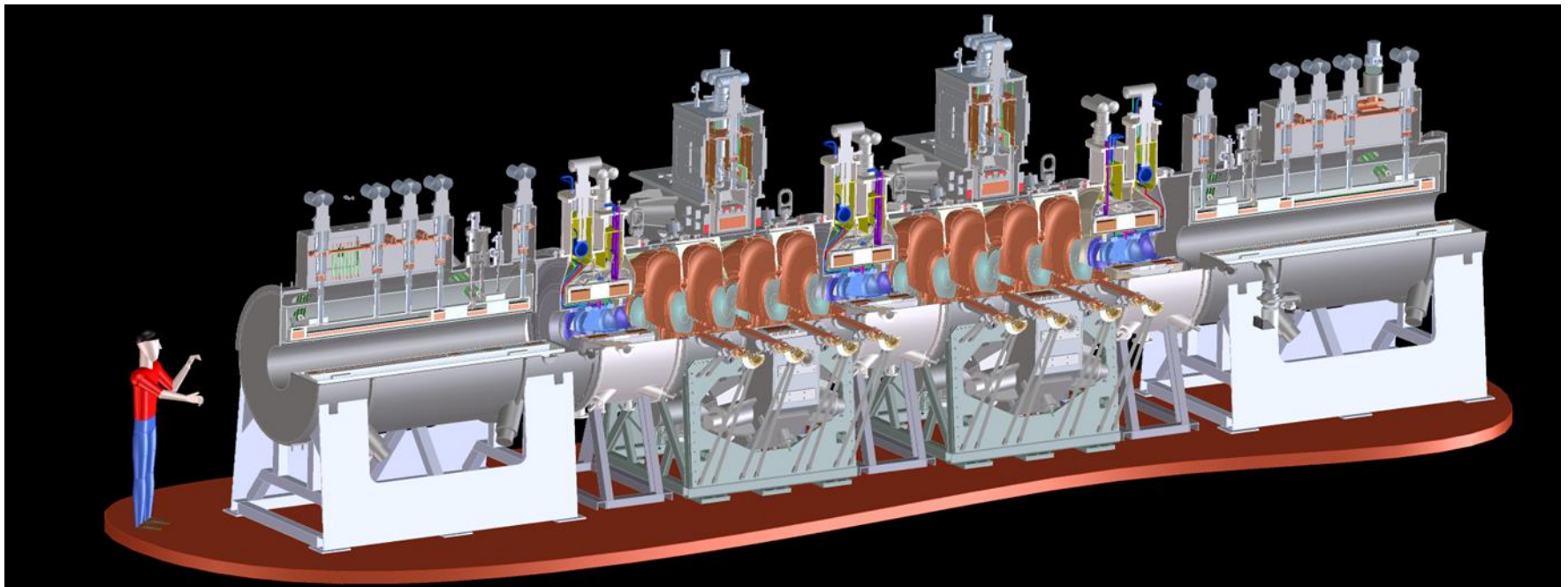




Status of US Magnets





Outline



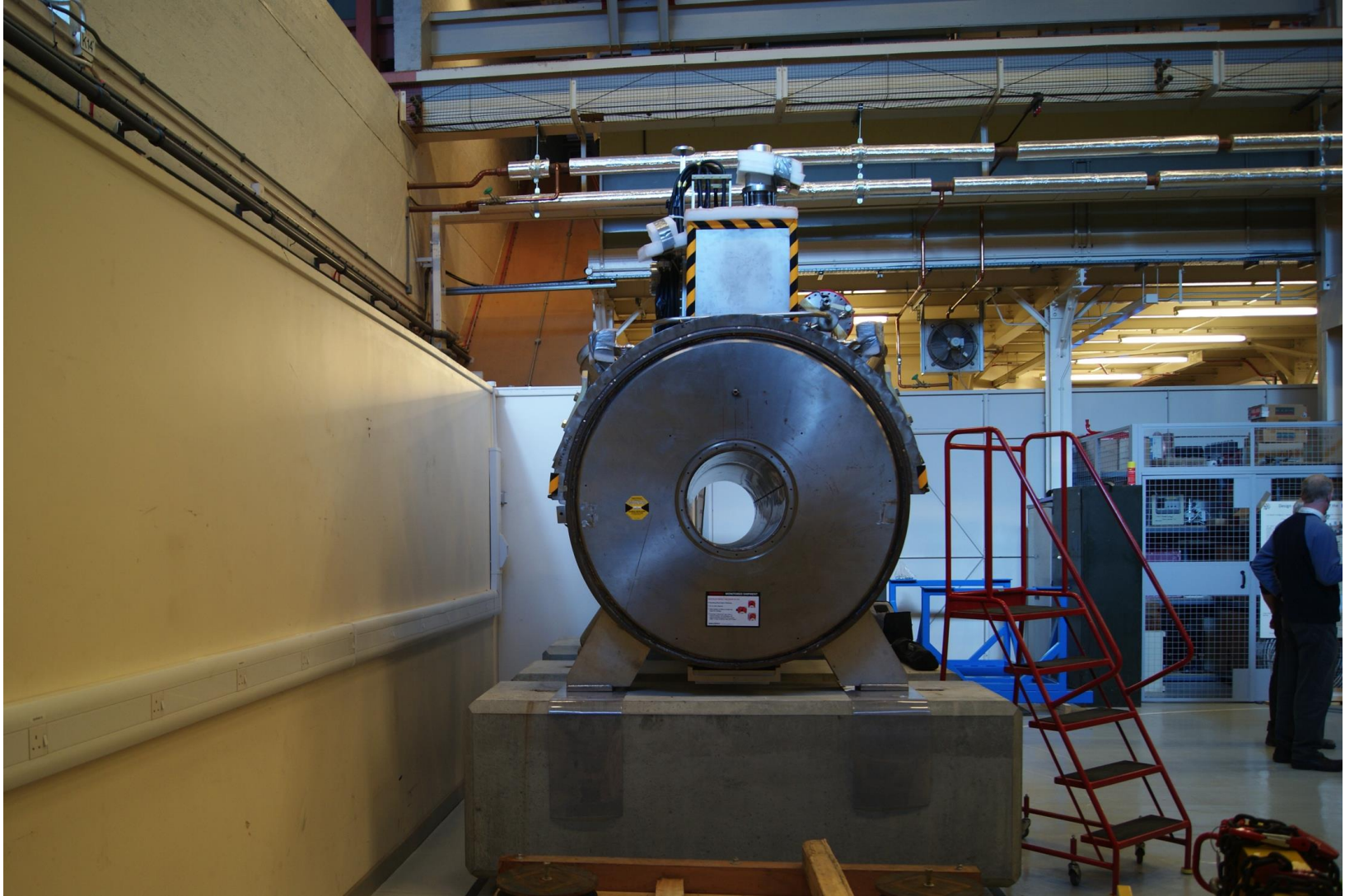
- Spectrometer Solenoids
 - 2 needed for Step IV
- Coupling coil magnets
 - 2 needed for Step VI
- Magnetic mitigation
 - Overview of procurement
 - More from Jason today & Holger tomorrow at MPB

