

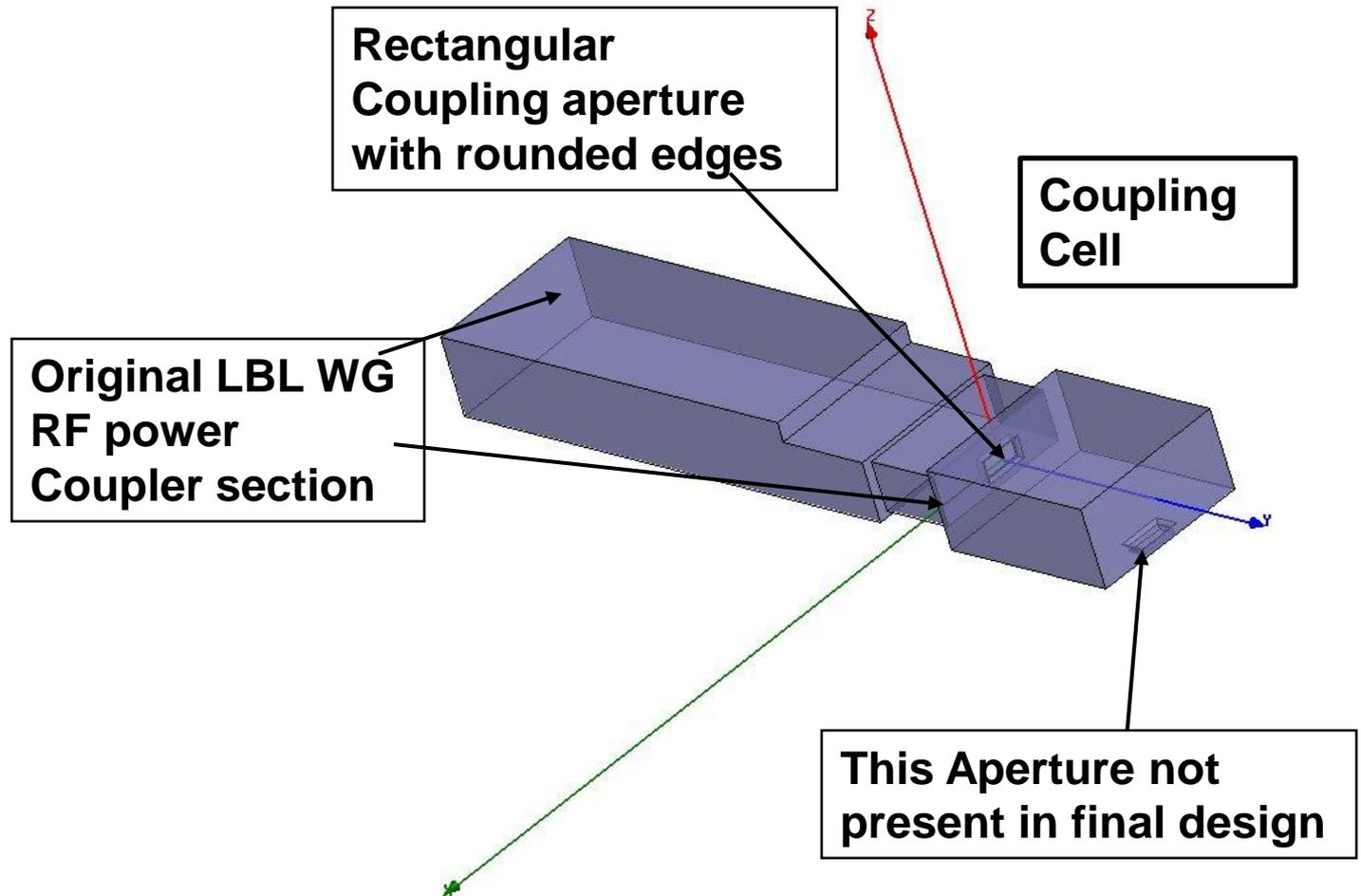
**805 MHz Box Cavity Status**  
**Fridays Collaboration Meeting**  
**03/13/09**  
**Al Moretti**

## **Outline :**

- **Description of the Box cavity Concept.**
- **HFSS Model of the cavity.**
- **Box Cavity Summary Plans.**
- **CAD Drawings.**
- **Specifications.**
- **Qo, Resonant Impedance, Power requirements, peak surface fields.**
- **Conclusion.**



