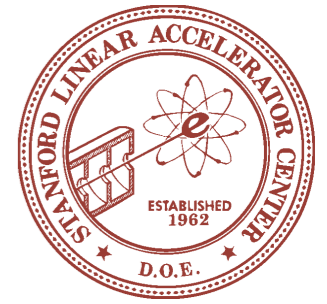


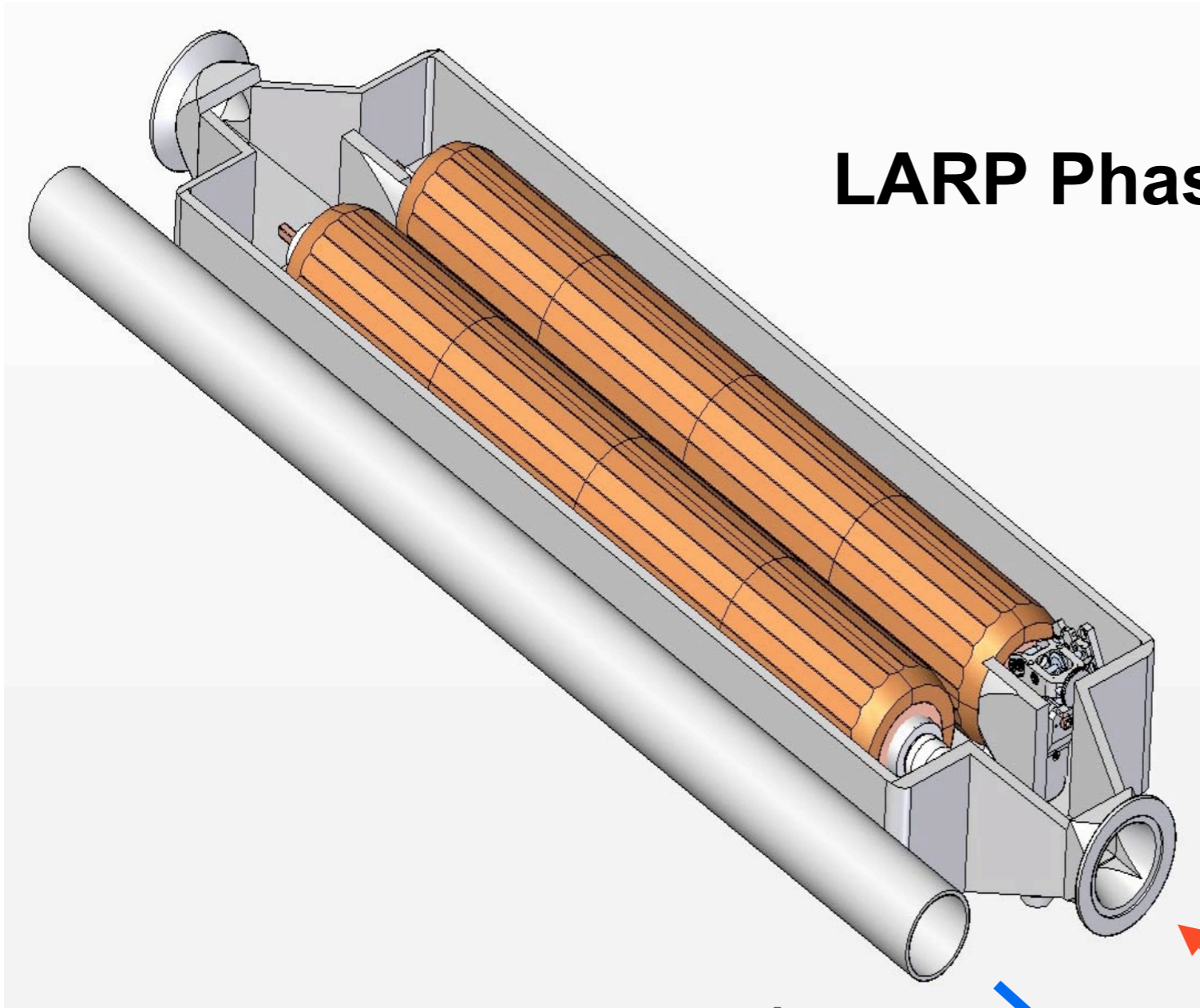
**LARP**

# US LHC Accelerator Research Program

**BNL - FNAL - LBNL - SLAC**



## **LARP Phase II collimator Progress and Plans**



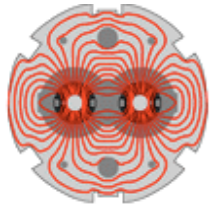
**beam**

**beam**

10 December 2007

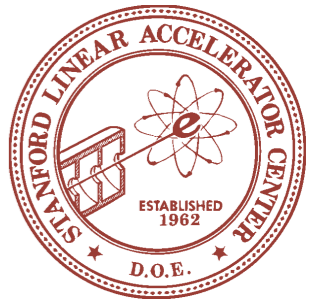
LARP Collimator Video Meeting

- Gene Anzalone, Eric Doyle, Lew Keller, Steve Lundgren, Tom Markiewicz & Jeff Smith

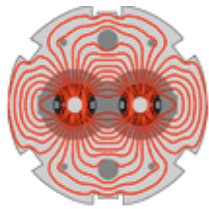


**LARP**

## Recent Progress



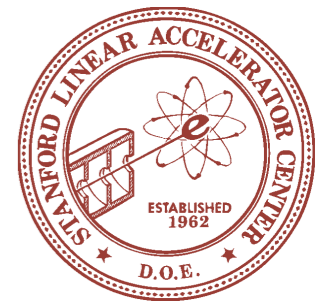
- Utilizing SLAC's new 3D printer for making fast prototypes
- First Full-length Mandrel winding and brazing
- Prep for Heating tests
- Prep for RF contact Measurements
- Prep for Phase I collimator controls and tests here at SLAC
- Further MAFIA simulations
- Gaining experience with bench top impedance measurements