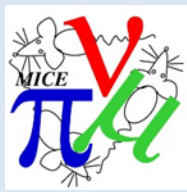
- SS2 has been completed and shipped to RAL
 - Reached full operating current (+2%) in flip and solenoid modes
 - Soak test a full current performed
 - Tested with iron shield in place
 - Minimal re-training
 - Fully mapped with CERN mapper
 - With & with out shield
 - x-check calib. With NMR probe





SS 2 in R9 at RAL





SS1 – Second spectrometer solenoid



- All assembly work on SS1 was completed back in late July, including iron shield installation
- Instrumentation and control systems were fully debugged along with several enhancements
- Vacuum vessel was pumped out and cold mass cooled down at the end of July in preparation for the initial powered testing
- However, several issues have prevented the magnet training from being completed as of this date



SS1



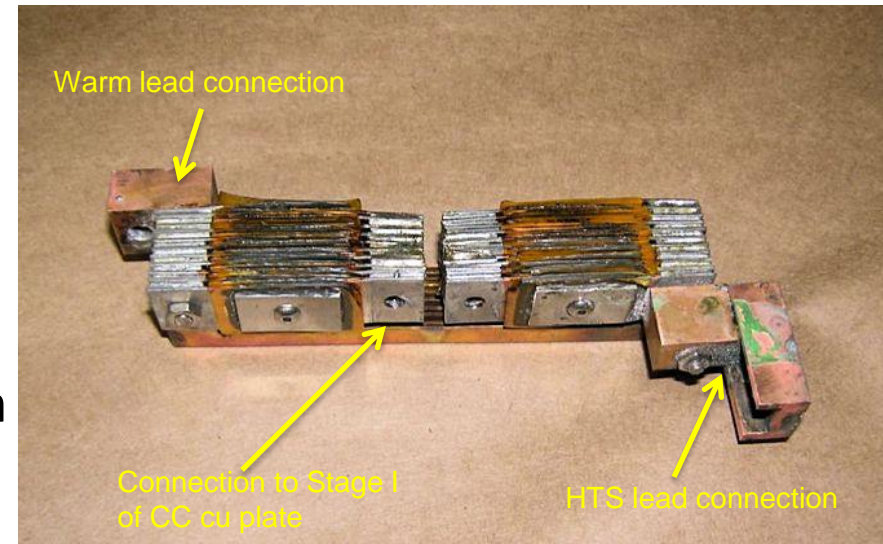
- The magnet has been cooled down three times with several issues arising that required warm up and repair
- The initial issue was vacuum leaks in the power lead vacuum feed throughs, caused by inadequate support of the external warm leads
- During subsequent powered testing, an HTS lead burned out at ~ 135 A
- After replacing the lead and cooling down again, another HTS lead was found to exhibit resistive behavior at low current, necessitating warm up



Power lead thermal intercept



- After opening the tower access port, close examination of the HTS lead area found several loose connections between the thermal intercepts and the 1st stage plate
- Intercept connected to the HTS lead showing resistive behavior was found to be the most loose
- Original solder joints lacked the structural strength to resist loads from coiled warm leads
- Repair consisted of a bolted connection with indium foil in the joints – all 8 intercept joints repaired
- All 8 HTS leads replaced with new units from HTS-110





Additional SS1 mods

- Temperature sensors have been added to the top end of the HTS leads (and a sensor on the bottom of one lead)
- The voltage tap wiring was reconfigured and carefully checked prior to the most recent powered tests
 - Previous issues with the HTS lead voltage taps appeared to have resulted in power supply instability during ramping
 - The instabilities apparently caused added heat load to the cold mass as well
 - The taps and the power supplies all worked well with no instability or dropped channels

Note: voltage tap wiring of SS2 will be reconfigured in R9 and new sensors will also be added

- **SS1 cool down has begun**



SS1 Ready





SS1 completion plan



- Training of SS1 expected to start ~Nov. 18th after cool down and system checkout
- SS1 testing & mapping scheduled to be complete in February.
 - Approximately 2 months schedule slack for contingency
 - Ship time is about 2 weeks door-door
 - Delivery to RAL, May 2014
- Cryocooler testing to take place at LBNL in parallel with training



