



# MICE Construction Status

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**Muon Collider Workshop—BNL  
December 7, 2007**

- Introduction
- System description
- Construction status
  - MICE hall
  - Muon beam line
  - Production target
  - Detectors
  - Spectrometer solenoids
  - RFCC module
  - FC module
  - LH<sub>2</sub> system
- Schedule
- Next steps
- Future possibilities
- Summary

## • Motivation for MICE

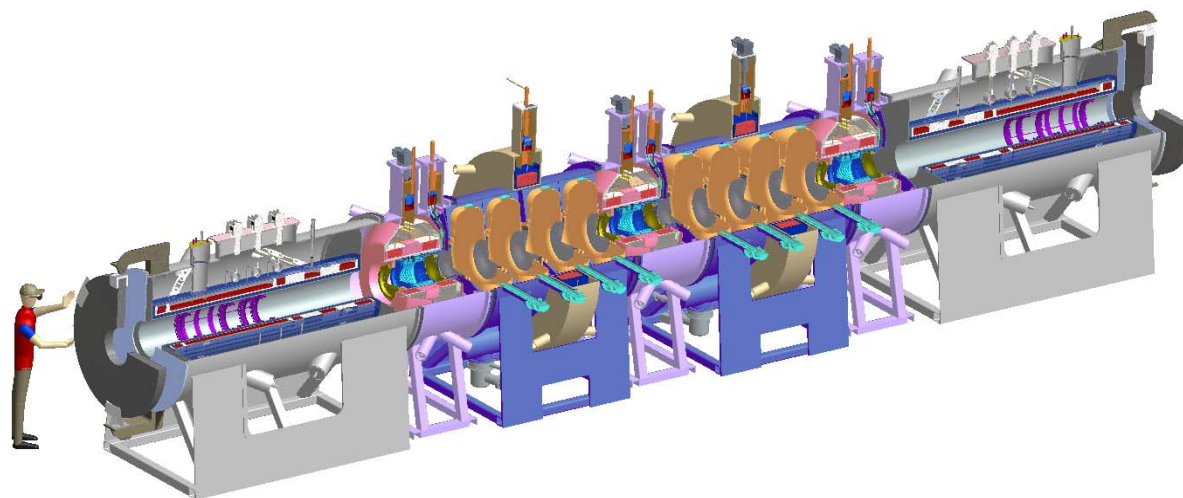
- muon-based Neutrino Factory is most effective tool to probe neutrino sector and, hopefully, observe CP violation in leptons
  - results will test theories of neutrino masses and oscillation parameters, of importance for both particle physics and cosmology
- a high-performance Neutrino Factory ( $\approx 10^{21}$   $\nu_e$  aimed at far detector per  $10^7$  s year) depends on ionization cooling
  - straightforward physics but not experimentally demonstrated
- facility will be expensive ( $O(1B\$)$ ), so prudence dictates a demonstration of the key principle
- a Muon Collider depends even more heavily on ionization cooling

