SPL@BNL Update

Ilan Ben-Zvi
for the Stony Brook, BNL and AES SPL teams
Presented by Rama Calaga

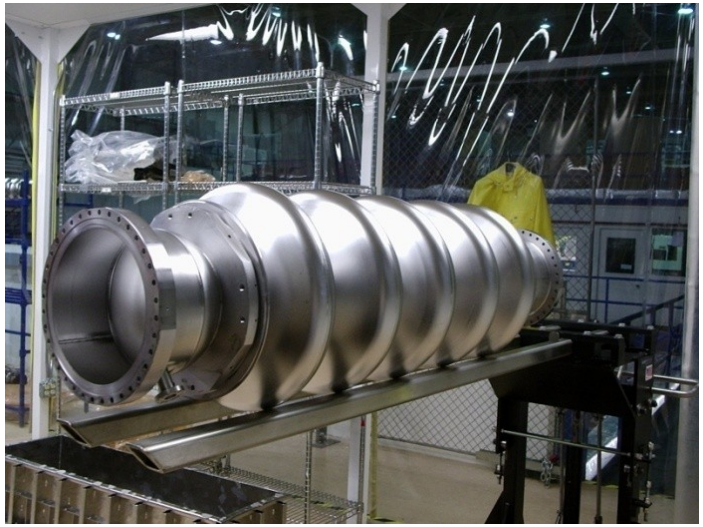
The BNL High-Current R&D

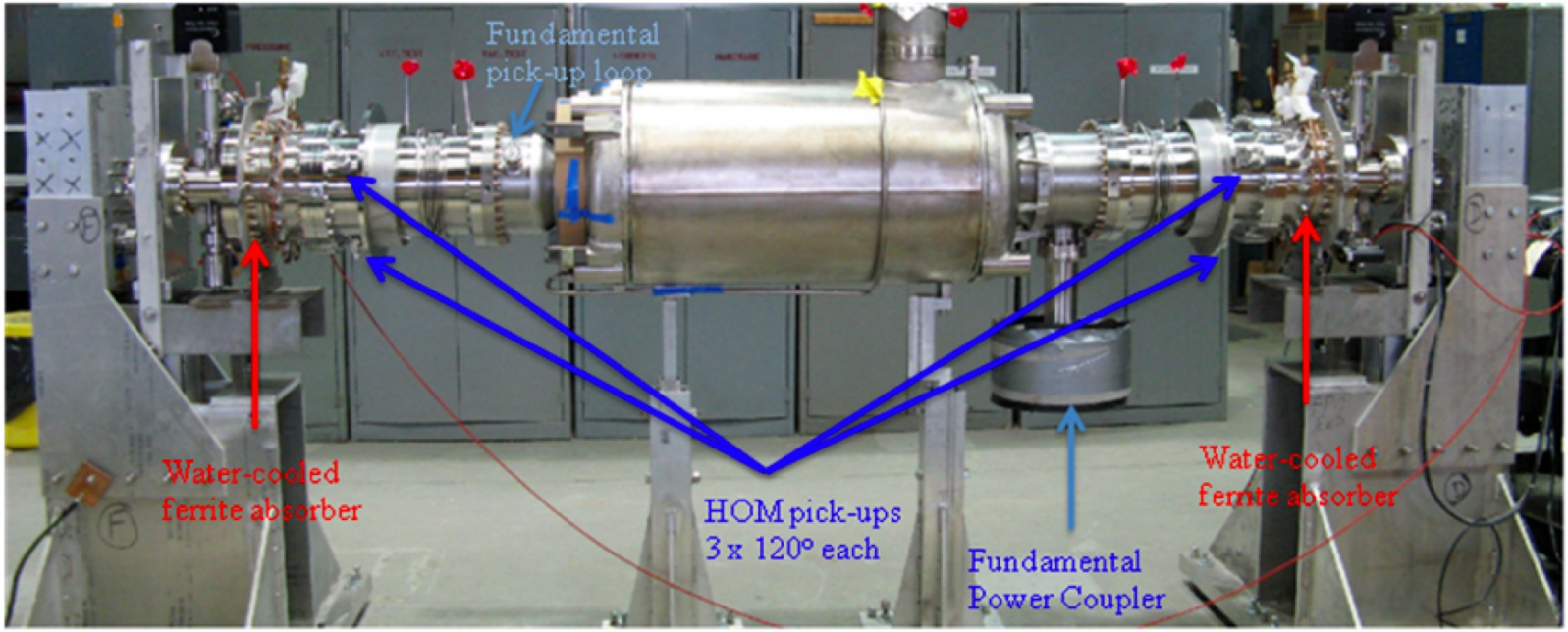
- Aimed at CW beam currents of >0.5 amperes
- We are developing a new 5-cell high-current cavity
- Collaboration with AES
- Much was reported in last meeting at Lund.

Our first high current ERL cavity:

