

# MICE RFCC Module Update

MICE CM27 at RAL, UK  
July 8, 2010

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Steve Virostek  
Allan DeMello

Lawrence Berkeley National Laboratory

# MICE RFCC Module Update Overview

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- RF cavities
- RF cavity frequency tuners
- Cavity RF couplers
- Beryllium windows
- RFCC module schedule



# RF Cavity Progress Summary

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- Completion of second set of five cavities by Applied Fusion expected in September 2010
- Physical (CMM) measurement of first five cavities recently completed
- RF frequency and Q measurements of first five cavities recently completed
- Local (near LBNL) electro-polishing company has been identified and discussions initiated



# RF Cavity Fabricator - Applied Fusion, Inc.

- E-beam welding of stiffener rings and equators complete
- Port holes are machined and ready for port pulling



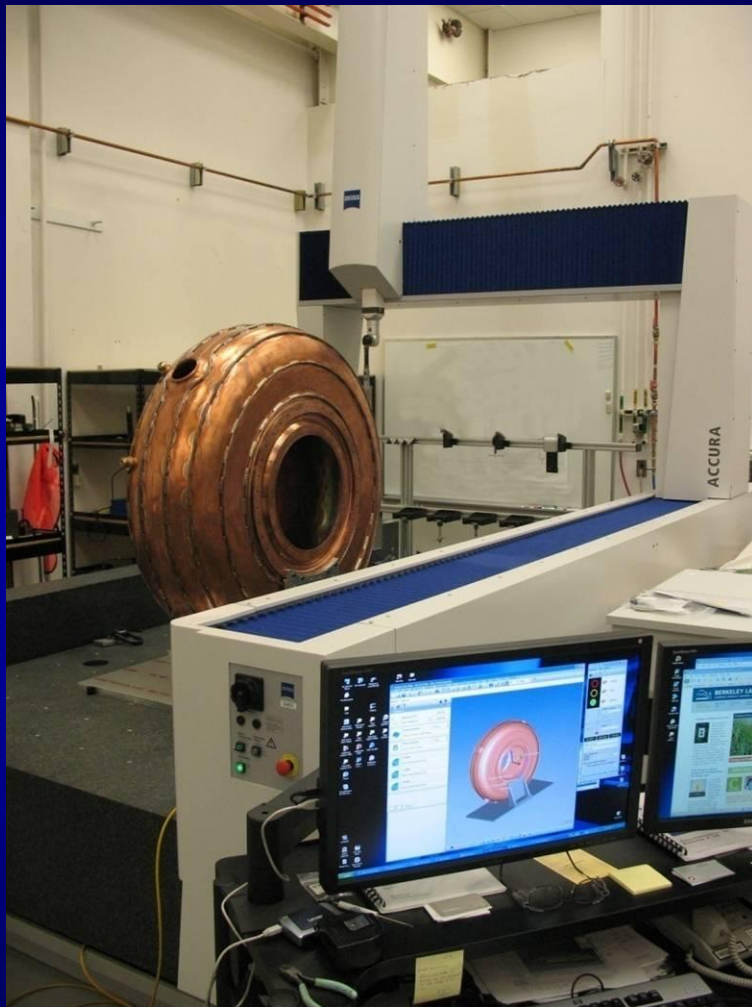
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# RF Cavity Physical Measurement



- Physical measurement of the first five cavities using a CMM is complete
- Specialized tooling was procured to allow measurement of cavity inner profile
- Cavities are ~10 mm narrower than nominal (likely caused by cooling tube brazing), but no issues are expected
- Second set of five cavities will be inspected when delivered to LBNL



# RF Cavity Frequency Measurement



- RF frequency measurements for the first five cavities are complete
- The three Be windows at LBNL have also been characterized
- Refer to Derun Li's talk for details

# RF Cavity Electropolish Vendor



Milpitas California (40 mi to LBNL)

- The inside surface of each RF cavity will be electropolished
- Discussions under way with local company



Large SS piping weldment at AET



Electro-polish tank dimensions:  
12' Long x 5' Wide x 6' Deep



# RF Cavity Future Work

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- Physical (CMM) and frequency measurements will be performed on the remaining five cavities when they become available
- Leak and flow check of the cooling tubes will be performed
- The inside surface of each RF cavity will be mechanically buffed and electropolished
- The ten cavities will be “tuned” to each other through plastic deformation (if necessary) for best center frequency (to be done at LBNL)





