SY-RF-BR

LHC - Beam Wire Scanner Impedance Study Update

18/02/2025

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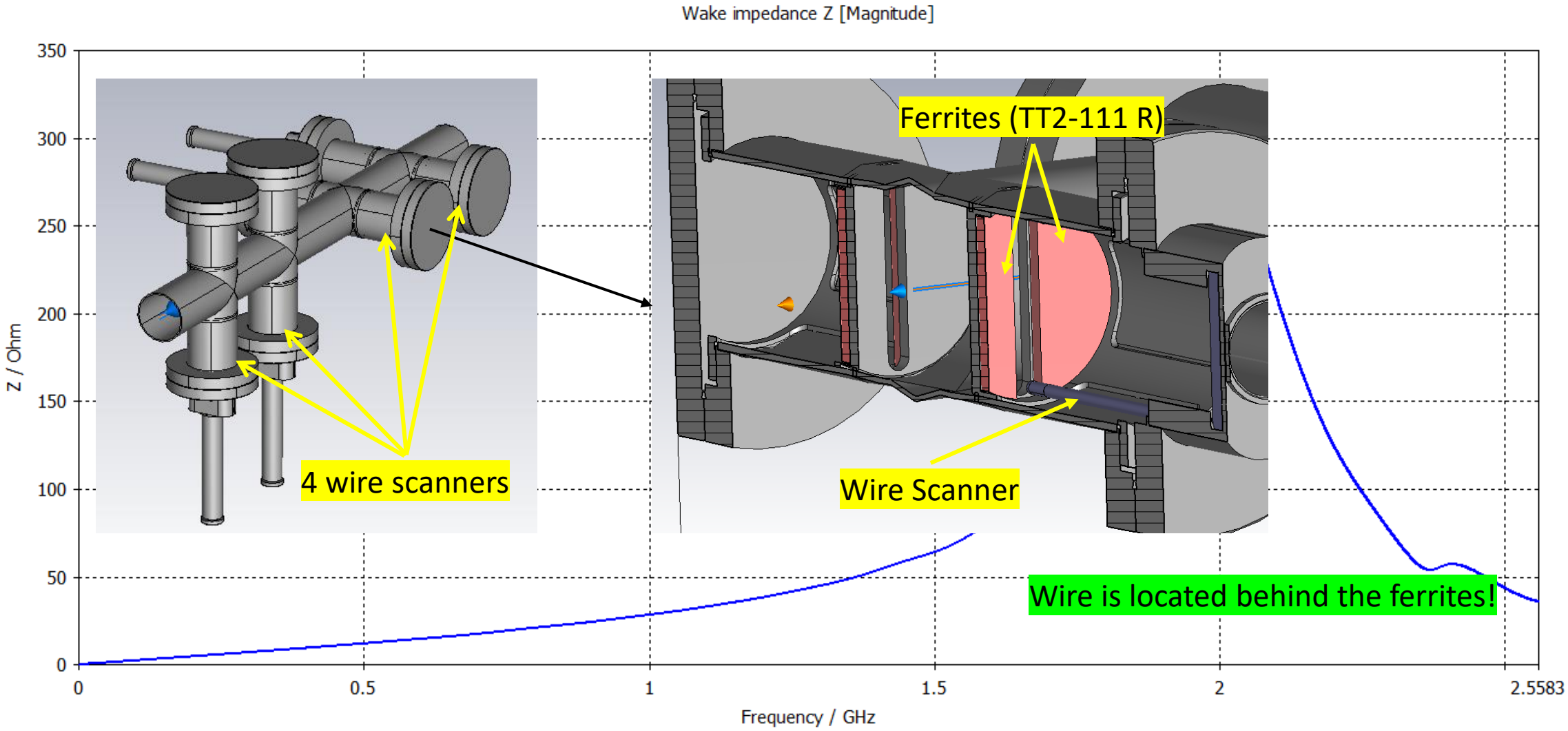
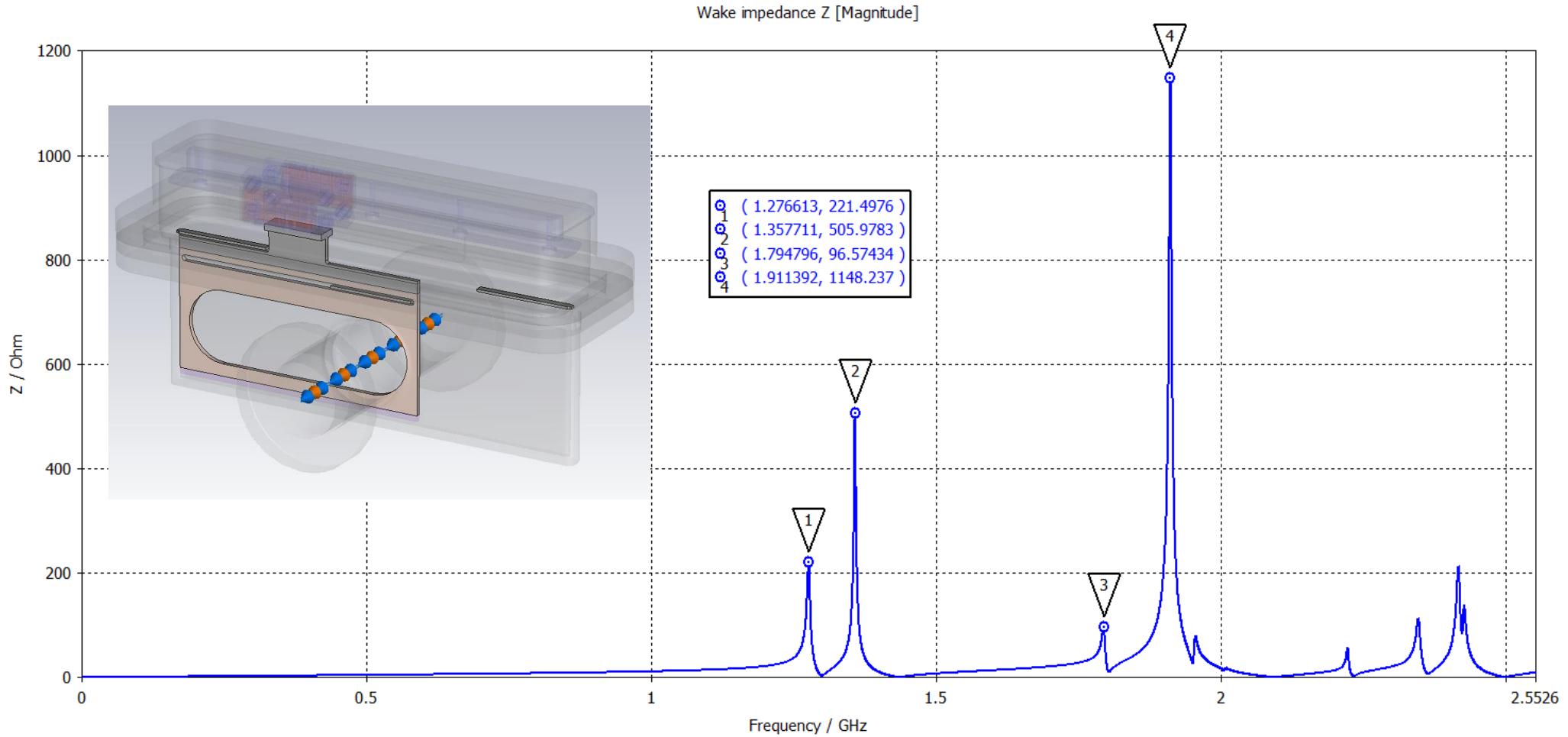
Outline

- Legacy Model
- Improvements on the Model
  - Follow up
  - RF Absorber Usage
  - Studied Models
  - Updated Model
  - Previous vs Updated Model
- Beam-induced RF Power Loss
- Conclusion & Future Work