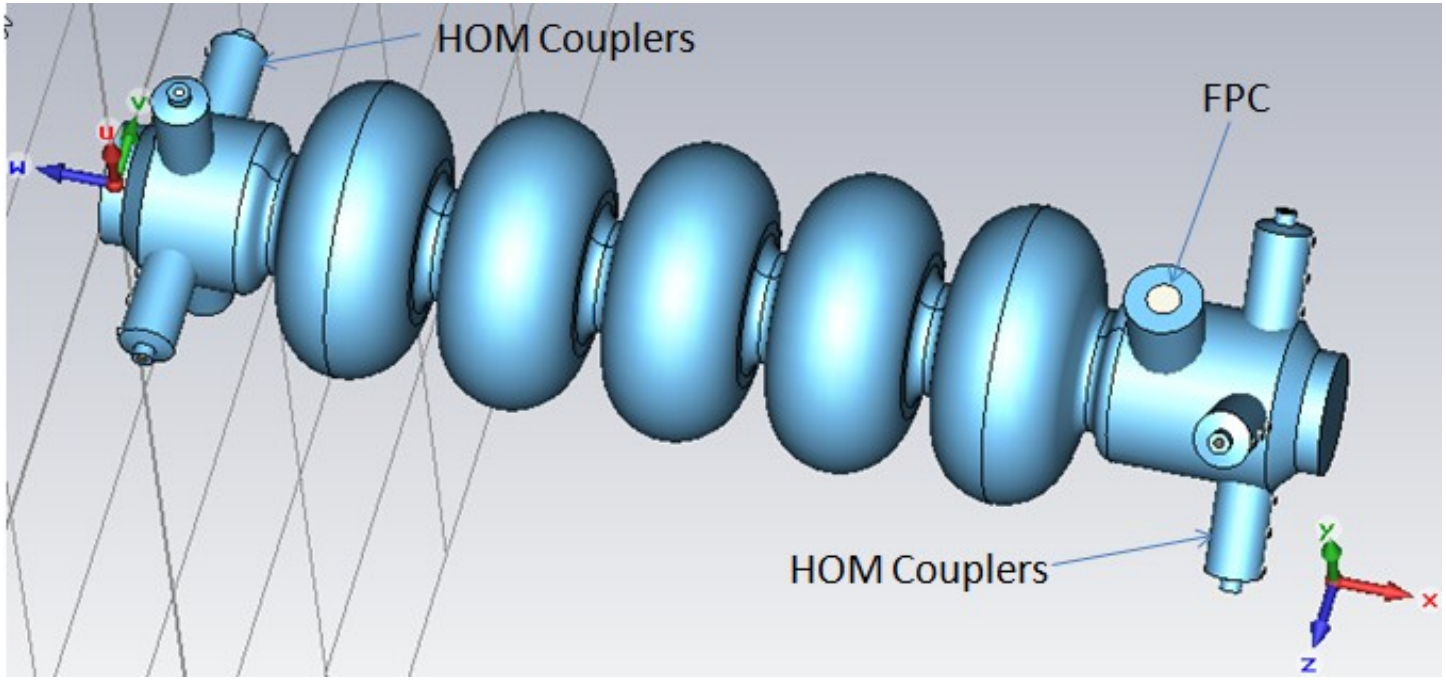
Reached 20 MV/m with Q of 10^10

Tested horizontally to 20 MV/m

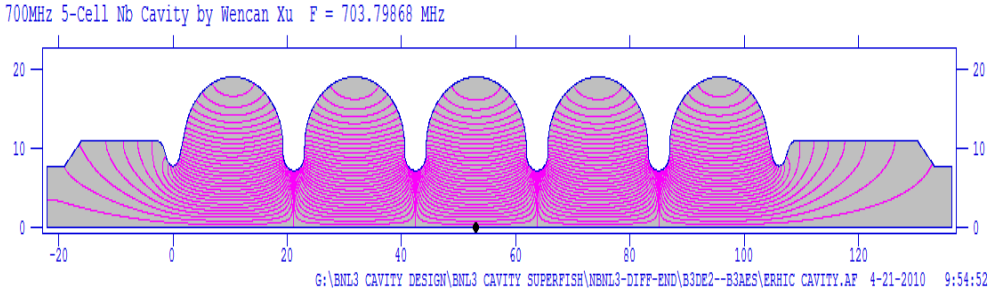


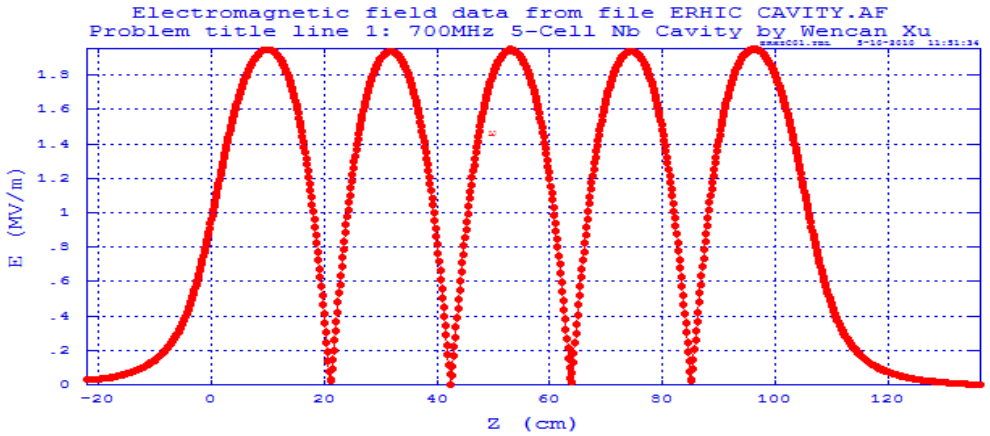


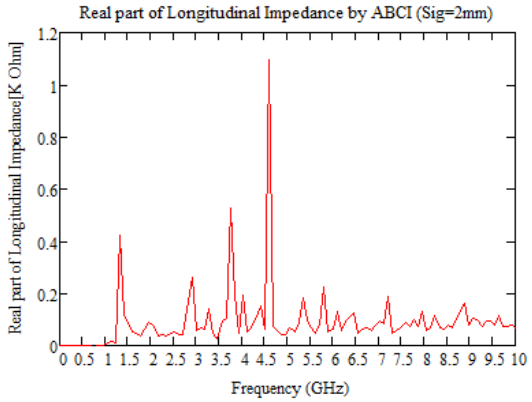
Design of new ERL cavity

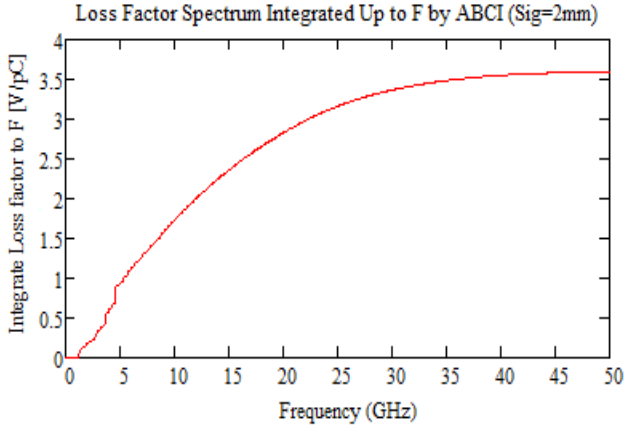


Hallmarks: Improved SRF properties and HOM damping.
Use pick-up probes rather than ferrites or waveguides.
HOM power conducted through coax lines to room temperature loads.