## Orthogonal E and H Case



**HFSS Model showing only inside dimensions of the RF cavity and WG coupler**

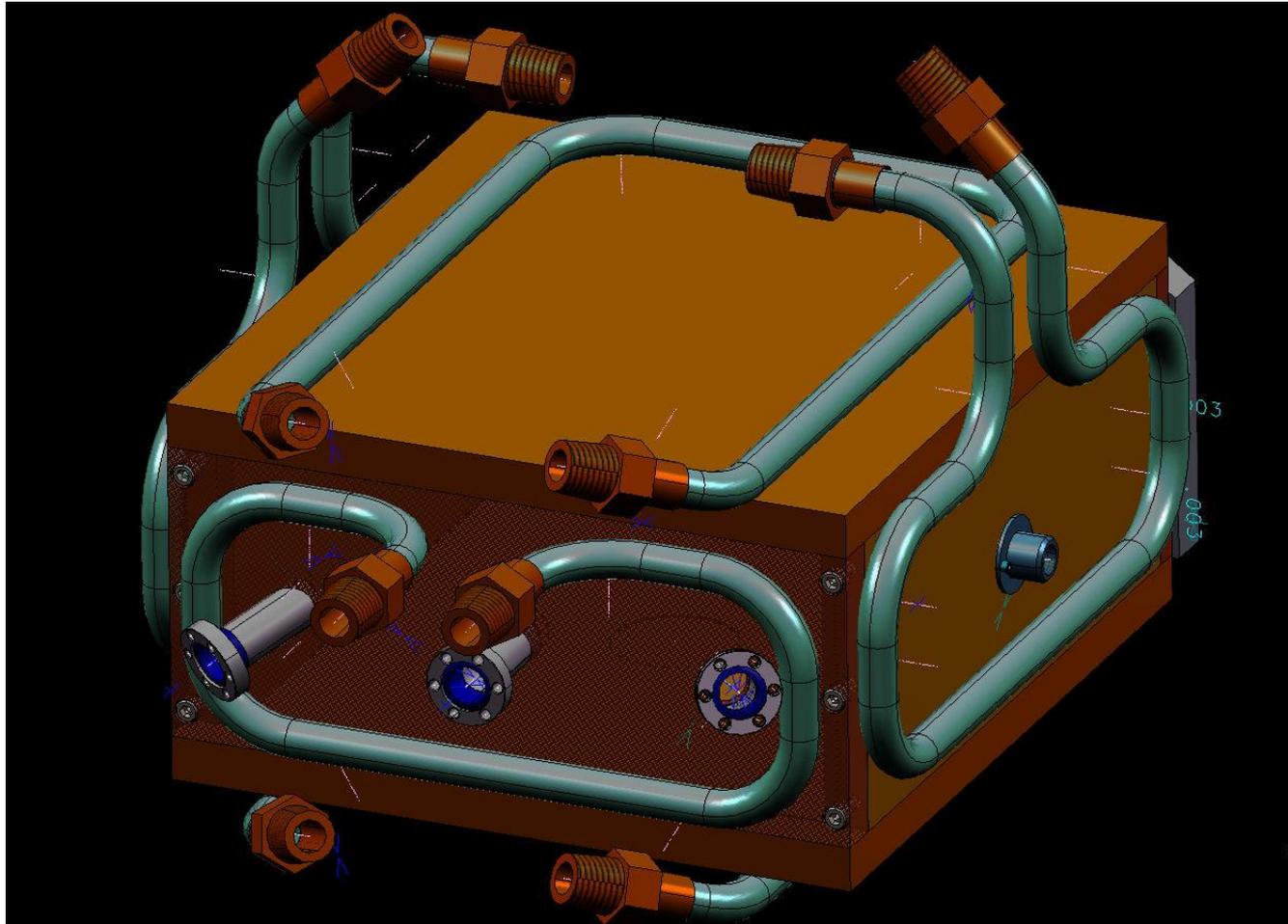
## **Box Cavity Summary Plans:**

- **Rectangular box cavity will be made of 101 OFE copper plates. First the sides will be screwed and foil hydrogen brazed together.**
- **This will come back to Fermilab and be finish machined; Coupling aperture will be machined in after a RF cold test to determine  $f_0$ ,  $Q_0$  and coupling hole size.**
- **Top and bottom plates, SS flange and viewing ports will be jugged in place and foil brazed together. This will be sealed and shipped back to Fermilab.**
- **Cooling tubes will be soft soldered on to the cavity.**
- **Another cold RF test will be made to determine  $f_0$ ,  $Q_0$  and coupling. Coupling aperture will be trimmed for near match condition if required.**
- **The rotating support fixture (upto 15 degrees) will be attached onto the current support frame.**
- **Vacuum system, drive waveguides, RF cavity pick-ups and after calibration testing will begin at 90 Degrees.**

