MICE RF Coupling Coil Magnets Update

Derun Li
Center for Beam Physics
Lawrence Berkeley National Laboratory
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Sofia, Bulgaria

Acknowledgements

LBNL , HIT MICE team members

In particular
SINAP MICE team members
Lixin YIN, Li WANG, Yun CAO and Sen SUN

Most of the work in this presentation are from them

Summary

- Overview of the MICE CC fabrication plan
  - Organization and responsibilities
- Coil winding status at Qi Huan Corp.
  - 1st MuCool coil winding ~ 50% finished
- MICE CC Cryostat design review at SINAP (Shanghai INstitute of Applied Physics)
  - Held at SINAP, October 13-14, 2010
  - Updates of major (proposed) changes of the updated design
- Update from HIT (Harbin Institute of Technology)
  - ICST test system
  - Welding of cold-mass cover plate
- Schedule and near term plans
  - Updated schedule

Overview of CC Fabrication Plan

- **Organization and responsibilities**
  - **LBNL responsible for MICE CC magnets, HIT responsible for the design and fabrication, in collaboration with LBNL**
  - **Recent responsibility changes**
    - **LBNL responsible for the cryostat design, in collaboration with SINAP (under US-China HEP Collaboration Agreement); an updated addendum signed between LBNL and HIT in early-August 2010**
    - **HIT oversee the fabrication with assistance from LBNL**
      - ICST test system
      - Cover plate welding of the cold-mass
- **CC fabrication at Qi Huan Corp., Beijing**
  - **Fabrication contract signed mid-March 2010**
  - **1st MuCool coil winding started early-July 2010, now ~ 50% finished**

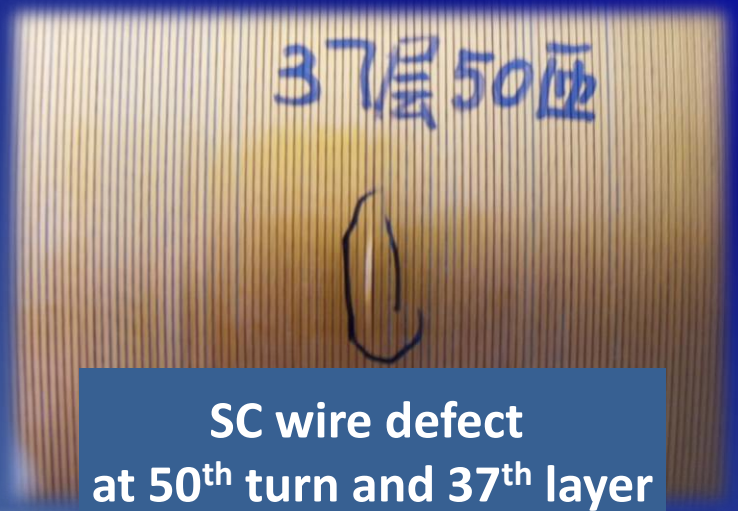
Coil Winding at Qi Huan Corp.

- 1st coil winding started early-July 2010
- 50% complete now
- 12 SC wire joints, wire width variations
- Average 2 layers/day (166 turns x 96 layers)
- Expected to complete by end of Nov. 2010
- Cold-mass cover plate welding contract signed mid-August 2010 at HIT

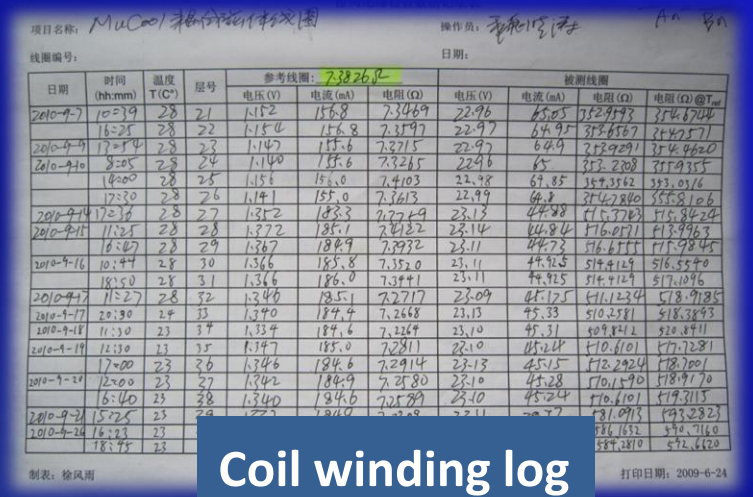
Update from Qi Huan Corp.