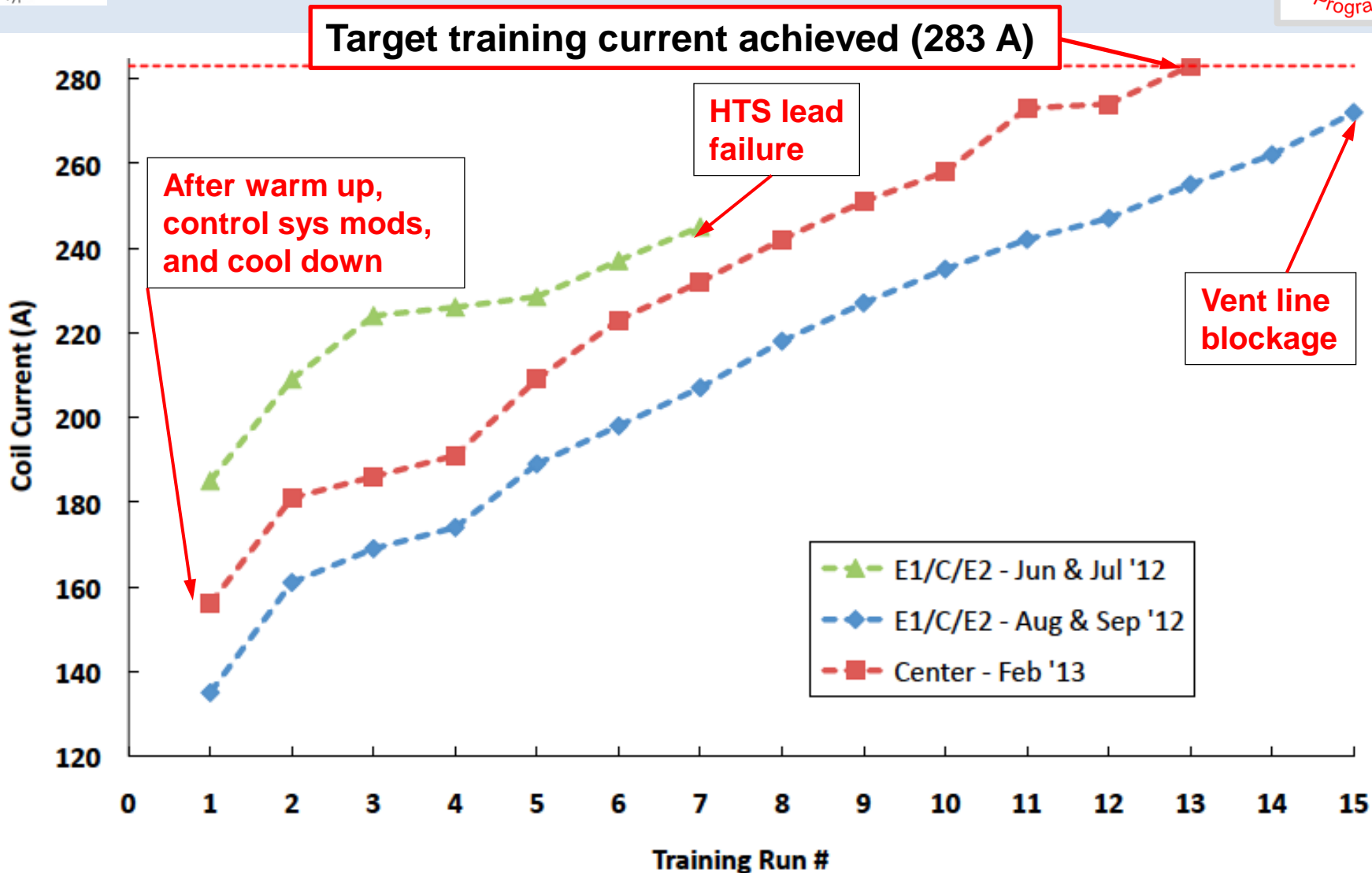
Note on SS training history



- SS2 was originally trained to 238 A when an HTS lead burned out (three 2-stage coolers, 07/2009)
- A modified SS2 was trained to 259 A when an LTS lead burned out (three 2-stage + one 1-stage cooler, 03/10)
- A final modification of SS2 incorporated five 2-stage coolers + one 1-stage cooler and reinforced LTS leads
- Training reached 245 A (7 runs) when an HTS lead burned out (07/2012)
- Training reached 274 A (15 runs) when an ice blockage occurred (09/2012)
- Target current reached (283 A, 13 runs in 02/2013) and full 3D magnetic mapping completed (06/2013)

