

# Spectrometer Solenoid Fabrication Status and Schedule RF Cavity / Coupling Coil Module Plan and Progress

**Steve Virostek**

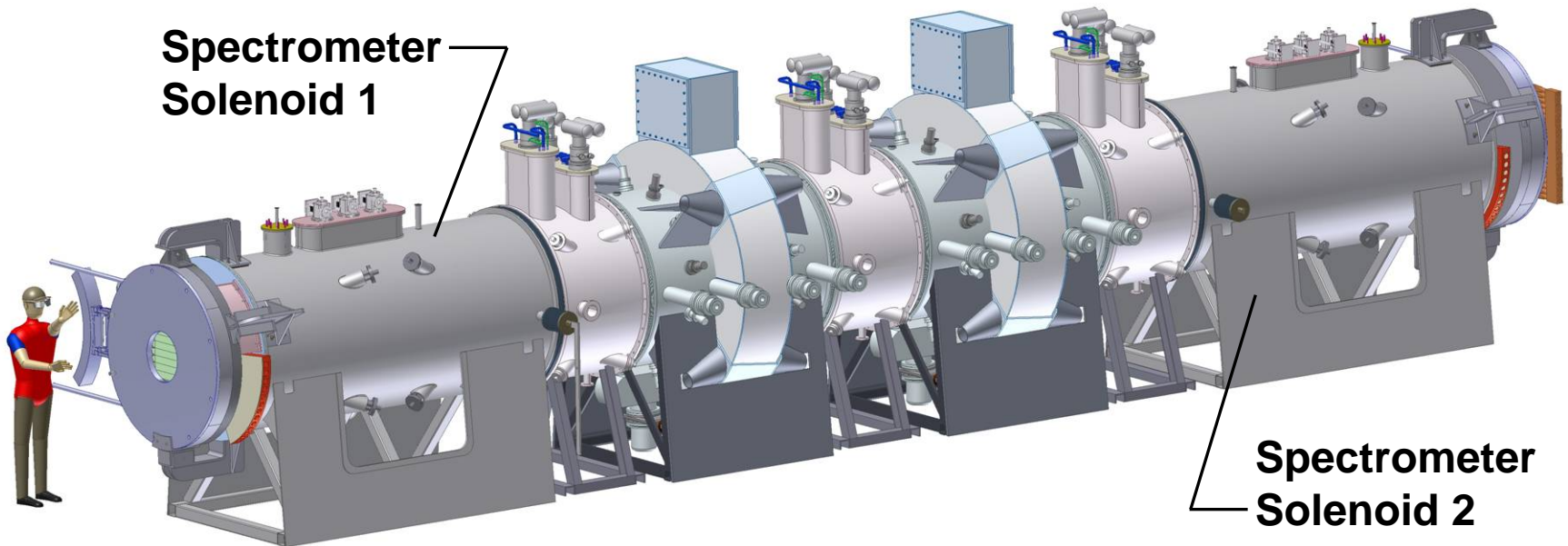
Lawrence Berkeley National Lab

**NFMCC**

March 18, 2008



# MICE Cooling Channel Layout



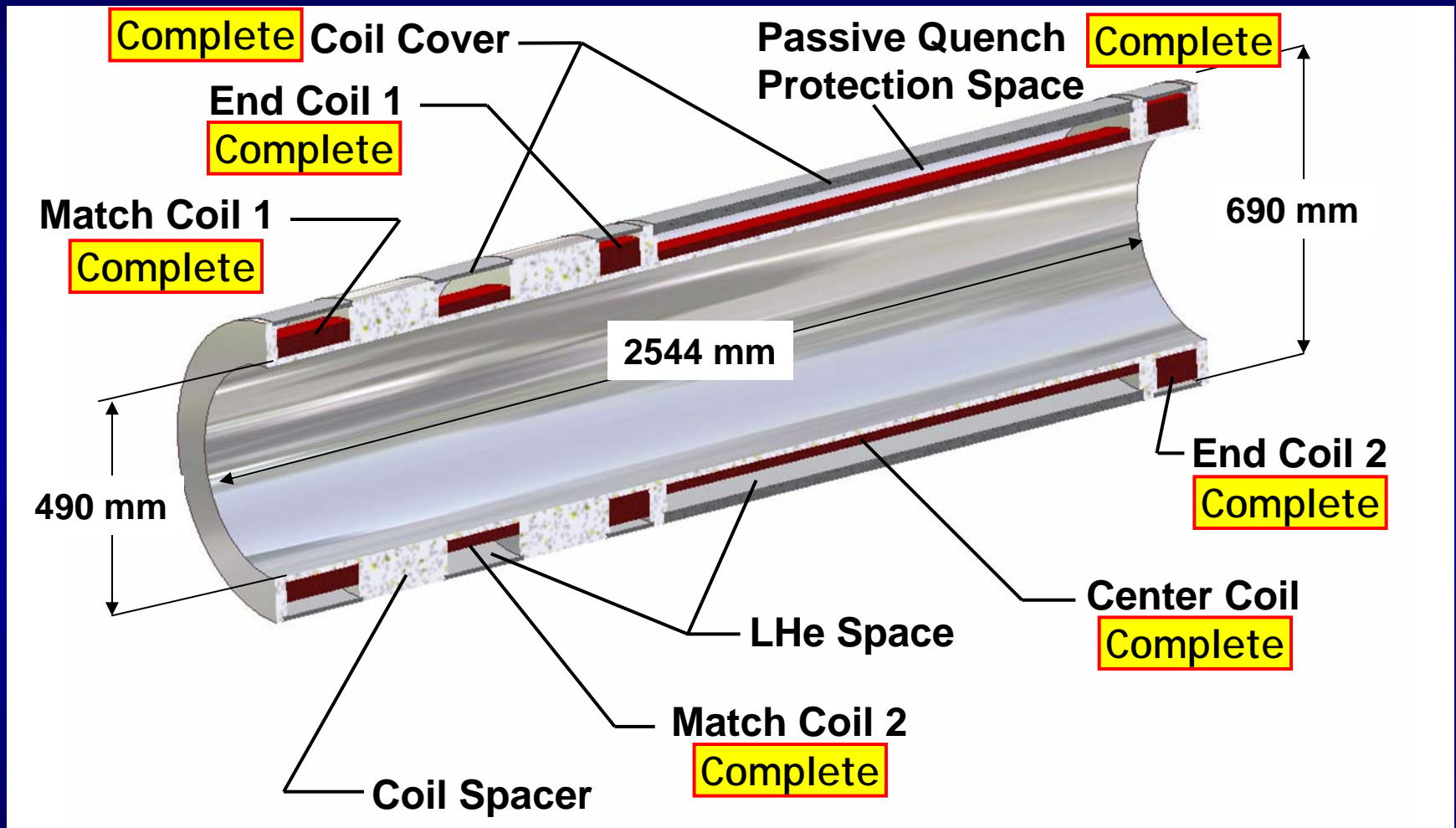
# Overview (Spectrometer Solenoid)