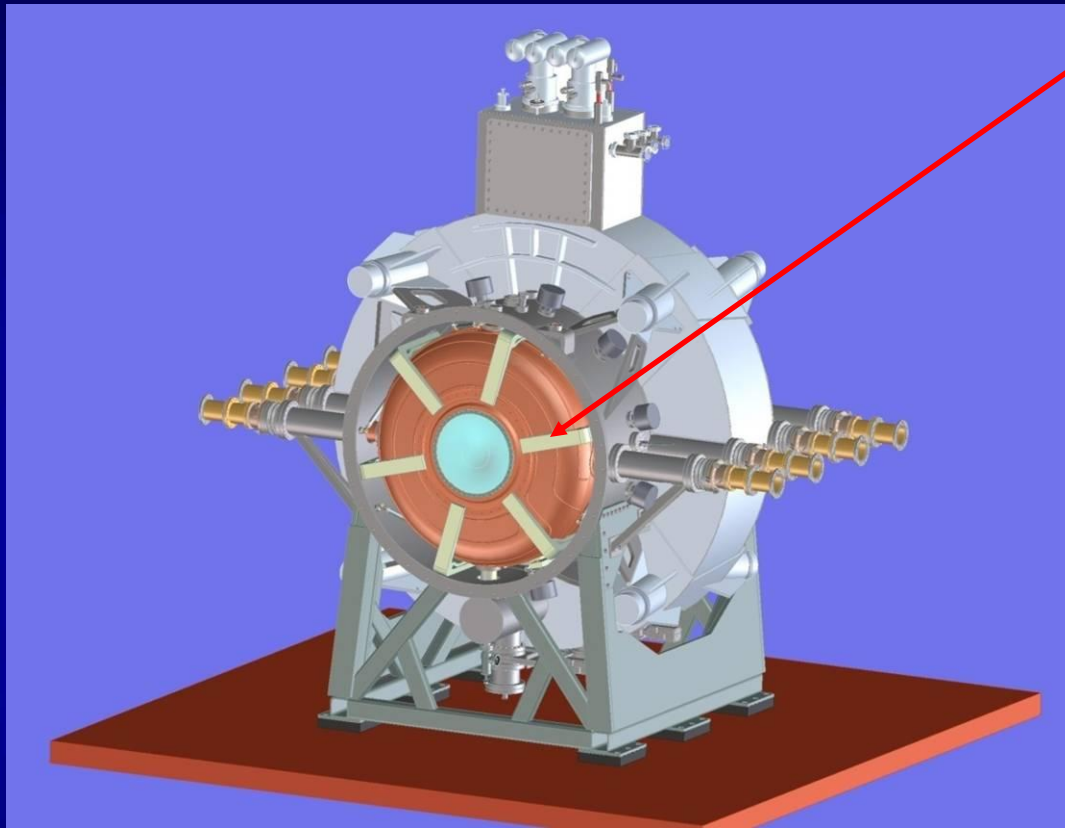
# RF Cavity Frequency Tuner Progress

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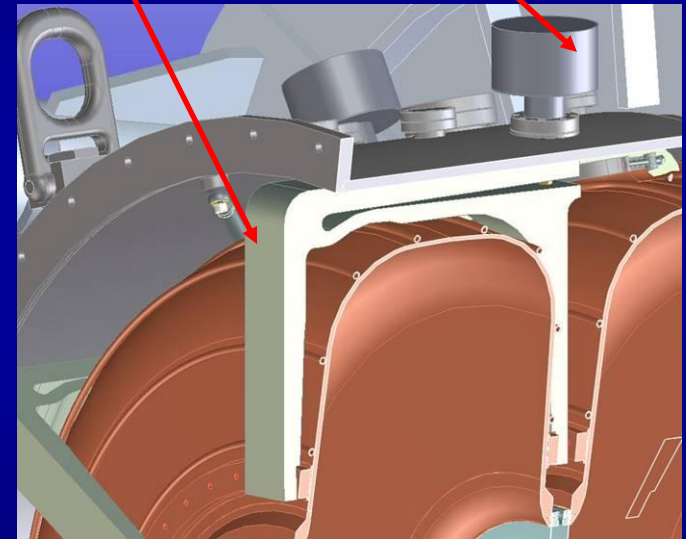
- Tuner design is complete
- One full size tuning arm (for testing the system) has been fabricated
- Aluminum test cylinder (1/6 of cavity) has been fabricated to replicate the cavity stiffness
- Assembly of a pneumatic actuator has been completed
- Control system components have been assembled into a working system
- Integrated tuner system has been tested, and  $\pm 2$  mm of tuner arm motion has been confirmed



# RF Cavity Frequency Tuner Overview



- 24 dynamic cavity frequency tuners per module
- Tuner Actuator
- Tuner Flexure Arm