Coil winding

SC wire joint



SC wire defect
at 50th turn and 37th layer



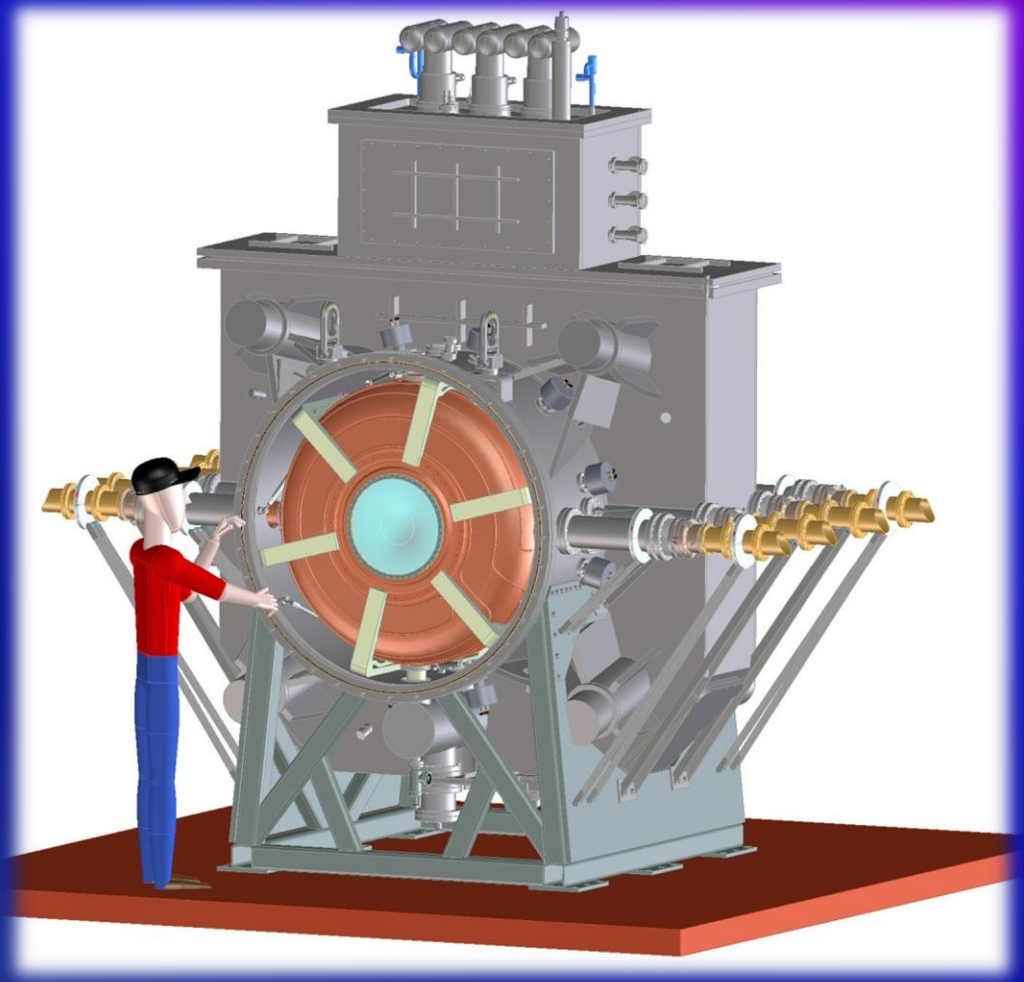
Coil winding log

MICE CC Cryostat Design Review

- The review was held from Sept. 13 to 14, 2010 at SINAP
- Review Committee was chaired by Prof. Alan Bross and report coming soon
- Review charges and areas:
  - Validity of overall cryostat design
  - Does the 3 cryo-cooler design provide sufficiently low heat load to the cold mass to allow stable operation?
  - Are the final assembly procedures defined?
  - How will the cold-mass reference position be transferred to external survey markers?
  - Does the mechanical design allow for repairs?
  - Cooling circuit update
  - Instrumentation/diagnostic sensors (temperature and LHe level)
  - The design for quench protection system (concerns)
  - HIT test system and cold-mass cover plate welding

