Status of the EC-funded HOM Damped Cavity Project

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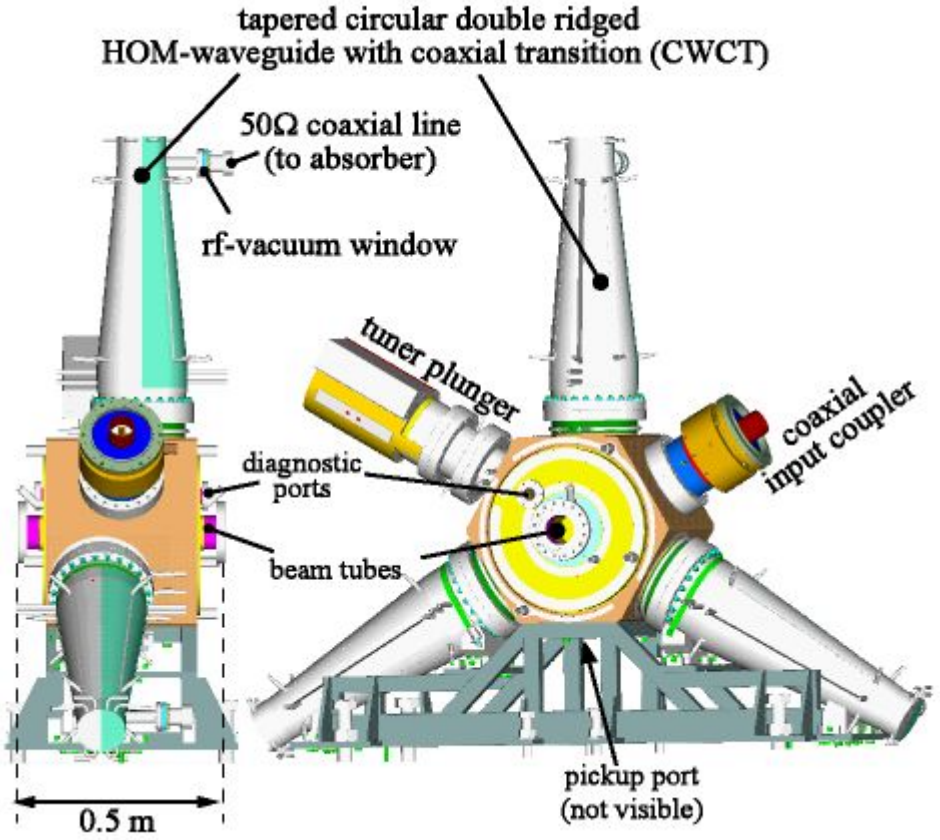
for the HOM Damped Cavity Collaboration
BESSY, Daresbury Lab, DELTA, MAXLAB, NTHU

- Cavity concept and design goal
- Simulation results
- Low power prototype cavity measurements
- Engineering design of high power cavity
- Manufacturing status
- Summary

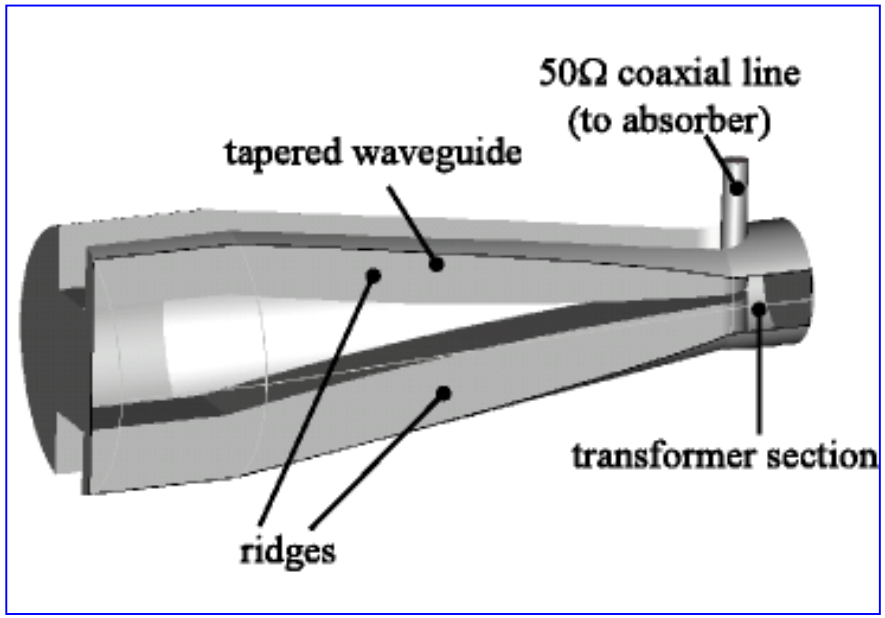
HOM-Damped Cavity Concept

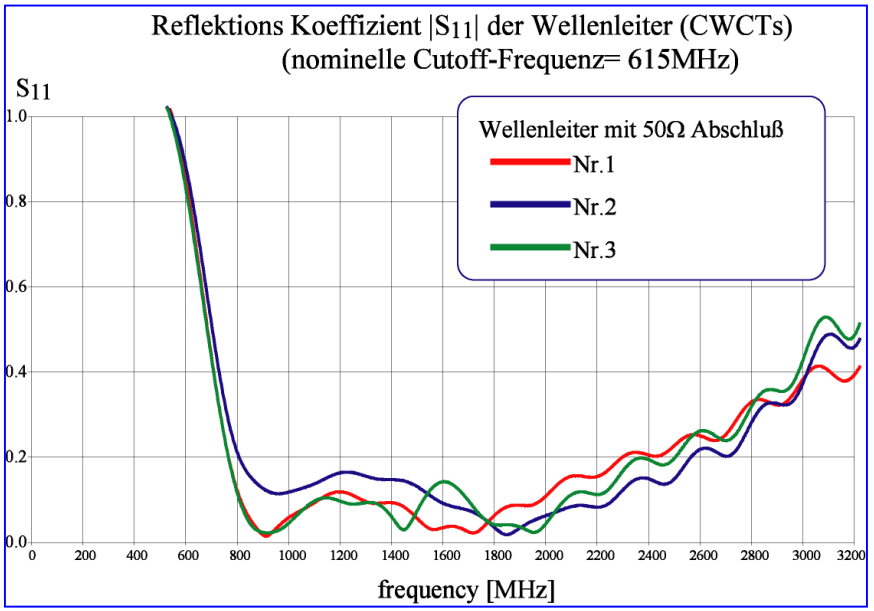


Design Goal

- Fundamental mode frequency f = 500 MHz
- Insertion length L < 0.7 m
- Shunt impedance $R_s > 4$ MΩ
- Max. thermal power capability $P_{th} = 100$ kW
- Compact design to fit into existing SR source tunnels

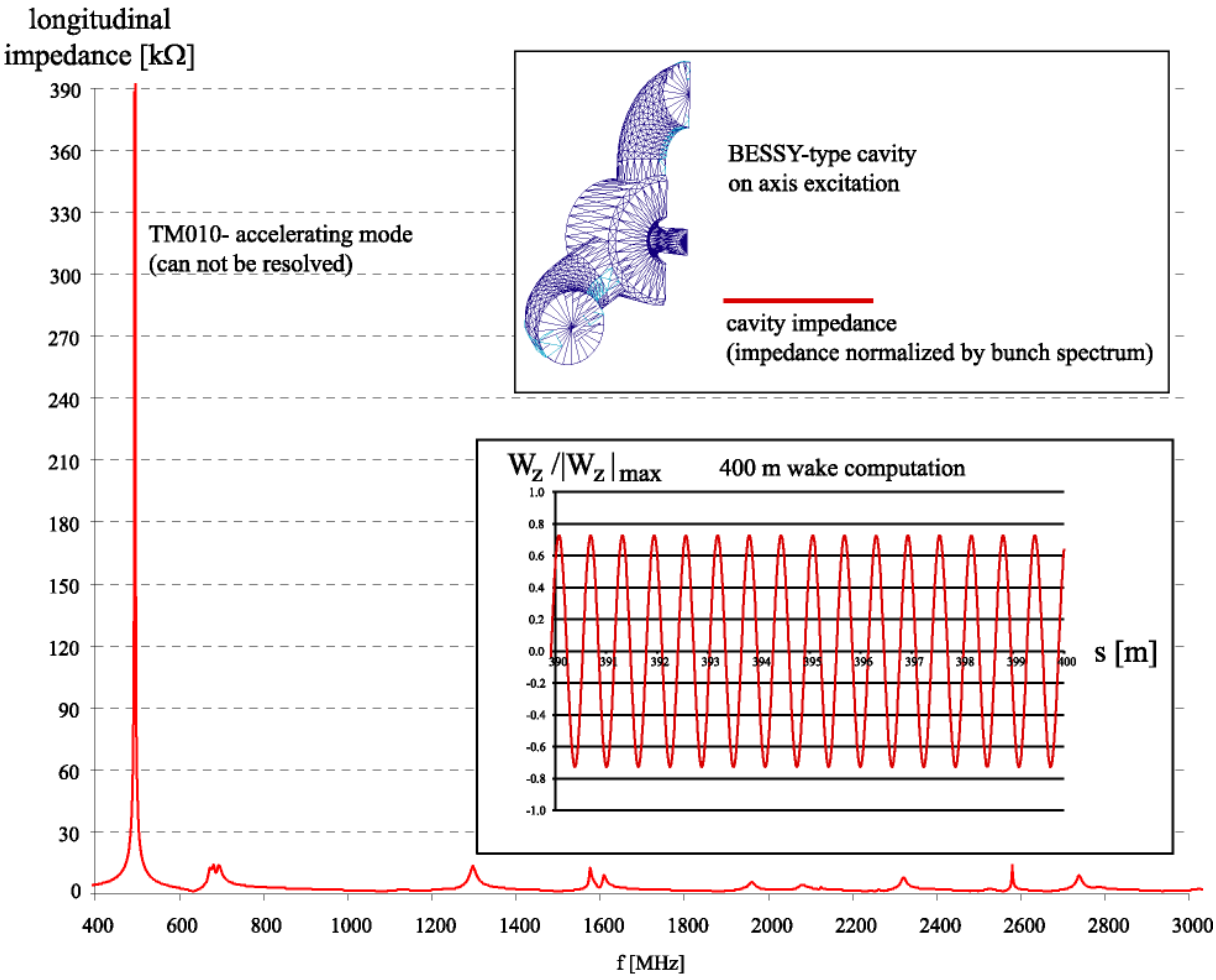
- Circular Waveguide to Coaxial Transition -