## • Cooling demonstration aims to:

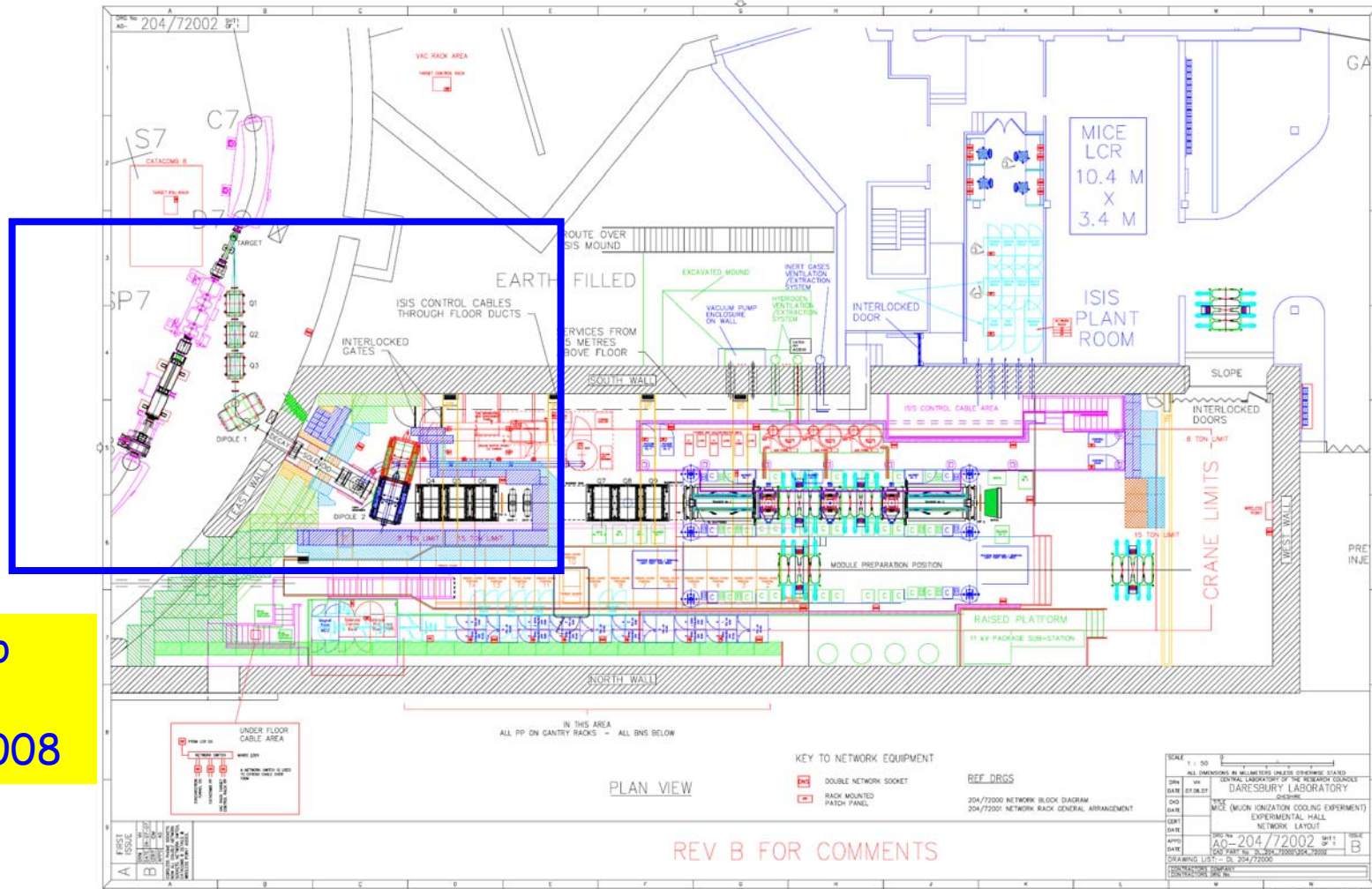
- design, engineer, and build a section of cooling channel capable of giving the desired performance for a Neutrino Factory
- place this apparatus in a muon beam and measure its performance in a variety of modes of operation and beam conditions

- Another key aim:
  - show that design tools (simulation codes) agree with experiment
    - gives confidence that we can optimize design of an actual facility
      - we are testing a section of “a” cooling channel, not “the” cooling channel
        - simulations are the means to connect these two concepts
- Both simulations and apparatus to be tested should be **as realistic as possible**
  - must incorporate full engineering details of all components into the simulation
- This talk will cover main component design and fabrication status

- **MICE** includes one cell of the FS2 cooling channel
  - three Focus Coil modules with absorbers ( $\text{LH}_2$  or solid)
  - two RF-Coupling Coil modules (4 cavities per module)
- Along with two Spectrometer Solenoids with scintillating fiber tracking detectors
  - plus other detectors for confirming particle ID and timing (determining phase wrt RF and measuring longitudinal emittance)
    - TOF, Cherenkov, Calorimeter



- Hall must contain a *lot* of equipment



Critical area to complete by January 20, 2008

- Hall has been (more or less) cleared to permit **MICE** equipment installation
  - D2 magnet has been installed in “out” position
    - permitted shielding wall to be built up around the area
  - quadrupoles being refurbished; to be installed in December/January