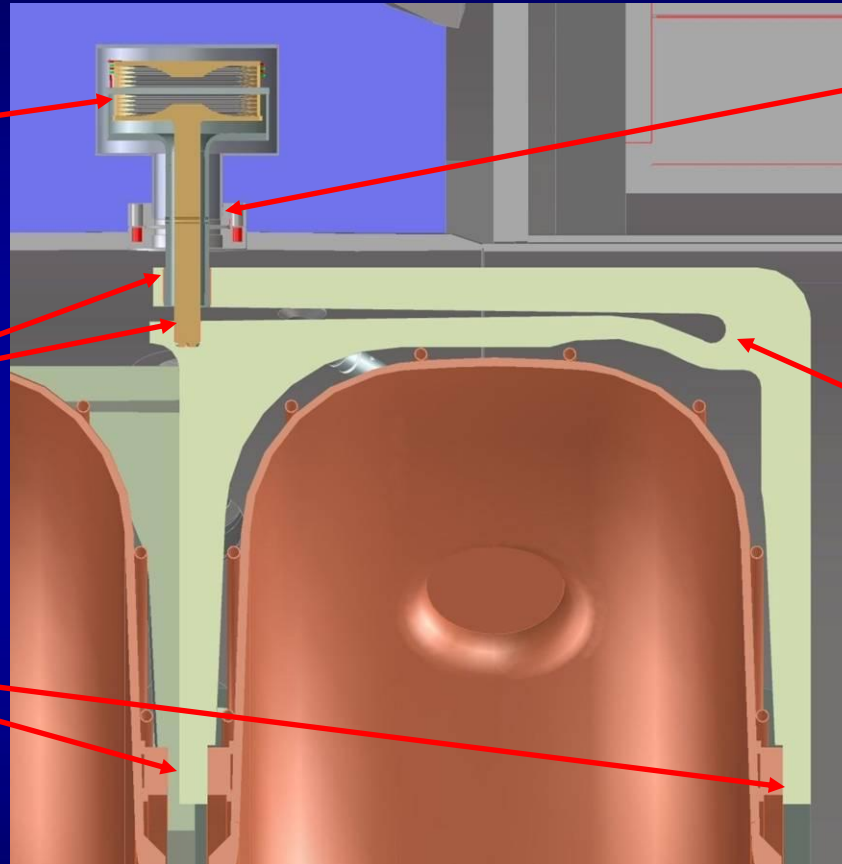


- Tuners operate in a bi-directional “push - pull” mode ( $\pm 2$  mm)
- Tuning will be automatically achieved through a frequency feedback loop



# RF Cavity Frequency Tuner Components

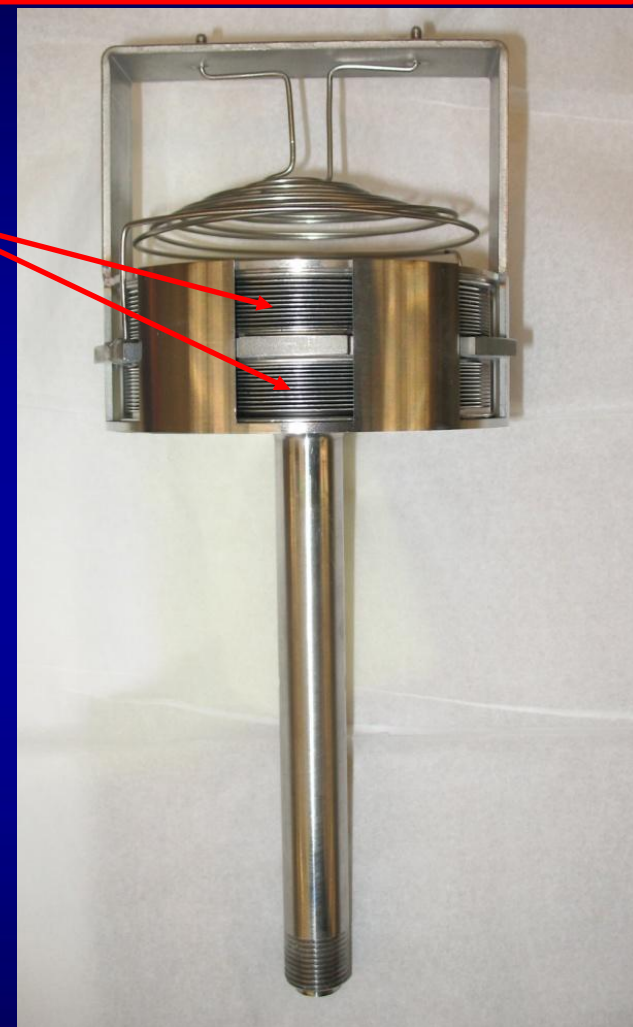
- Dual-action actuator
- Actuator is screwed into the tuner arm
- Fixed connection to cavity



- Tuner/actuators are thermally independent of the vacuum vessel
- Flexure tuner arm