Time Domain Simulations / MAFIA 3D

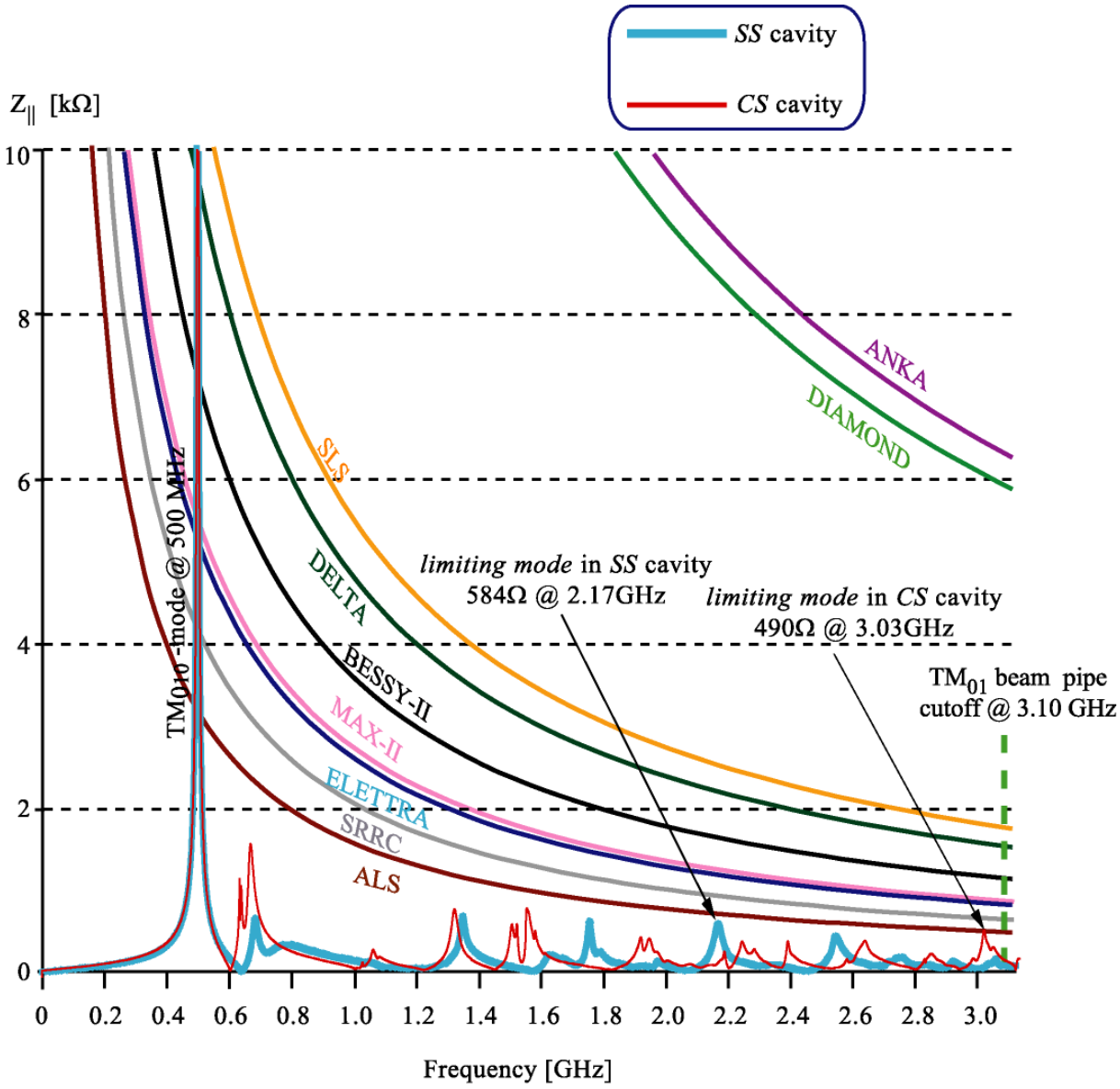
- pioneered by LBL and SLAC for the PEP II cavity
- improved by F. Marhauser / BESSY



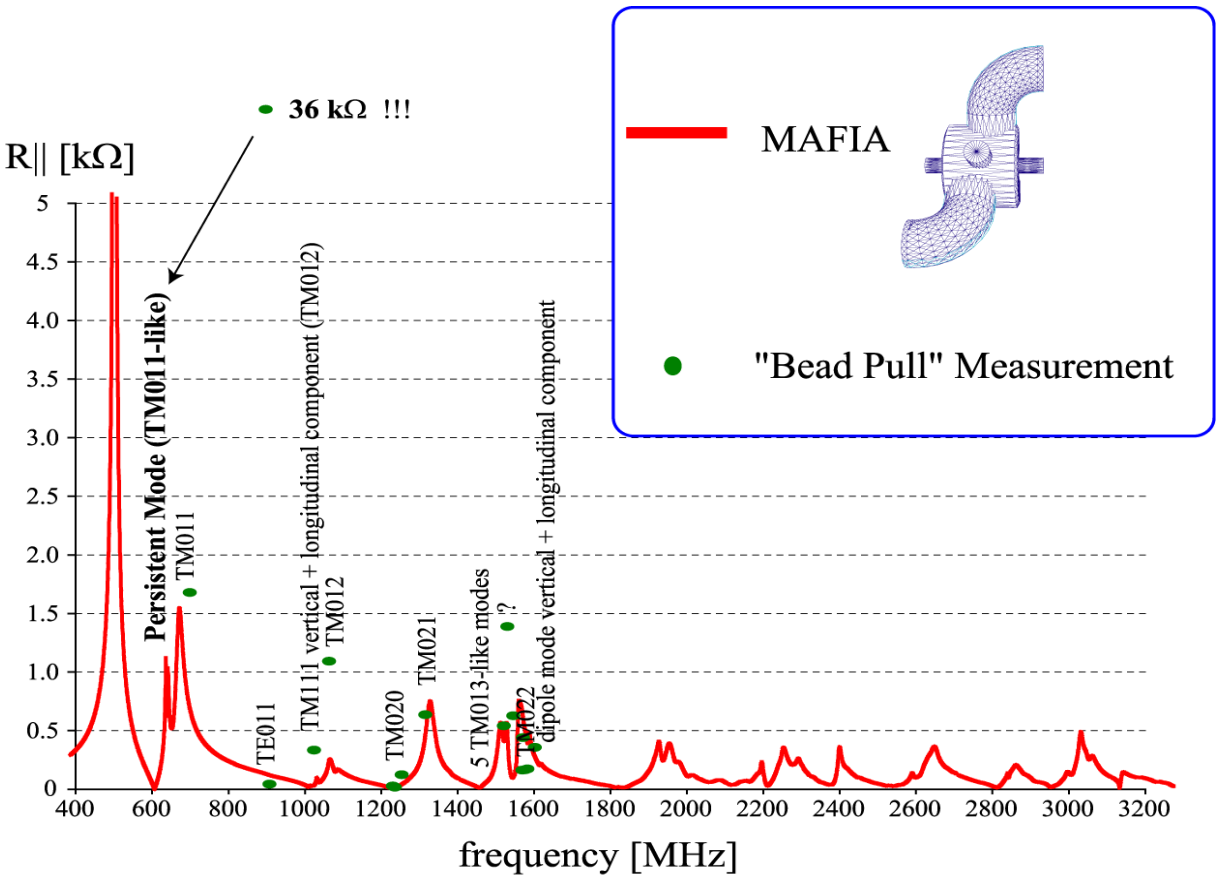
Optimisation of cavity parameters:

