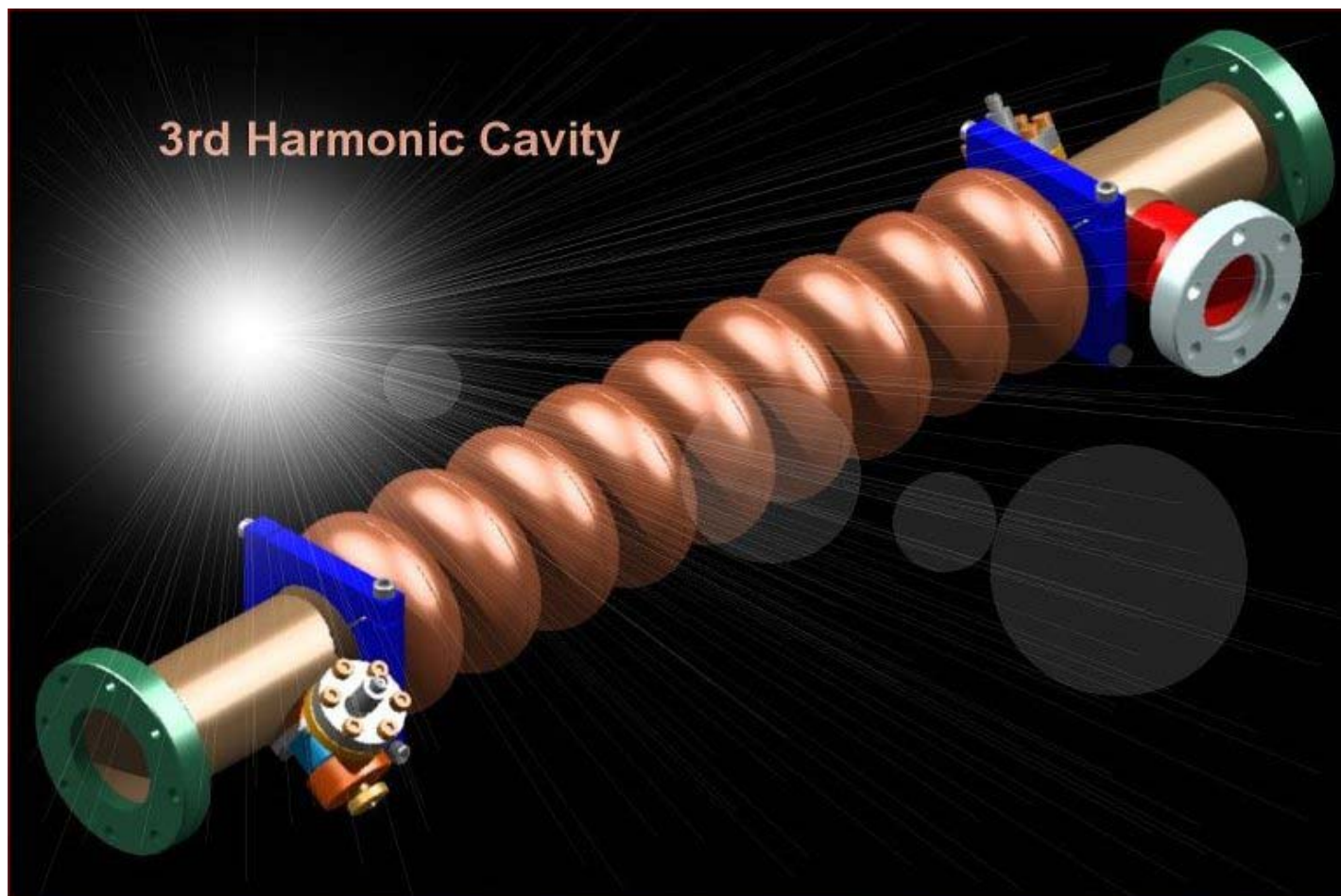




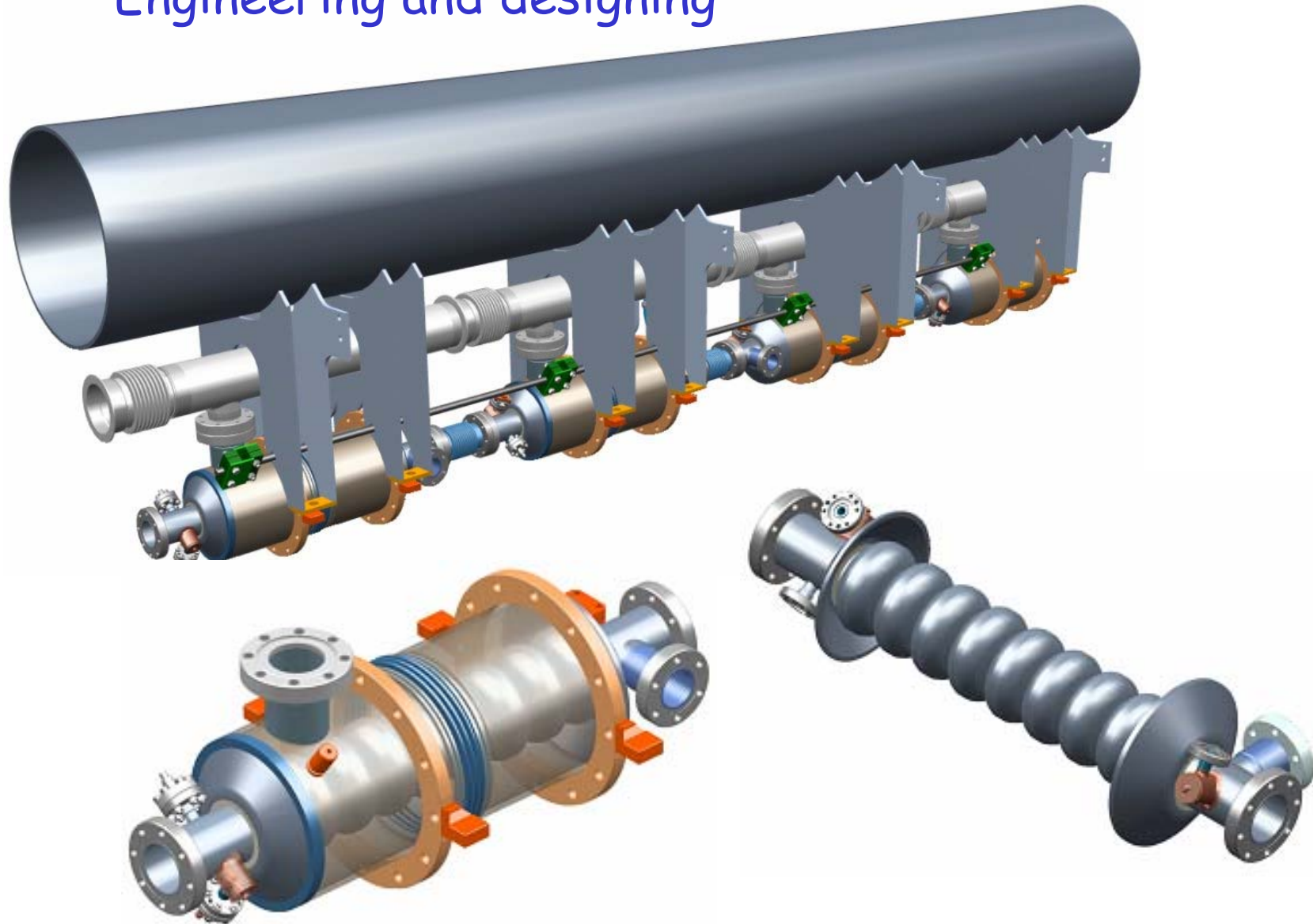
3.9 GHz work at Fermilab



+ CKM 13-cell cavity



Engineering and designing





**Protocol of the meeting about 3rd harmonic cavities during the TESLA
collaboration meeting at DESY on Sept. 16th 2003.**

1. Klystron

- 1.1. Order is placed Aug. 28th 2003, 11 month delivery.
- 1.2. Decision has to be taken what modulator should be taken: same as for CKM?