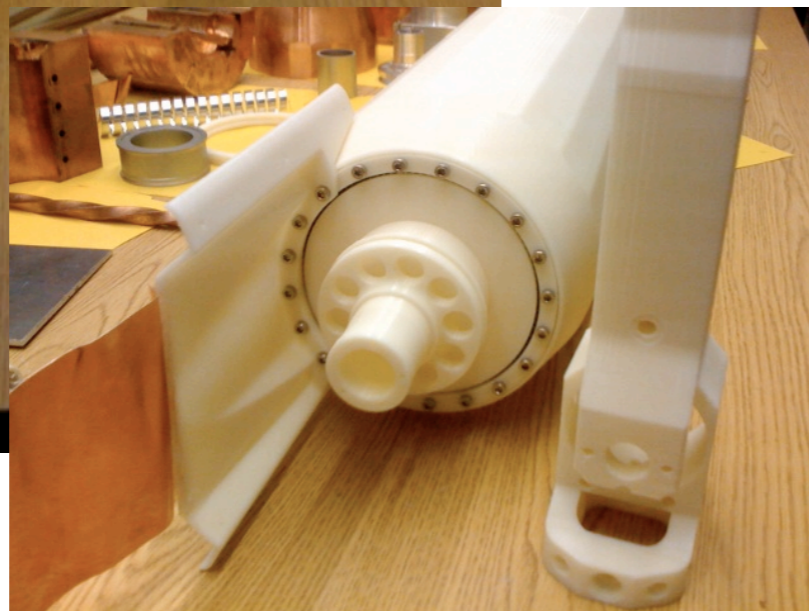
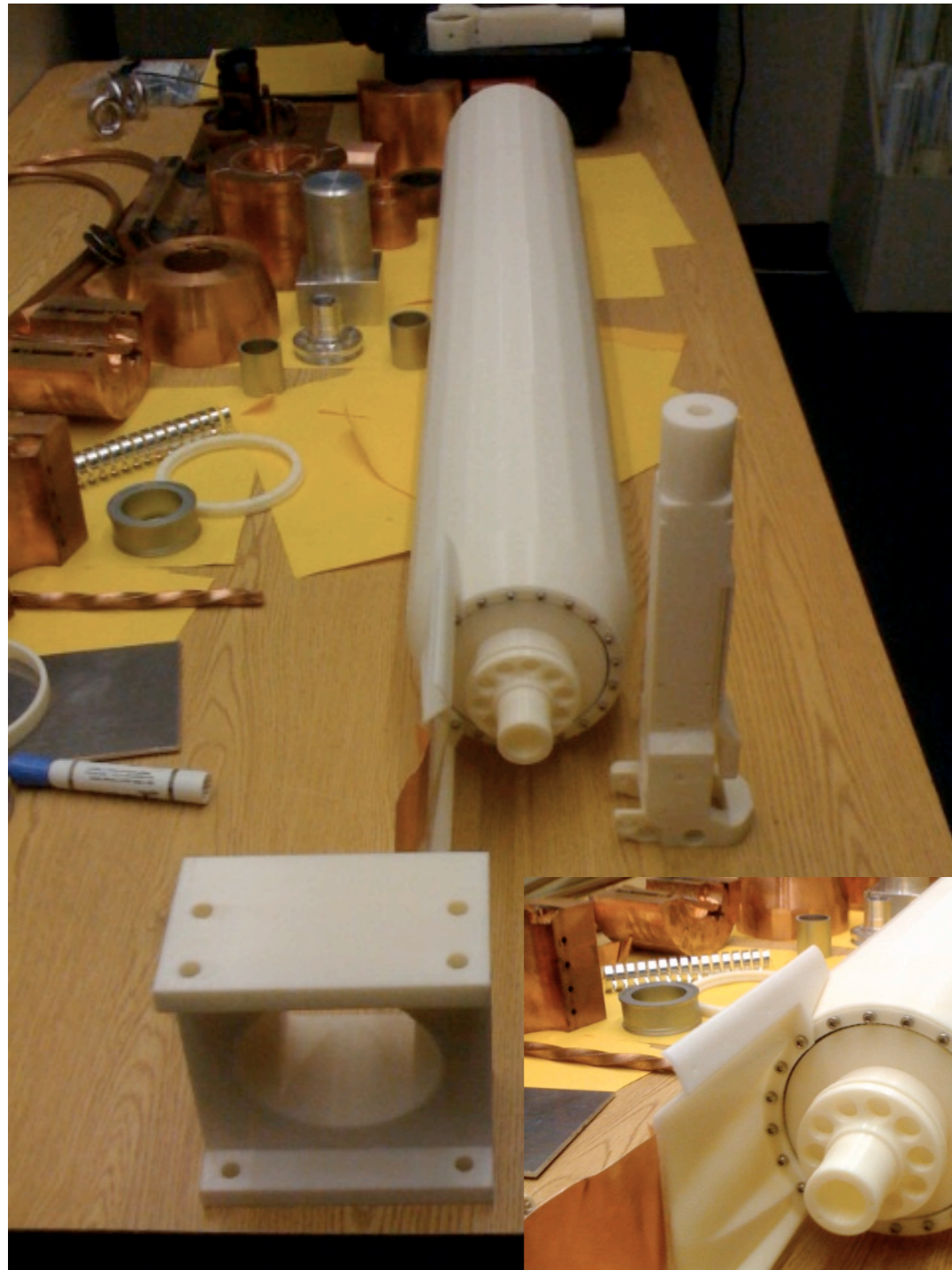
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# 3D Printer Samples

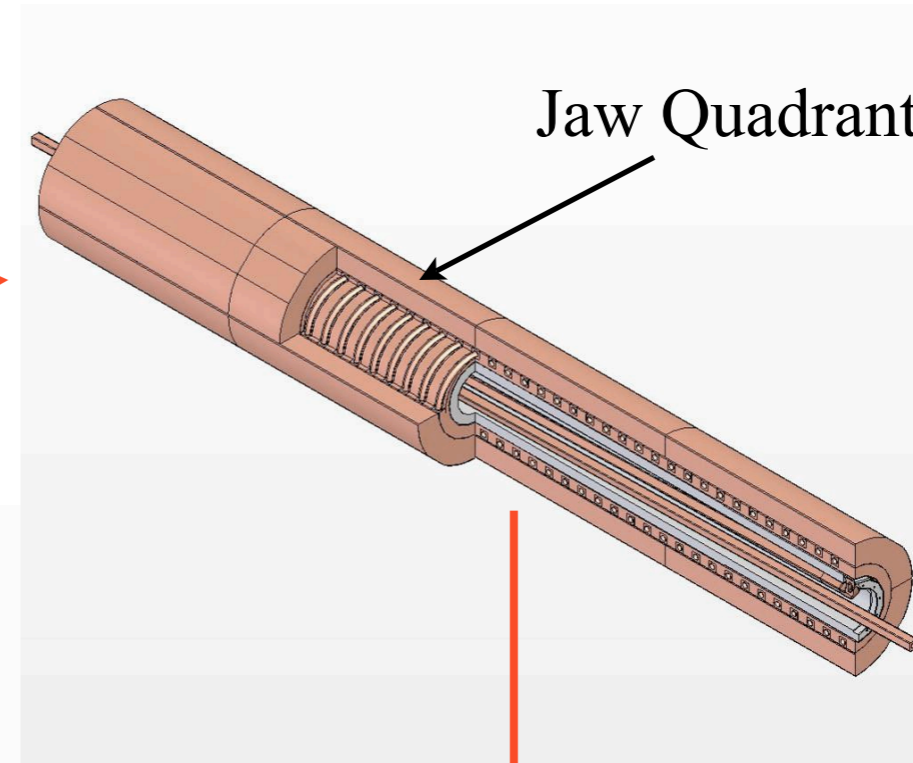
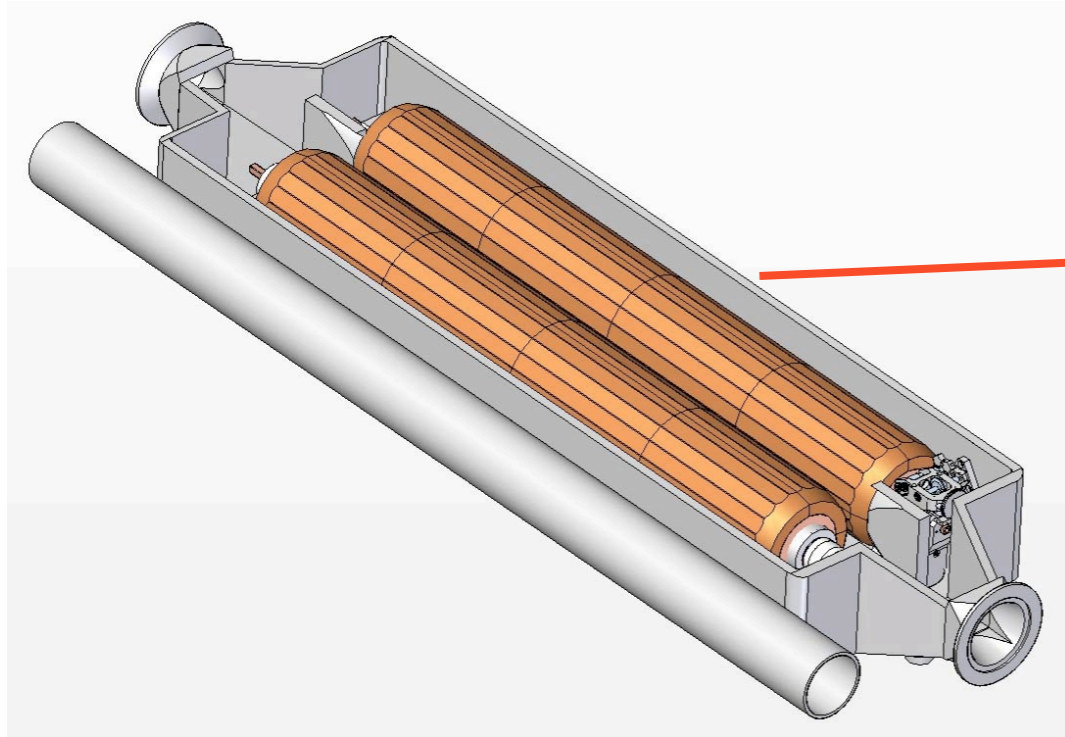
<http://today.slac.stanford.edu/feature/2008/3D-printer.asp>