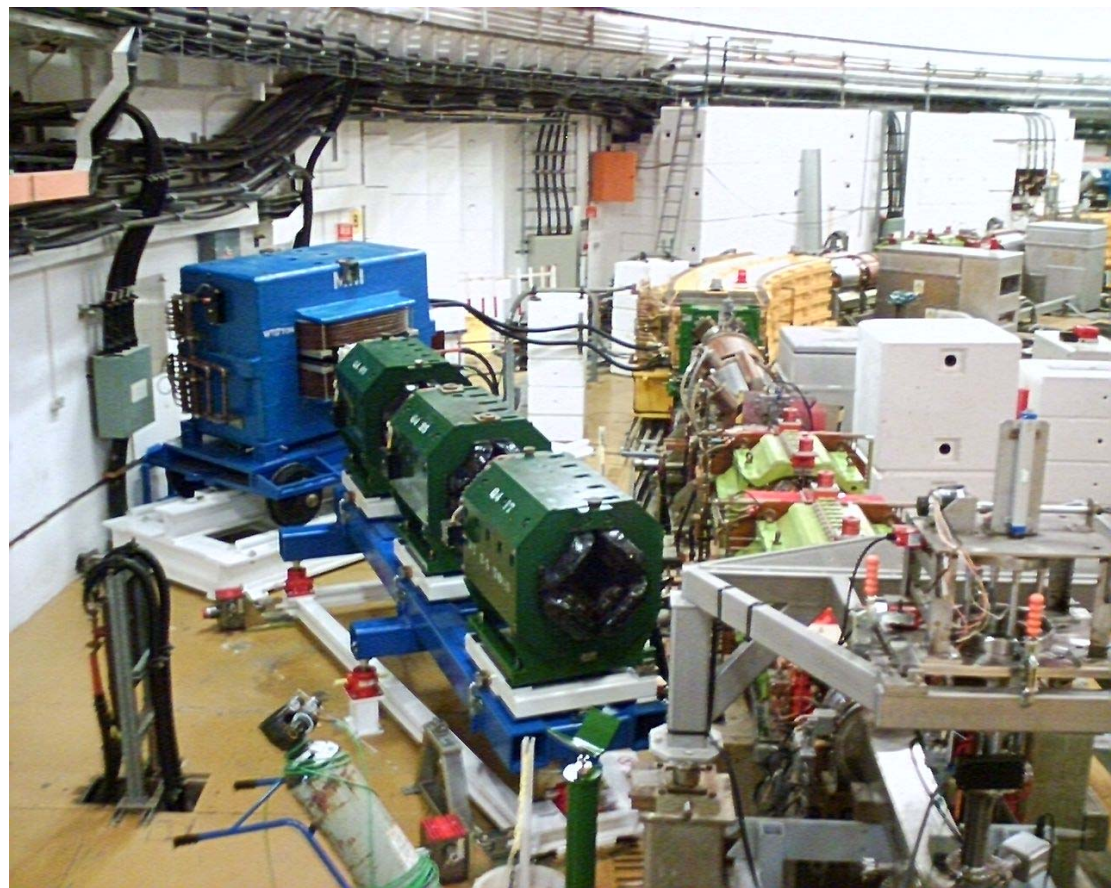
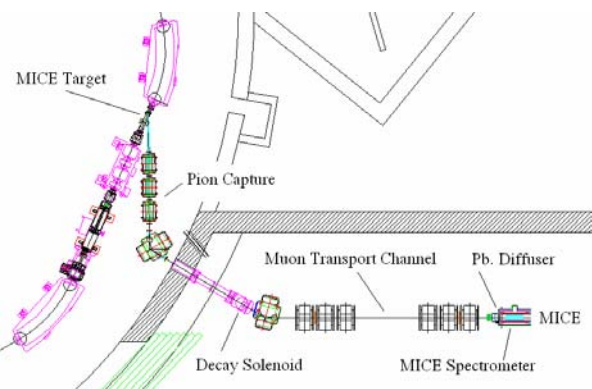
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- Upstream magnets installed in ISIS vault
  - vacuum chambers not installed and alignment not yet done
    - errors discovered in alignment and target box will be fixed in time for December installation





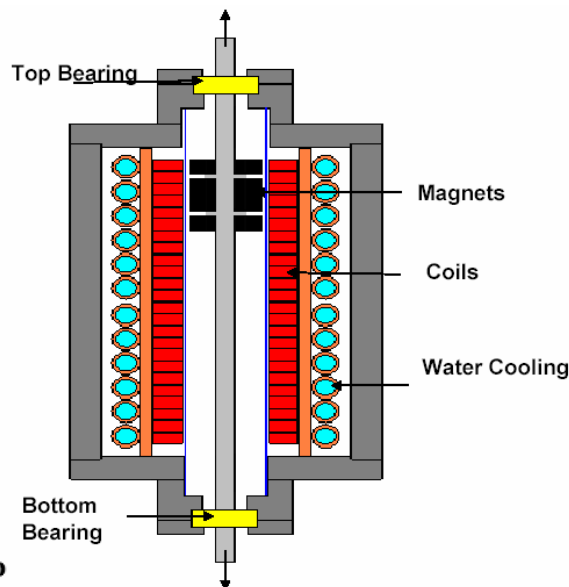
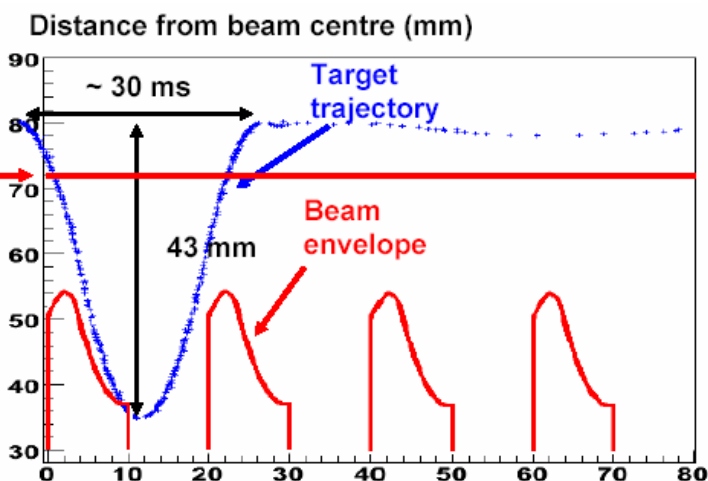
# Muon Beam Line (2)