Legacy Model

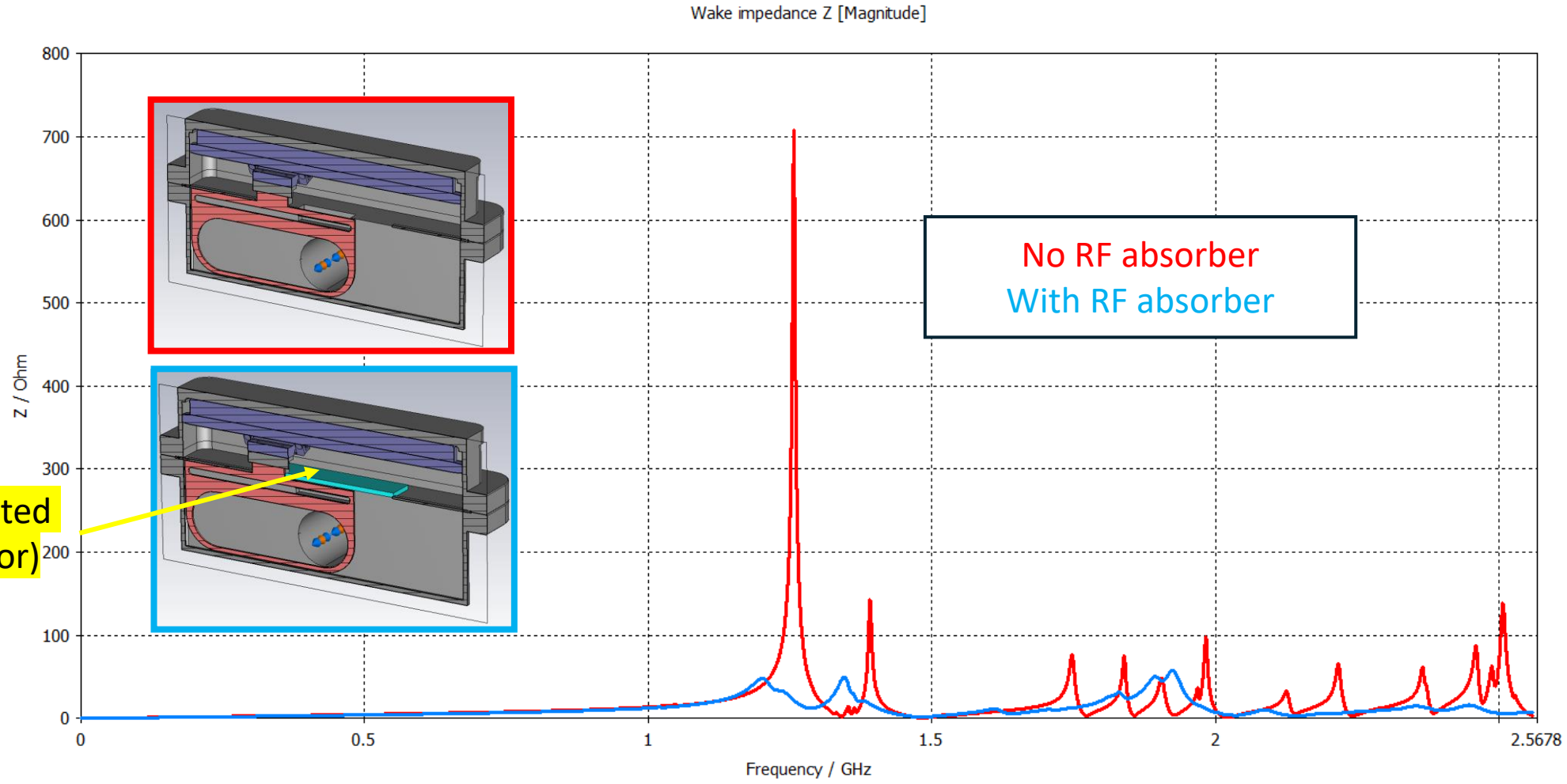


Follow up



For more info: ‘LHC BWS Impedance Study’, 93rd IWG Meeting

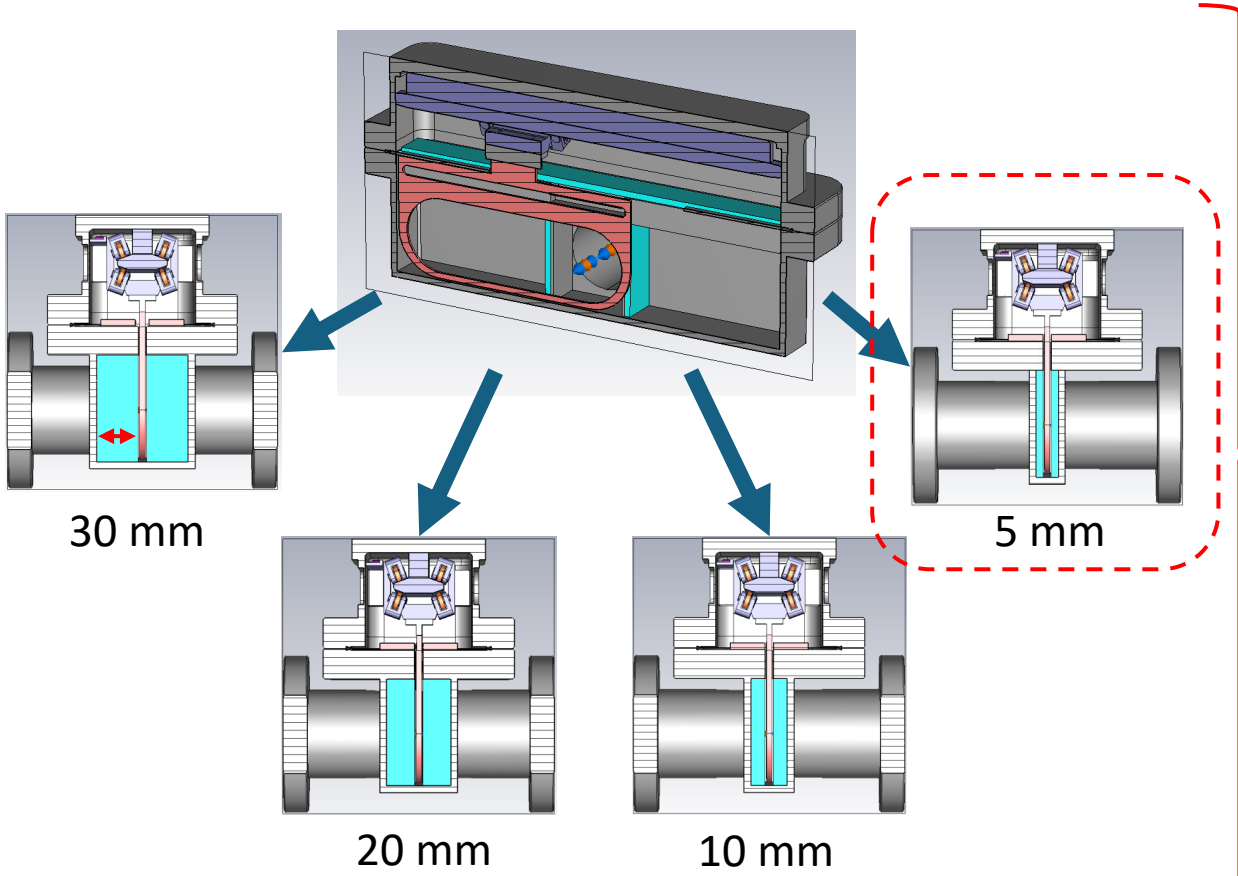
RF Absorber Usage



50 Ω NEG coated ceramic (macor)

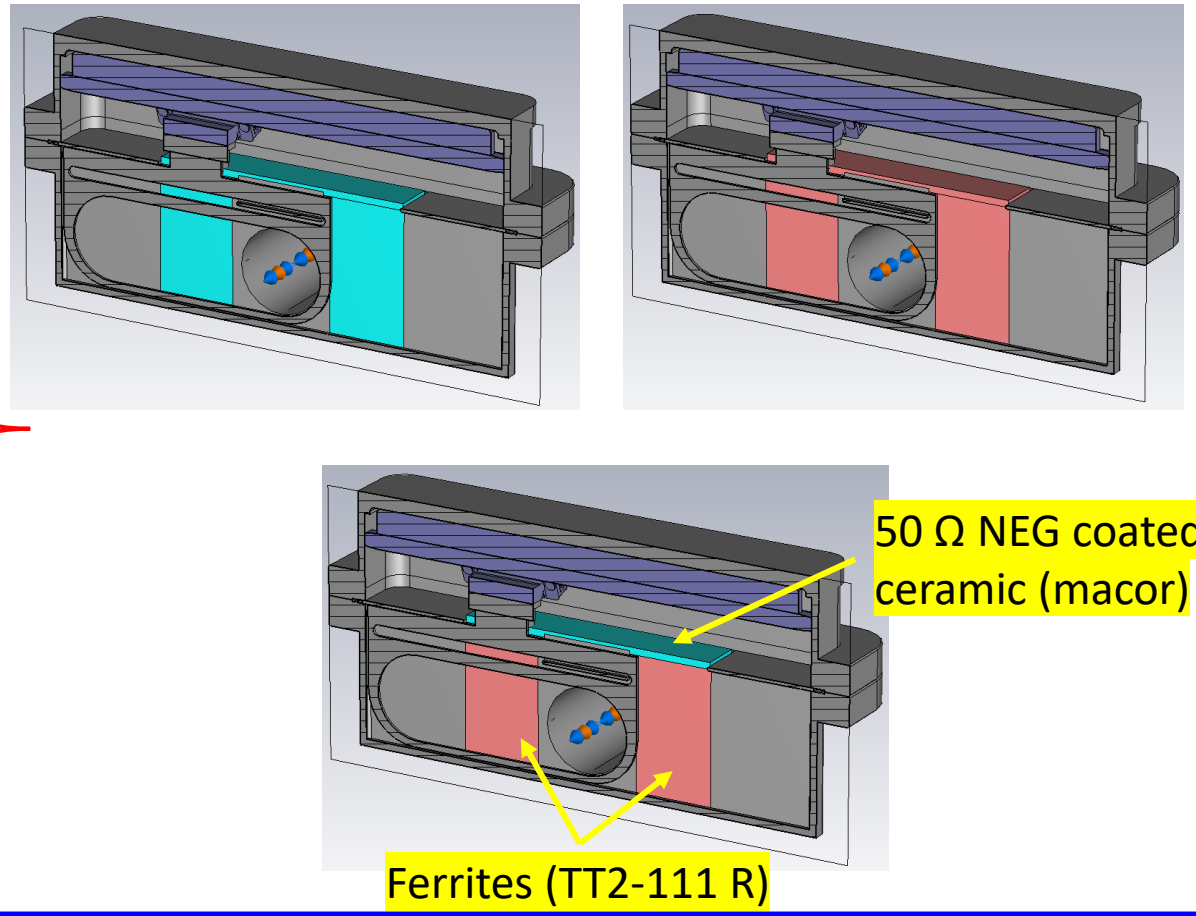
Studied Models

RF absorbers with different lengths on bottom chamber



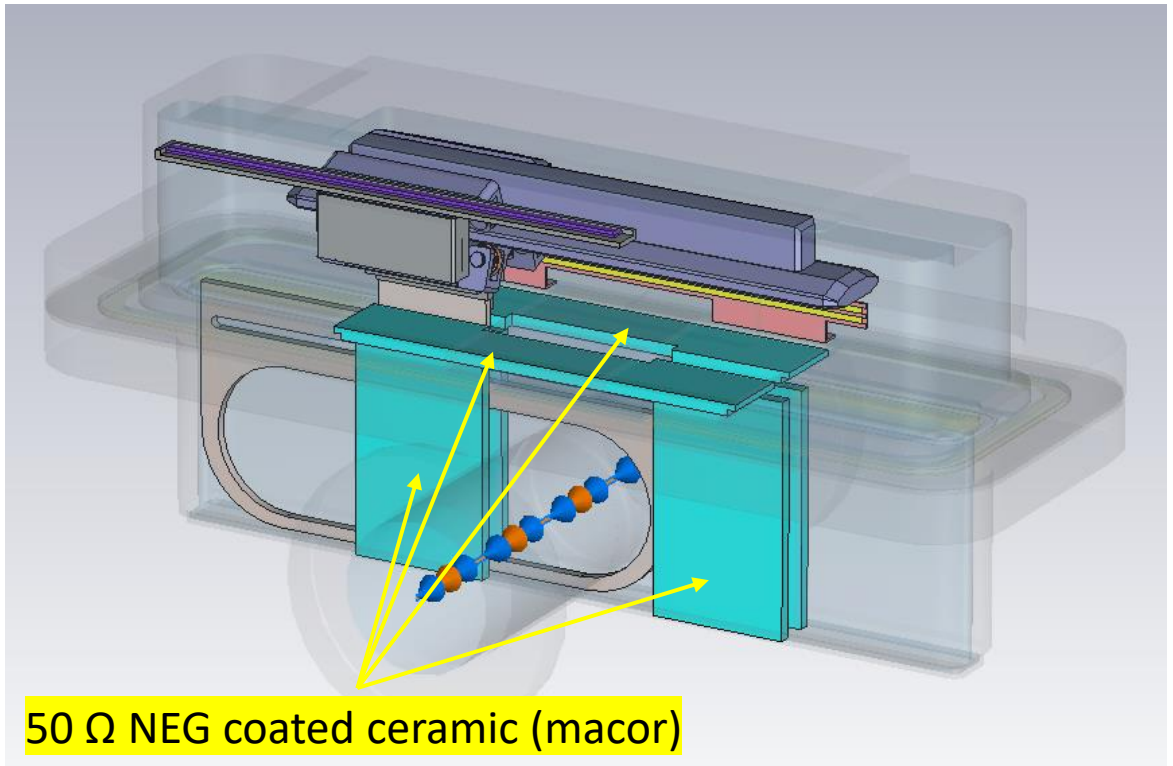
Absorber -> 50 Ω NEG coated ceramic (macor)