2. Cavity design and fabrication

- 2.1. ~~The first copper 9 cell cavity is brazed and ready for bench measurements~~
- 2.2. 18 copper half-cells are finished and can be brazed.
- 2.3. Niobium 3-cell cavity is fabricated and ready for cold test Oct 03
- 2.4. More Nb half-cells are shaped, measured and are ready for welding.
- 2.5. Nb Material for 7 cavities is in house.
- 2.6. Lorenz Force calculations are done, for wall thickness of 2.8mm no stiffening rings are needed
- 2.7. The short cavity beam tube (80mm) is implemented.
- 2.8. Make cavity tuning by only pulling - Preload the cavity.
- 2.9. Introduce reference ring for alignment. Define alignment procedure.
- 2.10. Estimated Δf for BCP is 12 MHz, for cool down to 2K is 6 MHz
- 2.11. HOM coupler design is finished, pick-up flange should be machined after welding of coupler.
For more precise adjustment of pick-up gap, the pick-up should be made out of Nb.
- 2.12. Helium tank is designed
- 2.13. Next will be to complete the treatment, handling and assembly procedures.

3. HOM

- 3.1. ~~There was again a discussion on the BBU limit: Jacek: should be bigger than 10^5 !~~
(Decision between Phillip and Jacek.)
- 3.2. The HOM's bench measurements have to be done with 2 9-cell cavities;
(Second cavity has to be brazed.)
- 3.3. Ursula van Rienen from Rostock University will calculate HOM's of two structures together,
(Nicolay gives the cavity shape to Ursula van Rienen)

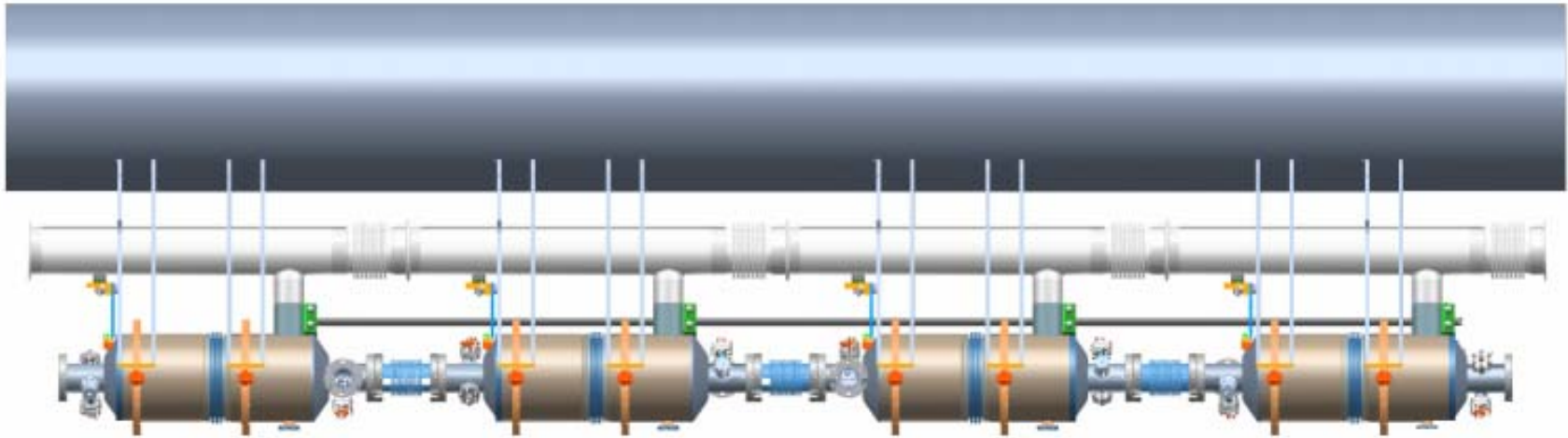
4. Input coupler

- 4.1. ~~Couplers should be placed to both sides of the module (due to limited space between the cavities)~~
- 4.2. Generally, an RF design is finished, but the following points have to be discussed:
 - 4.2.1. In general there is the feeling that the gap between inner and outer conductor is too small
 - 4.2.2. Design with a cold window was questioned
 - 4.2.3. Pumping speed is too small
 - 4.2.4. There was a suggestion to look for another input coupler solution
 - 4.2.5. We can't allow Kapton to be in the vacuum (outgassing)



3.9 GHz, 3rd Harmonic SRF System

Mechanical Developments Since September 2003

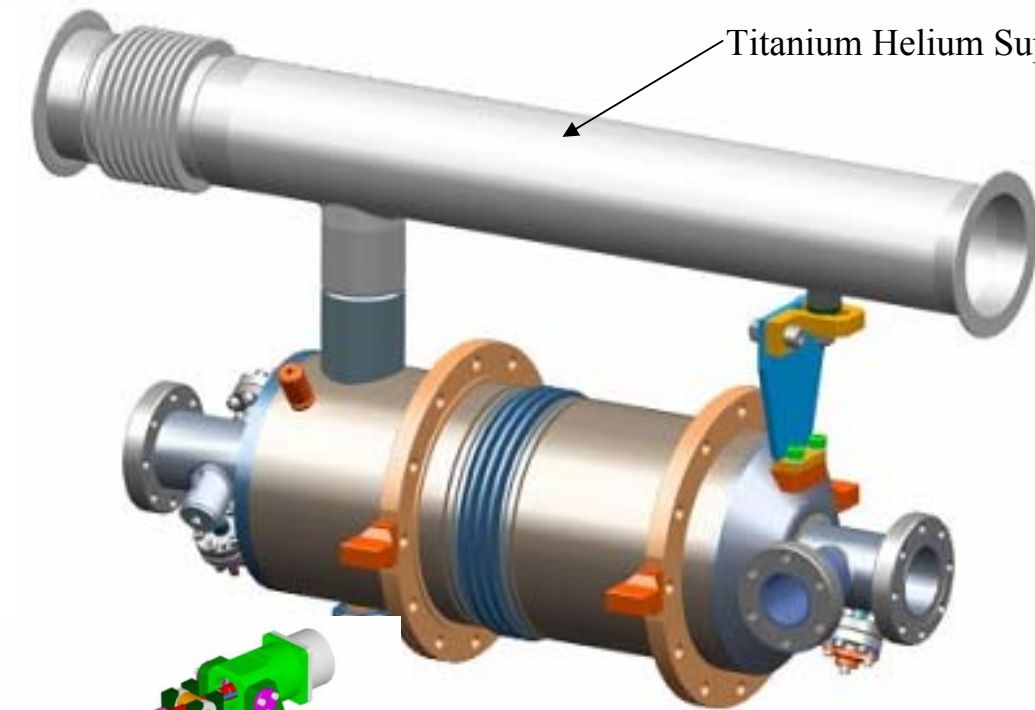


2.5m long Coldmass

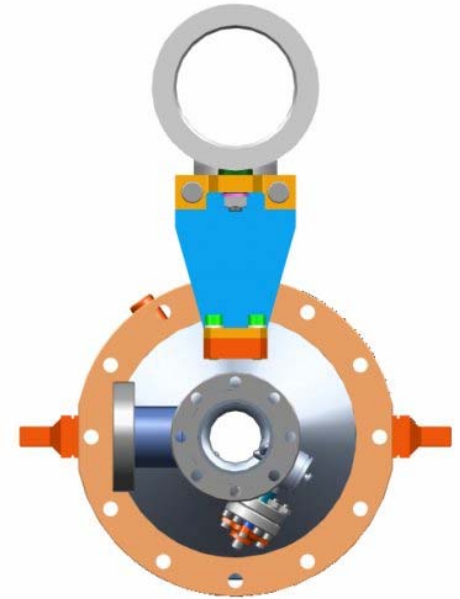
1. Design changes to Helium Vessel and RF Cavity End-Tubes.
2. Re-Design and Fabrication of Copper Model #2.
3. Niobium Weld tests for HOM Coupler and Formteil installation.