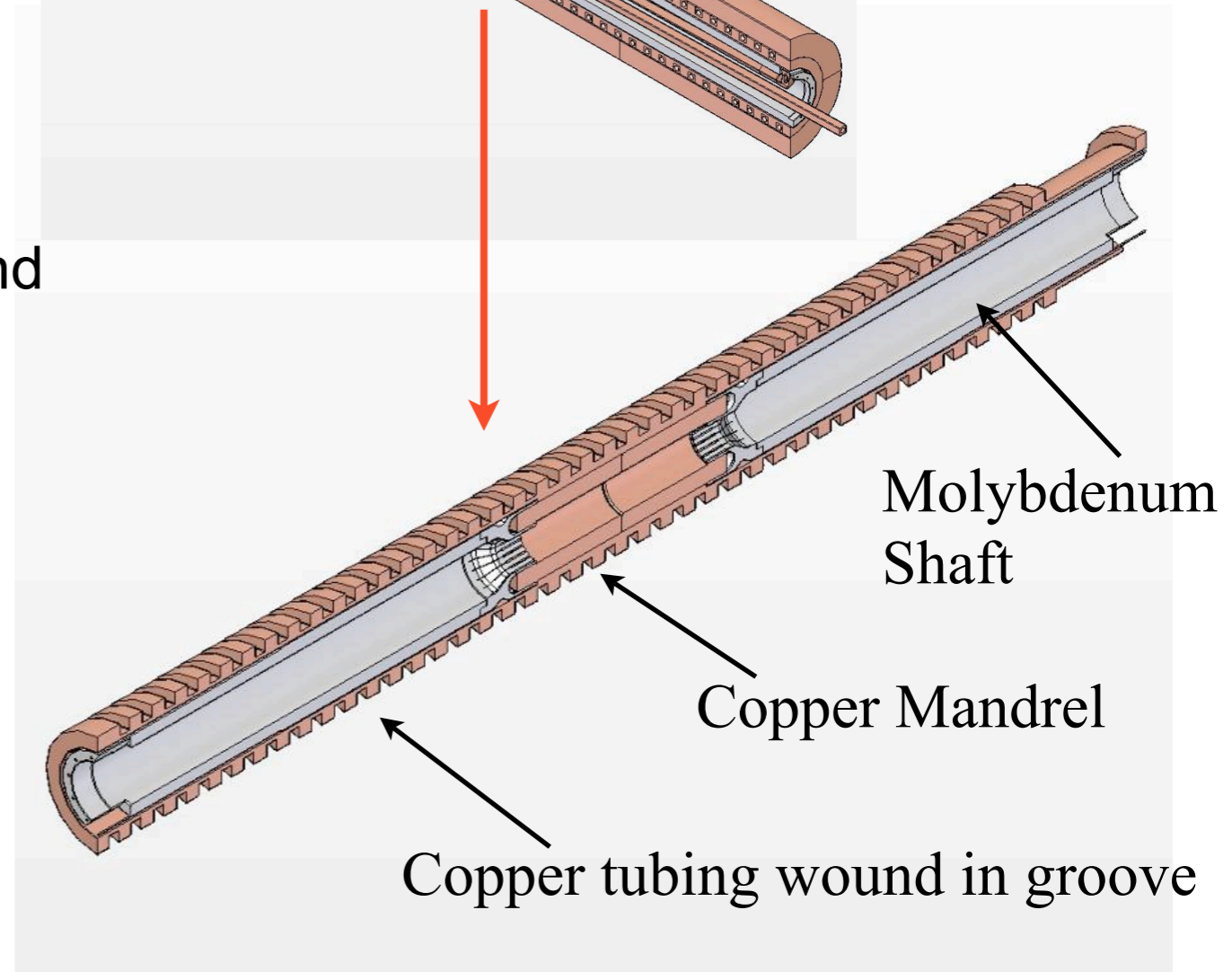
- SLAC obtained a 3D printer recently.
- We're the first group to use it for making prototype components
- Will use to make a full collimator jaw mock-up and test moving of parts
  - Assembly process
  - Support configuration
  - Moving jaws in and out
  - RF shielding designs
- Here's what we've "printed" so far...



# Mandrel Winding

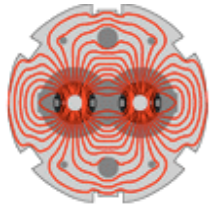


- Jaw composed of molybdenum shaft and copper mandrel wound with copper tubing for cooling. Exterior Jaw quadrants brazed on top of mandrel
- Gained much experience in winding full length mandrel



# Inserting molybdenum shaft into Mandrel

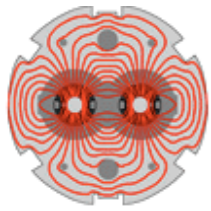




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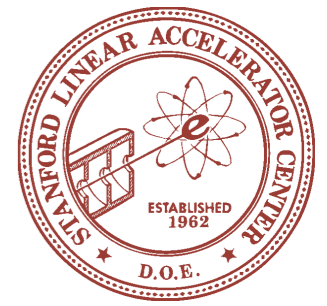
# Coil Winding



