# MICE RF Cavities and RFCC Module Update

**MICE CM32 at RAL, UK**

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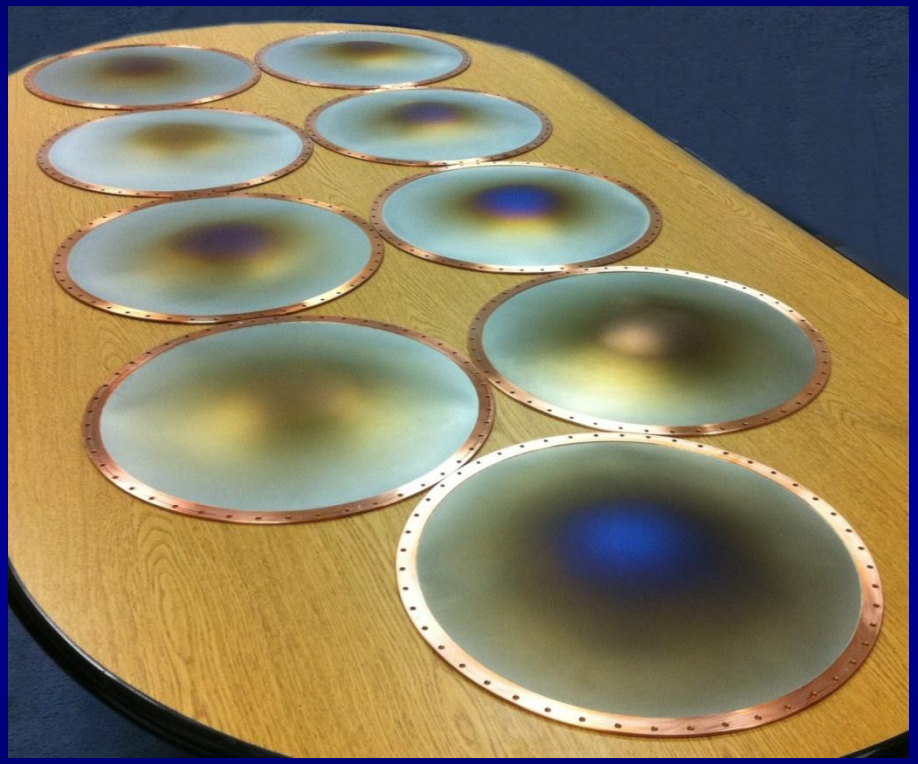
# Current Status of RFCC Module

- **RF Cavities:**
  - All 11 beryllium windows received at LBNL (1st RFCC module)
  - Ten ceramic RF windows received
  - Six tuner flexures are being fabricated at Fermilab
  - Components for 6 actuators are being fabricated
  - RF coupler design has been modified to eliminate the gap between the outer coax and the RF loop
  - Fabrication of fixturing for the electropolishing is complete
  - Mechanical smoothing of the cavity inside surface before EP
  - Single cavity vacuum vessel, being fabricated at Keller Technology in Buffalo New York, is complete and should be at Fermilab this wk.

