Progress Report on the Dual-Use Cryostat

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EDM collaboration meeting
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Outline

1. Dual-use cryostat for EDM
2. Summary of progress (or current status)
3. Assembly and testing of Dual-use cryostat
4. List of things to do / Timeline
5. Summary

Dual-use cryostat for EDM

Main components:

Outer vacuum chamber
4k and 50k Heat shields (HS)
Cooling tubes and blocks
LHe dewar
Dilution Refrigerator (DR)

(The cryostat consists of more than 1000 parts excluding bolts and nuts)

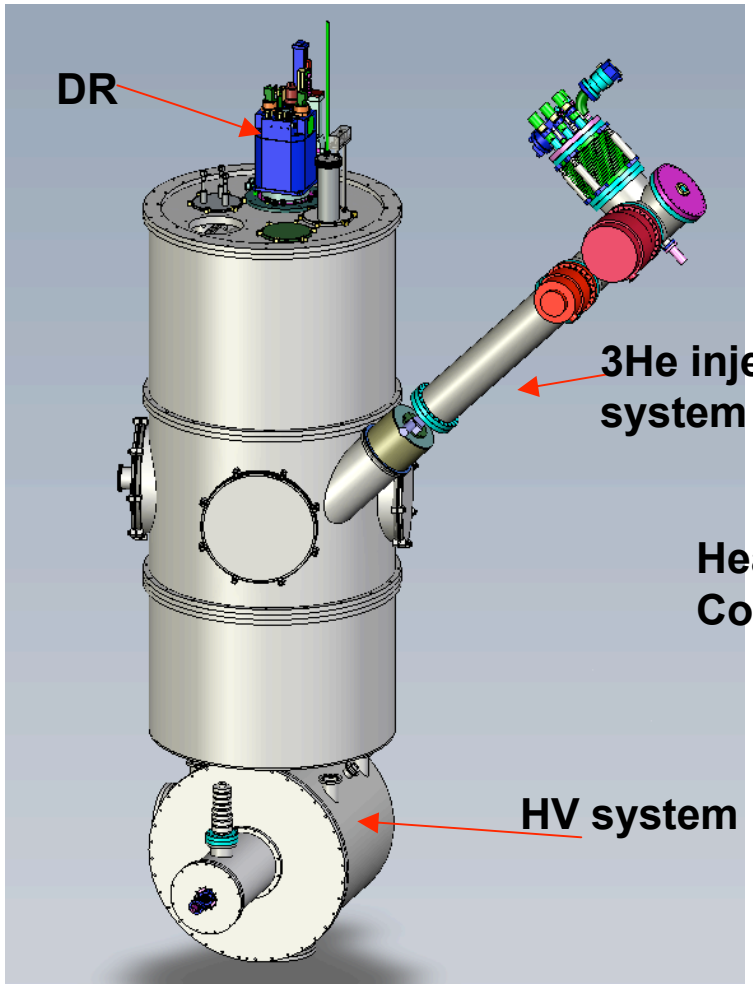
Cryostat work consists of:

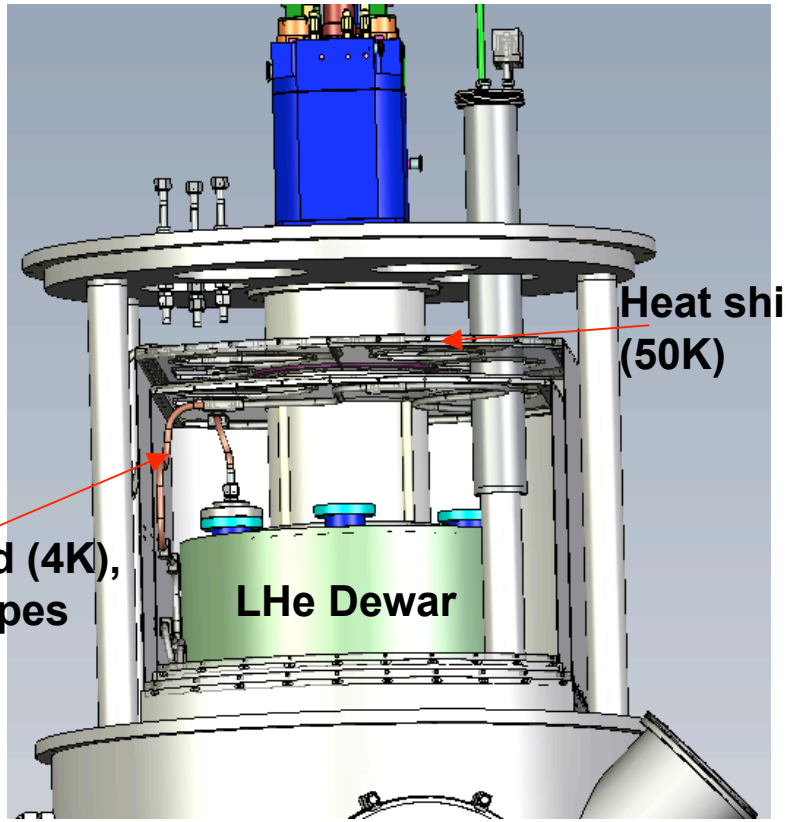
Cryostat design (almost done)
Ordering parts (nearly done)
Modifications of the design and parts (whenever needed)
Assembling and testing the dual-use cryostat (in progress)

Work being performed at Los Alamos

The cryostat will be used with 3He and HV systems to perform R&D work.