- cavity radius and length
- nose cone angle and radius
- position of CWCTs

Longitudinal Impedance and Thresholds

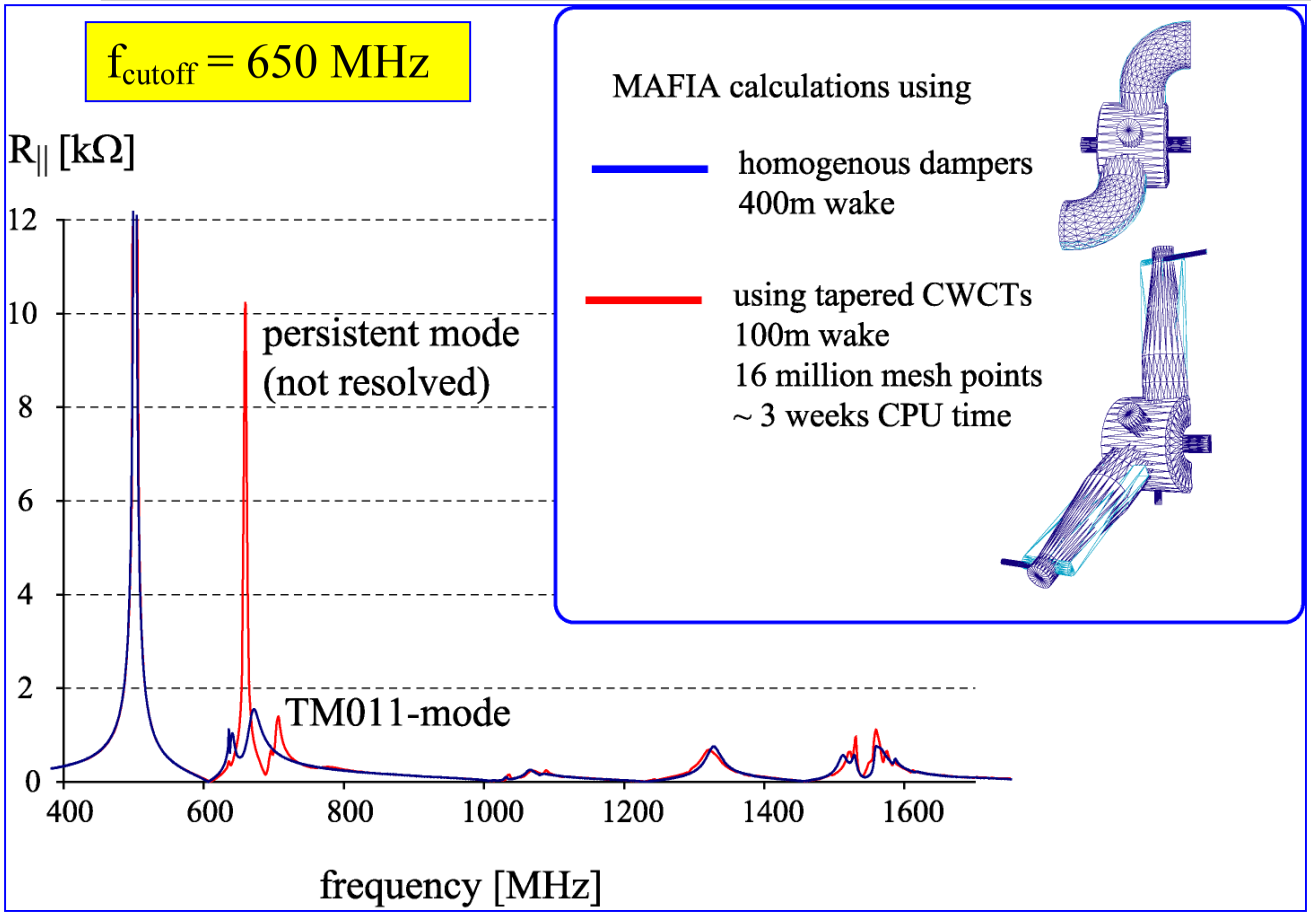


Longitudinal Impedance Measurements for Low Power Model Cavity



Homogenious vs. ridged waveguide geometry in MAFIA simulations

$f_{cutoff} = 650$ MHz

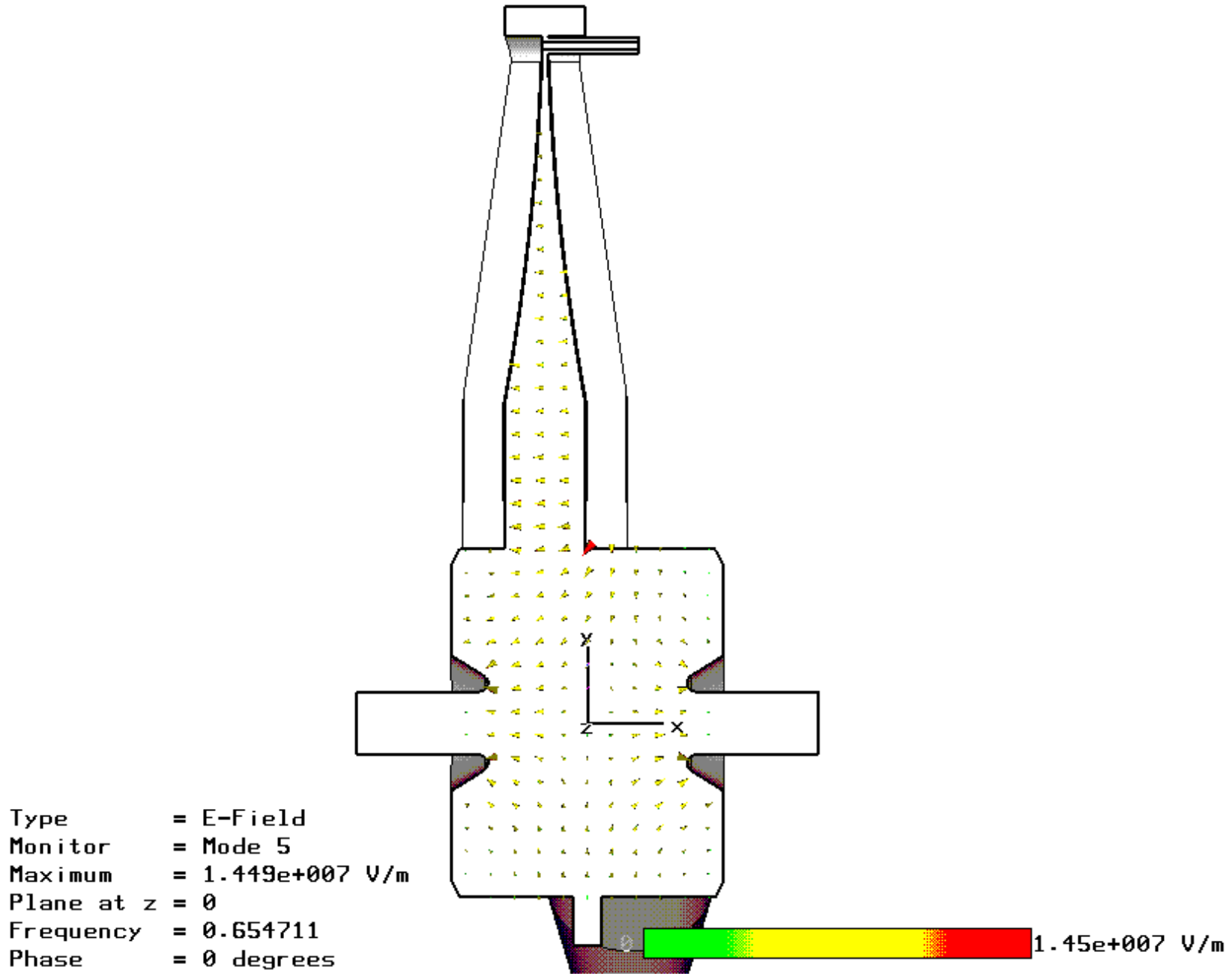


MAFIA calculations using

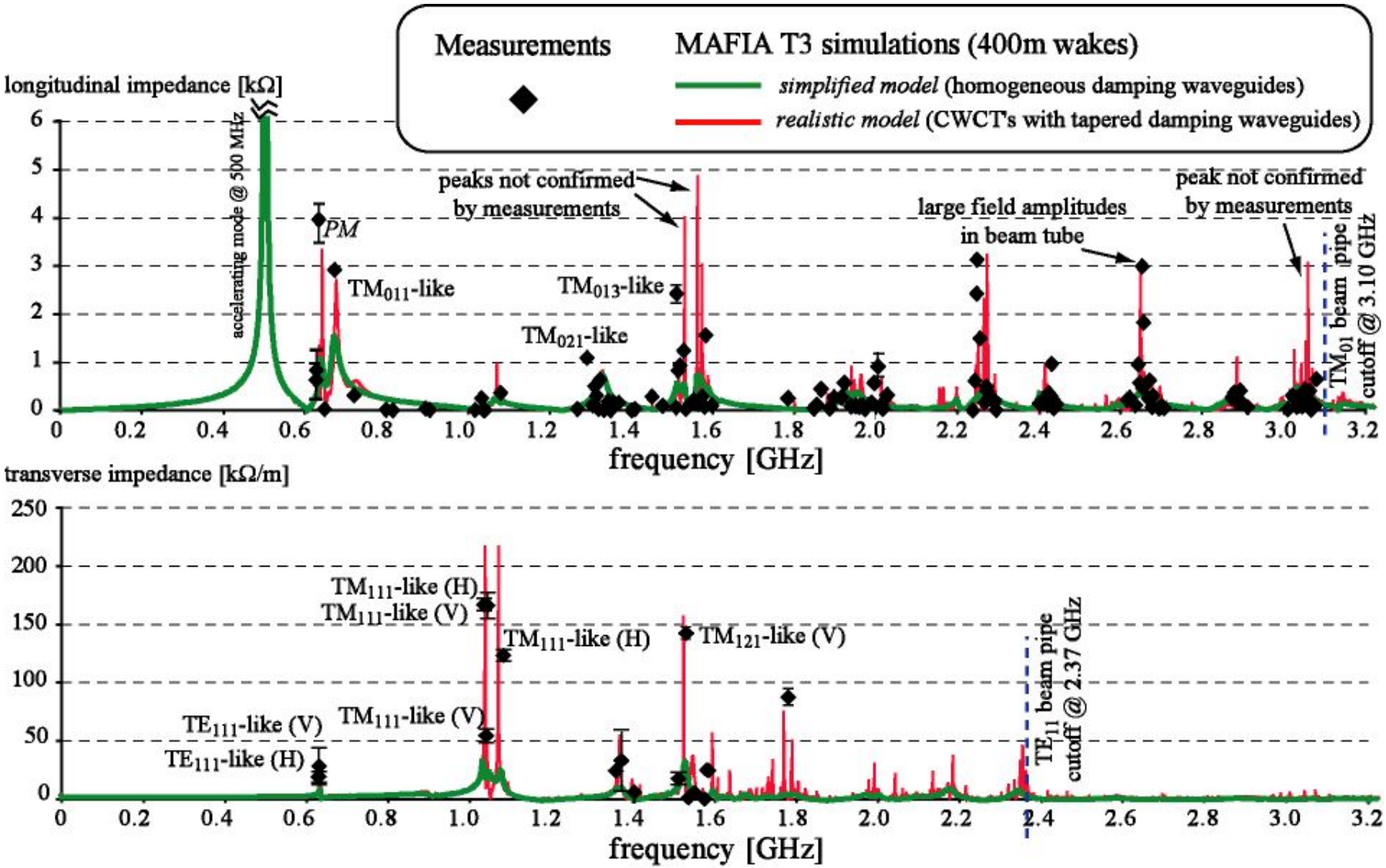
homogenous dampers
400m wake

using tapered CWCTs
100m wake
16 million mesh points
~ 3 weeks CPU time

→ persistent mode showed up
→ mode related to CWCT geometry
→ mode close to CWCT cutoff with low group velocity


Type = E-Field
Monitor = Mode 5
Maximum = 1.449e+007 V/m
Plane at z = 0
Frequency = 0.654711
