MICE RFCC Module Update

MICE CM29 at RAL, UK

February 17, 2011

Allan DeMello

Lawrence Berkeley National Laboratory

MICE RFCC Module Update Overview

- RF Cavities
- RF Cavity Frequency Tuners
- Toshiba RF Coupler Windows
- RF Cavity Beryllium Windows
- Single Cavity Vacuum Vessel
- Changes to RFCC Module Support Frame
- Change in RFCC Module Length

All 10 RF Cavities are at LBNL

- Fabrication set-up cavity
- Cavity on inspection stand
- Six cavities in their shipping crates
- 3 cavities are stored in another location

RF Cavity Electro-polish

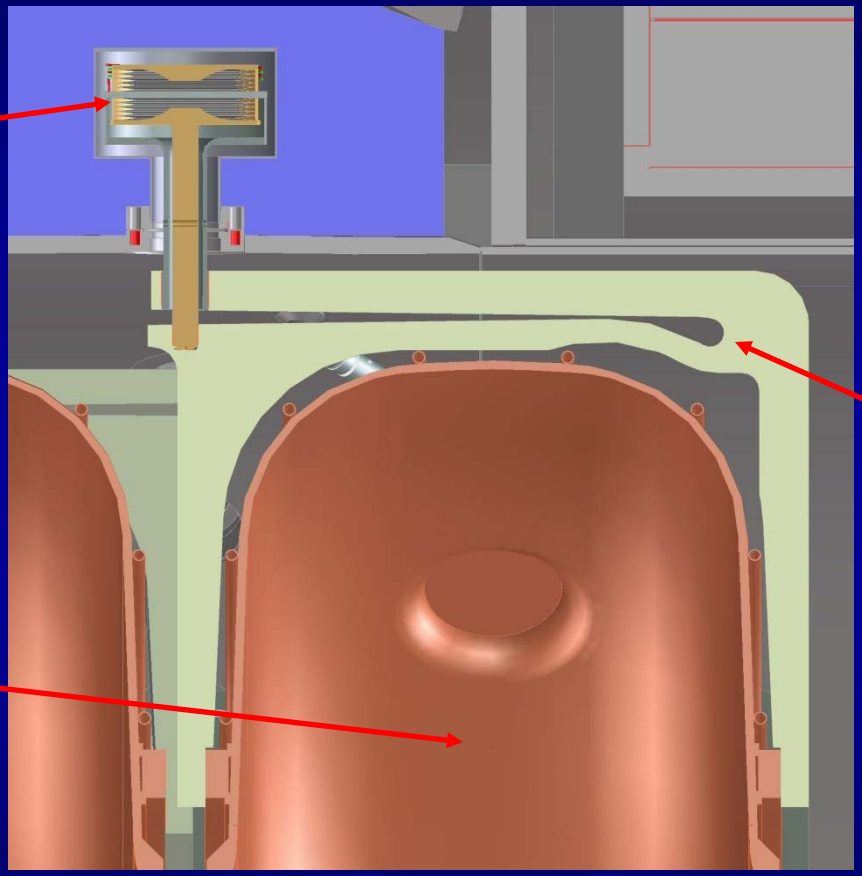
- The inside surface of each cavity needs to be electro-polished
- Electro-polish will be done at LBNL in a similar process to the Jlab electro- polish of the prototype cavity

RF Cavity Future Work

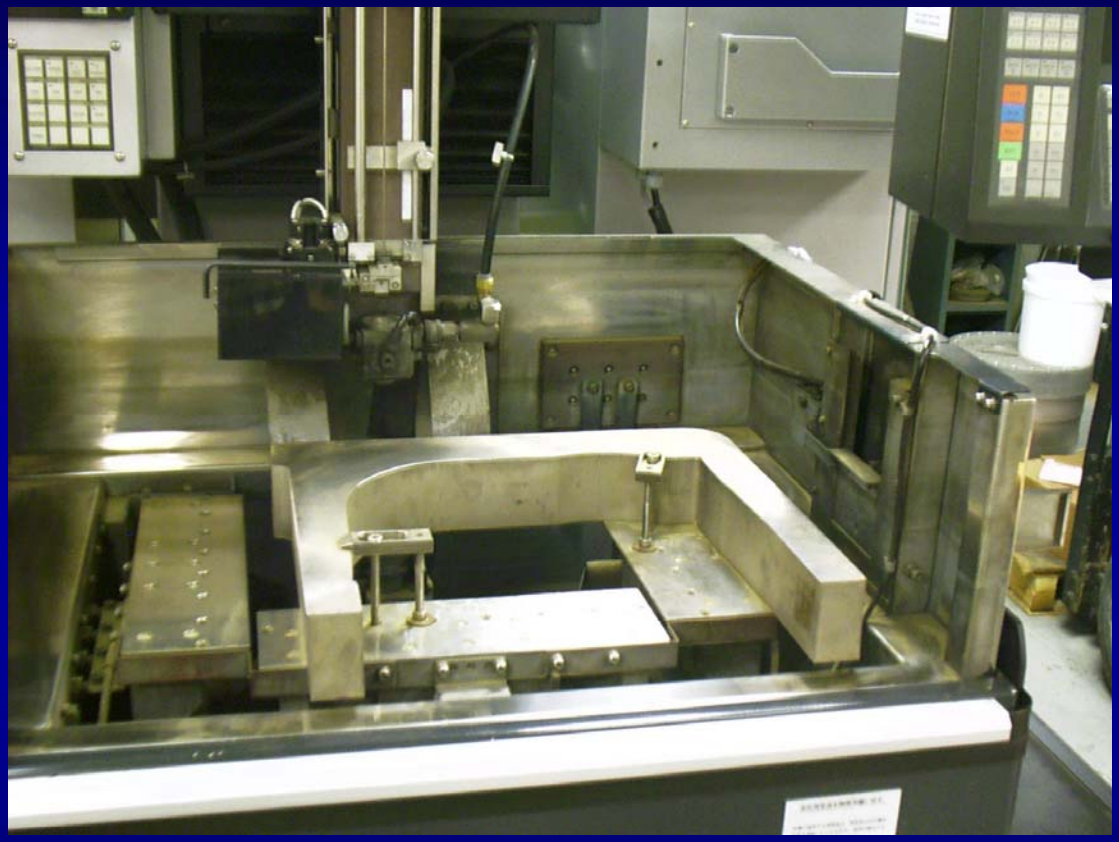
- Physical and frequency measurements will be performed on the remaining 5 cavities
- Electro-polish of the inside surface of each cavity remains to be done
- The cavities must be "tuned" to each other for best center frequency (10 cavities) by plastic deformation if necessary (will be done at LBNL)

RF Cavity Frequency Tuner Components

- Dual – action actuator
- Flexure tuner arm
- RF cavity

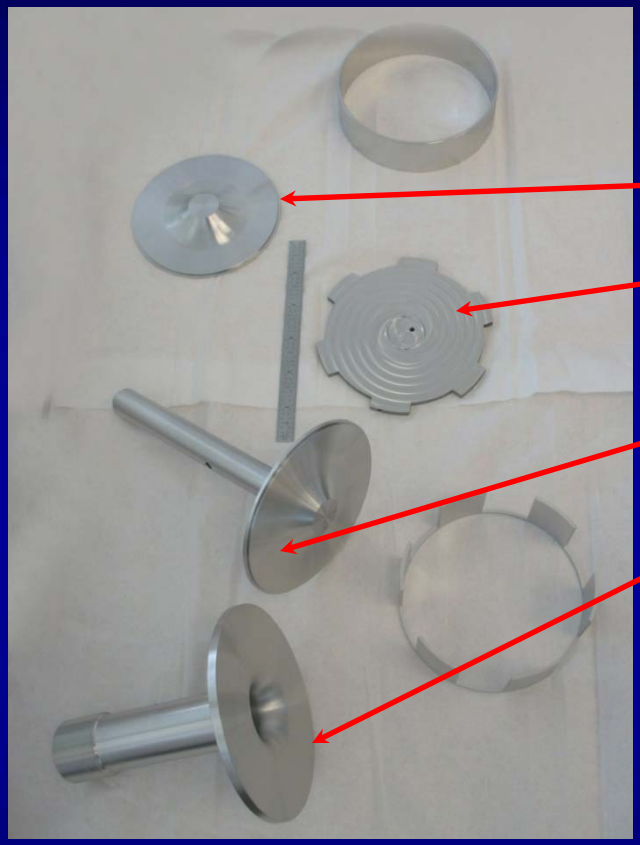


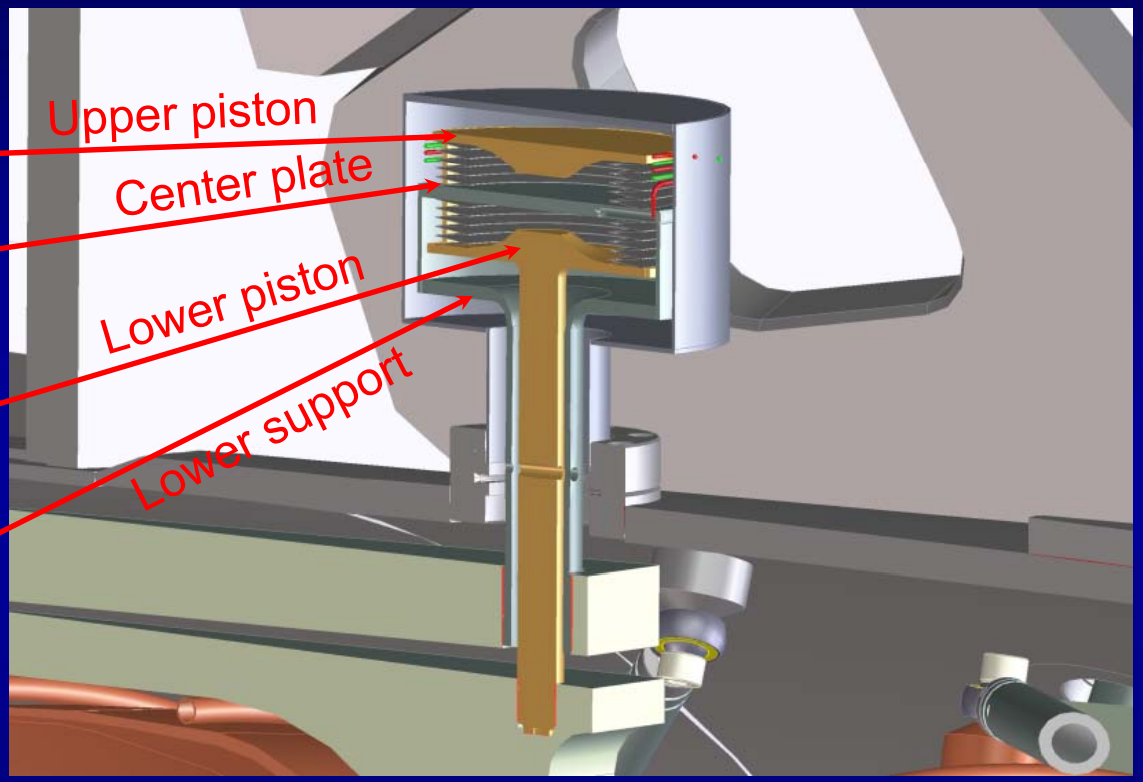
RF Cavity Frequency Tuner Flexure



- Six tuner flexures are being fabricated at the University of Mississippi (D. Summers and M. Reep)