Cryostat (Full Assembly)

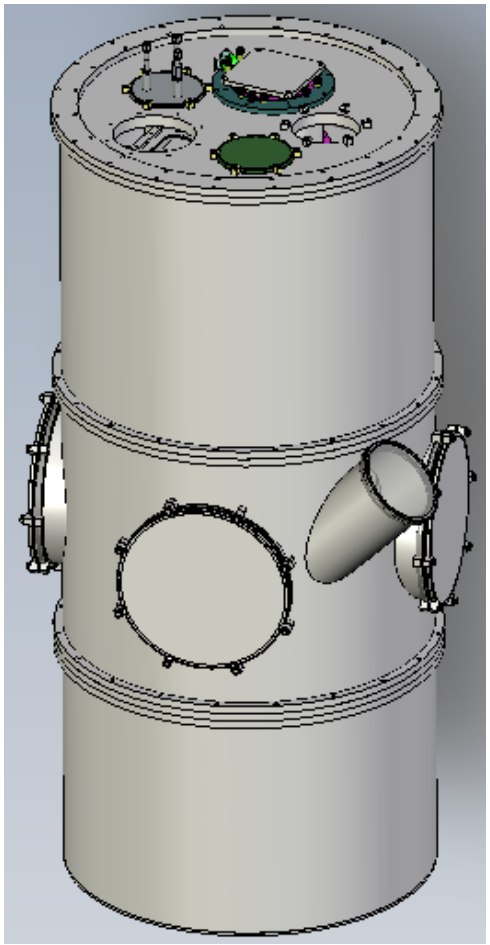




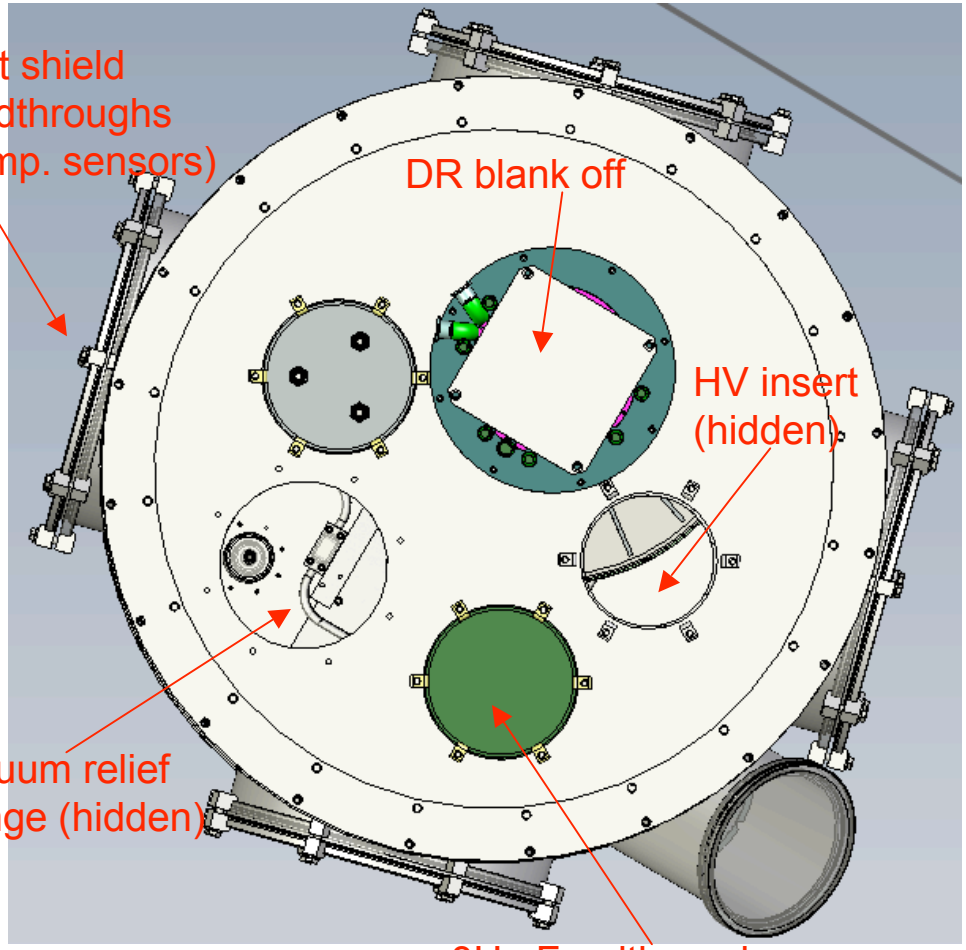
E-Drawing files courtesy of John Ramsey

Cryostat without DR, HV, 3He

Side view



Top view



Summary of cryostat work

- **Assembly work started in June 2007**
- **Leak test on outer vacuum chamber done**
- **Test assembling the heat shields**
- **Leak check on copper tubes and blocks for heat shields**
- **Work often delayed due to unexpected things**