- Decay solenoid was not installed during August shutdown
  - leak discovered; now repaired and ready for testing
  - refrigerator installed and being commissioned
    - loss of cooling power (75 → 65 W) found; believed due to compressor
  - cooldown tests of decay solenoid will begin this week



# Production Target (1)

- New Ti target mechanism has been tested for reliability
  - 3.7M activations in 12 weeks
  - demonstrated required acceleration (80g) to dip target into ISIS beam in last ms of ISIS cycle
- Uses linear motor with Ti fin at 1 Hz rate



- Issue with bearing wear was identified
  - original ceramic bearings wore out quickly and generated substantial dust
  - self-lubricating leaded bronze bearings much better
    - much reduced dust generation
      - but, activation of leaded bronze dust is unacceptable to ISIS
  - diamond-like C coated bearings and shaft now approved for operation
    - will use identical system outside ISIS to look for bearing wear
- Recent glitches:
  - coil short and shaft damage from PS wiring error



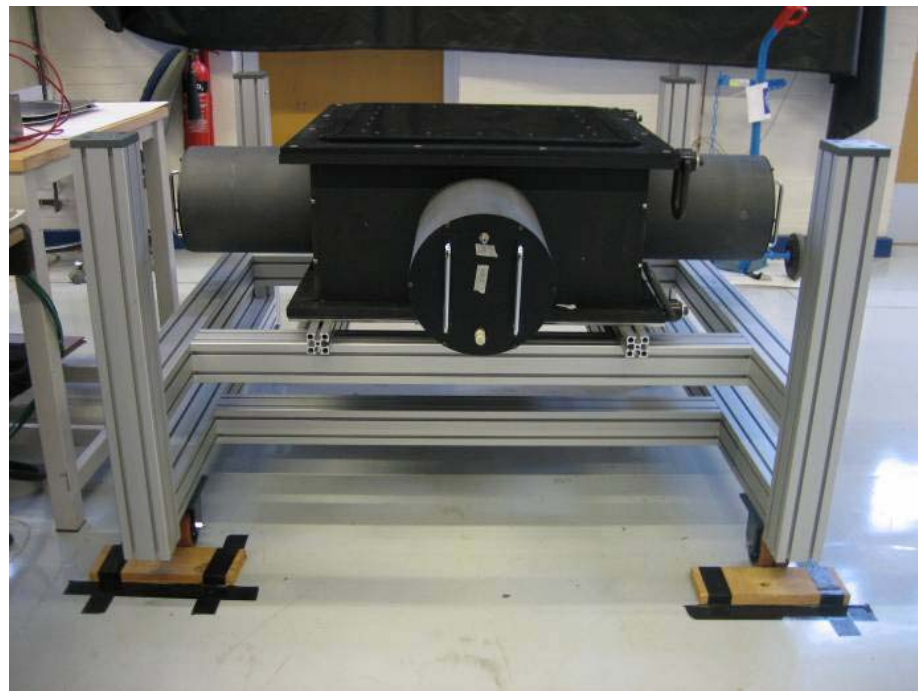
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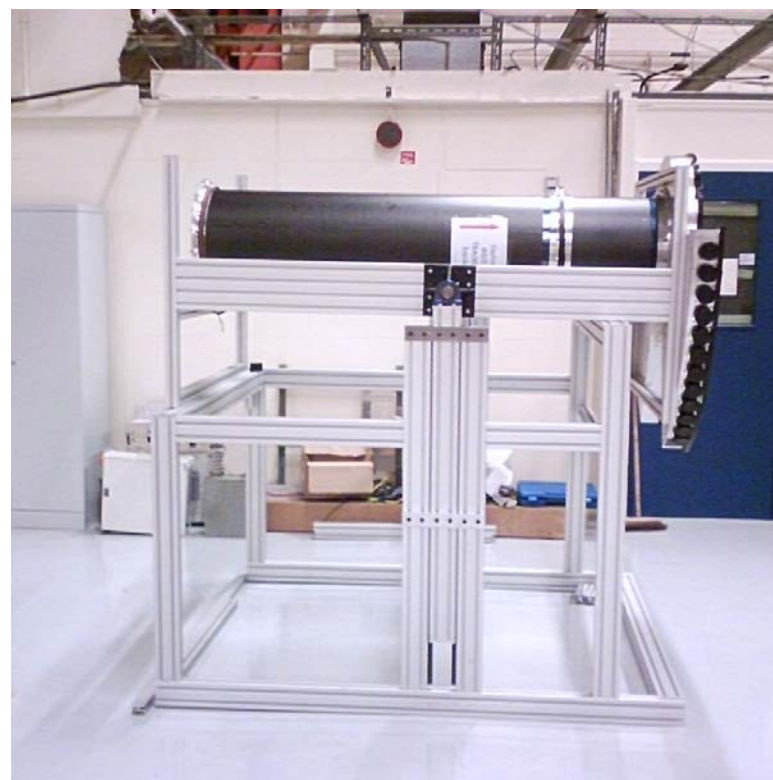
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- Considerable progress on detector systems
  - most Cherenkov components at RAL
  - tracker prototype tested; final version completed
    - VLPC cryostats 1 & 2 had problems (leak; temperature too high) requiring repairs at FNAL

