Progress and Plans for Cavity Tests at MuCool Test Area

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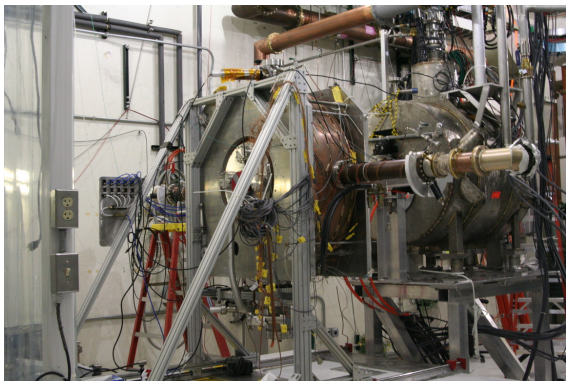
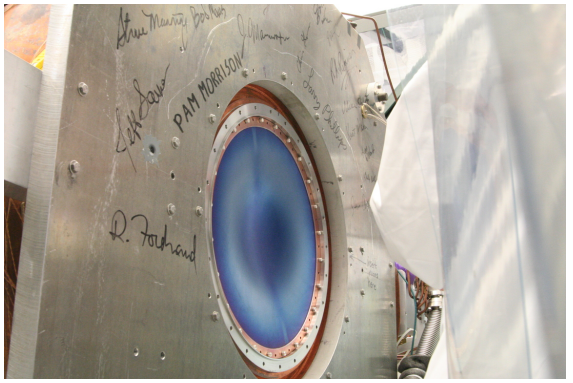
MICE Collaboration Meeting

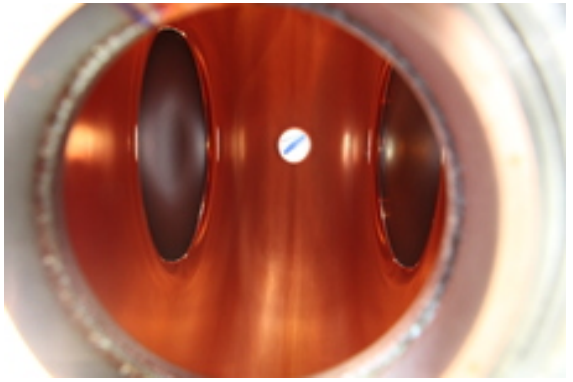
June 18, 2013 -- IIT

MTA 201-MHz Program Overview (Surface treatment, NF channel, MICE)

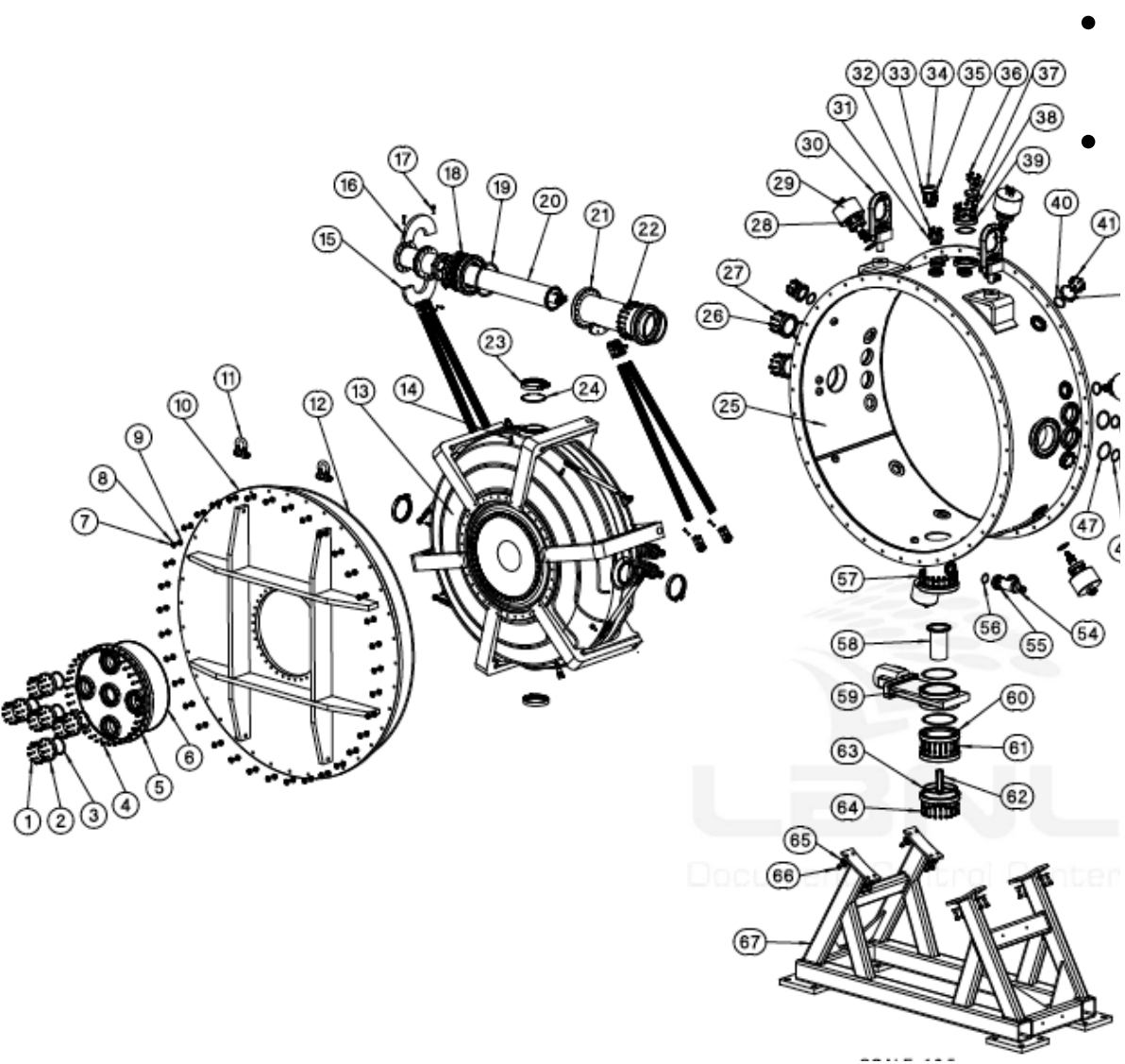
- 201-MHz MICE prototype cavity with SRF-like surface treatment (EP, HP rinse)
  - Conditioned to design gradient quickly
  - Demonstrated operation with large curved Be windows
  - Somewhat reduced performance in fringe field of solenoid
  - No surface damage seen on cavity interior
  - Some evidence for sparking in the coupler
    - Multi-pacting studied (T. Luo)
    - Design now modified
    - Also looking into TiN coating
  - Radiation output measured (MICE detector backgrounds)
- Future
  - Install/operate single-cavity vessel
  - Large diameter magnet (coupling coil) needed for field configuration closer to MICE/cooling channel



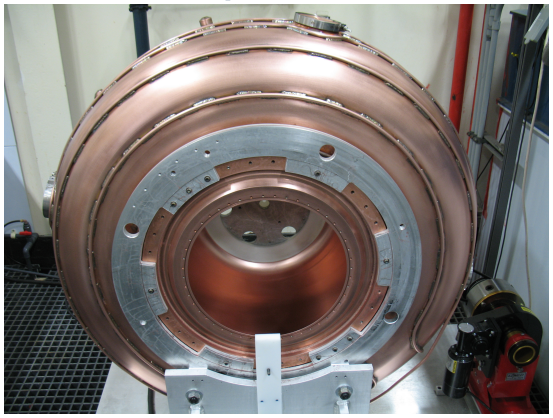




201-MHz Single-Cavity Module

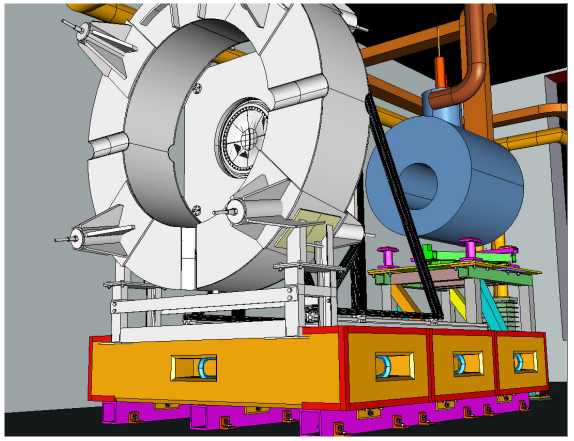


- MICE cavity in vacuum vessel for MTA test
- Components
  - 1st MICE cavity EP'ed at LBNL
  - Vacuum vessel built at Keller
  - Be windows in hand
  - Actuators built at LBNL
  - Tuner forks built at FNAL
  - Ready for fabrication of new couplers at LBNL