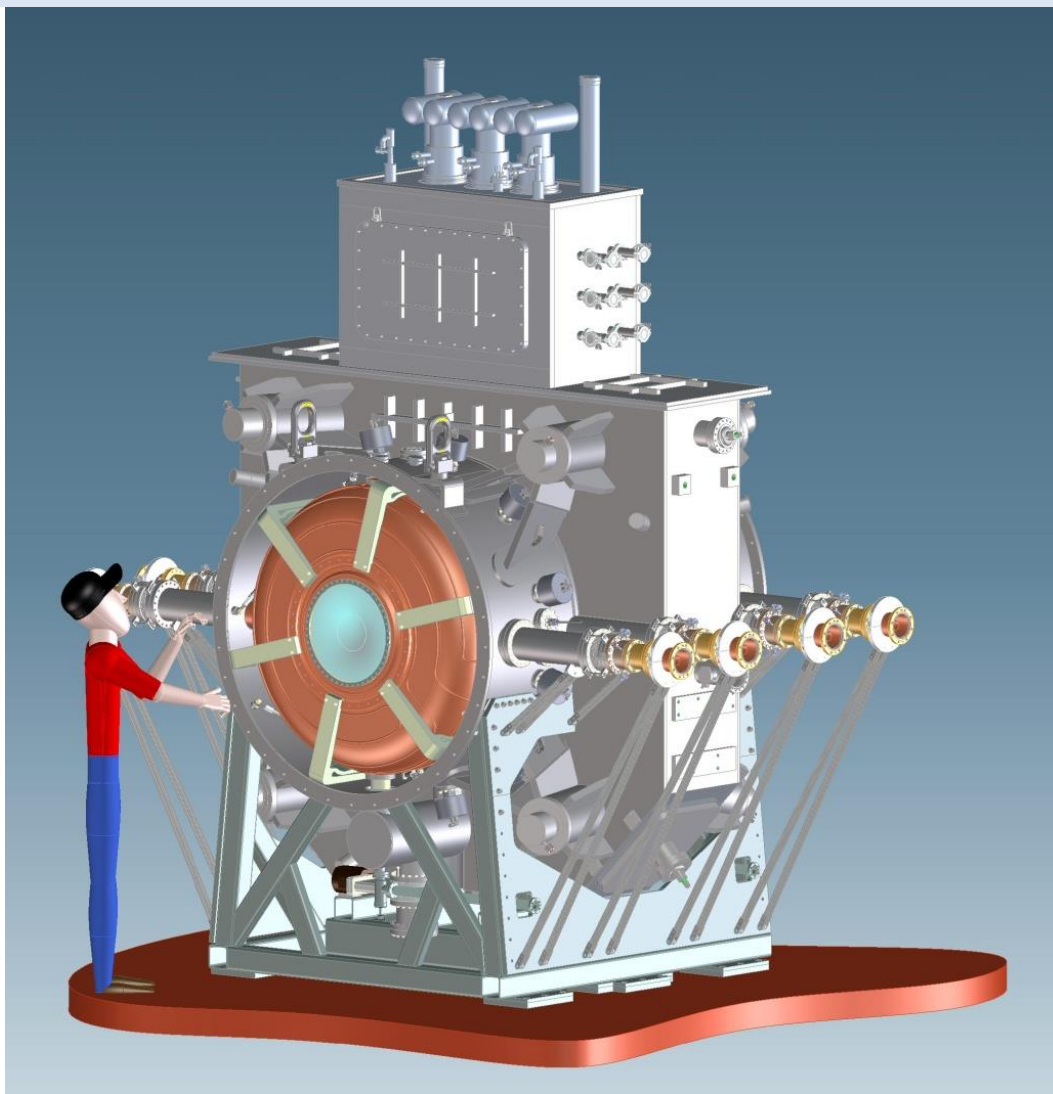


SS2 training runs

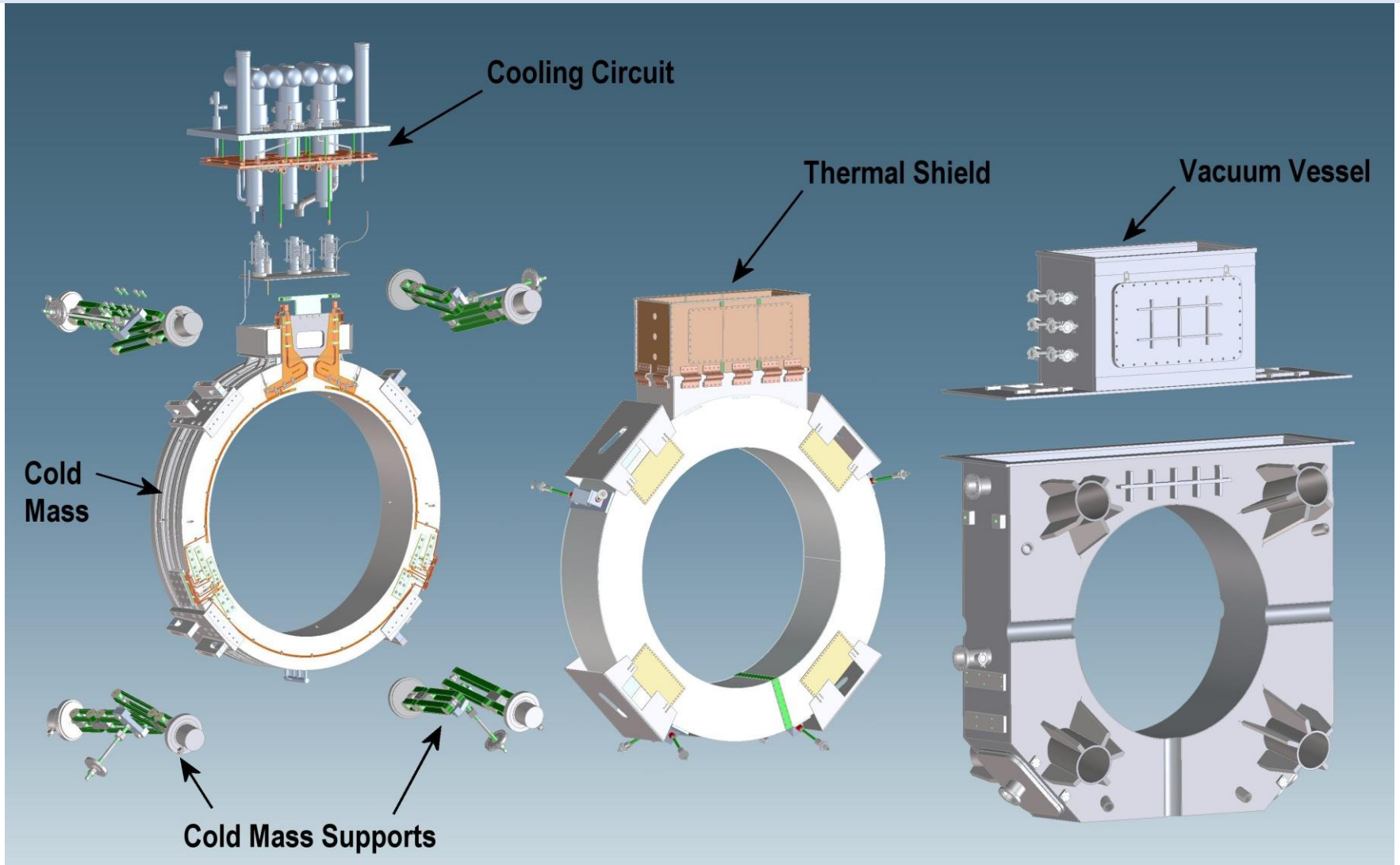




Coupling Coil magnets (CCM)



Coupling Coils

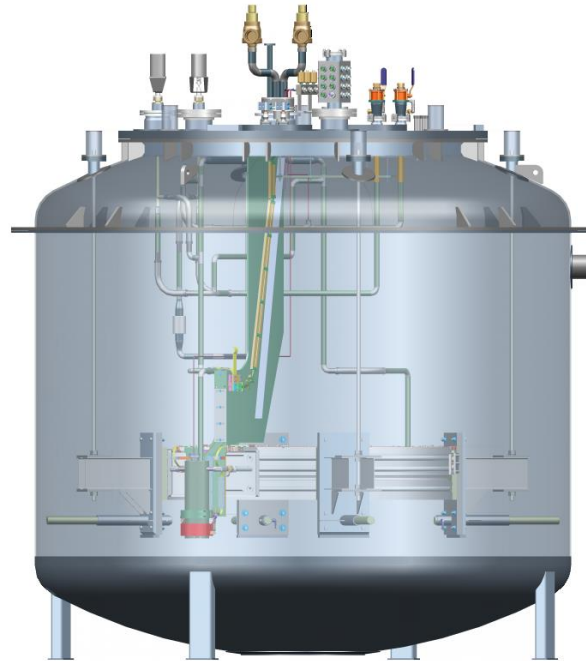




CCM cold mass #1 testing

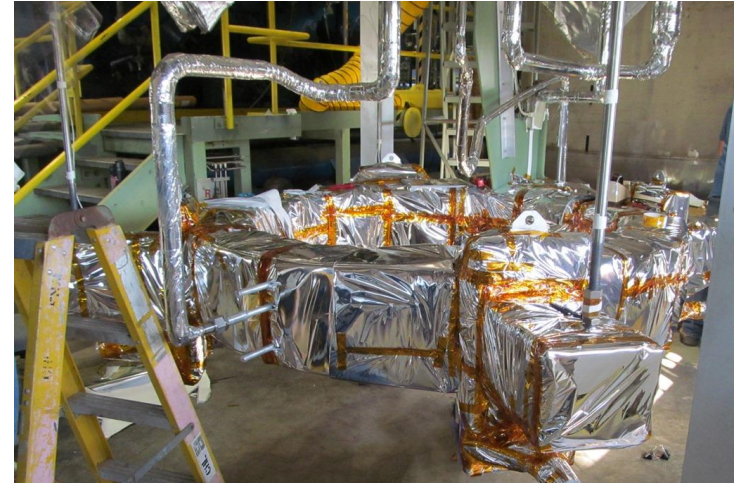


- The first cold mass is in the Fermilab Solenoid Test Facility
 - Total of 4 will be fabricated and tested
 - 2 CCMs for MICE + 1 for MuCool Test Area (MTA)