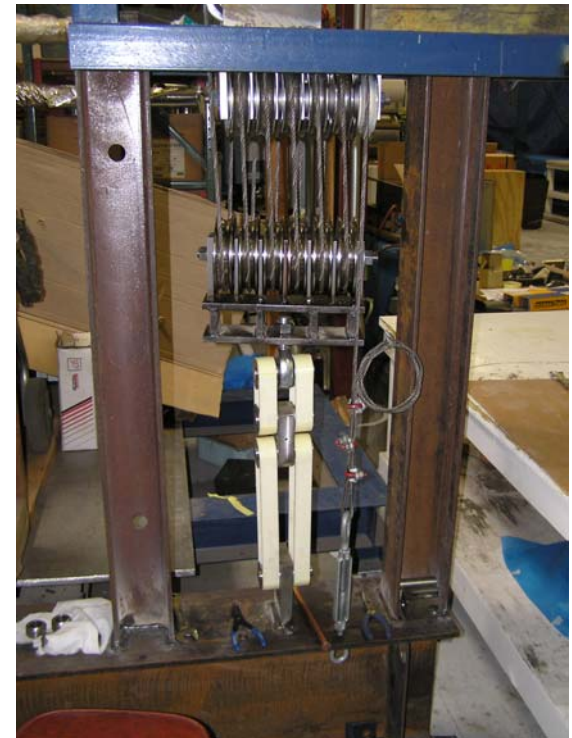
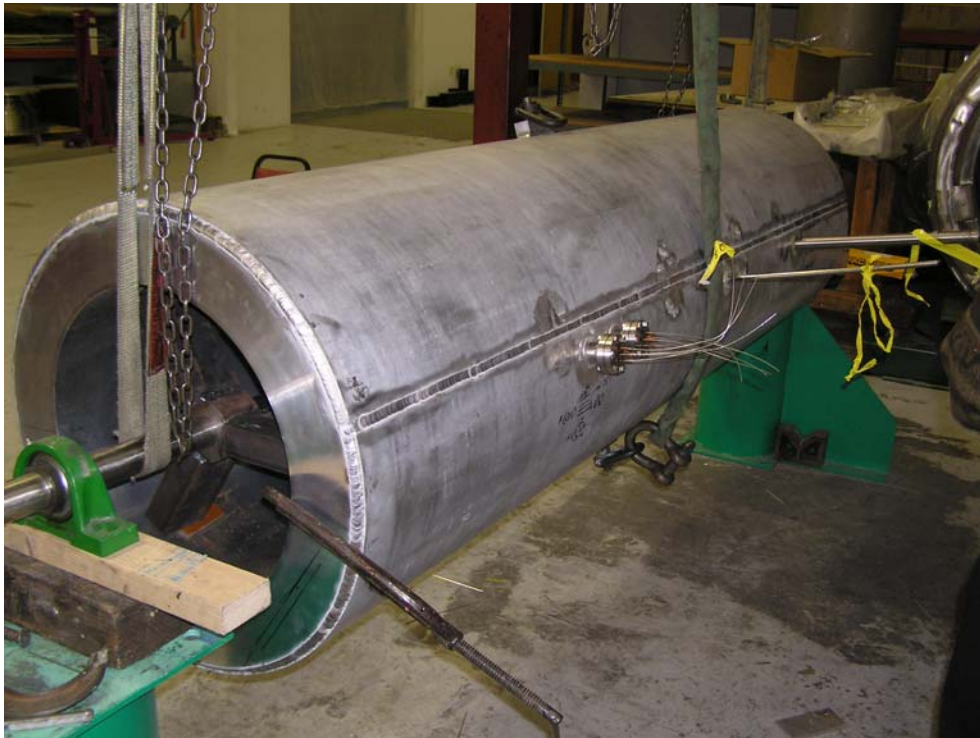