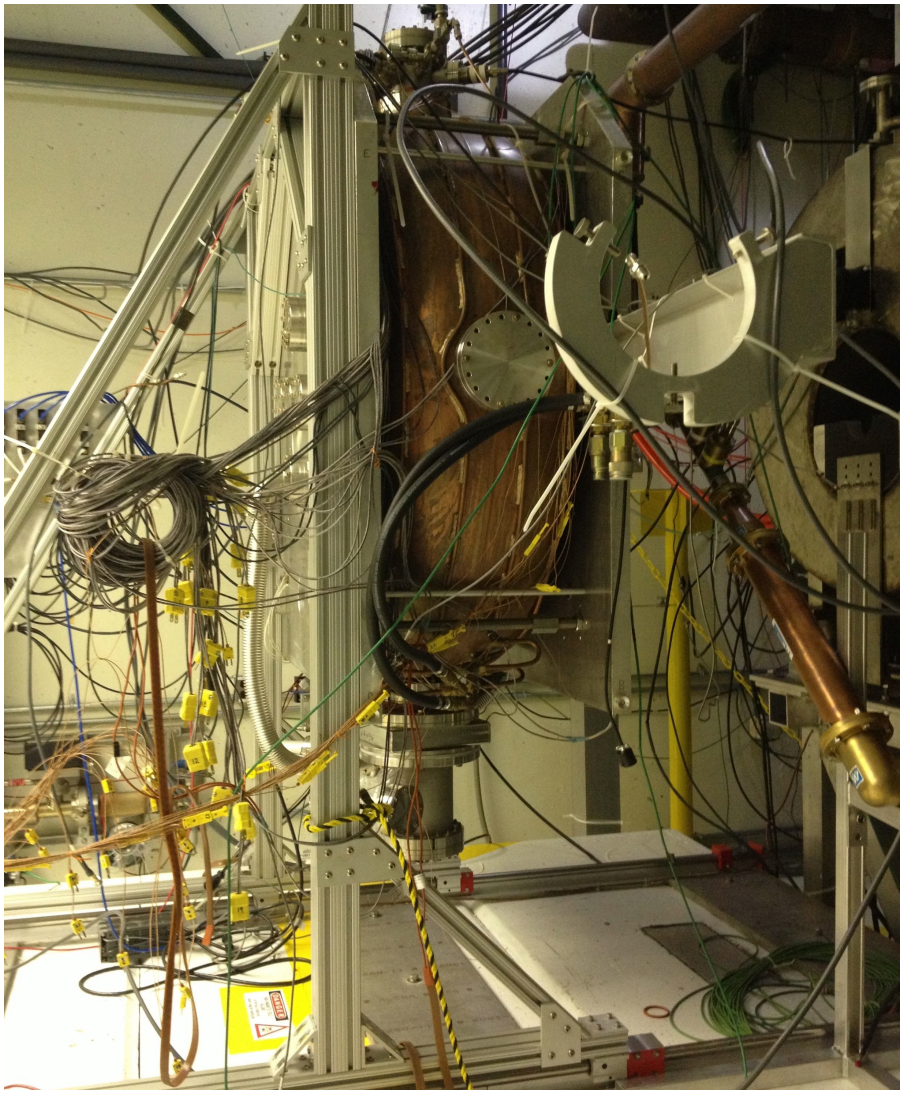


201-MHz Single-Cavity Module

- Assembly/integration
  - Cavity and vessel at Lab-6
  - Clean room prepared
  - Plan in place for handling and transport (R. Schultz, J. Volk)
  - Assembly fixtures designed (A. DeMello)
  - Tuner control bench tested (L. Somaschini talk)
- Expect operation Fall 2013
  - beam test also under consideration
- Ultimately will be tested with the first Coupling Coil Magnet
  - Requires 6-month MTA shutdown