Models with different absorber configurations

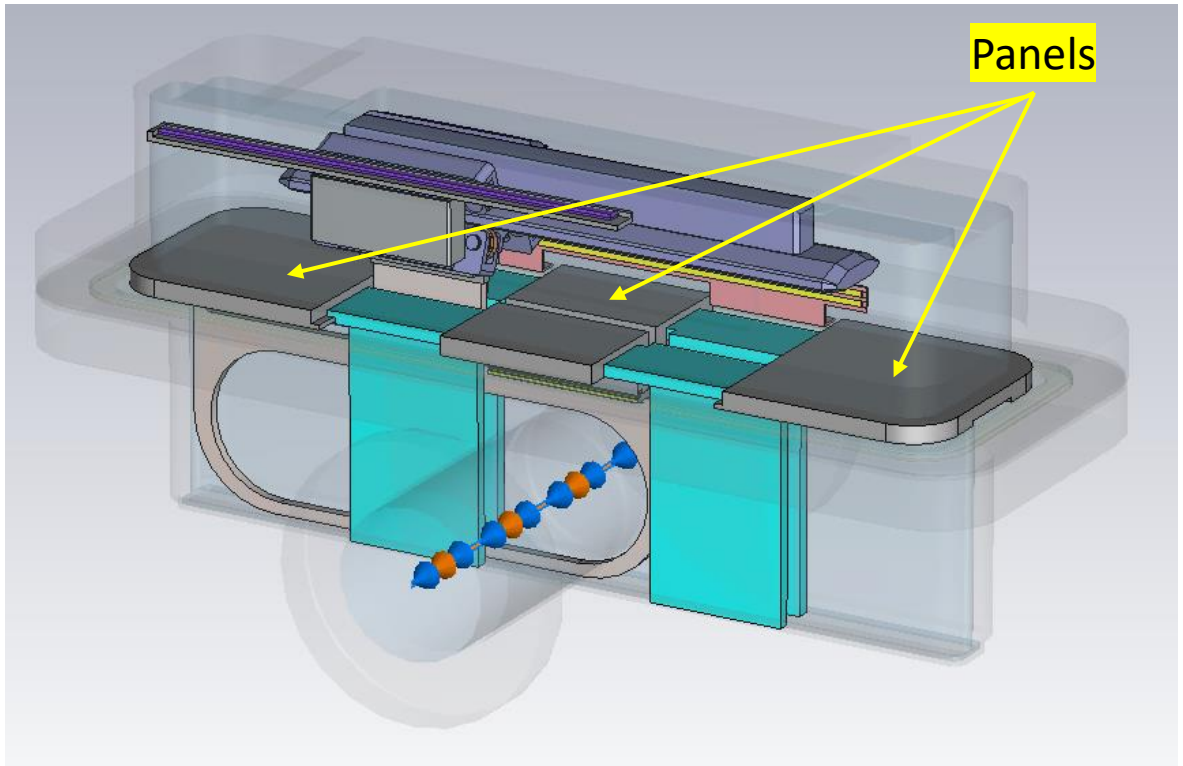


Updated Model

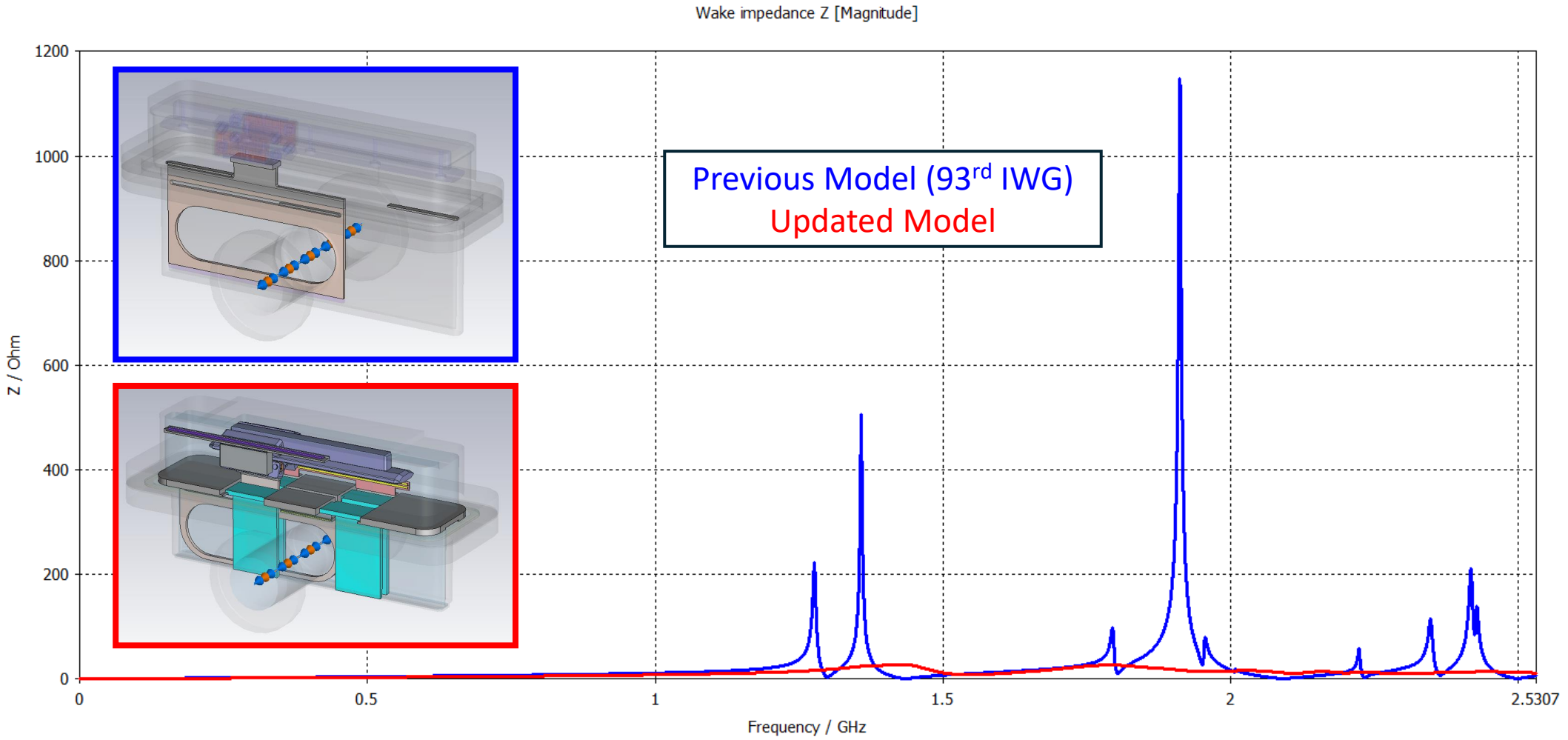
RF Absorber Locations



RF Absorber and Panel Locations

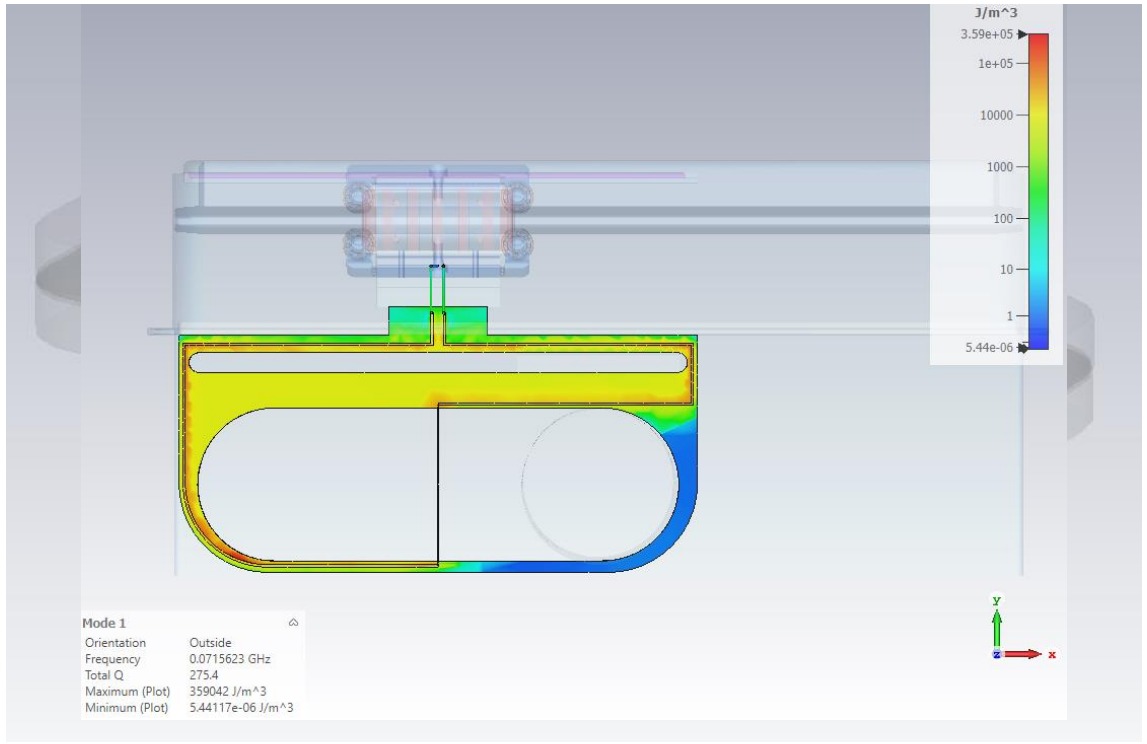


Previous vs Updated Model

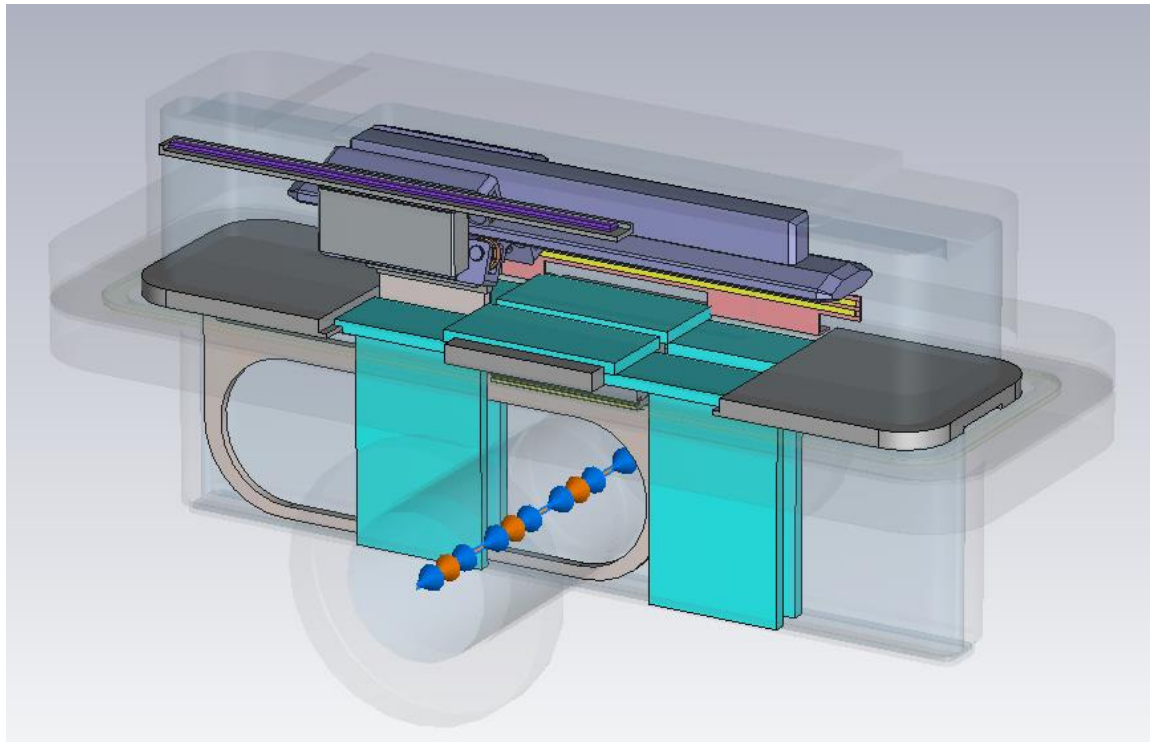


Remark (1)

Current Design

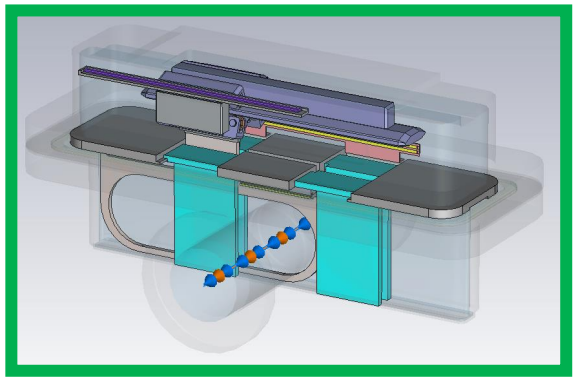


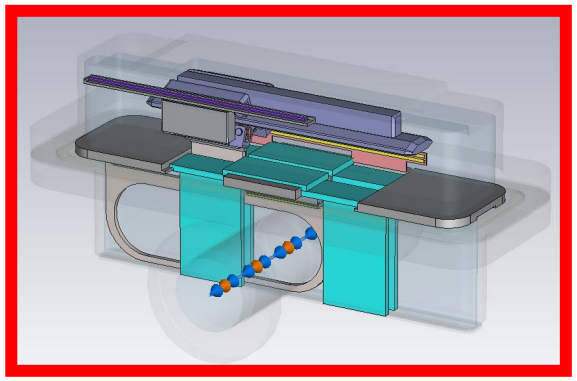
Current Design + Absorbers on the middle panel

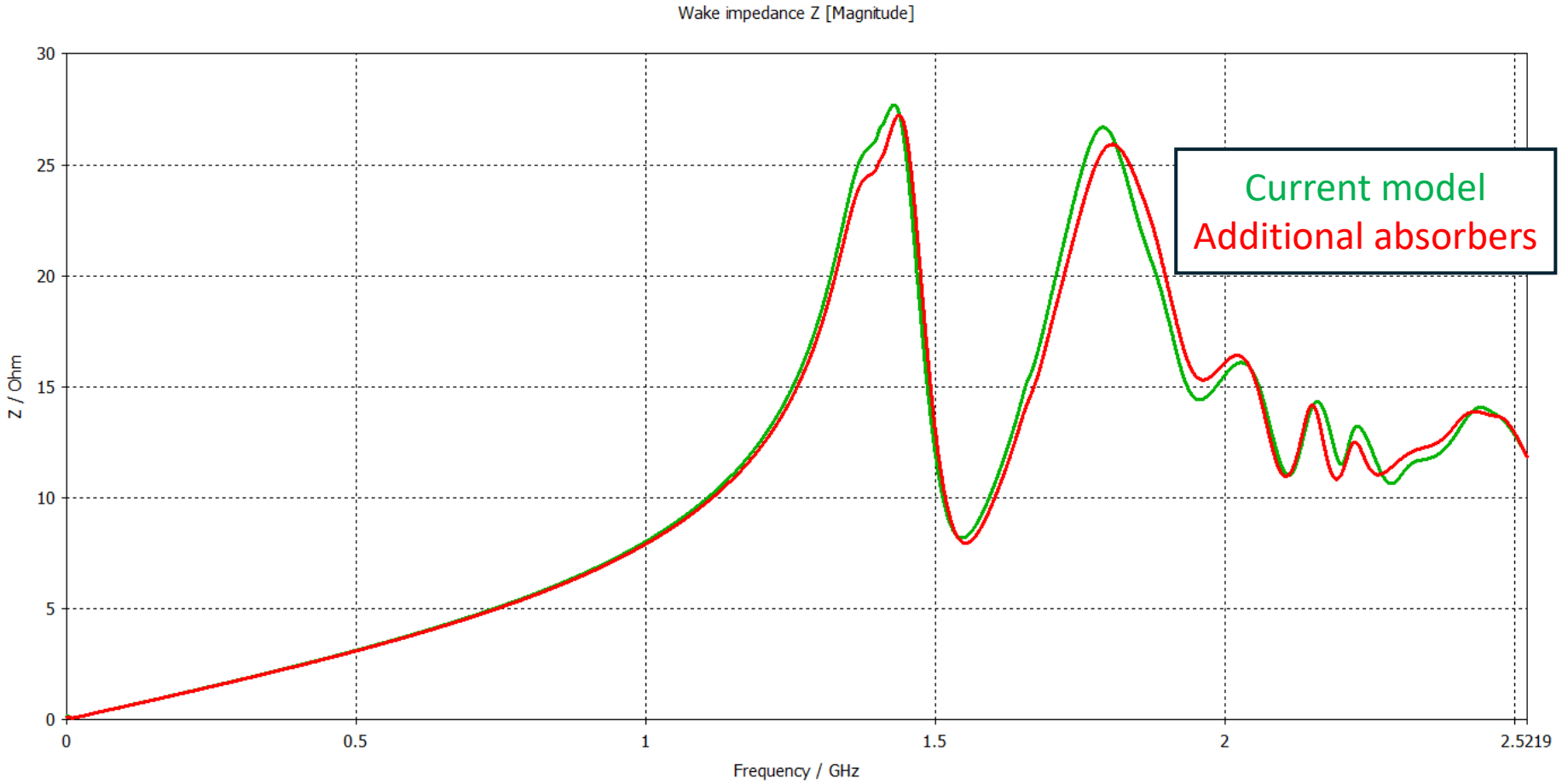


- There will be wire with copper track on the card. -> Loop!