The Cryostat Design Update

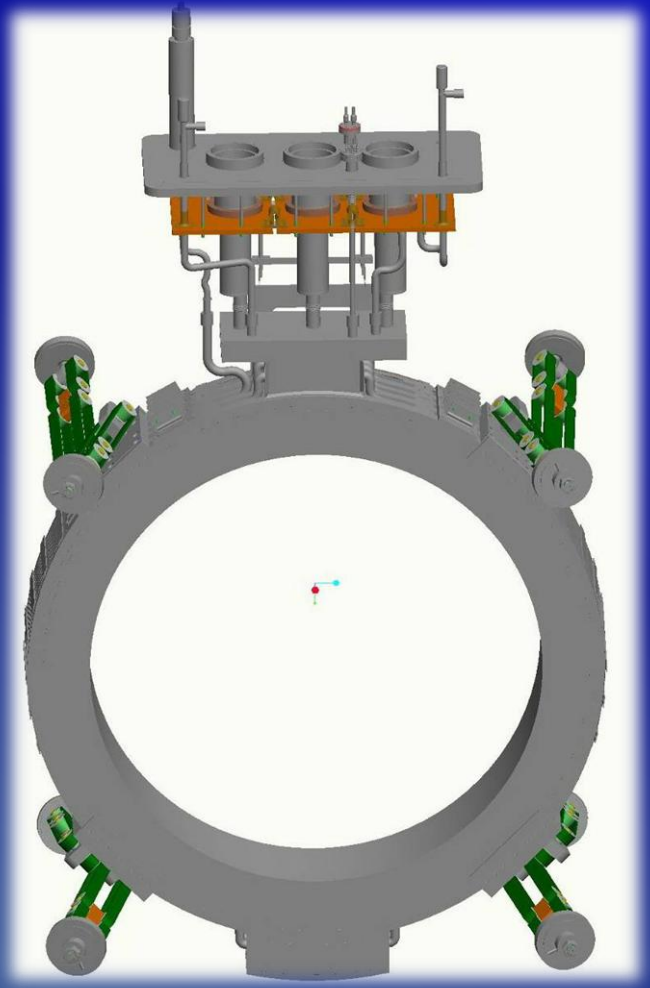
- An updated cryostat design was presented by SINAP MICE team
- The updated design significantly improves to the performance
  - Three cryo-coolers as base
  - More robust and temperature margin
  - Easier for assembly
  - Easier access for future repair and adjustment
  - A direct method to reference cold mass position to outside survey fiducial
  - Improved cooling circuit



Major Changes in Cryostat

All proposed changes have been supported and confirmed by relevant FEA simulations