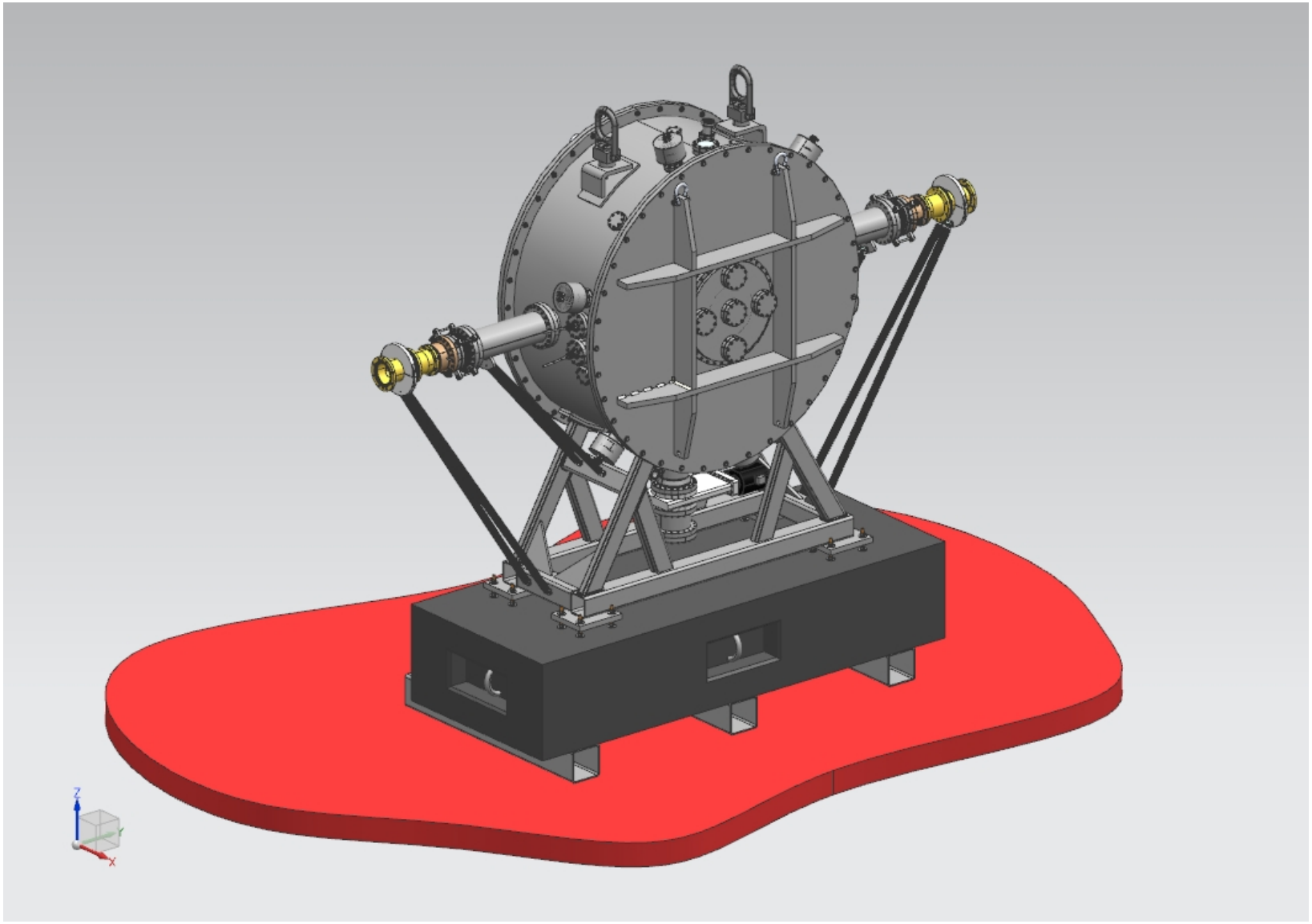


Current configuration

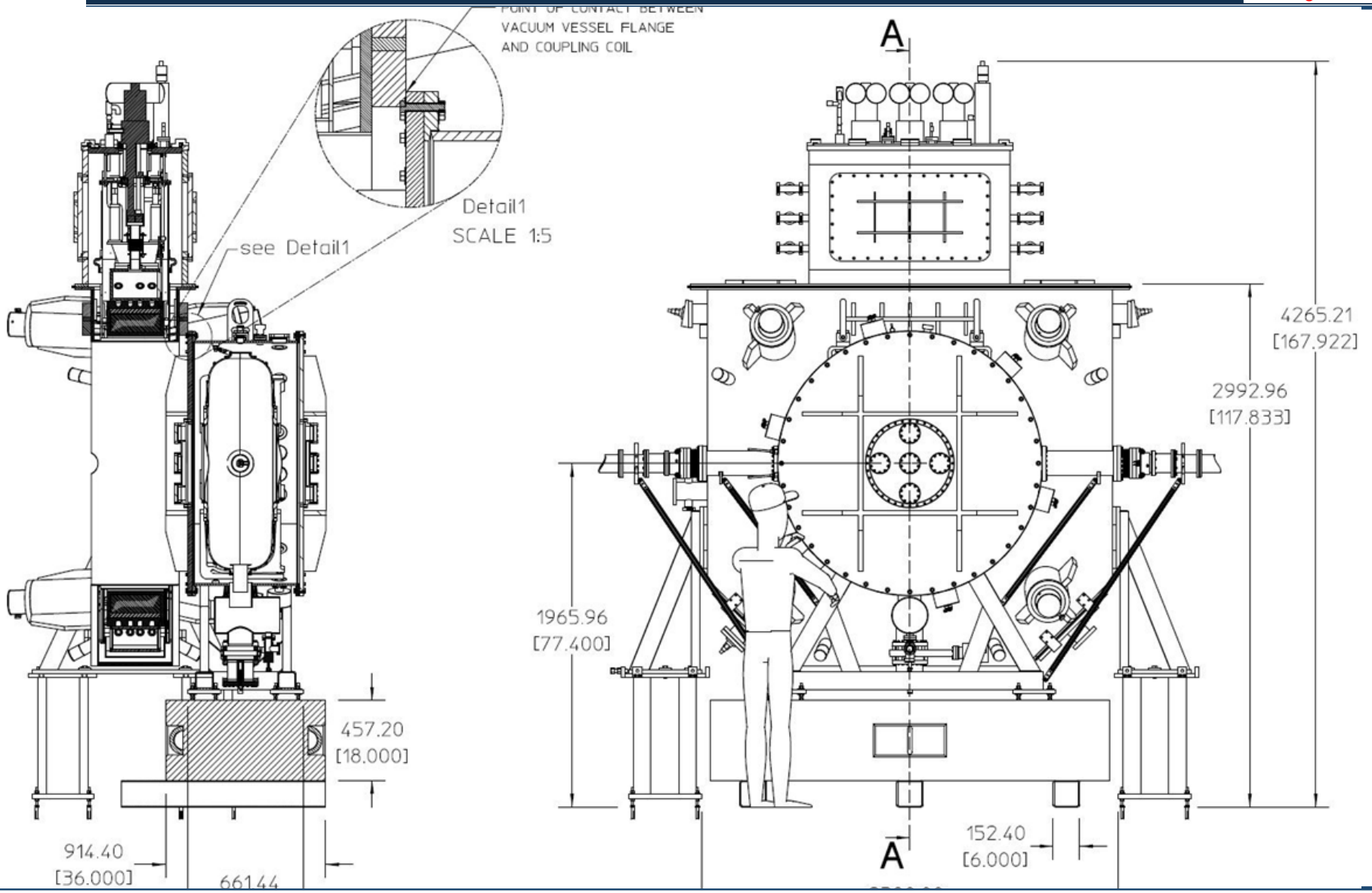


- Original prototype cavity still in the hall
  - was lifted onto platform during long shutdown with shield wall out
  - using temporary forklift
- No vacuum vessel, air outside
  - end-plates for support
- Couplers already removed
  - one cut up for inspection
- To be lifted off platform
  - with new gantry crane
    - span limited by entry maze
  - and rolled out through labyrinth on casters
- Rails will be reused for new module
- Be windows will be transferred to new cavity

Next -- Single-Cavity Vessel

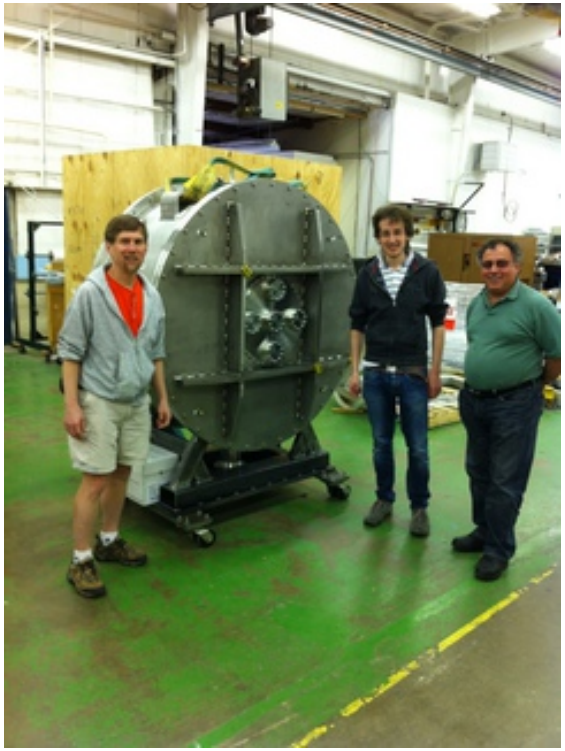


Final layout -- RFCC$_{lite}$



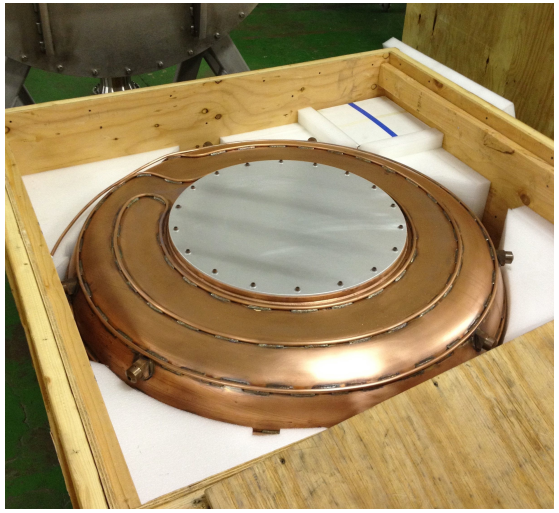
Components in Lab-6

Vacuum vessel on transport stand



Tuner installation fixture (horizontal stand)