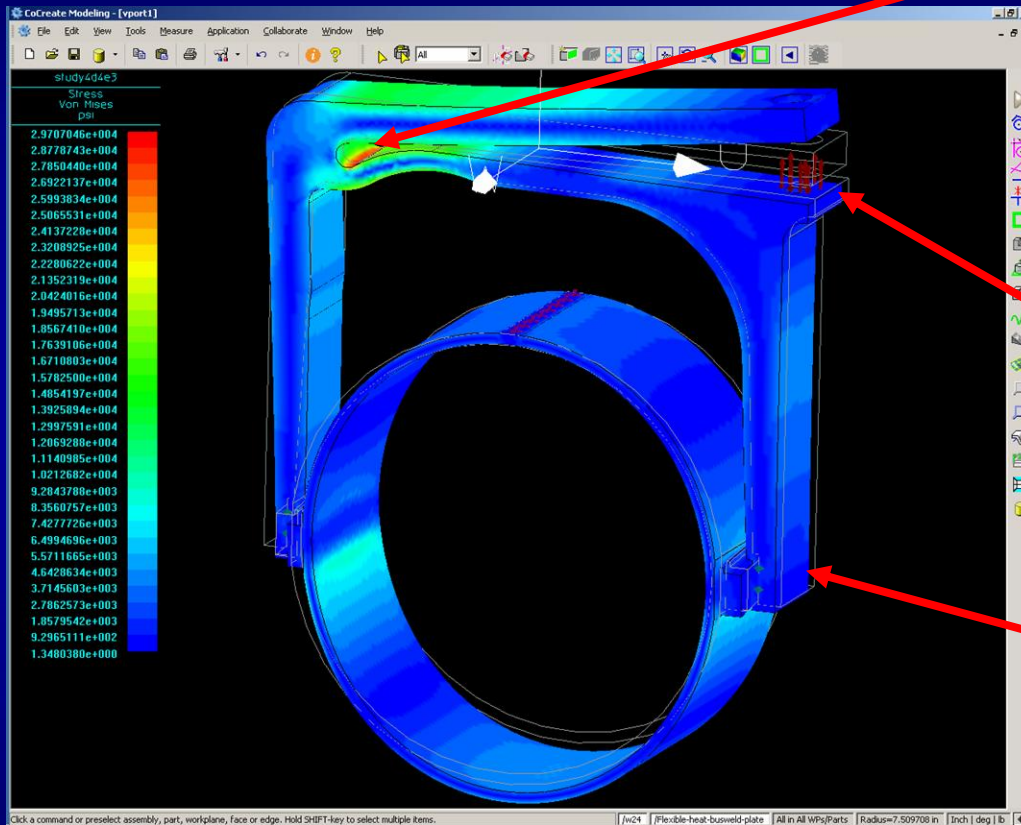
# Prototype Actuator Design

- Dual-action (push/pull) actuator
- Actuator mechanical components (except bellows) were fabricated and assembled at LBNL
- Forces are transmitted to the cavity stiffener ring by means of “push-pull” loads applied to the tuner flexure arms by the dual action actuator assembly





# Tuner System Analysis Review



- The Von Mises stress at the flexure is 205 Mpa (30 ksi)