700MHz 5-Cell Nb Cavity by Wencan Xu F = 703.79868 MHz
G:\BNL3 CAVITY DESIGN\BNL3 CAVITY SUPERFISH\NBNL3-DIFF-END\B3DE2--B3AES\ERHIC CAVITY.AF 4-21-2010 9:54:52


Electromagnetic field data from file ERHIC CAVITY.AF
Problem title line 1: 700MHz 5-Cell Nb Cavity by Wencan Xu
E (MV/m)
Z (cm)


Real part of Longitudinal Impedance by ABCI (Sig=2mm)
Real part of Longitudinal Impedance[K Ohm]
Frequency (GHz)

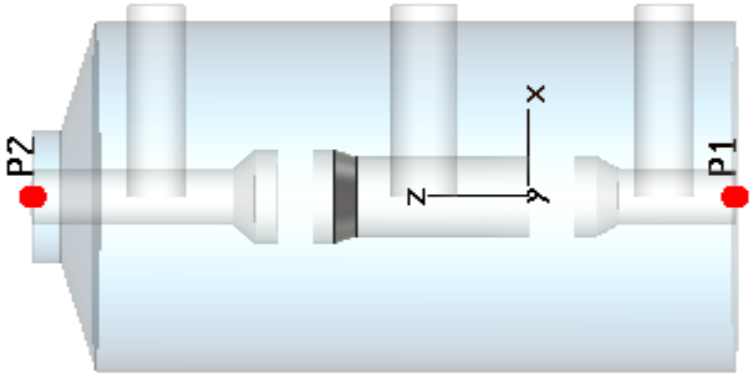

Loss Factor Spectrum Integrated Up to F by ABCI (Sig=2mm)
Integrate Loss factor to F [V/pC]
Frequency (GHz)

Comparison: New and original

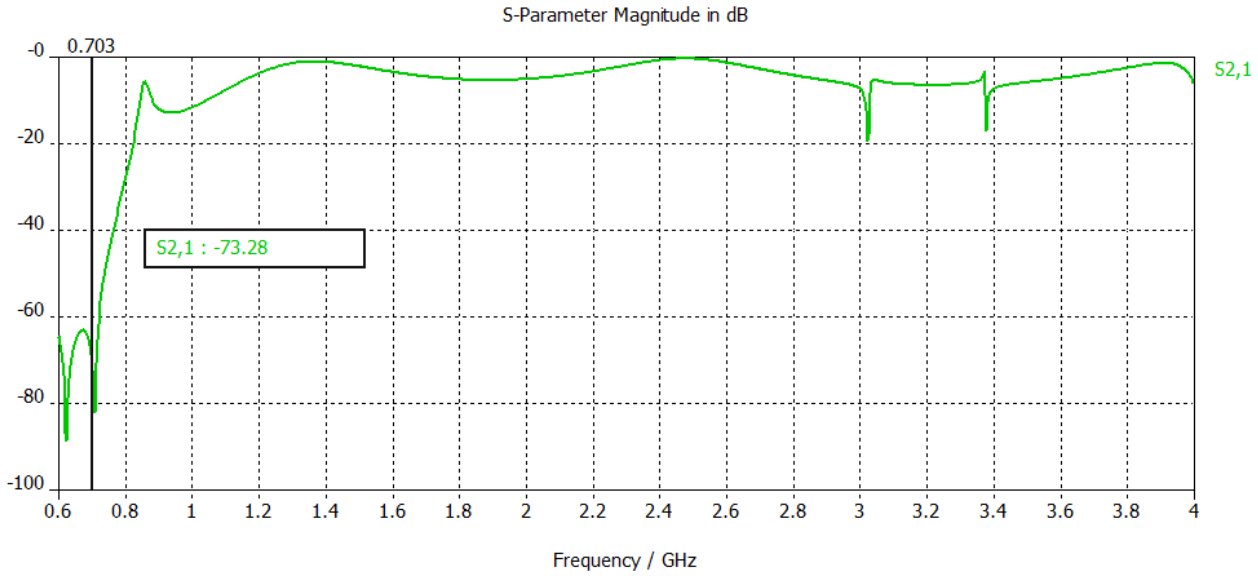
Parameters	BNL I	BNL III
Frequency [MHZ]	704	703.79
beta	1	1
Cells No.	5	5
Geometry Factor	**225**	**283**
(R/Q)/cell [Ω/cell]	**80.8**	**101.26**
Epeak/Eacc	1.97	2.46
Bpeak/Eacc [mT/MV/m]	**5.78**	**4.26**
Coupling factor [%]	3.00	3.02
Length (cm)	152	144 (SPL), 160 (eRHIC)
Beam pipe radius (mm)	120	110