Cooling Circuit Updates



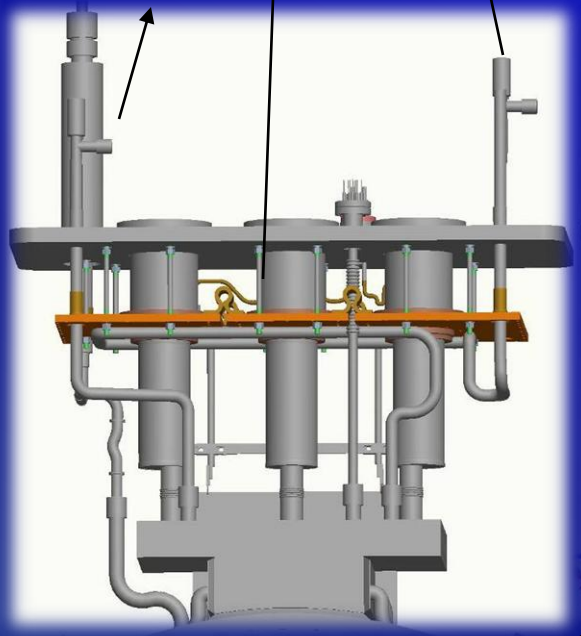
Coiled heat exchanger

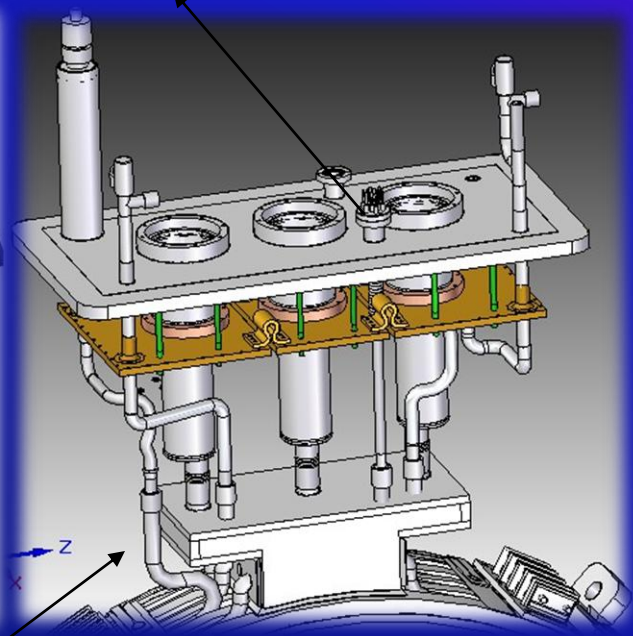
Gas He vent line

Burst disc vent line

LHe level sensor tube

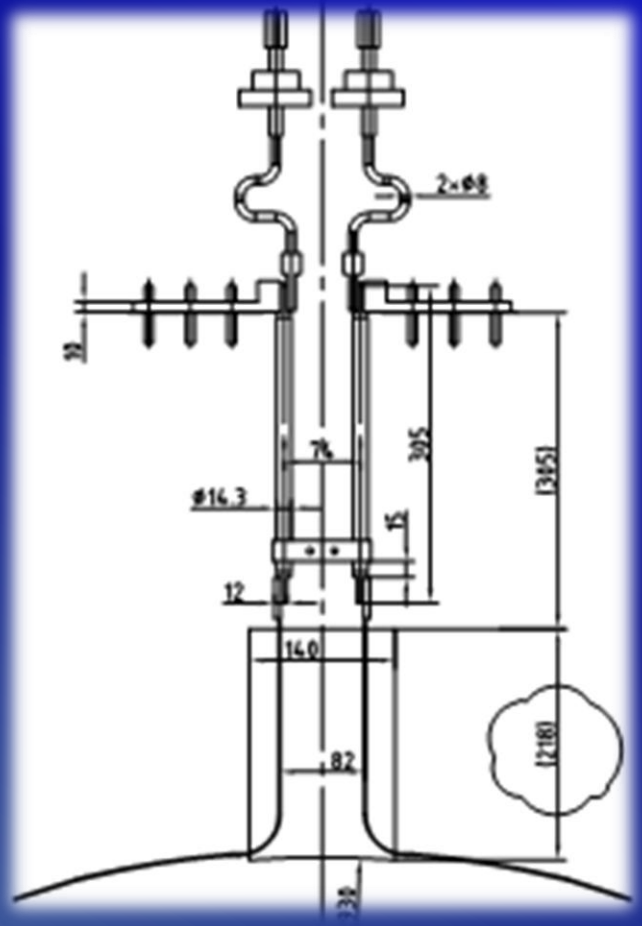
GHe vent



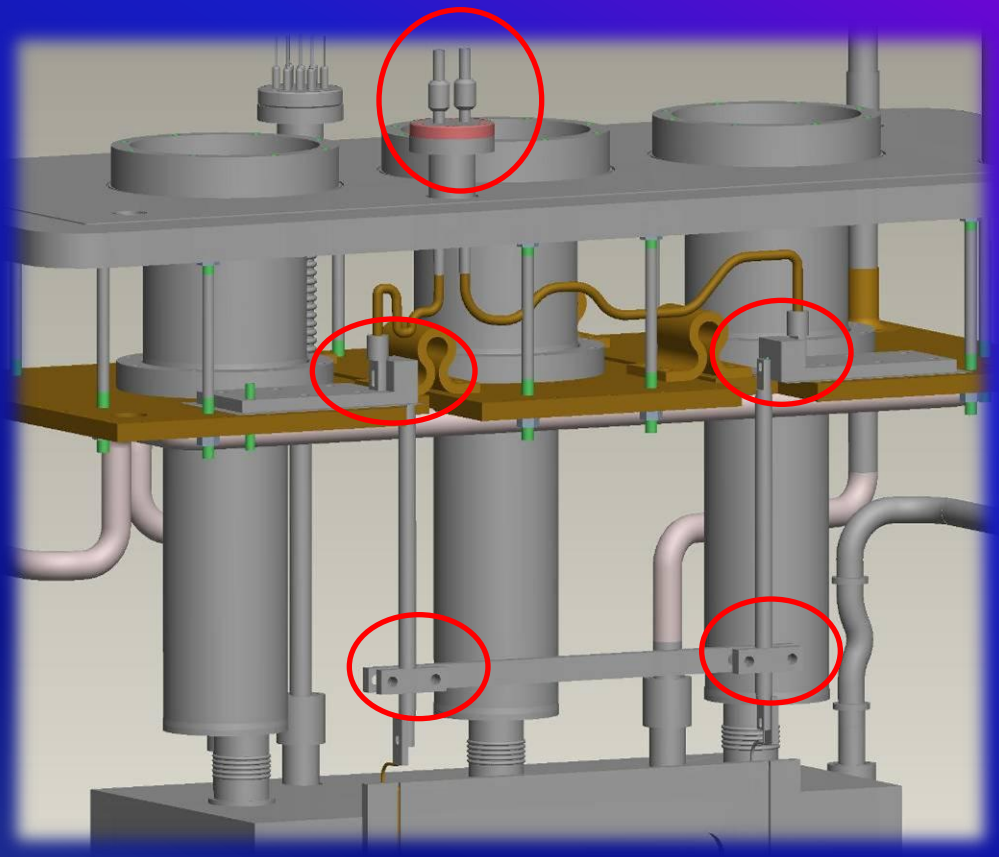


LHe supply line for cold down