- The input load by the air actuator is 3.56 kN (800 lb)
- The tuner arm displacement is 5.4 mm (10.9 mm bi-directional)
- The cavity displacement is 1.0 mm per side

# Tuner Flexure and Test Ring



- Full size (3" thick stainless steel) prototype tuner flexure with actuator and test ring

- Prototype actuator threaded into tuner arm

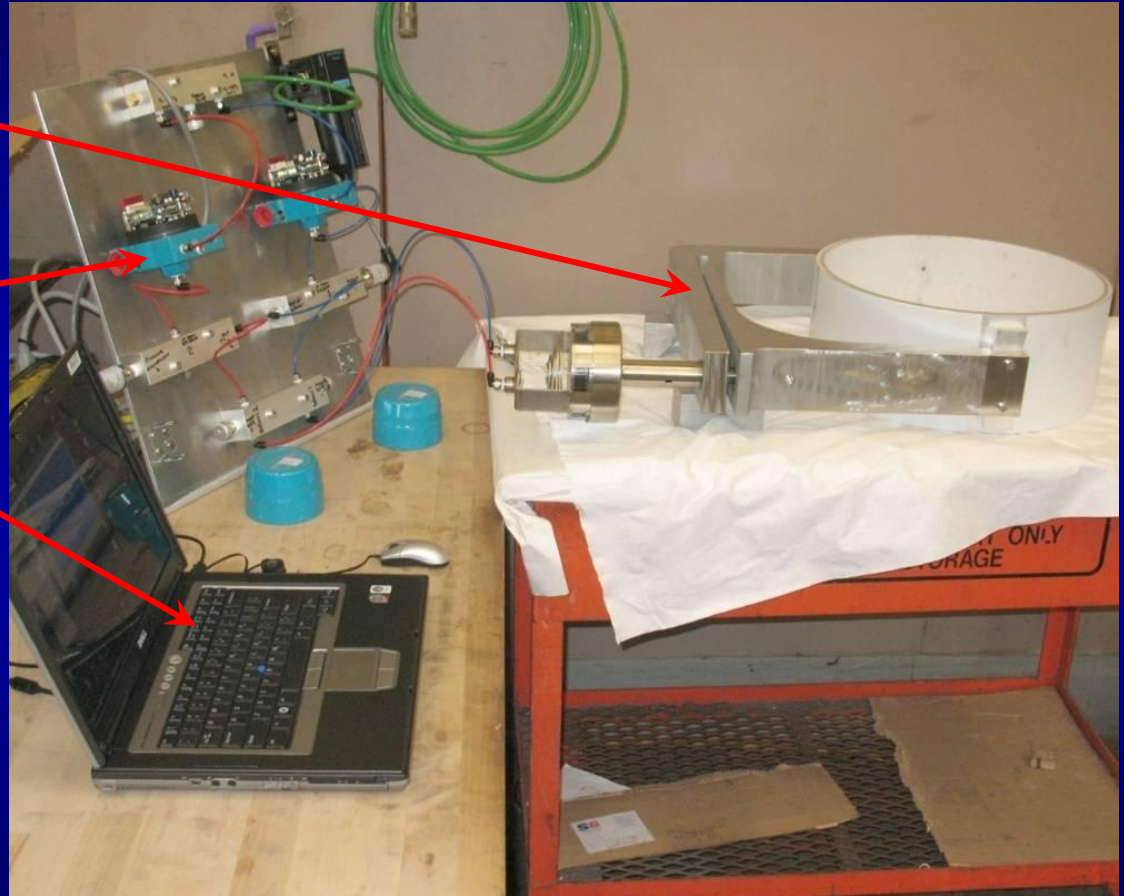
- Aluminum test ring with spring rate equivalent to  $1/6^{\text{th}}$  of a cavity



