

# Spectrometer Solenoid Update

MICE Collaboration Meeting #31  
University of Mississippi

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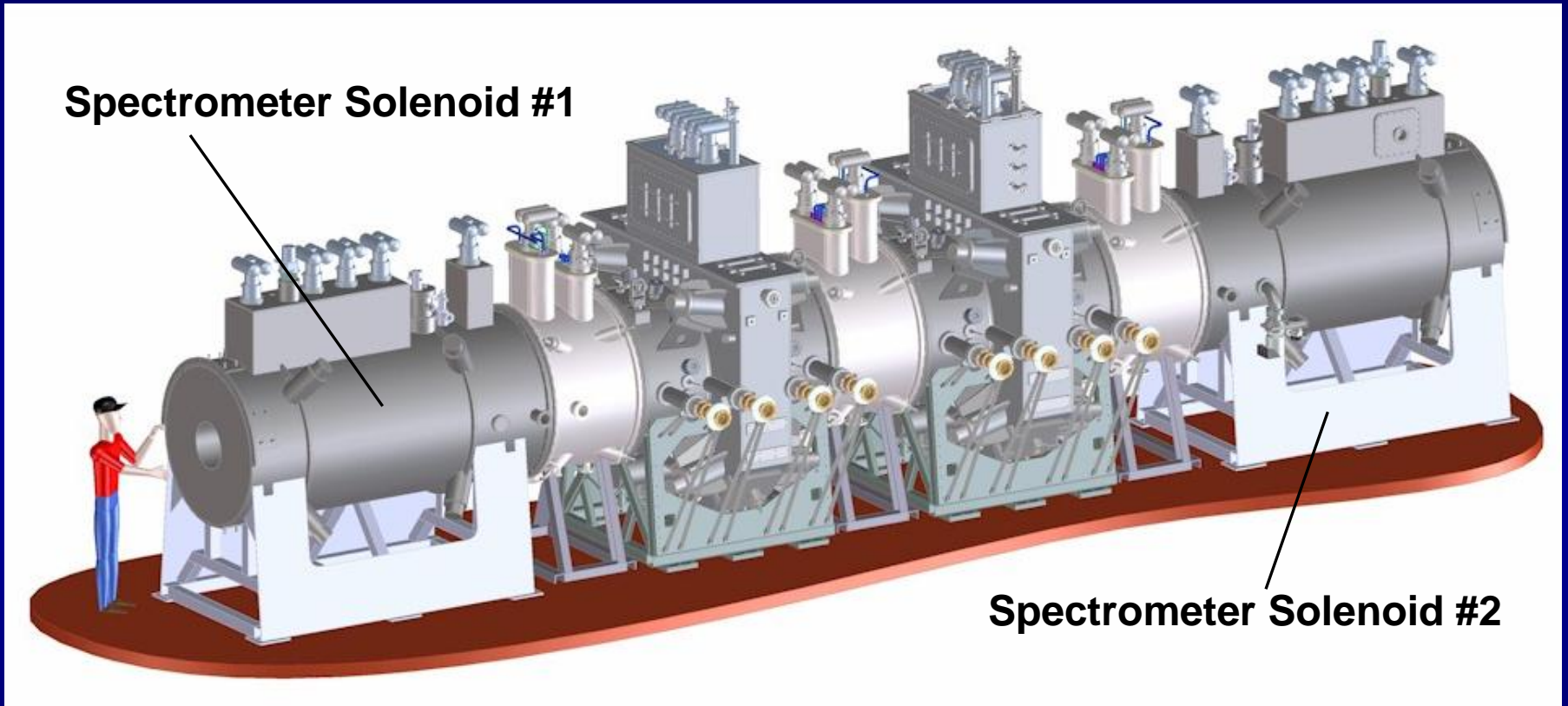
# Topics

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- Magnet design assessment
- Summary of design modification plan
- Quench system plan
- Fabrication and assembly progress
- Project schedule