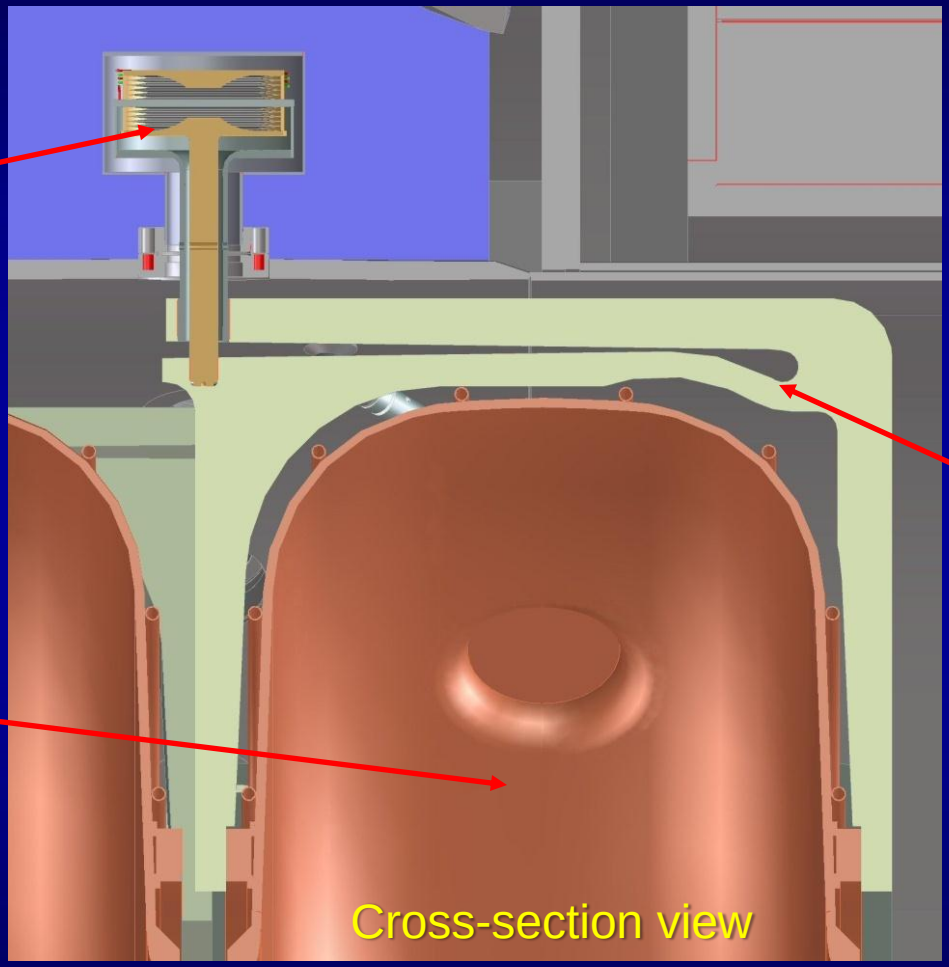
# Beryllium Windows

- Eleven beryllium windows have been fabricated so far:
  - Curved thin (0.38-mm thick) window with TiN-coating on both sides
- Received two new beryllium windows recently, these two windows have been fabricated by Materion Electrofusion (fomer Brush-Wellman) to replace the windows rejected due to excess distortion with improved brazing design/technique: no distortion is observed.