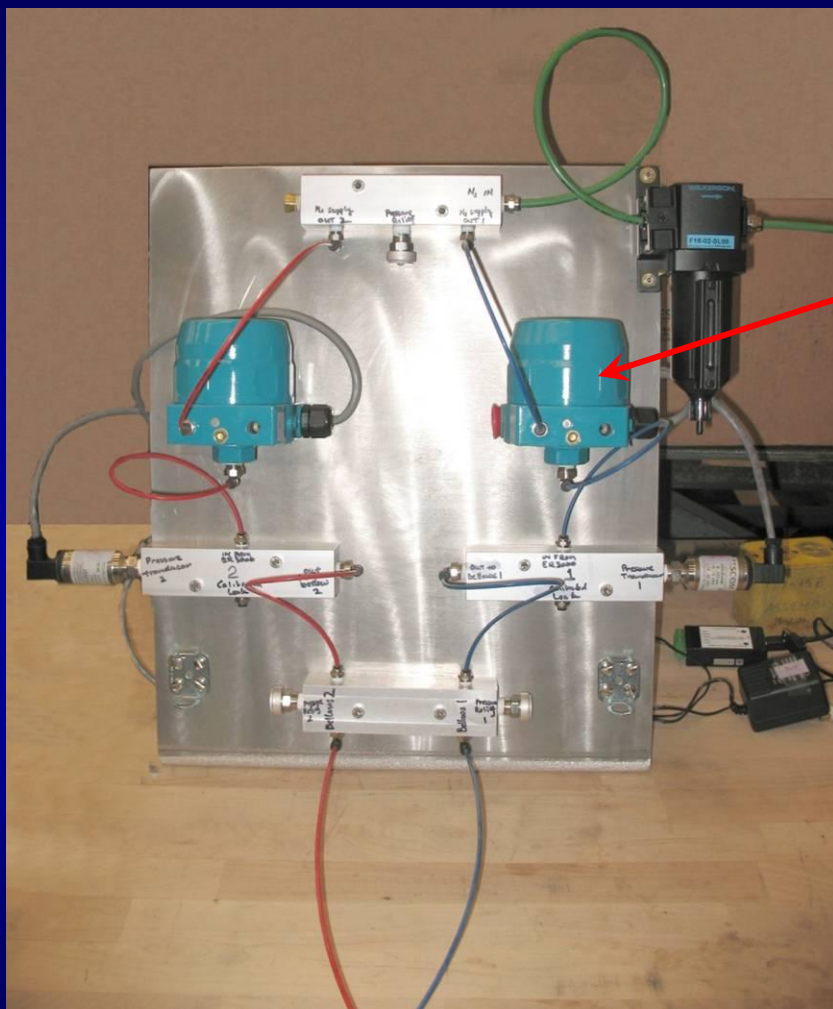
# Prototype Tuner Arm Test Setup

## Test set-up includes:

1. Actuator, tuner arm and test ring
2. Control regulators and manifolds
3. Computer control



# RF Cavity Tuner Control System

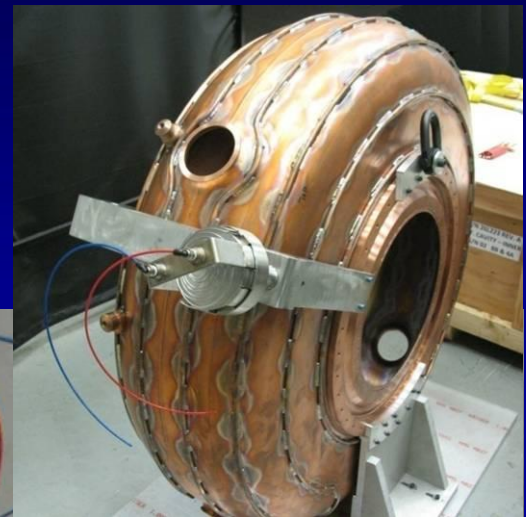
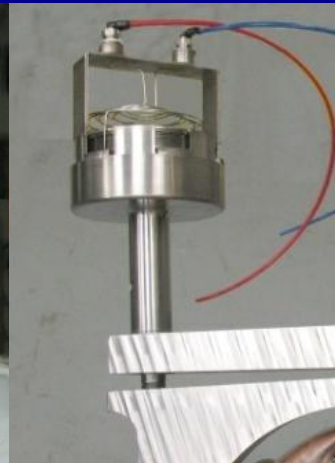
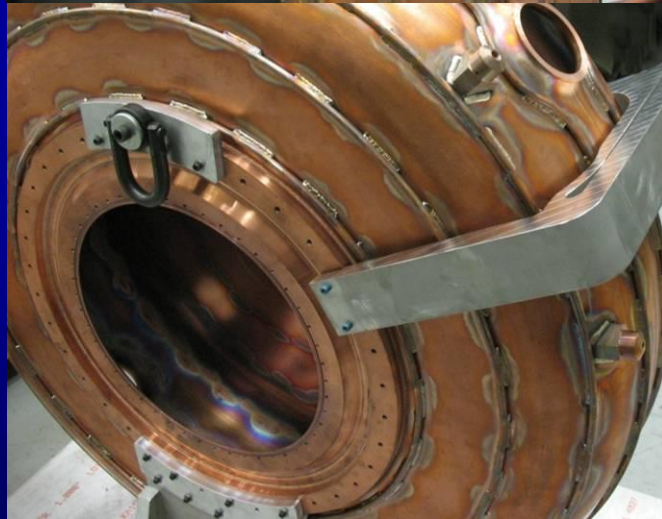
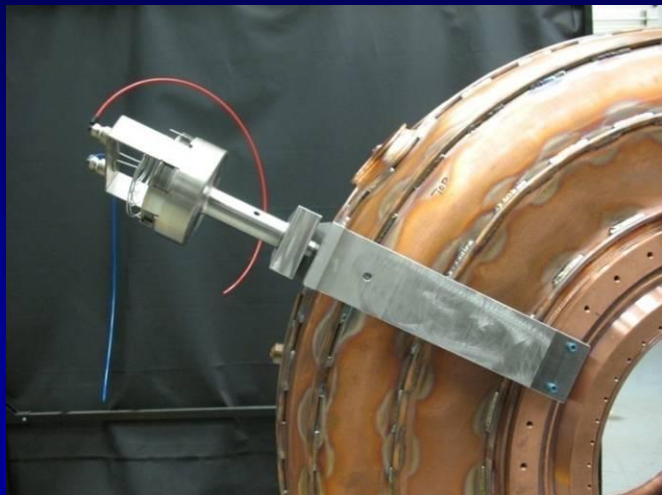


- Emerson ER3000 electronic pressure controllers - one for each side of the actuator
- $\pm 0.1\%$  accuracy (over 110 psi range)
- Remote computer controlled for frequency feedback
- 16 total modules required for two RFCC modules



