

HOM damper for CRAB Cavity

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CRAB cavity

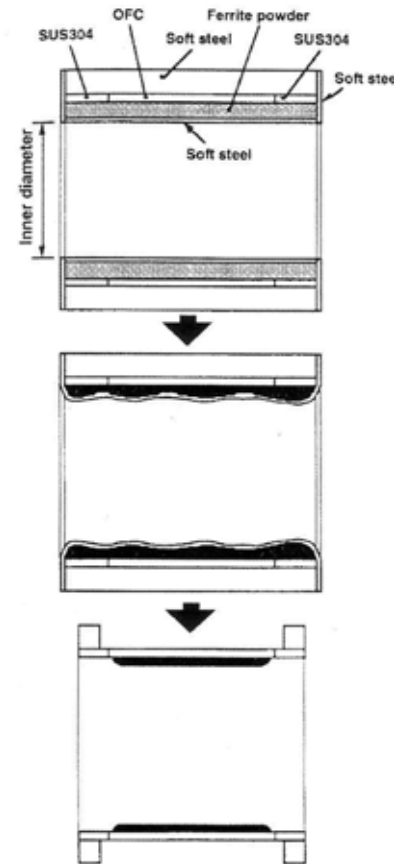
KEKB

HOM damper

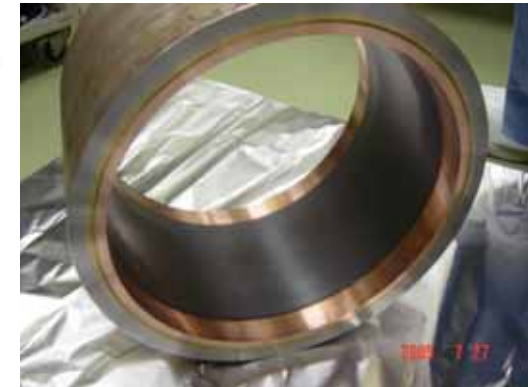
- Damp HOM (>600 MHz) and LOM (400 MHz)
- Ferrite damper
 - Developed for KEKB superconducting accelerating cavity
 - HIP (Hot Isostatic Press) : 1500 atm, 900 °C
- Size: 240 ϕ x 120 mm, 4t
 - Almost the same size of SBP damper used for accelerating cavity
- Expected RF load at 1.6 A, 1500-bunch
 - LBP: 15 kW
 - Coaxial: 4 kW
- Need 4 dampers and 2 spares
 - 9 dampers HIPped, 6 dampers fabricated

Fabrication of HOM dampers

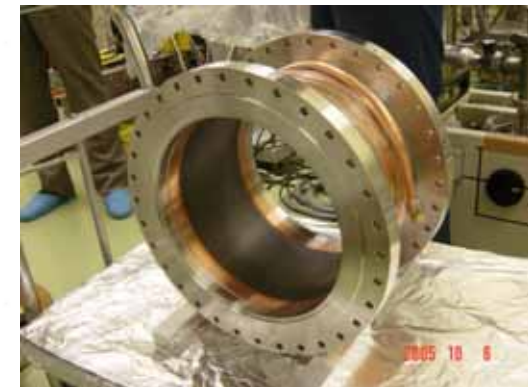
- Baking of ferrite powder
- Canning of ferrite powder
- HIP 1500 atm, 900 °C
- Machining of ferrite surface
- UT
- Baking
- Cutting of iron base
- EBW of stainless steel flange
- Winding of copper pipe
- High power test: up to 10 kW
- Low power test: mode damping test
- Evacuation



T. Tajima

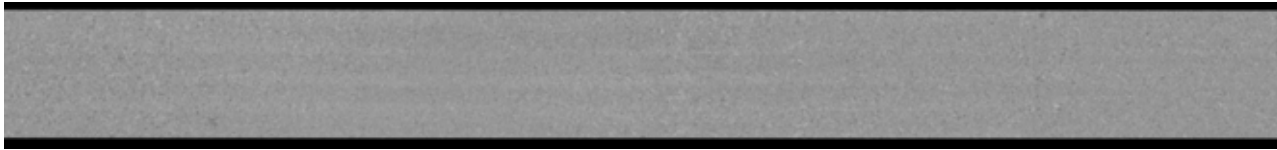


Before Baking



Before high power test

UT



#1



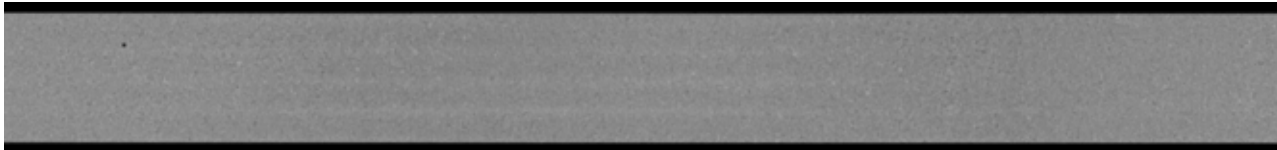
#2



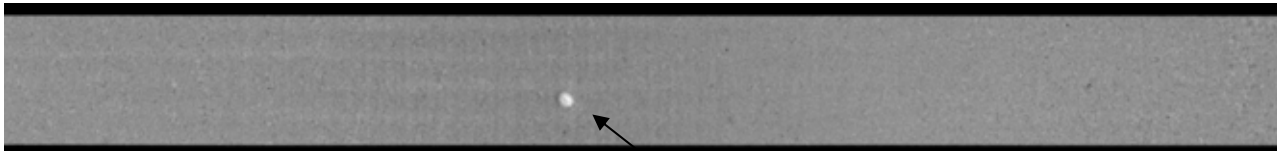
#3



#4

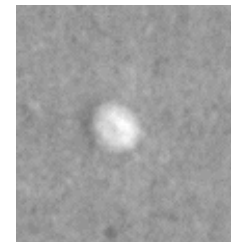


#5



#6

#6 has a white circle image
Suggesting bad contact to copper base



UT

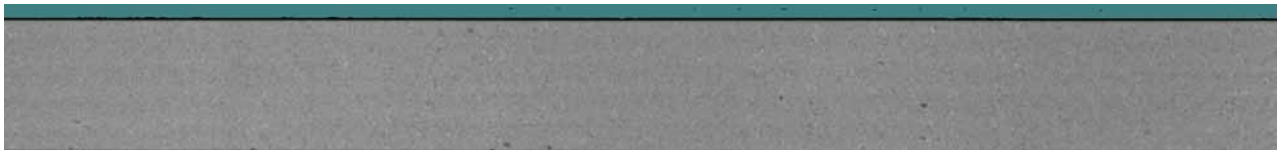
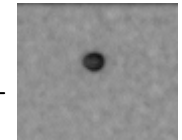