Actuator Component Fabrication





- Actuator mechanical components (except bellows) for 6 actuators are being fabricated at University of Mississippi (D. Summers and M. Reep)

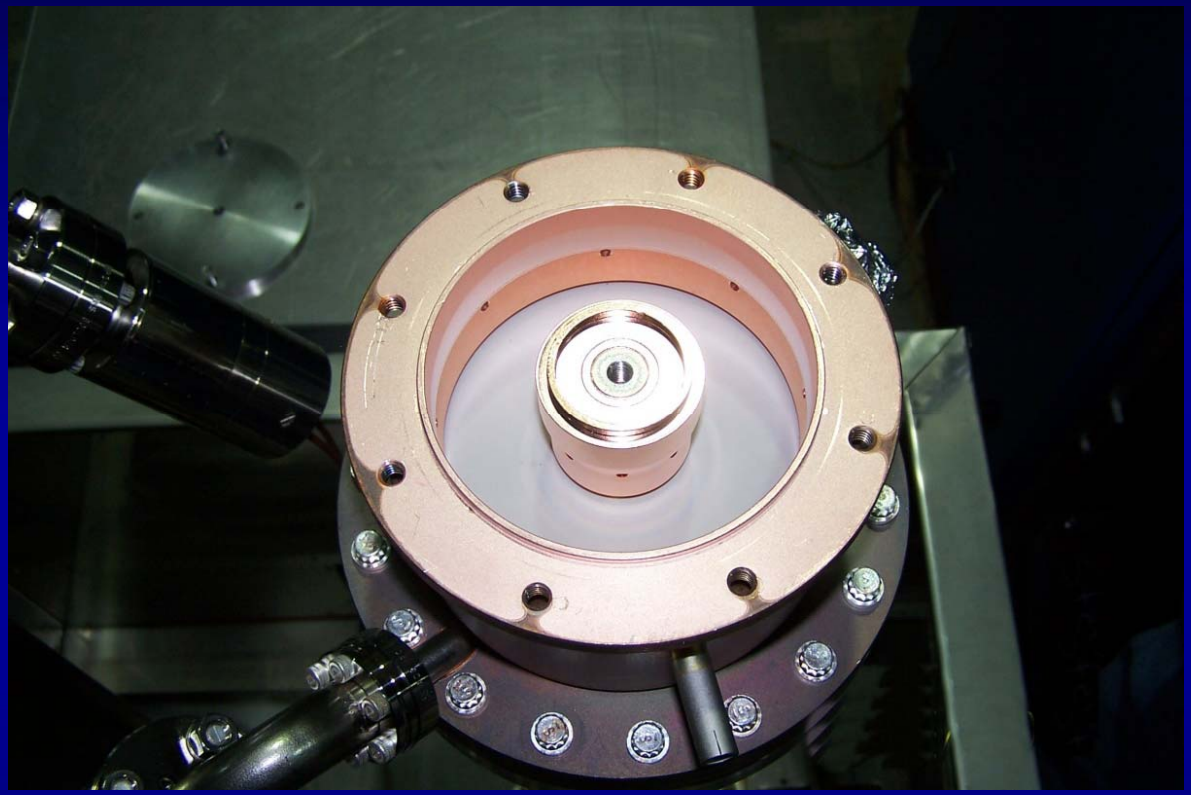
Actuator Bellows

- Sample bellows from a new vendor is at LBNL for testing

RF Cavity Tuner Control System

- Emerson ER3000 electronic pressure controllers have been sent to Pierrick Hanlet (Fermilab) for control software development

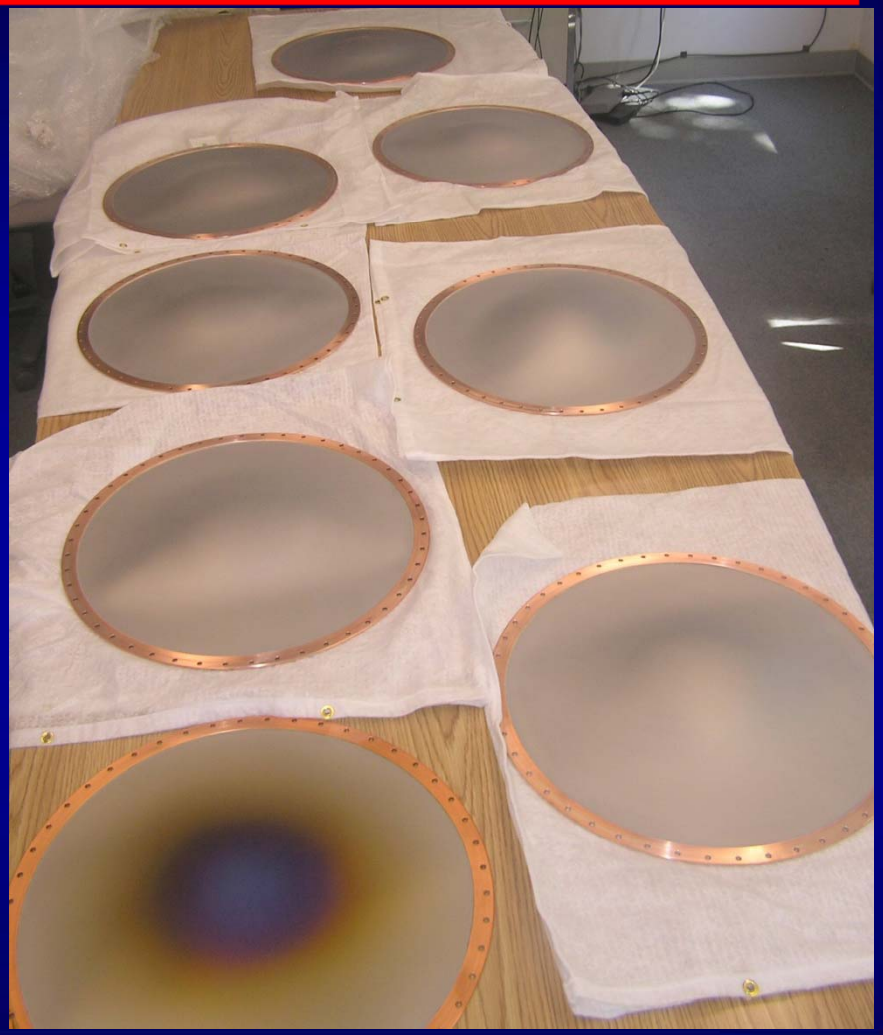
Toshiba RF Window



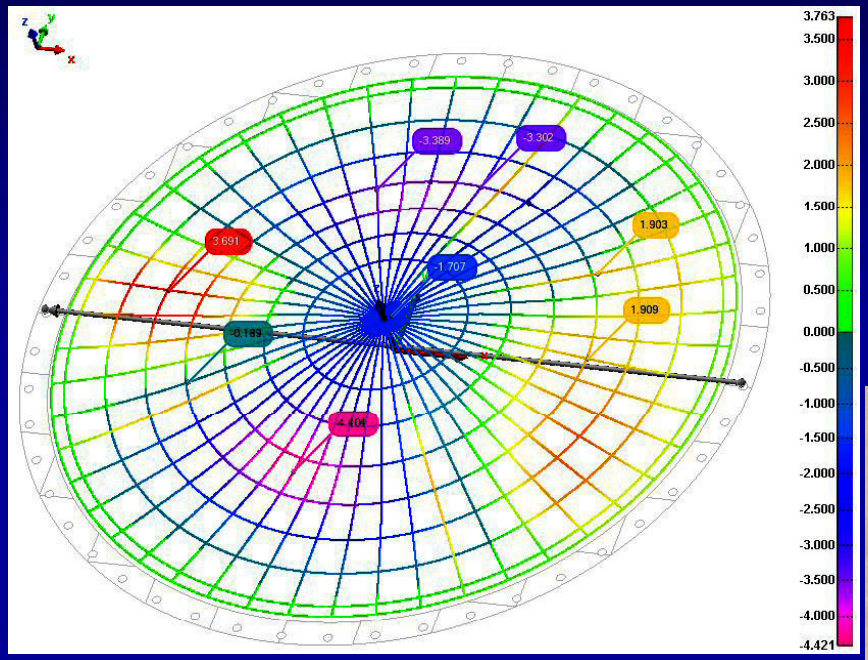
- 10 Toshiba RF windows ordered by University of Mississippi
- Delivery due at the end of February

RF Cavity Beryllium Window

- 11 Beryllium cavity windows have been fabricated
- 9 are coated
- 3 have been accepted from Brush Wellman
- 6 are being evaluated
- 2 may be rejected due to excessive distortion