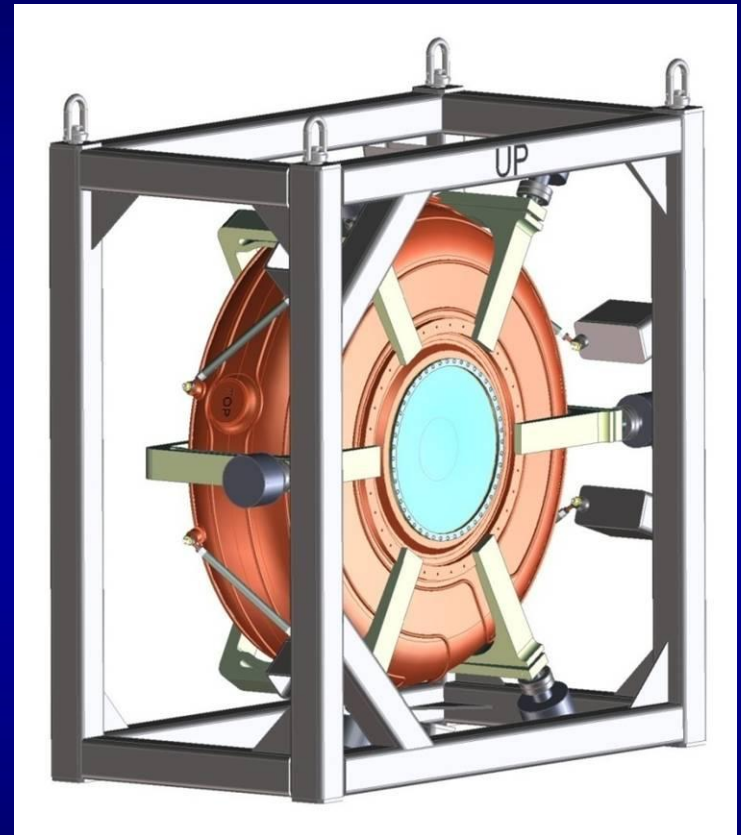
# RF Cavity and Frequency Tuner

- Prototype tuner/actuator mounted on cavity

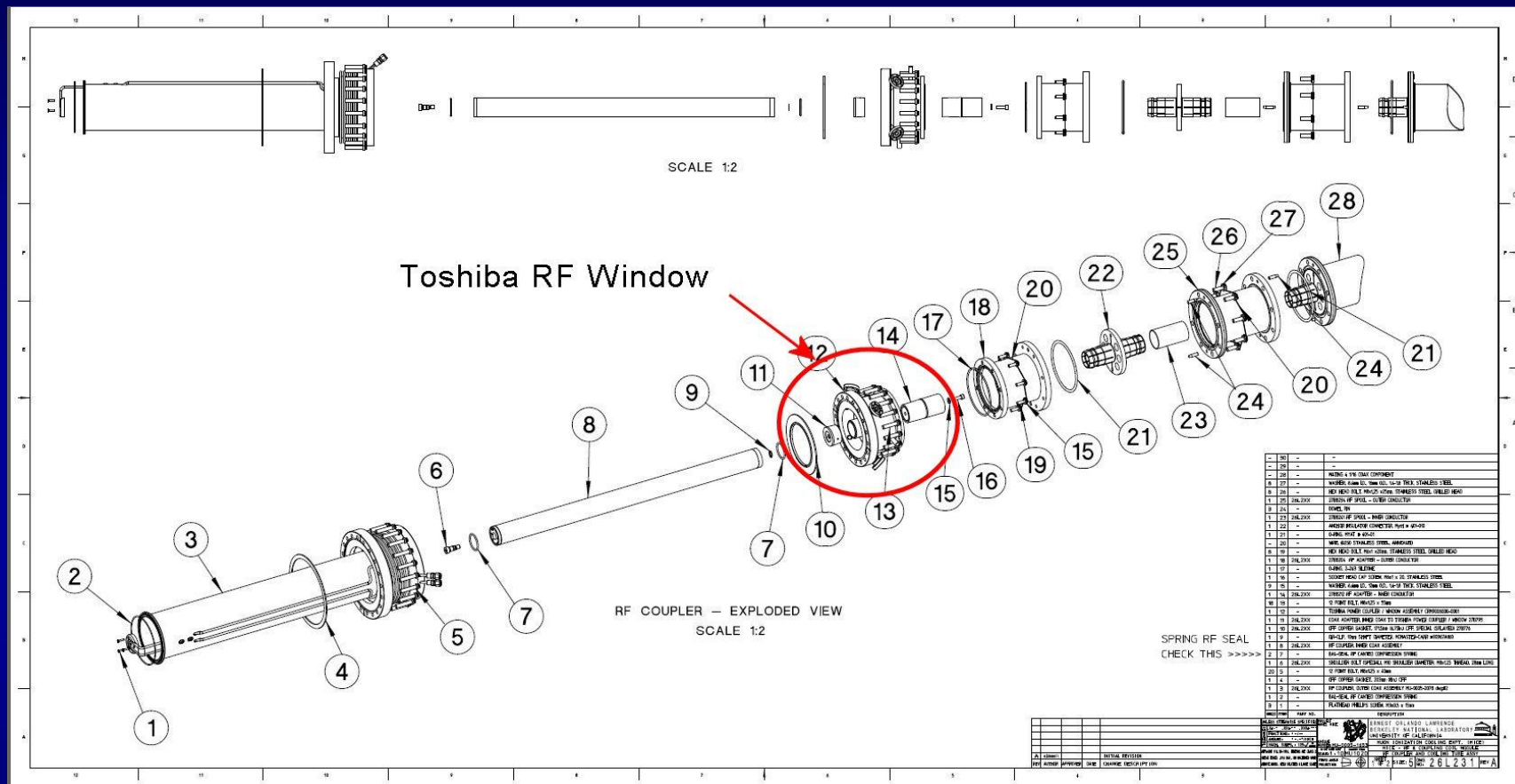


# RF Cavity Frequency Tuner Future Work

- Order parts for 5 more (6 total) actuators (incorporating any refinements from the prototype)
- Fabricate 5 more tuner flexures
- Build a cavity suspension frame
- Test the RF tuning system with 6 tuners and actuators on a cavity
- Actuators will be manifolded together
- Frequency measurements will be taken to verify the frequency tuning range