Cold Mass MLI Installation

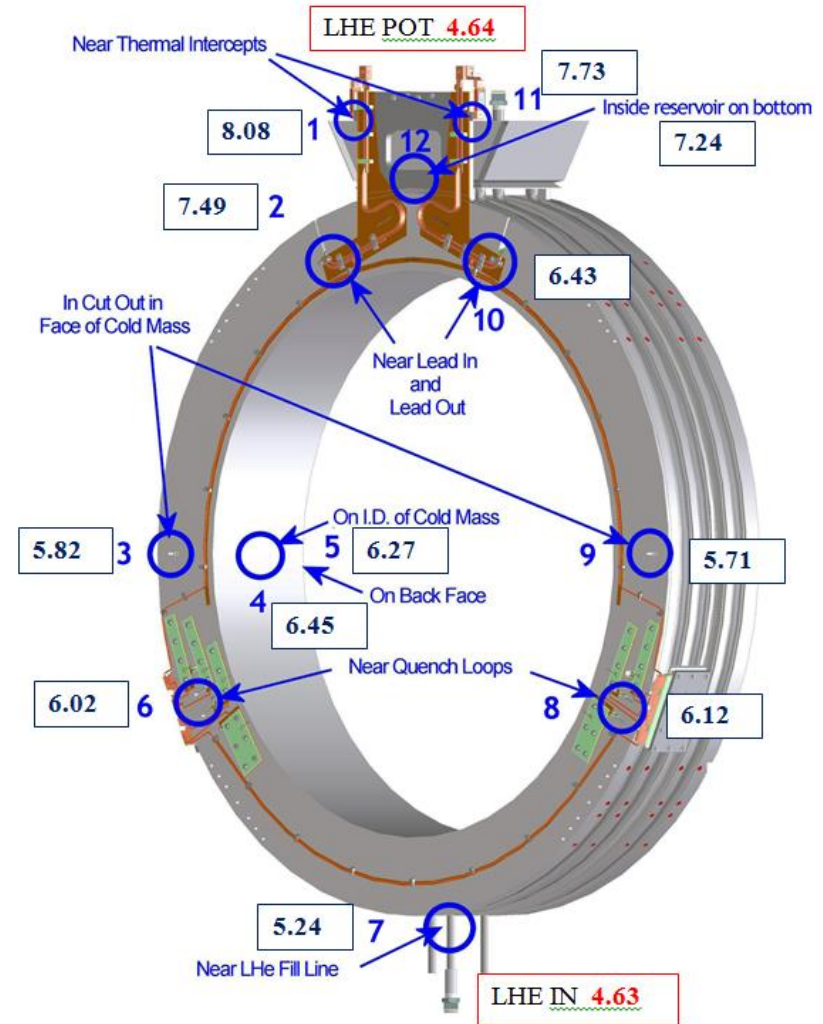


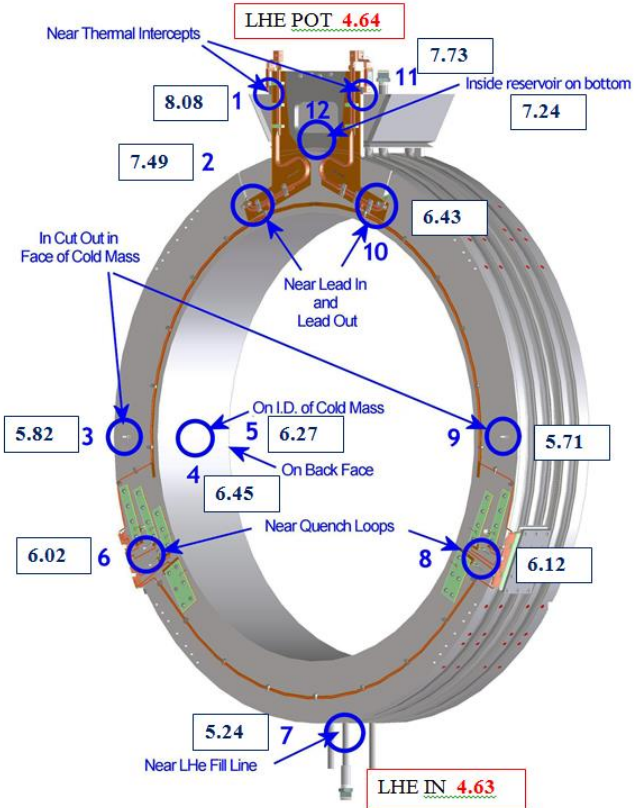


CCM cold mass #1

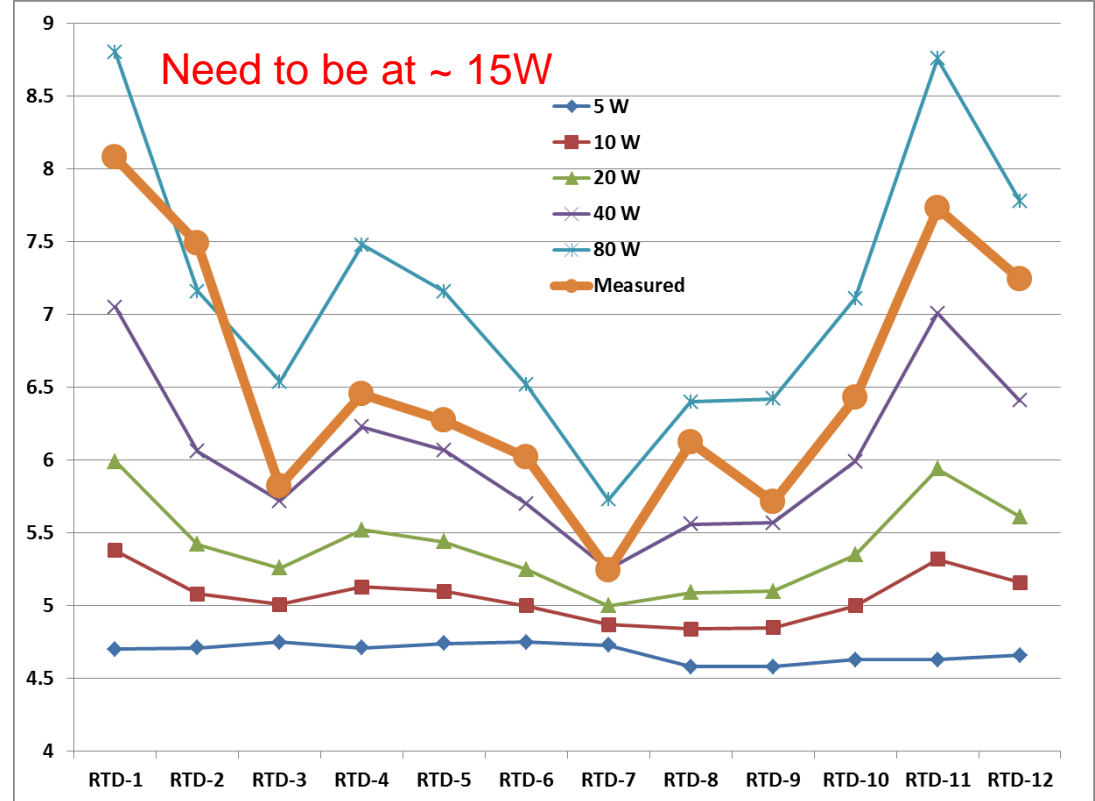


- Completed cool down week of 9/9/13
- Heat load too high
 - Cooling tube at 4.6K
- Measured heat load ~ 70W
 - Expected 10W
- Insulating vacuum good
 - 10^{-6} Torr





LBNL Thermal Model (Heng Pang)