Power Leads and Cooling



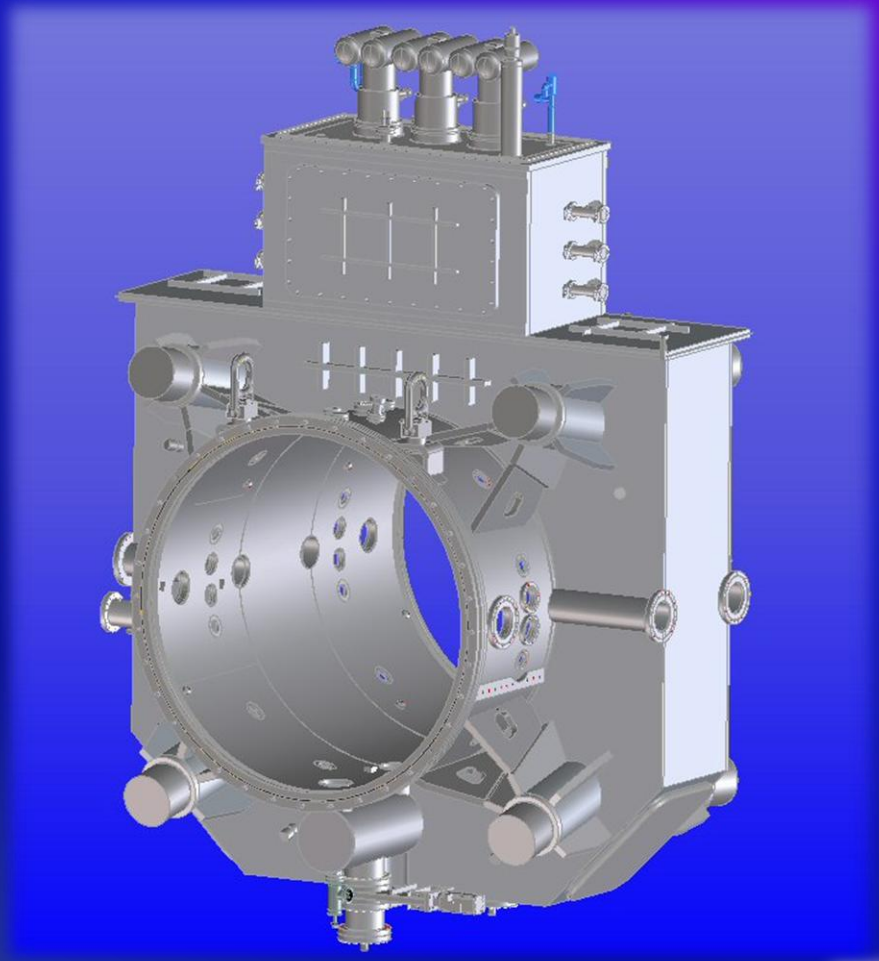
Previous design



Updated design

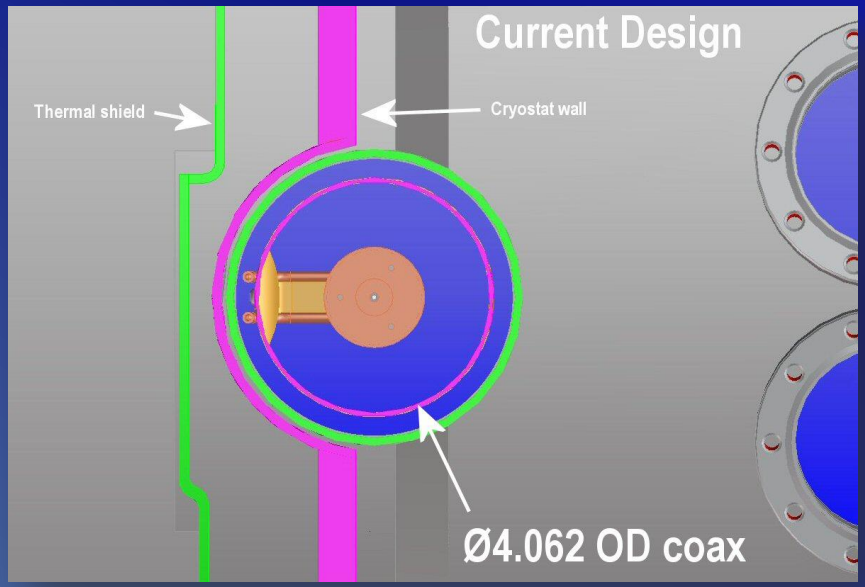
Assembly and Interface

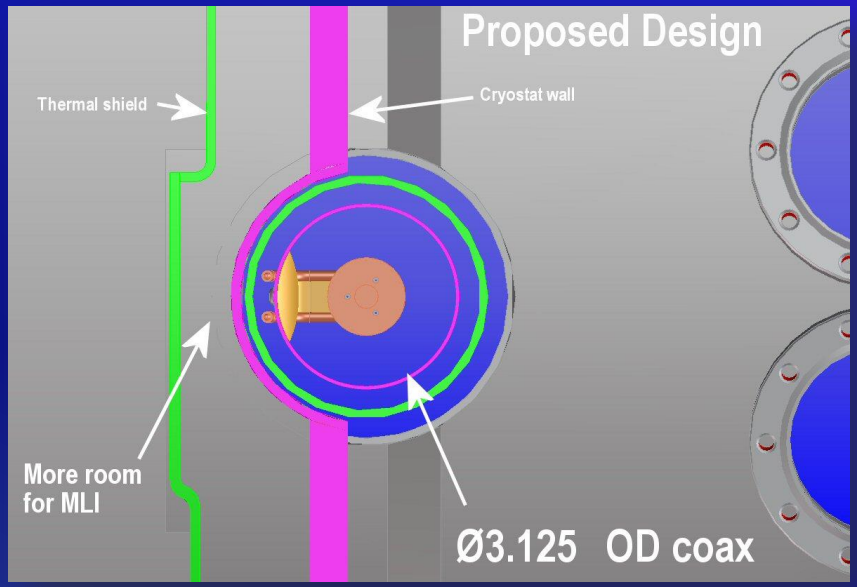
- Many interface issues
- Preliminary progresses
- Assembly procedures
- Supporting structures