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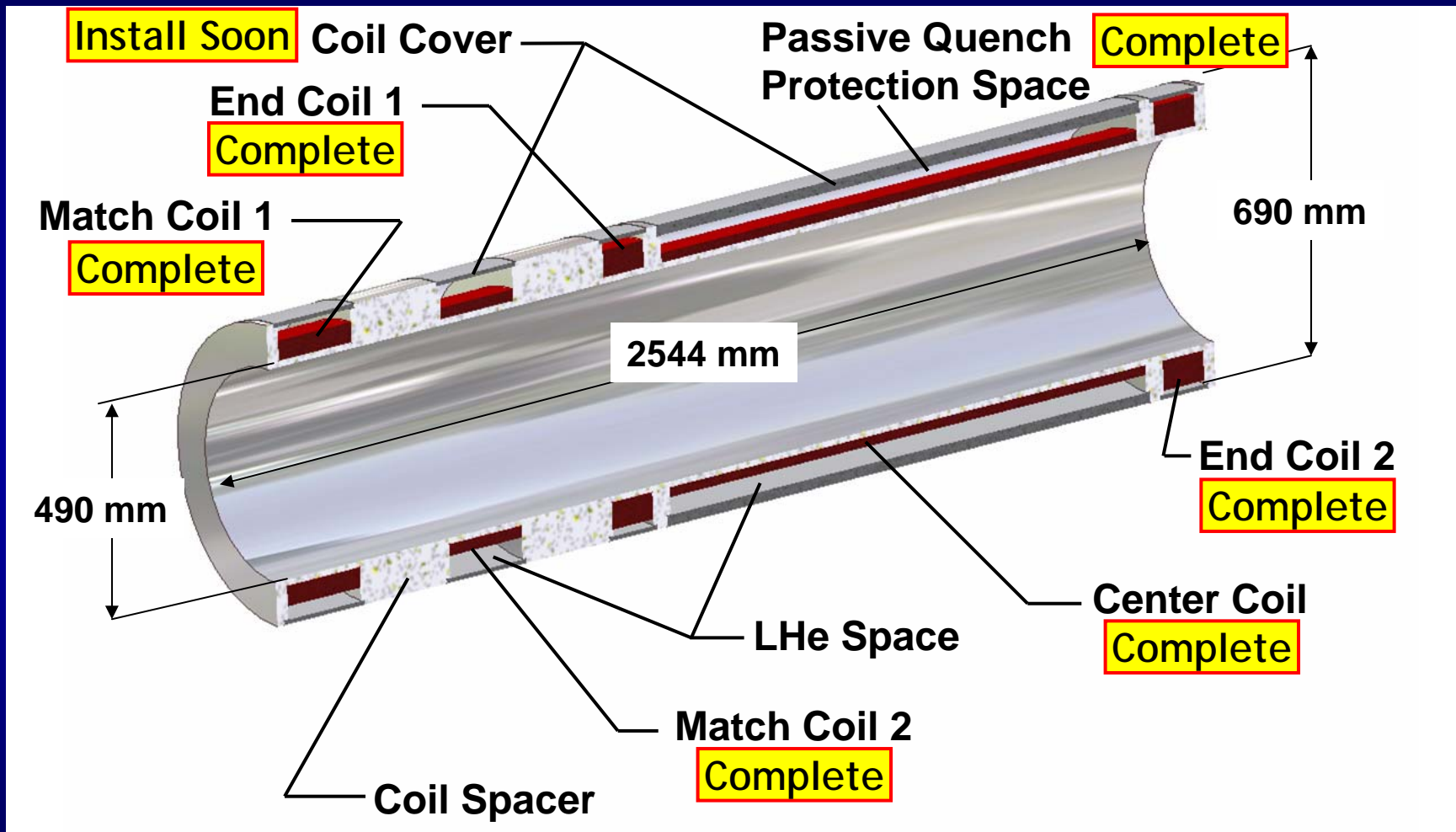
- Completion of first magnet has been delayed by a problem with cold mass support clearances
- A second issue regarding the poor cryocooler performance in an off line test has been resolved
- Currently expect fabrication of the first magnet to be complete by mid to late April
- Coil winding, banding, wiring and reinforcement of the 2<sup>nd</sup> magnet is finished
- Completion of the second magnet to follow the first by approximately two months



# Spectrometer Solenoid Cold Mass #1



# Spectrometer Solenoid Cold Mass #2



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# Completed Cold Mass Assembly - Magnet #1



Cold mass prior to welding  
of support bands



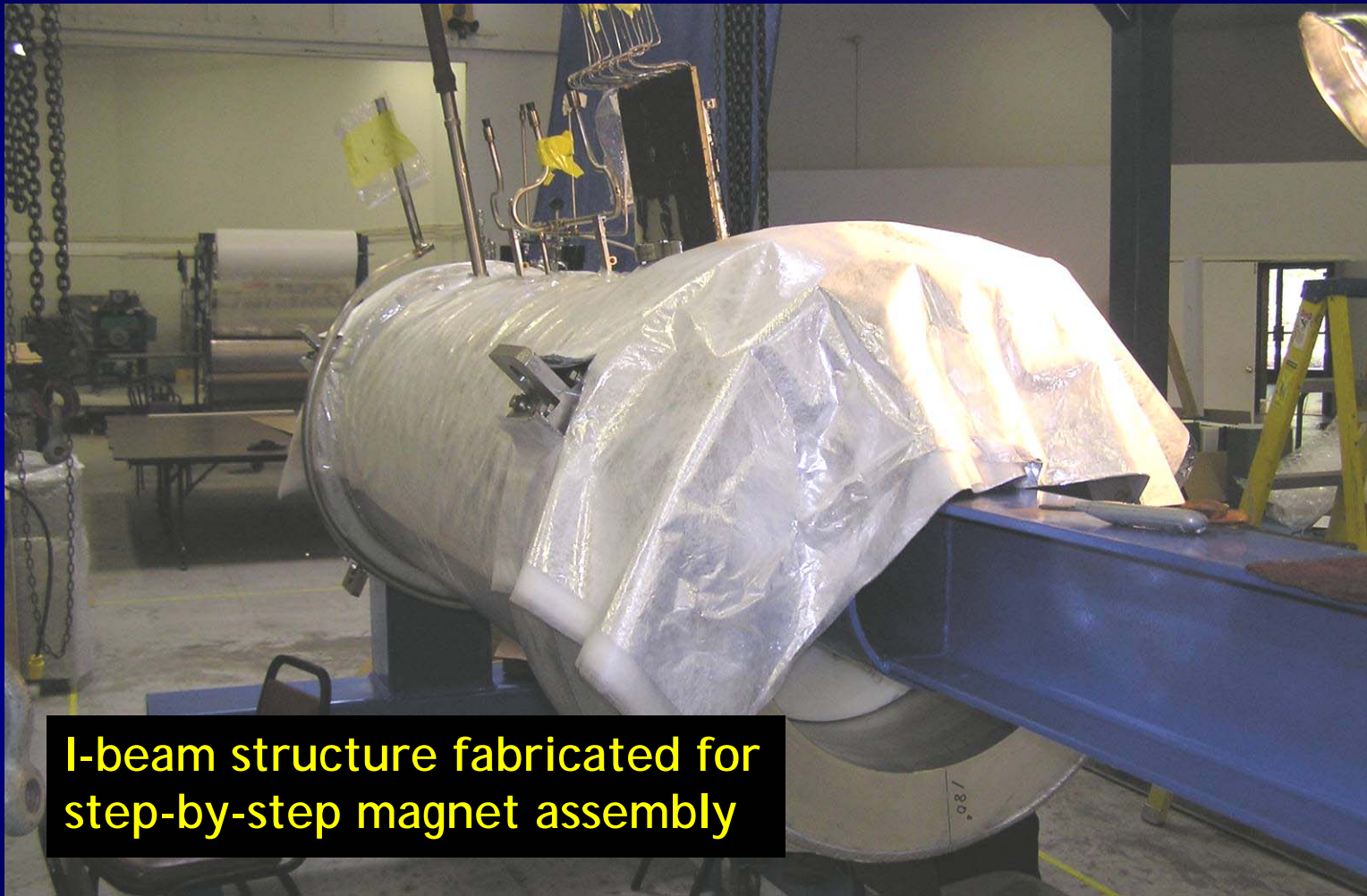
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# MLI Wrapping of Cold Mass Assembly