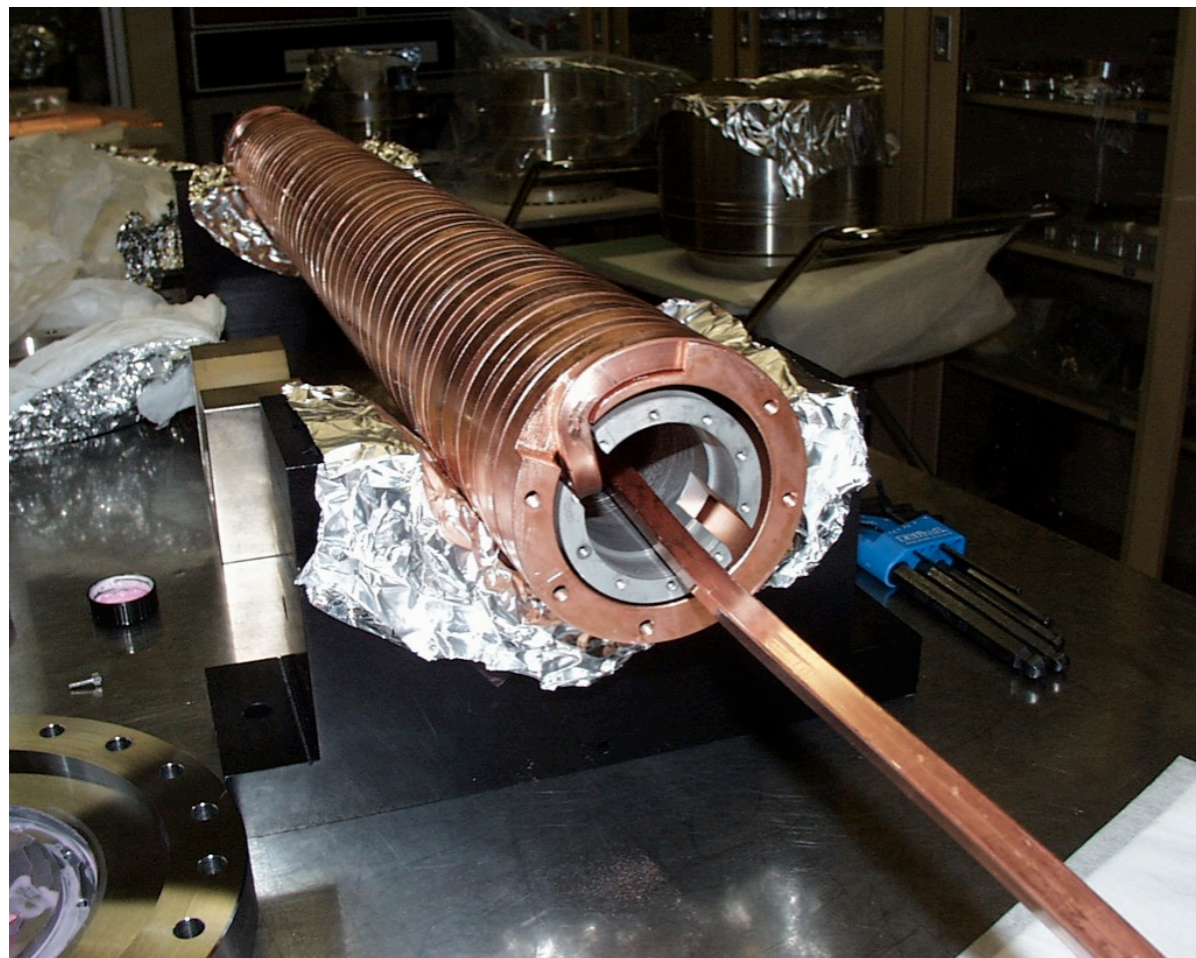


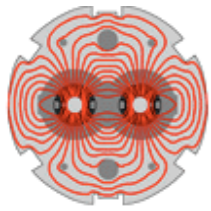
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# First Brazing Preparation



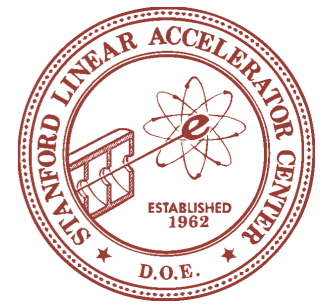
- Two brazing steps.
  1. braze shaft and copper coil to Mandrel
  2. braze jaw quadrants to mandrel
- Here are pictures showing preparation for first brazing
- On support stand and ready for insertion in baking oven
  - Brazing beginning of next week



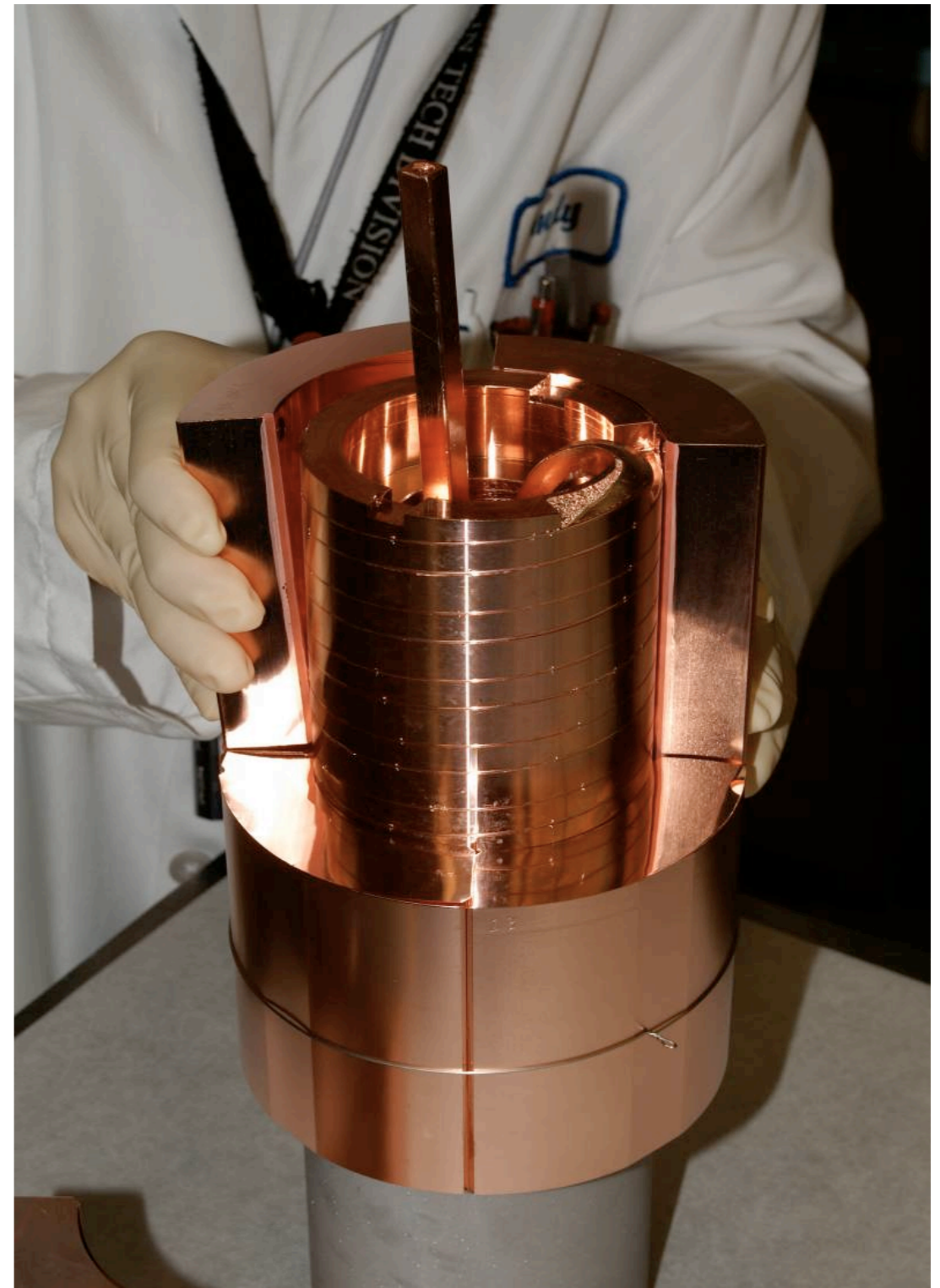


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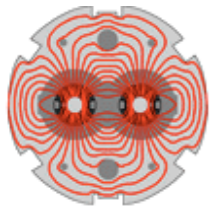
## Second brazing



- Second brazing will braze outer Jaw Quadrants to Mandrel
- Here's a shorter jaw we assembled and brazed last year.