RF Coupler Region

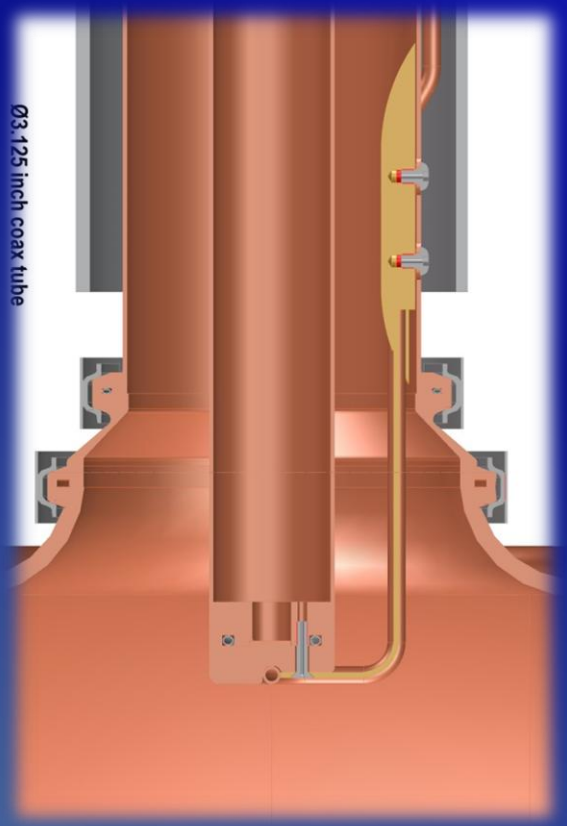
- **Issue:** extremely tight space in RF coupler region for MLI and difficult for assembly
- **Proposed solutions:**
  - Reduce RF coupler from 4 1/16 to 3 1/8: ~ 0.5 cm more space
  - Make RFCC module slight longer and keep the RF coupler dimensions