**I-beam structure fabricated for step-by-step magnet assembly**



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# Outer Thermal Shield



**Shield assembled from  
3/16" aluminum sheet**



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# MLI Wrapped Thermal Shield



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# Installation of Thermal Shield over Cold Mass



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# Installation of Thermal Shield over Cold Mass



**Thermal shield is positioned with hoist during installation**



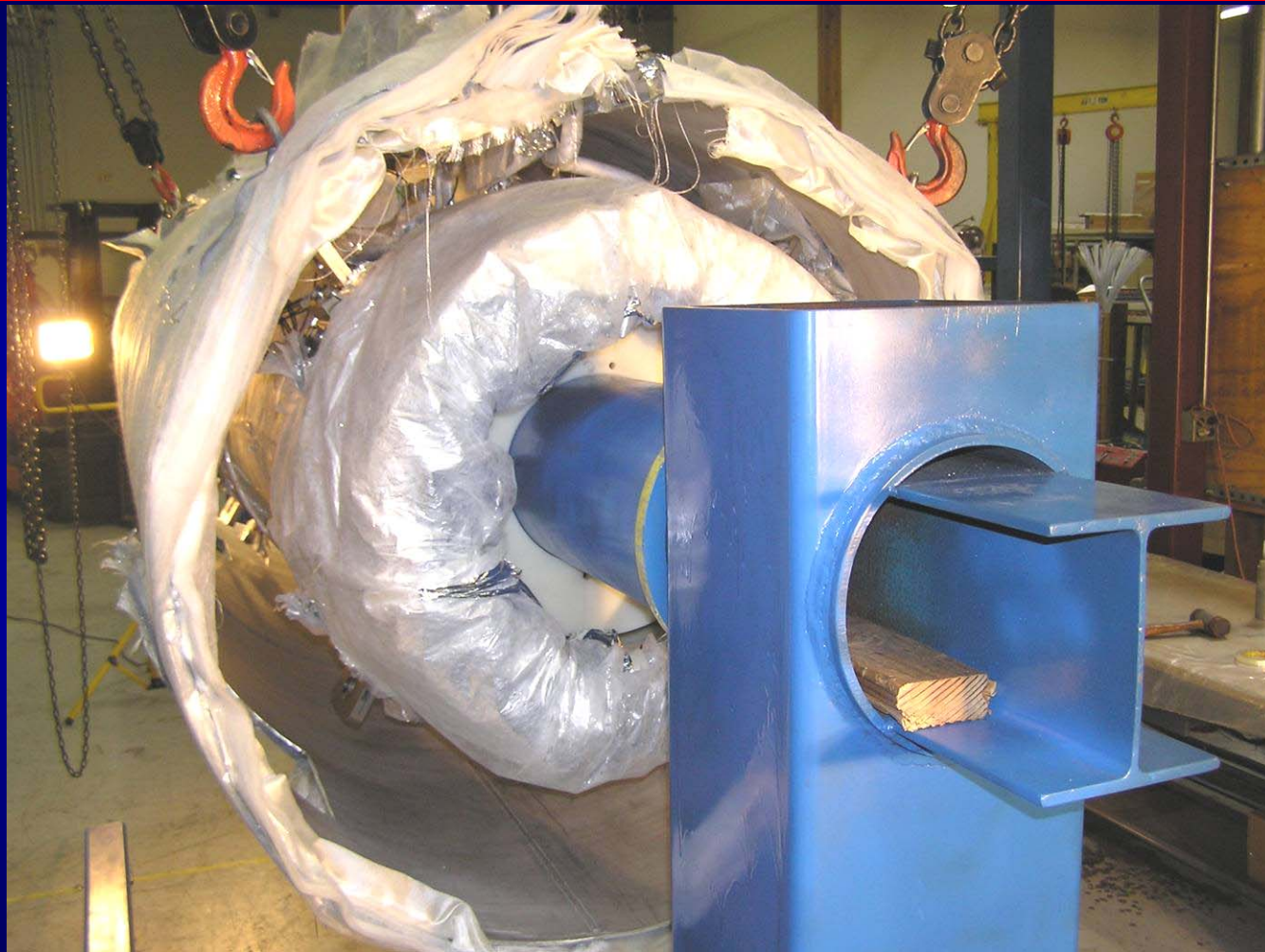
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# Installation of Thermal Shield over Cold Mass



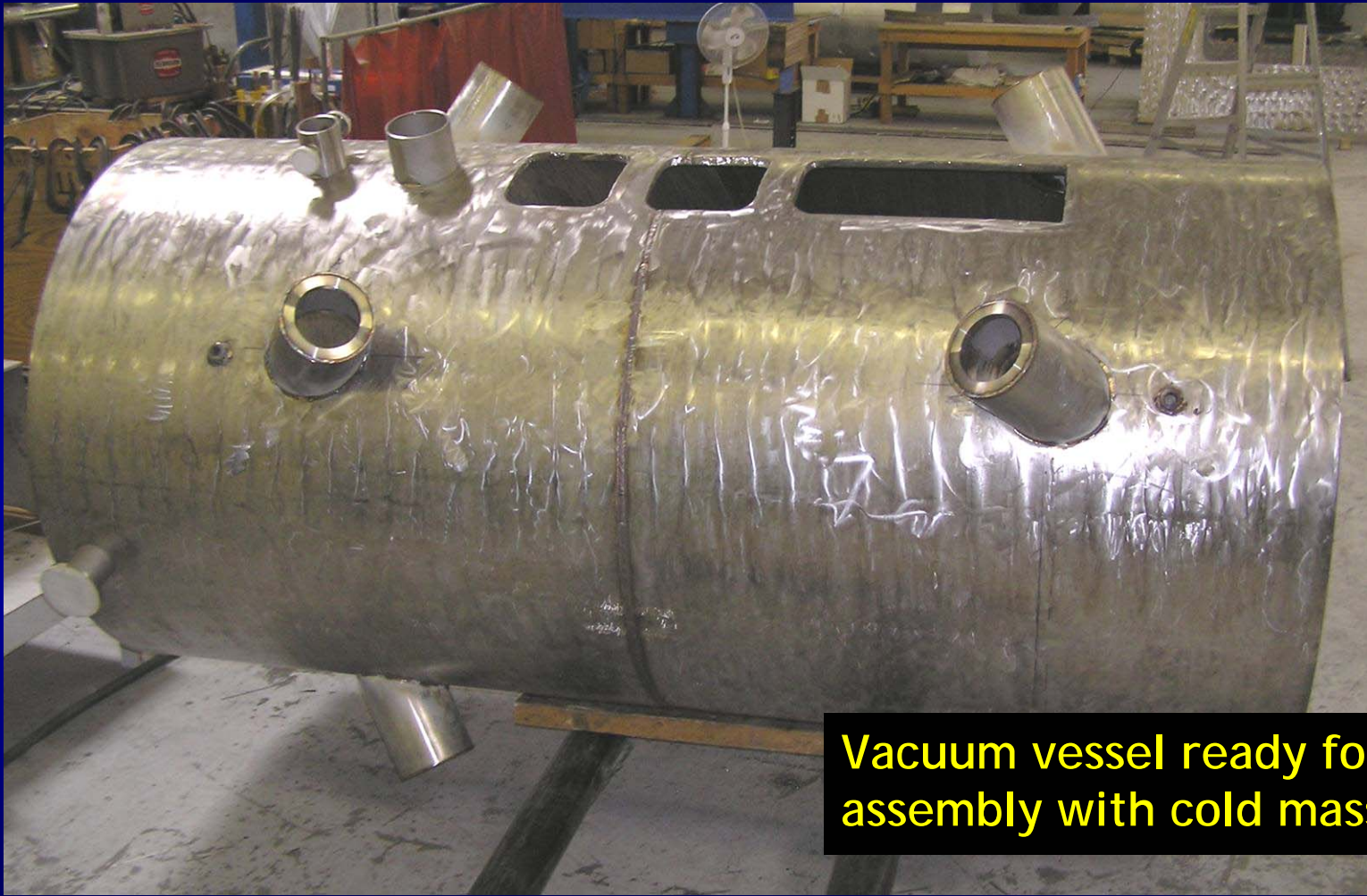
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# Vacuum Vessel and Support Stand