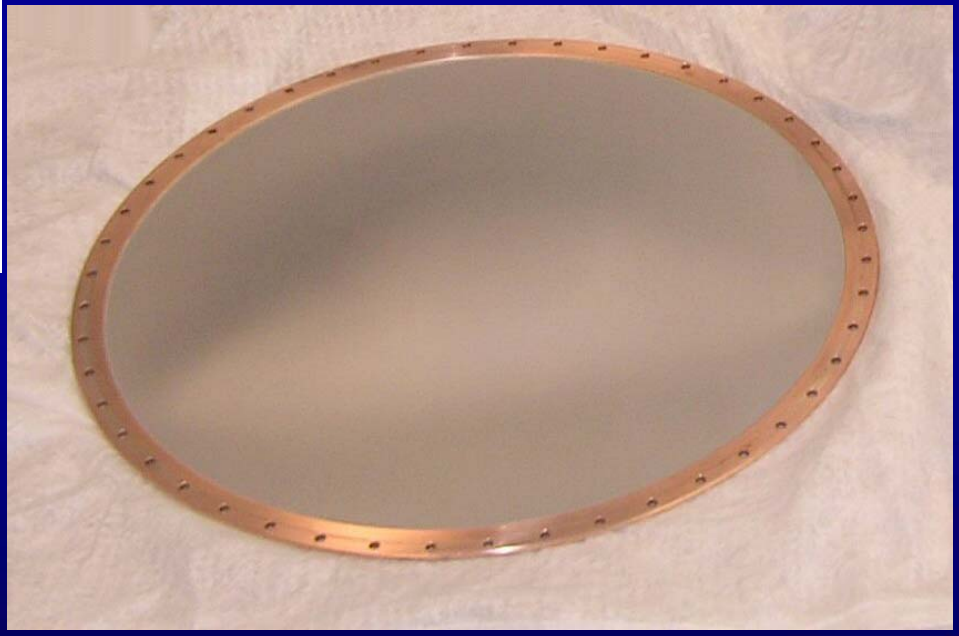


RF Cavity Beryllium Window

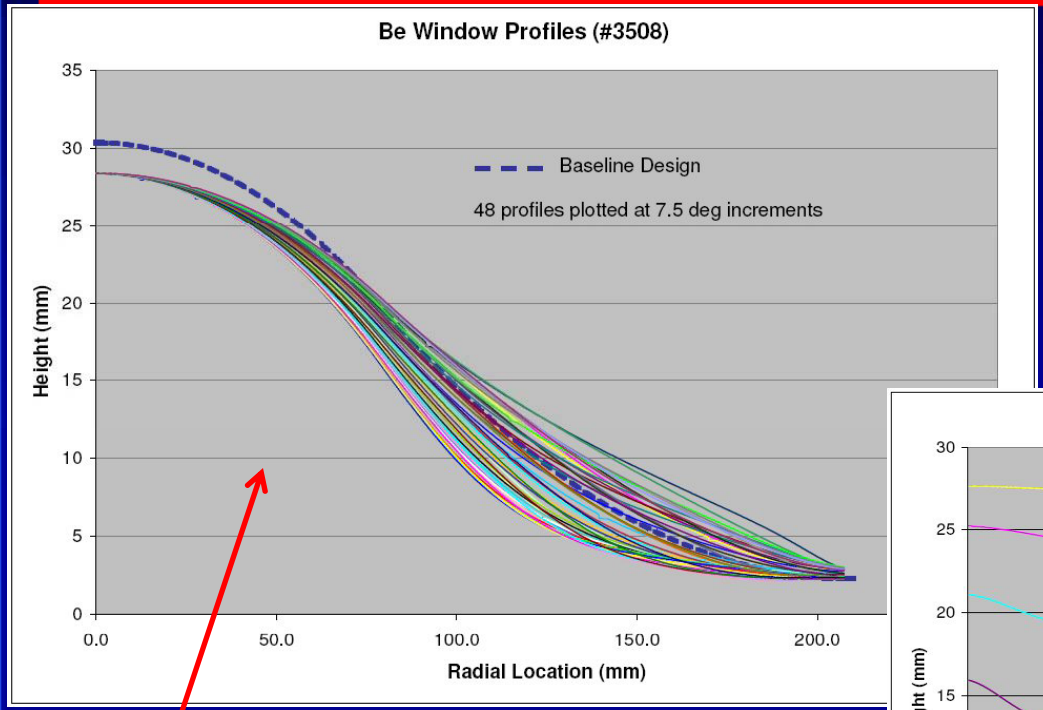


- Plot of the laser inspection machine data

- Distorted window

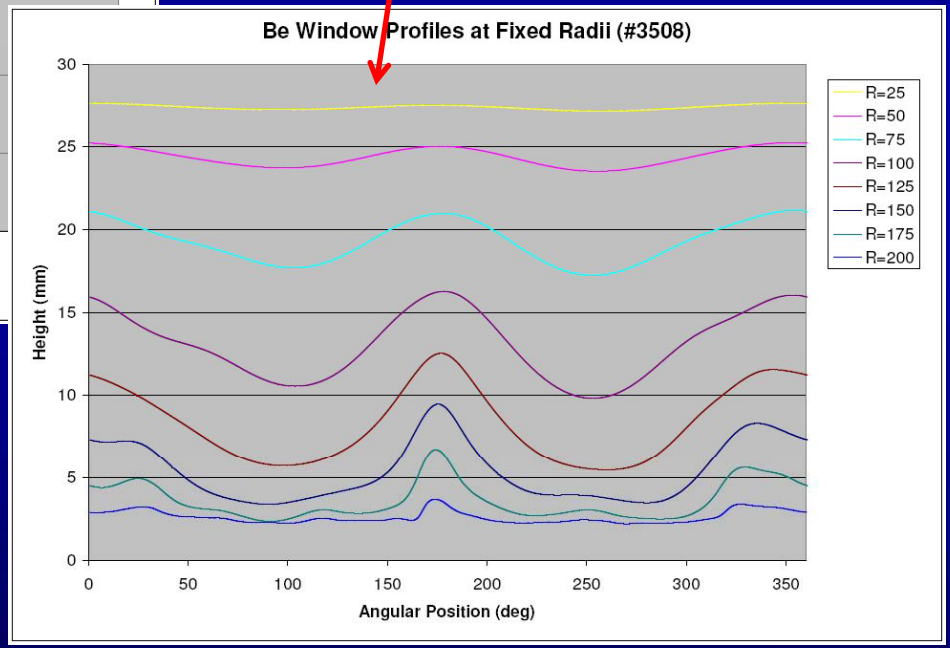


RF Cavity Beryllium Window Inspection

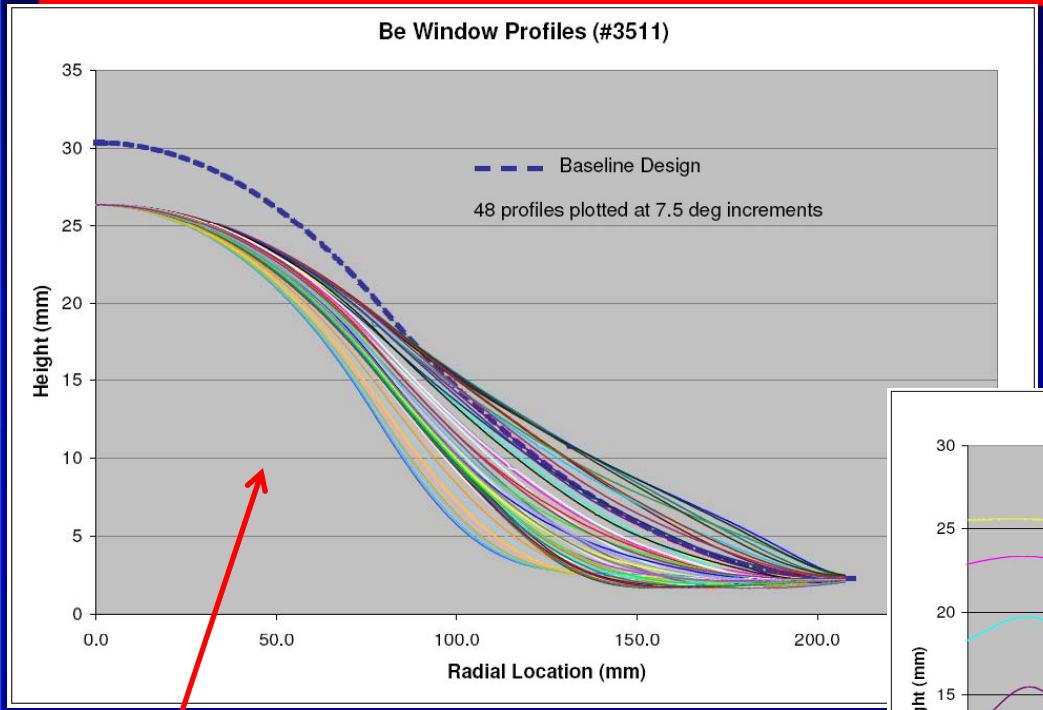


- Radial profiles of the Be window

- Fixed radius profiles of the Be window

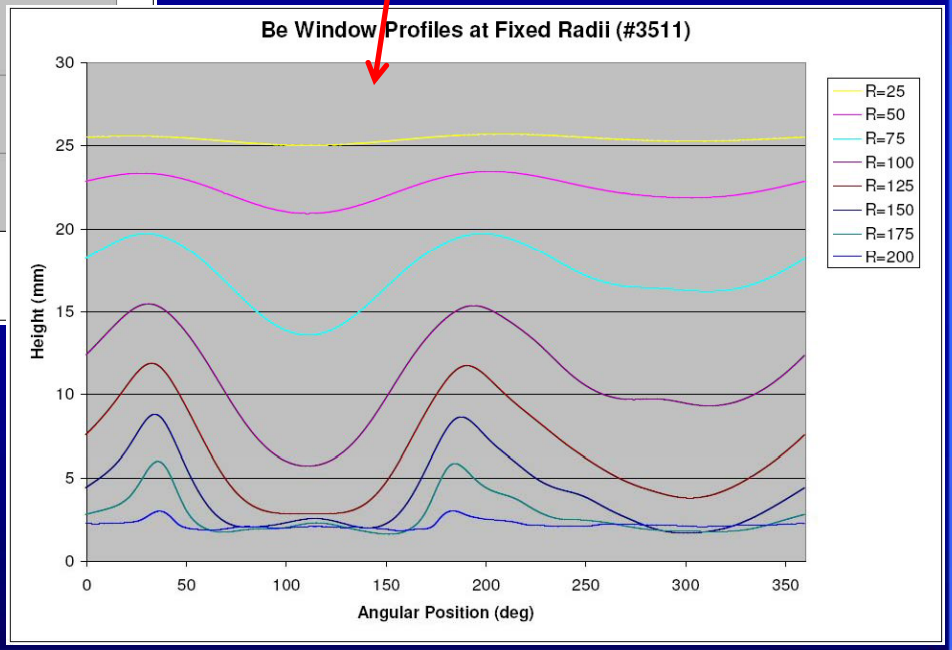


RF Cavity Beryllium Window Inspection



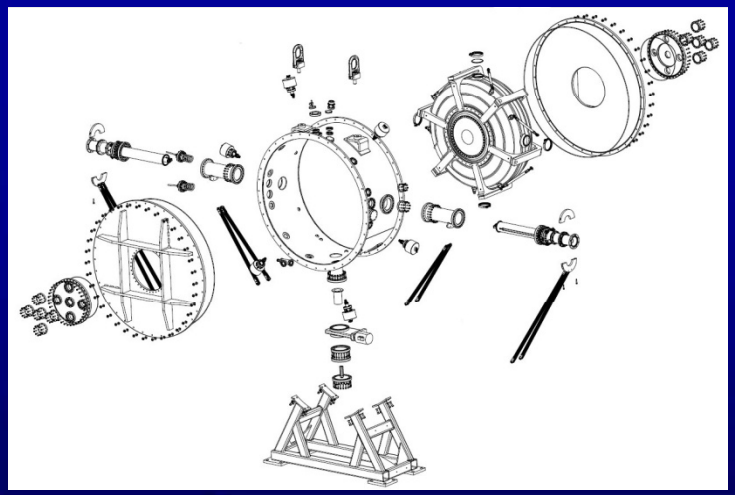
- Radial profiles of the Be window

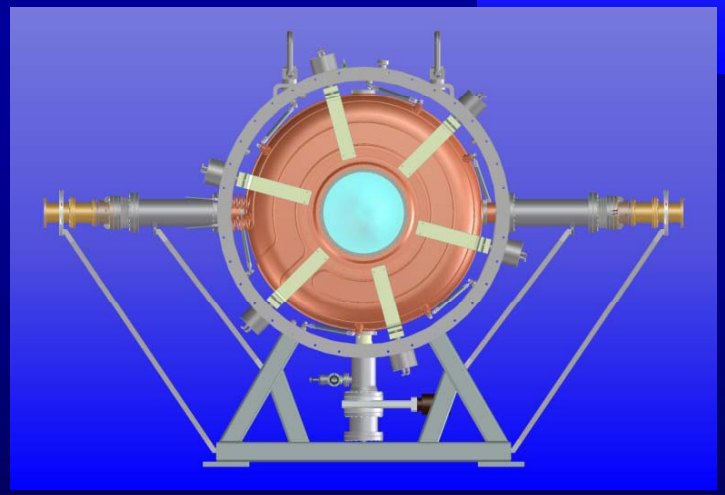
- Fixed radius profiles of the Be window



Single RF Cavity Vacuum Vessel

- Design (at LBNL) is complete
- Drawings are nearing completion
- Kept the same dimensions and features of the RFCC (as much as possible)
- One vessel designed to accommodate two types of MICE cavities (left and right)
- Design review (to be organized by Fermilab) will take place soon