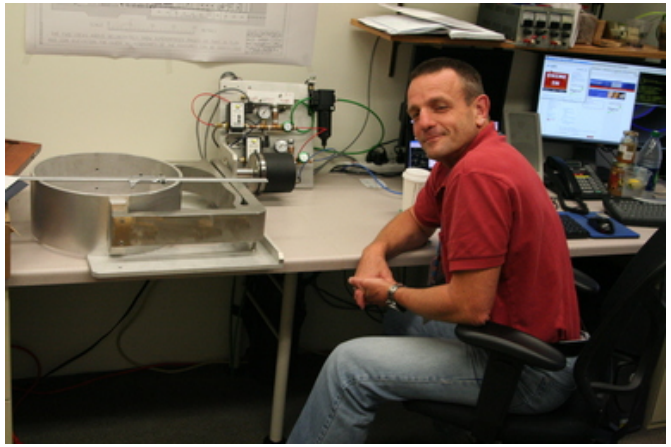
Tuner forks

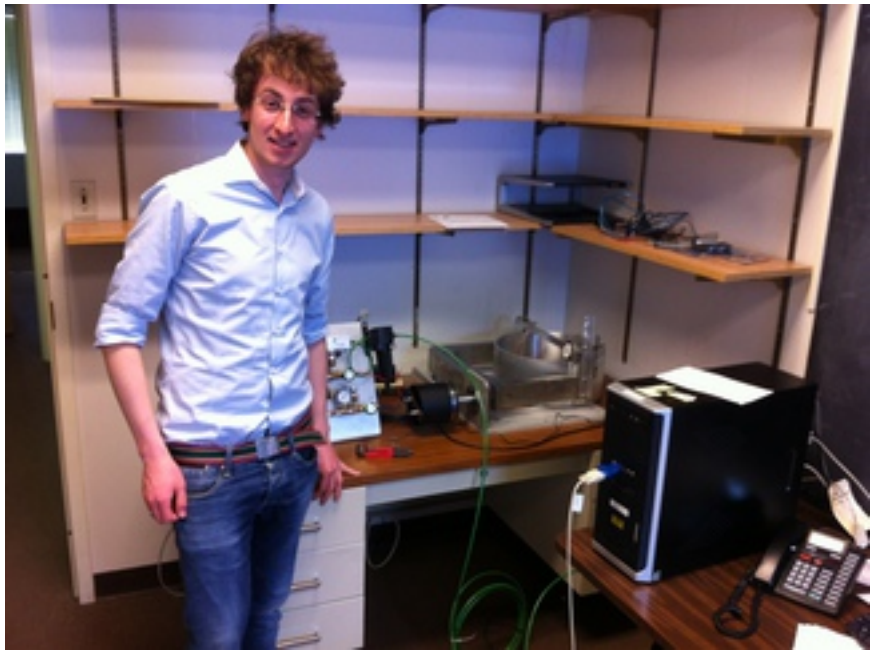


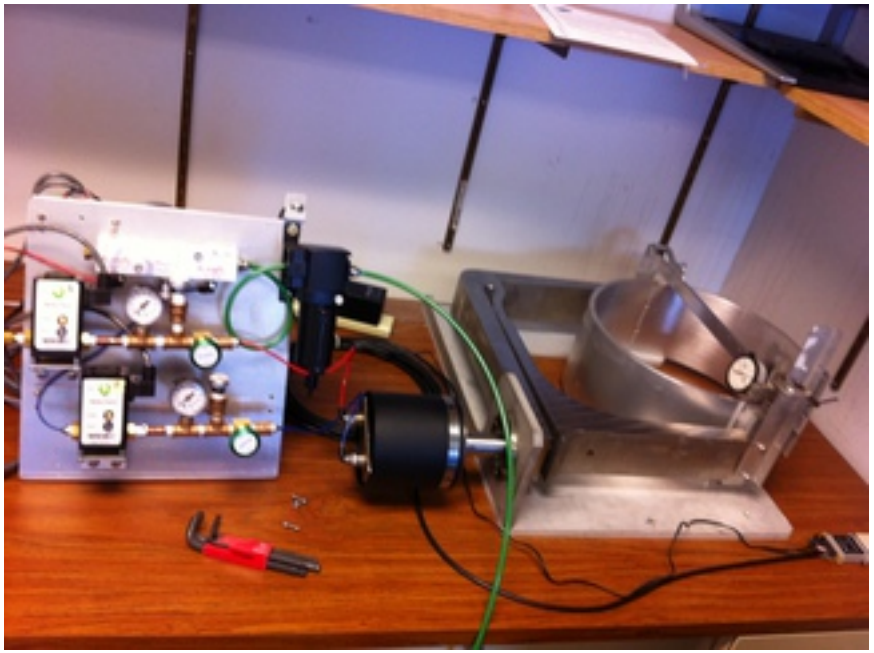
Cavity

Tuner bench tests

- First set up on P. Hanlet's desk (EPICS)
- Transferred to L. Somaschini's desk (LabVIEW)
- Forks to be trimmed/tested in Lab-6
- All actuators in hand
- 2 new proportional valves purchased