**Vacuum vessel ready for assembly with cold mass**



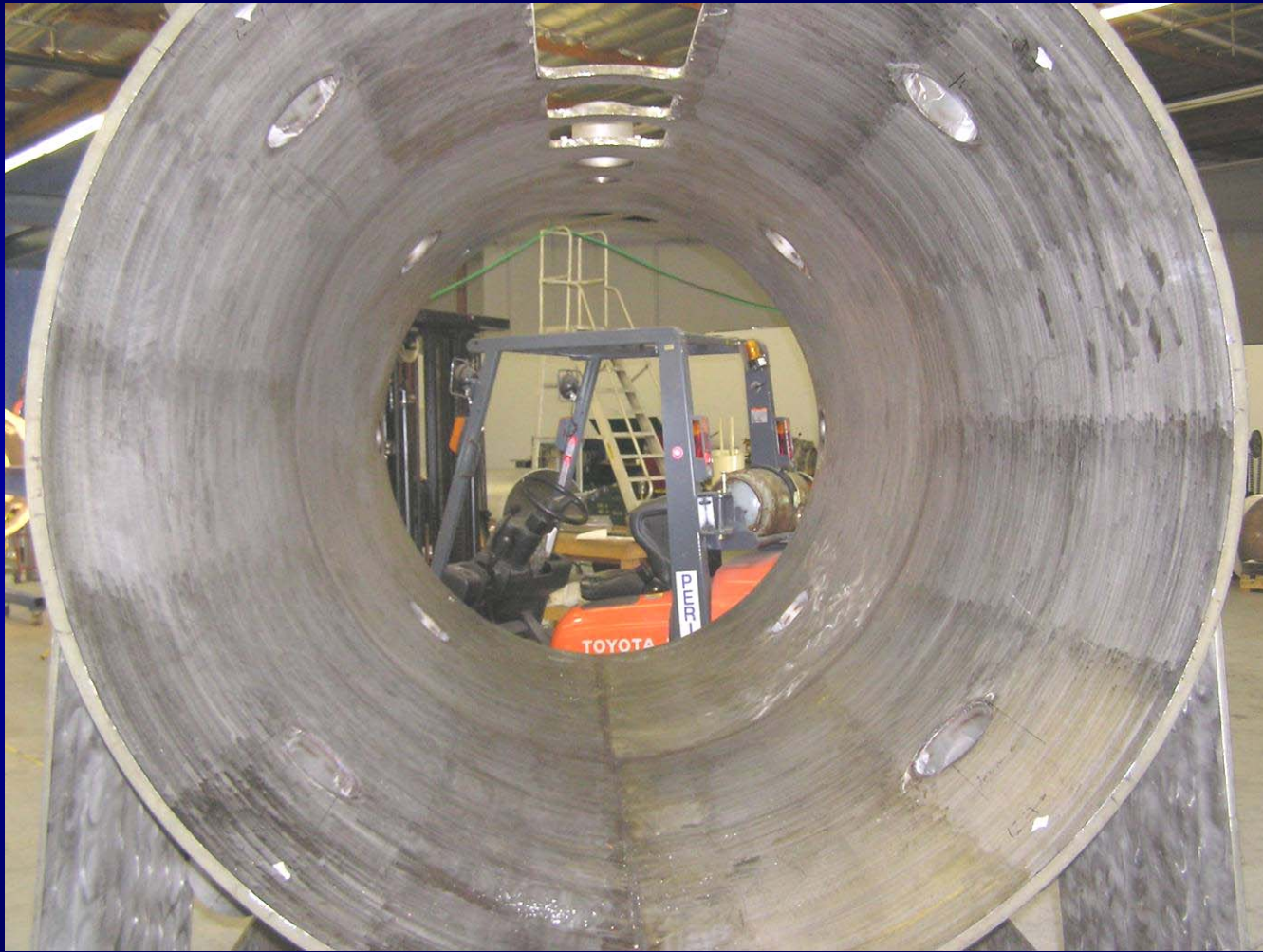
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# Inner Vacuum Vessel



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# Service Tower Assembly



Service tower accommodates three cryocoolers and fill/vent lines (one cryocooler sleeve assembly shown in place)



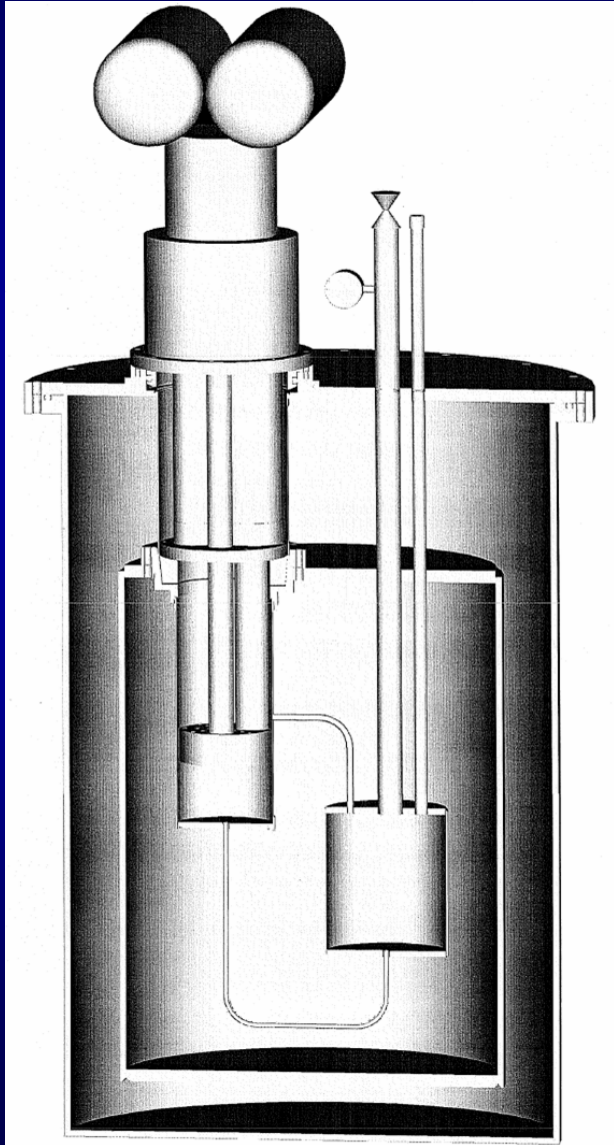
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# Cryocooler Experiment