Remark (2)

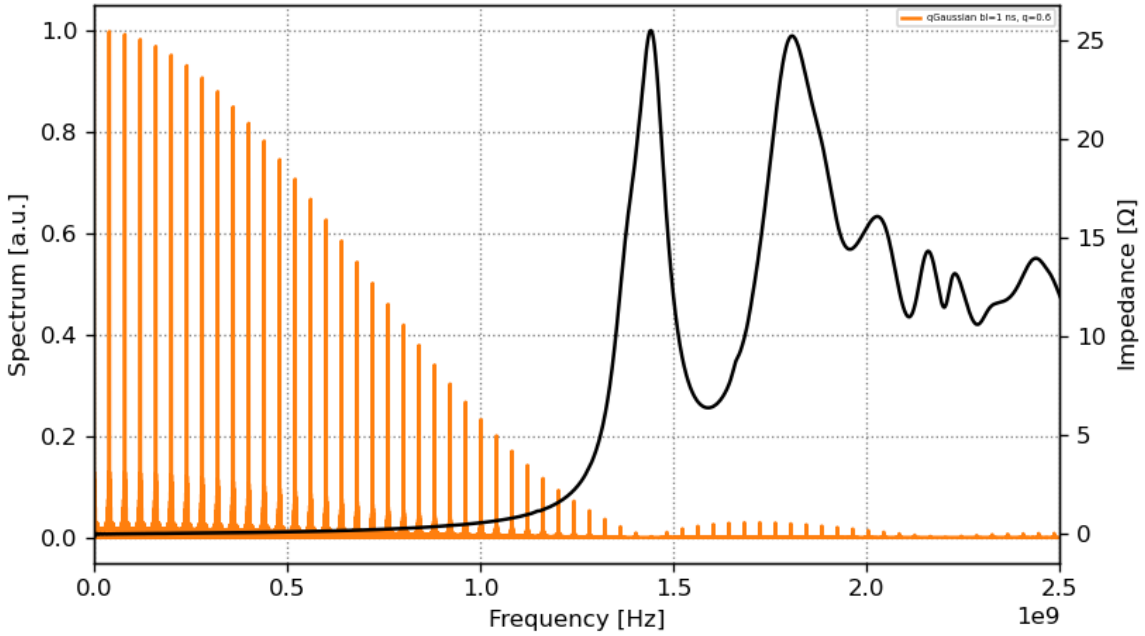




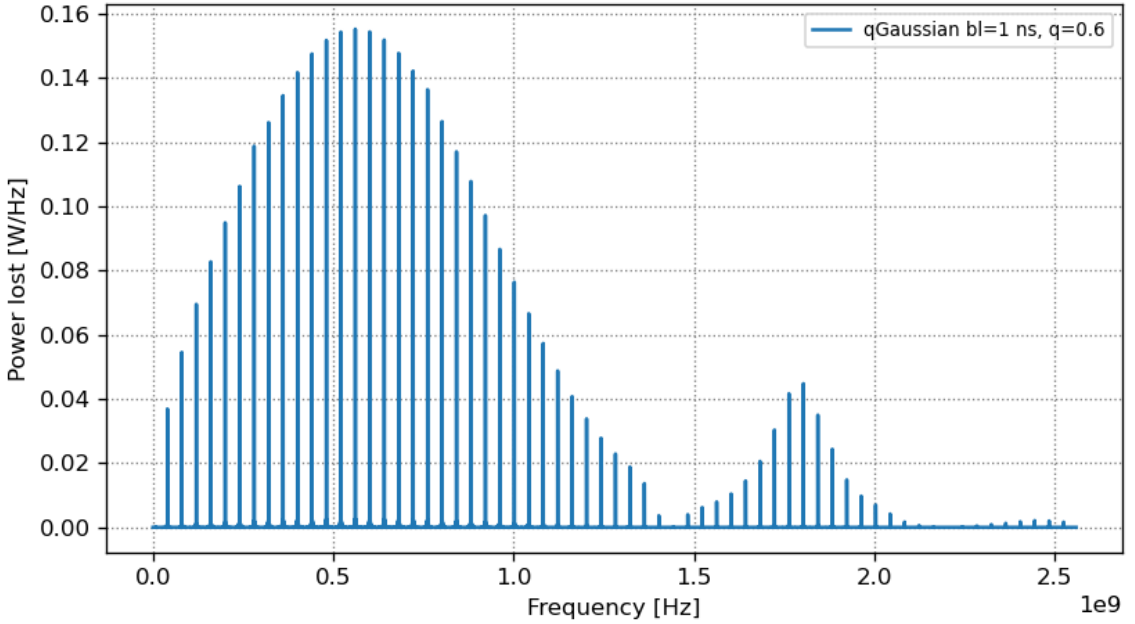

Wake impedance Z [Magnitude]
Z / Ohm
Frequency / GHz
0
5
10
15
20
25
30
0
0.5
1
1.5
2
2.5219
Current model
Additional absorbers

Beam-Induced RF Power Loss

Power Loss



Power Spectral Density over Frequency



Bunch length -> 1 ns
Number of particles/bunch -> 2.2e11

q-Gaussian Distribution

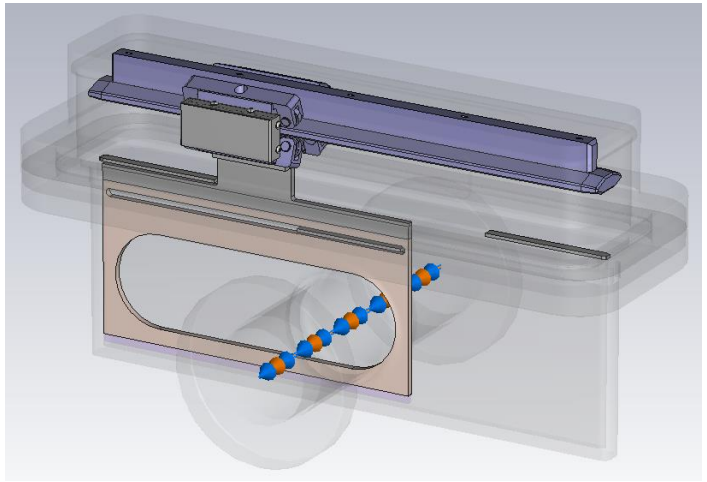
Power Loss -> 4.59 W
Max. Power Loss -> 5.03 W

Beam Induced Heating Computation code – BIHC

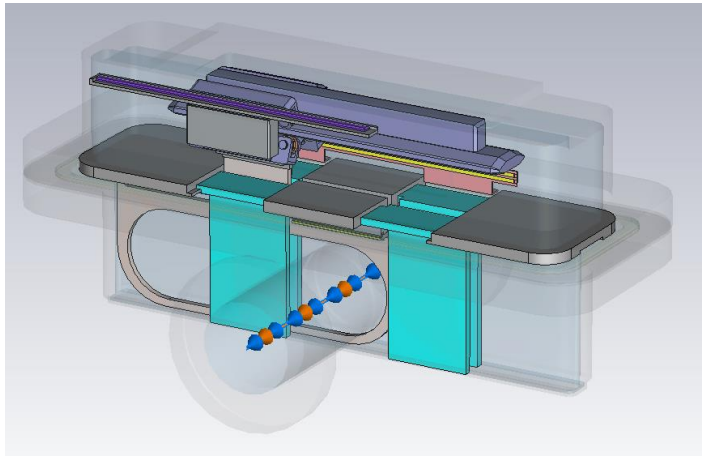
Conclusion & Future Work

- The BWS model is equipped with RF absorbers both in the lower and upper chambers. All the peaks in the previous model (presented in 93rd IWG meeting) has mitigated.
- The panels are updated for better mechanical assembly and RF contact.
- Calculated beam-induced RF power loss is ~5 W for q-Gaussian beam distribution with 1 ns bunch length and 2.2e11 p/b intensity.
- Integration model and transverse impedance simulations will be performed.

Previous Model



Updated Model



SY-RF-BR

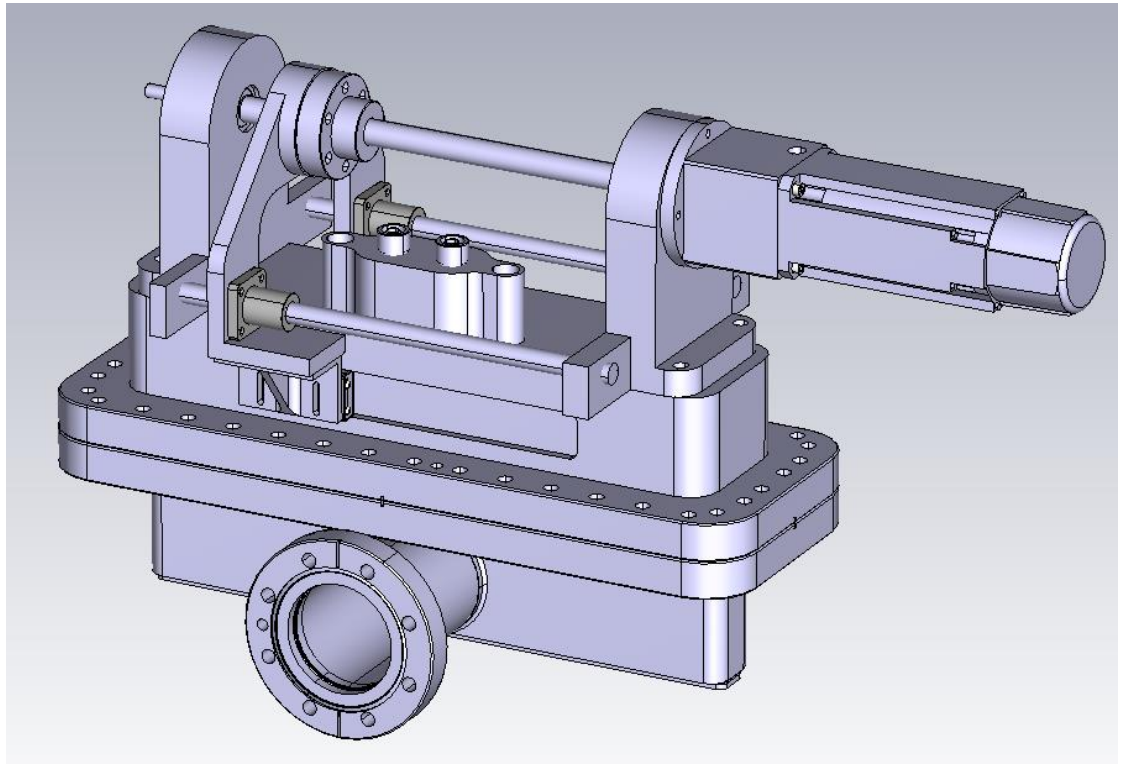
Thanks for your attention!