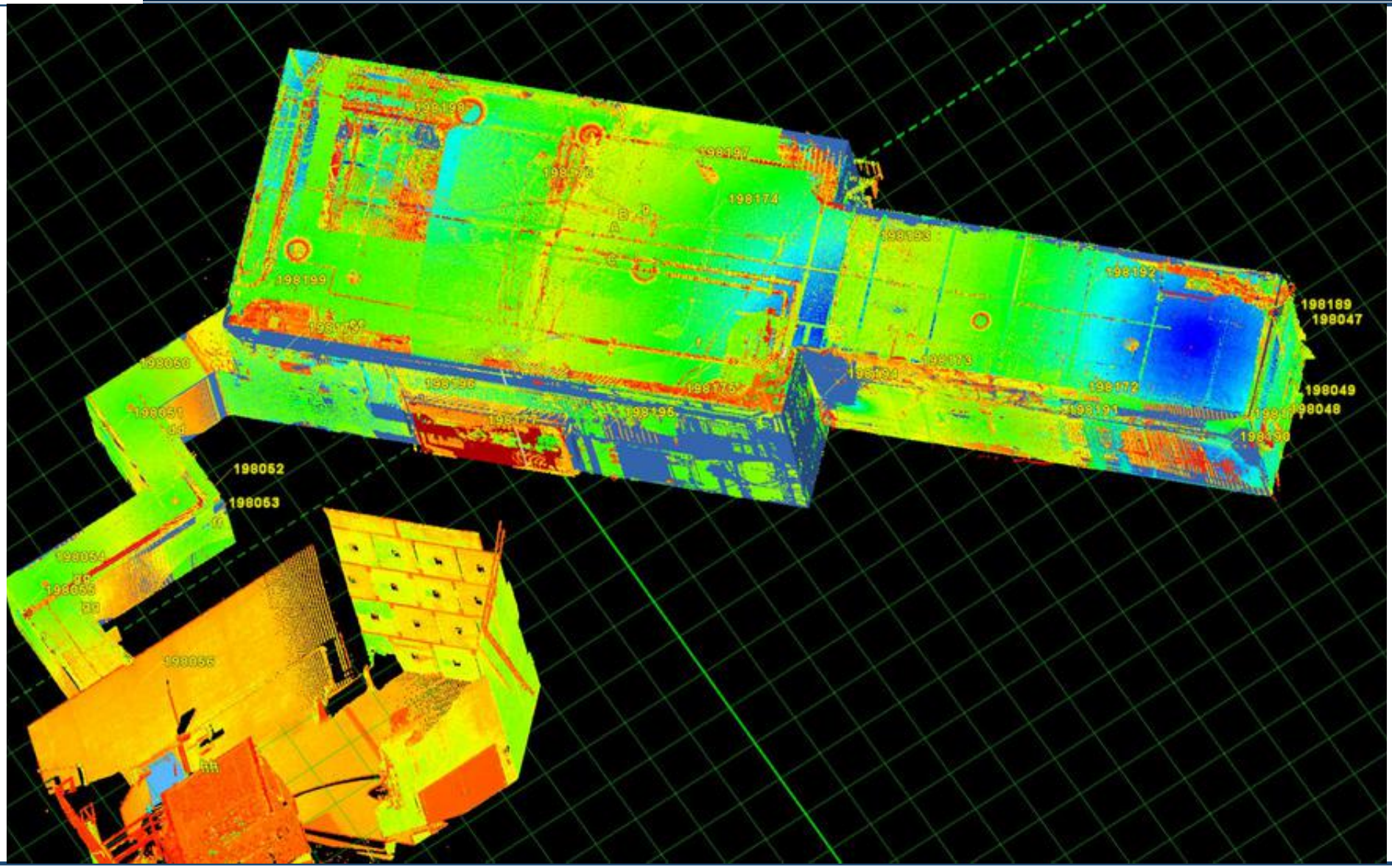




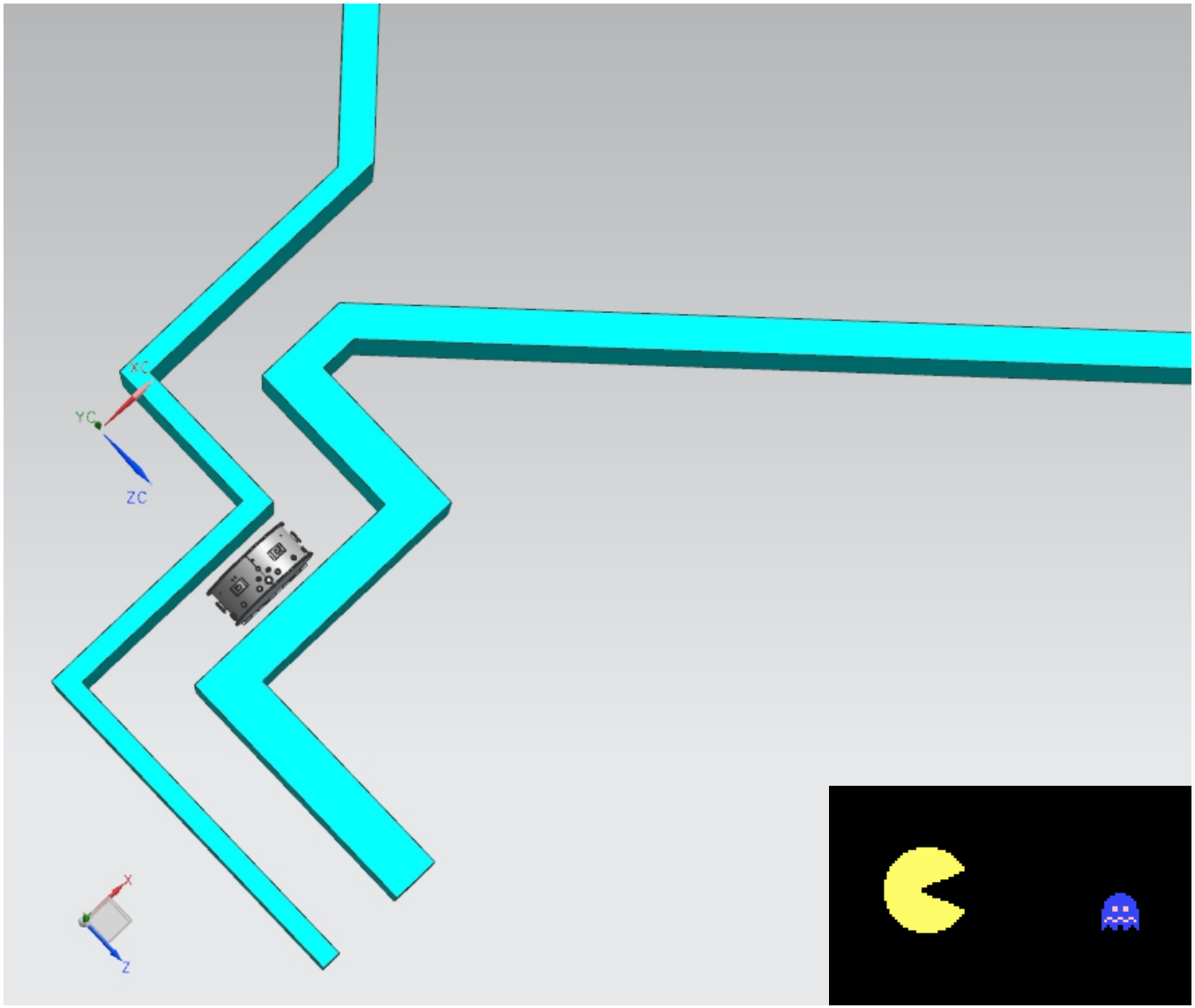
Module Transport

- Will bring into MTA hall through labyrinth
- Vessel with heavily ribbed doors too wide for labyrinth
  - Will remove and roll in doors separately
  - Put on thin cover plates to keep module interior clean
- Module on stand too tall for clean room and labyrinth
  - New “transport” stand is 10” shorter
- Tight fit – checked with laser scan data