# RF Cavity Frequency Tuner Components

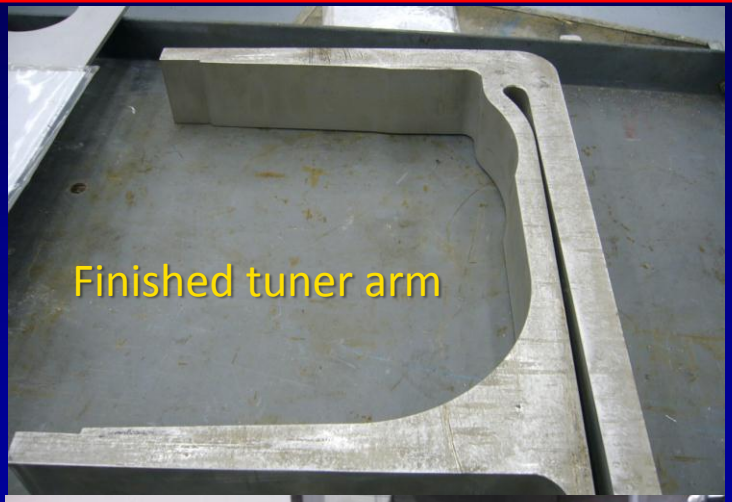
- Dual – action actuator
- RF cavity




- Flexure tuner arm

Tuning range:
 230 kHz

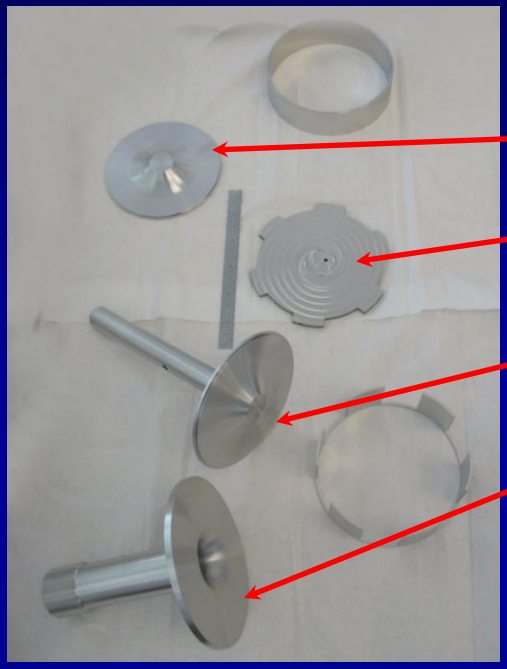
# Cavity Frequency Tuner Flexure

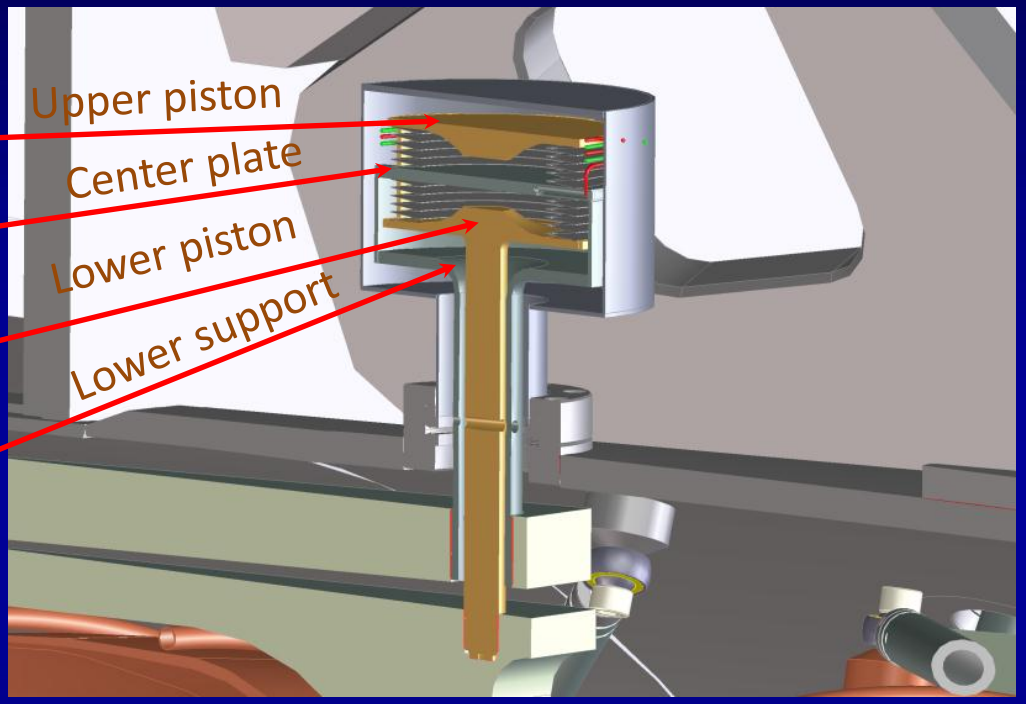




Six full size tuner flexures are being fabricated at Fermilab

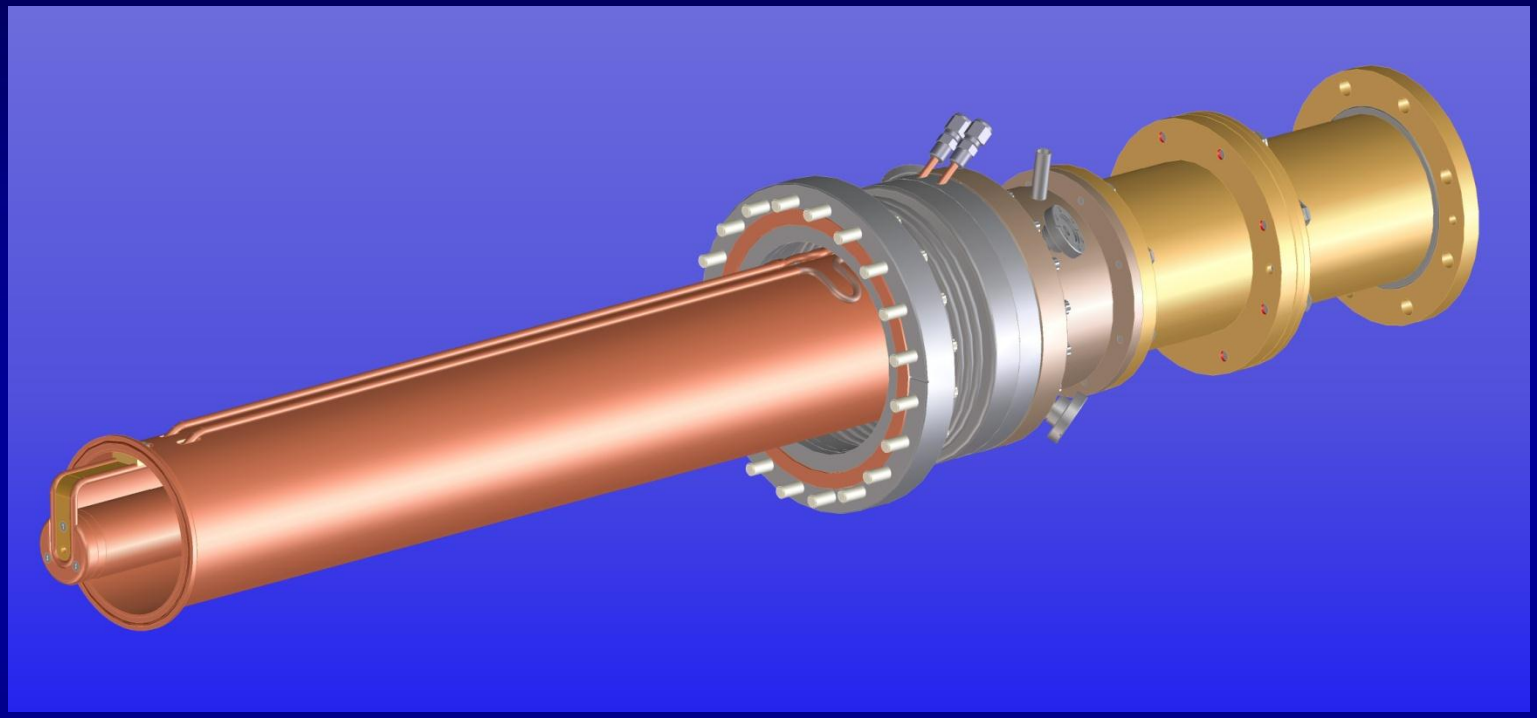