#7



#8

#8 has a black dot image
Suggesting a void

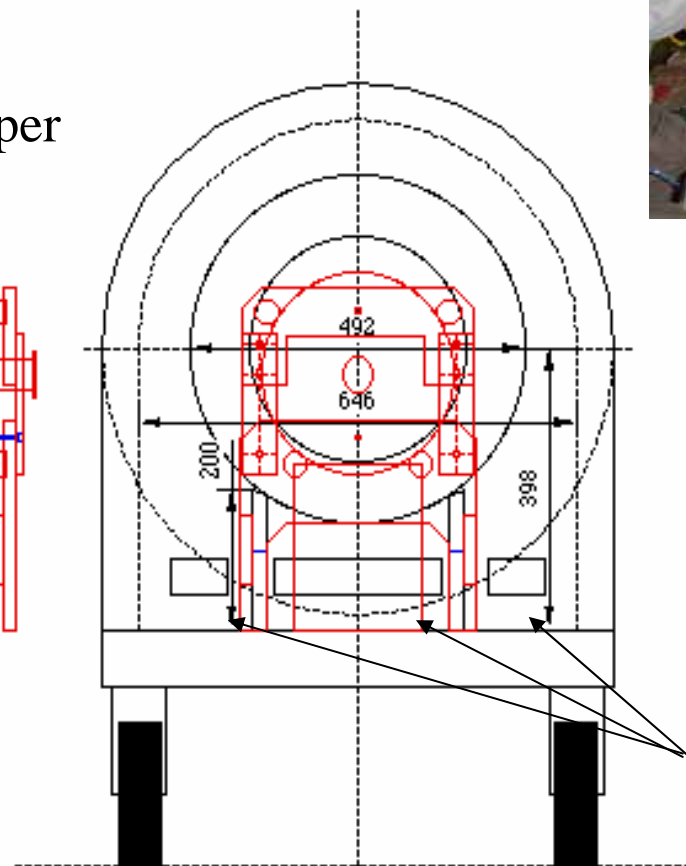
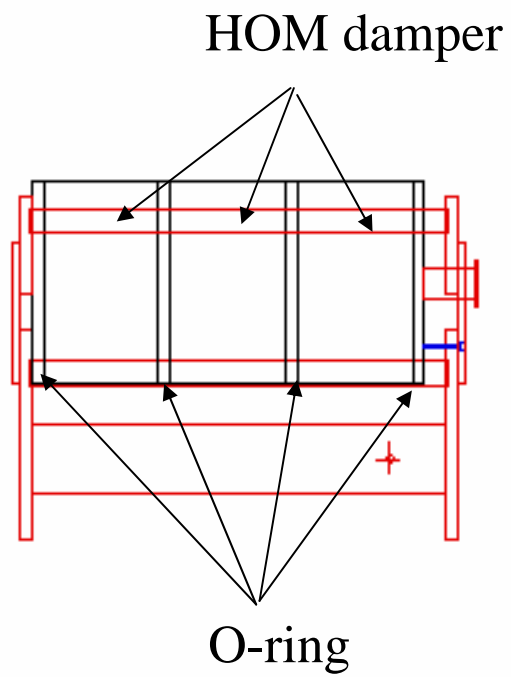