# MICE Cooling Channel Layout



# Magnet Design Assessment

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- Key requirements: train coils to 275 amps, maintain LHe in cold mass w/coolers - **Not yet achieved for either magnet**
- Prompted by previous testing and review committee recommendations, LBNL has carried out a series of analyses
- A variety of design improvements are being implemented based on the results of the analyses
- The focus of the analyses included:
  - Quench protection system design
  - Heat leaks to the 4.2K cold mass
  - Thermal/mechanical performance of the radiation shield
  - Overall shield and cold mass cooling power available



# Design Modification Plan

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- Reduction of cold mass heat leaks:
  - Improve MLI application and QC
  - Improve vacuum insulation and measurement
  - Eliminate radiation shine in vent/fill lines
  - Implement provisions to damp thermo-acoustic oscillations
  - Reduce cold mass support intercept temperatures
- Addition of two 2-stage cryocoolers to the system
- Stabilize the cold leads w/extra copper to prevent burnout
- Improve the radiation shield performance:
  - Reconstruct the majority of the shield with pure aluminum
  - Improve the thermal connection from the coolers to the shield



# Quench System Plan

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- **Passive quench protection system:**
  - Extensive analyses indicate the existing passive system will work
  - Will be implementing strict controls: temperature limits on HTS leads, automatic PS shut-off based on quench voltage signals
- **Bypass resistor cooling scheme**
  - Conductively cool the quench resistors to prevent overheating
  - Demonstrated reduction in peak temperature and no electrical shorts under cycling through an off line test
  - Design and fabrication is complete
- **Active protection of HTS leads**
  - Divert current from quenched HTS leads with an active, external circuit
  - Current is forced from leads and into the quench resistors, initiating a magnet quench



# Recent Progress (administrative)

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- The completed modification plan was presented to and approved by the MAP Tech Board (9/13/11)
  - Minor recommendations by the committee have and are being addressed
- A contract modification was added to the Wang NMR purchase order for the completion of detailed design work for the system modifications (now complete)
- A 2<sup>nd</sup> contract modification was added to the PO for completing all of the physical magnet modifications (work is now under way)



# Fabrication/Assembly Progress (cold mass)

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- The Magnet 2 cold mass was previously opened in the quench system area to allow modification
- The conductively cooled quench resistor assembly has been fabricated and installed in the magnet
- Electrical checks of the coils, quench diodes and resistors, and voltage taps have been performed
- New penetrations for the five 2-stage cryocoolers are complete
- Vent line modifications and parts fabrication is under way
- New lead feedthroughs to the cold mass using a welded flange (instead of a Conflat) have been assembled and soon installed