## Purpose:

- Measure cooler performance @ 2.5-22 K
- Confirm drop-in mode, measure heat leak

## Update:

- 1<sup>st</sup> series of tests completed in November
- Results were not conclusive due to some deficiencies in the test apparatus
- System was modified including addition of a larger liquid He storage vessel
- Recent poor performance in testing due to either bad cooler, convective currents between 1<sup>st</sup> and 2<sup>nd</sup> stages or thermal acoustic oscillations in piping
- These issues were addressed, and 1.5 W cooling power at 2<sup>nd</sup> stage confirmed



# Cryocooler Experiment



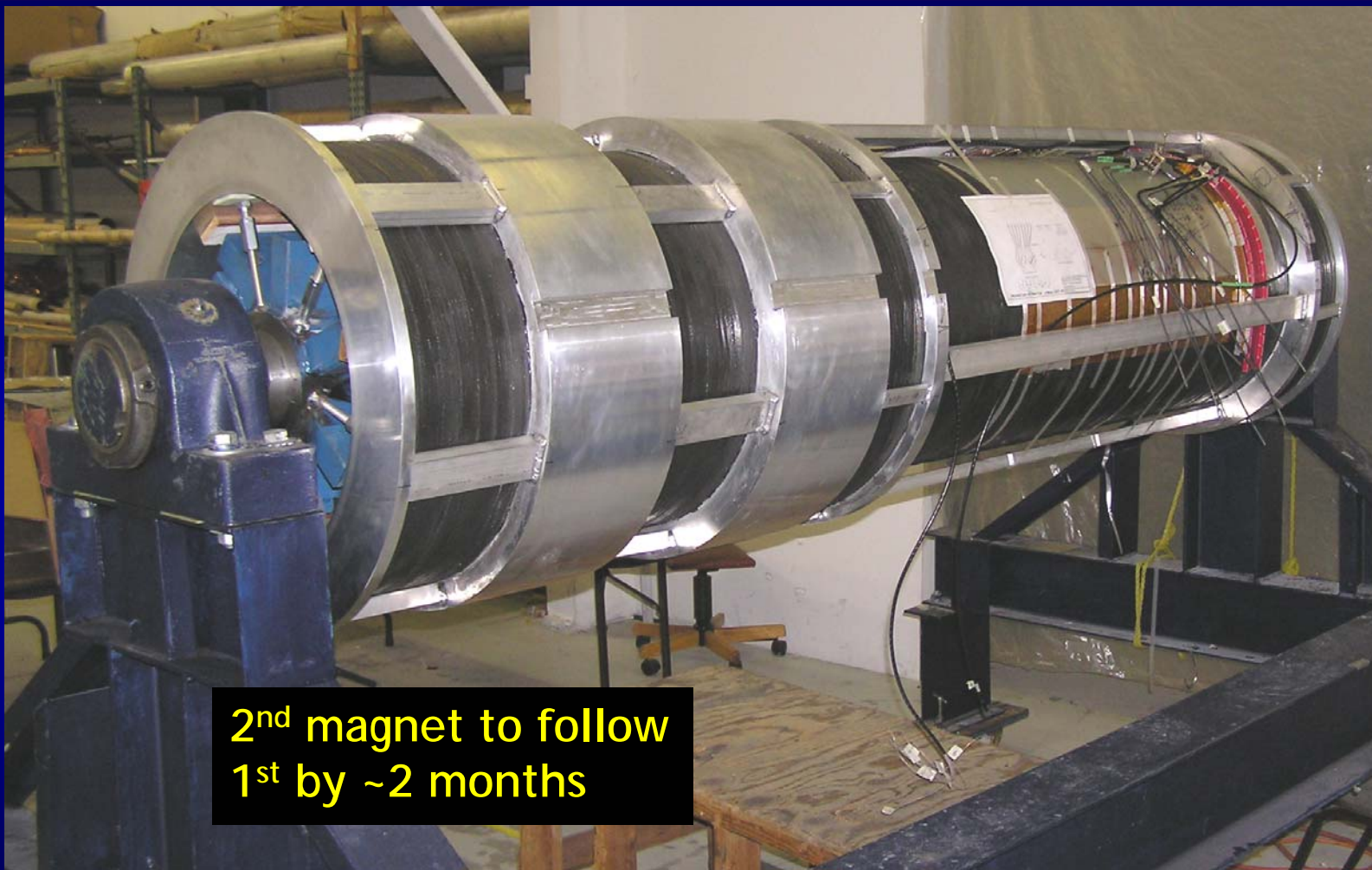
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# Magnet #2: Cold Mass Winding Assembly



2<sup>nd</sup> magnet to follow  
1<sup>st</sup> by ~2 months



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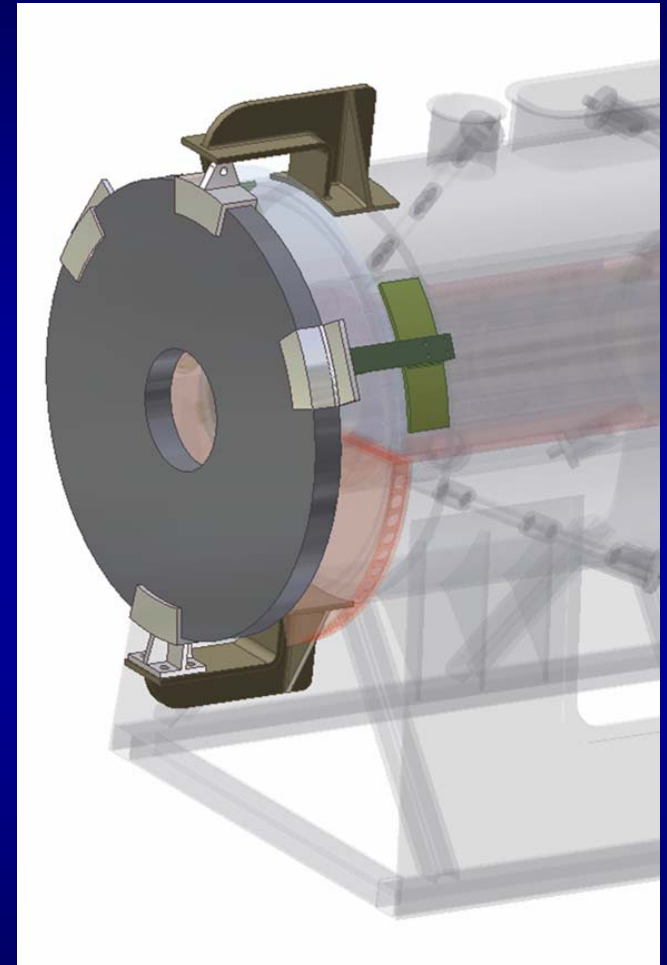
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# Spectrometer Solenoid Iron Shields