- **Have been working on fixing leaks on LHe dewar**

In near future, we will perform

1. Cooling tests:

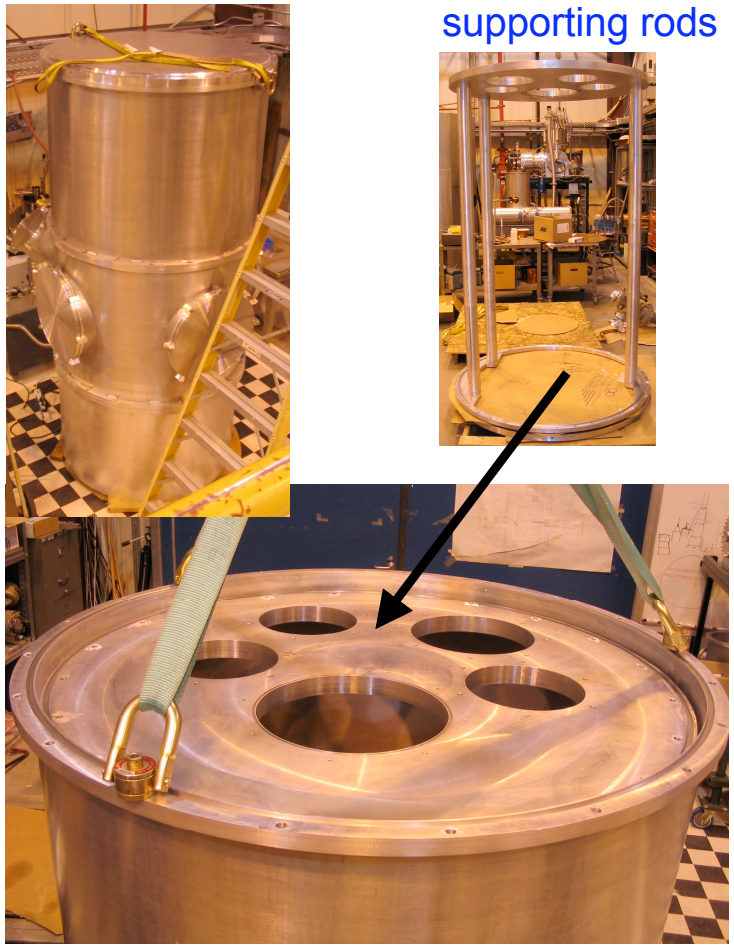
Run without DR to check the performance of heat shields
Run with DR to check the performance of DR

2. R&D work

Assembly and leak tests of the outer vacuum chamber

- Test assembly of the outer vacuum chamber (the top plate had NO flanges)
- Performed vacuum leak test. Leaks found (from the o-ring joint) and fixed (Jun&Jul 2007). Achieved ~10^-6 Torr using a turbo and scroll pump.
- Install the real top plate with 5 blank-off flanges. Installation was tricky due to the limited crane height. Leaks found and fixed. Achieved ~10^-6 Torr

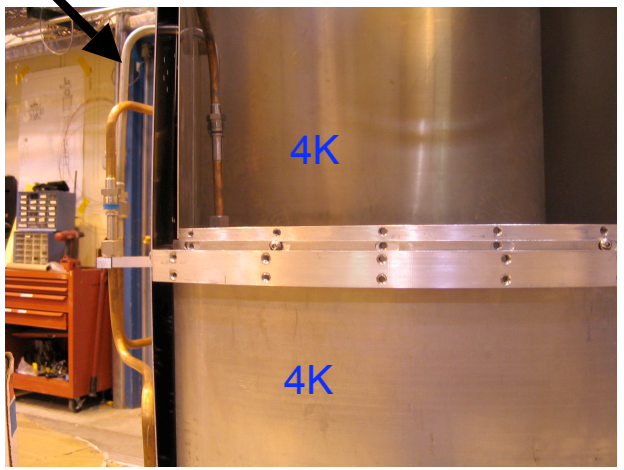
Top plate with supporting rods

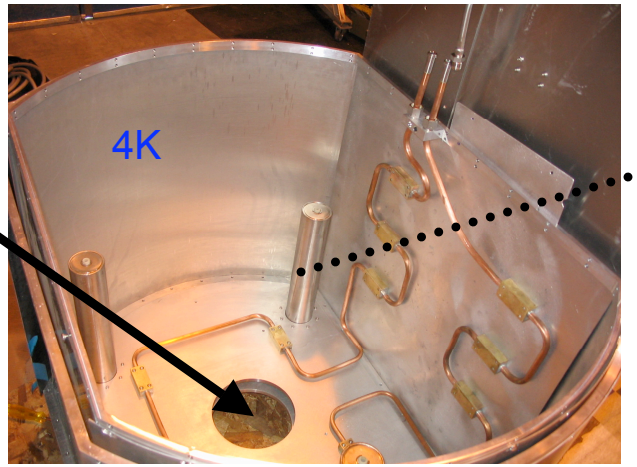


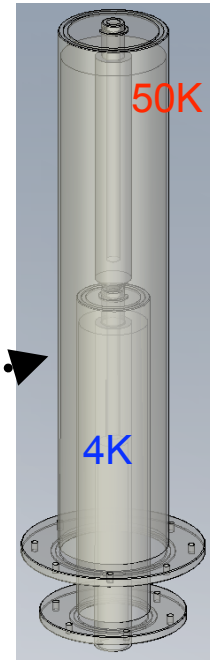
Installation of top+mid chamber pieces through the top plate