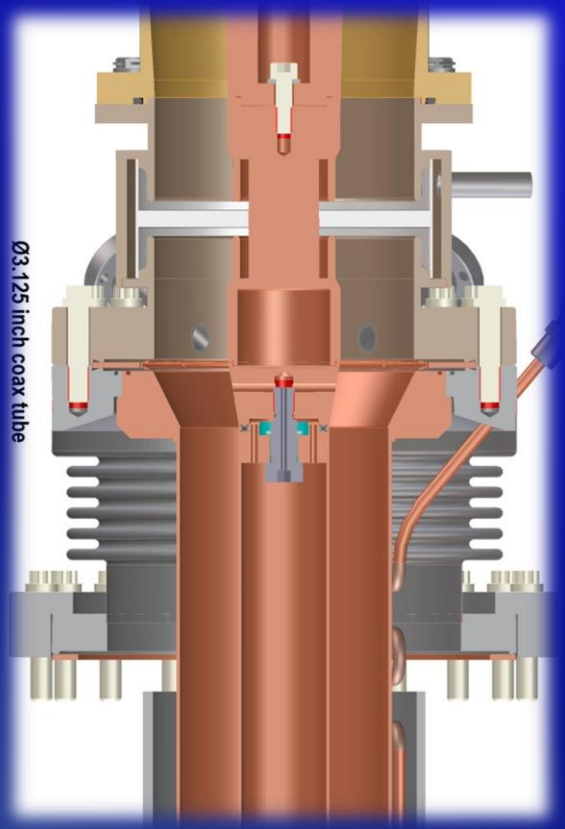


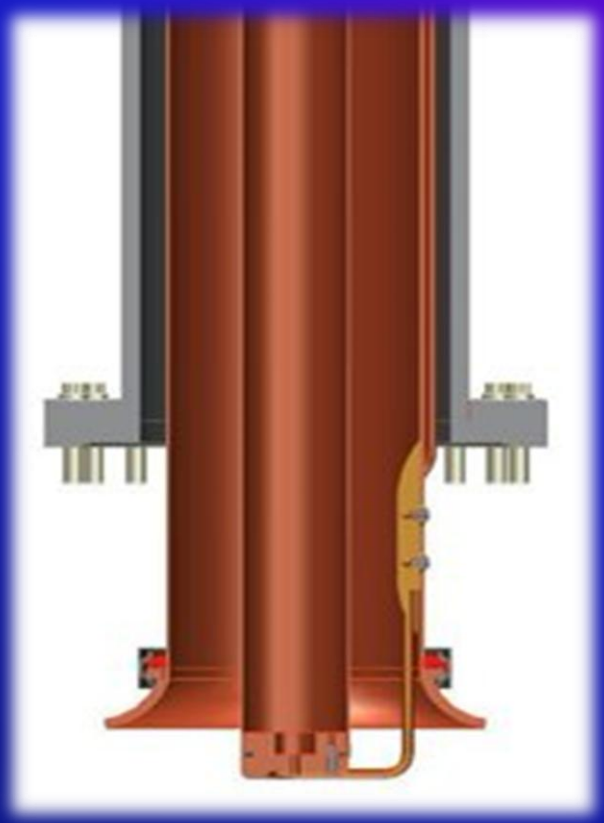


Modification of RF Couplers

- **Proposed solutions:**
  - Reduce RF coupler from 4 1/16 to 3 1/8: ~ 0.5 cm more space





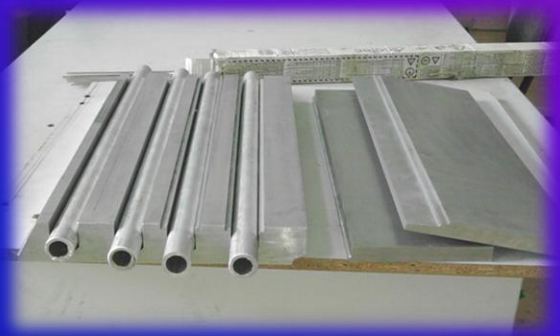


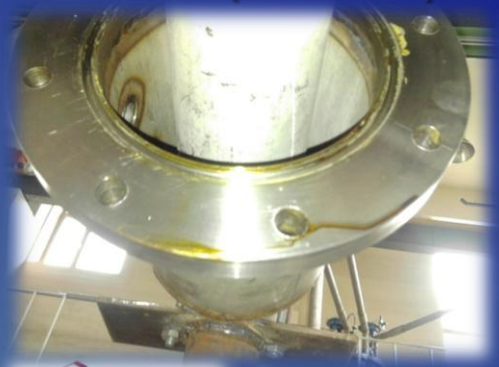
3 1/8” Coupler

4 1/16” Coupler

Update from HIT

- ICST test system: system disassembled
  - Transfer line contamination
  - New transfer line ordered
  - System ready by end Nov. 2010
- Cold-mass cover plate welding
  - Test sample made
  - Welding fixture in progress (with help from LBNL)