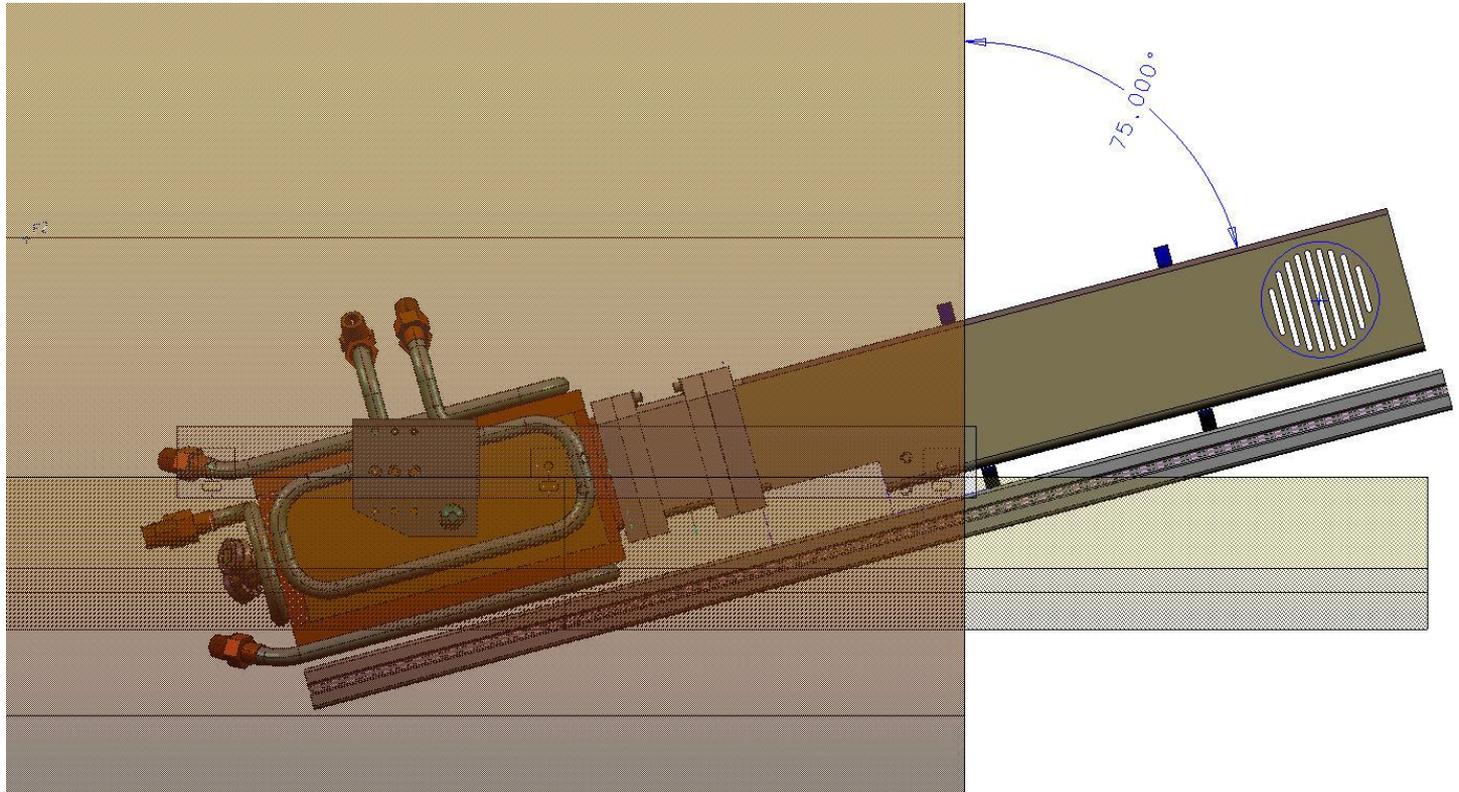
# First Braze Cycle



Completed box cavity after Second Braze cycle and soldering on the Cooling Tubes.



## Box Cavity Attached to Waveguide and rotation Assembly.



# Specifications

The following are some of the specs for the square cavity:

**Tolerance of parts** =  $\pm 0.005$ "

**Inside finish** = 30 u inches

**Average power** = 5 kW with half the power dissipated equally on the Top and bottom plates the remainder almost equally on the 4 sides.

**Pick-up ports:** Three min-ConFlat vacuum feed-thru ports in the side opposite the coupling aperture, 2 with field pick-up loops and one with a Sapphire vacuum viewing window on a mini Con Flat flange.

**Temperature:** max  $\Delta T$  rise on inside surface of + 58 ° C at 5 kW.

**Rotation Angle:** 90 +  $\Delta 15$  degrees.

# Schedule and Cost estimate

## Schedule

➤ Detailed drawings completed	-----	1 week from now
➤ Procurement of materials Cu plates	-----	2 weeks
➤ Machining parts for first braze cycle	-----	4 weeks
➤ First hydrogen braze cycle	-----	2 weeks
➤ Machine parts for second braze cycle	-----	1 week
➤ Second braze cycle	-----	2 weeks
➤ Attaching the cooling and rotation structure	-----	1 week
➤ Installation in magnet with vacuum and RF	-----	1 week
		<b>Total 14 weeks with high priority!</b>

➤ Material copper plate	-----	\$2000
➤ 2 braze cycle	-----	4000
➤ Machining of parts	-----	10000
➤ Miscellaneous material and parts	-----	4000
		<b>Total = \$ 20,000.</b>

# Calculated Parameters of the cavity and cavity dimensions

HFSS normalizes all parameters to 1 W of input power to the waveguide coupler and solves for the frequency, gradient, coupling factor,  $Q_0$  (in cavity mode) etc.