- Design integrated with TOF shield, and all fabrication drawings are near complete
- Two sets of shields needed at FNAL and two sets at RAL
- Quote obtained from JK Mfg near FNAL; need final drawings before placing order
- One of two shields at FNAL may be shipped to RAL, 2<sup>nd</sup> set fabricated in UK



# Updated Schedule Summary

Task Description	2006						2007						2008																
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Place Magnet Order with Wang NMR (LBNL)	◆	Complete																											
Complete Magnet System Design & Review			◆	Complete																									
Deliver Superconductor to Wang (LBNL)		◆	Complete																										
Procure Coil Formers, Leads, Instrumentation, etc.				Complete																									
Wind Coils on Coil Formers																													
Deliver 4 ea Cryocoolers to Wang (LBNL)																													
Buy Power Supplies & Send to Wang (LBNL, UCR)																													
Assemble and Leak Check He Shell																													
Fab System & Perform Cryocooler Tests																													
Fab and Load Test Cold Mass Supports																													
Assemble Shield, Vac Vessel, Cold Mass Suppts																													
Install Hi-Tc Leads, Recondensers & Cryocoolers																													
Leak Checks, Cooldown & Acceptance Tests																													
Prepare, Package and Ship Magnets																													
Magnet Setup at FNAL																													
Magnetic Measurements & Commissioning at FNAL																													
Ship Magnets to RAL for Installation																													



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# Summary (Spectrometer Solenoid)

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- 1<sup>st</sup> magnet expected to be complete in April
- Magnet to be tested at vendor, shipped to FNAL
- Completion delayed by cold mass support issue and cryocooler/condenser performance problem
- Coil winding, banding, reinforcement and wiring of 2<sup>nd</sup> magnet finished
- Cryocooler test modified and performance verified
- Magnet #2 to follow ~2 months after #1
- Iron shield fabrication to start soon



# Overview (RFCC module)

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- A bottoms-up, WBS based plan (including a cost estimate and schedule) has been developed for completion of two RFCC modules
- A task list of ~300 items includes: engineering, design, reviews, procurement, fabrication, assembly, testing and shipping
- Current plan calls for funding and/or effort from the following institutions: Lawrence Berkeley National Lab, ICST/HIT at Harbin, University of Mississippi, UC Riverside and Oxford Physics



# Funding and Schedule

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- The early finish schedule and no contingency cost estimate results in delivery of the completed RFCC modules near the end of FY09
- Currently projected funding may be sufficient to complete the project on the two year schedule
- Contingency and float can be provided by the use of FY10 funds and by stretching the schedule into FY10, if necessary
- RF cavity design and fab is on the critical path



# Preliminary Plan

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- The detailed design of the cavities and associated subcomponents will be based on the prototype cavity design developed at LBNL and J-Lab
- The MuCool and MICE Coupling Coils have been designed and will be fabricated & tested at ICST
- LBNL engineering will coordinate the fabrication of the cavities using a combination of in-house shops, collaborator shops (U. Miss.) and outside resources (spinning, e-beam welding, etc.)





# Preliminary Plan (cont'd)

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- Subcomponent procurements (Be windows, RF windows and couplers, vacuum system, cryocoolers, power supplies) will be specified by LBNL & purchased w/funds from various sources
- Coupling coils, cavities and other components will likely be integrated into RFCC modules at LBNL using in-house technical resources
- Module testing will take place at LBNL prior to shipping to the MICE hall at RAL





# Engineering, Design & Technical Resources

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- An additional FTE engineer (Alan DeMello) at LBNL has been assigned to work on the module along with M. Green & S. Virostek
- ICST has the engineering and technical resources needed to complete the design and fabrication of the coupling coils (with some LBNL oversight)
- Technical resources, machine shops & assembly facilities are currently available at LBNL



# Funding Plan

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- Projected available funding through LBNL (FY07-FY09), U. Miss. and UC Riverside may be sufficient to cover the estimated project costs
- ICST is funding the manpower & a portion of the raw material costs for completion of the coupling coils (bulk of material is coming from the US)
- The current cost estimates do not contain contingency - additional project \$ to be available in FY10 should provide adequate contingency