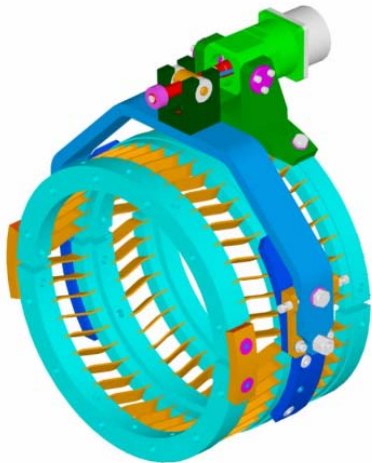
Helium Vessel with SRF Cavity and He Supply Line



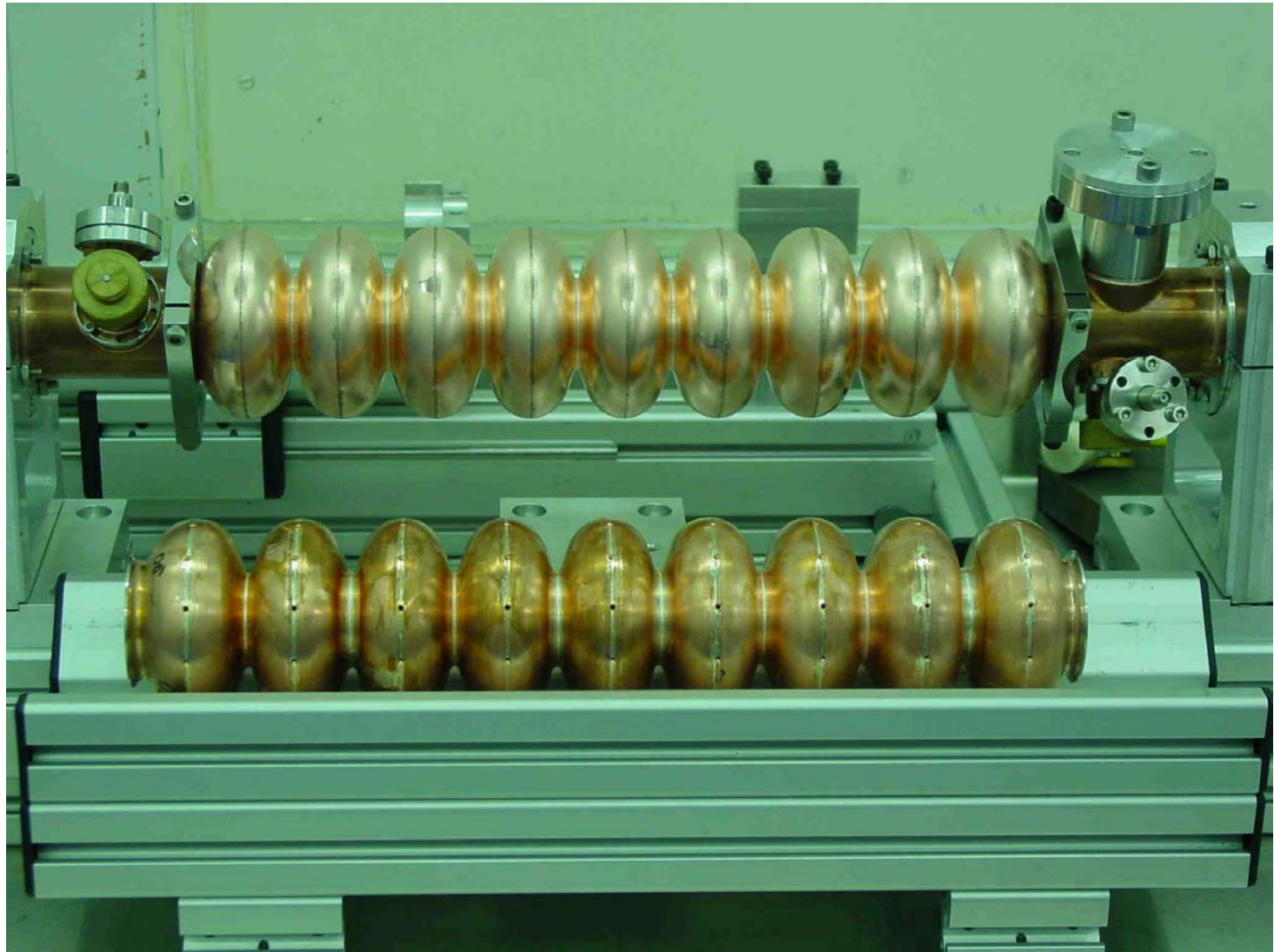
Titanium Helium Supply Tube



Old design



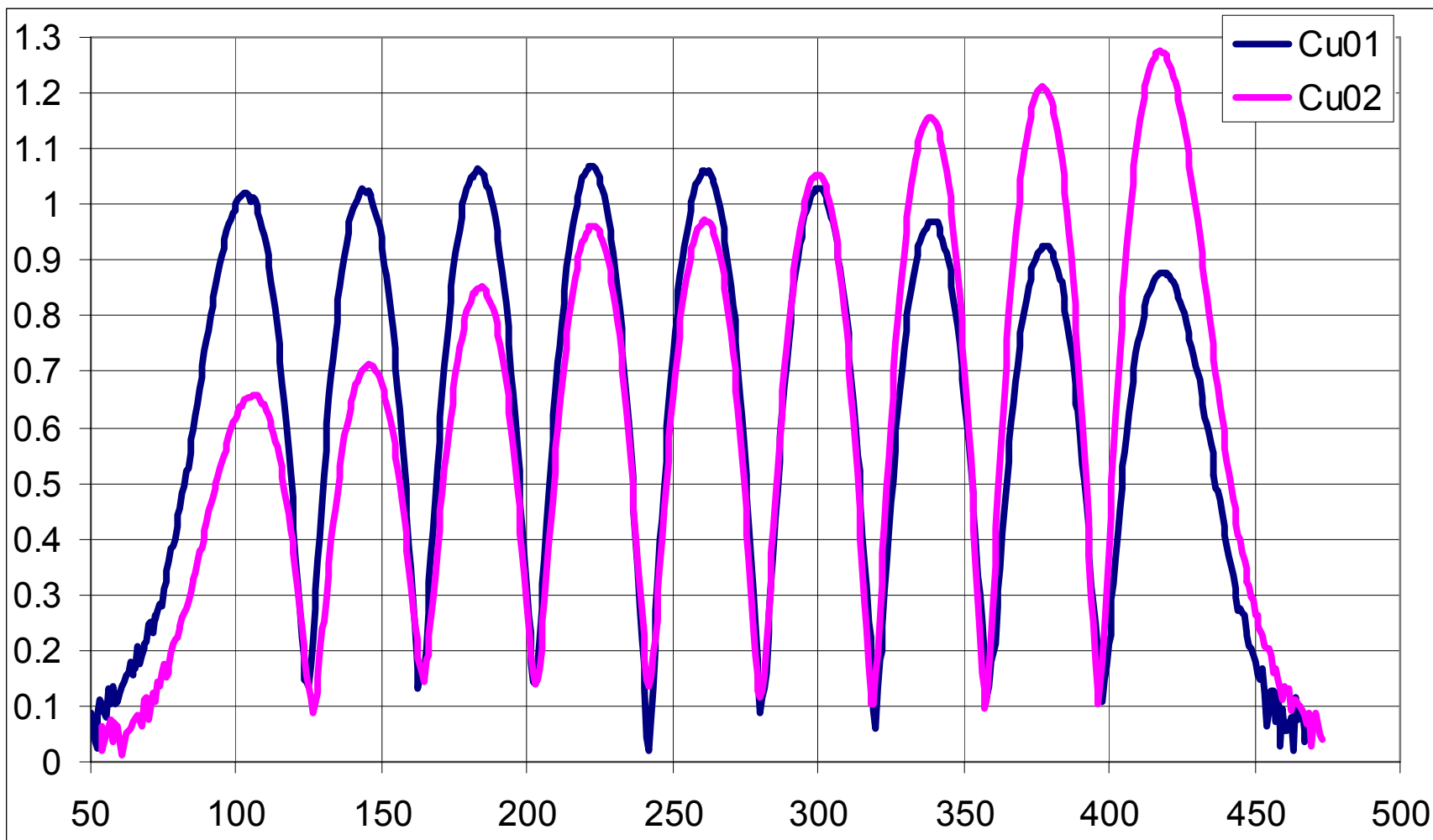
DESY Style Blade-tuner
scaled-down redesign



Cu01. Dumbbells brazing alloy 50Au50Cu, Equators brazing alloy 65Au35Cu.
Cu02. Dumbbells brazing alloy 65Au35Cu, Equators brazing alloy Cusil 72Ag28Cu.