Cherenkov in cosmic ray test

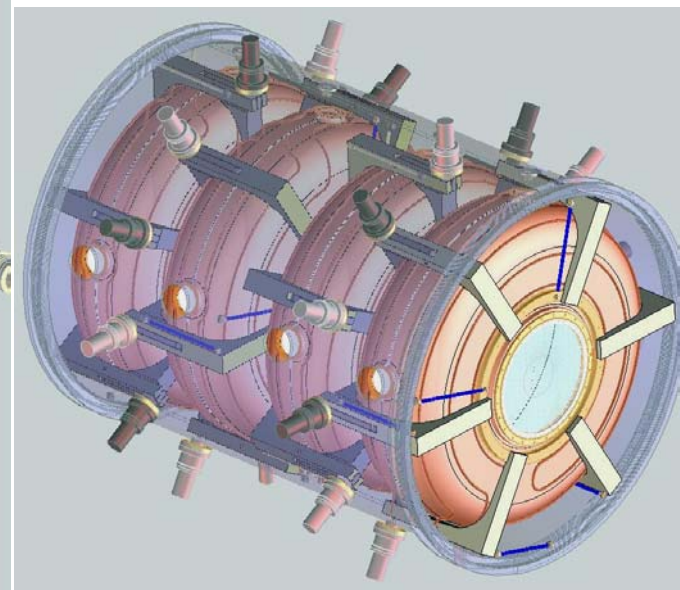
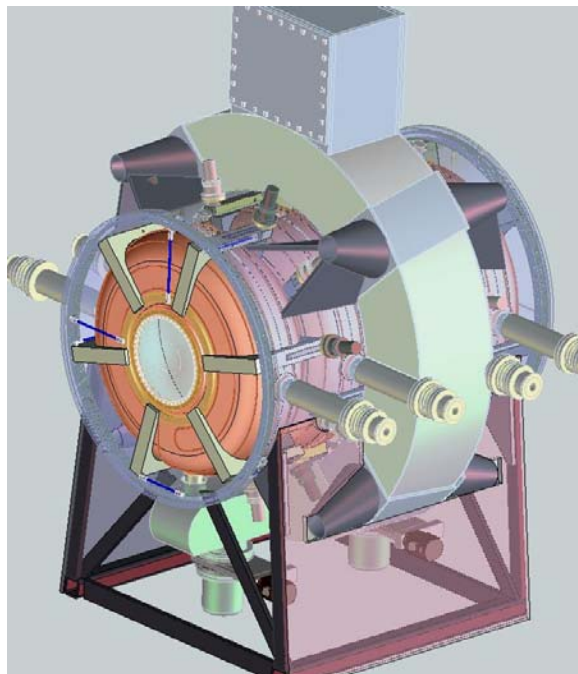
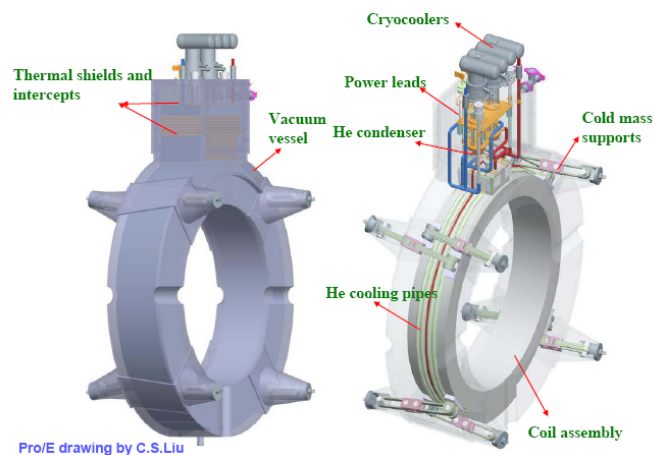


Tracker 1

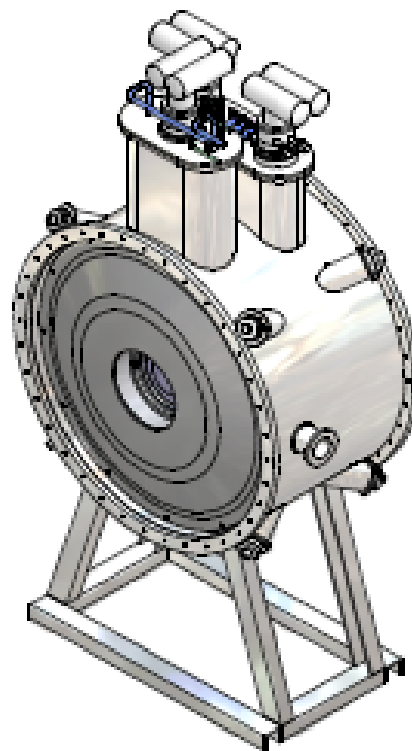
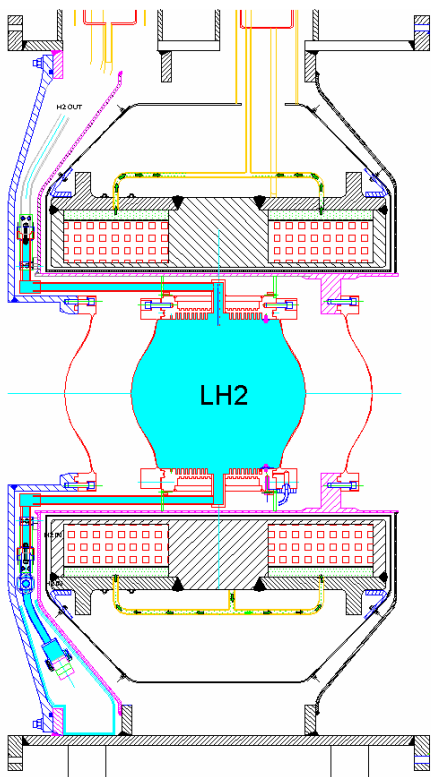
- First magnet cold mass complete
  - cold-mass supports complete and tested
    - ready to install in vacuum vessel
- Second magnet now wound and banded
  - remaining fabrication steps to be completed early in 2008