Phase = 0 degrees
Y
Z
X
1.45e+007 V/m

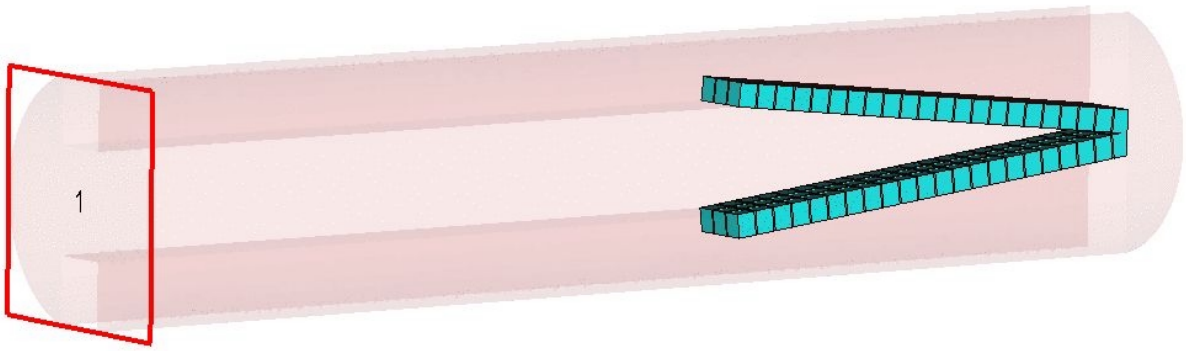
Impedance Measurements: Bead-Pull System

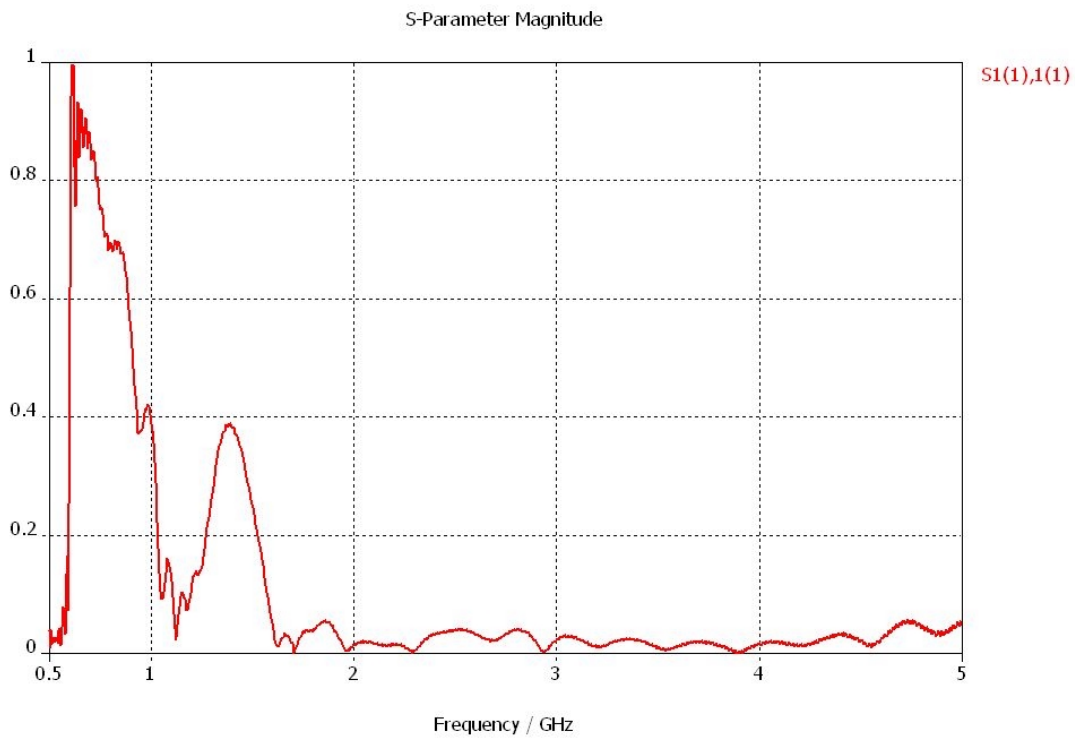

Measurements
MAFIA T3 simulations (400m wakes)
simplified model (homogeneous damping waveguides)
realistic model (CWCT's with tapered damping waveguides)
longitudinal impedance [kΩ]
accelerating mode @ 500 MHz
PM
TM011-like
TM013-like
TM021-like
peaks not confirmed by measurements
large field amplitudes in beam tube
peak not confirmed by measurements
TM01 beam pipe cutoff @ 3.10 GHz
frequency [GHz]
transverse impedance [kΩ/m]
TM111-like (H)
TM111-like (V)
TM111-like (H)
TM121-like (V)
TE111-like (V)
TE111-like (H)
TM111-like (V)
TE11 beam pipe cutoff @ 2.37 GHz
frequency [GHz]