Special thanks to Leonardo Sito for the help on the BIHC code.

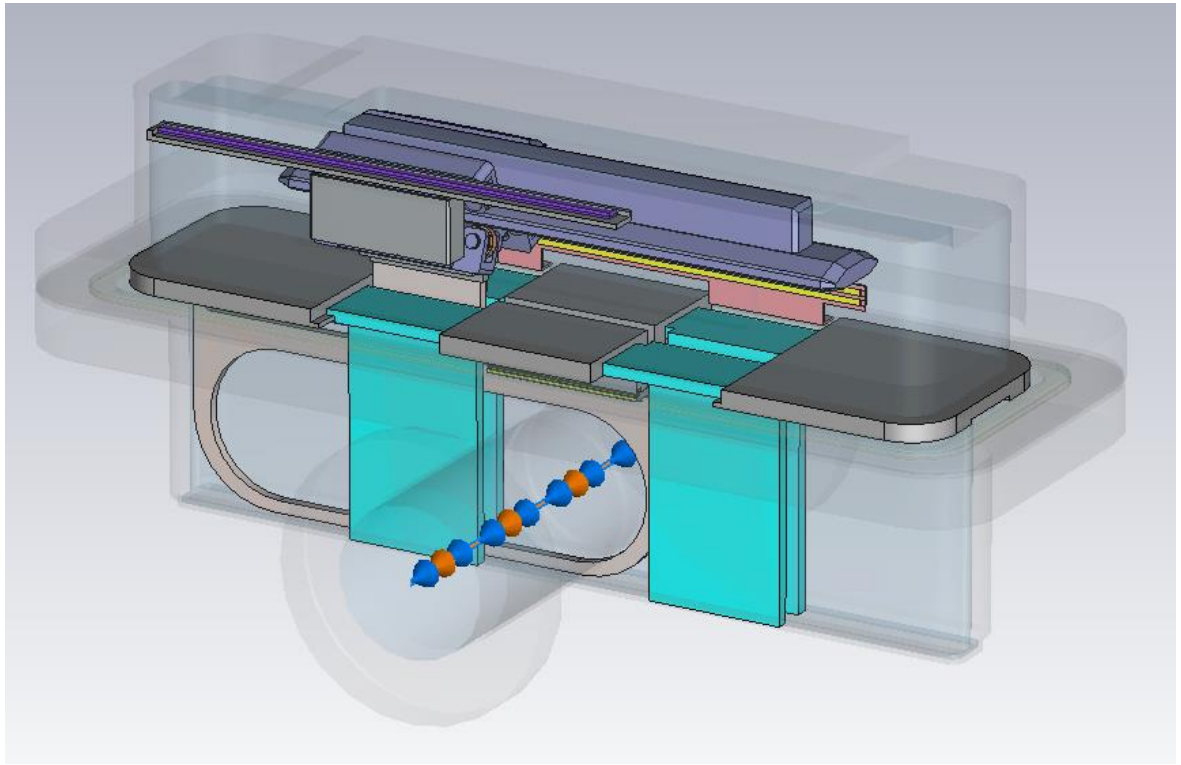
Backup Slides

BWS Model

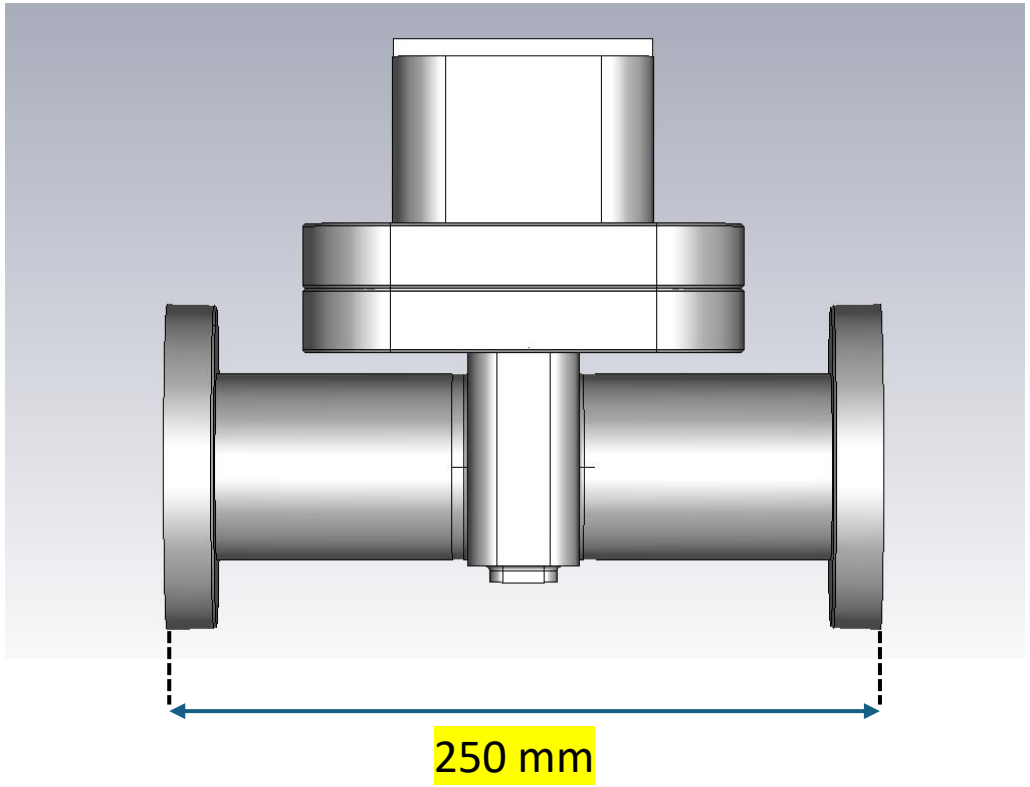
Mechanical Model

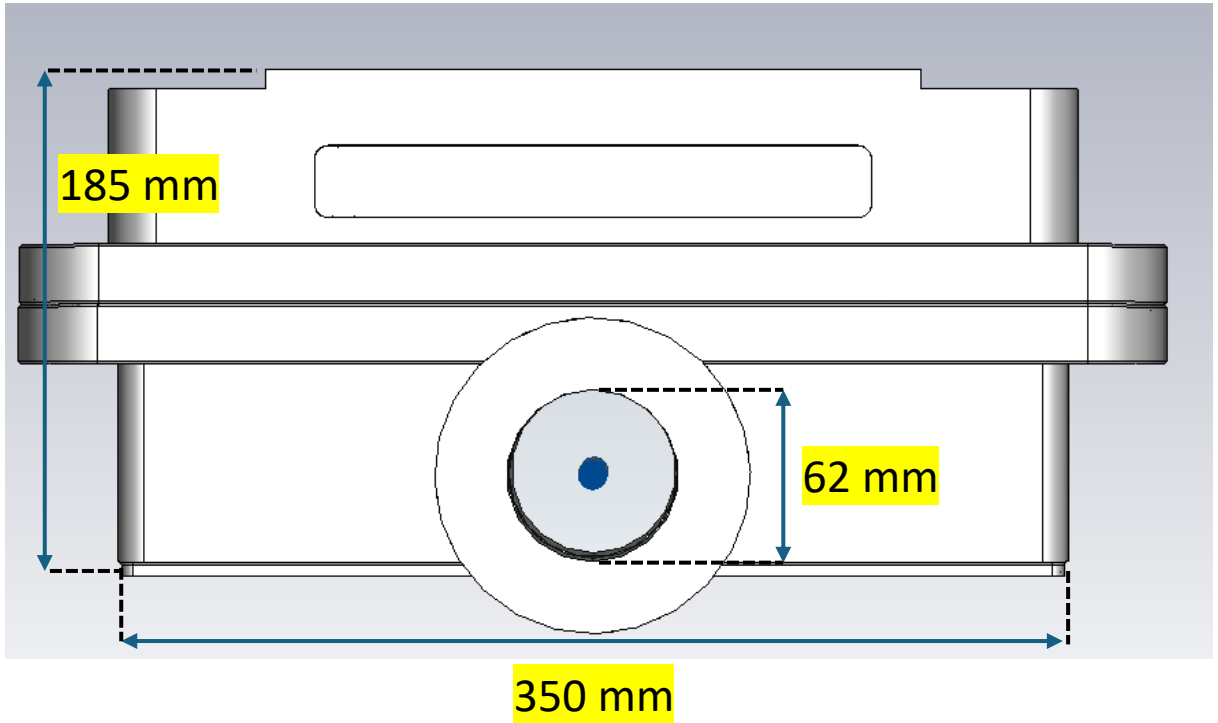


Simplified CST Model

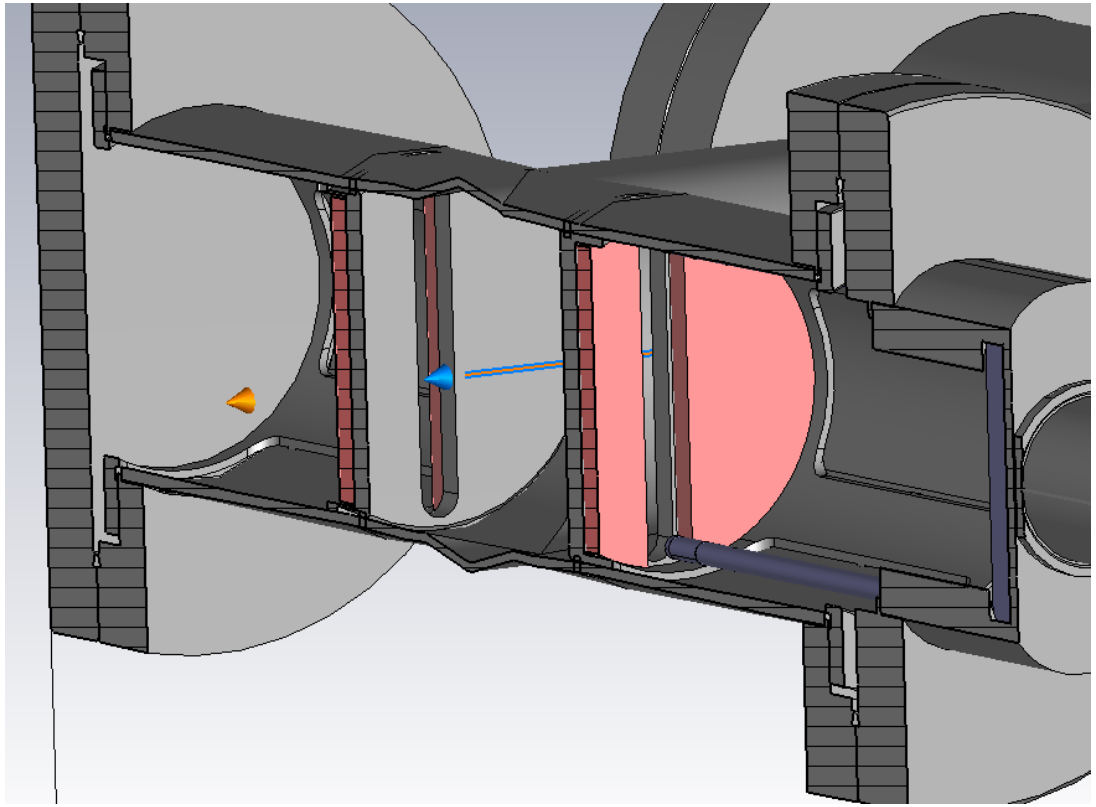


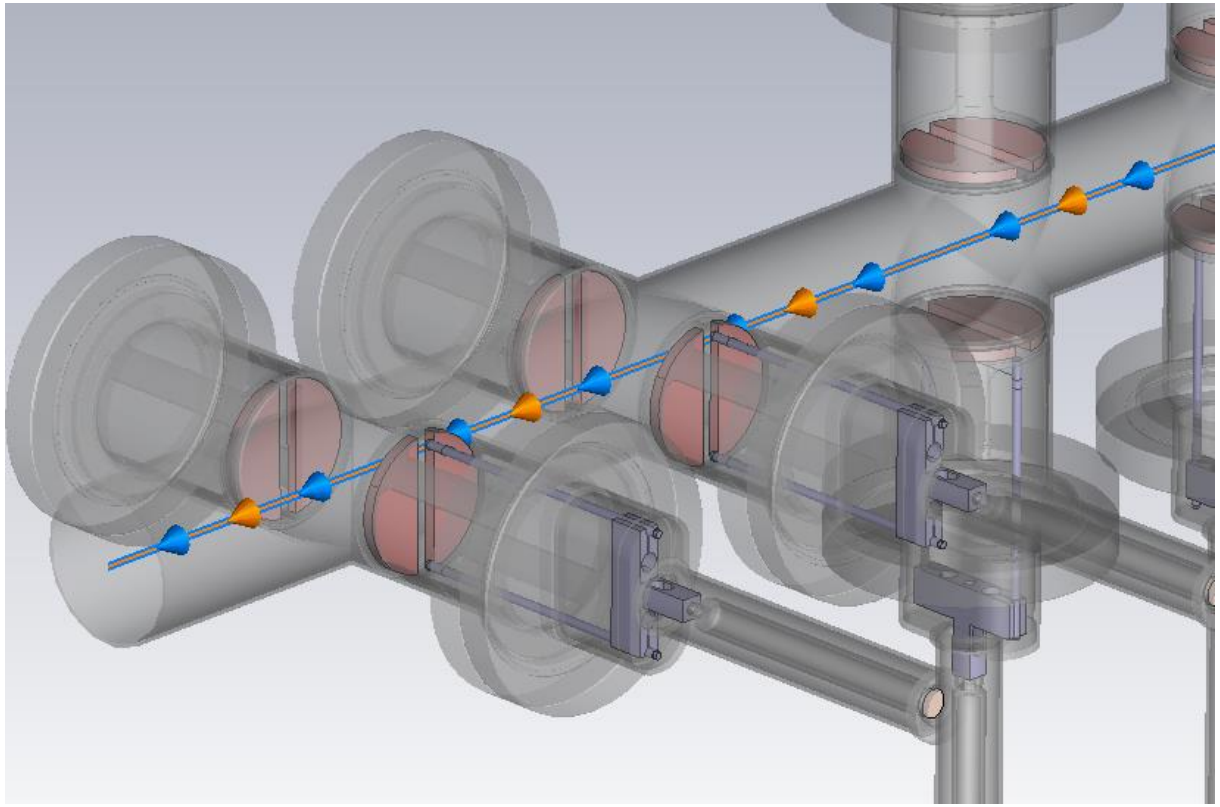