Assembling heat shields

1. Performed a test assembly of heat shields (Aug 2007)
2. Horseshoe pipe which connects the end of 4k cooling tube and the beginning of 50k tube were made and installed.
3. Both shields stand on three cylinders (G10 tubes inside)
4. Sliding seal installed on the bottom of 4k shield (not pictured)

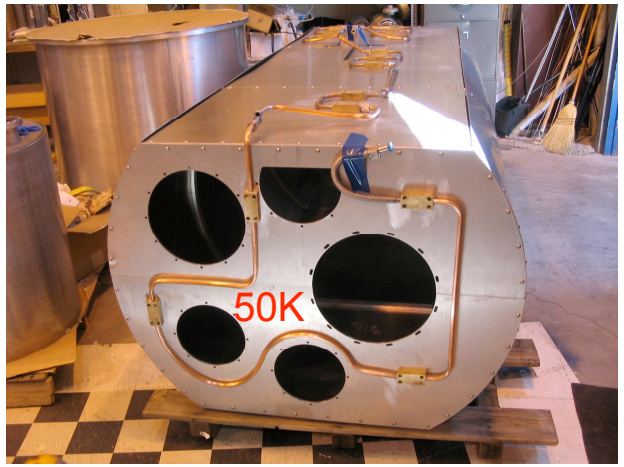






Copper tubes and blocks to cool the heat shields

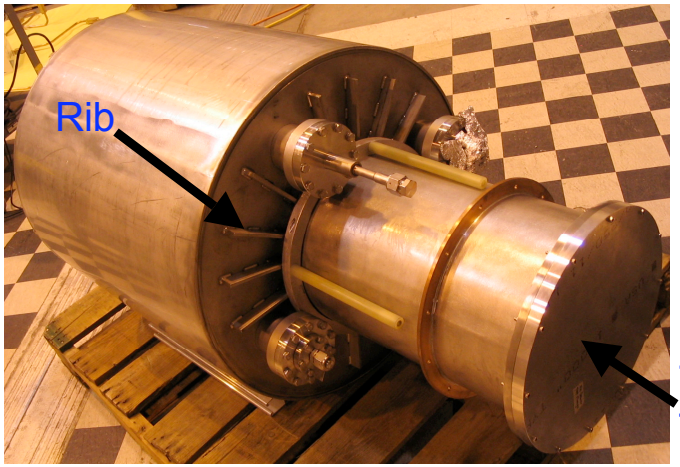
- During the cryostat operation, helium gas from the LHe dewar is pumped out. The He gas flows in the copper tubes and blocks attached on heat shields to cool them at ~4k and ~50k.

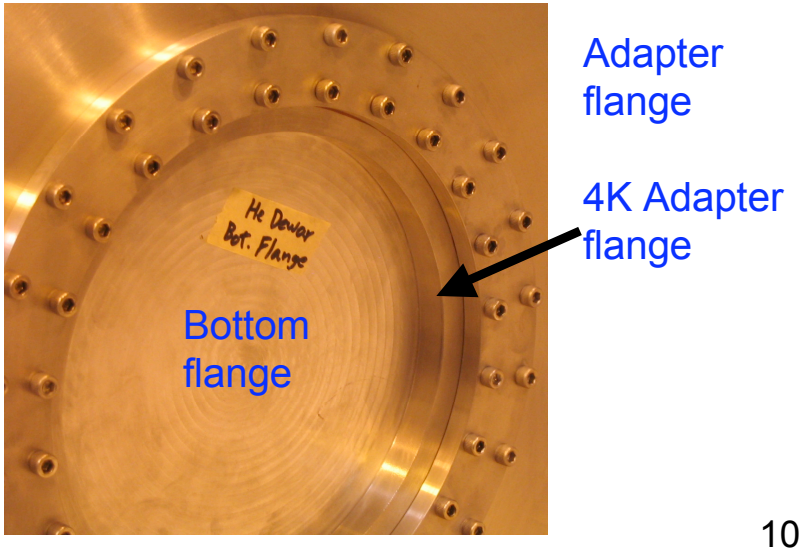


1. Flowed nitrogen gas in the tubes and also used a plasma pump to clean the inside.
2. Performed leak check on the cooling tubes and blocks (found and fixed many leaks)
3. 4k tube design modified (Oct 2007)