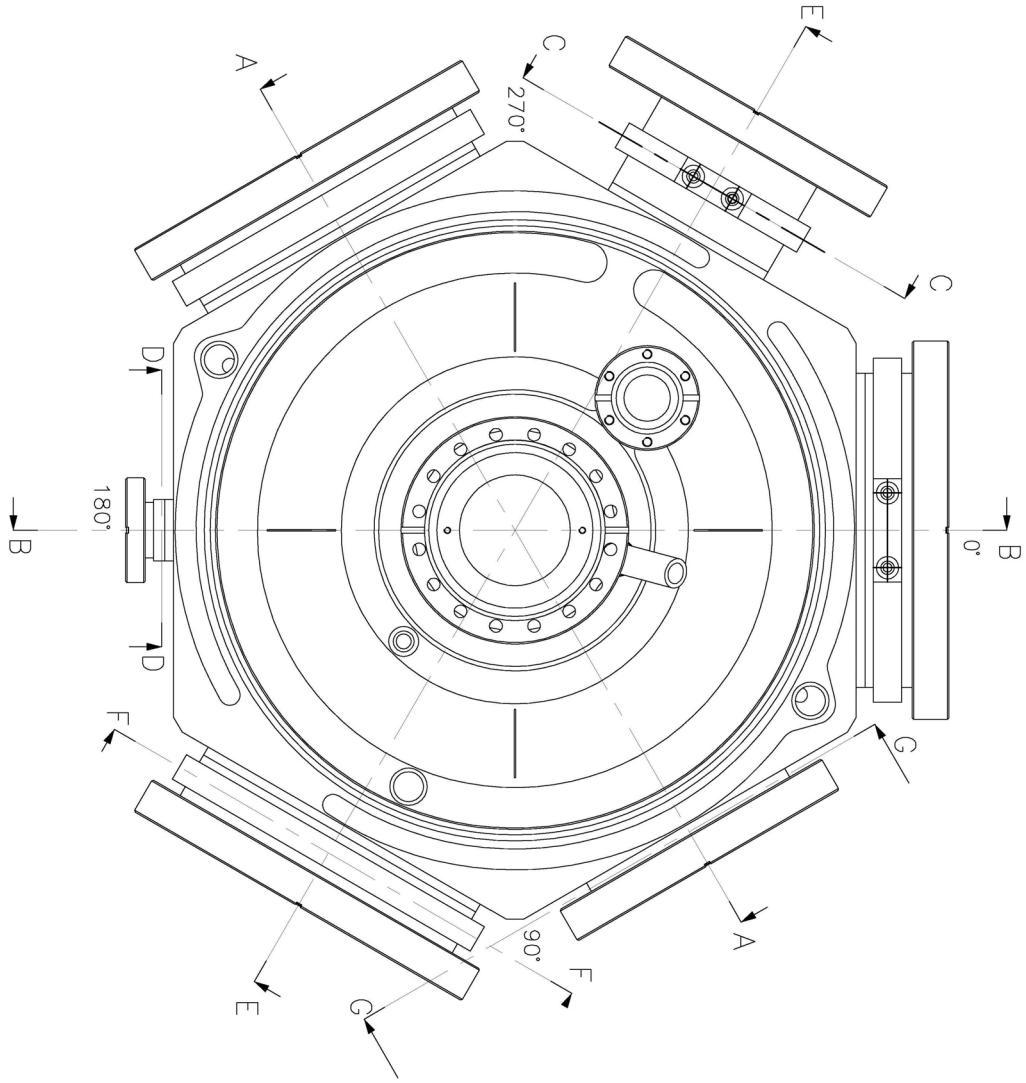
Conceptual design of a ridged circular waveguide load with ferrites

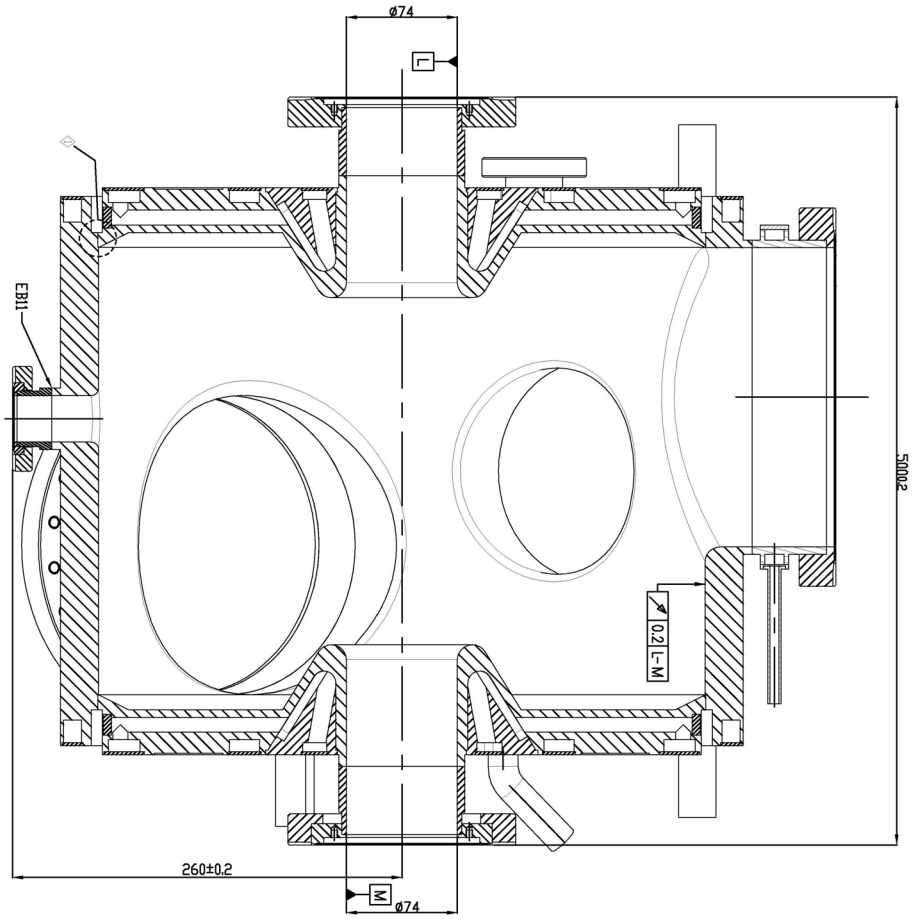
Simulation with Microwave Studio Code

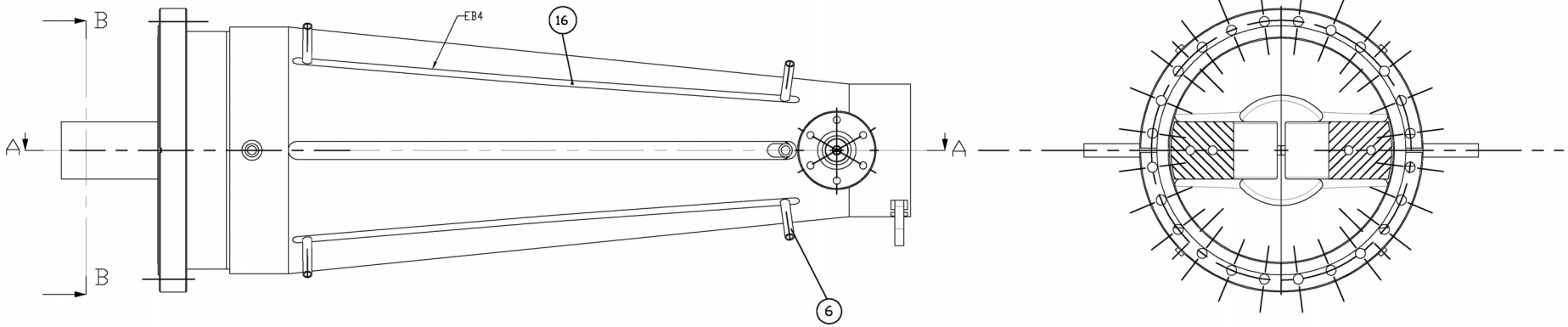
Absorber material: Al N / 40% Si C from Ceradyne Inc.