# Actuator Component Fabrication





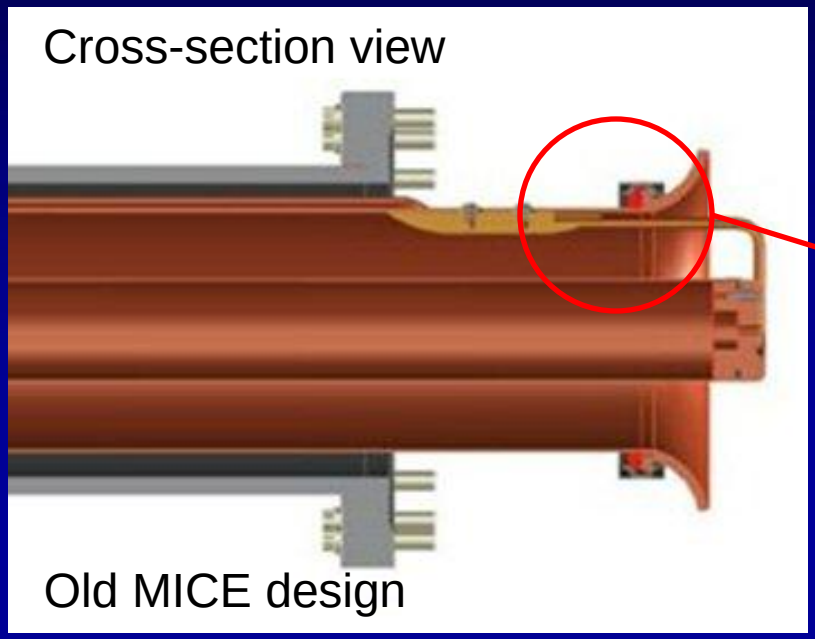

- Component for six actuators are currently being fabricated by a local vendor
- The actuators will be assembled at LBNL

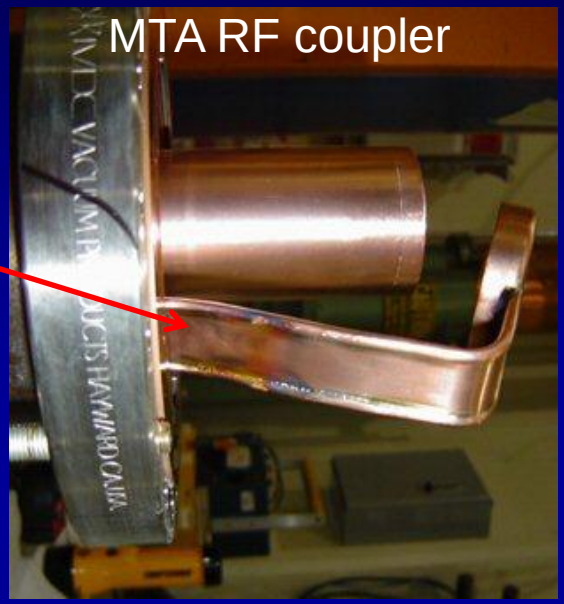
# RF power (loop) coupler



- RF power (loop) coupler design has been modified to eliminate the gap between the loop and the outer coax tube