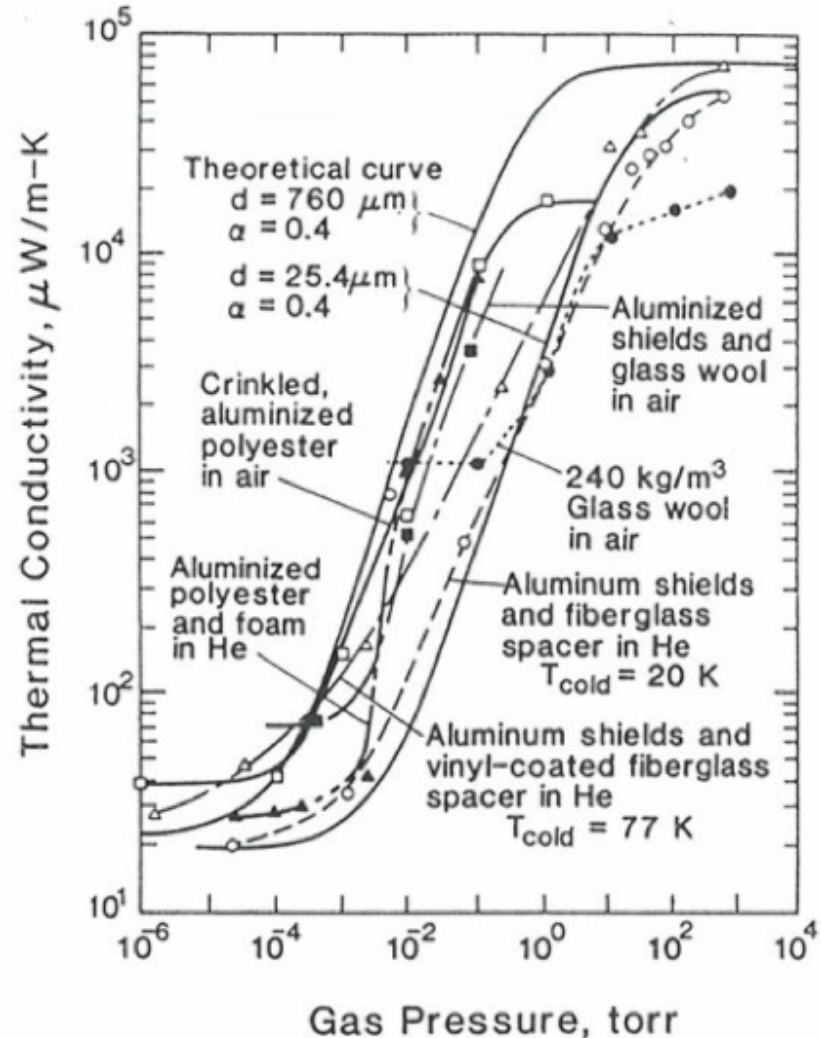
- Measured cold mass surface temperatures correspond to a model uniform heat load between 40 and 80 W. Measured heat load was ~75W
- Coil quenched at ~ 63A. Very likely at short sample limit.



Likely culprit – bad MLI



- Bad vacuum in MLI
 - Wrapped too tightly with wrong tape
- Thermal shorts introduced in the wrapping

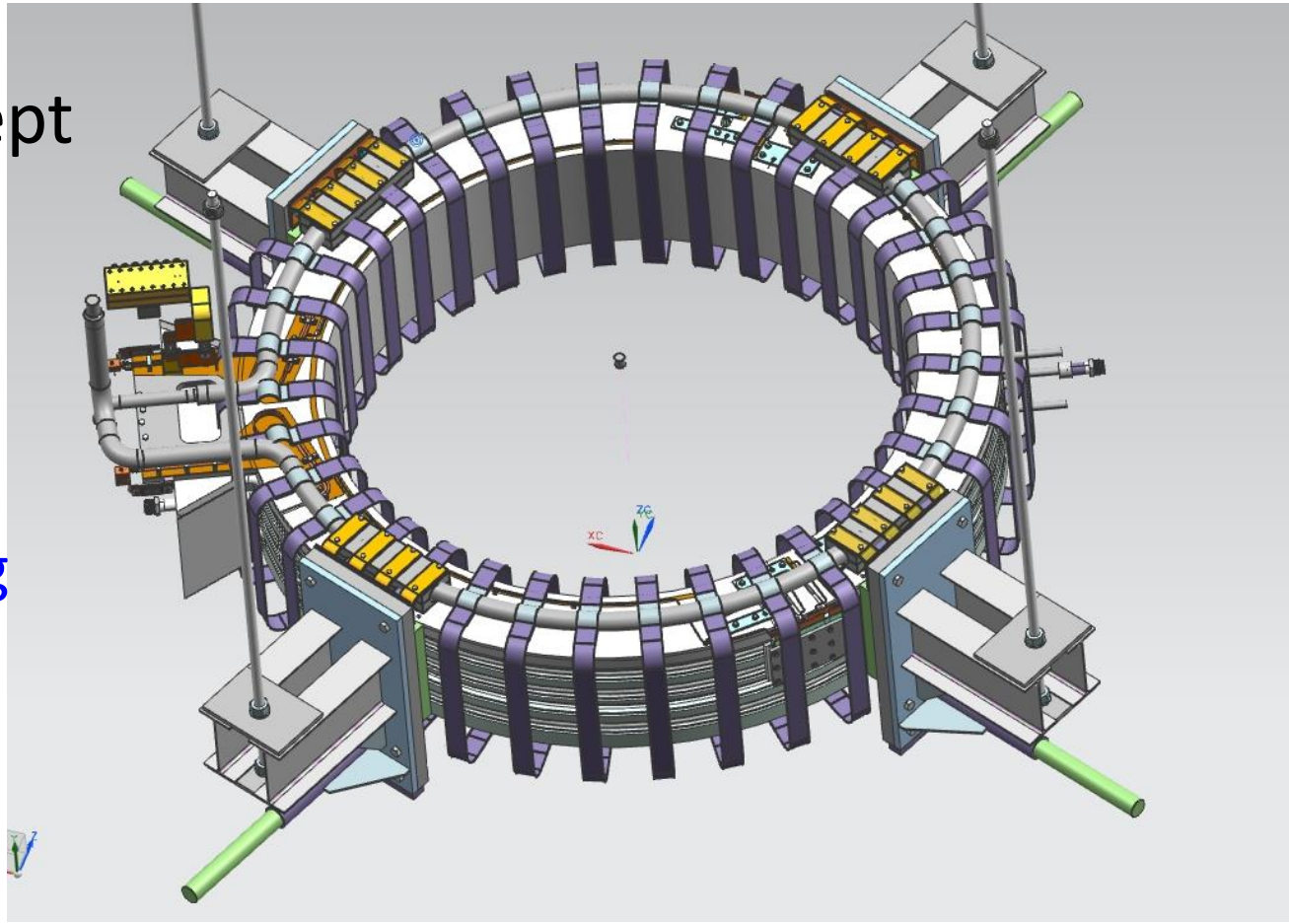




Steps Forward



- Rewrap MLI
- Introduce thermal intercept for mechanical supports
- Improve insulating vacuum
 - More pumping speed
 - Install RGA
- Add additional Temp sensors