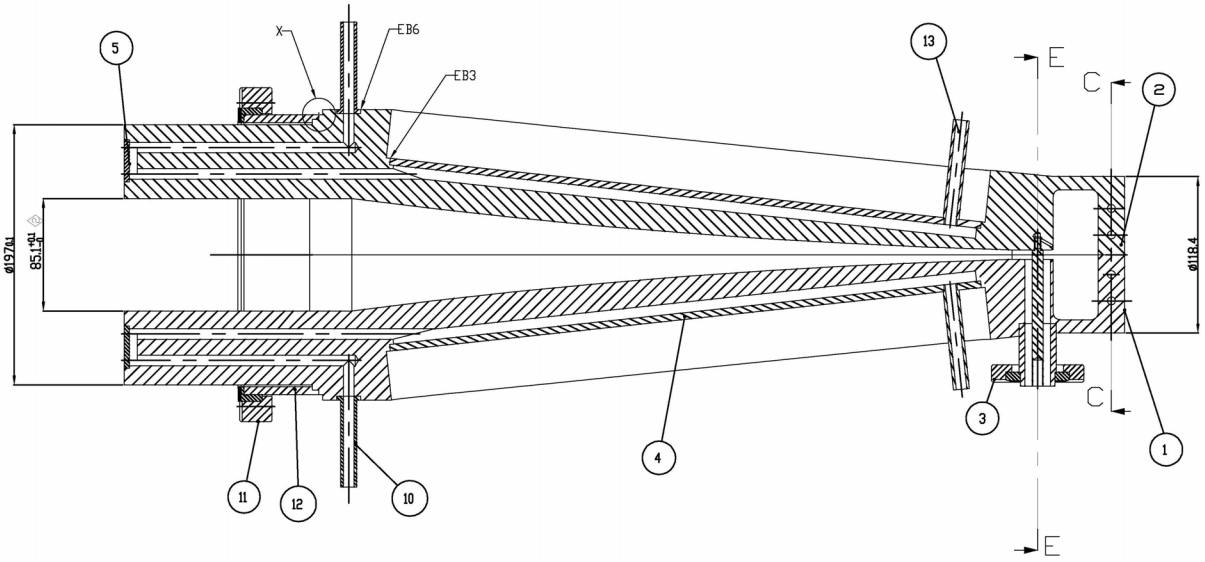


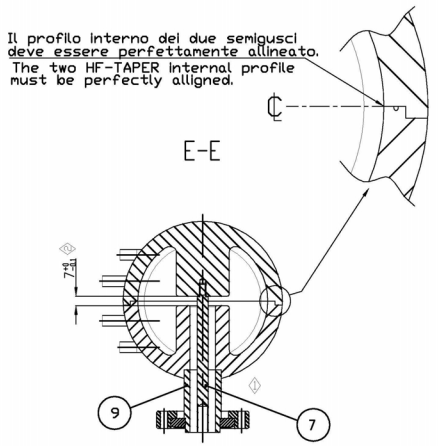

A
C
270°
E
C
D
180°
B
B
0°
D
F
G
A
90°
F
E
G

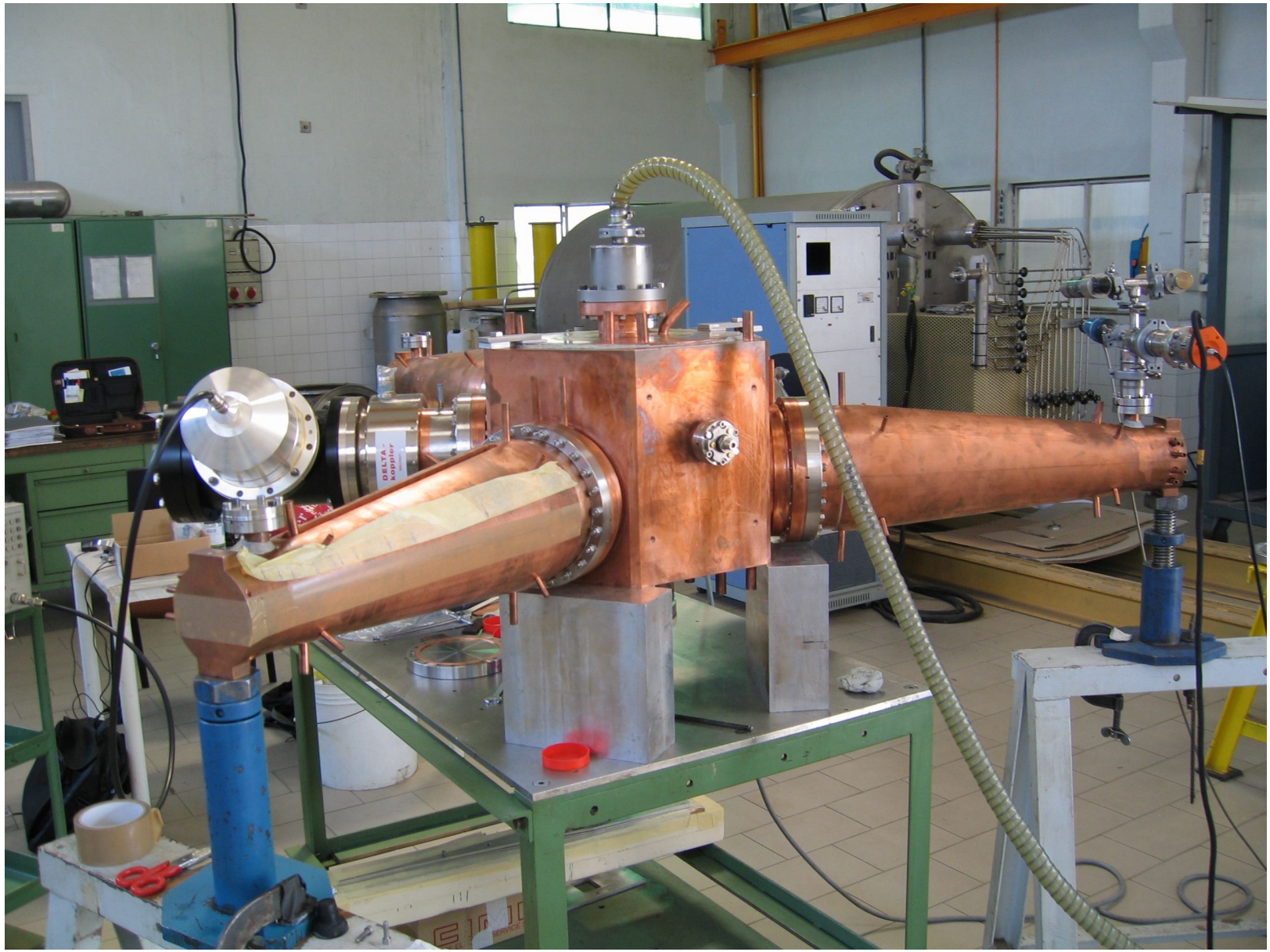

ø74
A
EB11
0.2 I-M
500±2
260±0.2
M
ø74

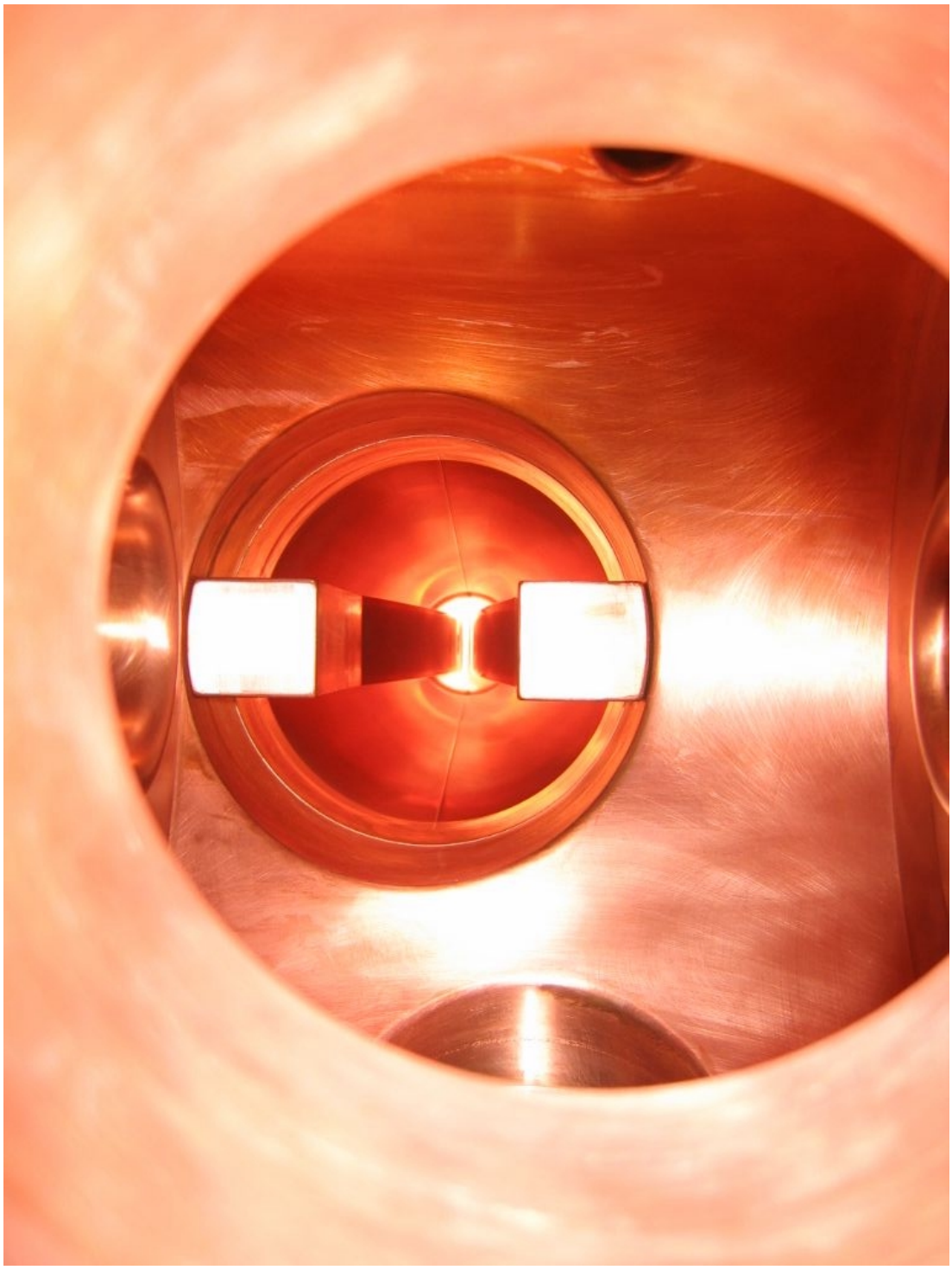

B
A
B
EB4
16
6
A
B-B

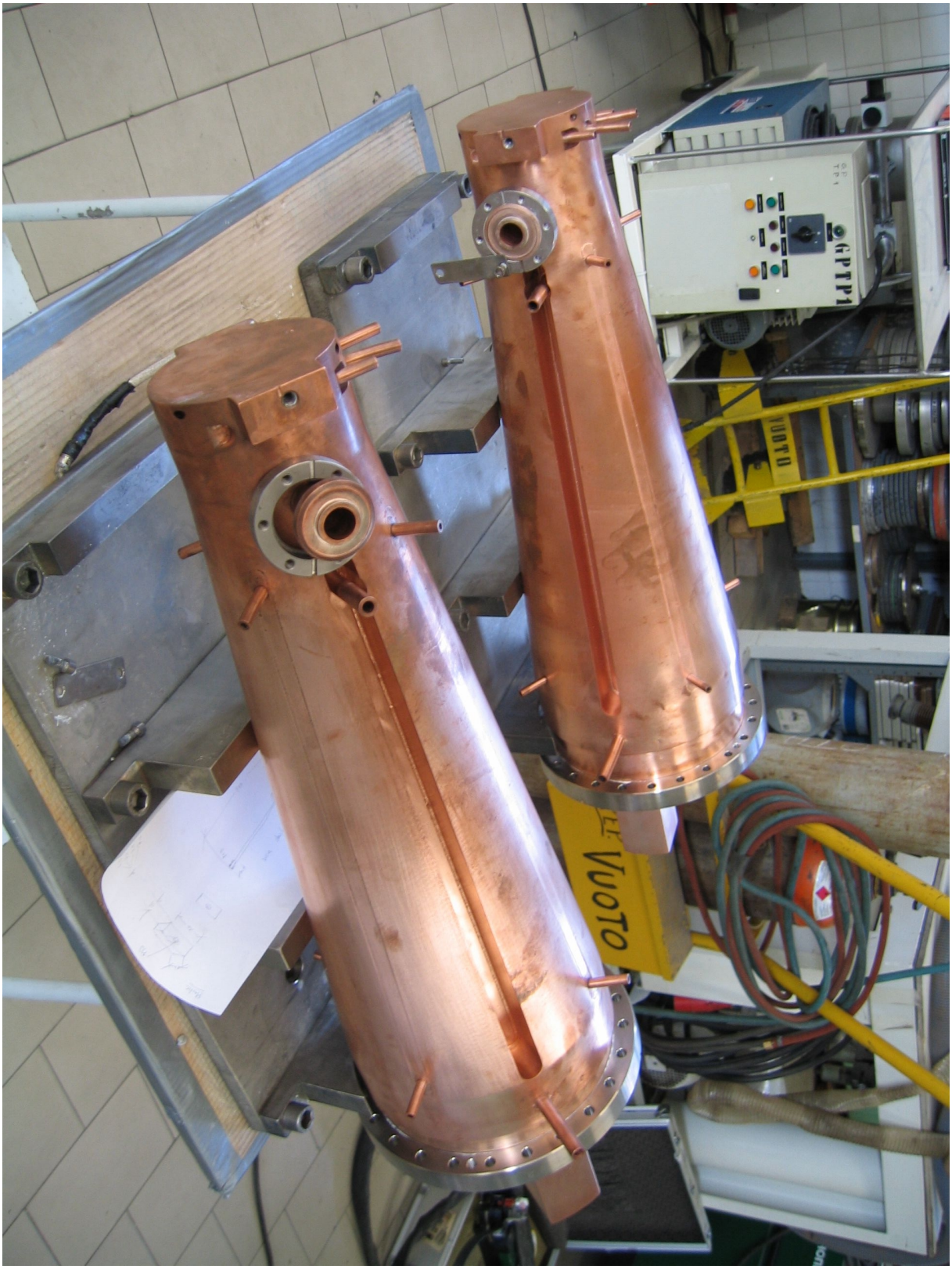
A-A

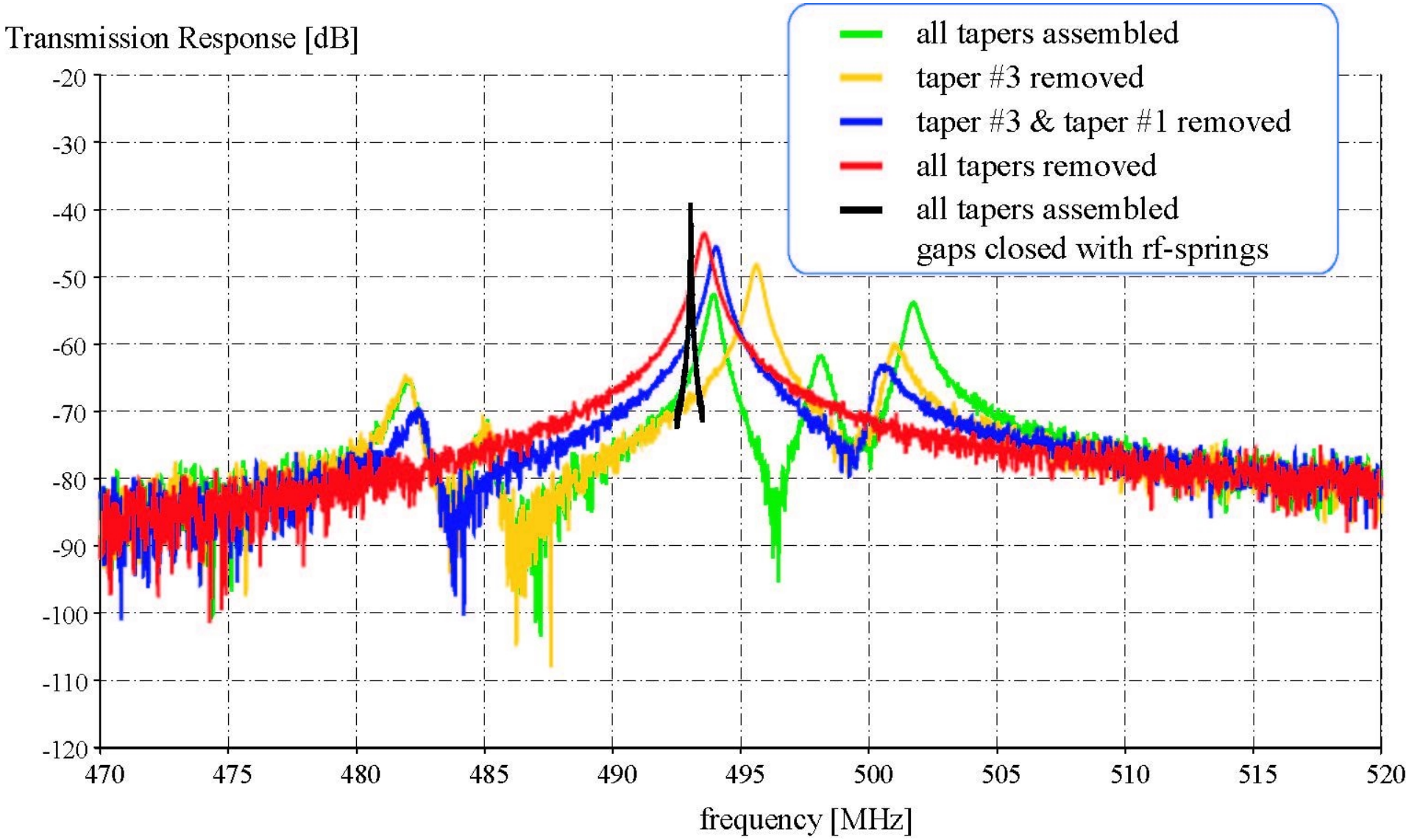

5
X
EB6
EB3
13
E
C
2
Ø197±1
85.1±0.1
Ø118.4
3
4
C
1
11
12
10
E

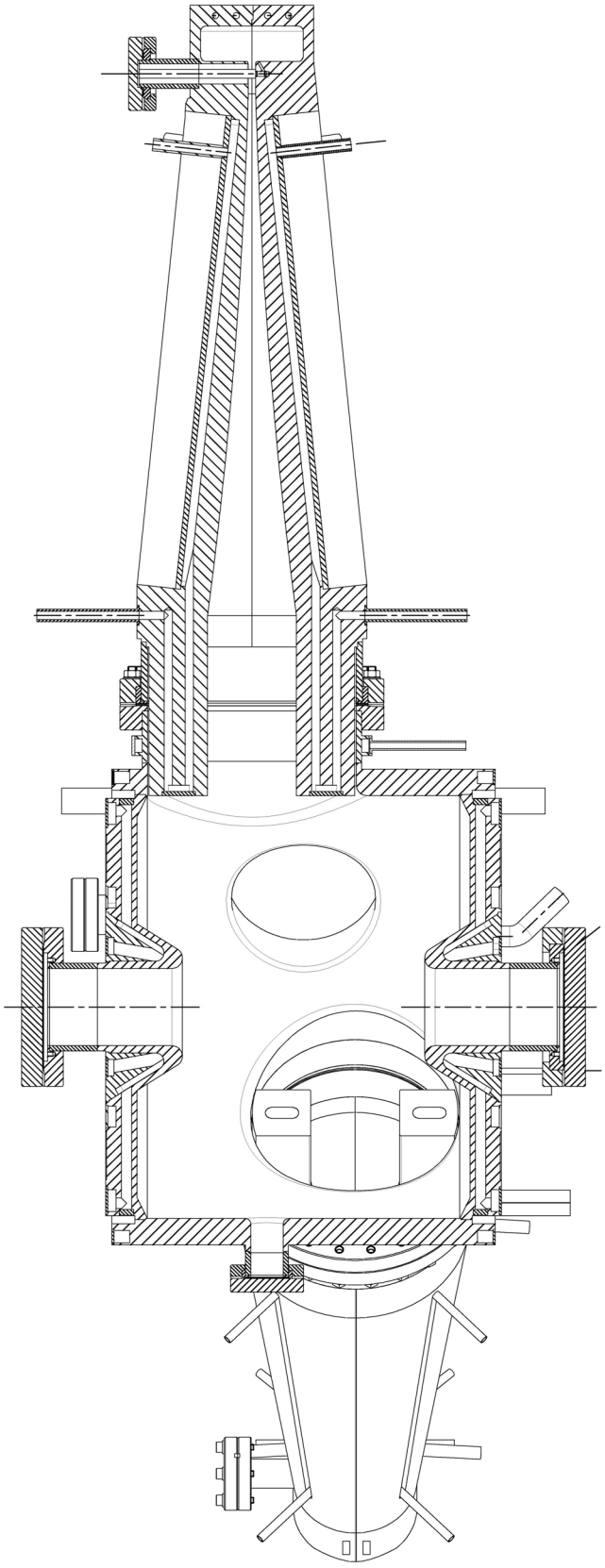

Il profilo interno dei due semigusci
deve essere perfettamente allineato.
The two HF-TAPER internal profile
must be perfectly aligned.
E-E