BWS Model - Dimensions





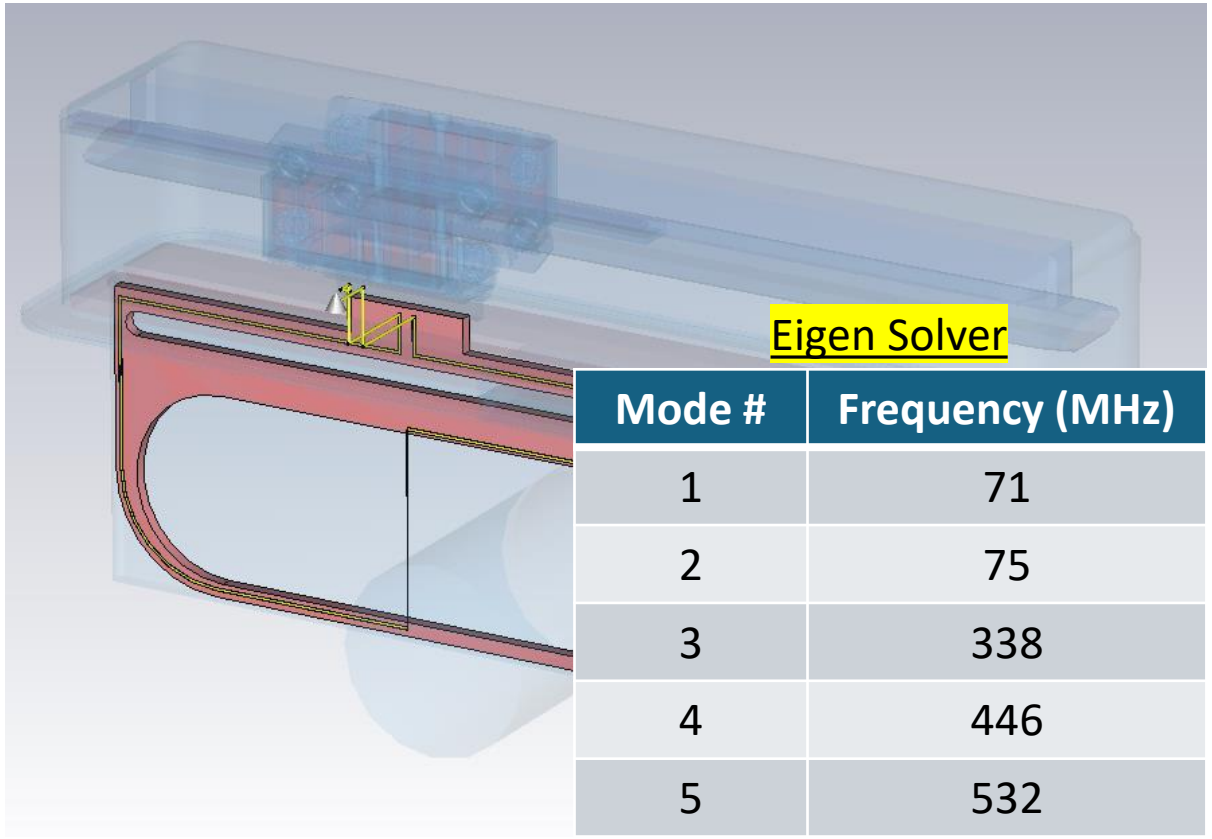
BWS Legacy Model





BWS Model Trial with Wire (1)

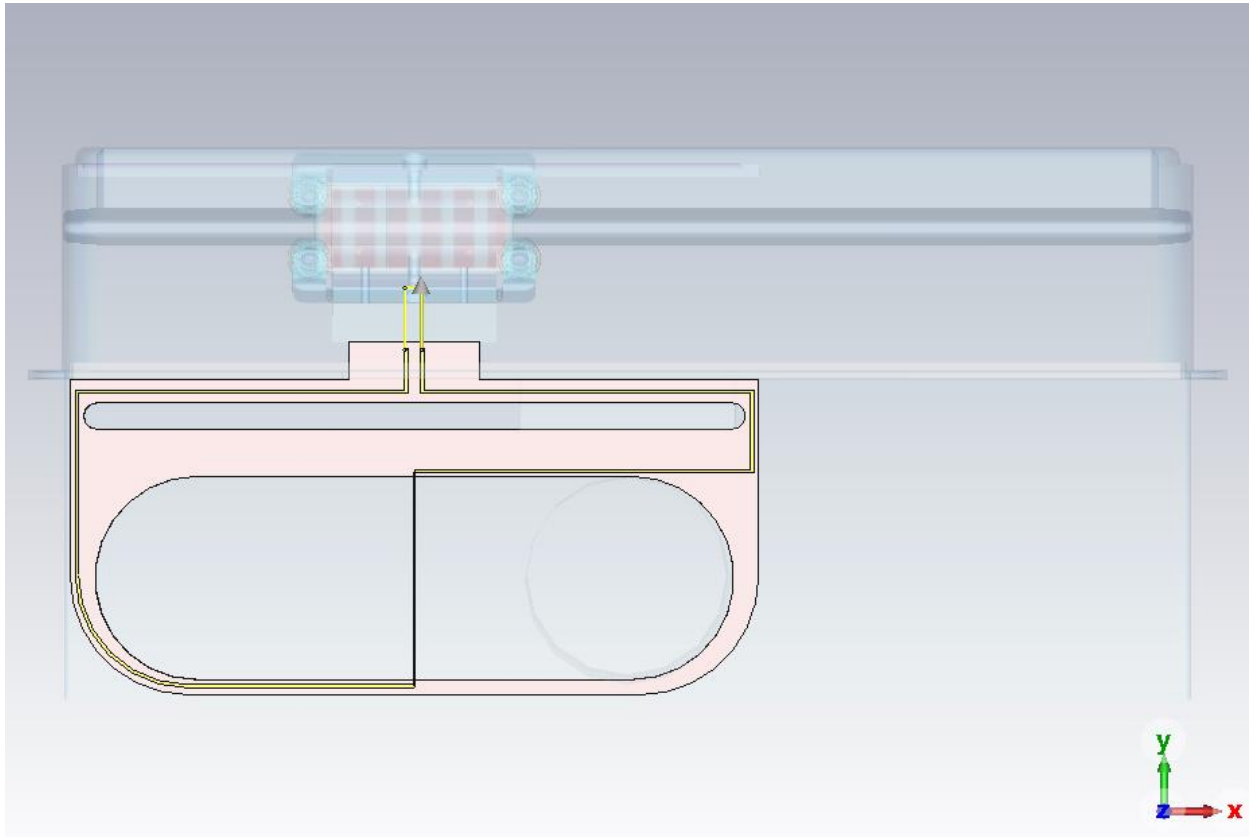
CST Model with Wire & Feedtrough



Eigen Solver

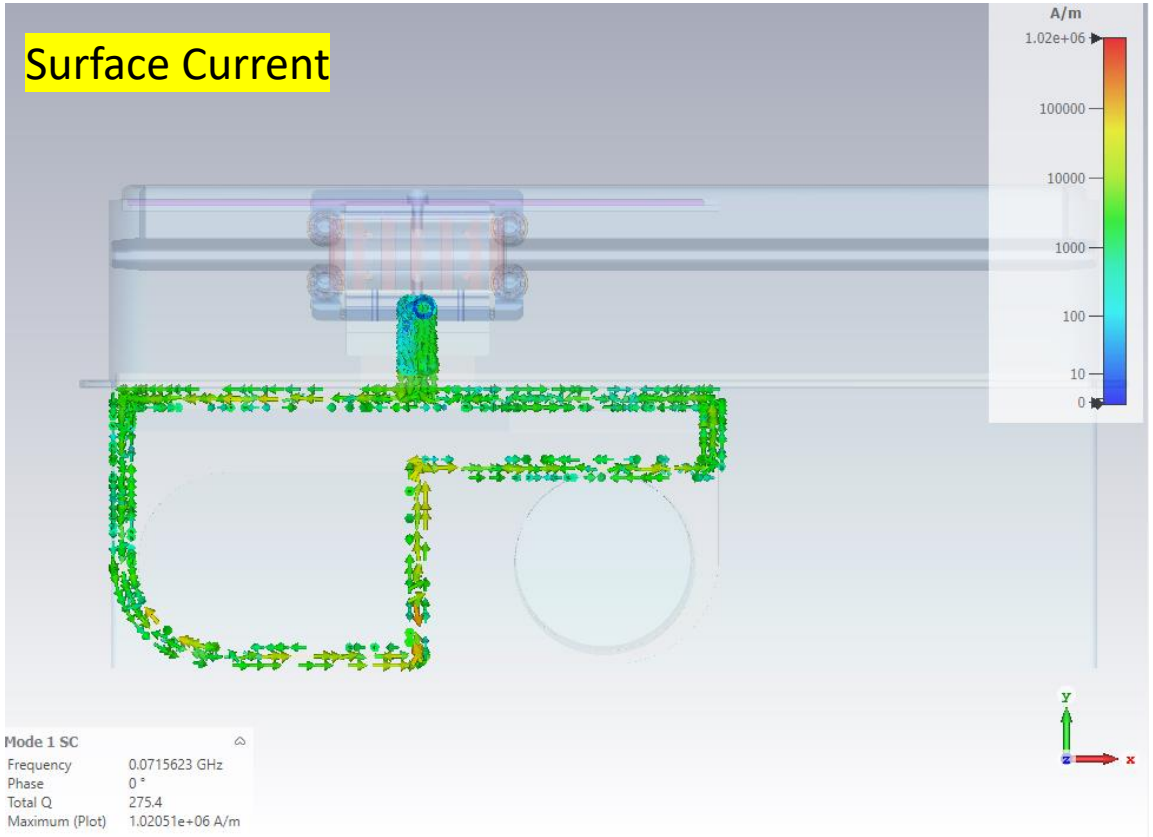
Mode #	Frequency (MHz)
1	71
2	75
3	338
4	446
5	532