#9

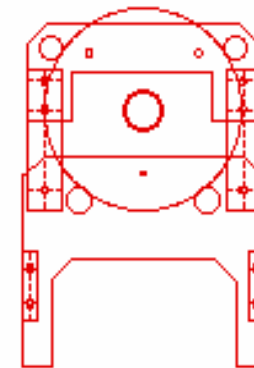
Baking stand



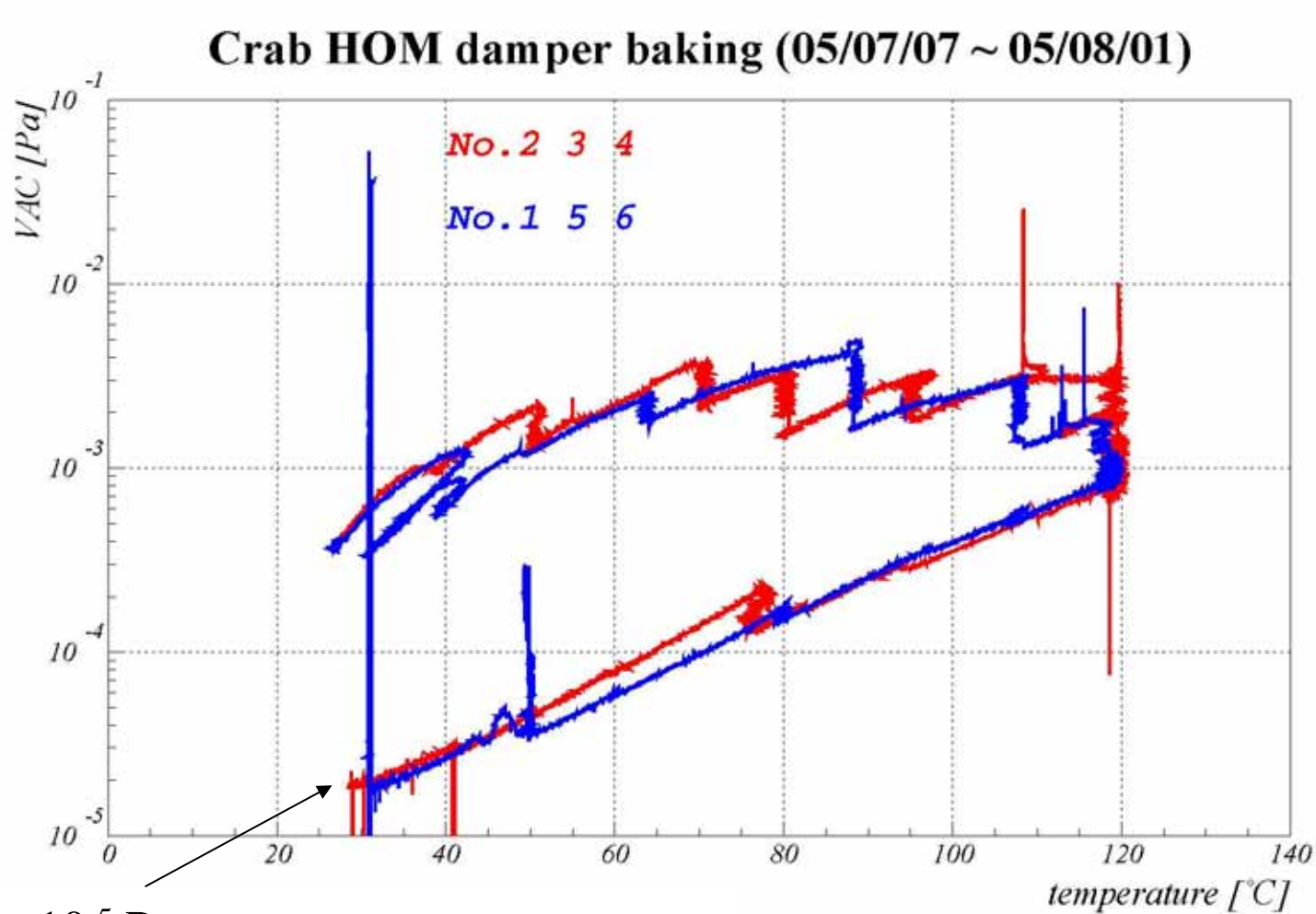
Baking chamber



Heater