7±0.1
9
7

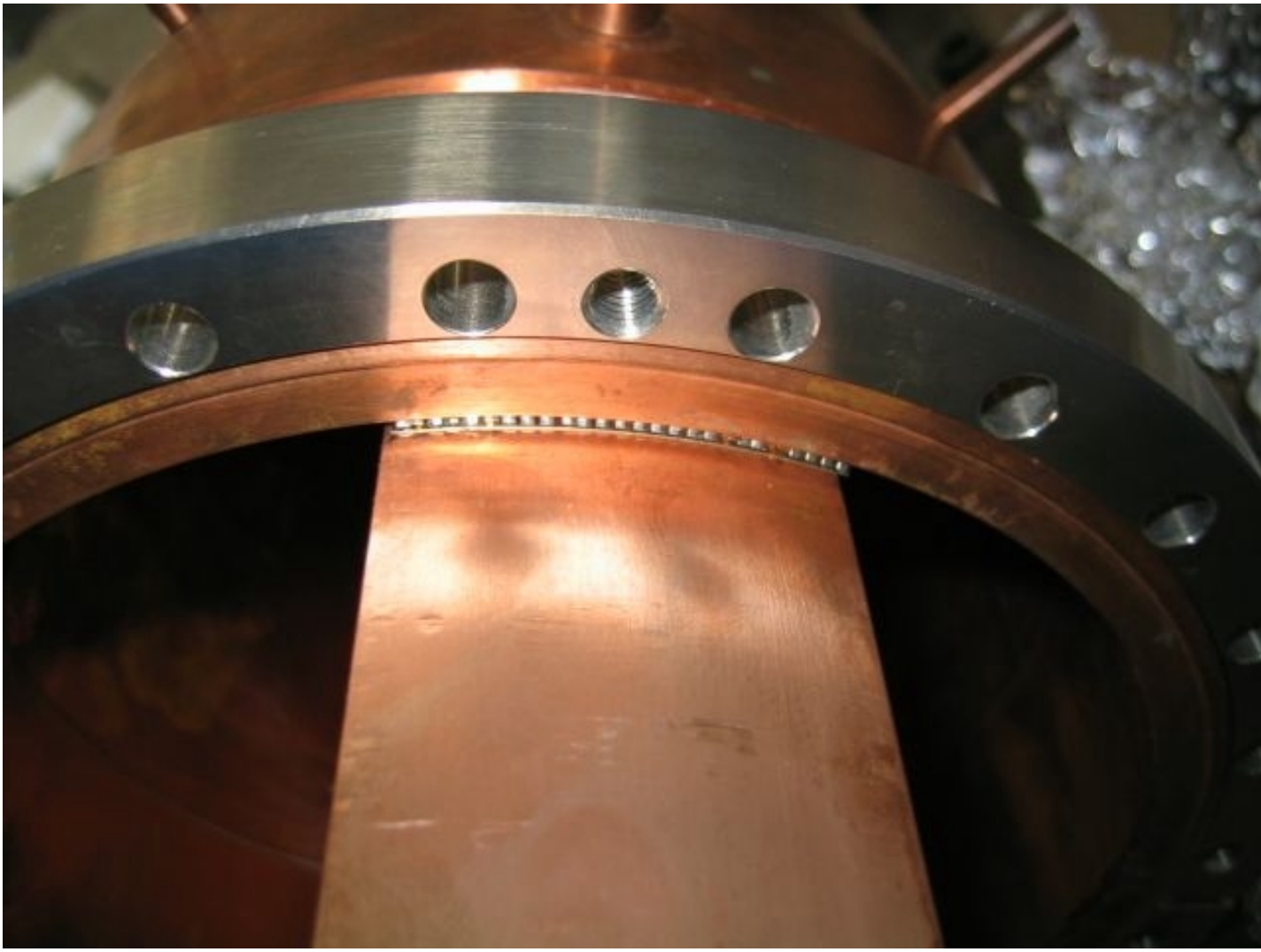





GPTP1
VUOTO


Transmission Response [dB]
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
470
475
480
485
490
495
500
505
510
515
520
frequency [MHz]
all tapers assembled
taper #3 removed
taper #3 & taper #1 removed
all tapers removed
all tapers assembled
gaps closed with rf-springs





Summary

- **Detailed HOM impedance measurements have been performed for a low power 1:1 aluminium cavity, giving**
  - ♠ **longitudinal HOM impedances** **< 4 kΩ**
  - ♠ **transverse HOM inpedances** **< 170 kΩ/m**

- **Measurements are in good agreement with numerical calculations. → Simulation tools are reliable**

- **A high power prototype cavity designed for 100 kW thermal power is under manufacturing. First power tests are scheduled for December 2003.**

- **Installation into the DELTA ring and first beam tests are planned for February 2003**

- **An improved broadband 7/8“ EIA coaxial rf vacuum window has been developed and tested up to 1 kW (at 1.3 GHz)**

- **An alternative HOM coupler / damper design based on a homogenious ridged circular waveguide with internal loads is under investigation in an attempt to further reduce the HOM impedances.**