Band-stop filter design

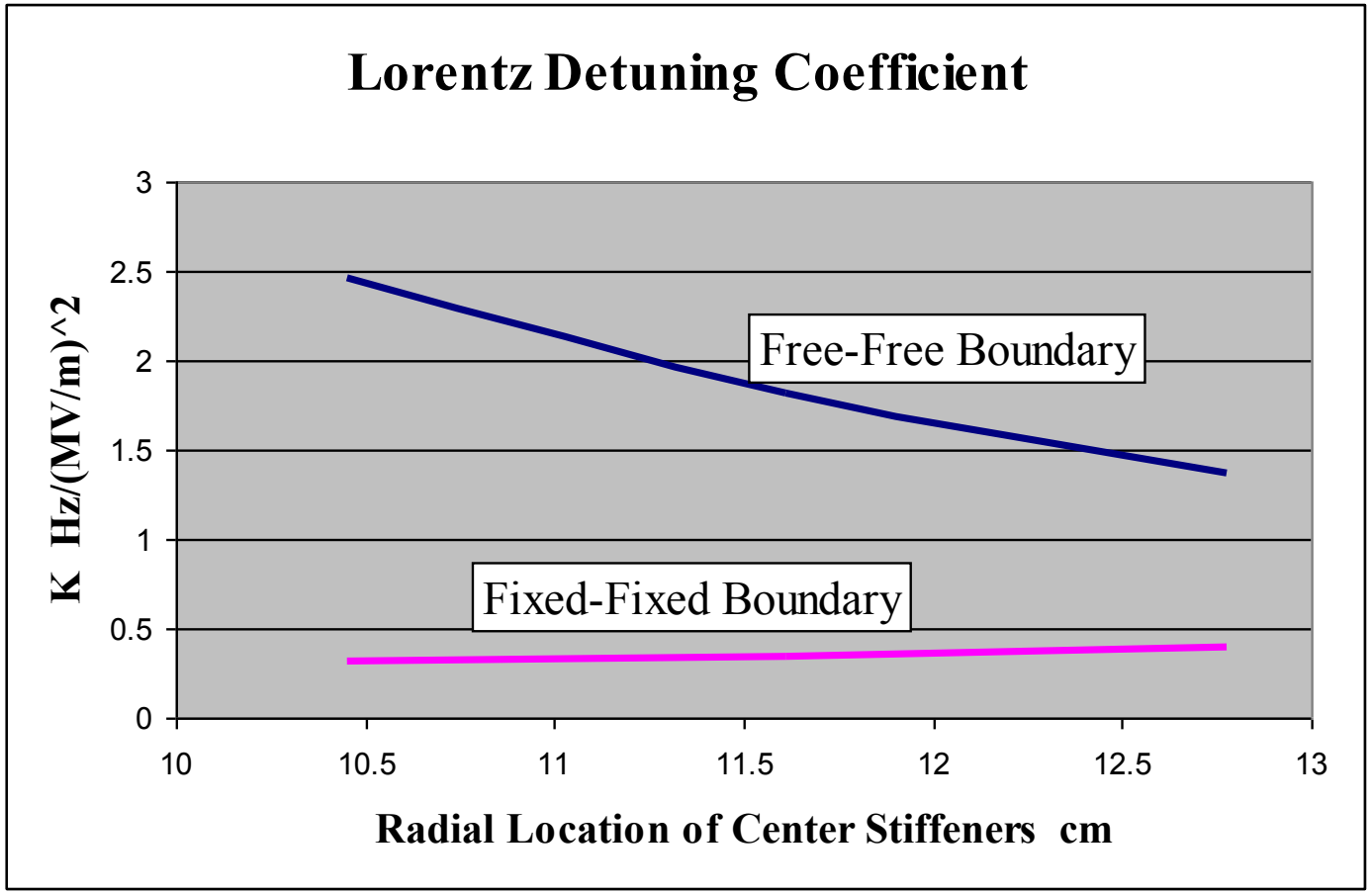
Wencan Xu



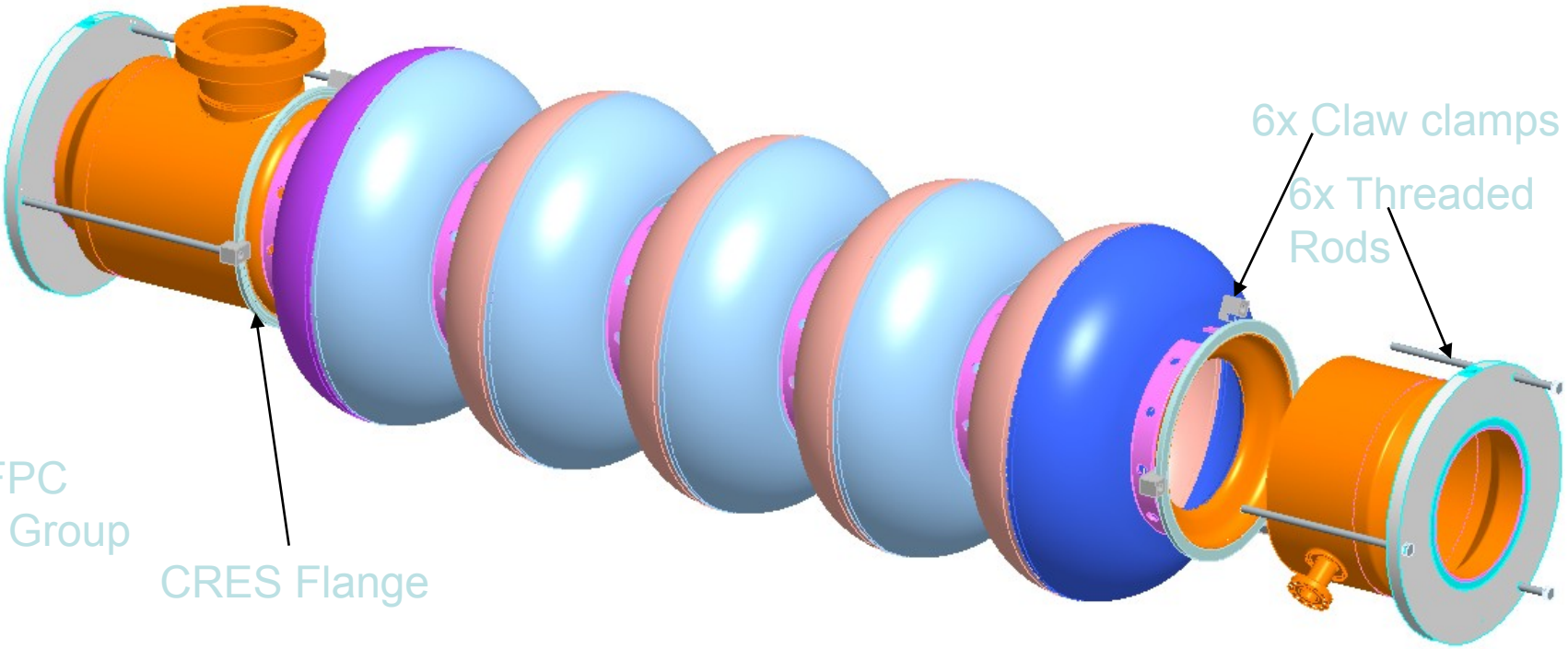
A band-stop filter is simpler and safer than a notch filter.