- The vessel and accessory components will soon be ready for fabrication (Fermilab to identify vendors and send out request for quotes)

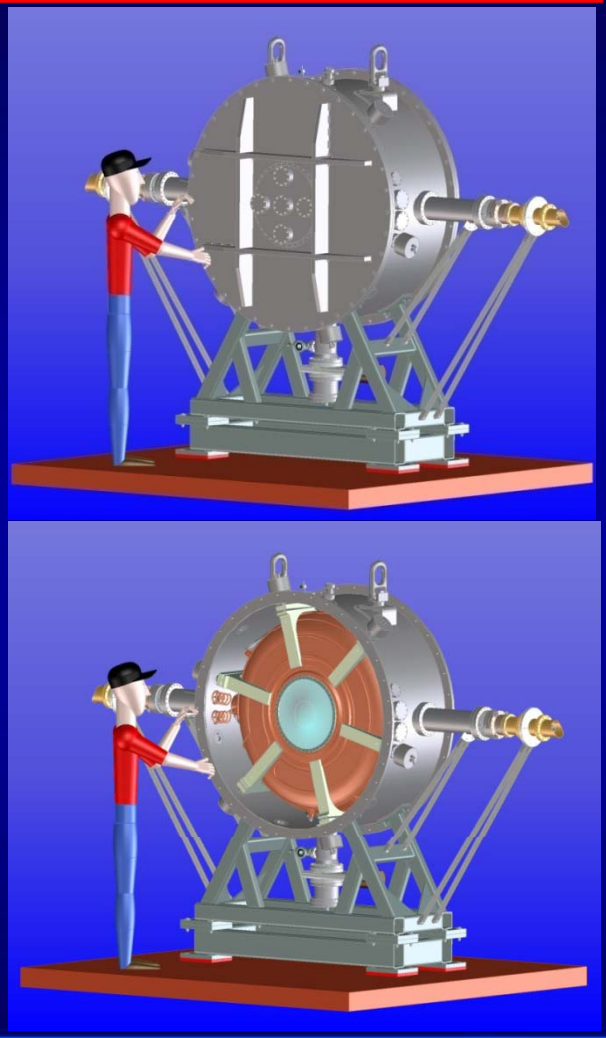




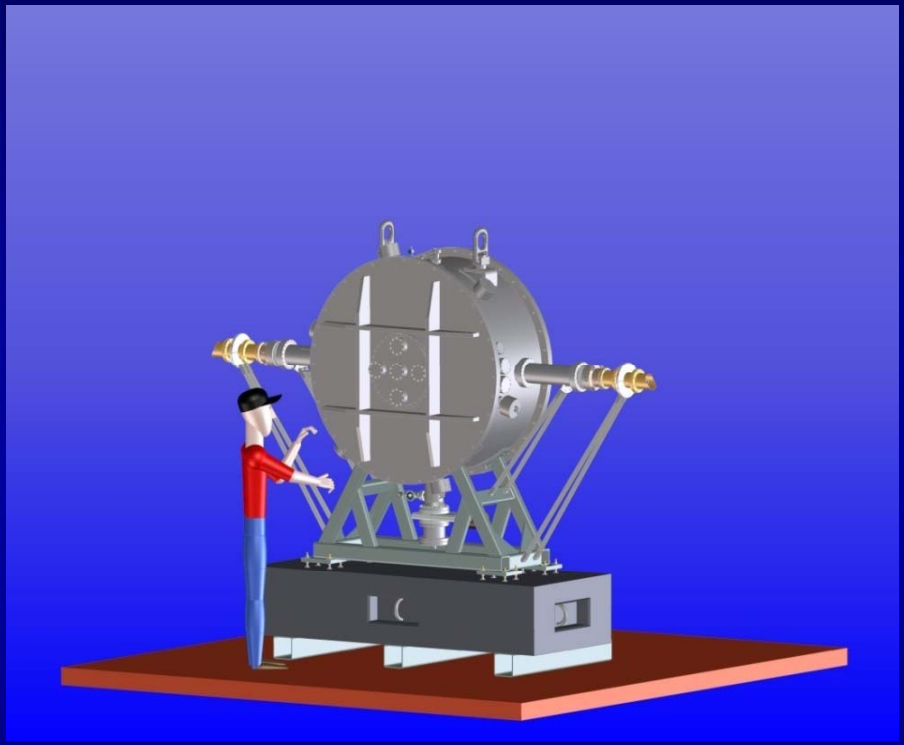
Advantages of Single RF Cavity Vacuum Vessel for MICE

Prior to having MICE RFCC module, the single cavity vessel will allow us to:

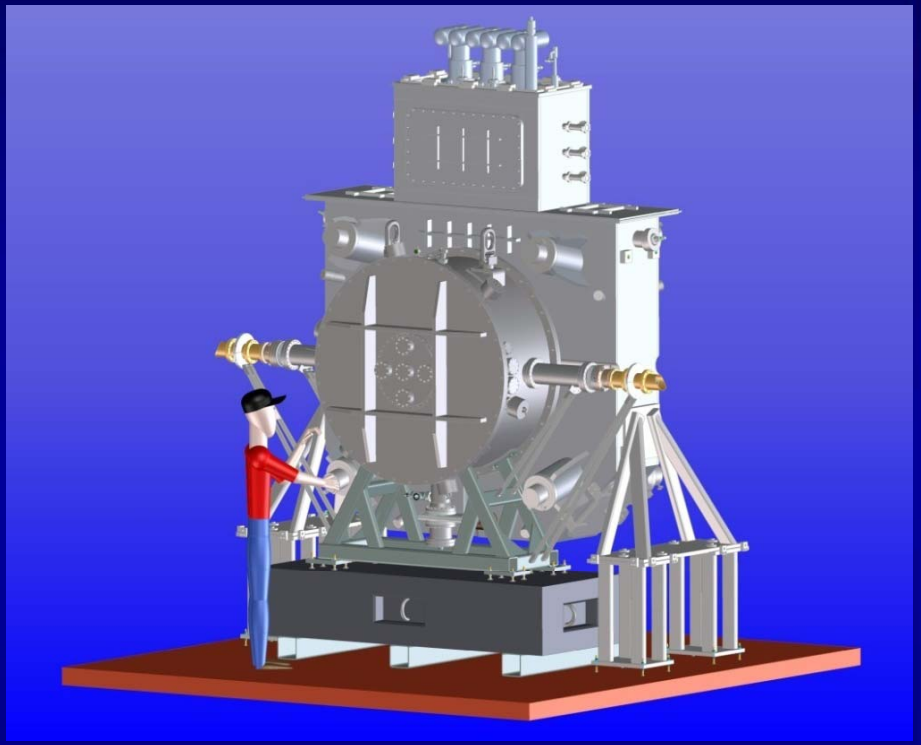
- Check engineering and mechanical design
- Test of the RF tuning system with 6 tuners and actuators on a cavity and verify the frequency tuning range
- Obtain hands-on experience on assembly and procedures
  - Cavity installation
    - Beryllium windows
    - RF couplers and connections
    - Water cooling pipe connections
    - Vacuum port and connections
    - Tuners and actuator circuit
  - Aligning cavity with hexapod support struts
  - Vacuum vessel support and handling
  - Verify operation of the getter vacuum system
- Future LN operation