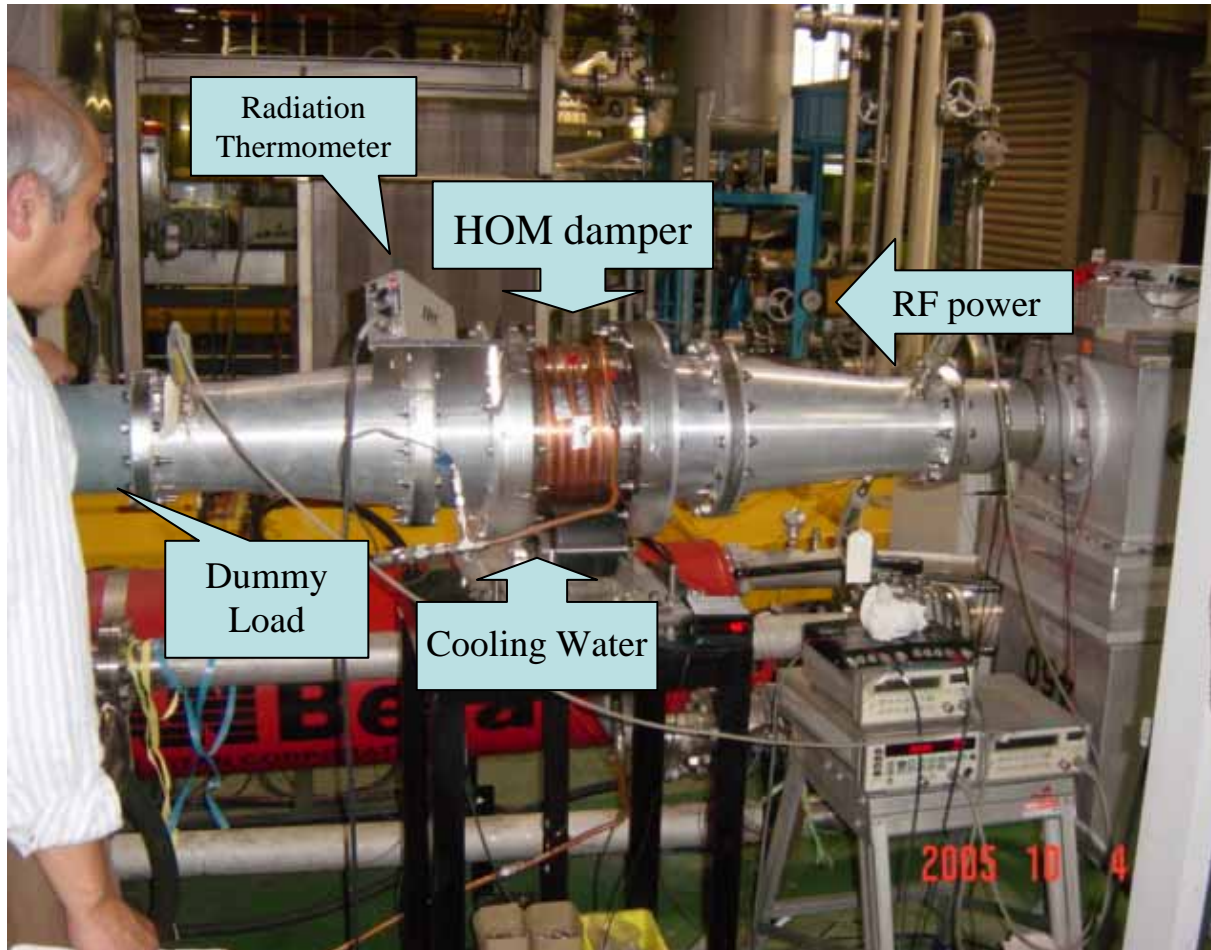
Temperature vs. pressure



2×10^{-5} Pa

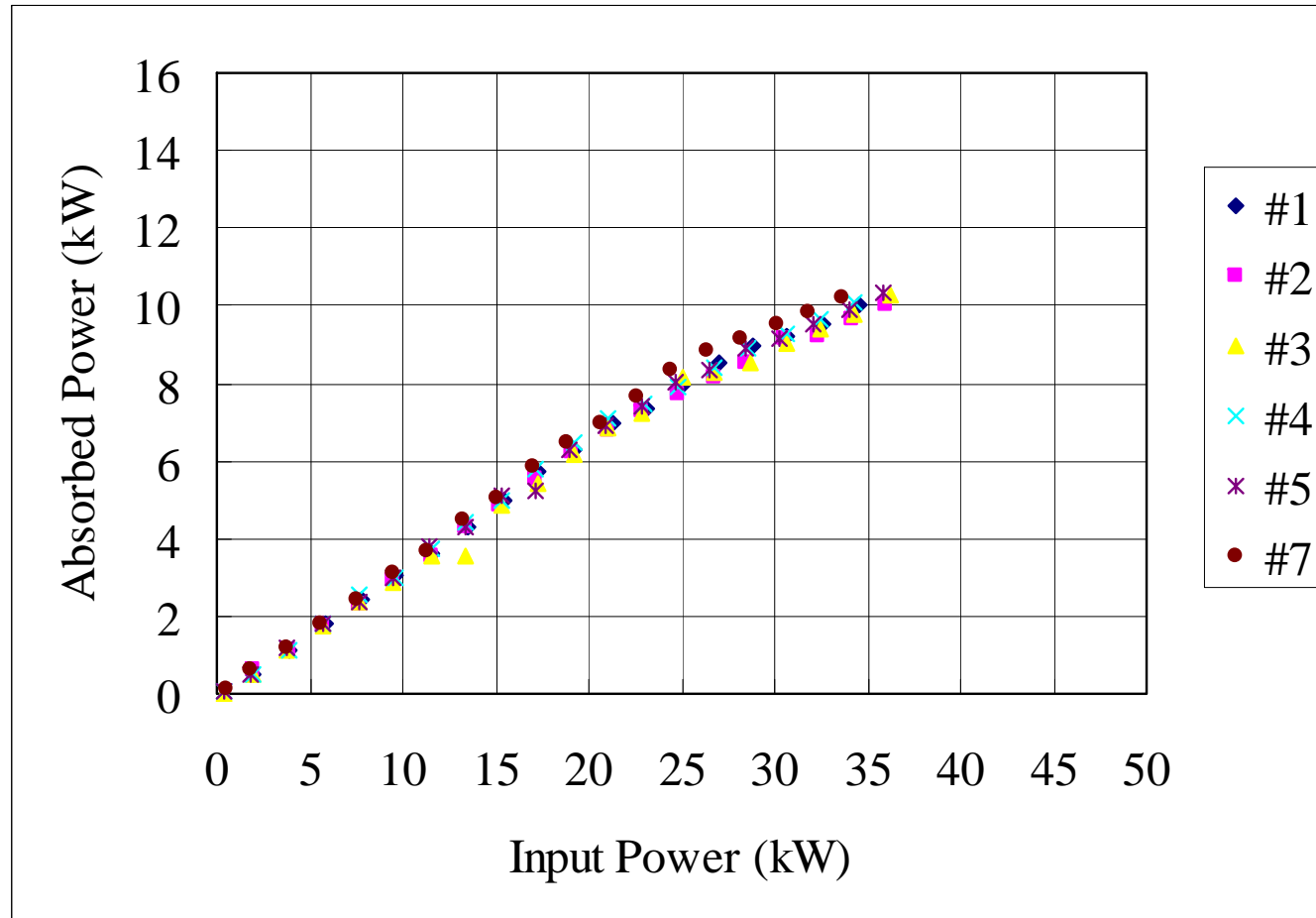
Out gassing rate: 6×10^{-10} torr L/s cm²