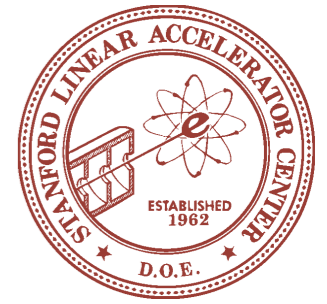




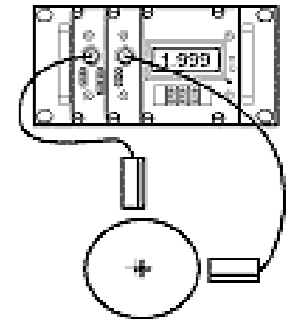


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# First Full Length Jaw Thermal Tests

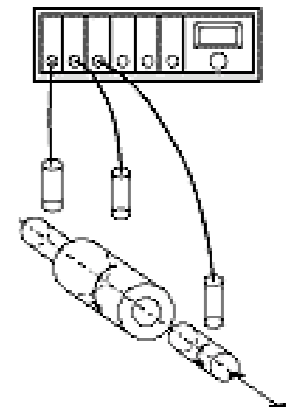
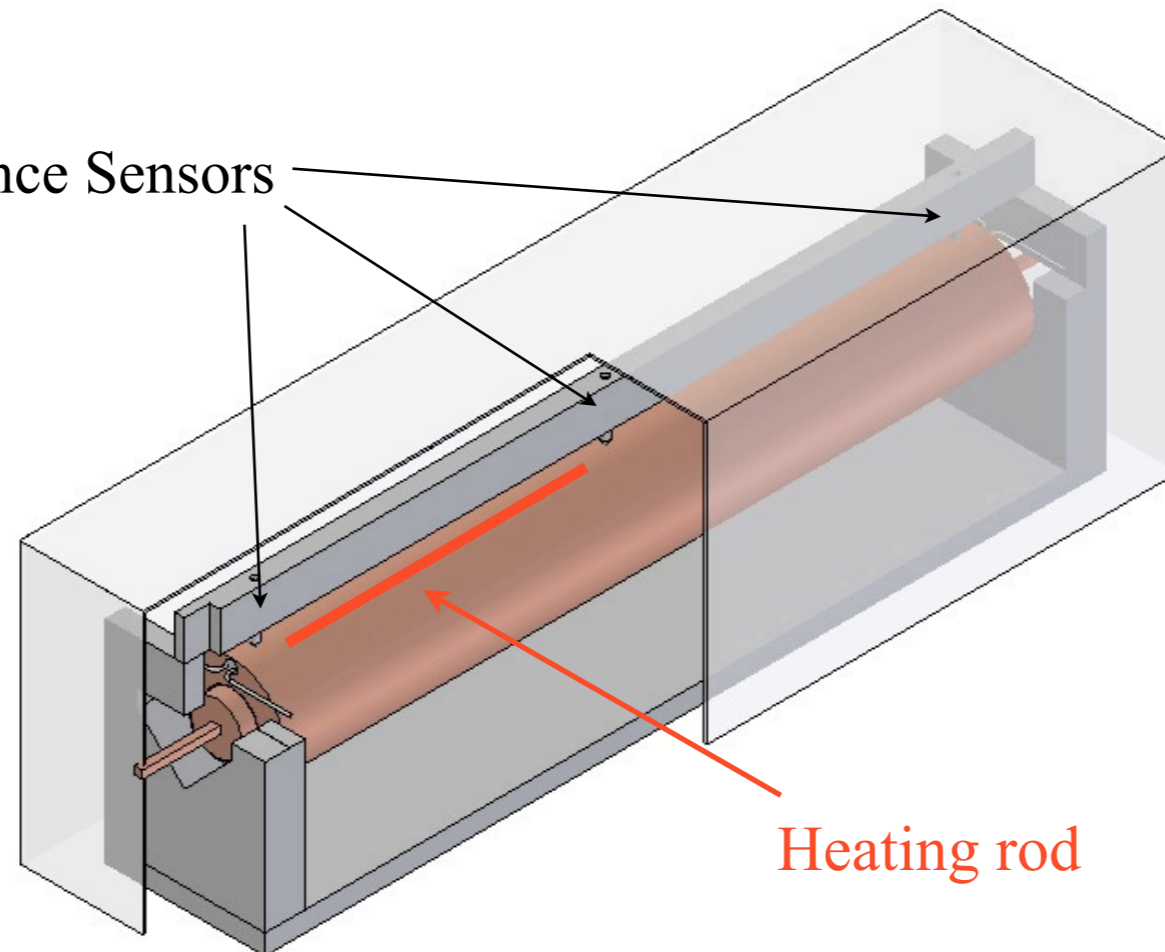


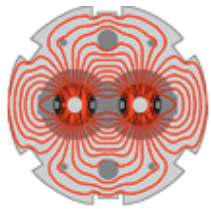
- This jaw will undergo thermal tests using two 5 kW heaters placed along jaw surface (simulation steady state beam heating)
- Sensors will then measure thermal deflection to confirm ANSYS simulations.



Images from [www.capacitec.com](http://www.capacitec.com)