Liquid Helium Dewar

- Important to make sure that the LHe dewar is leak tight BEFORE installation into the cryostat (Put blank-off flanges on top and bottom)
- some design modifications were needed
- Bottom flange was designed for 5-mil thick kapton but it did not seal. Sealing surface polished but it's ~8mil polish
- Decided to use Indium wire instead of kapton. The grooves for 32-mil Indium were made on the flange.
- Four conflat ports (leak check needed) are for
  - Cooling cryostat heat shields
  - Cooling HV heat shields
  - Vacuum relief
  - Cooling 3He tri coil
- Ribs added to the dewar top plate to add strength to it (leak check needed)



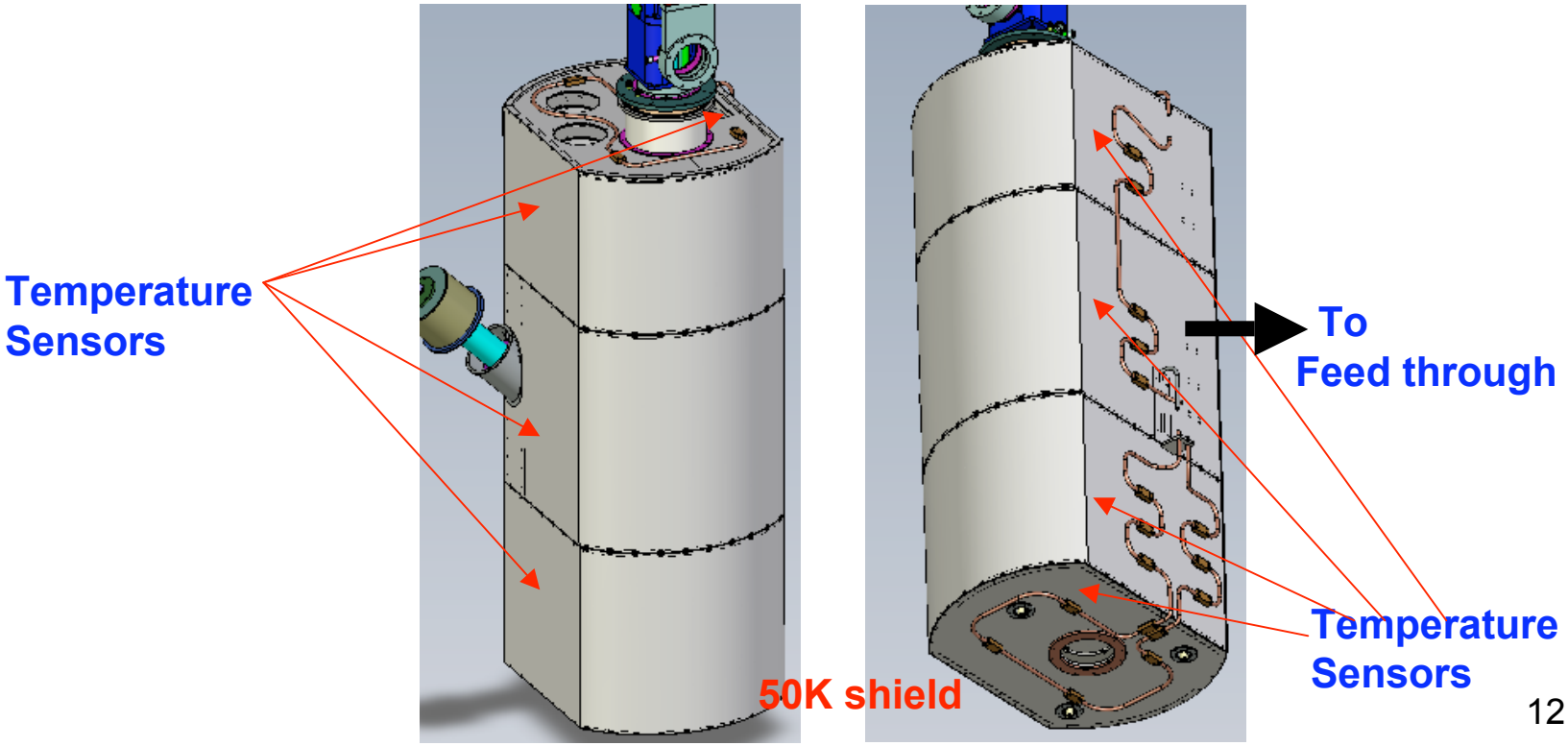


Temperature sensors for heat shields

- **Bought silicon diode sensors made by Lakeshore.**
  - **4K shield: DT-470-SD-12A [T>1.4K, Accuracy: +/-0.5K]**
  - **50K shield: DT-471-SD [T>10K, Accuracy: +/-1.0K]**
- **Effect of magnetic field from the 3He tri coil (0.12T) is negligible at the sensor locations since the fields decays quickly outside of the coil (~0.005T).**
- **Use Stycase Epoxy 2850FT, recommended by Lakeshore, to install on heat shields**
- **Temperature sensor wires are connected with Burndy pins installed on heat shield panels so that the panels can be removed without breaking the wires.**
- **Lakeshore Temperature Monitor 218 will be used**
- **Two 20-pin feed throughs will be installed on a side flange: A side flange design was modified to have 4 feedthrough ports**