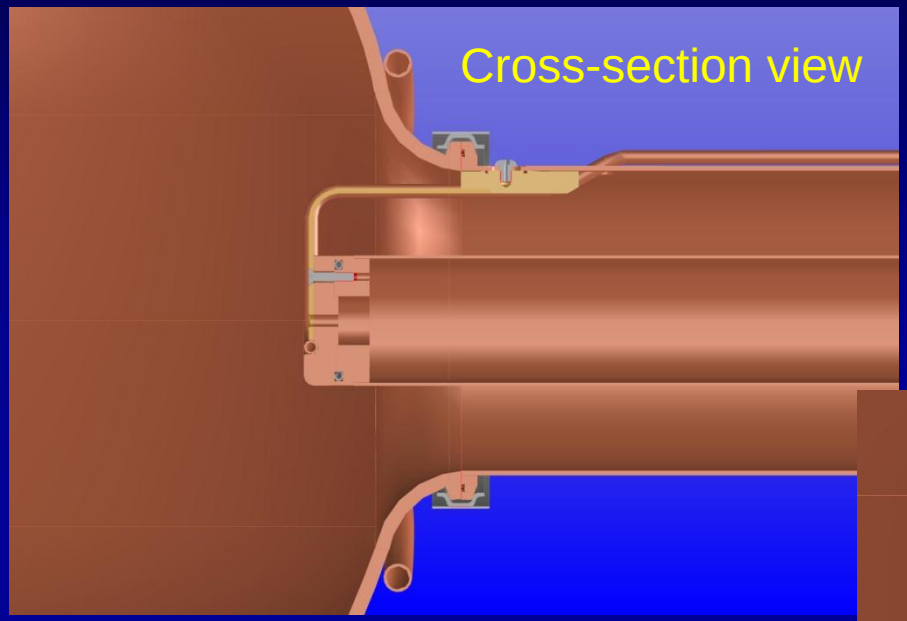
# RF Power (loop) Coupler (old)

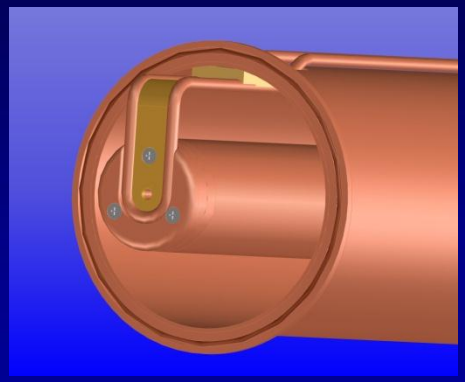


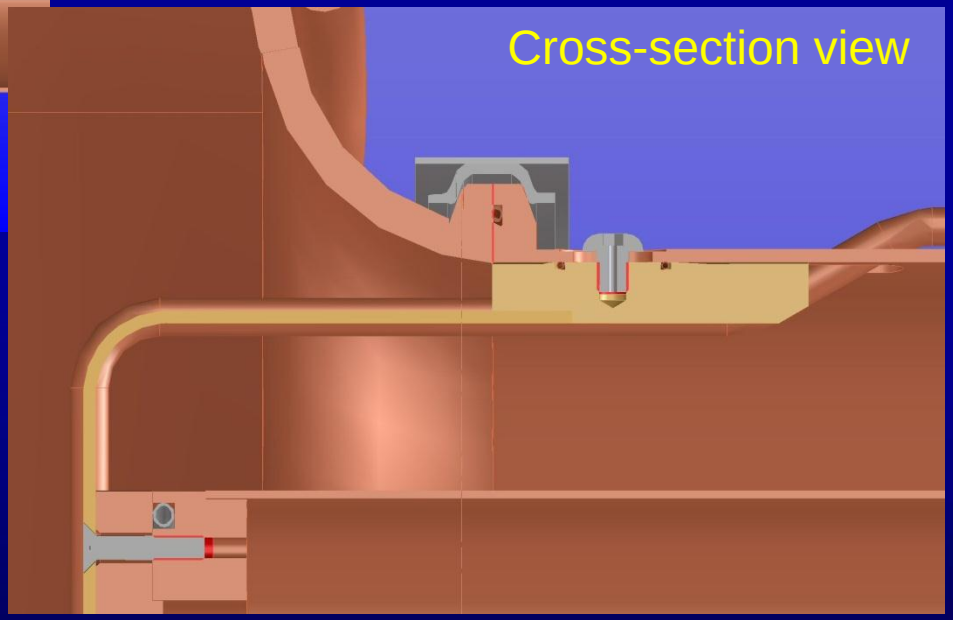




- Testing/experience of the prototype cavity at MTA: sparking at the coupler
- The coupler design has been changed slightly to increase the gap spacing
- The sparking region can be TiN coated if necessary (plan to be tested at MTA using the prototype cavity)
- Adding diagnostics: arc detector at the coupler region

# RF power (loop) coupler

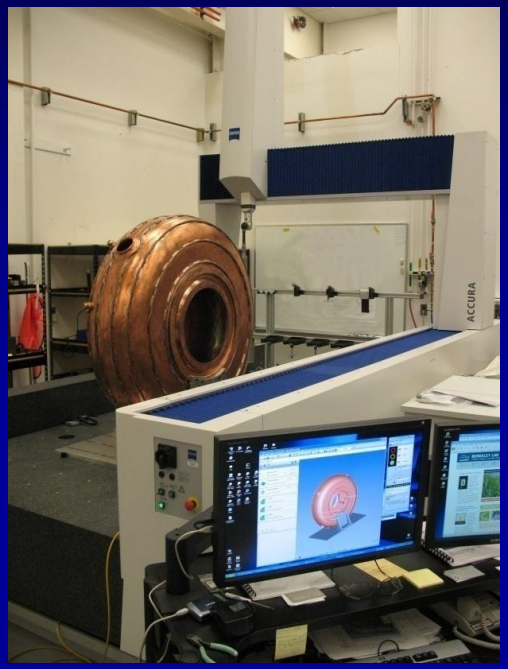





- Modified MICE RF power coupler design is complete, drawing package has been delivered to FNAL, and ready for fabrication
- Fabrication of the couplers will start soon