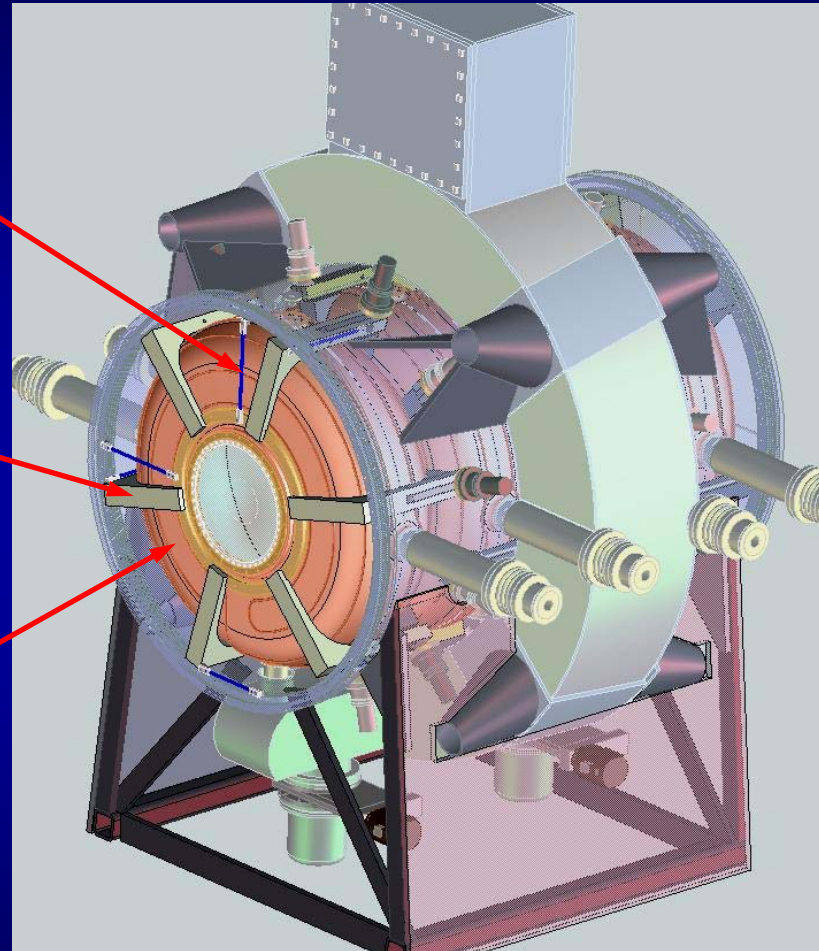


# Updated RFCC Module 3D CAD Model

Cavity suspension

Automatic tuners

201 MHz RF cavity



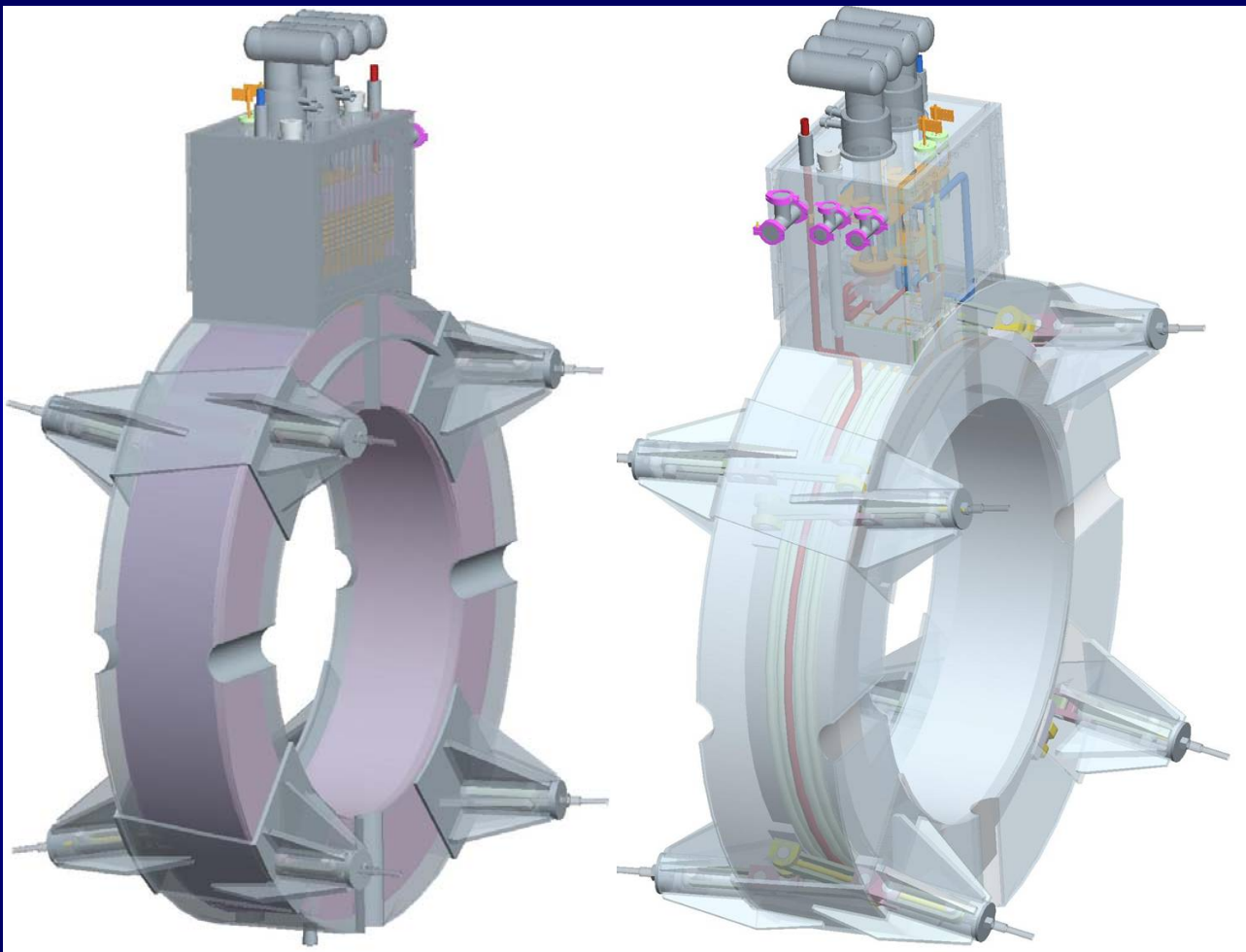
# Coupling Coil Update

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- An MOU between LBNL and ICST/HIT at Harbin for the Coupling Coil Project is in place
- The MOU includes an addendum with milestones and funding information as well as a technical agreement containing the magnet specifications
- 260 km of superconductor ordered (137 km rec'd)
- Additional procurements are under way - first shipment of materials has been received at ICST
- ICST has completed the magnet final design and is ready to wind a pair of test coils



# Coupling Coil Design



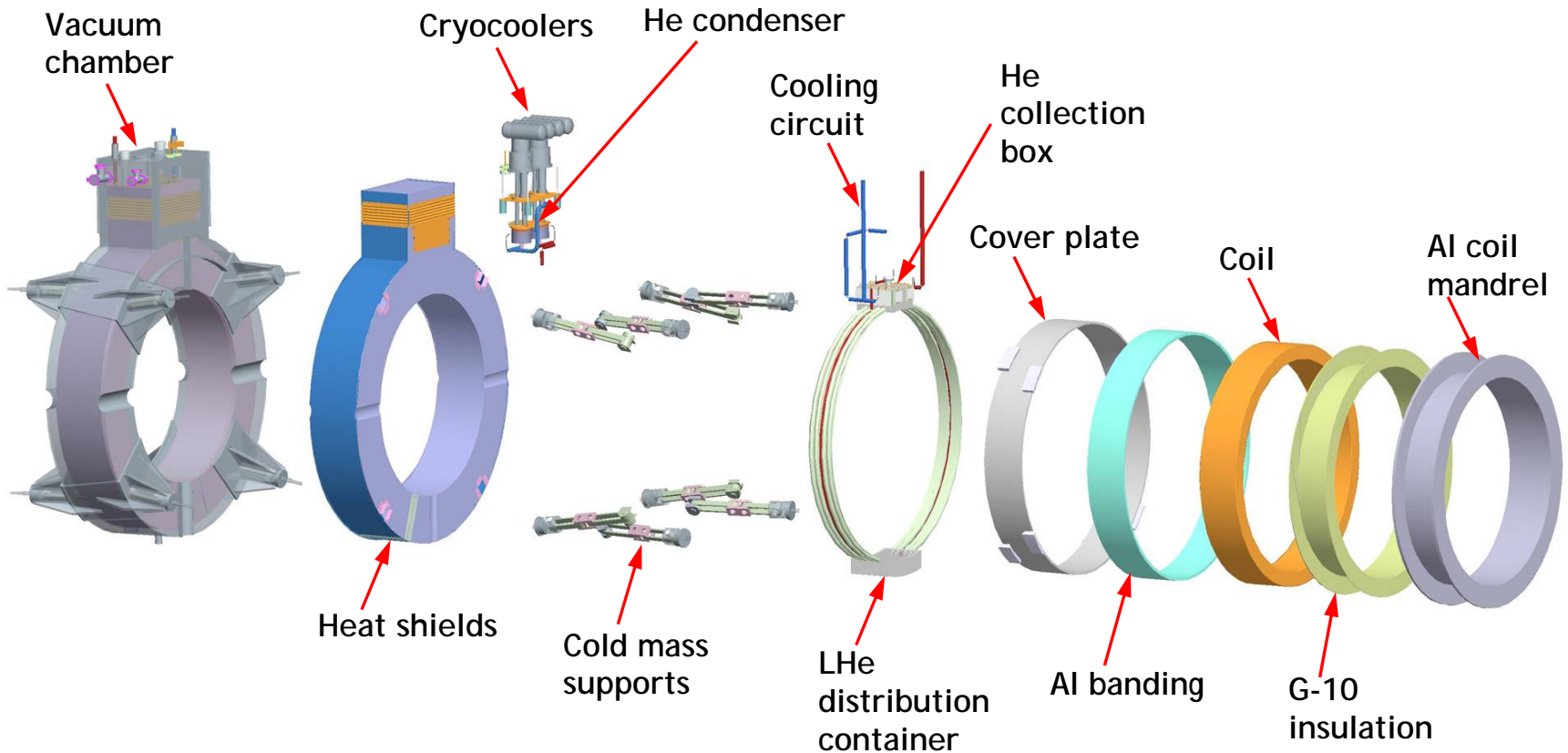
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# Coupling Coil Components