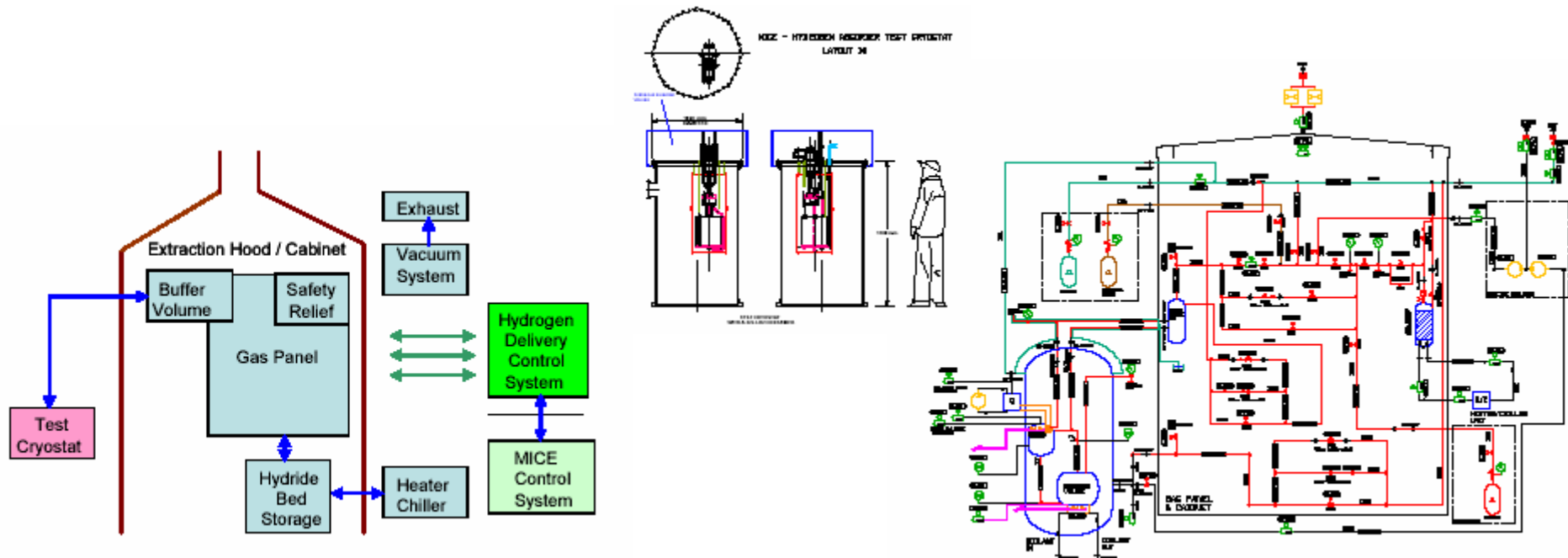
- **Module comprises one coupling coil and 4 RF cavities**
  - in advanced design stage
  - CC design and fabrication done in collaboration with ICST in Harbin, China
    - conductor ordered; first shipment this month
  - RF cavities will be similar to existing MuCool prototype
    - fabrication to get under way shortly



- Focus coil module presently out for tender
  - contract award presently delayed by STFC budget woes
  - two coils that can run with same or opposite polarity
    - 20-L LH<sub>2</sub> absorber (plus safety windows) fits inside