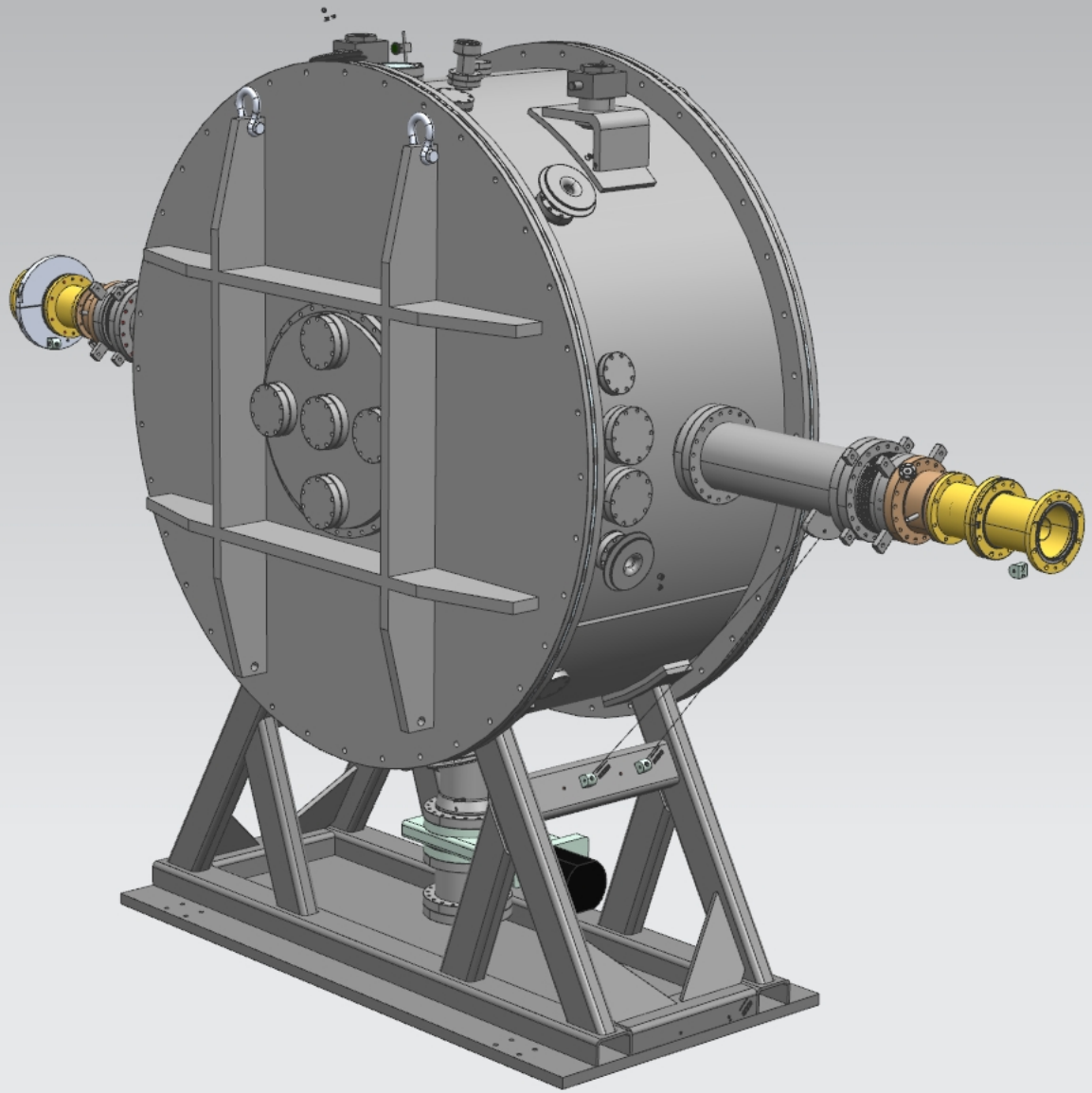
Laser scan data



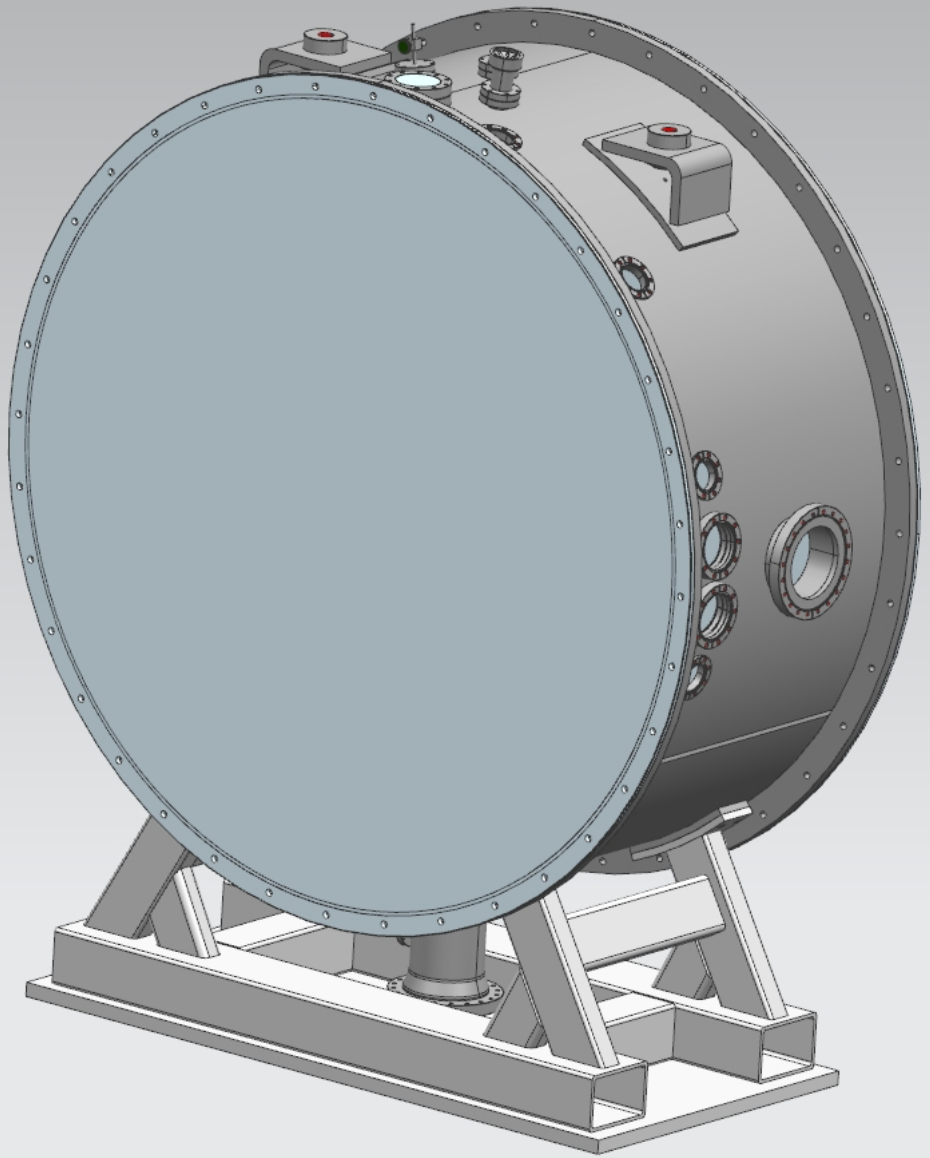
Through the Maze



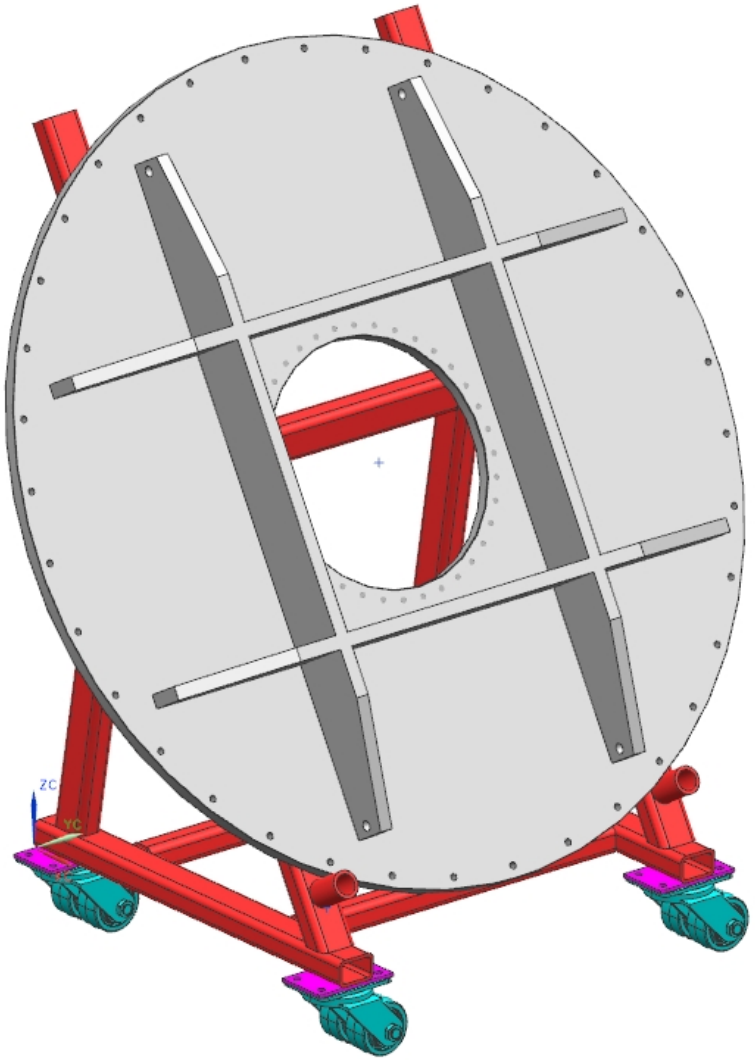
On Operational Stand



On Transport Stand, thin doors



Cover Plate Transport

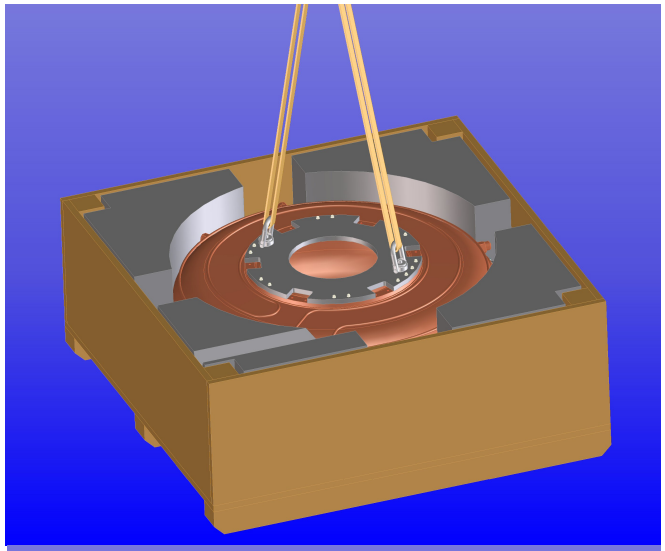


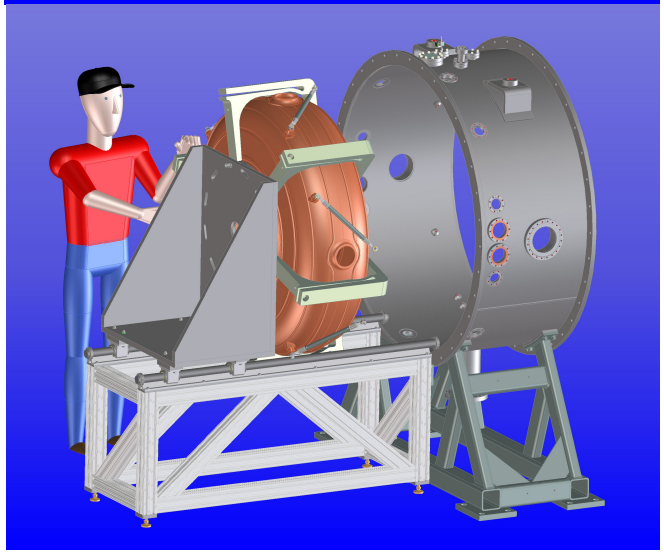
Lab 6 Clean Room

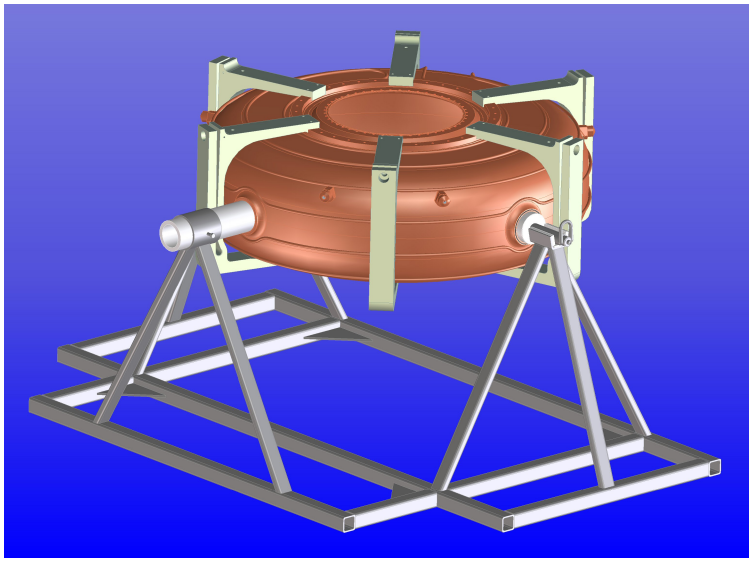
- Once doors removed & transport stand installed

- Cavity installation
  - All mechanical assembly and RF testing in clean room (class 100)
  - Horizintal stand – tuner insertio