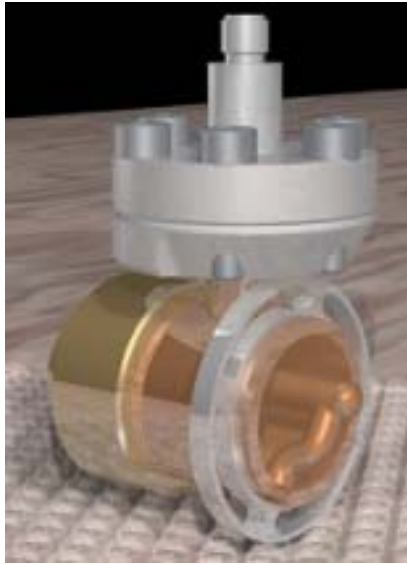
Copper 9 cell cavities before tuning.



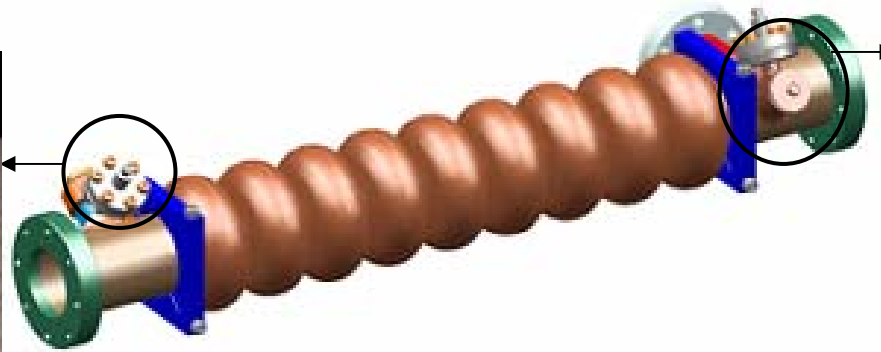
Cu01. $F=3895.41$ MHz.

Cu02. $F=3908.99$ MHz. $L=353.82$ mm.

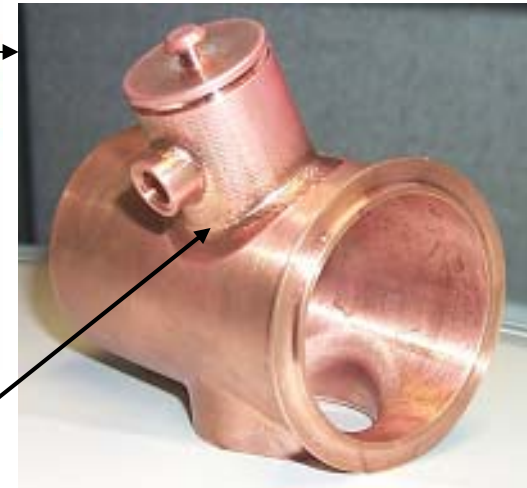
Copper Model #2



Old style HOM with needed improvements: used at this end of Copper Model #2



New HOM coupler to simulate Nb design

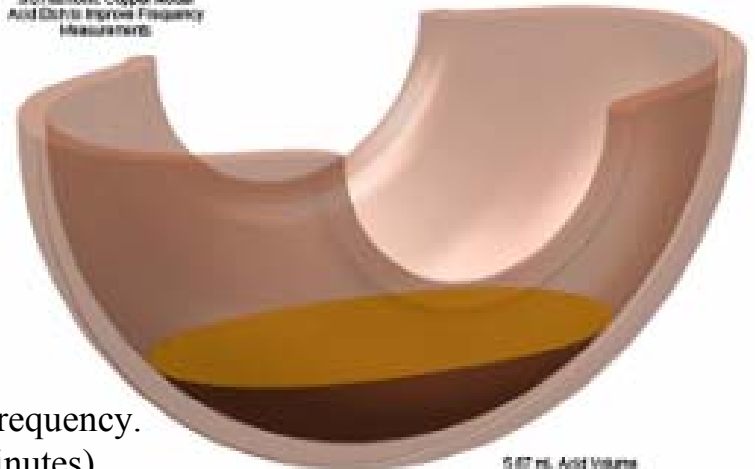


New HOM Coupler design: used at this end of Copper Model #2



Acid Etching to improve cell frequency.
(Rotated in cavity for 20 minutes)

3rd Harmonic Copper Model Acid Etch to Improve Frequency Measurements





Nb 3cell cavity assembly for the cold test.



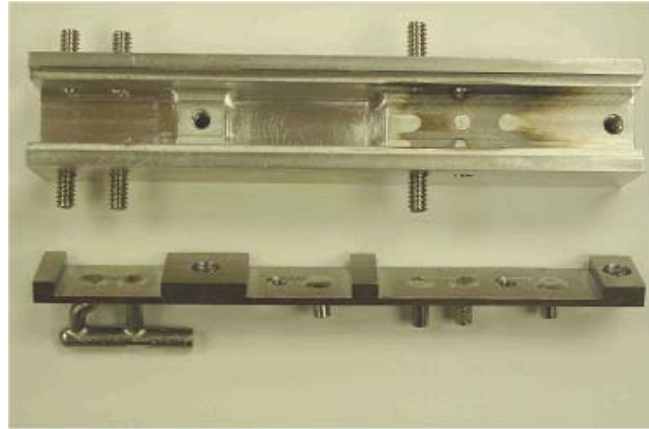


Formteil, Niobium Weld Testing

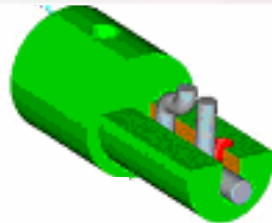
HOM coupler tube welding test and fixture.



HOM coupler loop welding test and fixture.