# Toshiba RF Window for Cavity RF Coupler



- Assembly drawing of cavity RF coupler showing Toshiba RF Window



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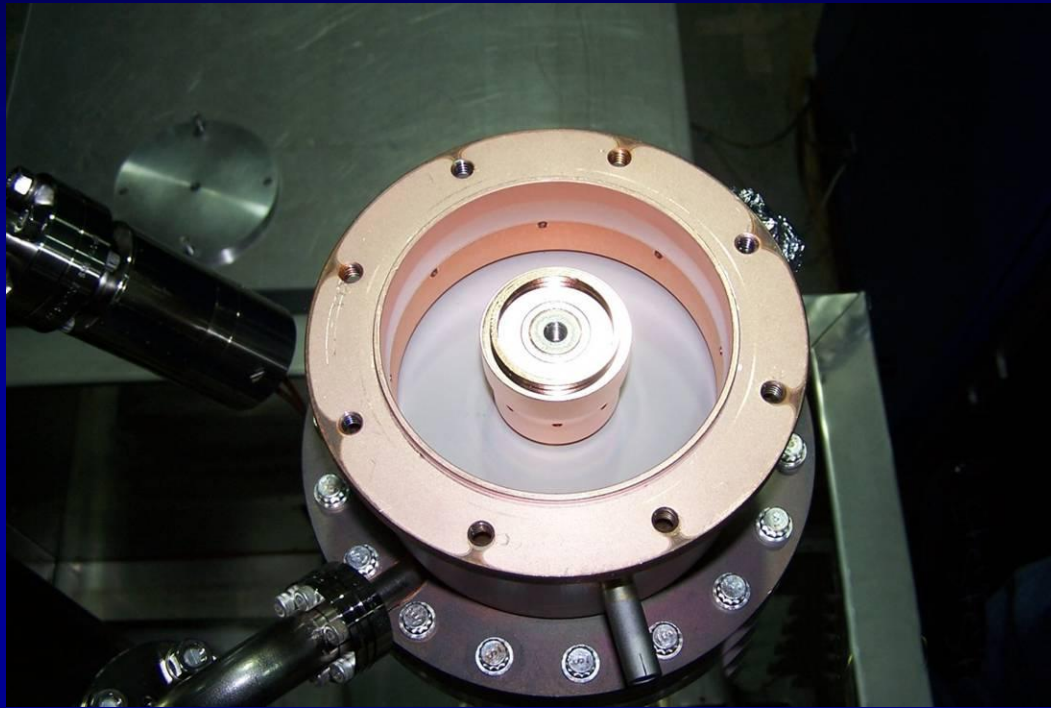
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# Toshiba RF Window



- Quote for 10 Toshiba RF windows has been obtained
- U. Miss. Is in the process of placing the order (~\$180k)
- Slight modification to SNS design (now all metric threads)



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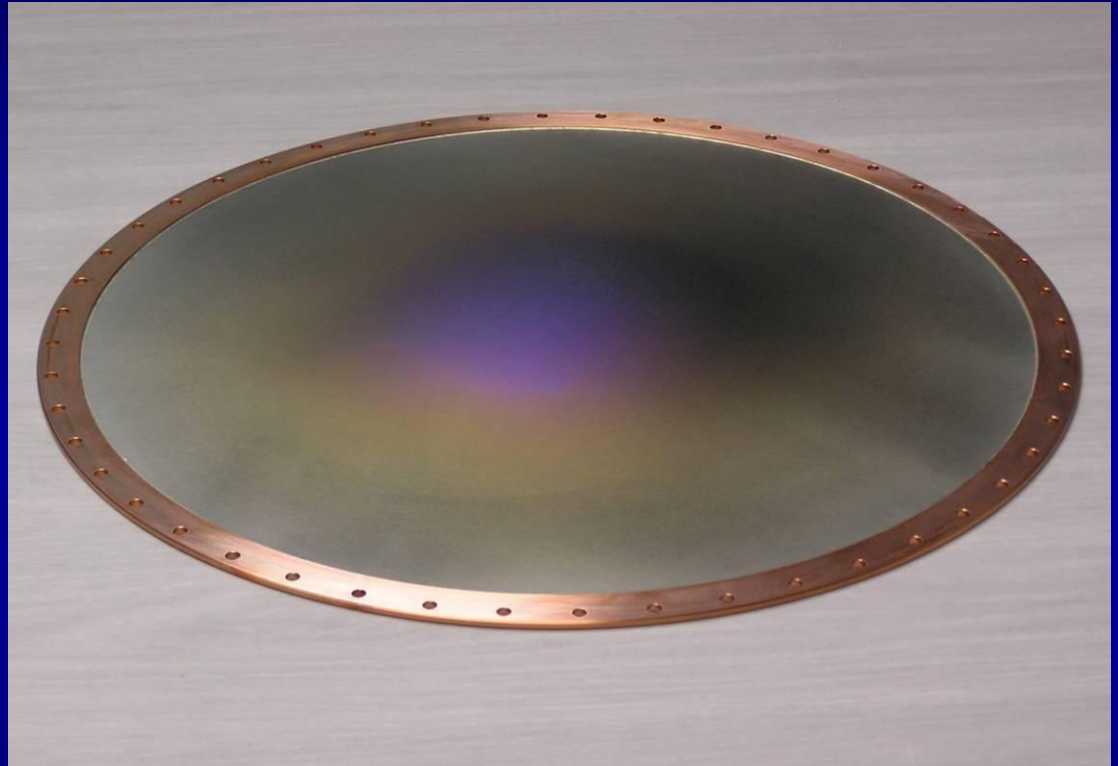
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# Beryllium Window Update

- 3 of 11 windows have been received by LBNL from Brush-Wellman
- Windows have been characterized during cavity frequency measurements
- An additional 8 windows are expected to be delivered in the next two months



# Schedule Summary