1W produces a gradient of 25 kV/m by scaling:

25 MV/m would take 1 MW ideal.

The Impedance across the center of the cavity is

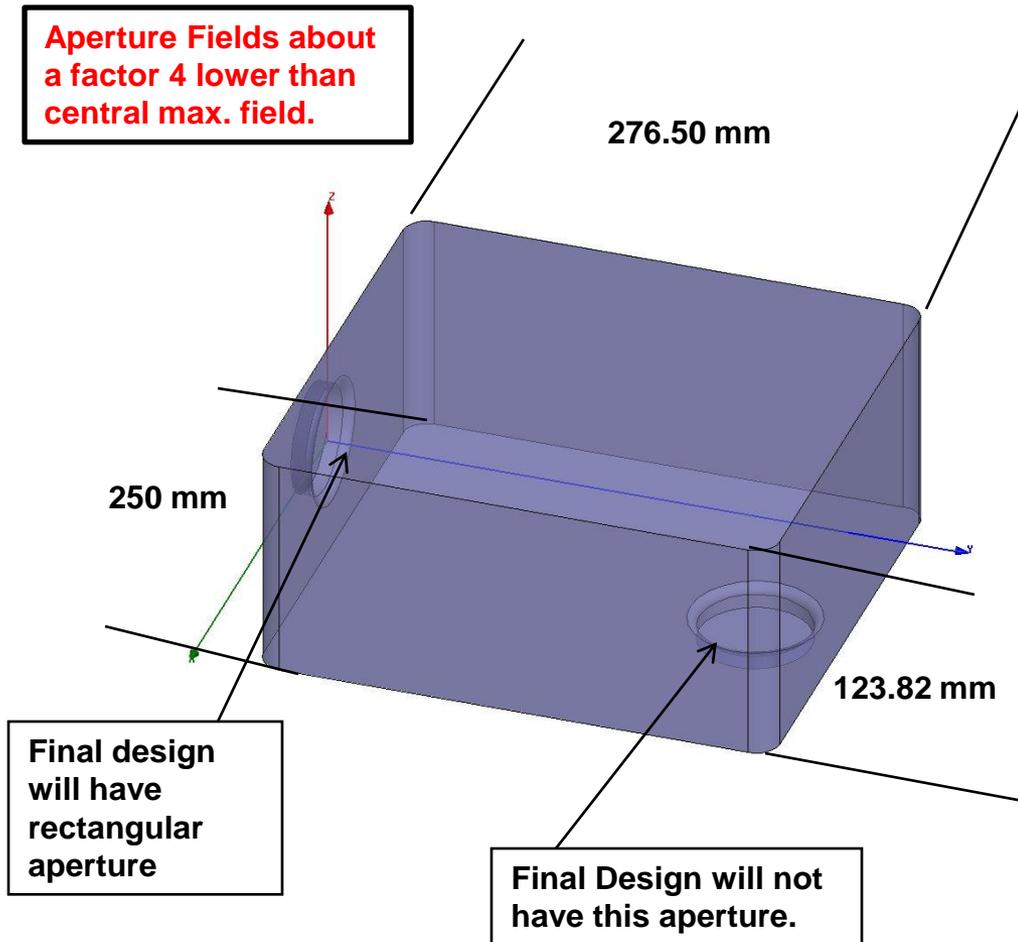
$$Imp = 9.5 \text{ M}\Omega.$$

This is the resistance across the center of the cavity given by

$$Imp = (\text{gap Voltage})^2 / 1 \text{ W}.$$

This uses the peak voltage and is in agreement with SuperFish and most published accelerator designs.

$$Q_0 = 27,400.$$



# Conclusion

- A team headed by Joel Misek of AD Mechanical department, Tim Hamerla, designer and Mark Lebrun, Co-Op student IU have been working on the design and fabrication methods for the orthogonal cavity. The design is complete; detailed drawings in about one week.
- The design for rotating the cavity in place by 15 degrees has been completed.
- The design of the water cooling tubes assembly has been completed.
- Preliminary schedule and cost estimate have been developed.
- A list of specification has been developed from the HFSS modeling and MAFIA.
- HFSS designs have been completed. The dimensions have been transferred directly from HFSS to the drafting department.