# Cavity Measurements

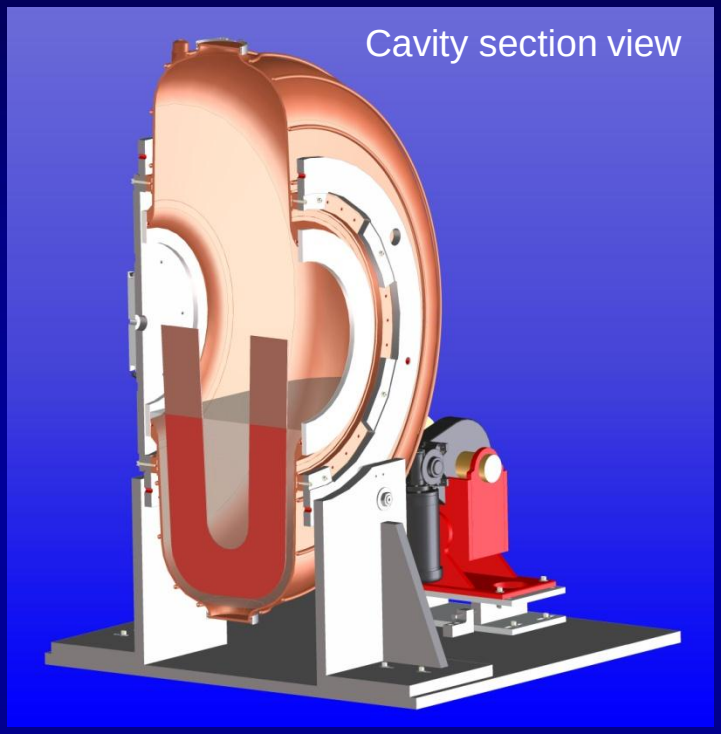


Cavity physical measurement

Cavity frequency measurement

- Physical measurements for the six remaining cavities expected to take approximately 1-1/2 weeks (60 hours)
- RF measurements and tuning to a center frequency after EP