High power test stand



High Power Test

Absorbed Power

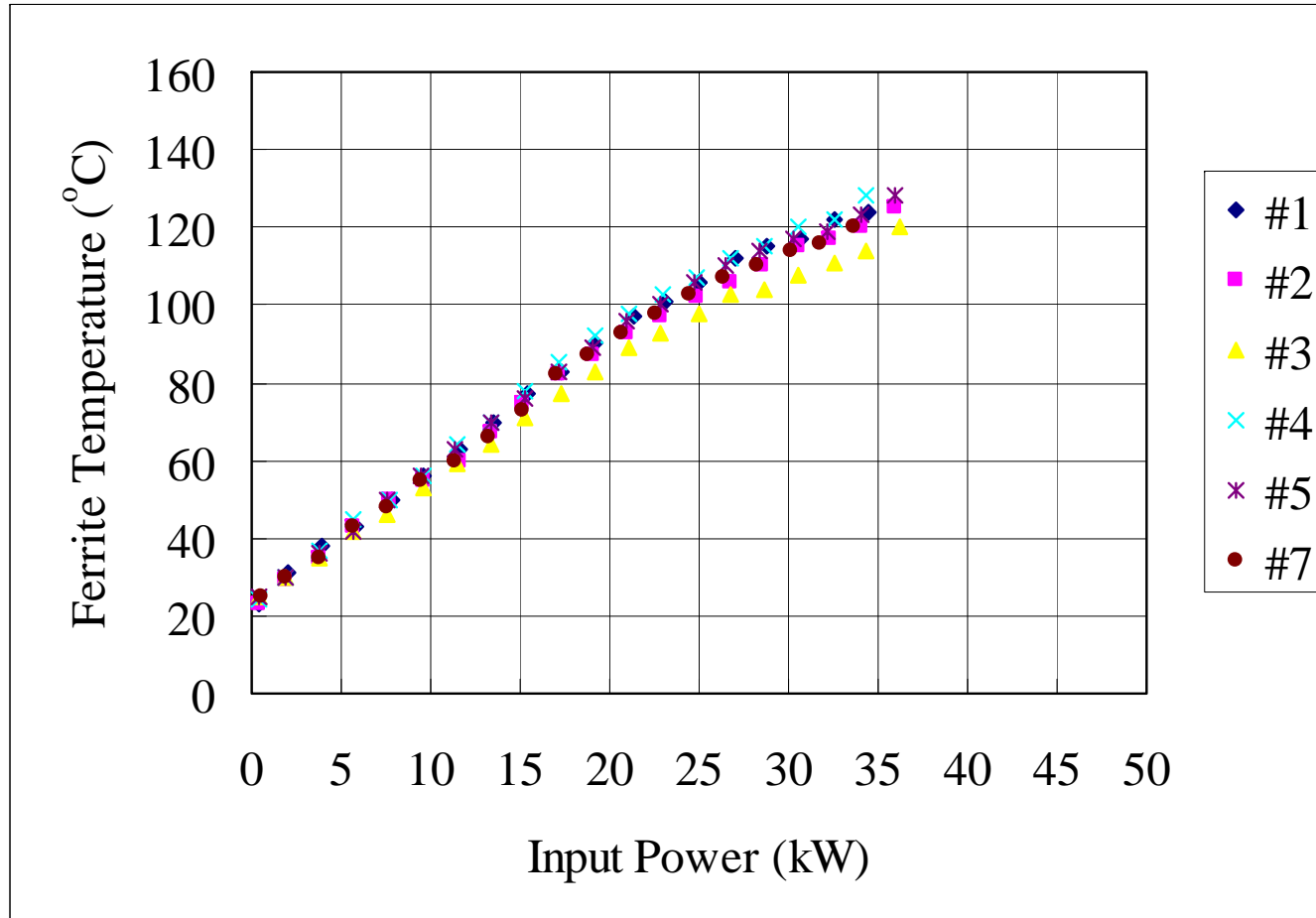


Up to 10 kW

Evaluated by cooling water temperature rise

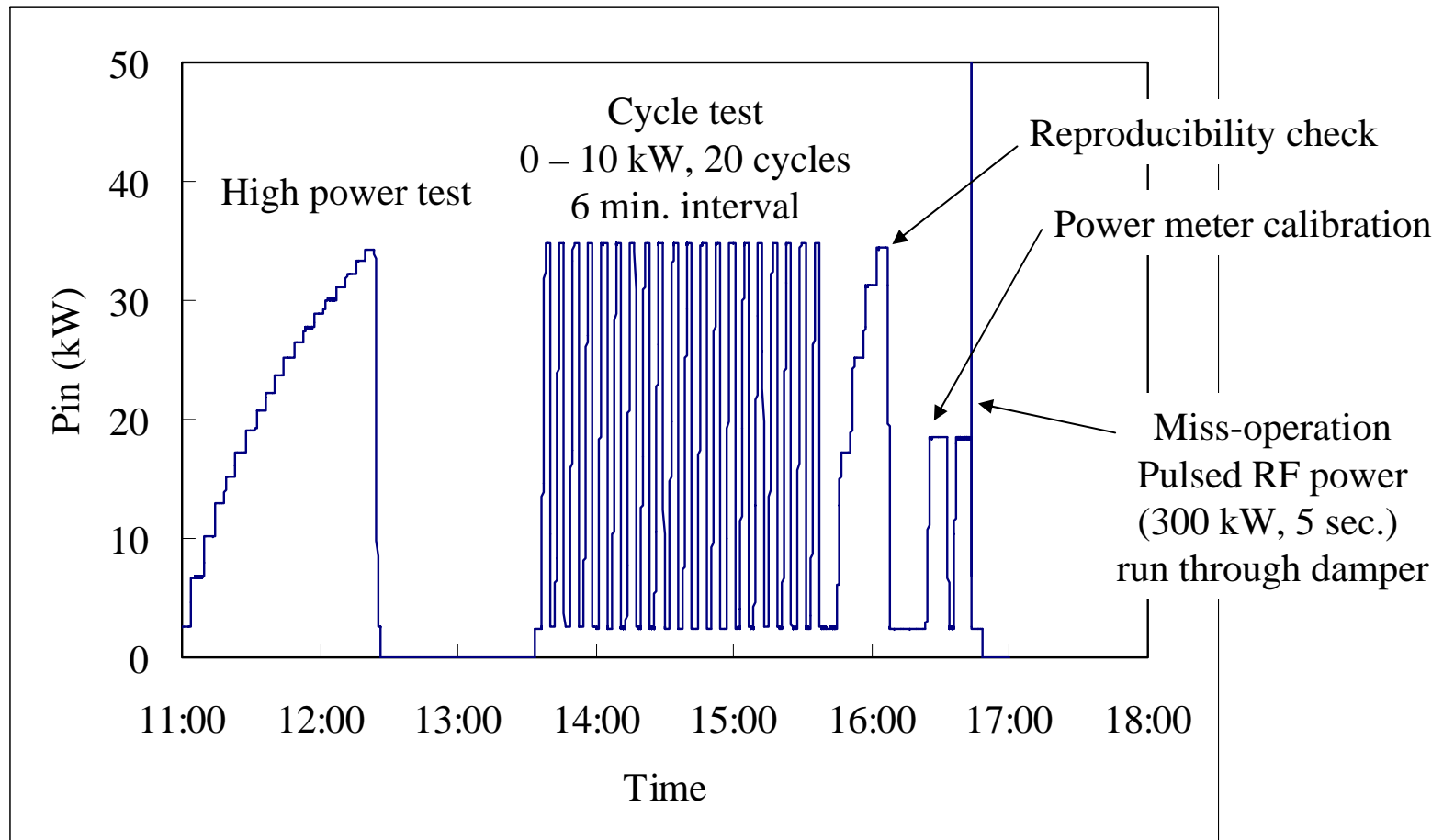
High Power Test

Ferrite temperature



Measured by radiation thermometer

Cycle test



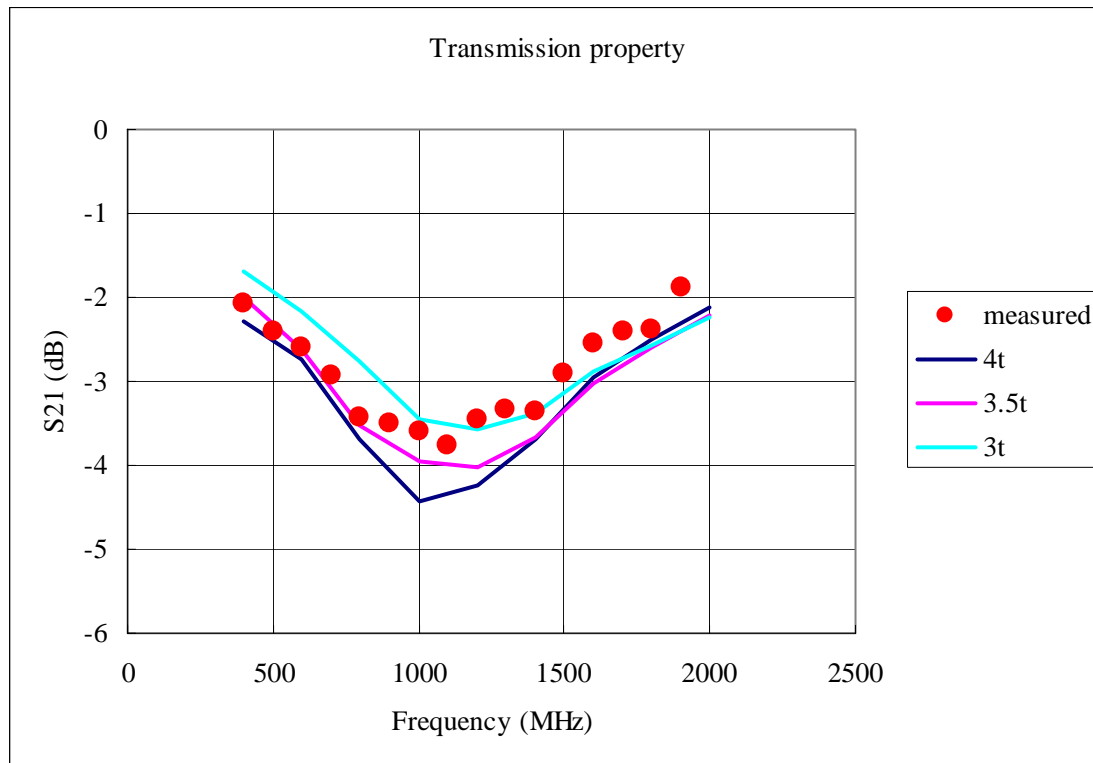
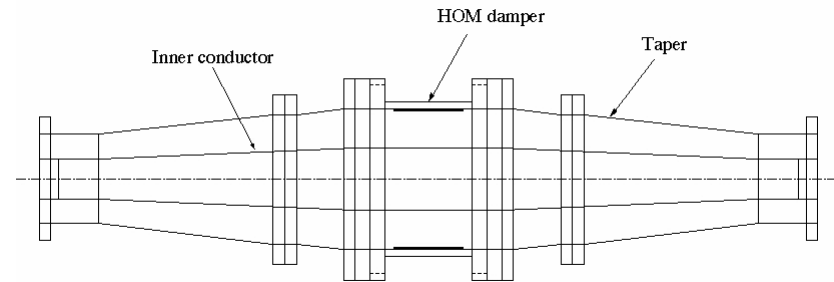
#4 damper experienced 300 kW