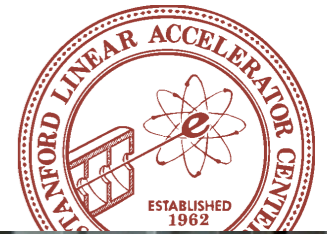
Capacitive Distance Sensors



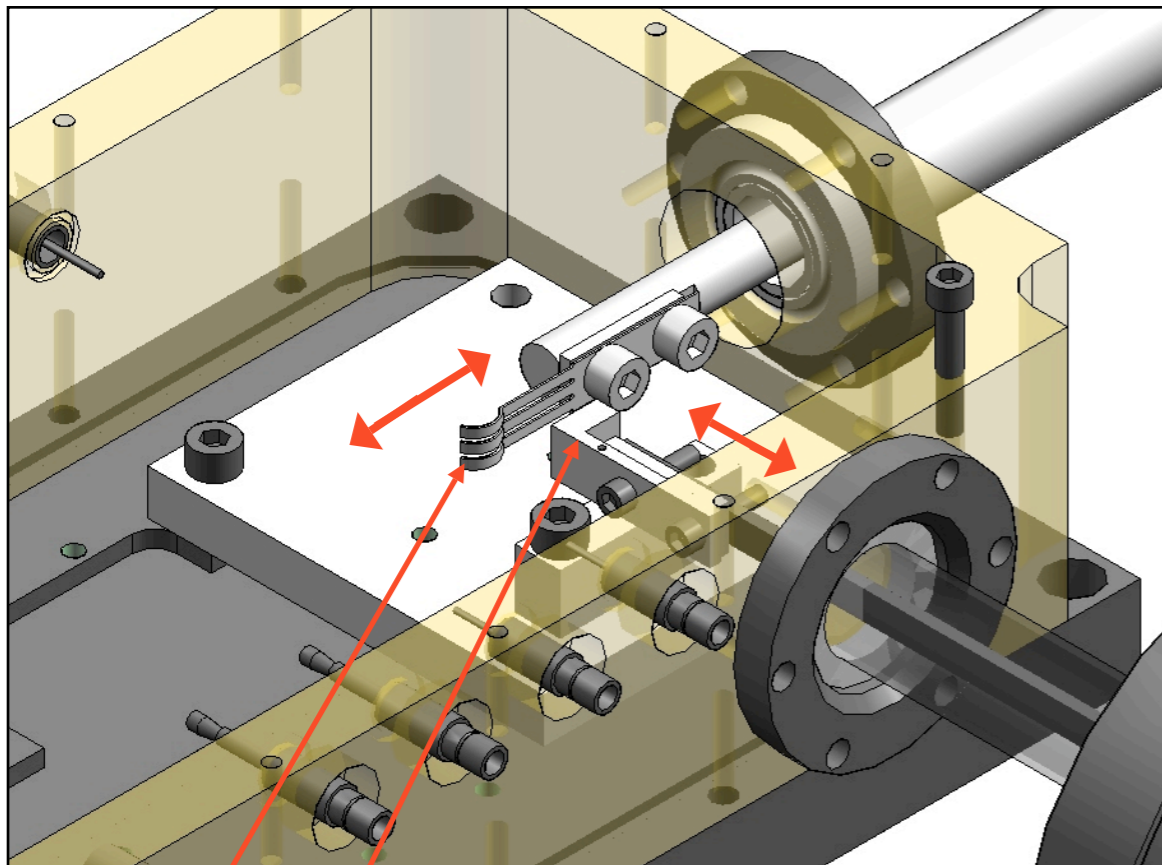


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# RF Contact Measurements to be performed