# Cavity Electropolish at LBNL

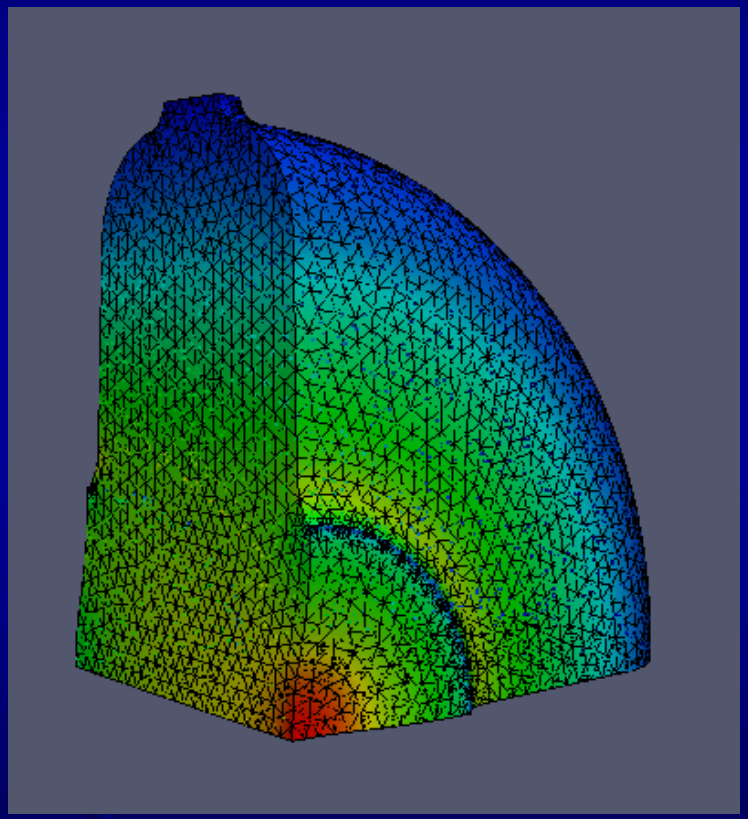



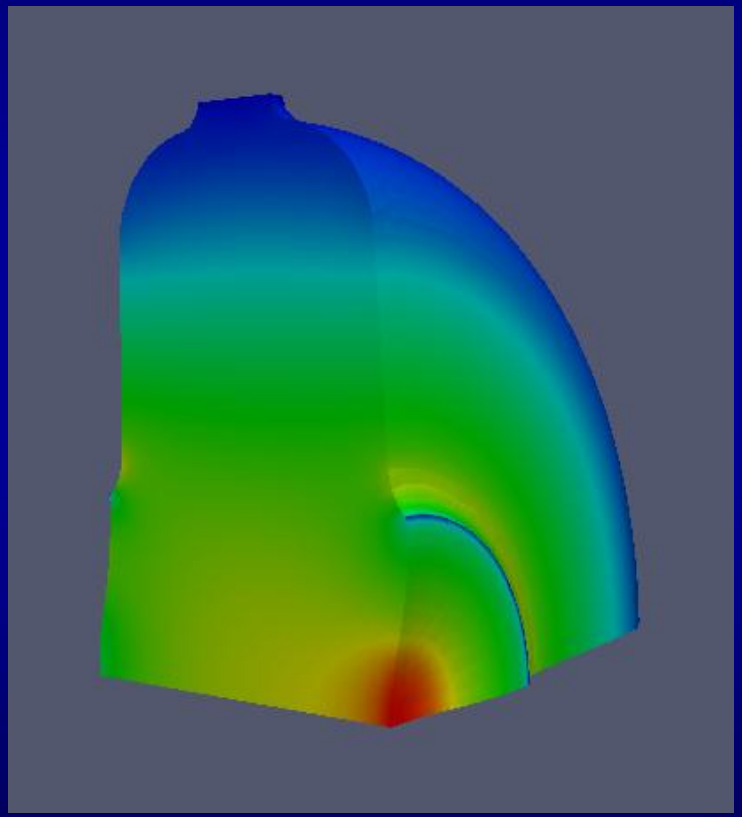

- The inner surface of each cavity will be mechanically smoothed and then electropolished at LBNL using the similar techniques developed at JLab for the prototype cavity
- Fabrication of EP fixturing is complete and electropolishing will start in soon (ES & H approval)
- Electropolishing process will take approximately 1- 2 days for each cavity or 4 weeks to complete all 10 cavities

# Simulations of MICE RF Cavity

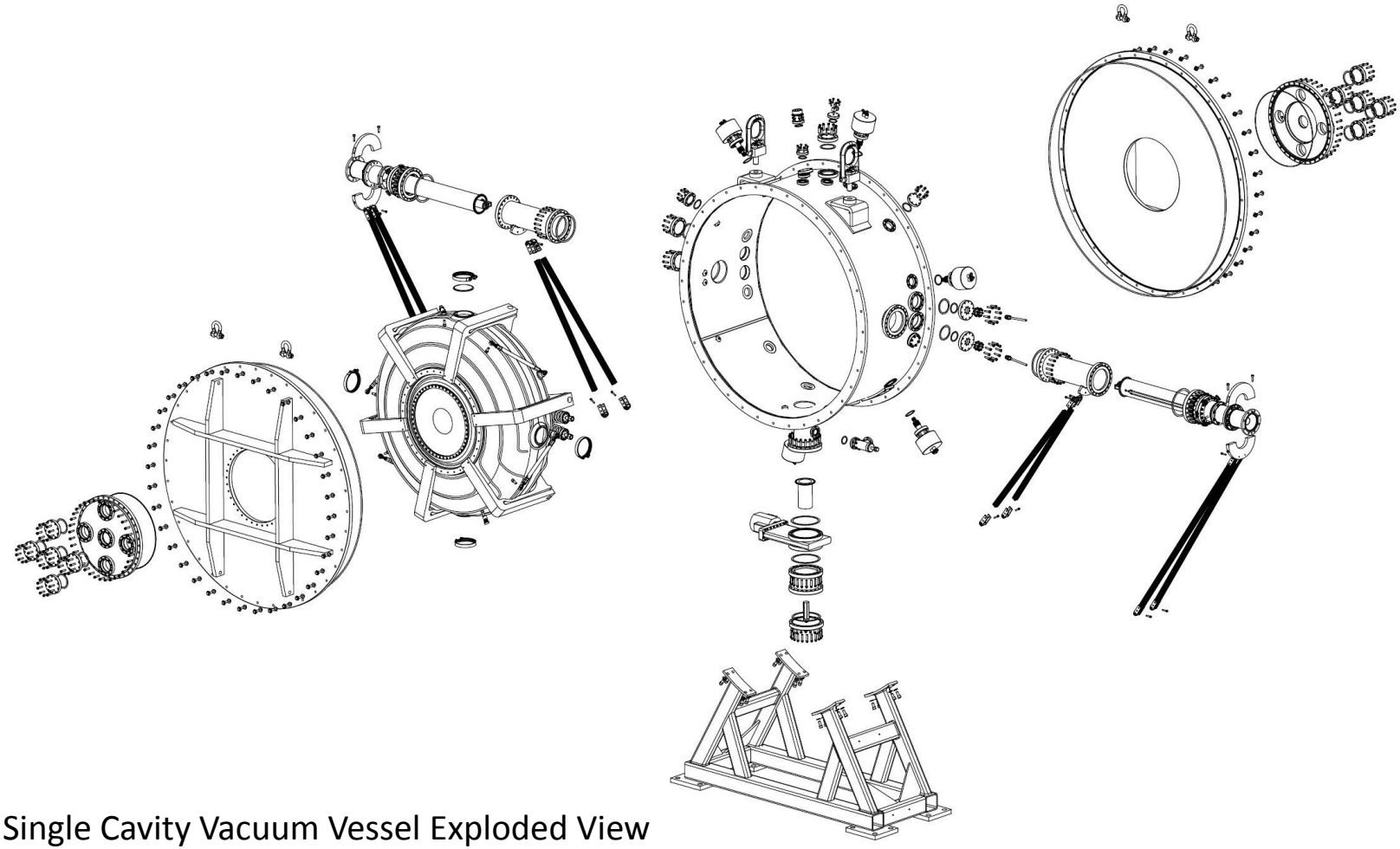
Study of external magnetic field on MICE RF cavity and coupler (Dr. Tianhuan Luo)