Temperature Sensor Locations

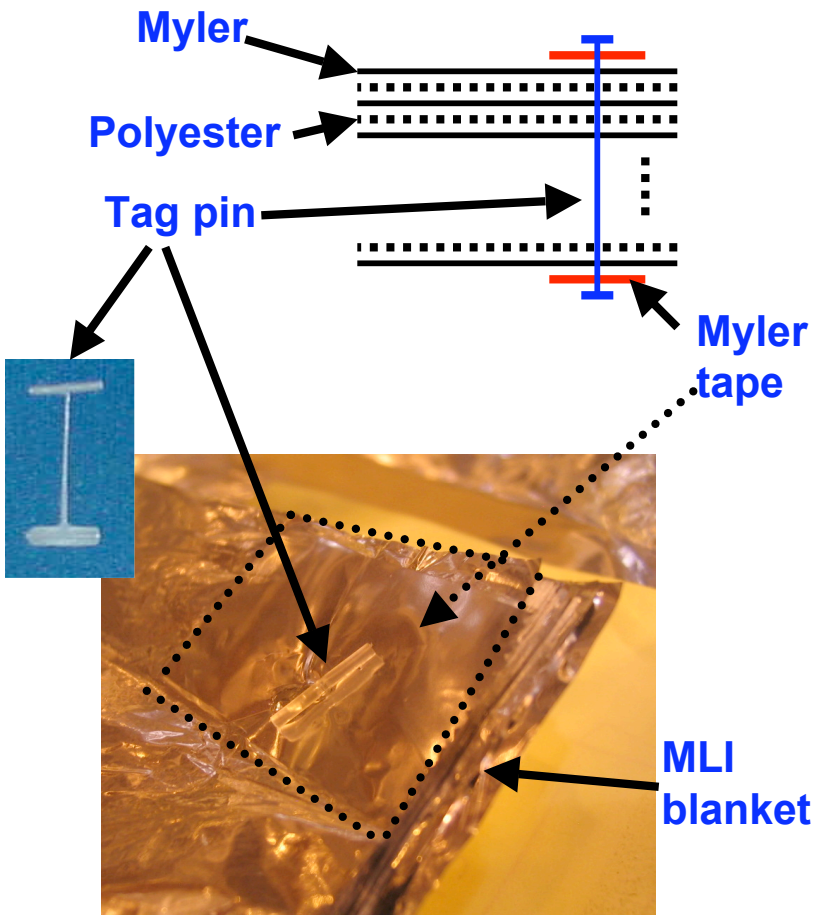
- 8 sensors will be installed on each heat shield.
- Three on each flat surface and one sensor each on top and bottom.
- Use Burndy pins so that the wires can be connected/disconnected easily when a panel needs to be removed.
- Wires from the sensors on 4k shield will go through the 50k shield
- Two sensors will also be installed on the LHe dewar



Multi Layer Insulation (MLI) Blanket

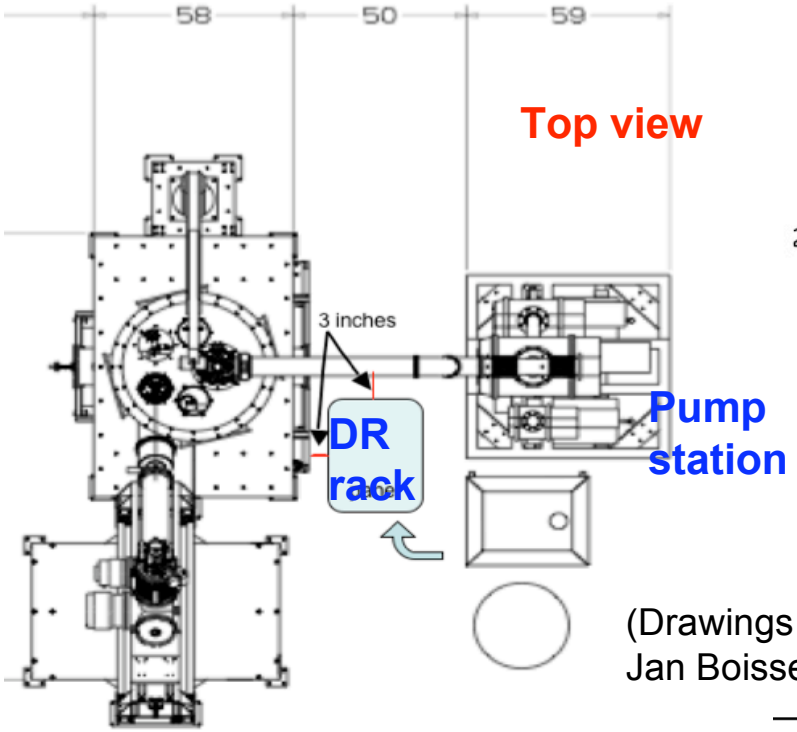
- MLI blanket manufactured at Cad Cut Inc.
- Consists of 30 layers of double-aluminized myler [0.25mil thick] and spacer (spunbonded polyester [4mil thick] by Reemay)
- Myler sheets perforated with 0.1in diameter holes, spaced 2in apart
- Use tag pins (made of nylon) to secure the blanket layers.
- Tag pin:0.5in long, blanket: ~0.2in thick
- Blankets to be installed around 50k heat shield and LHe dewar