Heard cracking sounds

This is the first evidence that the damper has cracks by RF power

Low Power Test

Transmission property

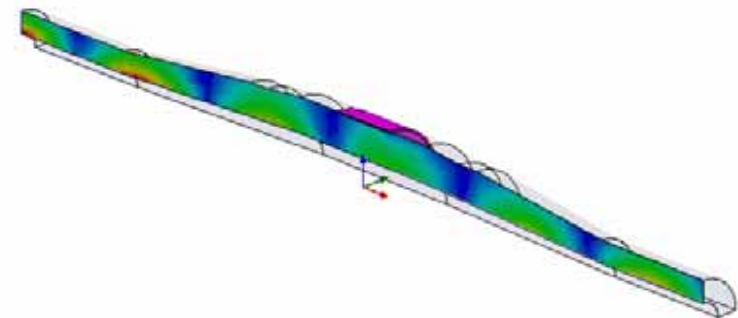


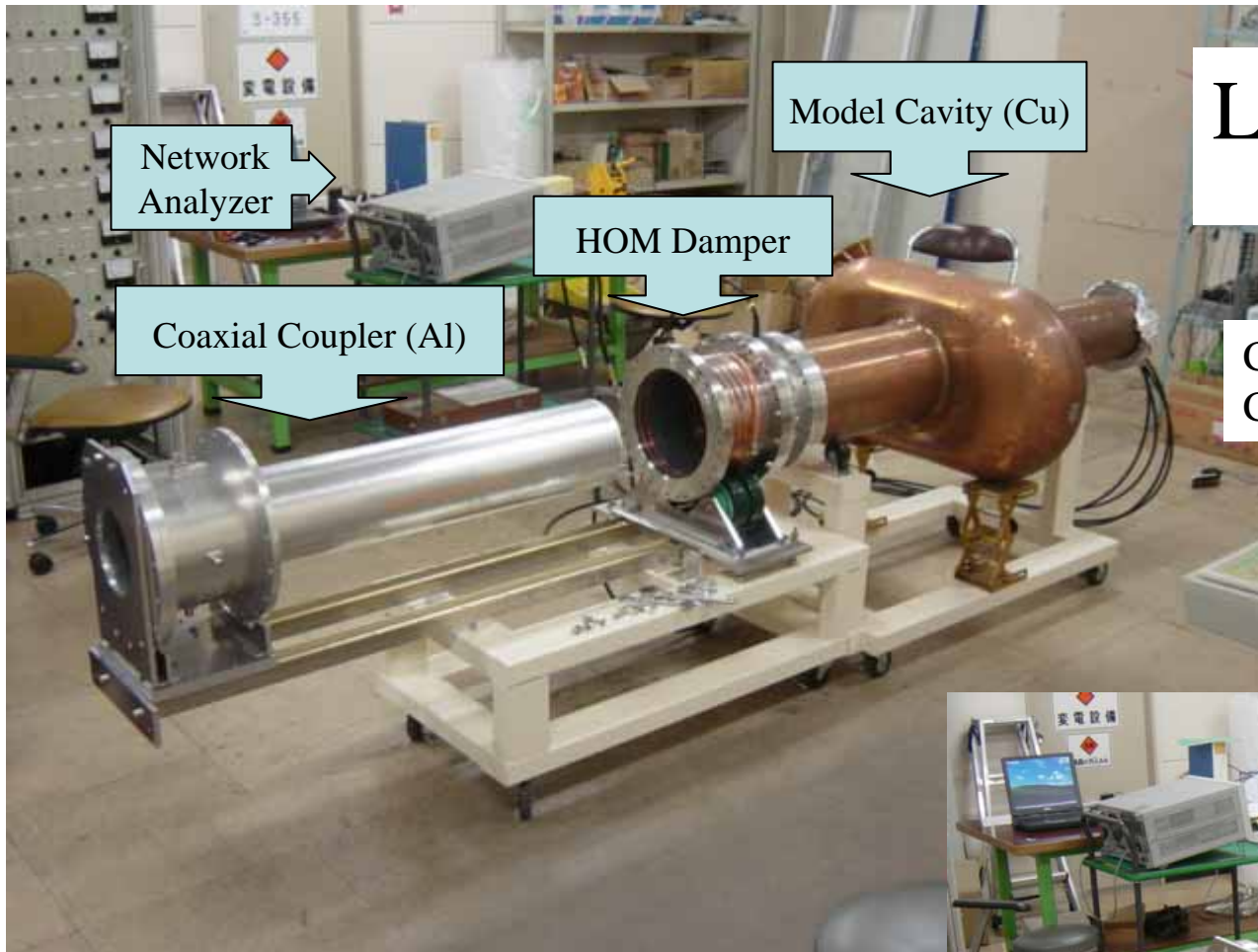
S21 was measured from 400 MHz to 2000 MHz.

S21 was calculated using HFSS for several thickness of the ferrite (nominal thickness: 4 mm).

Simulation with the thickness of 3.5t agrees with measured data.

S21 calculation using HFSS

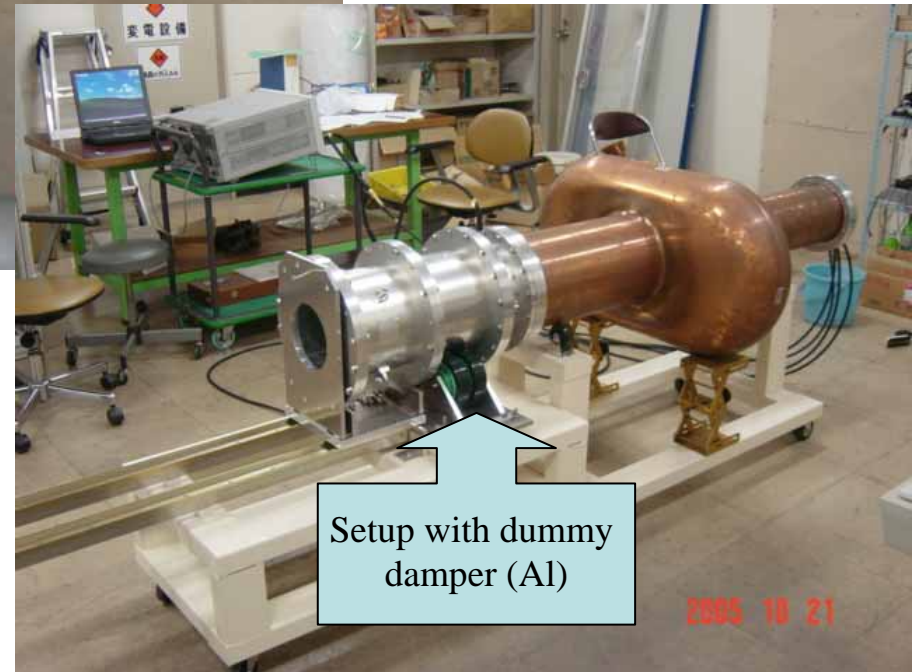
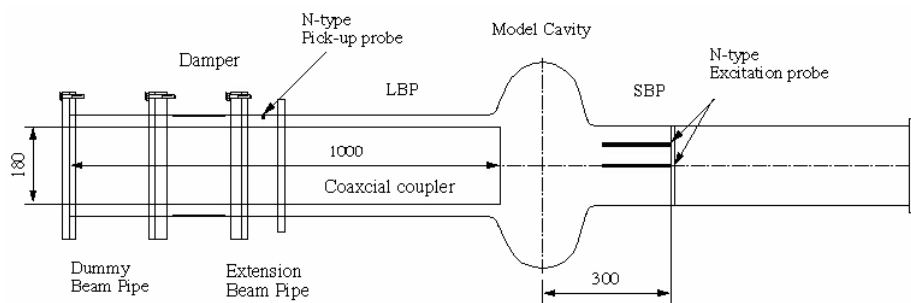