Calculated heat load in this configuration < 9W with nominal MLI properties



CCM Cryostat #1



- Being fabricated at LBNL
 - Scheduled to be completed 2nd week of Dec.
- Thermal shields and cooling circuit
 - Shield drawings done
 - Cooling circuit drawings still in process
 - Both will be fabricated at LBNL
 - Completion: April 2014

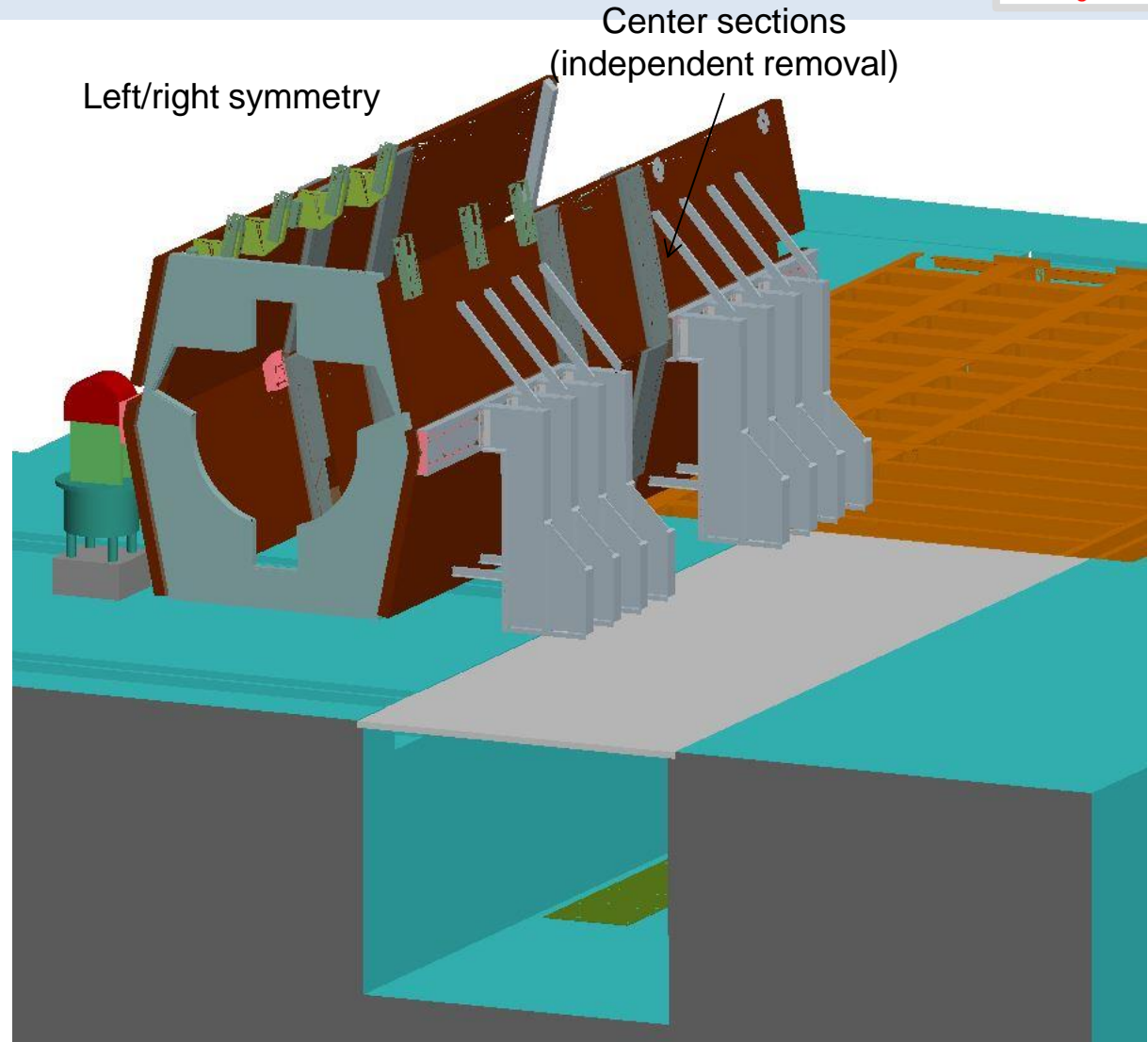




Partial Return Yoke

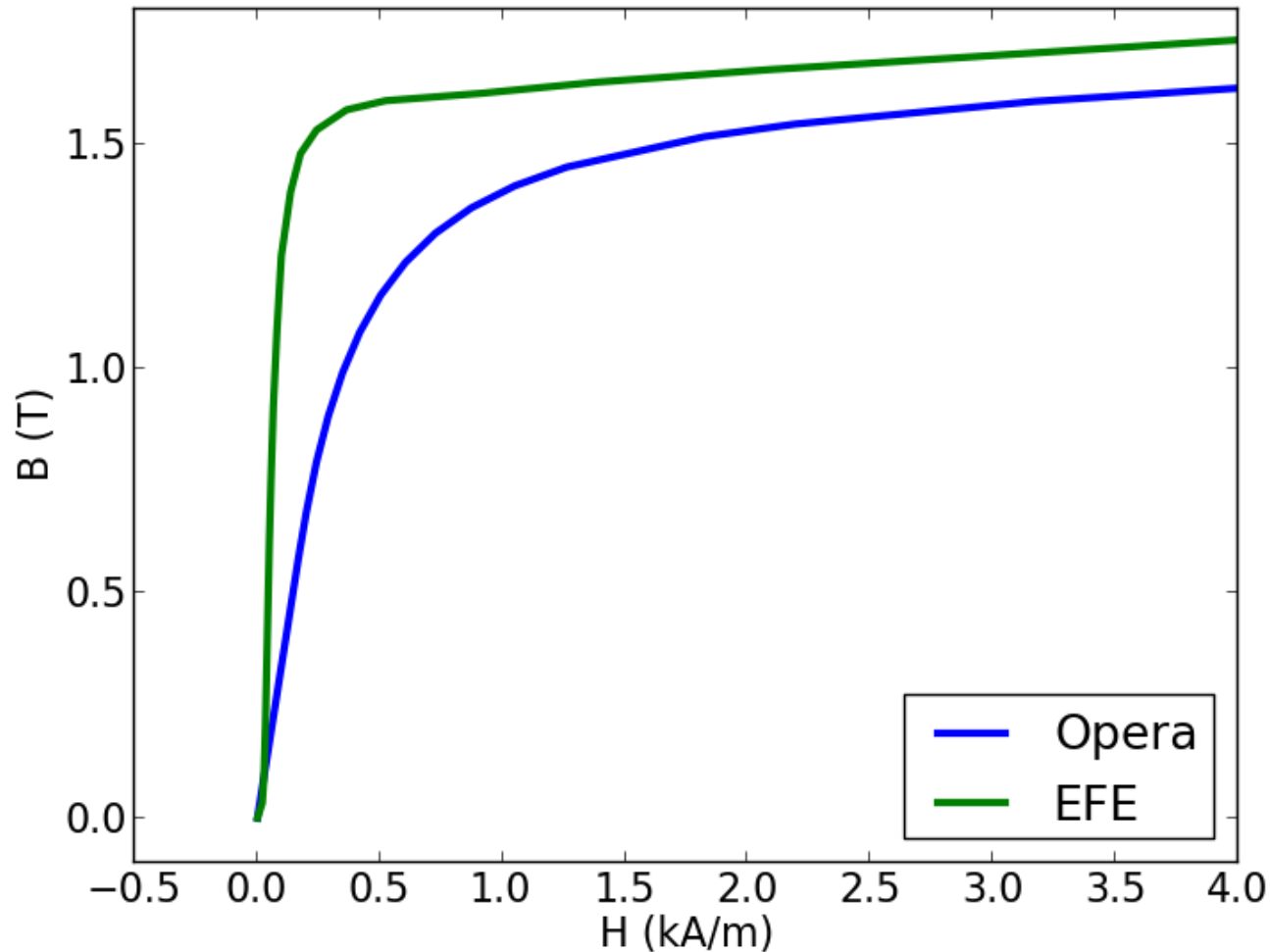


- Design nearing completion
- Procurement will separate raw steel procurement from fabrication
- Intend to use JFE-EFE steel



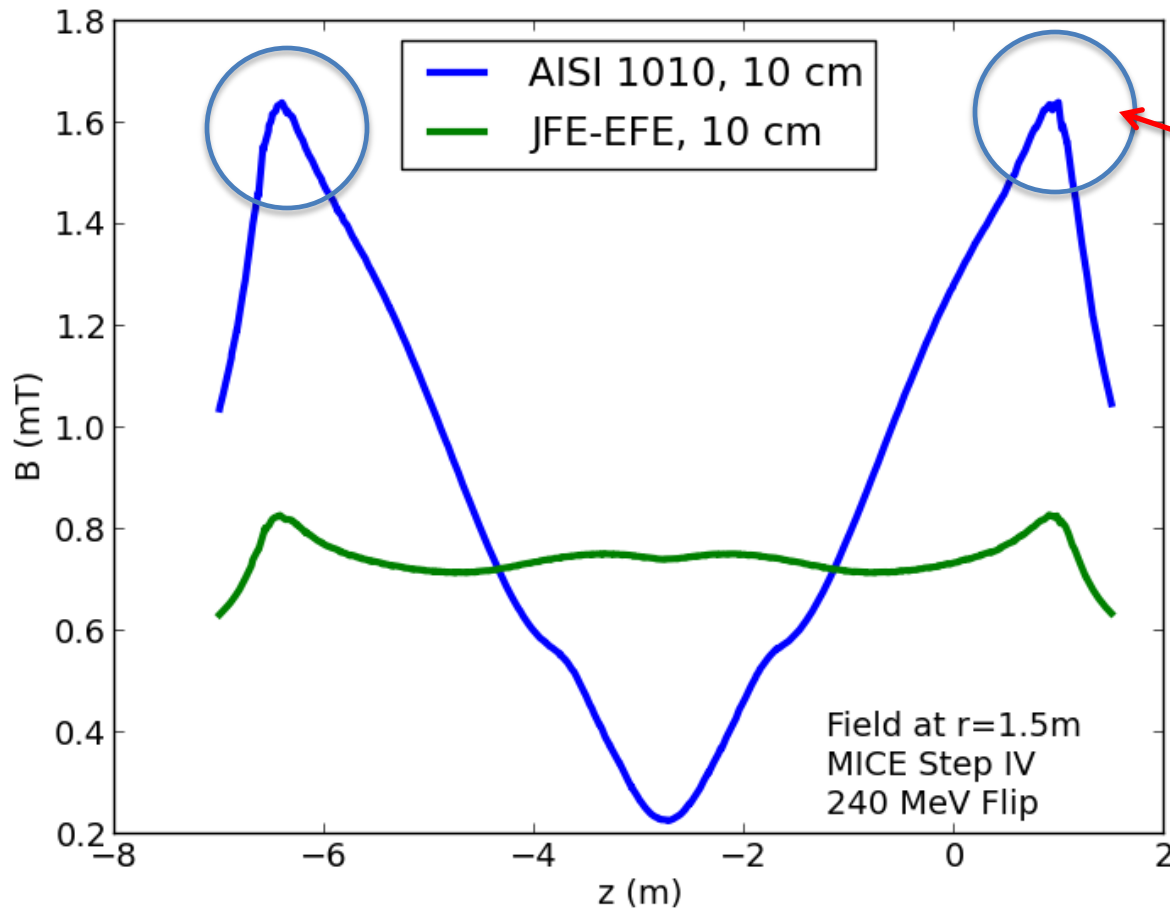


JFE: Extra Ferrite Electric





PRY Performance



Fiber Tracker
Readout location



Critical Dates



- SS #1 arrives at RAL 5/8/14
- PRY arrives at RAL 7/14
 - Note: partial could deliver south wall earlier
 - Note: Early order of steel could also improve
- CCM Prototype - Complete – Operational 10/14/15
 - Note: defined as MTA magnet
- CCM #1 Testing complete 12/6/16
- CCM #2 Testing complete 12/4/18
- RFCC #1 arrives at RAL 3/6/18
- RFCC #1 commissioning at RAL complete 8/29/18
- RFCC #2 arrives at RAL 9/6/19
- RFCC #2 commissioning at RAL complete 3/9/20

- MICE Opt. RFCC arrives at RAL 7/26/18
- O-RFCC #2 commissioning at RAL complete 9/20/18



Conclusions



- SS2 at RAL ready for tracker installation
 - Meets full operational spec & fully mapped
- SS1 scheduled to arrive in May
- Testing of CCM cold mass #1 halted in order to improve heat load to cold mass
 - Expect testing to resume in Jan. 14 (8 weeks)
 - Will release Qi Huan to wind second coil once we have data on cold mass #1
- PRY design is very mature
 - Hope to order steel by December 15th
 - Quotes coming in from fabricators
 - Fabrication readiness review (**internal**) in early January