Tag gun

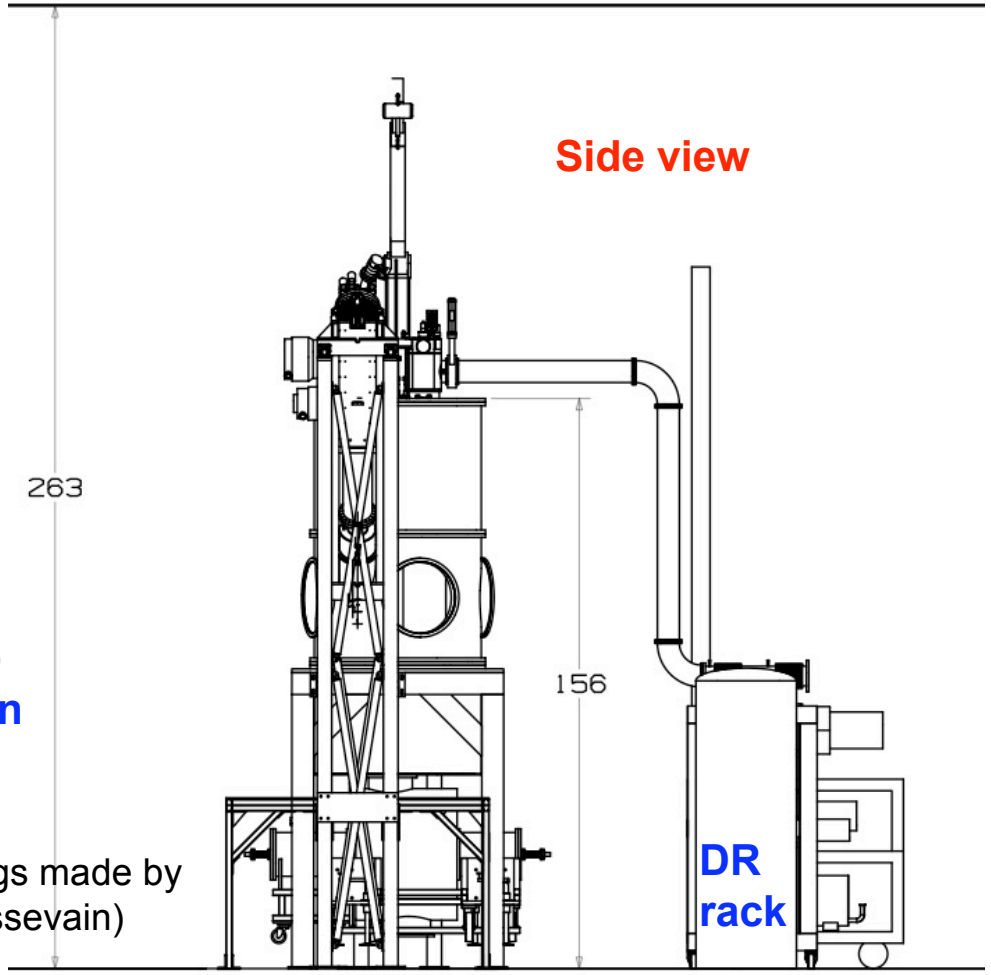


Layout in Bldg. 10 at LANL

- A draft design prepared by Jan Boissevain
- Height to the top of DR ~14.5 ft
- Cryostat and 3He platforms to be assembled
- Long LHe transfer line to be used
- Ordered and received long cables and bellows for DR gas/electronics



Top view



Side view

(Drawings made by Jan Boissevain)

Documentation

1. Cryostat Installation procedures (ppt file) [S. Tajima]
   - Installation procedures without DR, HV, and 3He subsystems (nearly done)
   - Procedures with DR and FULL installation procedures need to be prepared.

2. Dual-use cryostat design document for the cooling tests (with or without DR) is being prepared [T. Ito, Jan Boissevain, and S.Tajima]. It contains:
   1. Description of the apparatus
   2. Safety considerations
   3. Operating procedures
   4. Strength calculations

3. Integrated Work Document (IWD) required at LANL

List of things to do / Timeline

1. LHe dewar leak check [1 week or more]
2. Temperature sensor wiring and testing [2 weeks or more]
3. Prepare and install MLI Blankets [1 week]
4. Finish writing documents on safety, installation, and operations
5. Assemble the whole cryostat and do leak check [2 weeks or more]
6. Cooling test (without DR, HV, 3He installed) [1 week or more]
7. Install DR into the cryostat and perform cooling test (without HV and 3He installed) [3 weeks or more]

8. Install HV system and perform R&D
9. Install 3He system and perform R&D

Man power for Cryostat assembly

- LANL Technicians who have worked on the cryostat assembly
  - Todd Womack (since Aug 2007)
  - Joe Ivie (Jul-Dec 2007)
  - Tom Ortiz (until Jul 2007)
  - Jason Medina (Aug 2007)

- Available man power for cryostat assembly:
  ~1.5 technician (average) and physicists