Low Power Test

Mode damping

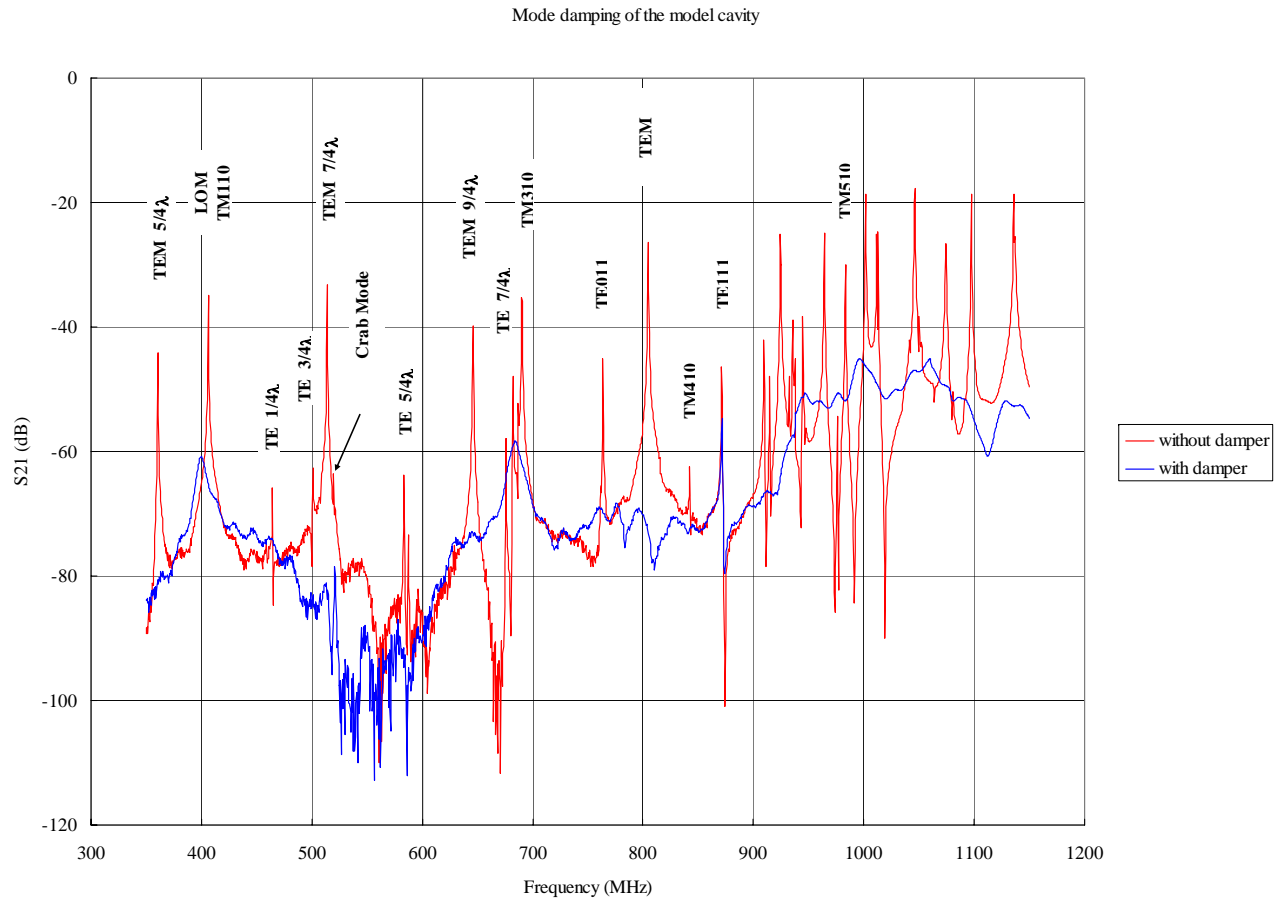
Check damping of LOM/HOM
Check validity of simulation



Setup with dummy damper (Al)

2005 10 21

Mode damping of the model cavity



Transmission property of the model cavity with/without the HOM damper. The LOM and HOMs are sufficiently damped. Q factor of the TE111 is still high, because of its weak coupling to the coupler.

Comparison with simulation

Frequencies and Q factors of several modes.
HFSS simulation agrees with measured data.

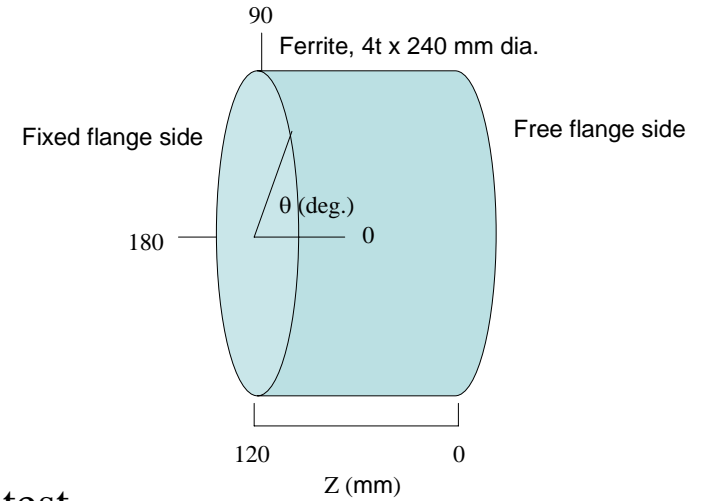
mode	HFSS		Measured	
	f (MHz)	Q	f (MHz)	Q
TM110	402	53	400	47
Crab	513	211	515	227
TM310	680	52	684	70
TM410	830	162	839	165
TE111	863	1546	871	1424
TM510	993	82	1000	49