Single RF Cavity Vacuum Vessel for MuCool

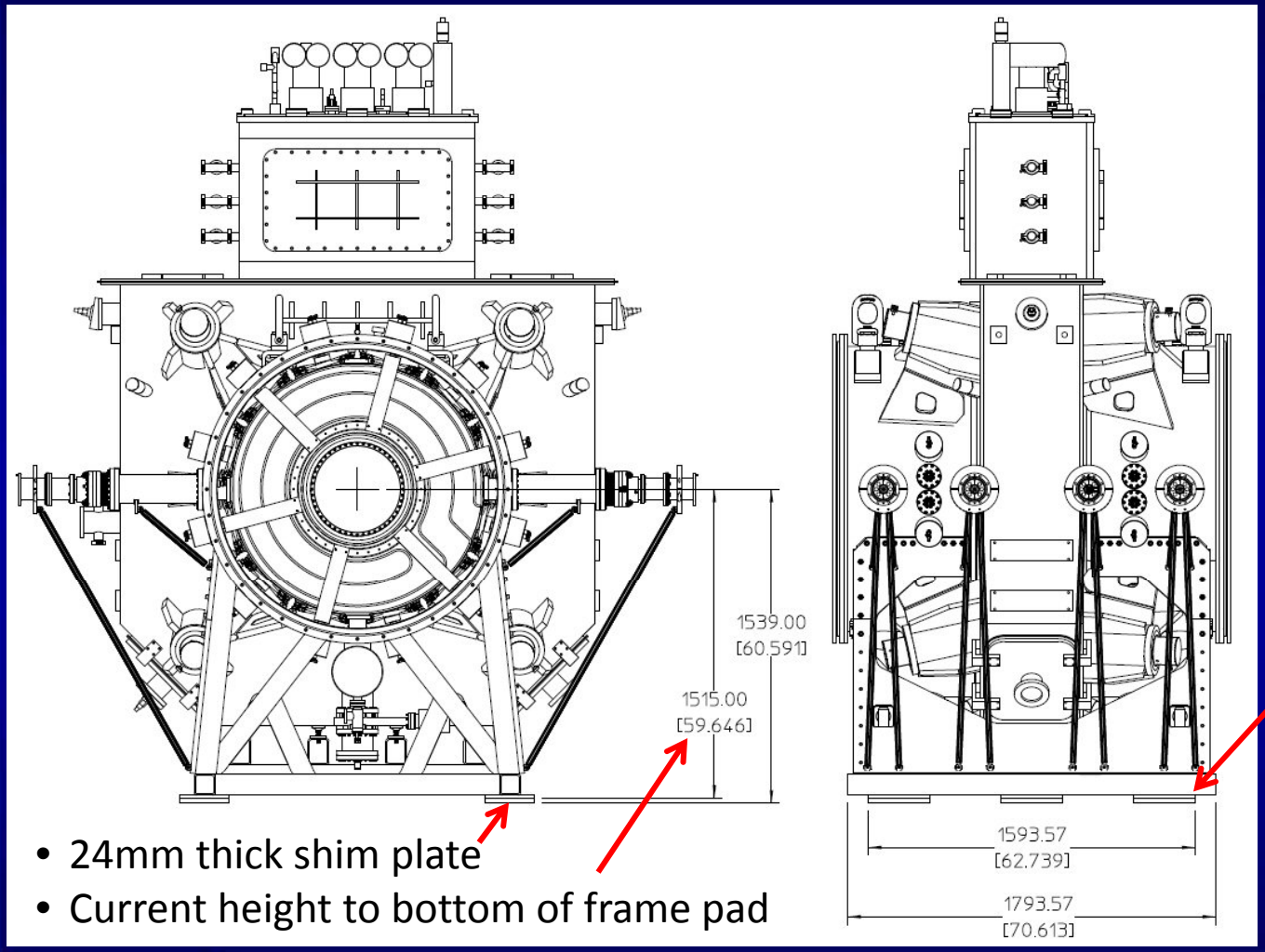


- MTA beam height configuration on concrete block



- MTA configuration with the coupling coil

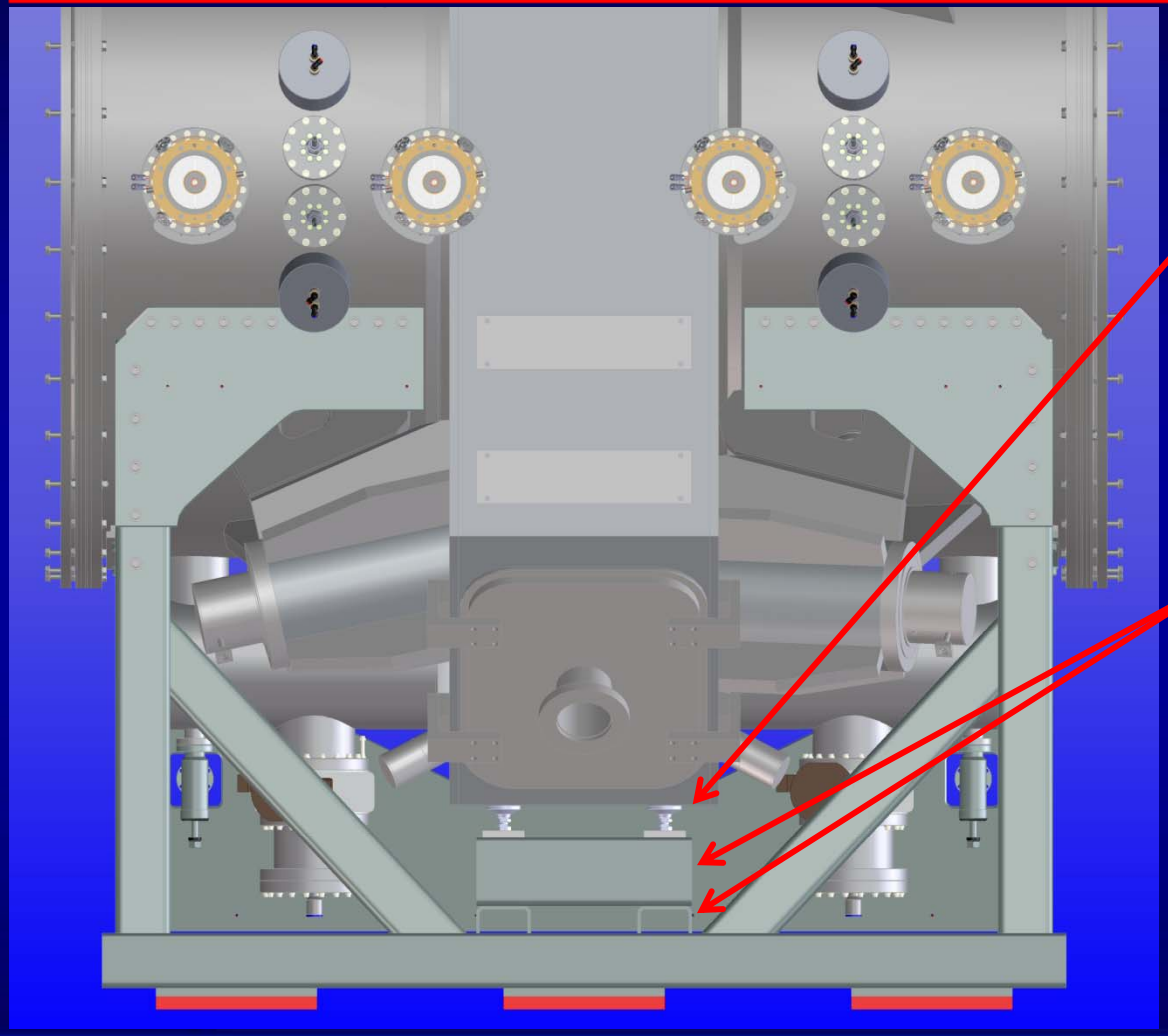
Move Frame Mounting Plates 100mm



- 24mm thick shim plate
- Current height to bottom of frame pad

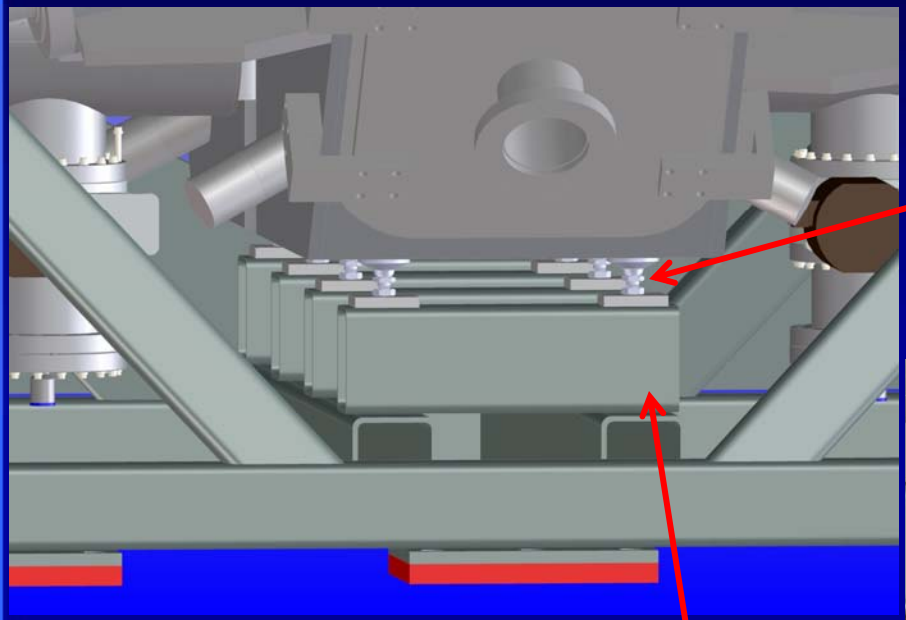
- RFCC module frame mounting plates moved inboard by 100mm