- 3D simulations (from CAD model) using SLAC's Omega-3P code: $f$ = 201.866 MHz
- MP simulations, and RF breakdown studies with an external magnetic field



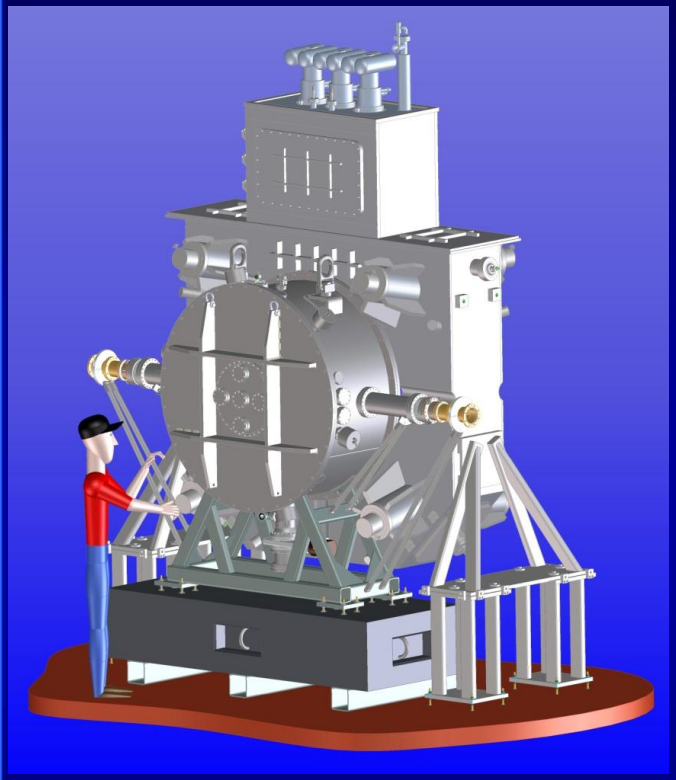


# Single RF Cavity Vacuum Vessel



Single Cavity Vacuum Vessel Exploded View

# Single Cavity Vacuum Vessel

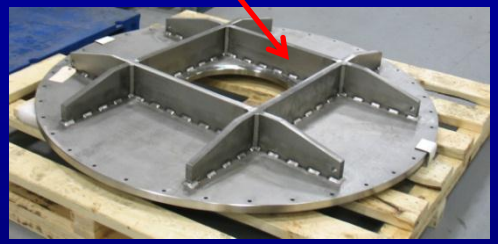


Single Cavity Vacuum Vessel and MuCool Coupling Coil Magnet

Vacuum vessel stand

Vacuum vessel

Vacuum vessel cover plate



Fabrication of the single cavity vacuum vessel is complete at Keller Technology in Buffalo New York

# RFCC Future Work

- **RFCC Vacuum Vessel:**
  - Vessel design is complete but needs to be updated to incorporate changes to the interface with the new coupling coil cryostat design
  - Fixturing for the assembly process needs to be finalized and drawings for fabrication generated
- **RFCC Module:**
  - Finalize fixturing for module assembly and shipping
    - for aligning the frequency tuners onto cavities
    - for inserting the cavities into vacuum vessel
    - shipping skid/tilt fixturing for shipping RFCC to RAL
- ***RF control/analysis :***
  - Diagnostics/control/analysis/interfaces
  - LLRF control (amplitude/phase) and correlations with detectors
    - Timing signal from detector, and calibration & synchronization with RF