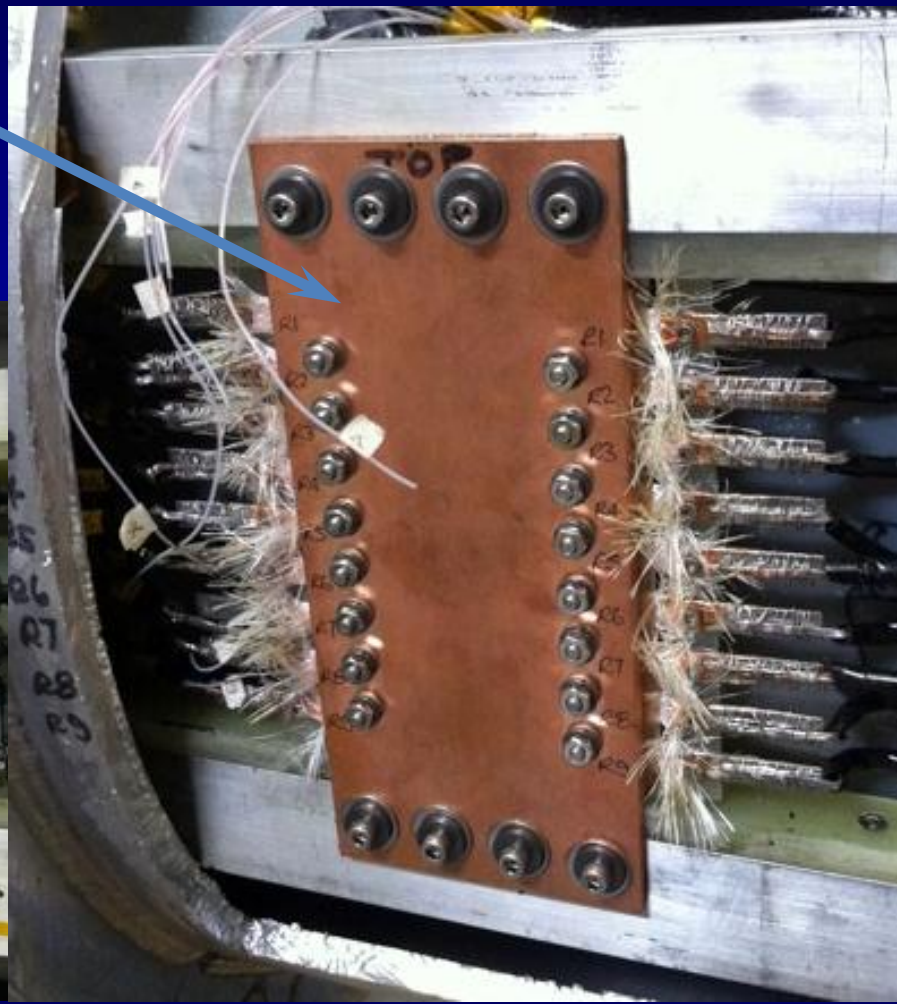




# Quench Protection

Conductively cooled resistors

Quench protection circuitry



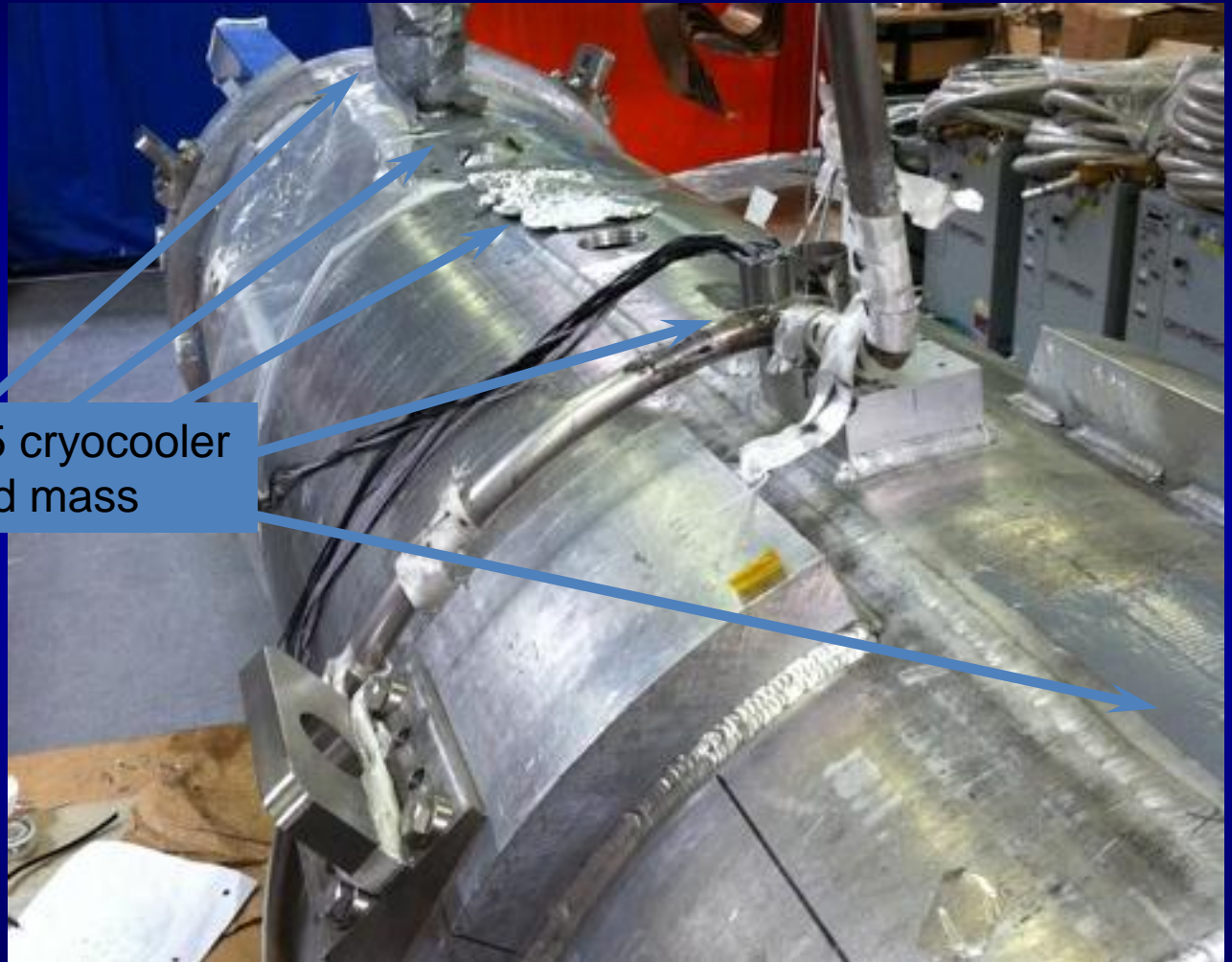
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# Cold Mass Modifications