Assembly

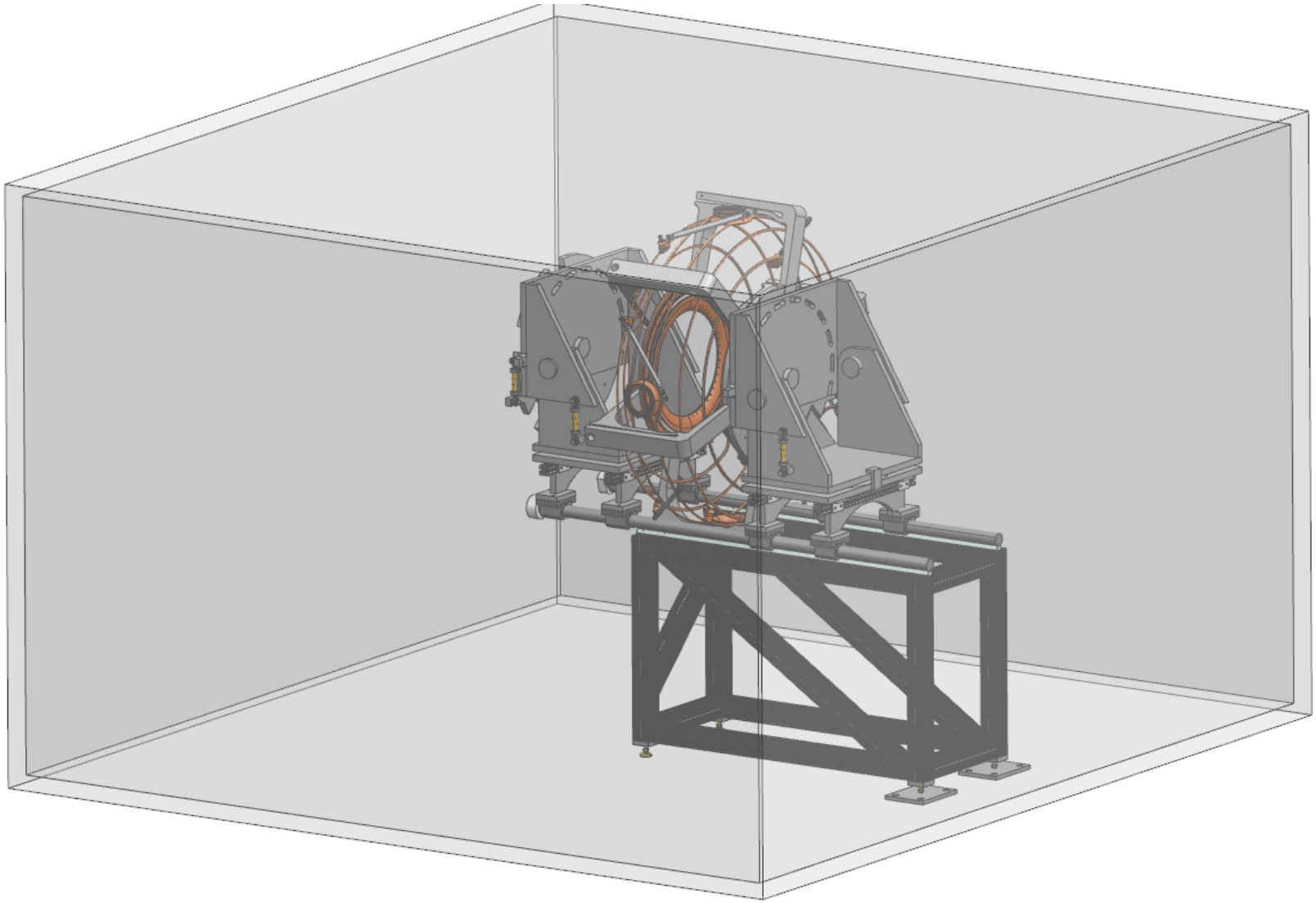






- Horizontal stand for tuner installation
- Vertical stand for cavity insertion
- Similar to MICE RFCC
- But simpler (one-sided)
- Welded designs changed to Al extrusion

Insertion Fixture in Clean Room

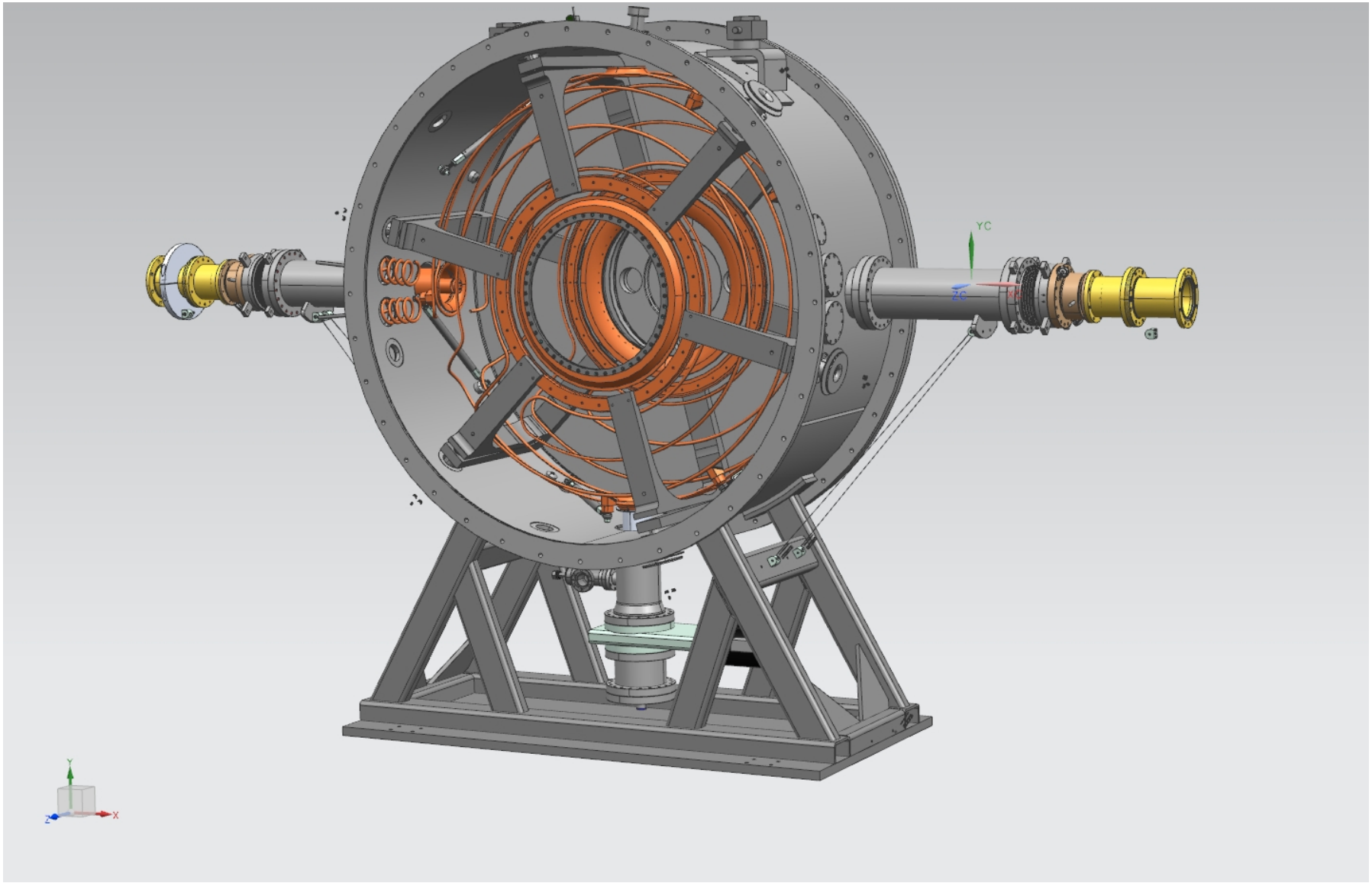


Assembly in MTA Hall

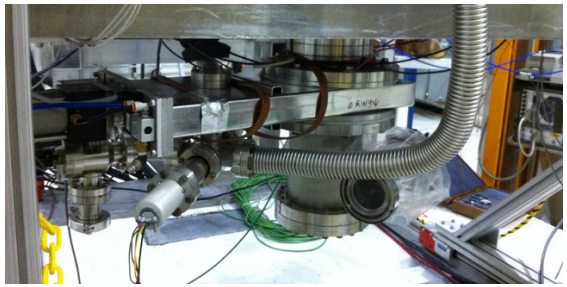
- Remove transport stand, install operational stand