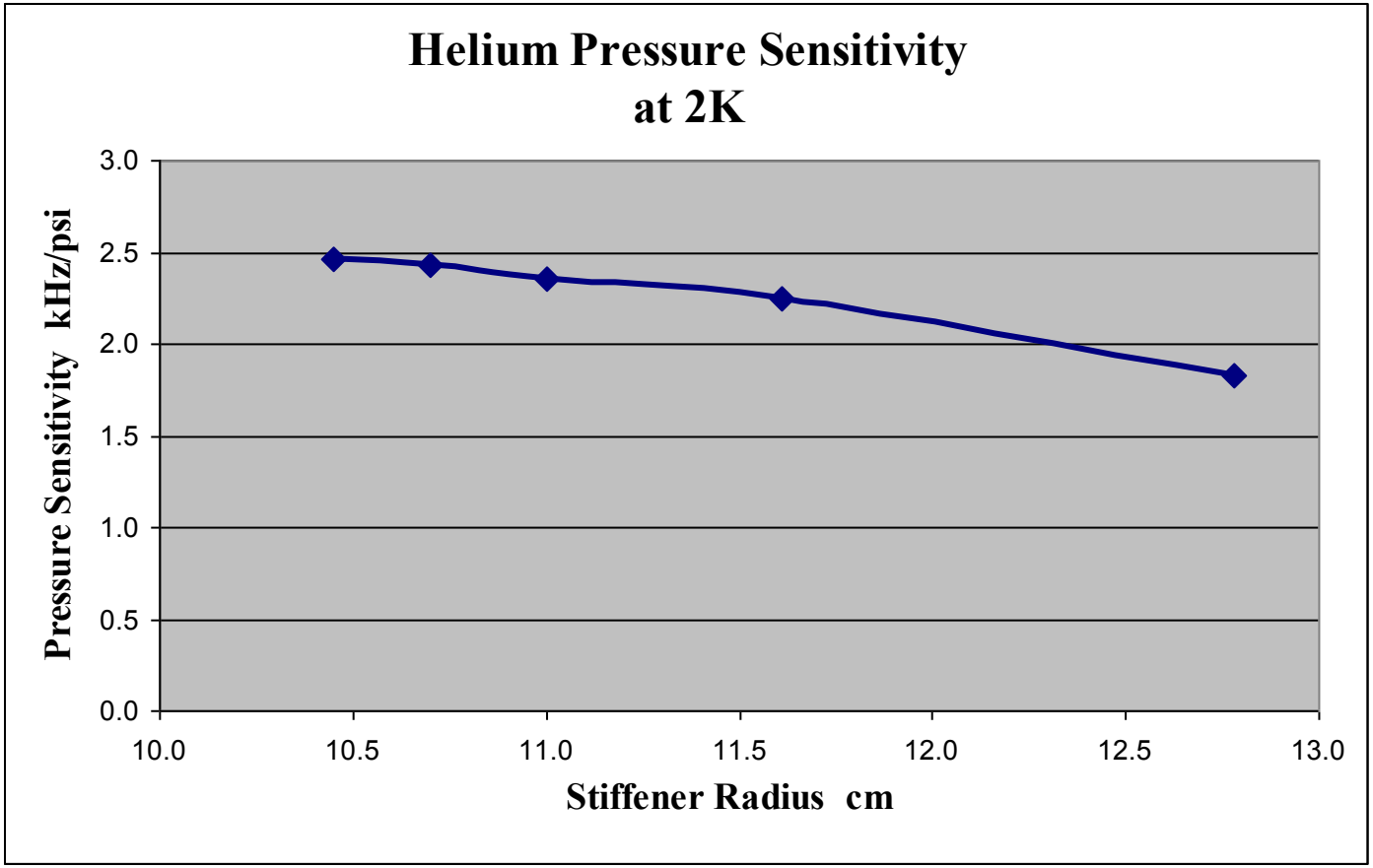
Lorentz Coefficient for Different Stiffener Locations



Design of a copper prototype (AES)