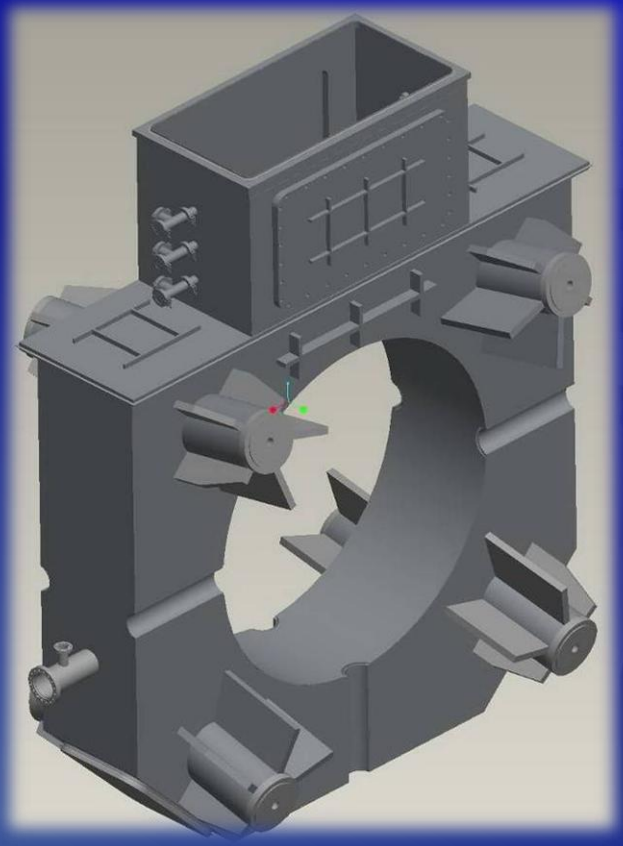
Near Term Plan and Schedule

- Finish the 1st coil winding by end of November 2010
- Finish ICST test system by end of November 2010
- Cold-mass cover plate welding
- Continue updating the CC cryostat design
  - More FEA simulations required on the cryostat vessel
  - Cooling circuit need to be further reviewed by experts or simulations
    - Air-plug
  - Quench protection also need to be reviewed
  - Interface with RF cavities and RFCC vacuum vessel
  - Technical discussions between SINAP MICE team and Qi Huan Corp. (received permission from HIT)
- A final design review on the CC cryostat design is required to happen soon before submitting MICE TB for approval
  - Can we combine two reviews?
- 3D, 2D drawings and fabrication of the cryostat

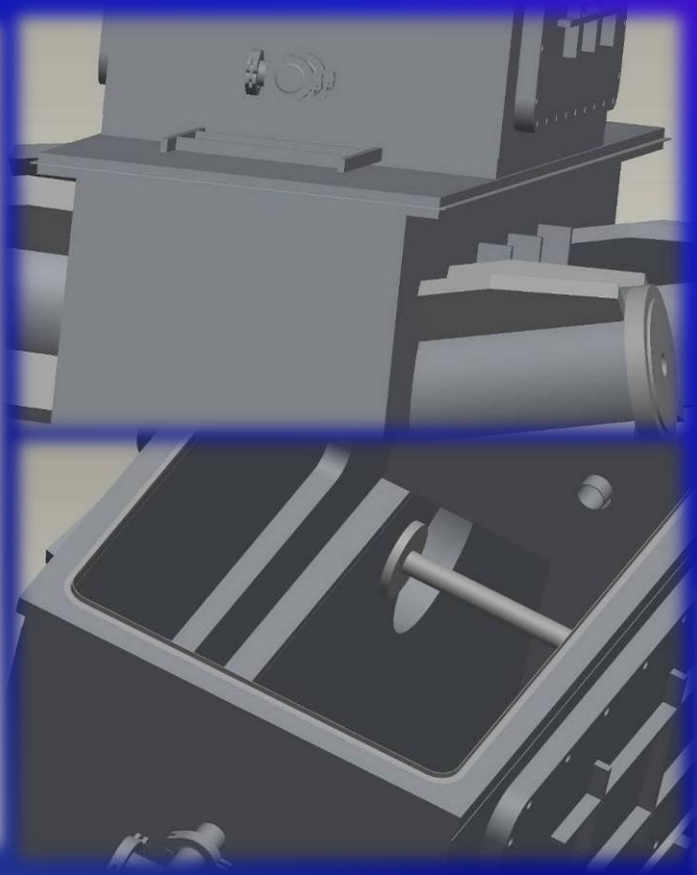
Updated CC Schedule

Task Description	CY 2010	CY 2011	CY 2012
MuCool Coupling Coil			
Cold mass fabrication and assembly			
Cryostat fabrication and final assembly			
Magnet testing and factory acceptance			
MICE Coupling Coil #1			
Cold mass fabrication and assembly			
Cryostat fabrication and final assembly			
Magnet testing and factory acceptance			
MICE Coupling Coil #2			
Cold mass fabrication and assembly			
Cryostat fabrication and final assembly			
Magnet testing and factory acceptance			

Progress after the Review



Vacuum port: ID is changed from 40mm to 100mm.



Angle changes of gussets in order to avoid interference with RF cavity vacuum vessel

Welding with cut-away redundancy instead of flange connection

Inside supports to reduce local deformation and peak stress of CC vacuum vessel resulting from the upper 4 cold mass supports