- In MTA Clean Room
  - Install doors
  - RF Couplers
  - Other vacuum hardware

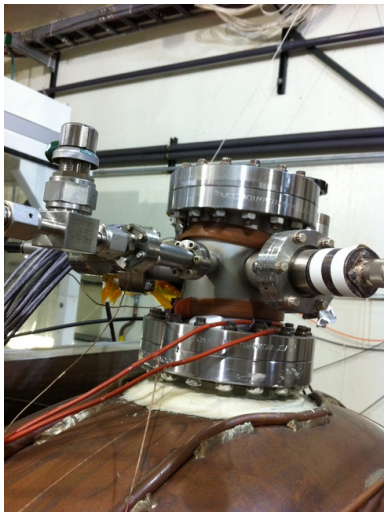
Put on doors in MTA clean room

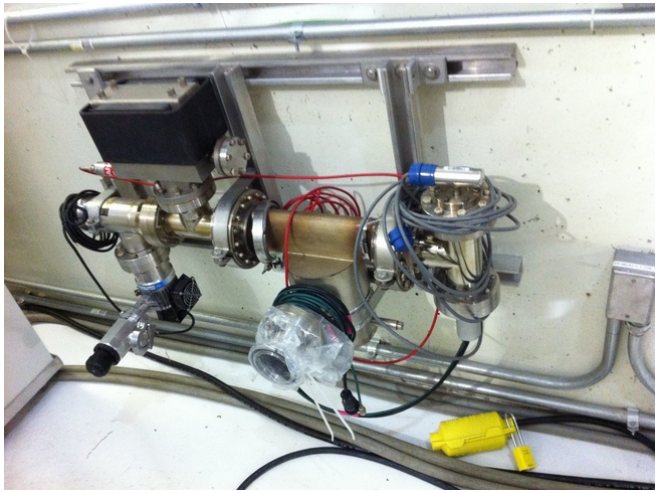


Vacuum system



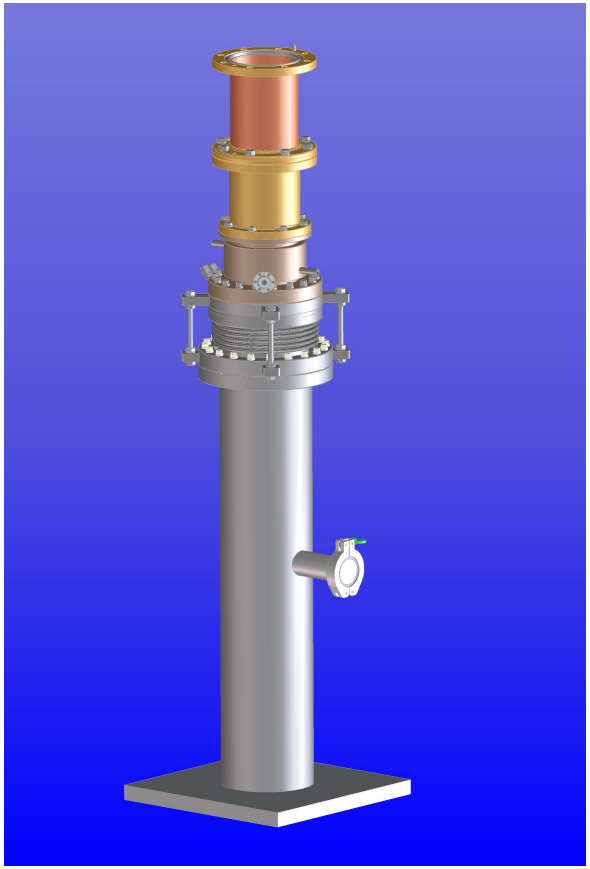
- Vessel arrived under purge
- Pumpdown test
  - Baseline 0.16 uTorr
- No other test planned until installation in hall
- Water feed-thru only concern
- Will reuse existing vacuum system
  - Getter + ion pumps
- Separate gauges for cavity, vessel and coupler vacuum pressure





Couplers

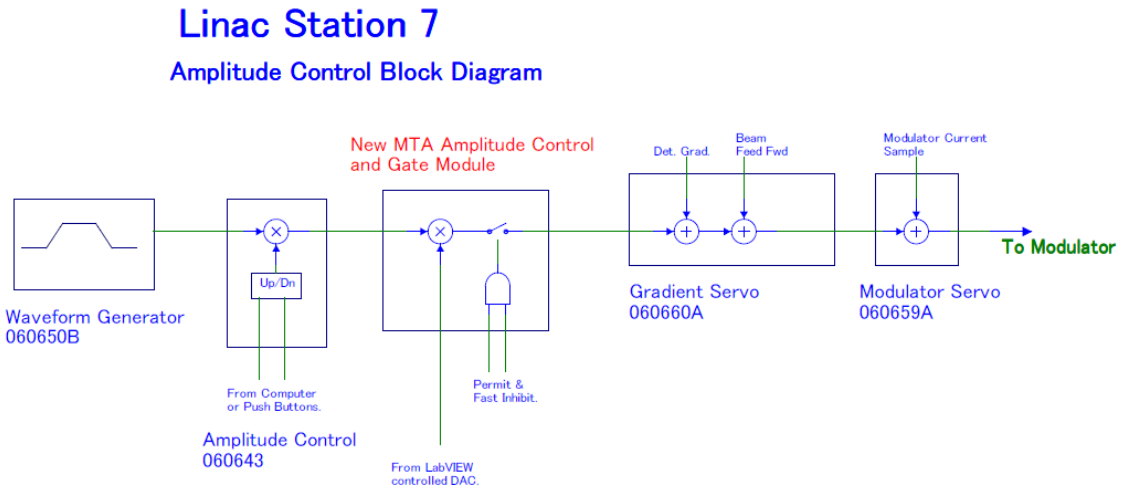
- Mechanical interface different from earlier prototype in air
  - Separate conditioning stand not feasible
- Vacuum test stand designed (A. DeMello) for initial certification at LBNL
- Drawings finalized modulo minor tweaks (A. DeMello)
- Materials/parts being purchased by Fermilab this week
- Fabrication at LBNL: 10-12 weeks
- Test-fit and coupling adjustment in Lab-6
- To be removed before transport and reinstalled in MTA clean room

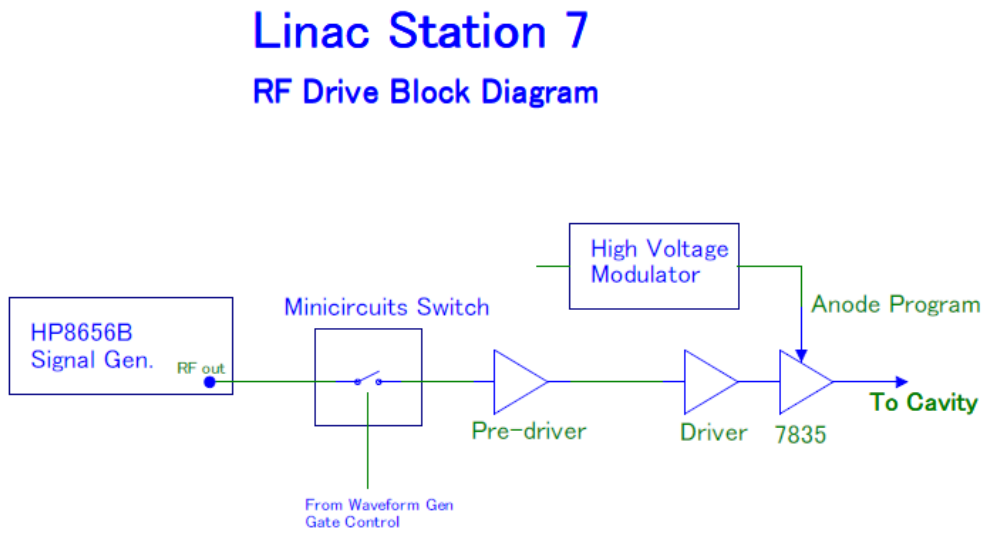


Diagnostics

- Vessel
  - Top plate (A. Moretti) for
    - RF pickups
    - cavity vacuum pickup
    - optical fibers
  - acoustic sensors under test on 805-MHz cavities (P. Lane, P. Snopok)
  - vacuum
  - thermocouples
- Couplers
  - directional couplers for forward/reverse power
  - vacuum
- External
  - Air pressure (tuner control)
  - Water temperature/pressure (cooling)

RF Controls (D. Peterson, R. Pasquinelli)





Linac RF station 7 modifications for MTA 201 MHz cavity testing

- Short Term (testing in progress)
  - Amplitude Control via modulator ramping
  - Frequency Control via HP8656B.
- Mid Term
  - Tuner Control via RS-485 and pneumatics.
- Long Term
  - New LLRF with phase control and beam sync.

- Frequency control through signal generator
- Driver amplifier driven into saturation
- Overall amplitude control through program curve to the Modulator

Outlook

- Expect to start assembly in June
- On track for results from operation of single-cavity module at MTA by cm37
  - tight schedule and lots of work to do
  - resource availability critical
- Installation will provide valuable experience for MICE RFCC module assembly
- And possibly some LLRF

Credits

- Most mechanical engineering material from Ryan Schultz (FNAL) & Allan DeMello (LBNL)