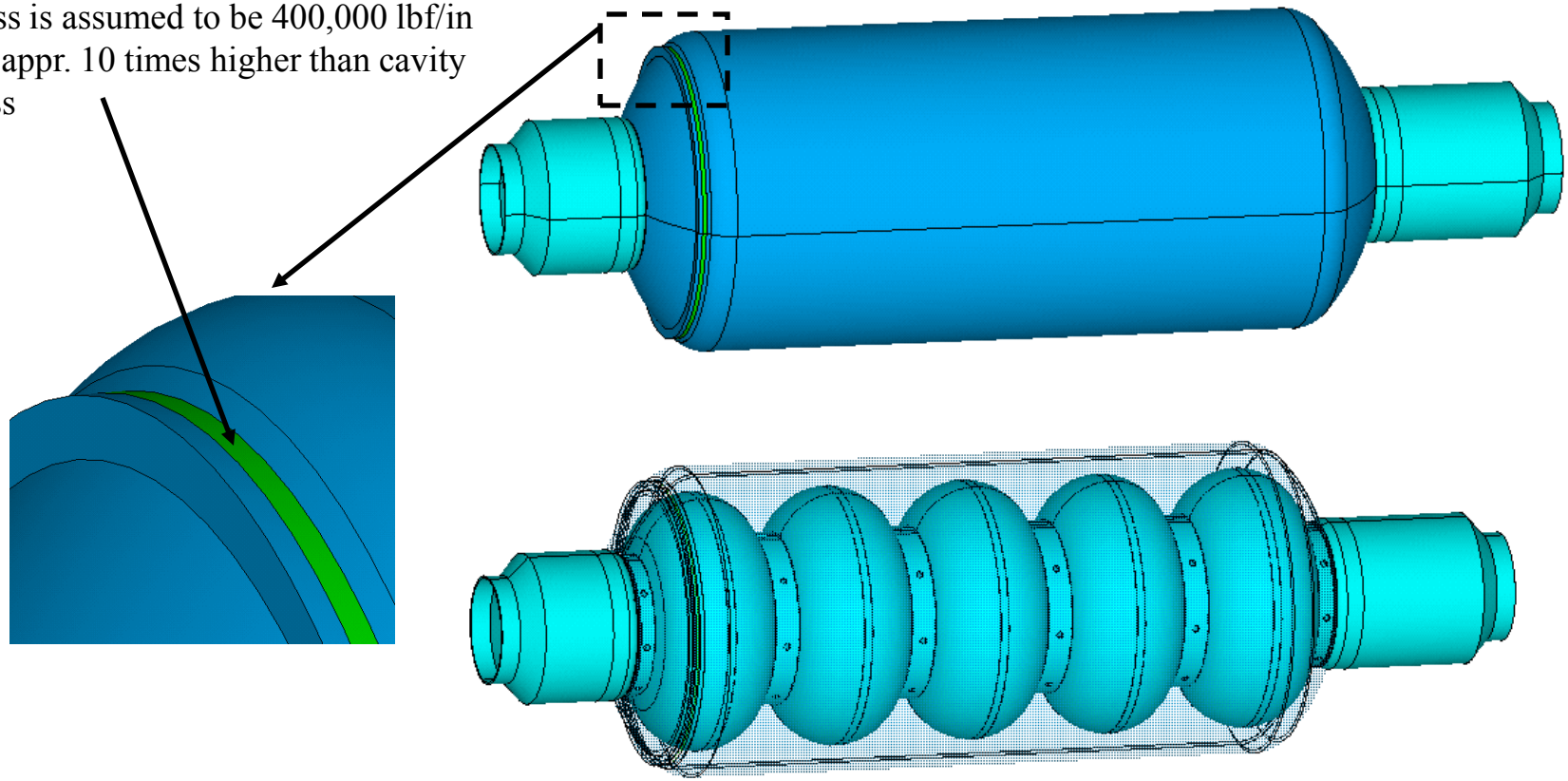
Helium Pressure Sensitivity



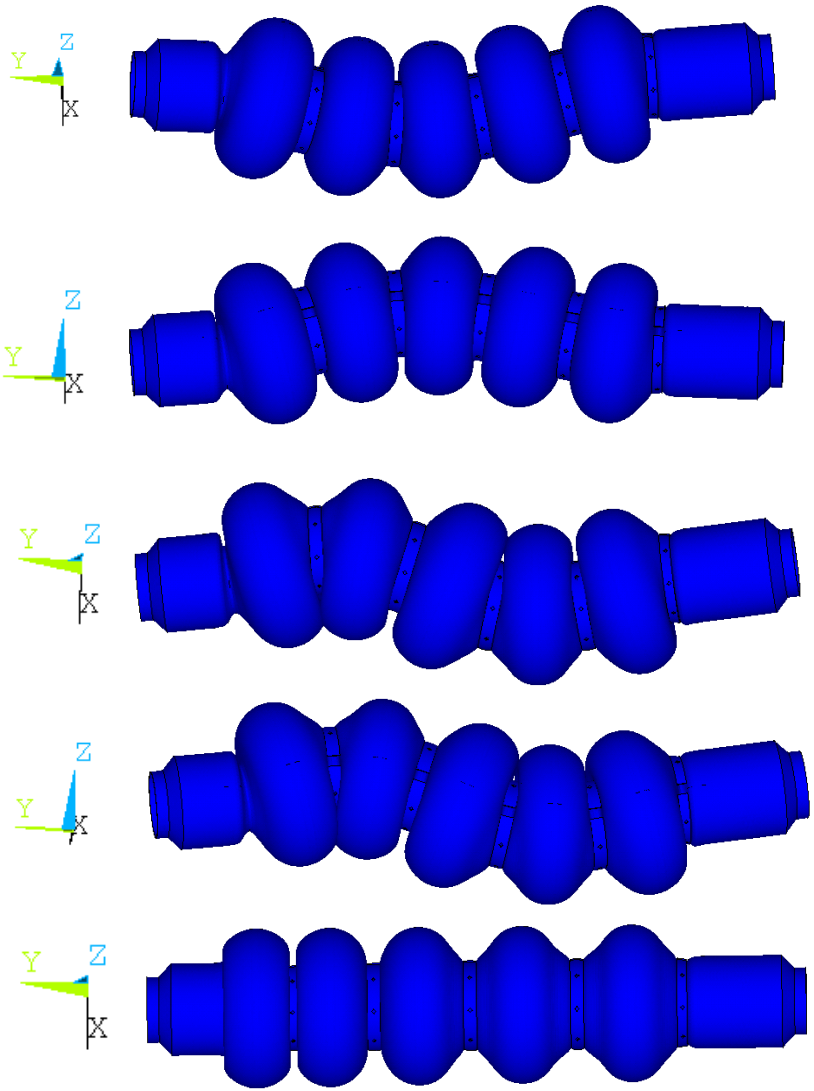
Model for Pressure Sensitivity and Structural Modes

Local modification to material modulus to account for bellows and tuner

Stiffness is assumed to be 400,000 lbf/in
This is appr. 10 times higher than cavity stiffness