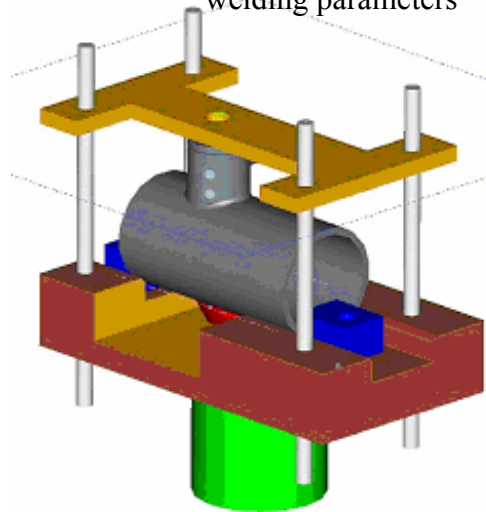


Formteil Tooling



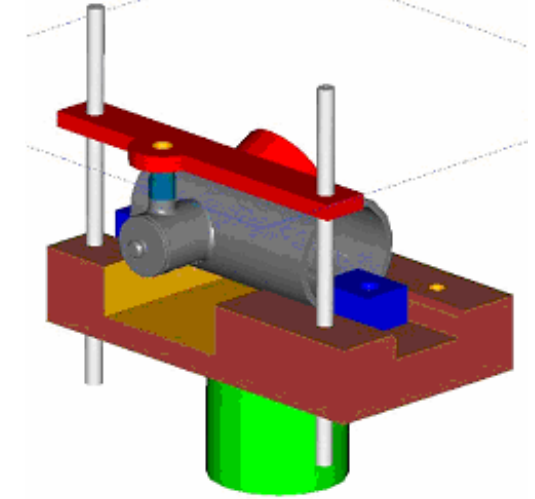
E-beam weld

Formteil welding to determine e-beam welding parameters



Welding fixture to mount HOM Coupler

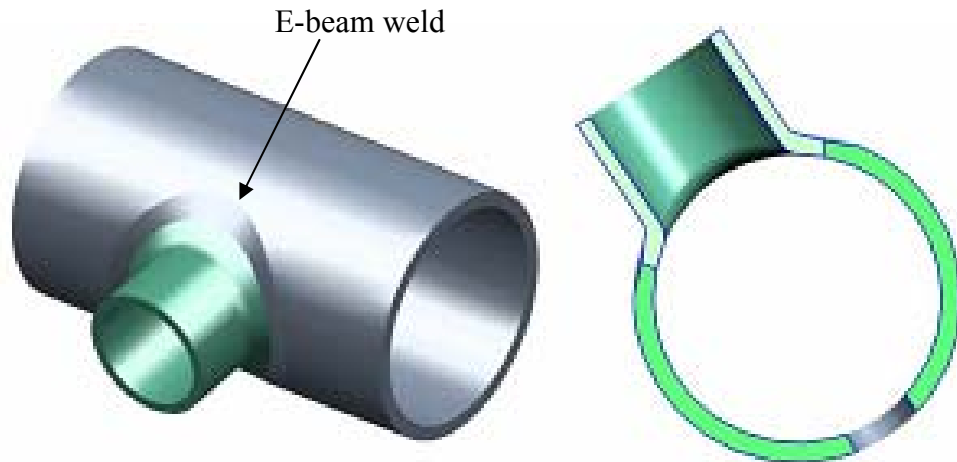
Formteil full penetration weld



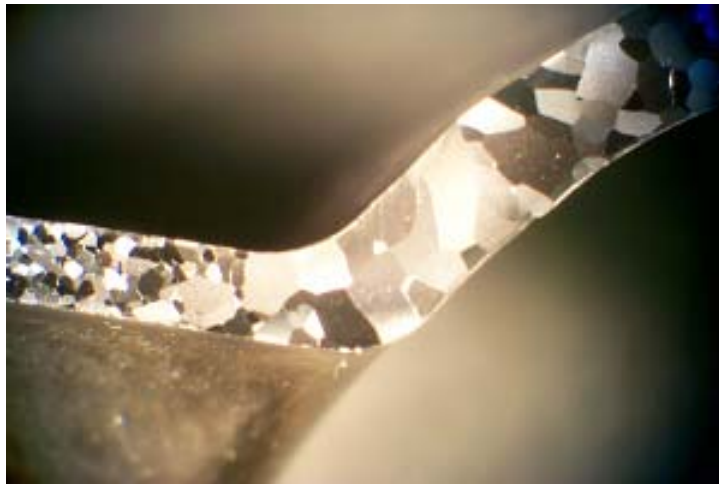
Welding fixture to mount support tube



HOM Coupler, Niobium Weld Testing



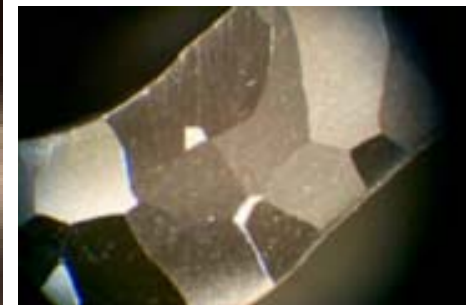
Sample welding to determine weld parameters



Grain structure after welding



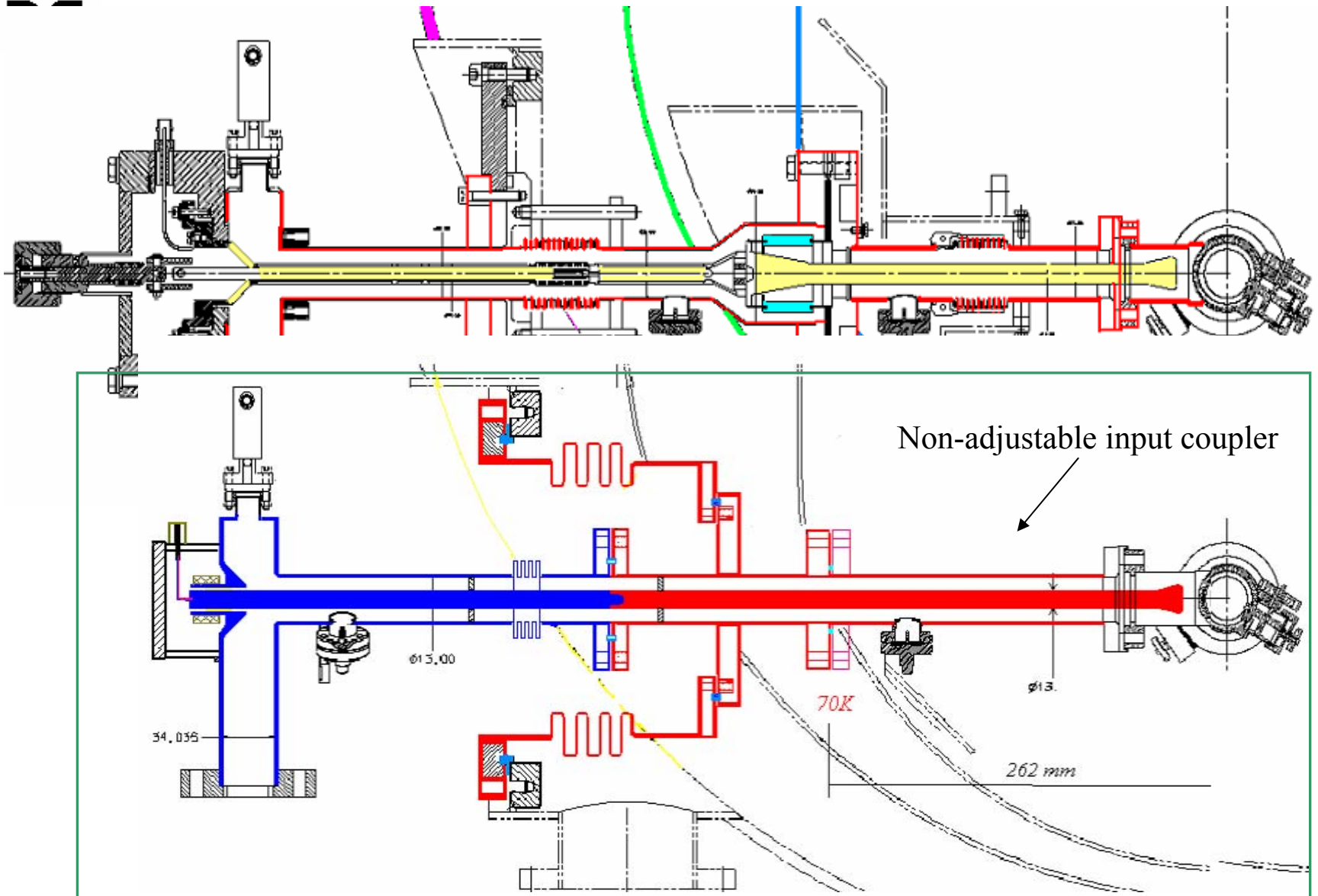
Final, acceptable weld for mounting HOM Coupler