Resources

1. Model of the dual-use cryostat (Jan Boissevain and John Ramsey)

eDrawings files available

List of all parts used in cryostat

2. Drawings (pdf files)

Many drawings are available on LANL P25eng computer (Windows machine)
Look for folders "PDF Package" under the following folder:

\p25eng\Ramsey\P-25 Projects\P-25\Cad\jcad_nx\edm\edm_test\

3. Pictures of the cryostat, DR, HV, 3He subsystems, etc

Summary

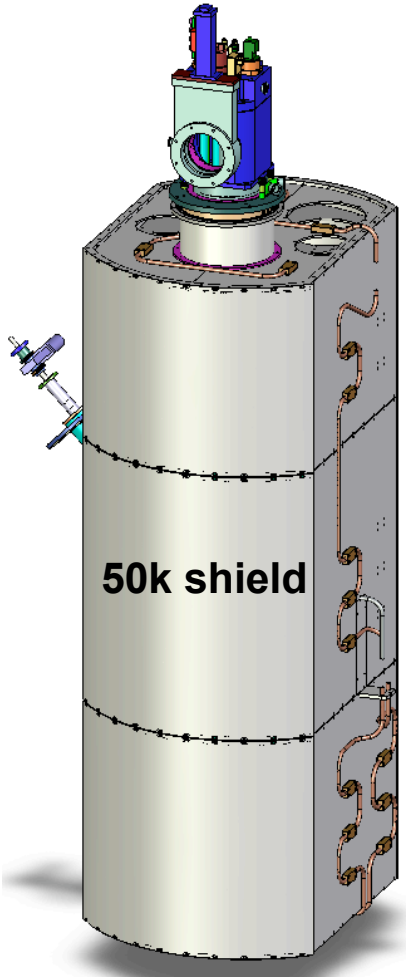
- Cryostat assembly work started in June 2007 and we've been making progress since then.

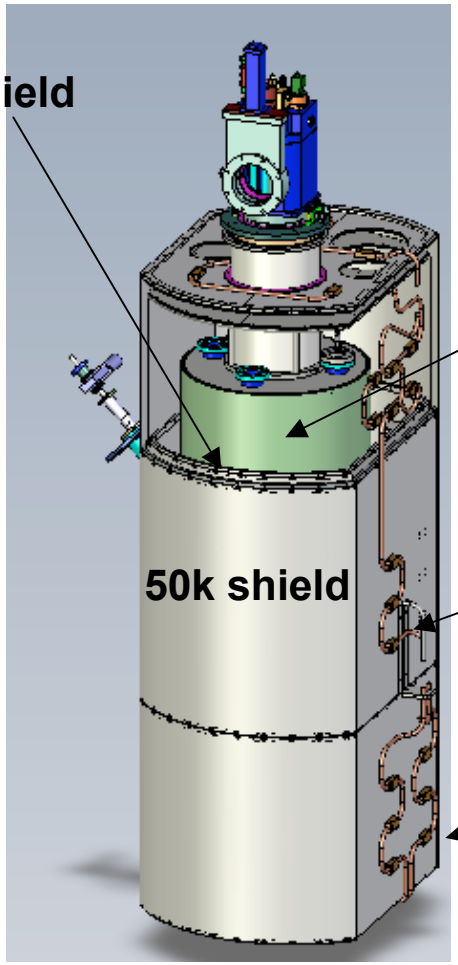
- Work delays happen due to unforeseen events:
  - technical difficulties (for example, kapton seal)
  - parts were not made as we specified
  - needed to ship the broken items for repair

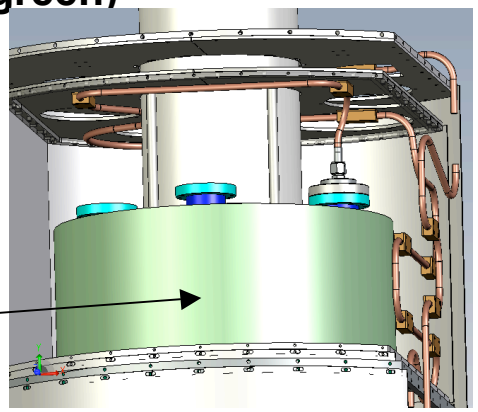
- Important to finish the cryostat work as soon as possible because HV and 3He R&D need to be done.

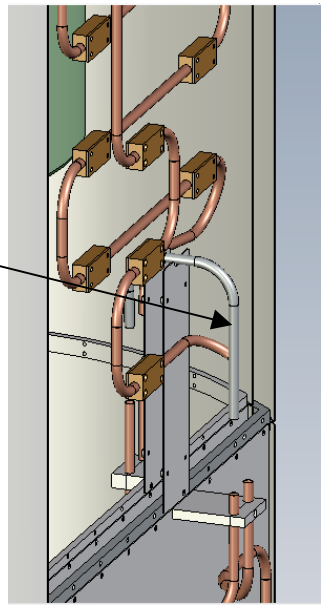
Heat Shields

Cooling blocks and pipes are attached to heat shields
50k shield, 4k shield (inside) and Helium dewar (shown in green)









Cryostat (Full Assembly)