First Five Cavity Mode Shapes



78.0 Hz

80.1 Hz

162.2 Hz

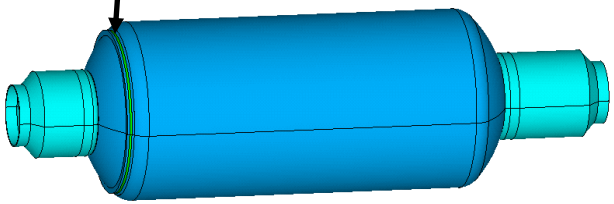
167.4 Hz

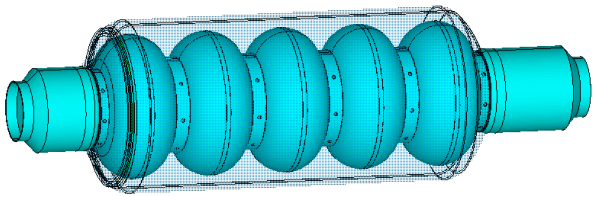
188.5 Hz

At 2K

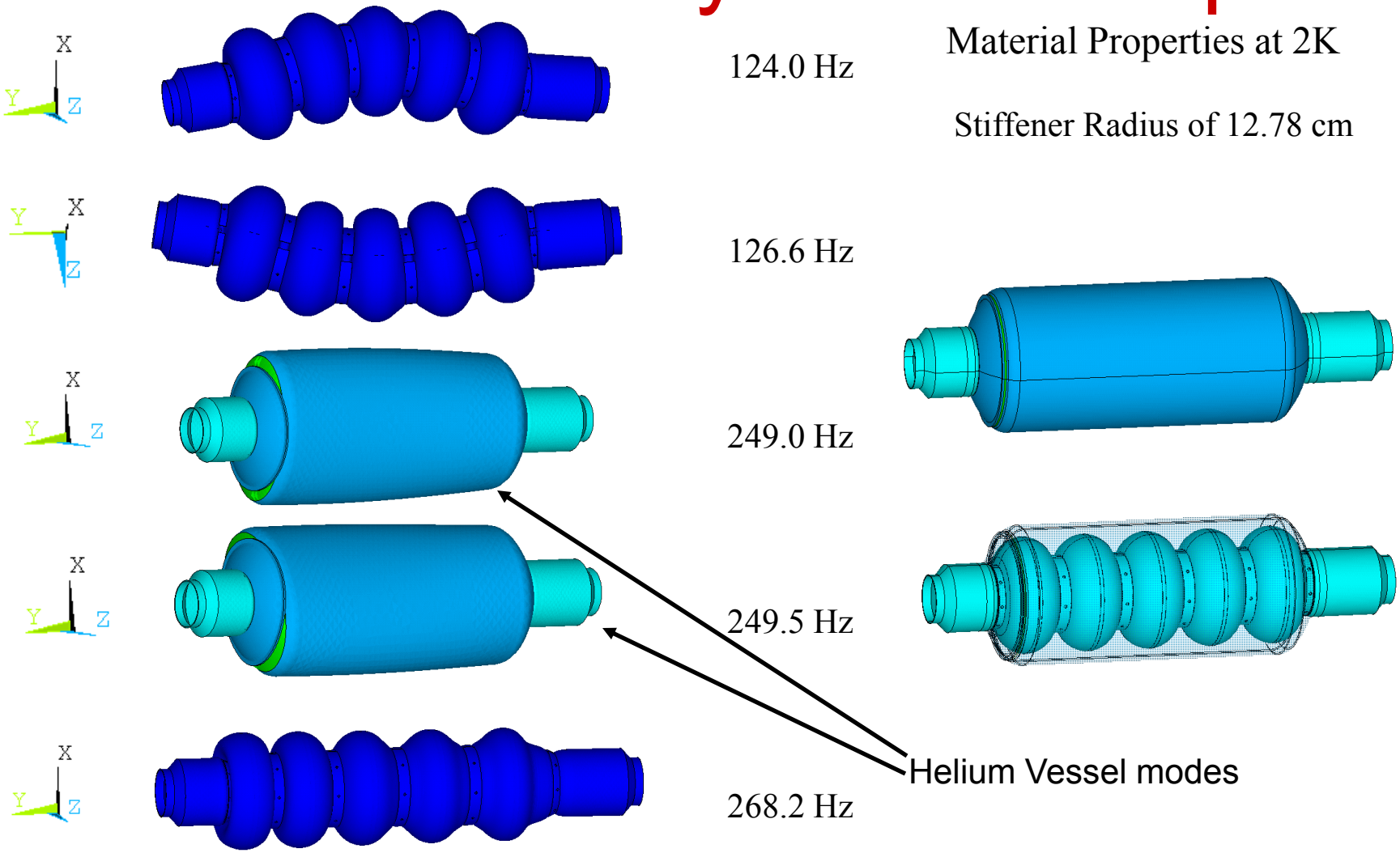
Stiffener Radius of 10.45 cm

Local modification to material modulus to account for bellows and tuner

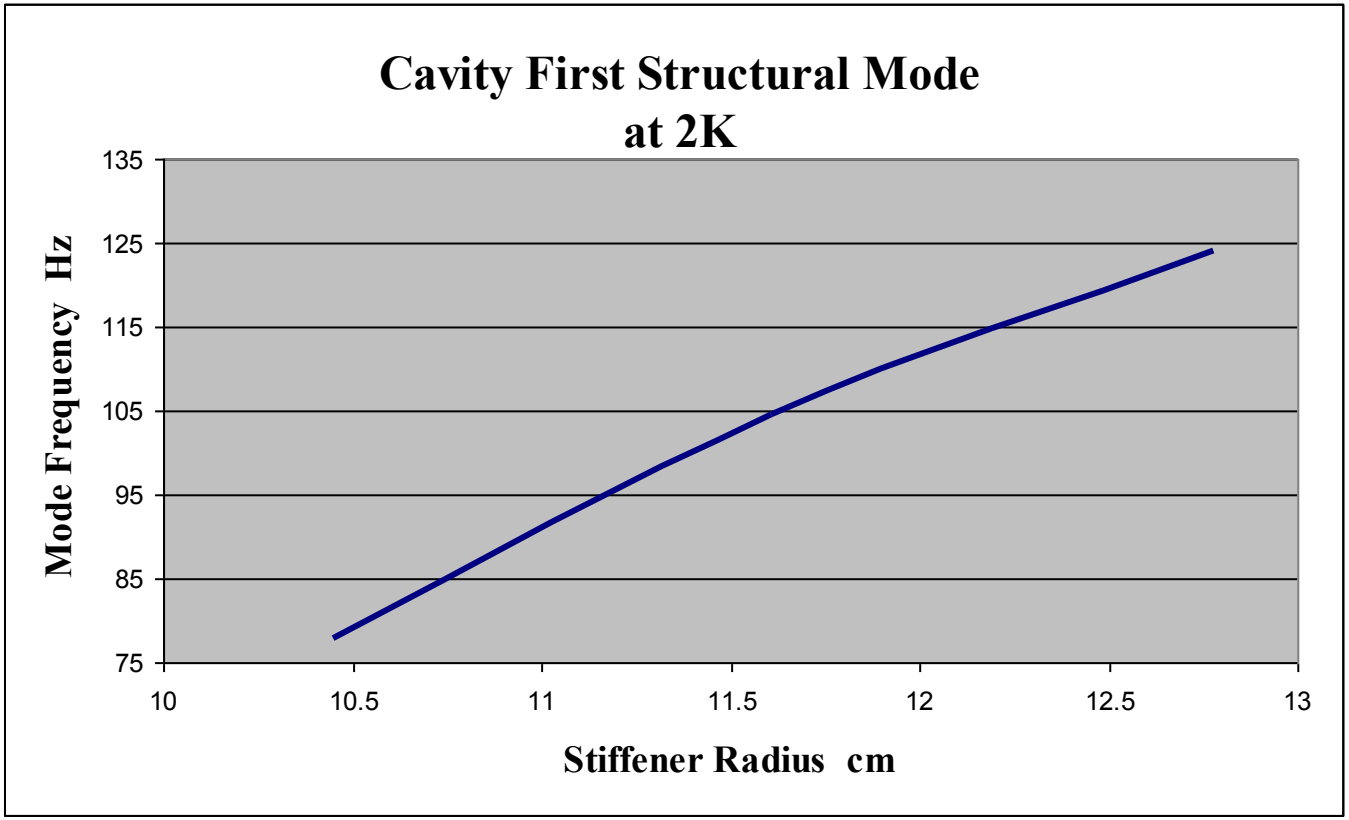




First Five Cavity Mode Shapes

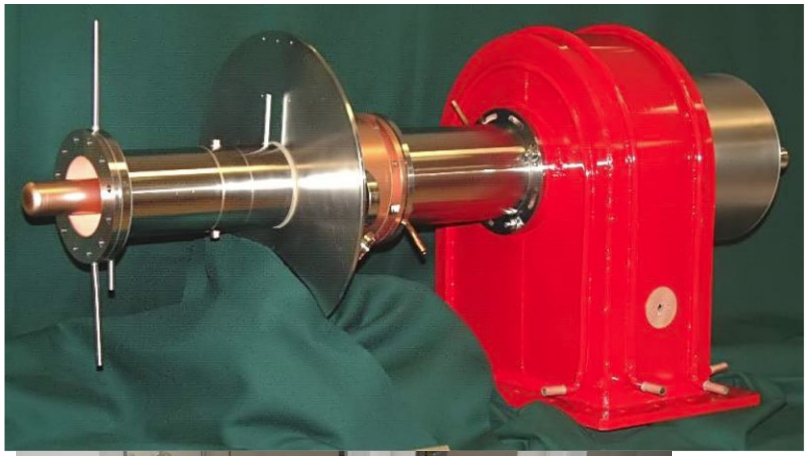


Cavity First Structural Mode

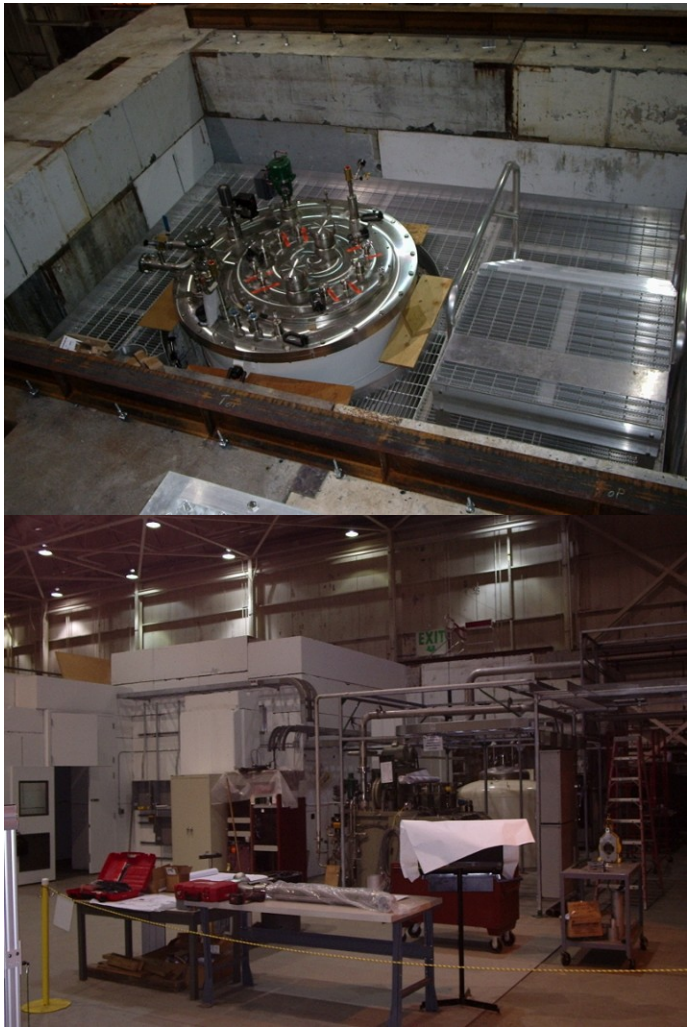


500 kW CW couplers for SRF gun cavity

- Two 500 kW were built.
- Conditioning cart built, ready to go
- Two similar but lower average power couplers to be tested to destruction.
- We have a 704 MHz 1 MW CW klystron



Vertical Test Facility



SUMMARY

- We are building a 5-cell high-performance cavity
- New features:
  - Better SRF performance
  - Probe with coax line and band-stop filter
- The cavity mechanical design and construction is done at AES
- We are testing 500 kW CW couplers
- We have 704 MHz MW RF and cryogenic testing capabilities