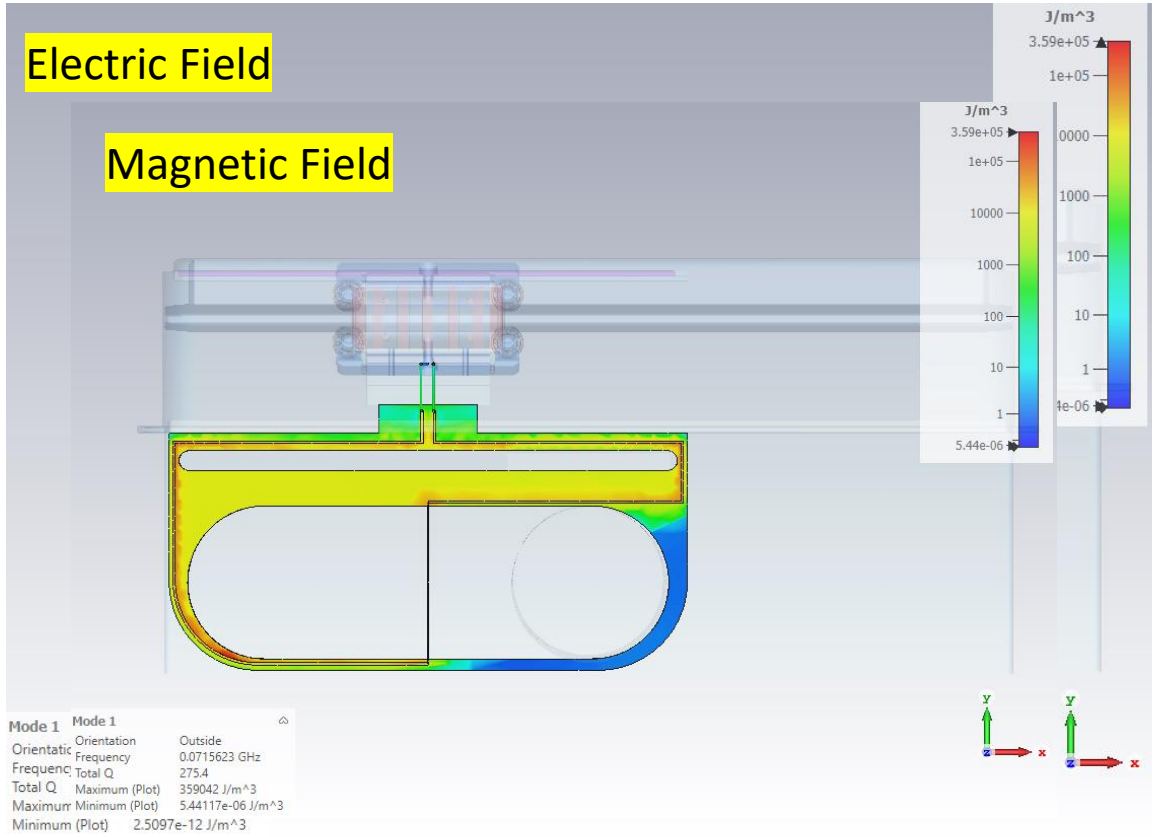
Front View



BWS Model Trial with Wire (2)

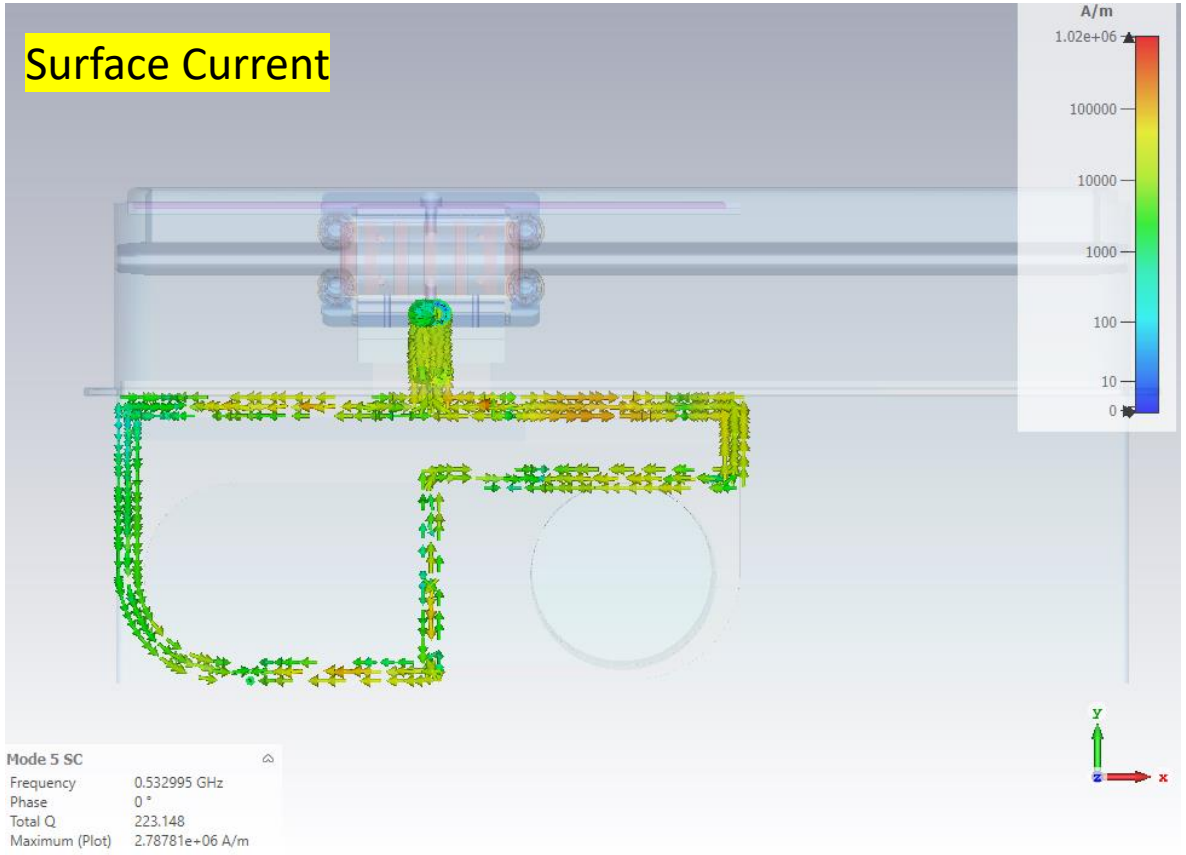
Mode #1 -> 71 MHz

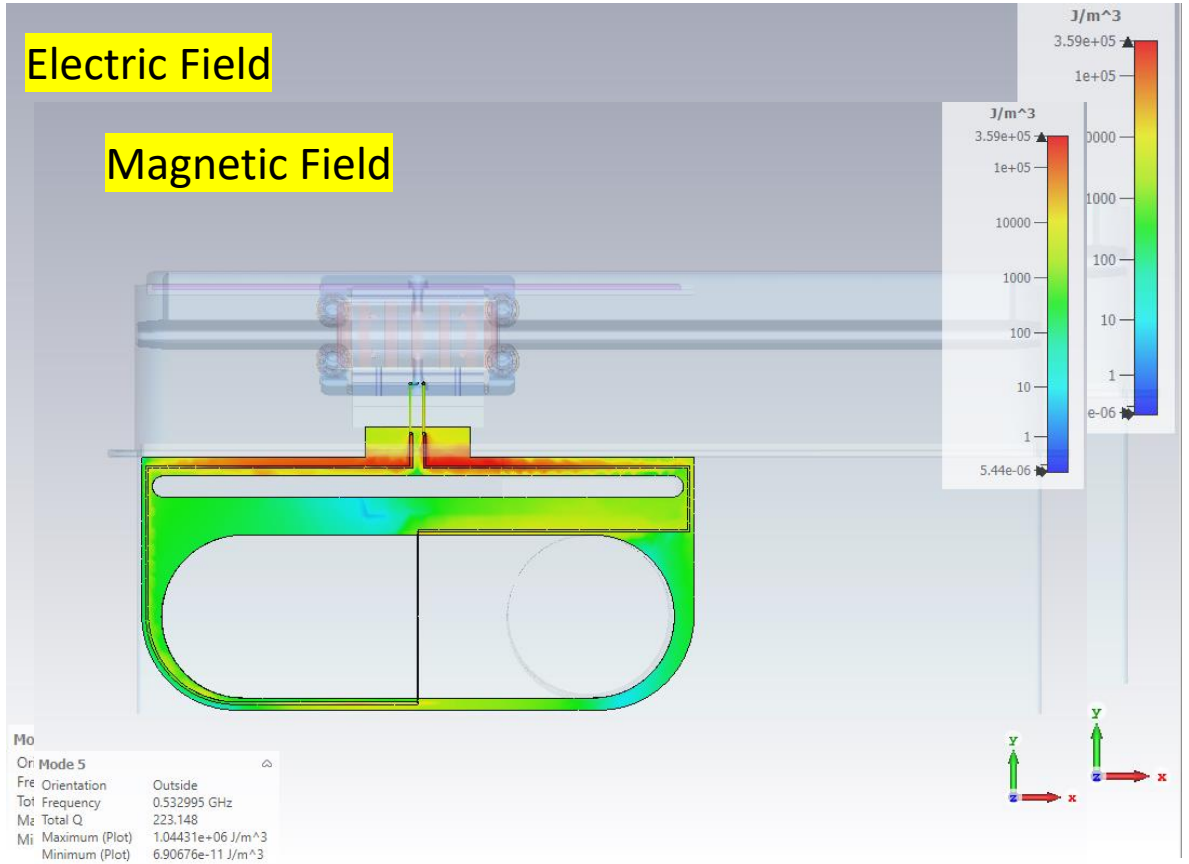




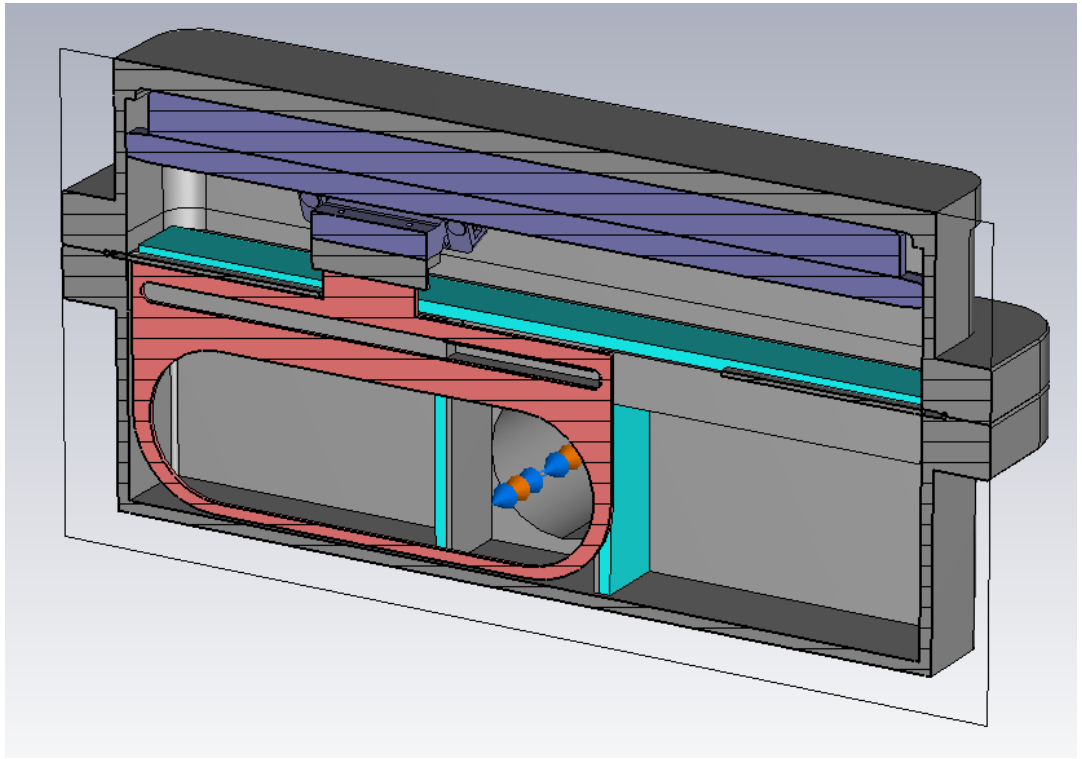
BWS Model Trial with Wire (3)