New holes added for 5 cryocooler connections to the cold mass

# Fabrication/Assembly Progress (cold mass)

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- Heaters have been initially placed on the cold mass and fill line - final installation soon
- Cernox temperature sensors calibrated by FNAL are now at the vendor and being installed
- Custom cut MLI blankets for the cold mass have been procured, installation of MLI support brackets will be complete next week
- All cryocooler connection tubes and flanges are nearly complete and ready for welding/brazing/installation
- A new cover for the helium vessel in the quench system area is complete, and welding will take place this week
- Magnet 2 cold mass to be ready for leak check in ~1 week



# Cold Mass Heaters

Cold mass and fill line heaters



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# MLI Support Brackets

Brackets to provide support for cold mass MLI blankets



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# Fabrication/Assembly Progress (other)

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- The outer portions and ends of the radiation shields have been remade with 1100 aluminum
- Modifications to the magnet vacuum vessels for added cryocoolers and new vacuum ports have been completed
- Custom cut MLI blankets for the radiation shields have arrived
- Machining of the tower steel and copper 1st stage plates will be done at LBNL
- All cryocoolers have been instrumented and tested for room temperature operation



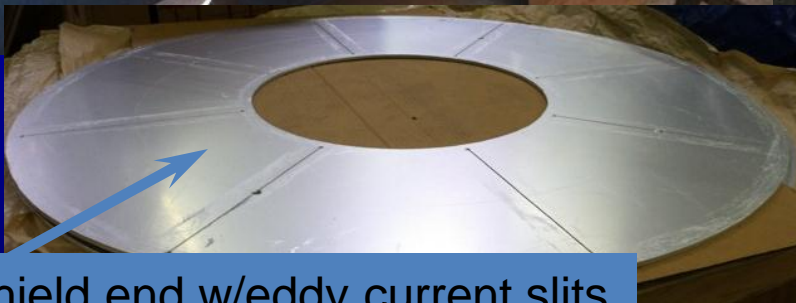
# Shield and Cryostat

Remade outer shield (1100 aluminum)



Cryostat modified for 5+1 cooler configuration

Remade shield end w/eddy current slits



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# Cryocooler Instrumentation

Calibrated Cernox sensor



Heat intercepted  
Sensor wires





# Magnet Completion Schedule

## Spectrometer Solenoid FY12 Schedule