Support for the Coupling Coil



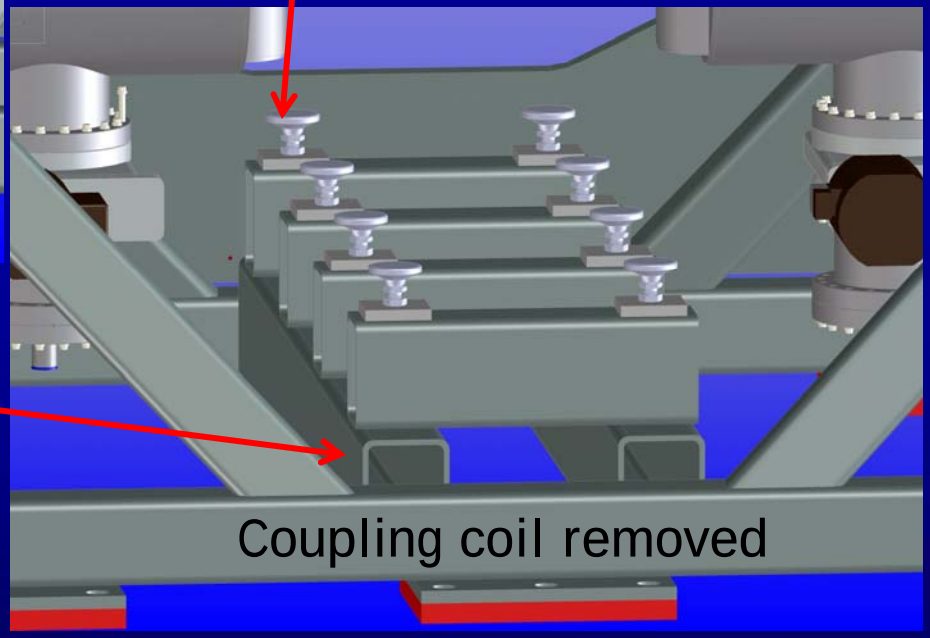
- 8 leveling jack screws with a capacity of 7200-lb (3265-kg) each
- 4 x 6 inch x 1/4 inch wall rectangular tube

Support for the Coupling Coil



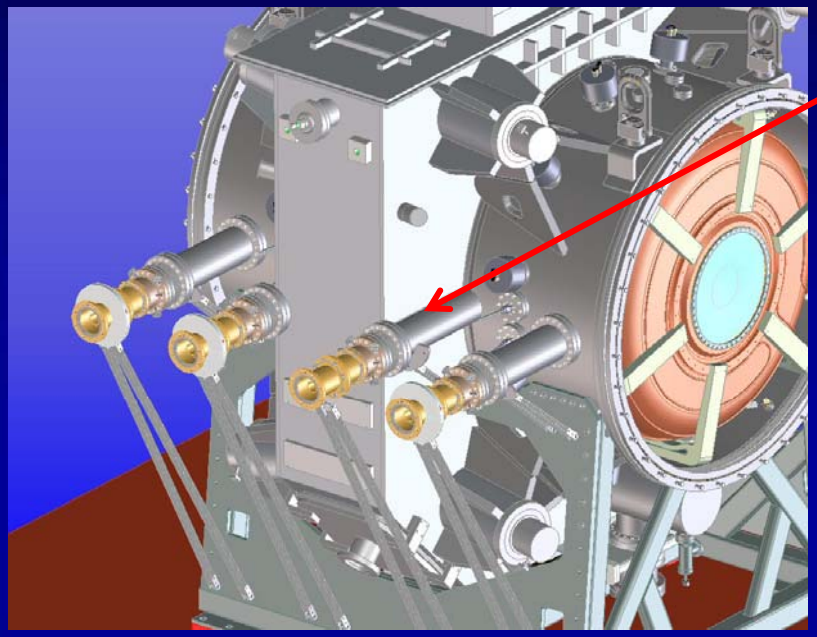
- Leveling Jack Screw with a capacity of 7200-lb (3265-kg) each

- 4 x 6 inch x 1/4 inch wall rectangular tube

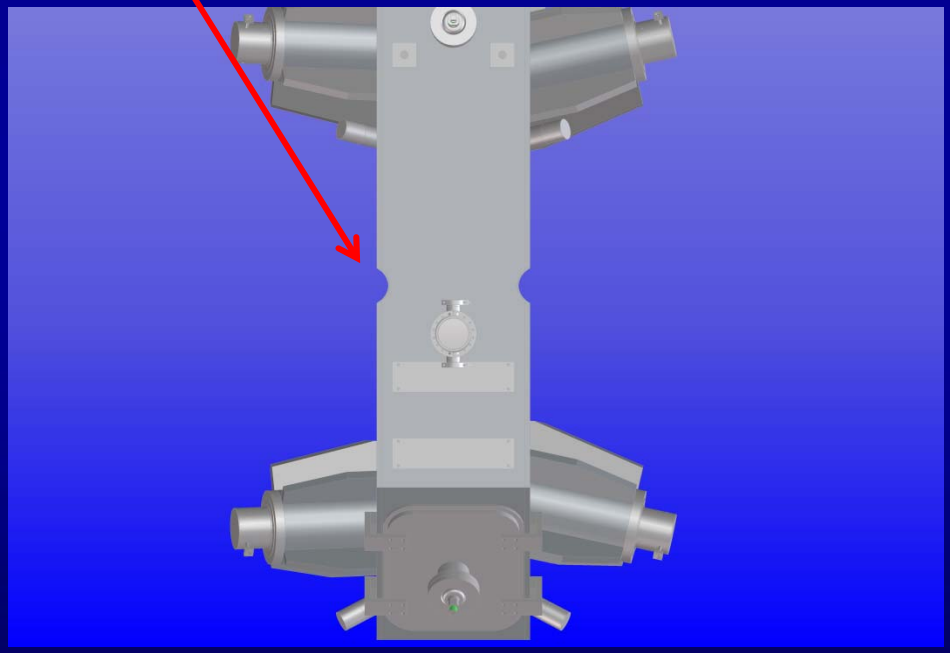


Coupling coil removed

RF Coupler and Coupling Coil Clearance



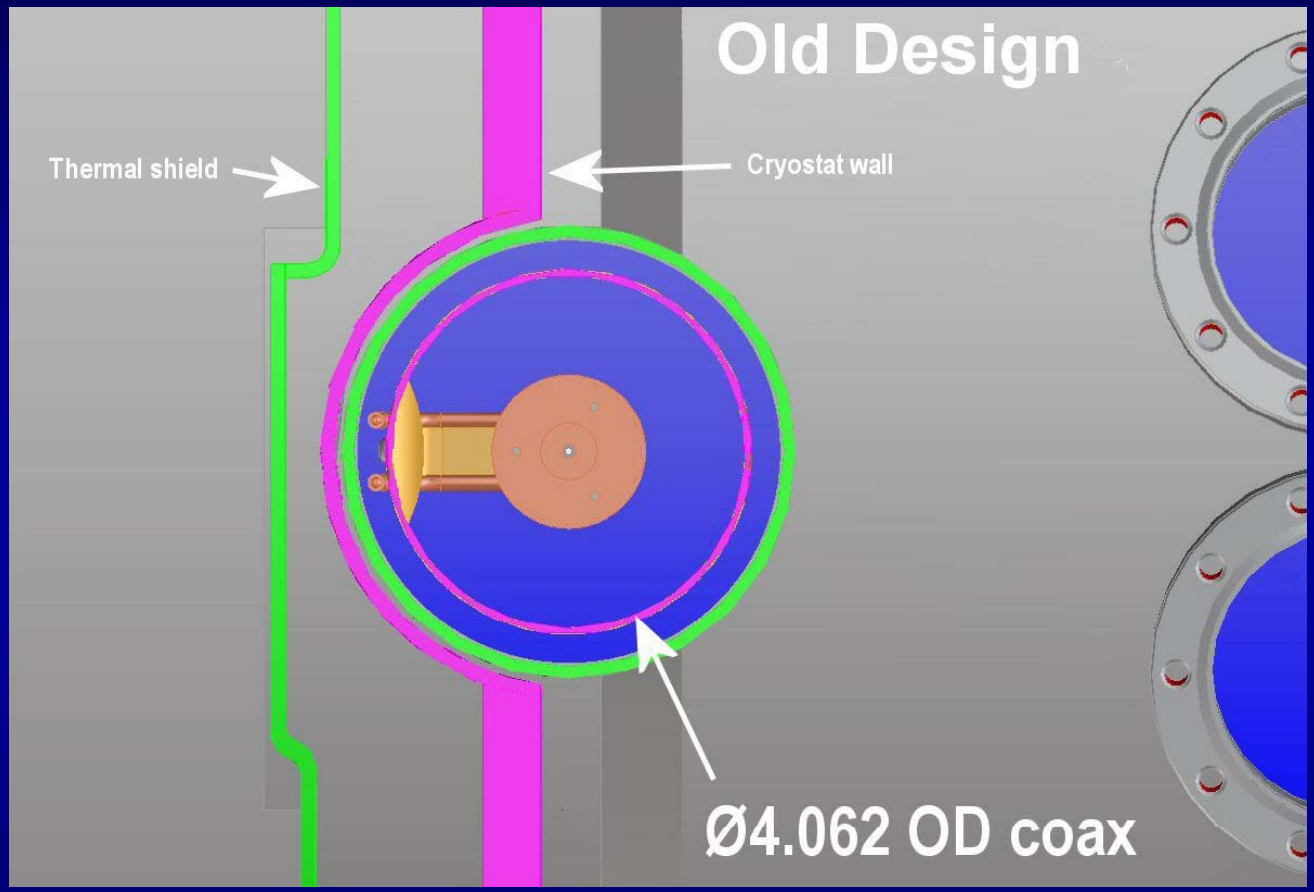
- Scallop in coupling coil cryostat for the RF coupler