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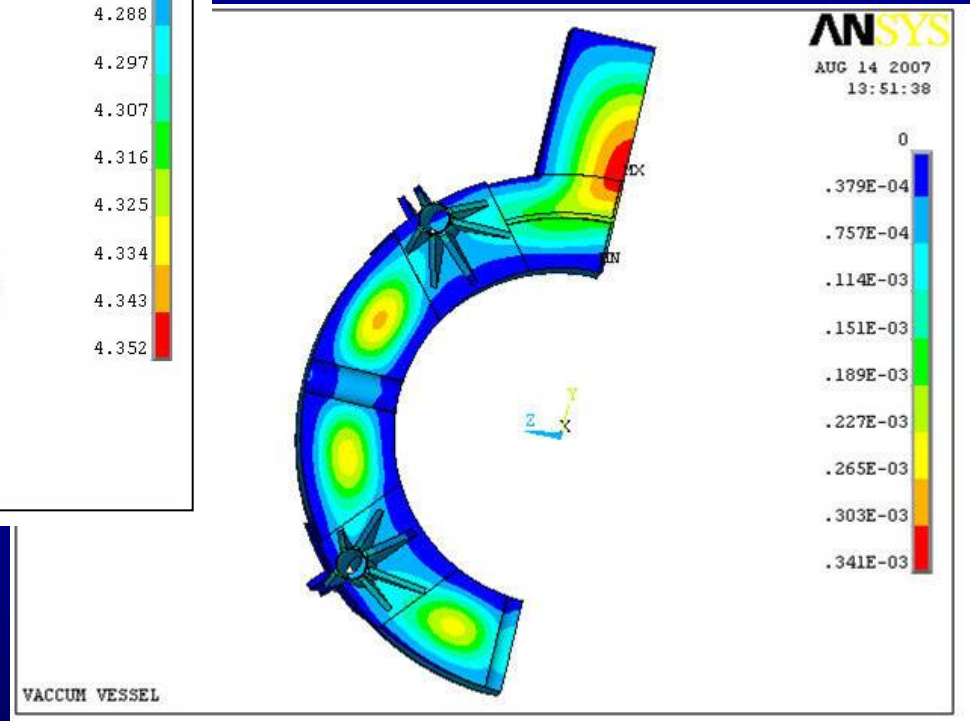
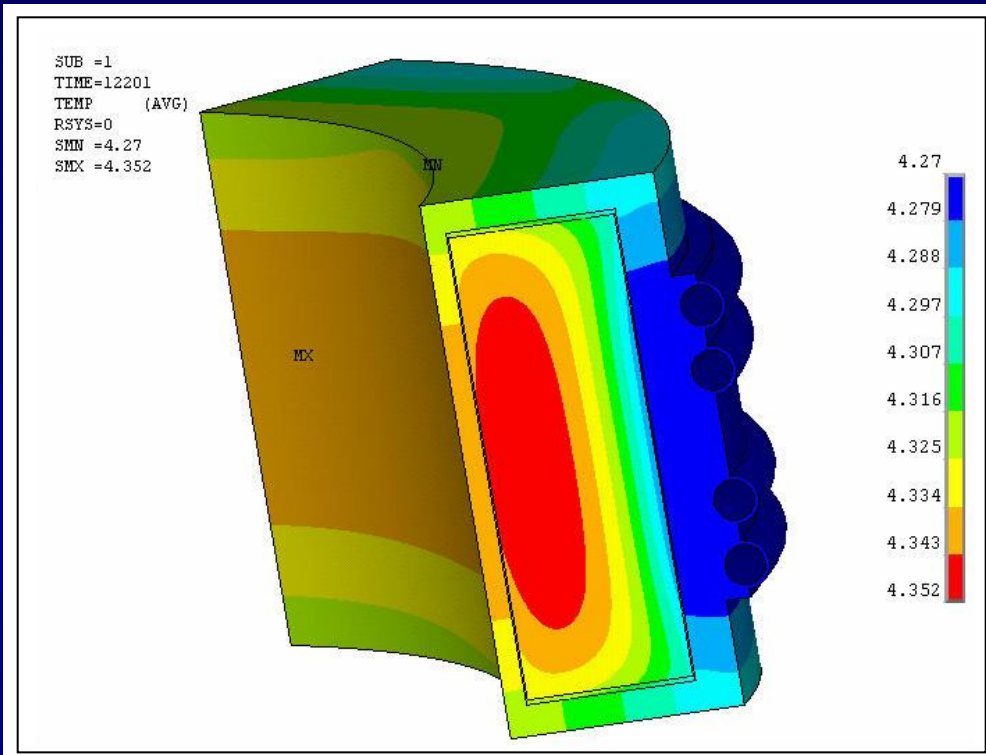
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# Coupling Coil Analyses



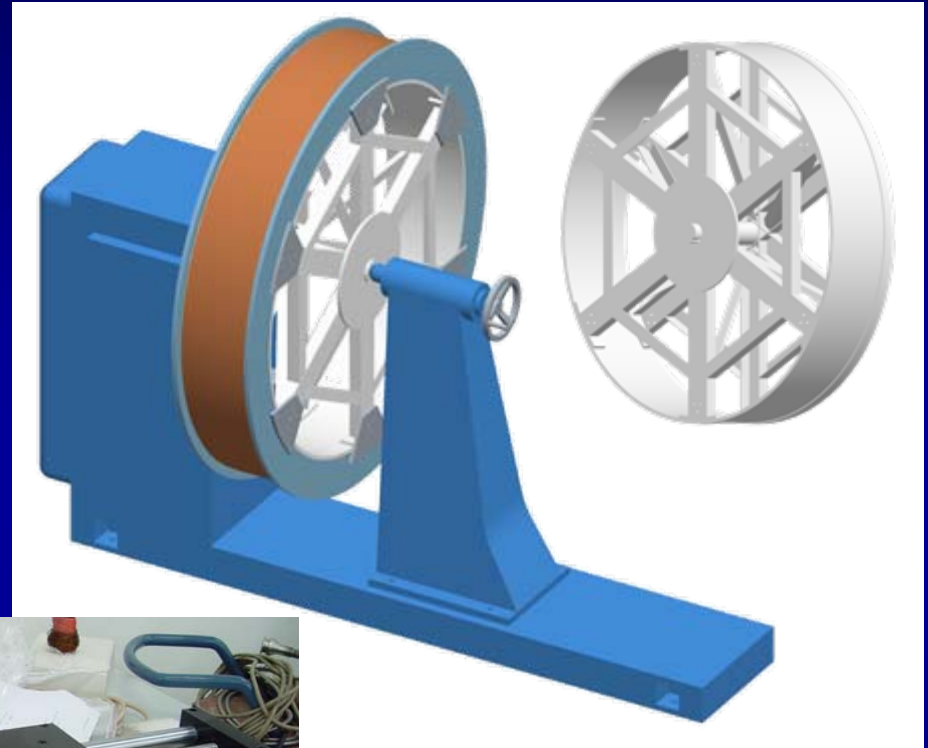
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# Coil Winding Tooling



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# Summary (RFCC module)

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- A detailed plan has been developed for the design and fabrication of two RFCC modules
- Both funding (?) and manpower required to complete the effort are available (new engineer on the project @ LBNL)
- ICST has completed the Coupling Coil design and is prepared to start winding a pair of test coils
- Material orders and shipment to ICST of Coupling Coil components are ongoing
- Design & analysis of the MICE 201 MHz cavity is under way
- A revised beryllium window design has been developed, and quotes have been obtained from the vendor