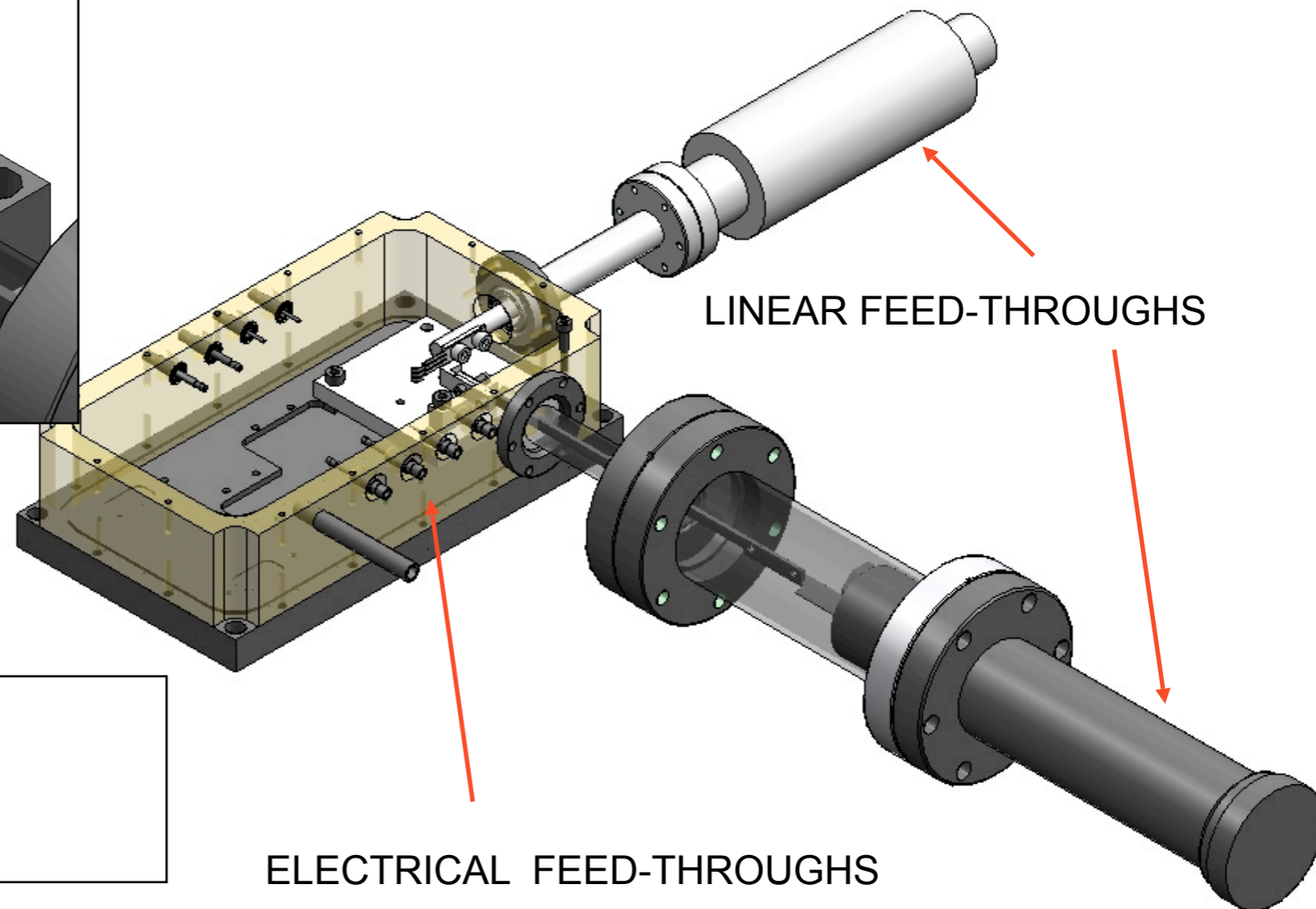


All equipment obtained and being assembled



ANVIL

SPRING - CONTACT



LINEAR FEED-THROUGHS

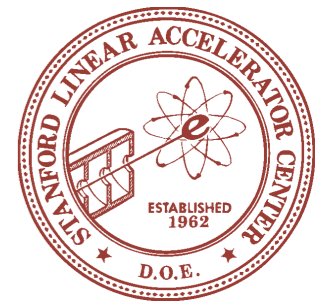
ELECTRICAL FEED-THROUGHS

## Contact Resistance Test Chamber

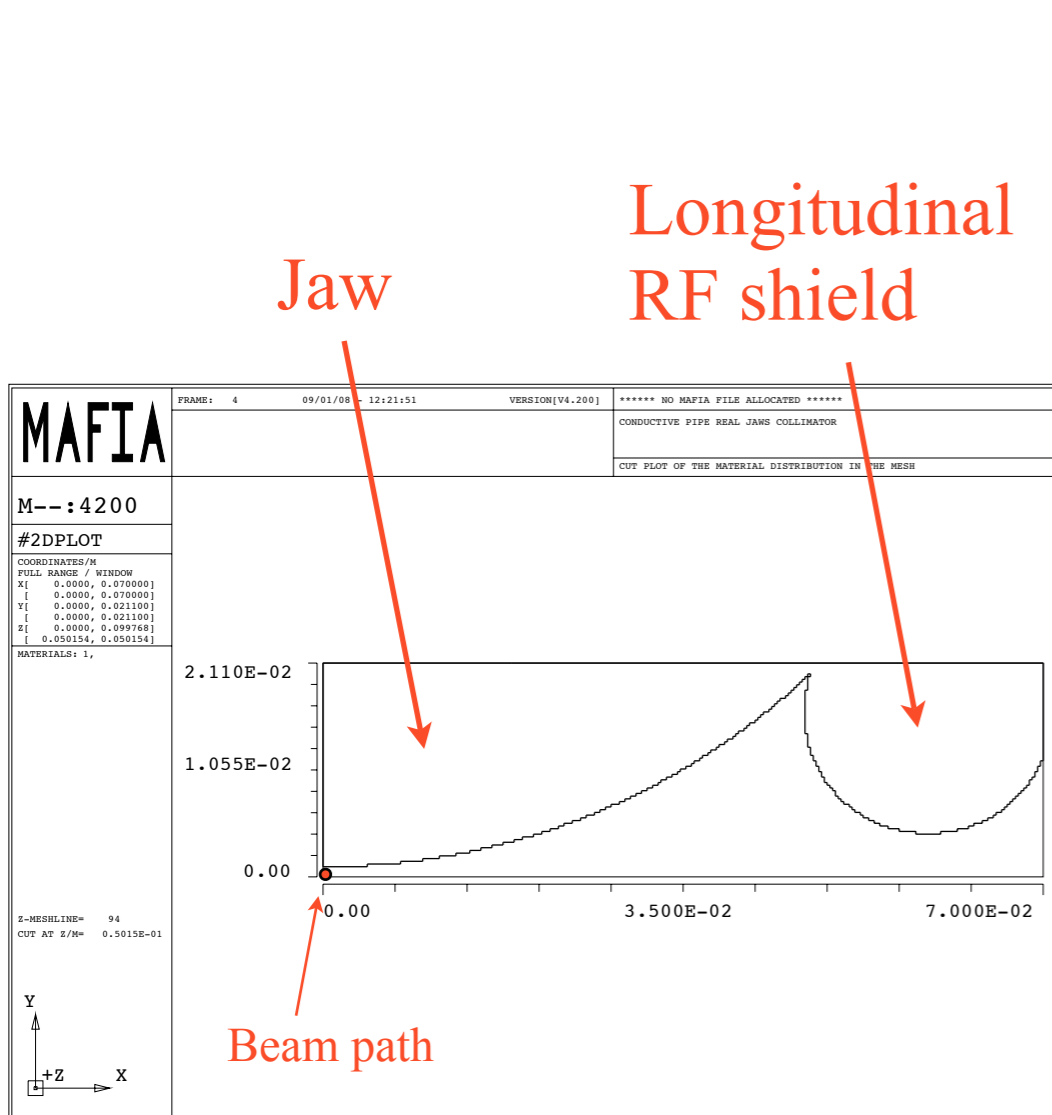
- Two axes: Normal & sliding
- Existing NLC seismometer vac chamber



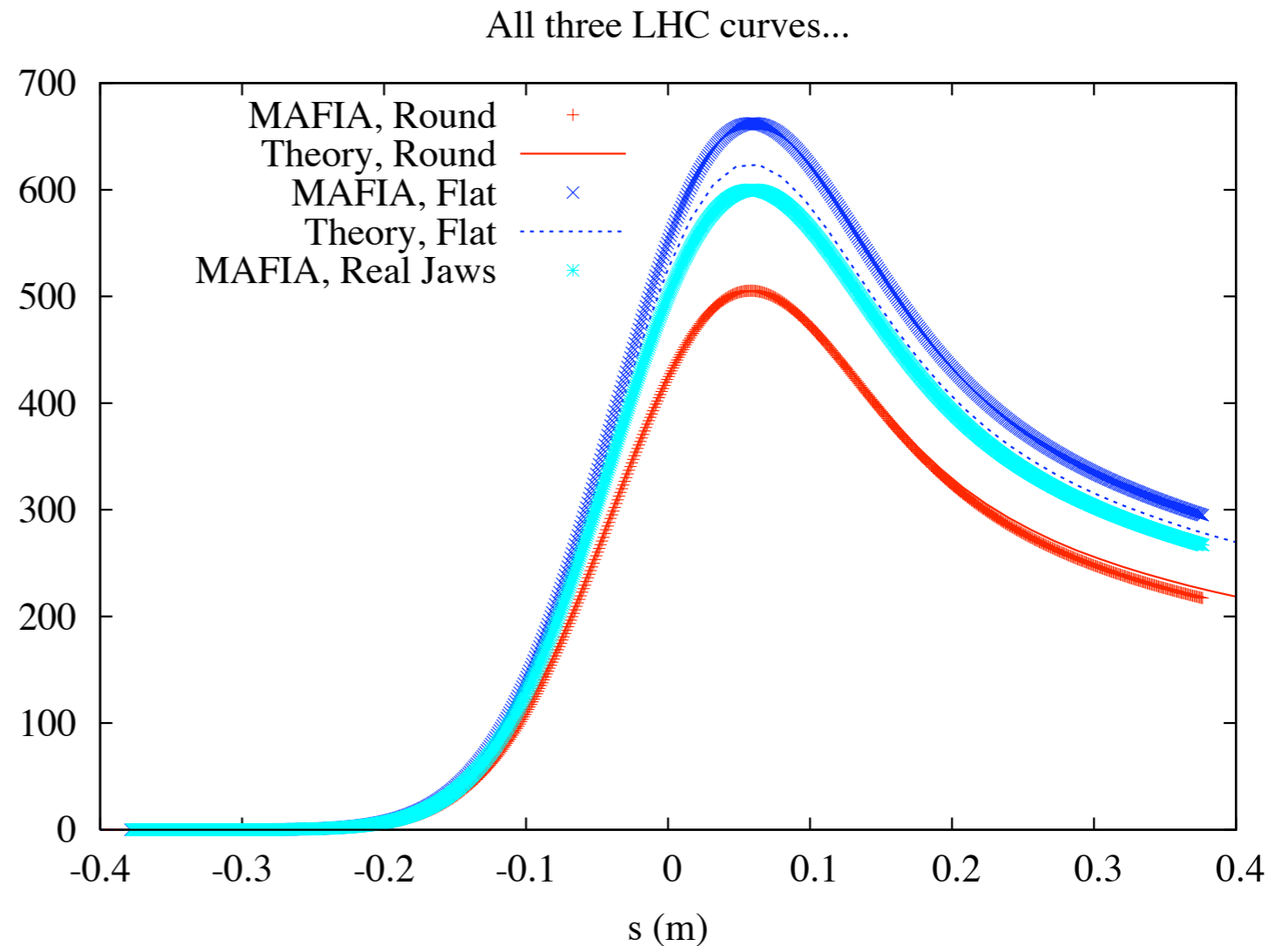
# New MAFIA resistive wall results



- Resistive wall wakefield for Jaw geometry roughly between a “flat” and “round” collimator.
- MAFIA simulation in line with theory (A. W. Chao, “Physics of Collective Instabilities in High Energy Accelerators” Ch 2.)