- Scallop in coupling coil cryostat forced a step in the thermal shield
- Step in thermal shield created an assembly problem

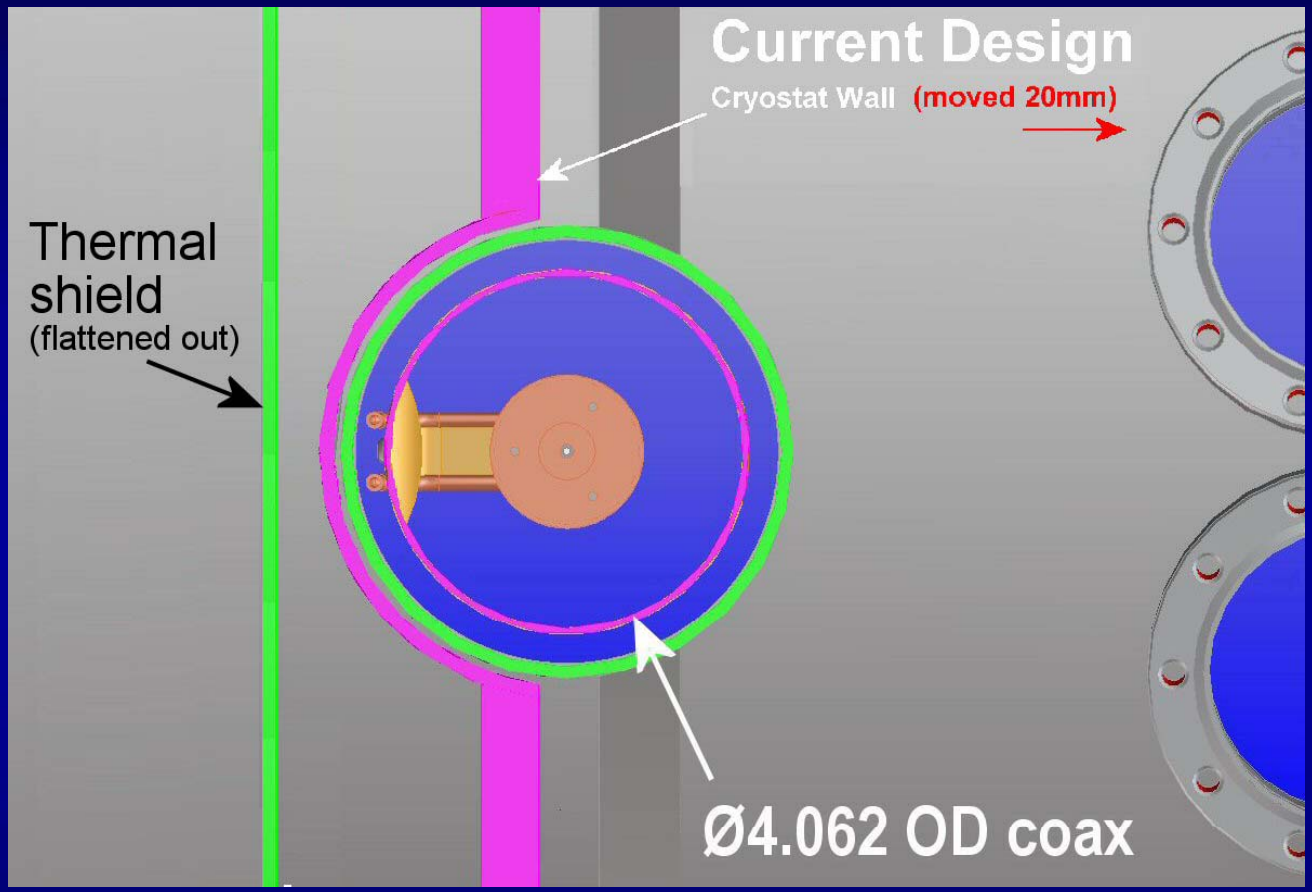
RF Coupler and Coupling Coil Clearance

- Original cryostat design with a step in the thermal shield to provide clearance for MLI
- This design created magnet assembly problems

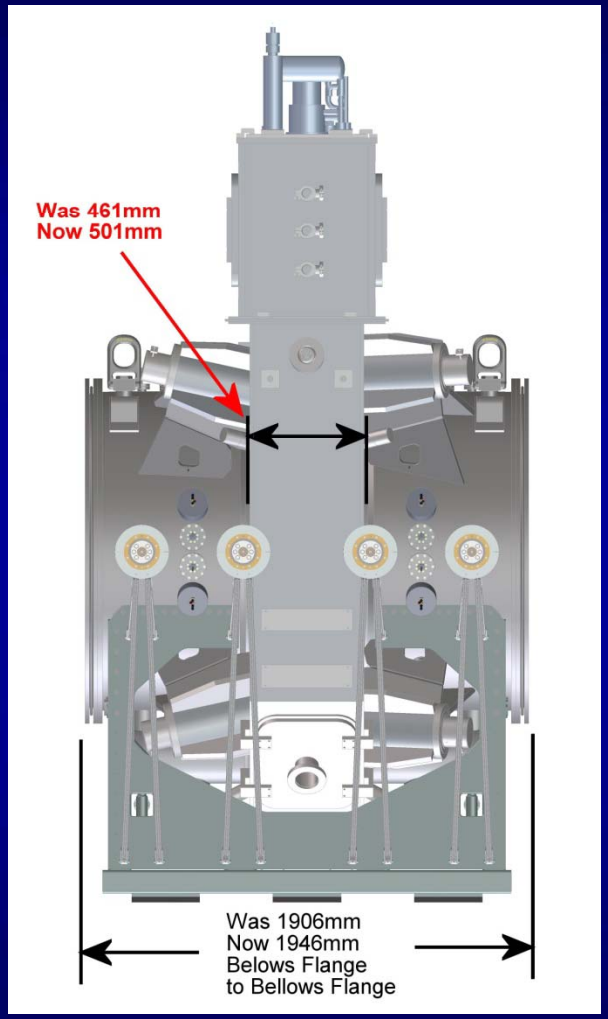


RF Coupler and Coupling Coil Clearance

- Moving the cryostat wall away from the thermal shield provides more clearance for easier assembly



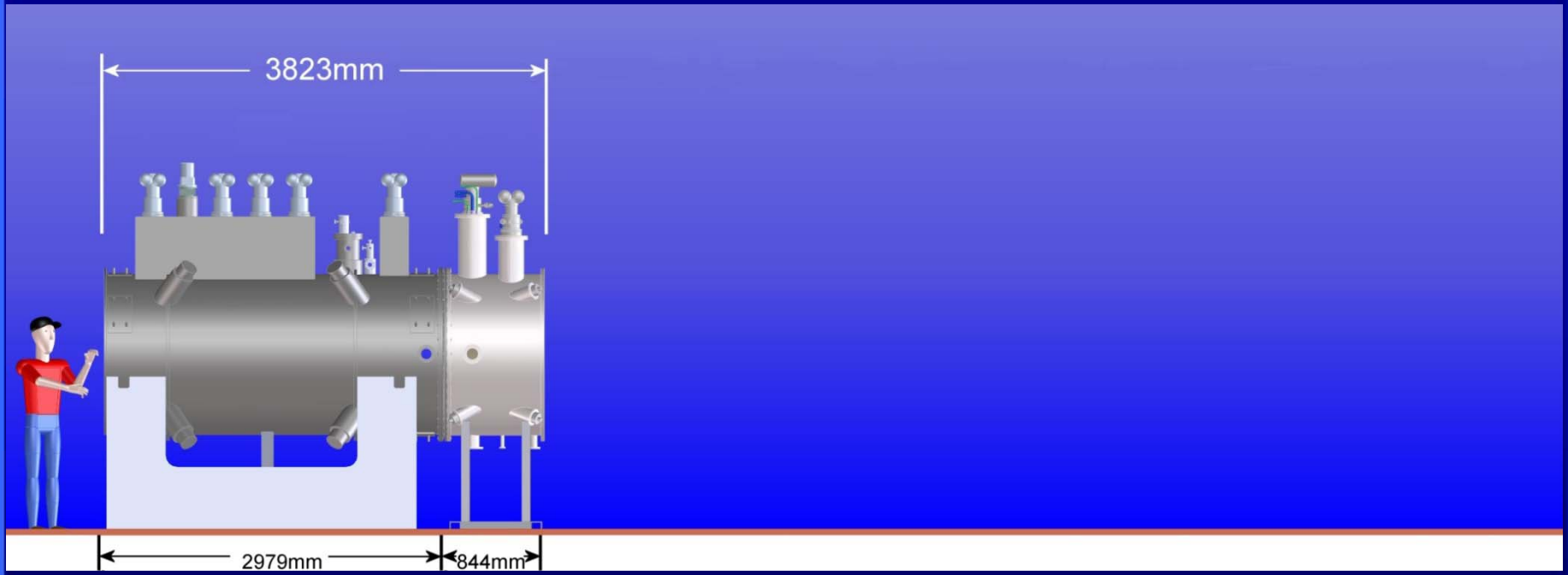
RFCC and Coupling Coil Change in Length



- Coupling coil cryostat width increased by 20 mm per side from 461mm to 501mm
- RFCC module length increased by 40mm from 1906mm to 1946mm
- Positions of the modules in the beamline are affected

