28 Institutions
>450 Collaborators



University of Colorado
Boulder