Close-up of grains

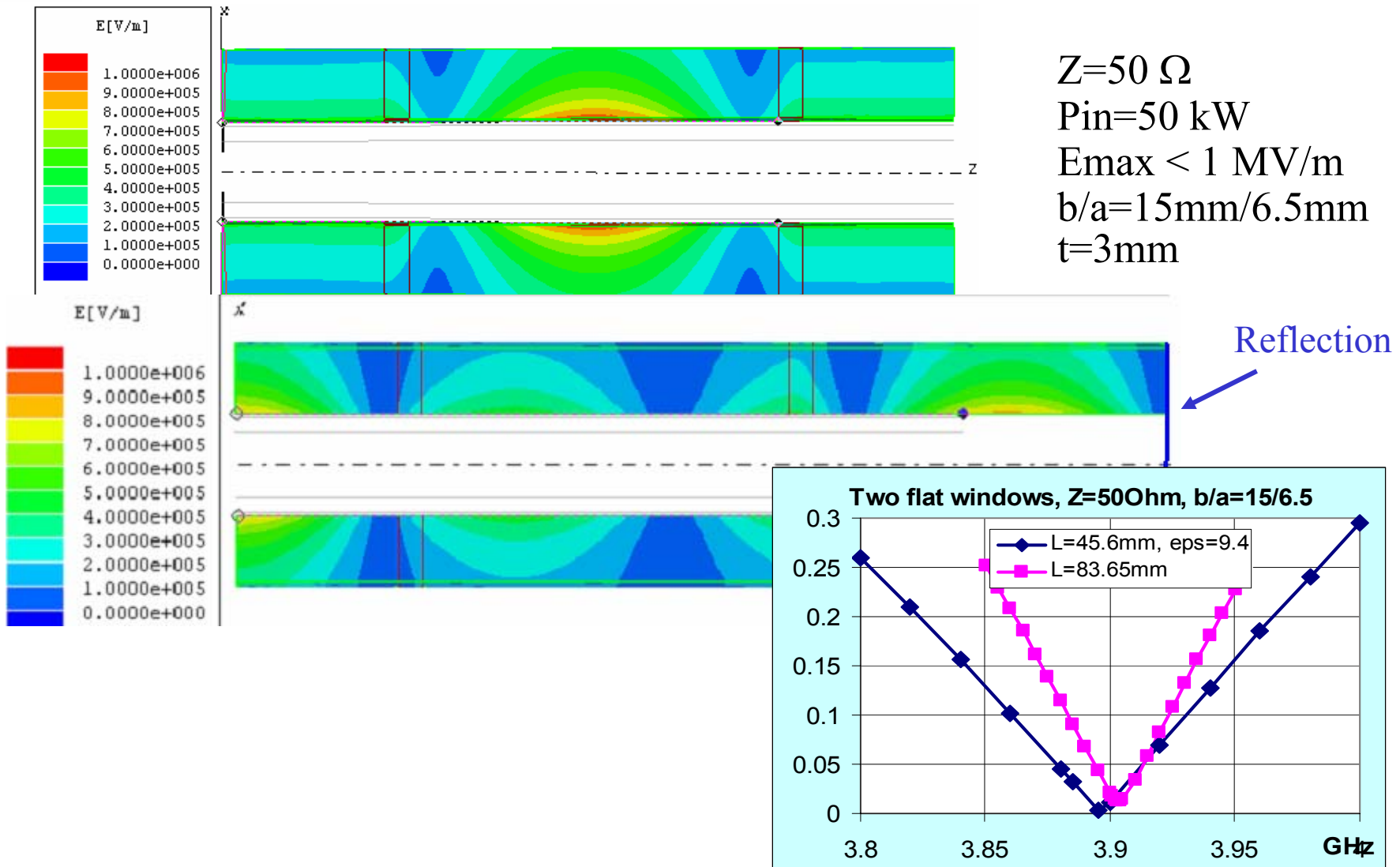


Adjustable vs. simple non-adjustable coupler

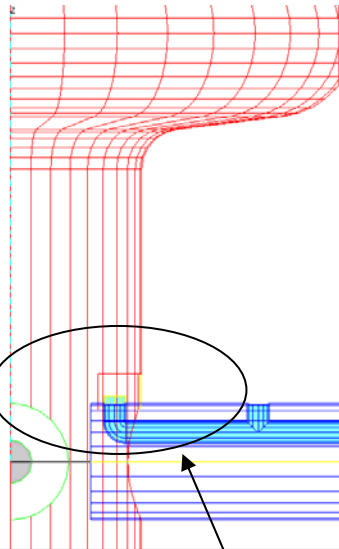




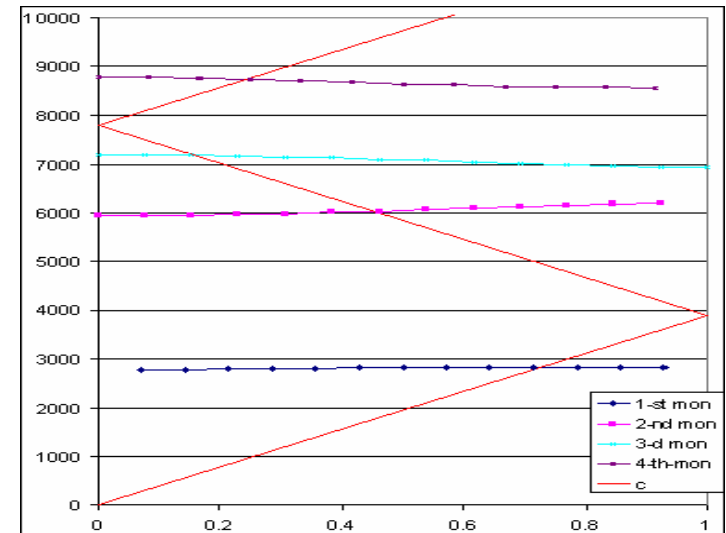
Two warm flat windows in coaxial coupler



HOM design for 3.9GHz CKM cavity

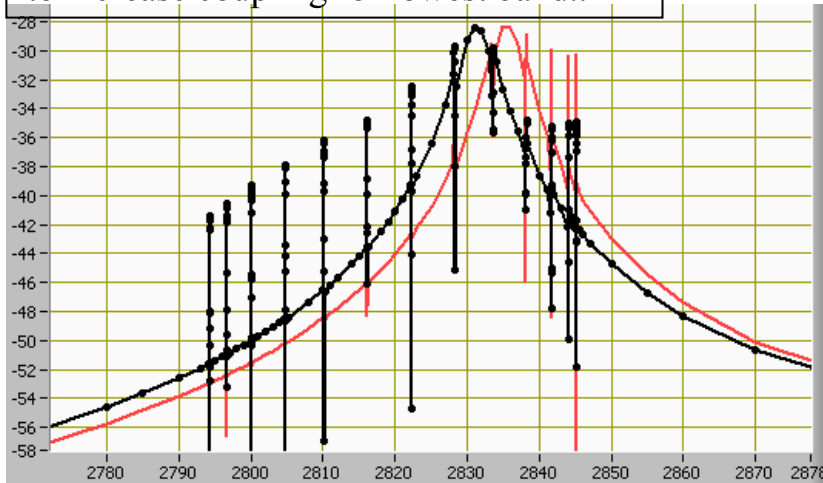


F1, MHz	Q	F2, MHz	Q
2794.4	2.0E+08	5957.0	2.2E+06
2796.6	4.4E+07	5960.4	9.8E+05
2800.1	1.6E+07	5969.0	8.5E+05
2804.8	7.0E+06	5983.0	8.2E+05
2810.2	3.0E+06	6002.0	8.1E+05
2816.2	1.2E+06	6025.6	8.1E+05
2822.3	3.7E+05	6053.0	8.3E+05
2828.2	6.8E+04	6083.3	8.5E+05
2833.6	2.6E+04	6115.1	9.1E+05
2838.2	5.1E+04	6146.7	1.1E+06
2841.7	1.6E+05	6175.9	1.4E+06
2844.0	3.7E+05	6200.2	2.3E+06
2845.2	1.3E+06	6216.4	7.2E+06