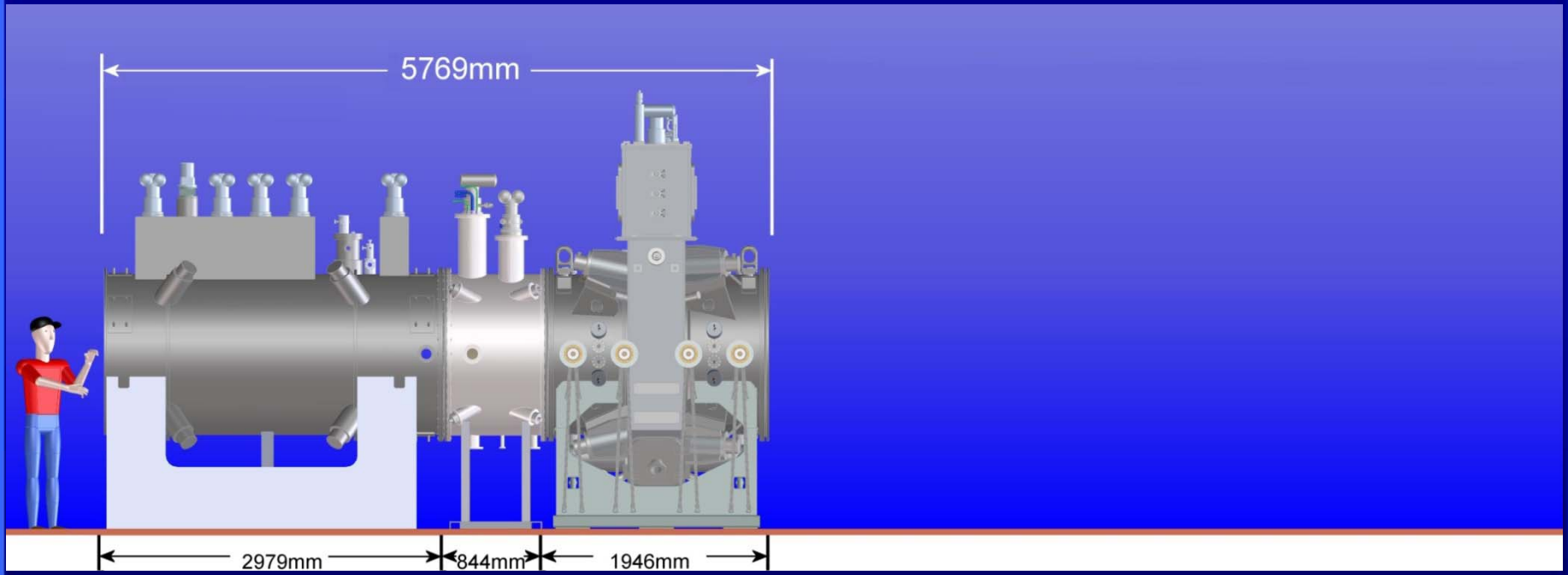
Affect of Increased RFCC Length on Beamline

- Spectrometer solenoid and first AFC module
- No change of beamline length



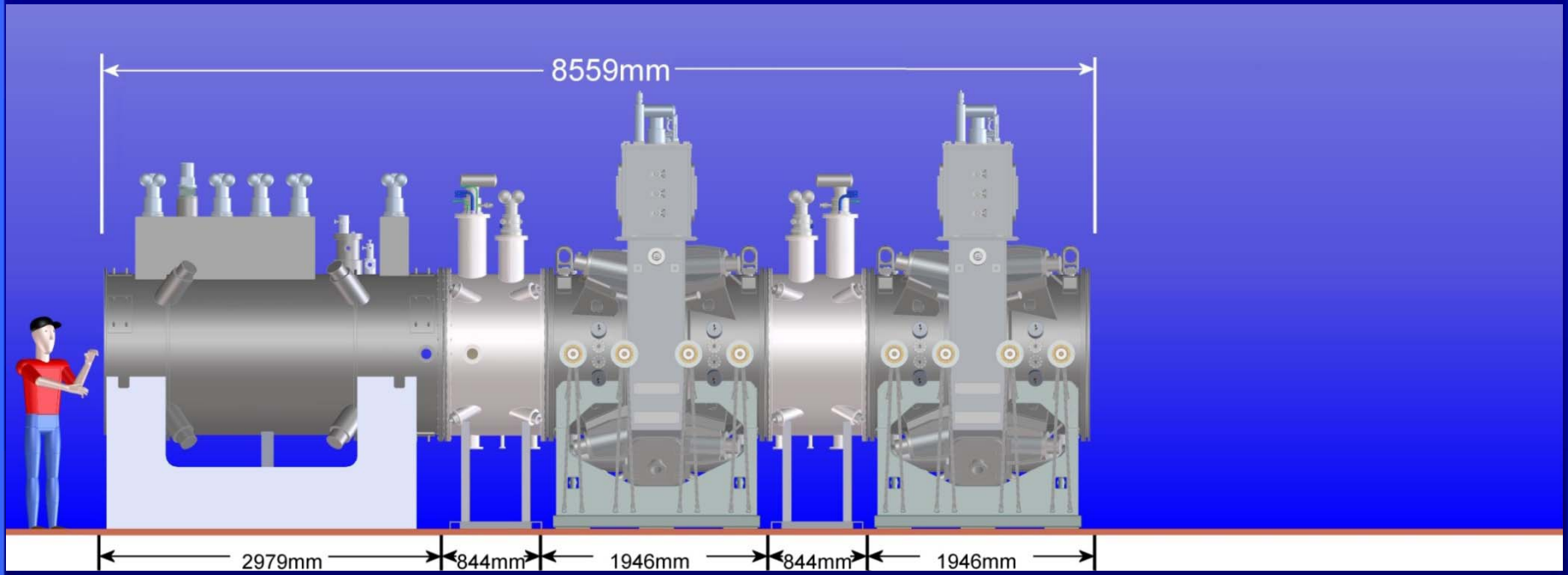
Affect of Increased RFCC Length on Beamline

- Add first RFCC module which is widened by 20mm per side
- Beamline length is increased by 40 mm



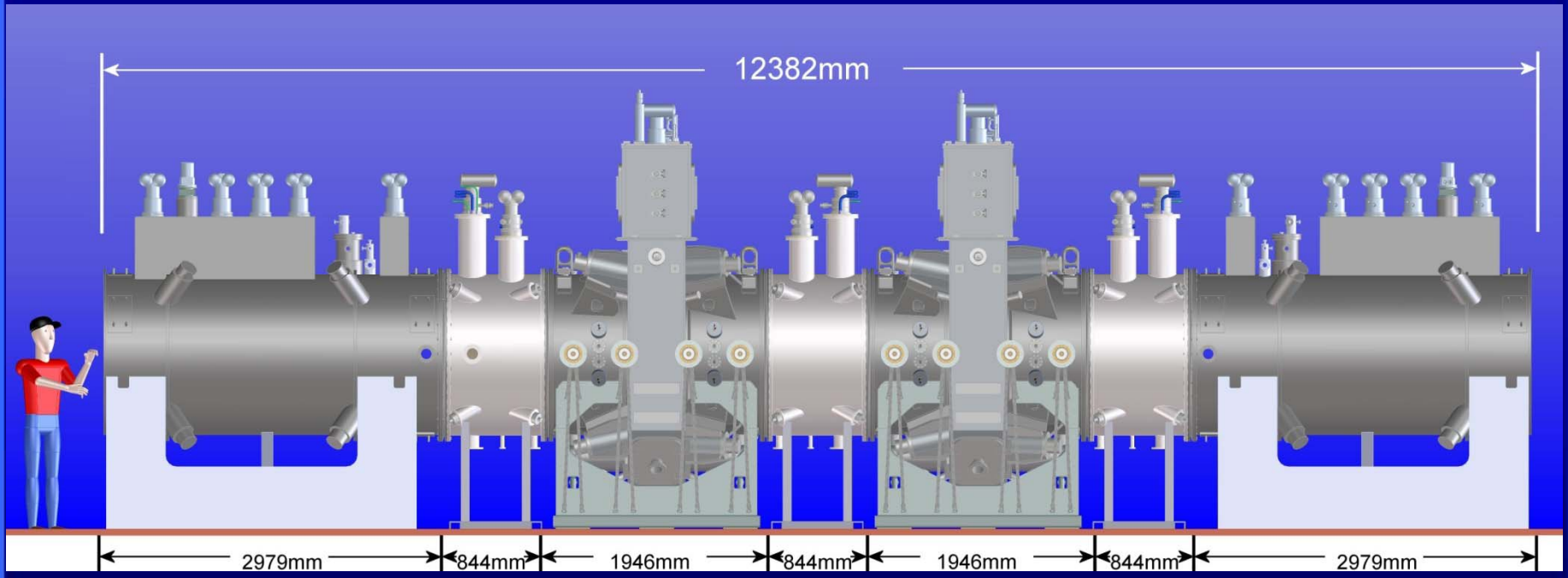
Affect of Increased RFCC Length on Beamline

- The second RFCC module (after the second AFC module) adds another 40mm
- Beamline length is increased by 80 mm



Affect of Increased RFCC Length on Beamline

- Complete MICE cooling channel beamline
- Beamline length is increased by 80 mm



Increased RFCC Length on Beamline Summary

- All modules after the first RFCC module are shifted down the beamline by 40mm
- All modules after the second RFCC module are shifted down the beamline by 80mm

- Analysis by Ulisse Bravar showed that the MICE cooling channel beam optics can be easily re-matched (MICE note: “Length Increase of the RFCC Module” Dec. 19, 2010)

RFCC Progress Summary

- All 10 RF cavities are at LBNL
- Received nine beryllium windows
- Ten ceramic RF windows ordered
- Six full size tuner flexures are being fabricated
- Components for 6 actuators are being fabricated
- New bellows vendor has been identified and a sample bellows is at LBNL for testing
- Control system components have been shipped to Pierrick Hanlet (Fermilab) for control software development
- Physical measurement of the second 5 cavities needs to be done
- RF frequency measurements of the second 5 cavities needs to be done
- Cavity post-processing (surface cleaning and preparation for EP) to start this year at LBNL
- Electro-polishing of all 10 cavities needs to be done
- The single cavity vacuum vessel drawings are nearly complete and fabrication will start soon