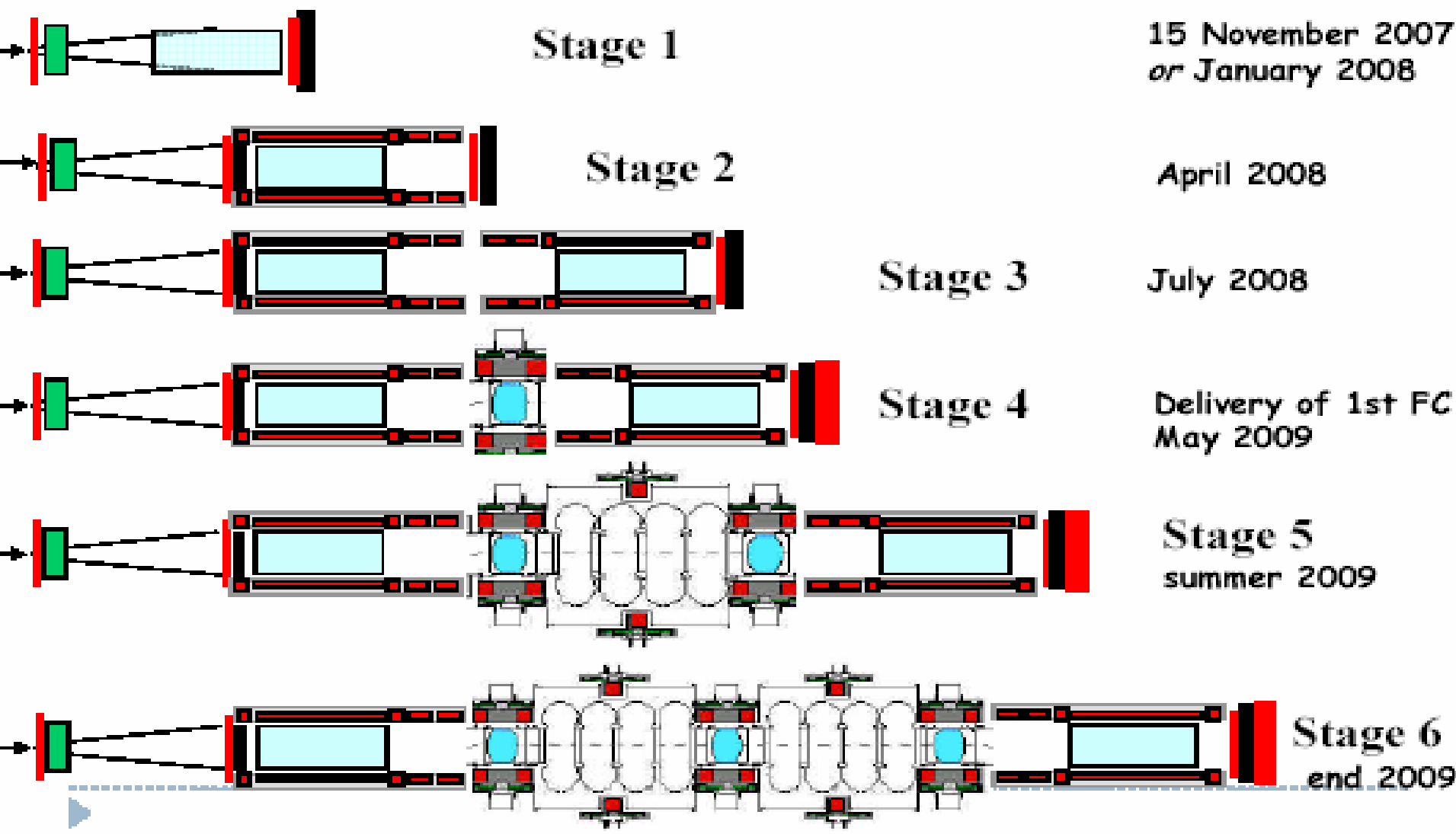


- LH<sub>2</sub> system design is based on using metal hydride bed as storage tank
  - evolution/absorption of H<sub>2</sub> controlled by hot water system
- Design has passed two international safety reviews and is presently being fabricated in industry





# Schedule



- Primary goal: be **ready for beam on January 20**
  - secondary goal: detector tests with cosmic rays in November-December
- Complete refurbishment and installation of decay solenoid
  - commission refrigerator and test solenoid
- Complete beam line quadrupole refurbishment and installation
  - refurbishment nearly complete
    - need alignment, power, cooling
- Fabricate and install magnetic shielding (for ISIS control room)
- Complete initial detector installation in MICE Hall
  - TOF0, Cherenkov, TOF1, tracker
    - need stands, cabling, alignment, reconnection to DAQ
- Complete **MICE** Local Control Room (well along)

- Natural follow-on to MICE would be a 6D cooling experiment
  - well-characterized muon beam line will be up and running
  - detectors would be available for reuse
    - back of envelope estimate is that we can measure emittance of  $25 \pi$  mm-mrad to about 10%
- No detailed planning yet on 6D experiment
  - MANX would be an obvious candidate if logistics are workable
    - initial look by Roberts indicated this is okay
  - alternative might be a test of a Guggenheim section
- MICE management would like to start a dialog on this topic
  - addition of Muons, Inc. as a MICE collaborator should help the process!

- **MICE** has made excellent progress towards Steps I & II in the past year
  - beam line magnet refurbishing and installation nearly completed
  - detectors being completed and readied for installation
  - production target operated at nominal parameters
  - spectrometer solenoids in production
    - first one available for measurement in December or January
  - design of coupling coils complete (ICST Harbin)
    - MOU in place between LBNL and HIT for fabrication
  - RF cavity design being finalized
  - focus coil module vendor selected
    - contract presently in limbo, unfortunately
- **We are looking forward to first beam soon!**