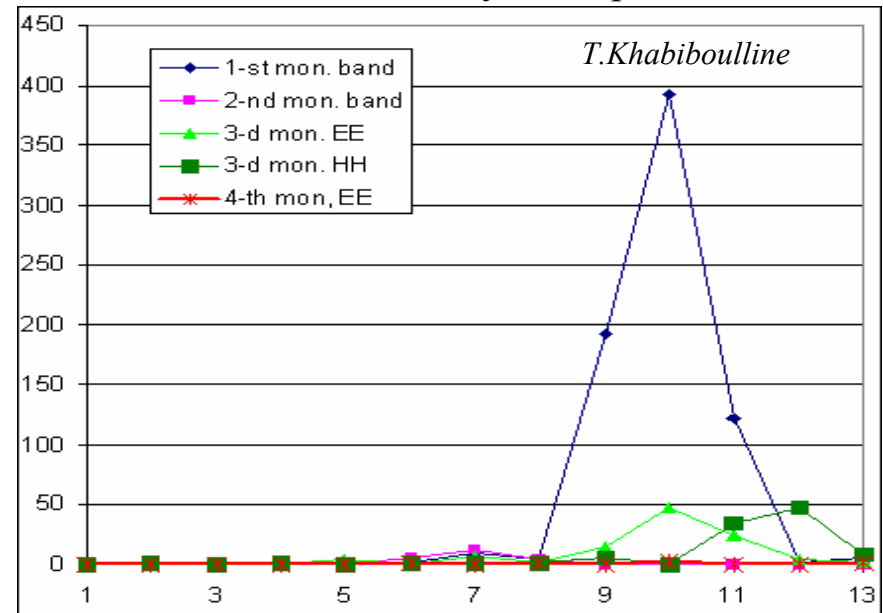


CKM 13 cell cavity monopole modes

L/4 resonance element at F=2830MHz to increase coupling for lowest band..



Example of the CKM HOM coupler. S21 with 2 couplers in opposite end of 13-cell cavity.



CKM 13-cell cavity monopole modes. R/Q
In 3rd and 4th bands high field in tube.



MATERIAL STUDIES FOR SC RF CAVITY DEVELOPMENT

•CHARACTERIZE MATERIALS IN SUPPORT OF FNAL SCRF CAVITY FABRICATION PROGRAMS

- quality control of raw materials**
- study of effect of critical production steps on material properties**
- witness sample program**

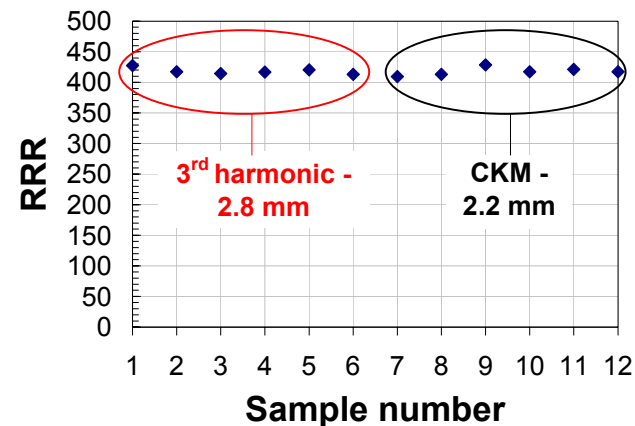
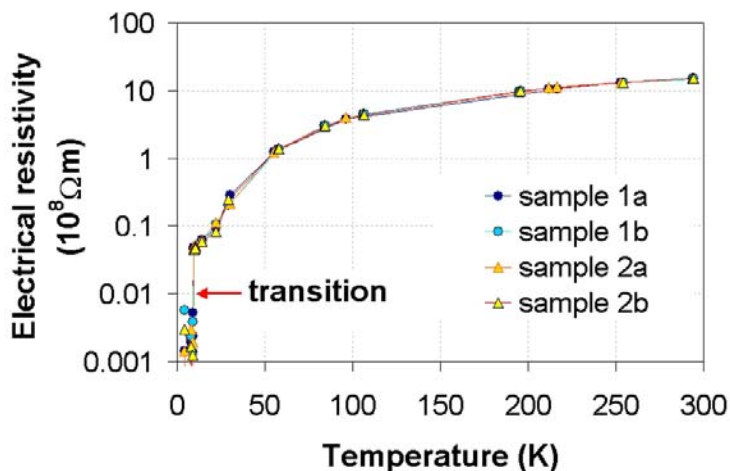
•PREPARATION FOR FUTURE LARGE SCALE SCRF PROJECTS AT FERMILAB

- SCRF materials lab infra-structure**
- proposal for fundamental SCRF material research**

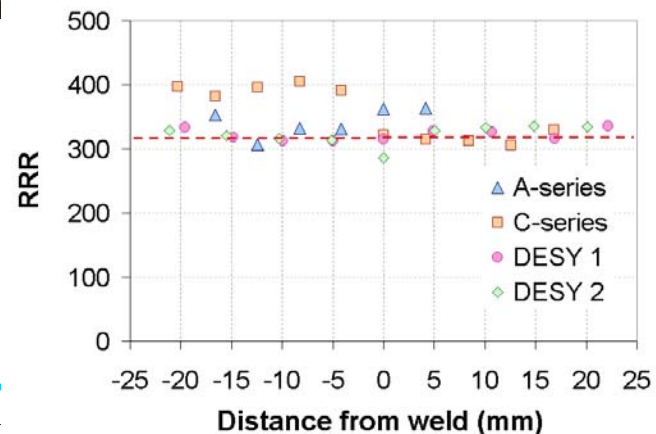


SUMMARY OF CURRENT ACTIVITIES

RRR Measurements: simple, very sensitive to purity, $RRR > 300$

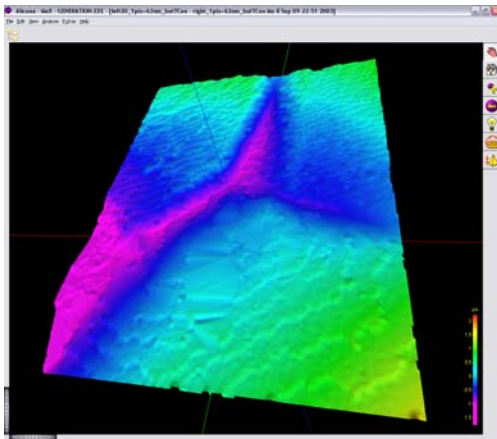
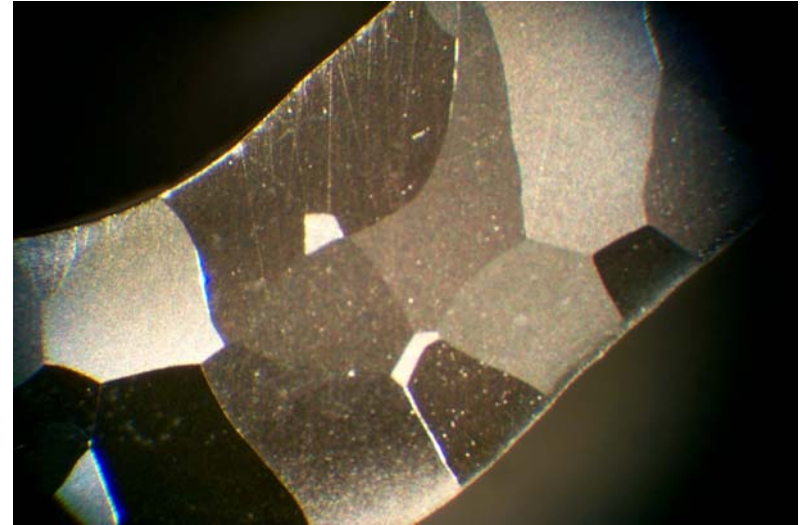
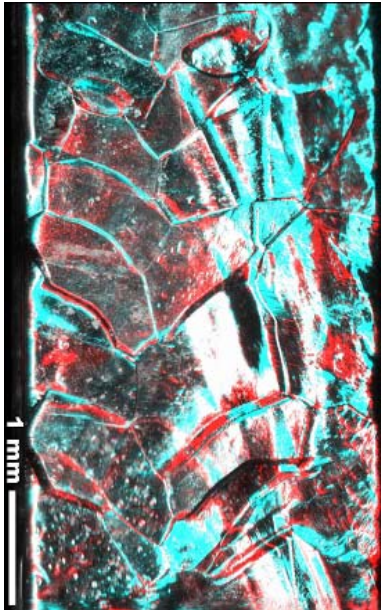