Evacuation

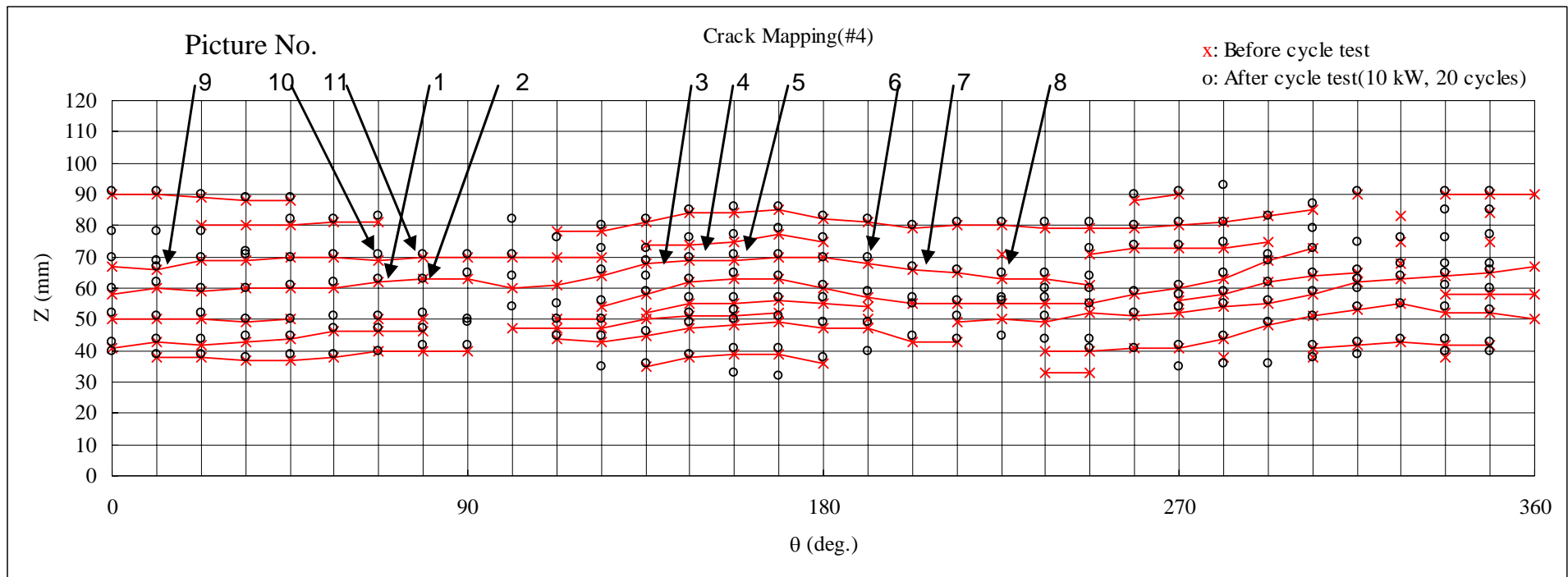


Crack mapping

A map of cracks was made after cracking using a micro-scope
 #4 damper was high power tested and cycle tested again
 Cracks were inspected once again
 No significant growth of cracks was found

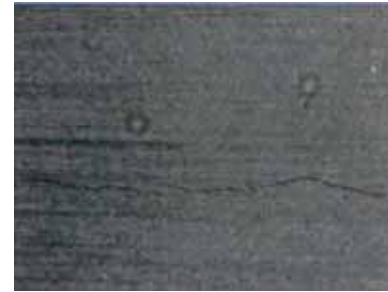


Cracks before and after the cycle test



Pictures taken before/after the cycle test

Before



After



1

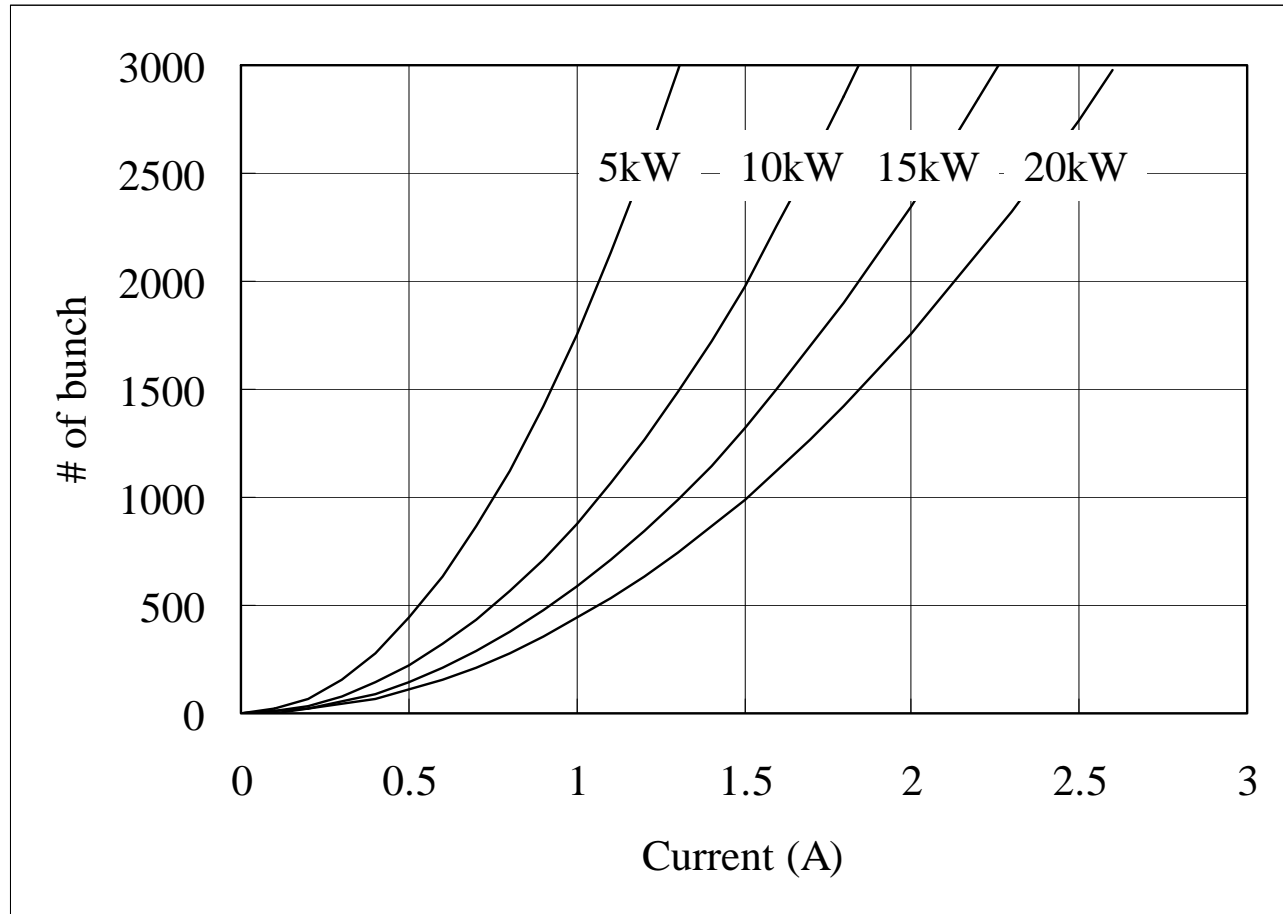
2

3

4

Pictures taken before/after the cycle test
These pictures show no growth of cracking

Expected RF power load of LBP damper



Summary

- 4 dampers and 2 spares have been fabricated and tested
- High Power Test
 - 10 kW absorbed (1500-bunch, 1.3 A)
 - Cycle test (0 – 10 kW, 20 cycles)
 - No damage
- Low Power Test
 - Transmission property test
 - Agreed with simulation
 - Mode damping test using a model cavity
 - Sufficient damping achieved
- Evacuation
 - #1, #2,#3: 5×10^{-11} torr l/sec cm²
- #1,#2: Assembled
- #4 : Cracks
 - Still can be used
 - High power test >10 kW