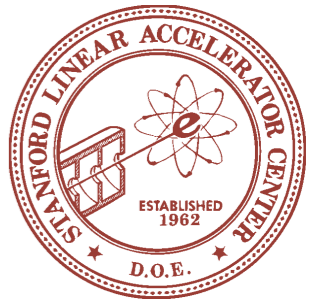


Resistive Wall Transverse Wake per unit length (V/pC/m/m)

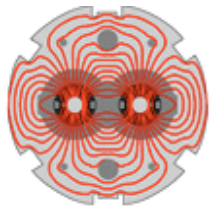




# Geometric Wake calculations

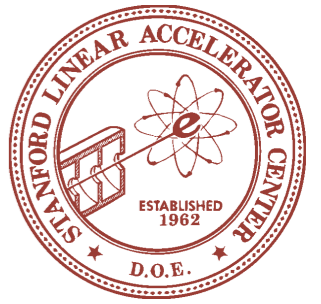


- MAFIA cannot calculate wakefields well for smooth transitions
  - Working with “simple” shapes and geometries.
  - Getting close to the Yokoya formula for smooth round collimator tapers.
    - Still working on it. Results may improve and may be able to look more directly at our complex geometry
- Now, this is all at high frequency (corresponding to bunch length)
  - Not looking at very low frequencies (kHz) with MAFIA.

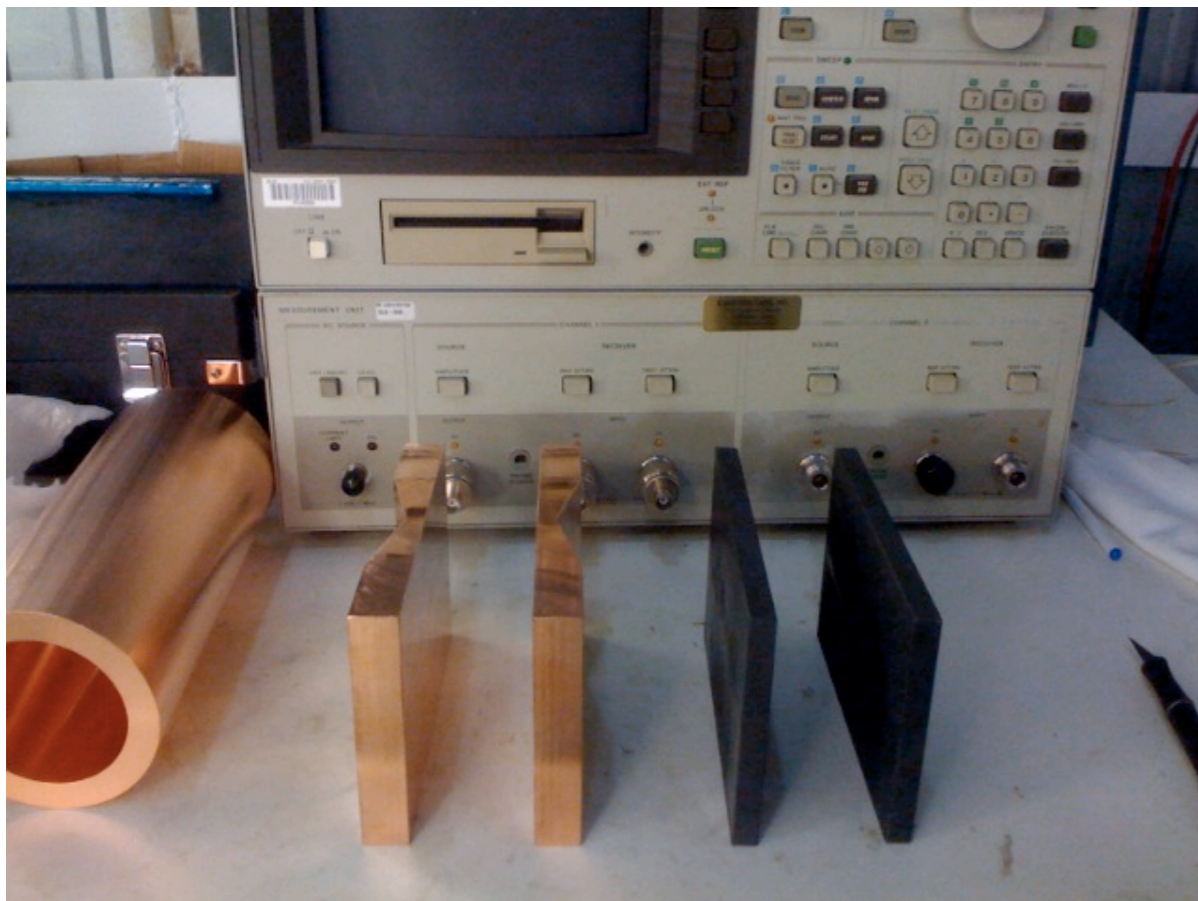


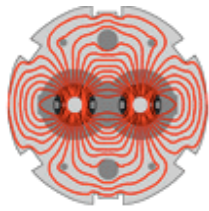
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# Bench-top impedance measurements



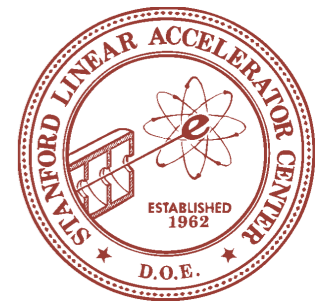
- Progress made in understanding bench setup.
- Beginning with repeating inductive by-pass measurements of graphite versus copper plates performed by Caspers, Kroyer, Metral, Roncorolo and Salvant at CERN. Working out some kinks...
- Will move on to performing measurements on full length graphite collimators.
- Measurements on components of our phase II prototype when built.





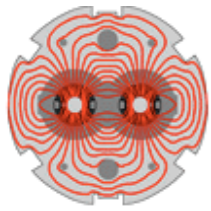
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# Mounting Our Phase I Collimator



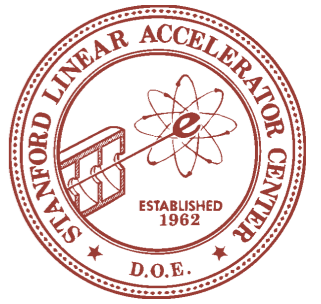
- Mounting Phase I collimator obtained from CERN. Support base being bolted to floor.
- Stepper motors and LabView control software obtained and being set up
- Will be used for
  - Impedance measurements
  - Testing mechanism with heavier jaw
    - Add extra weight to jaws
    - vertical/horizontal orientations
  - Determine what modifications are needed to motion control to accept our larger and heavier copper jaws.





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## Concluding Remarks



- Progress being made on several fronts.
- Working toward performing bench top impedance measurements
- Gaining much experience assembling and brazing copper and molybdenum jaws.
  - Many details to work out in multi-part assembly process.
  - Everything needs to fit just right at 1000C, yet assembled at room temperature. (Copper mandrel grows by almost 2 cm at brazing temperatures!)
  - Many thanks to the expert experience of SLAC's Klystron Department brazing gurus.
  - Thanks to Karl Bane, Cho Ng, Jim Lewandowski and Dan Van Winkle on MAFIA and impedance measurements
  - Also many thanks to the numerous people at CERN helping us out!