Samples:	A3	A4	A5
RRR measurement	284	310	330
U-sound pre-clean	X	X	X
100 min BCP etch	X		X
800°C bake	X	X	
20 min BCP etch	-	-	X
RRR measurement	302	110	359

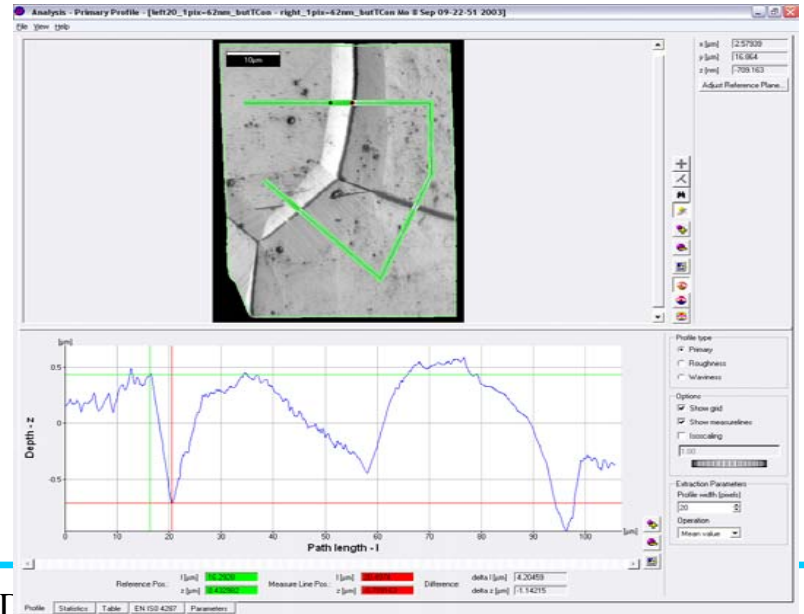




MICROSCOPY STUDIES

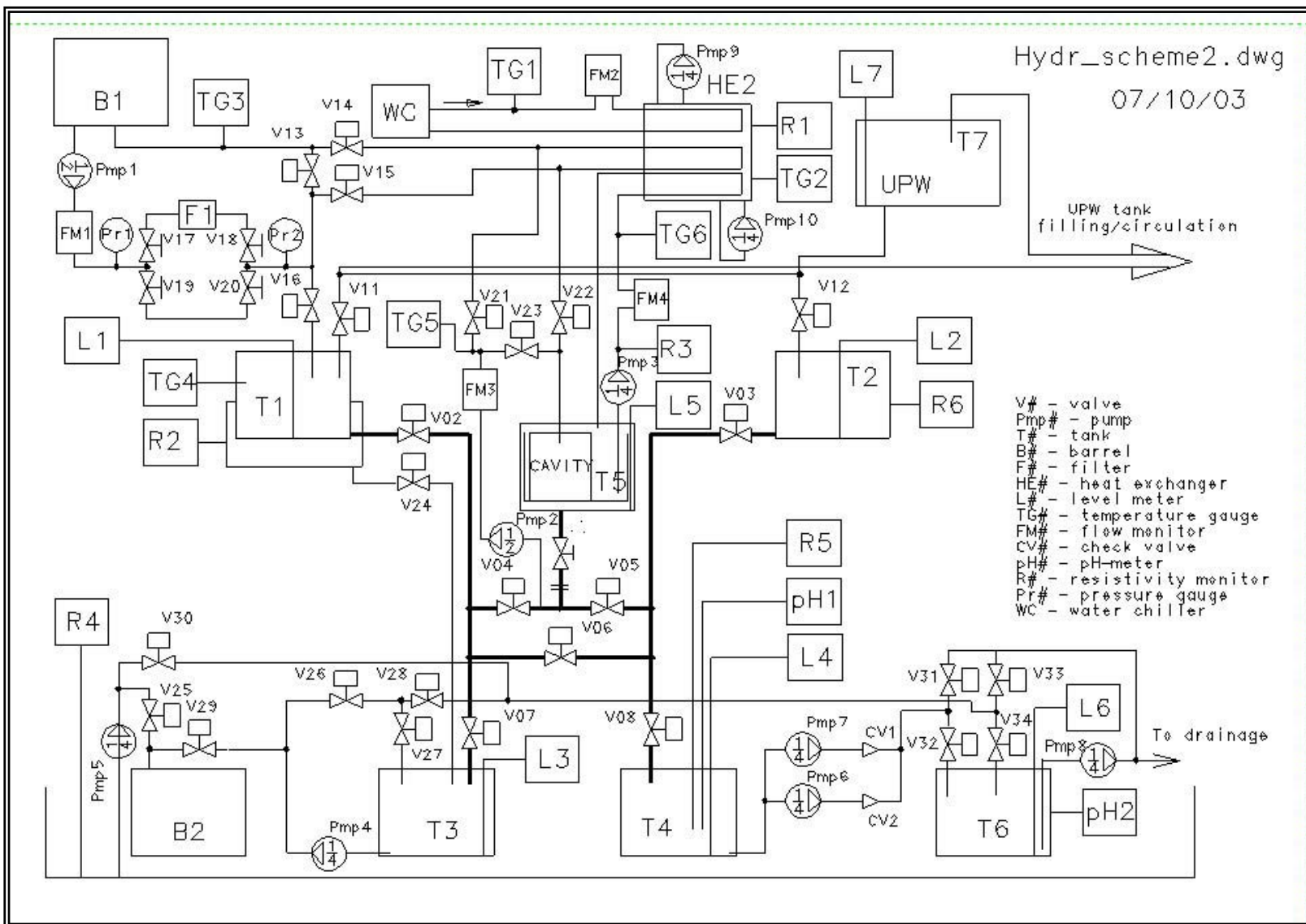


Profilometric measurements: 10 μm in BCP etched samples





FNAL-ANL BCP Facility





Mockup at MDL





FY 2004 plans

- Assemble hydraulic part of Mockup-2 – Dec. 03
- Complete control system (including electrical and pneumatic parts – April 03)
- Cavity handling infrastructure – March 03
- Safety review on site before the equipment is shipped to ANL
- Mount equipment at ANL (after the room is built it will take about one month)



Summary

- ✓ Second Copper prototype of 9-cell cavity is nearly ready for trapped modes searching. Need frequency and field flatness tuning.
- ✓ 3-cell cavity assembled for cold tests.
- ✓ Cavity design is finished
- ✓ Helium tank redesigned
- ✓ Blade-tuner design in progress
- ✓ Start design of simple non-adjustable coupler
- ✓ Welding tests of HOM coupler and tubes finished
- ✓ 53 blanks for 9-cell cavities sent to DESY for scanning
- ✓ Progress in chemistry
- ✓ Designing of low-mode/HOM coupler for CKM cavity