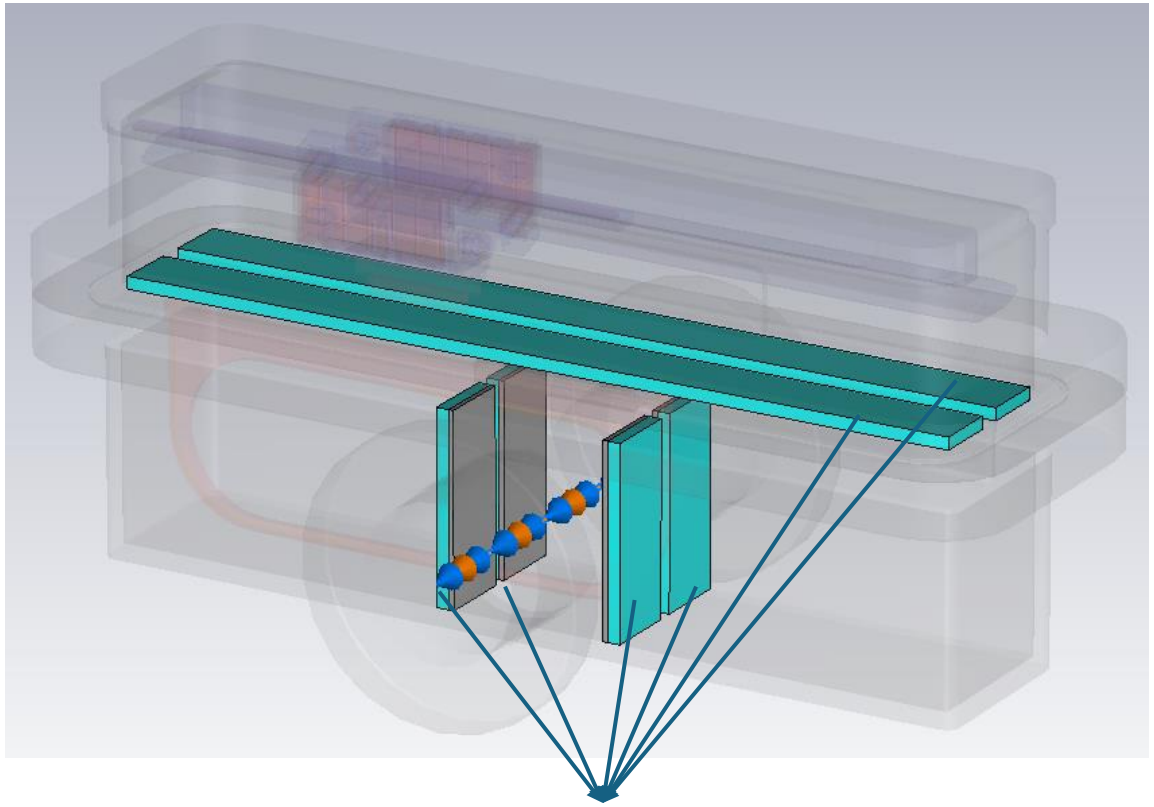
Mode #5 –> 532 MHz





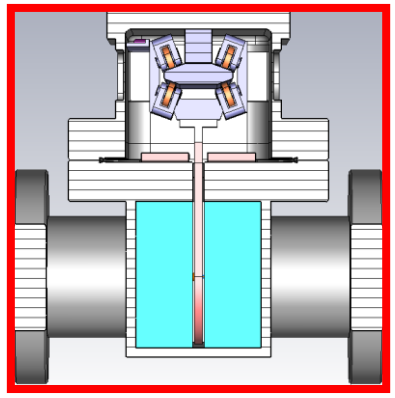
Models with Absorbers at Bottom Chamber (1)

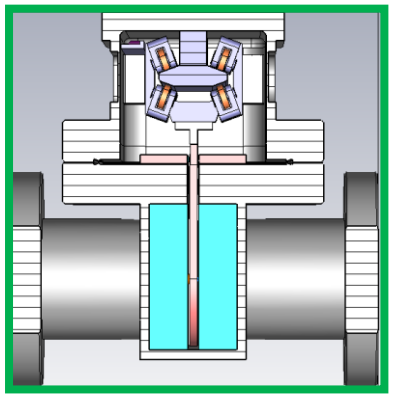


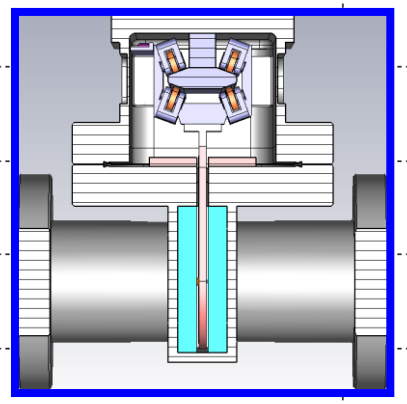


RF absorber -> 50 Ω NEG coated ceramic (5 mm thickness)

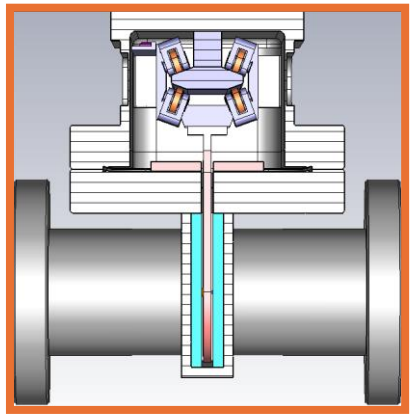
Models with Absorbers at Bottom Chamber (2)

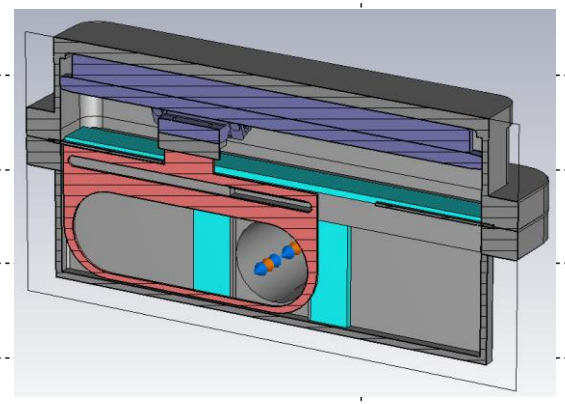




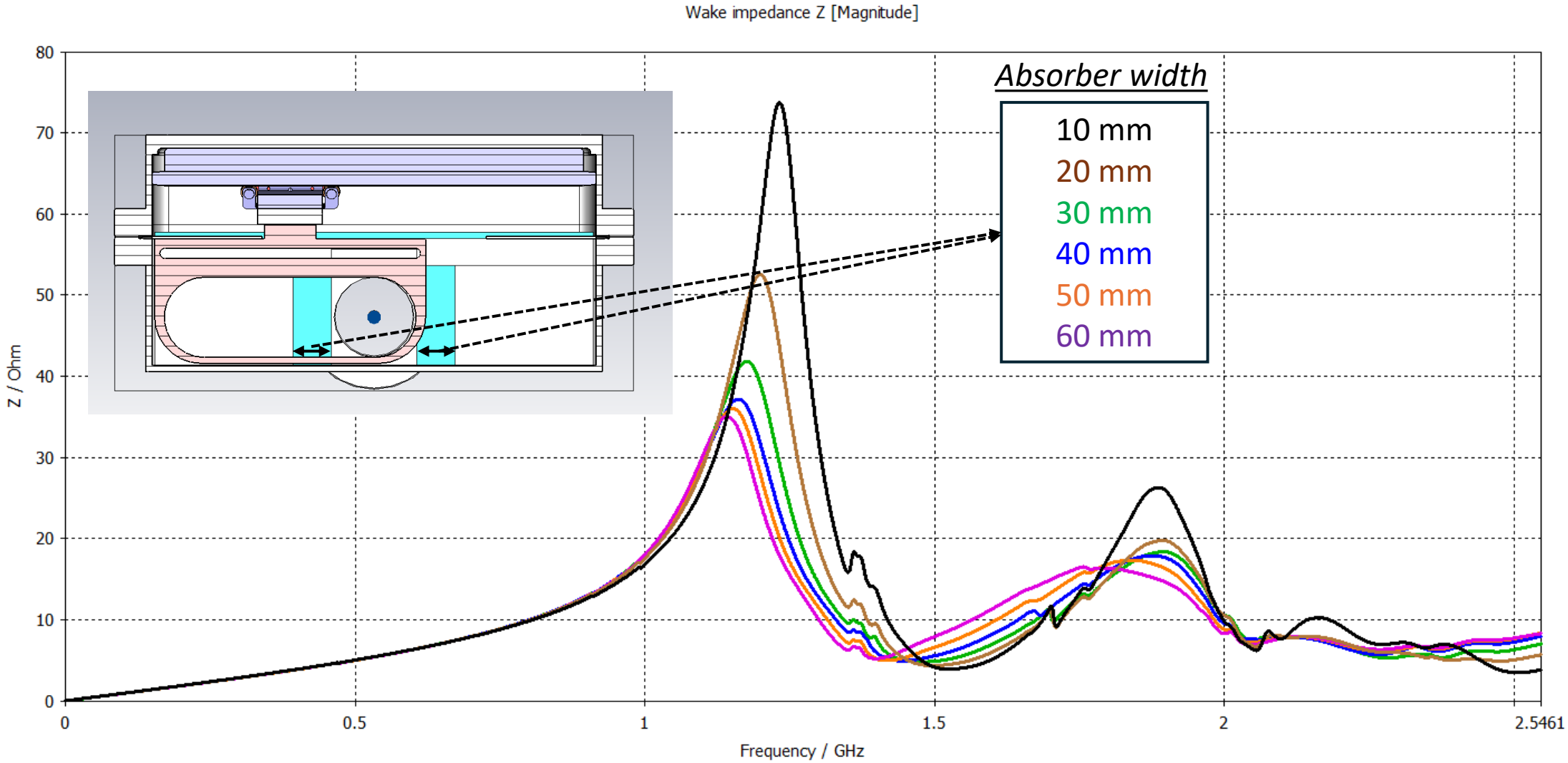


Models with Absorbers at Bottom Chamber (3)





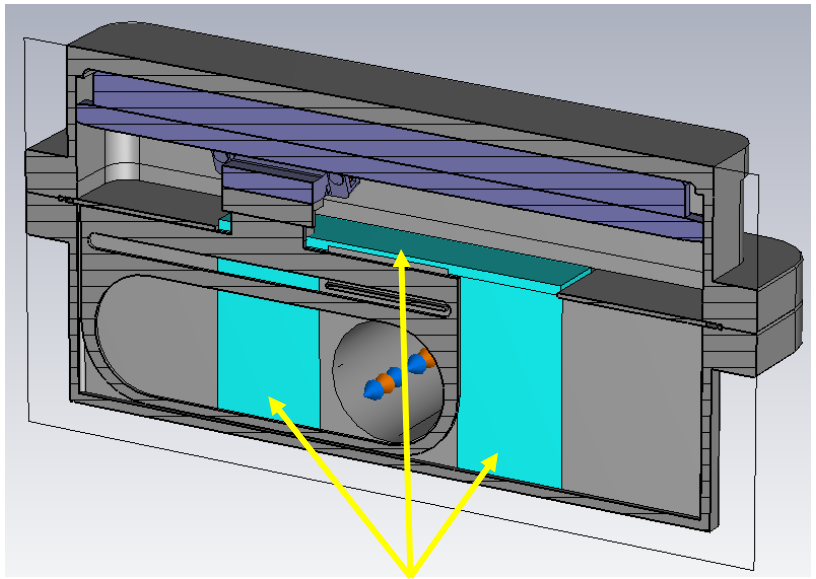
Absorber Width Change



Modified Bottom Chamber (1)

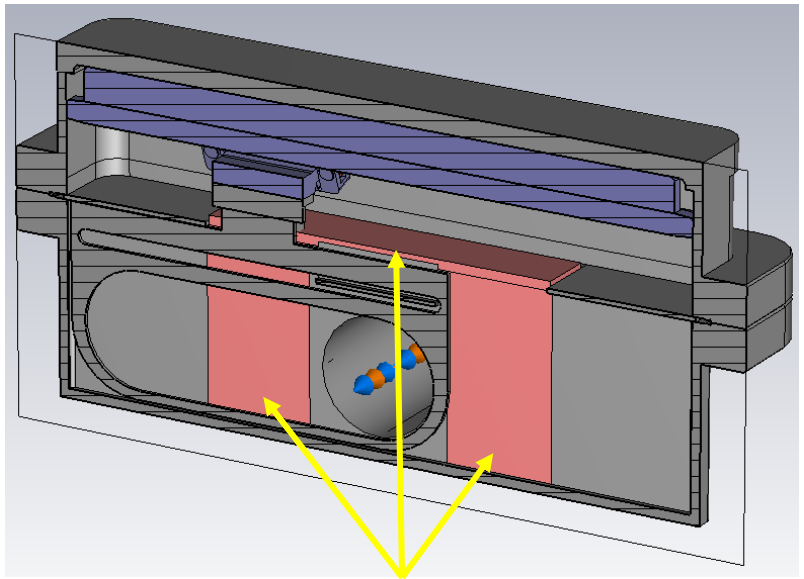
Impedance responses of modified model with different absorbers

Model with NEG coated absorbers



50 Ω NEG coated ceramic (macor)

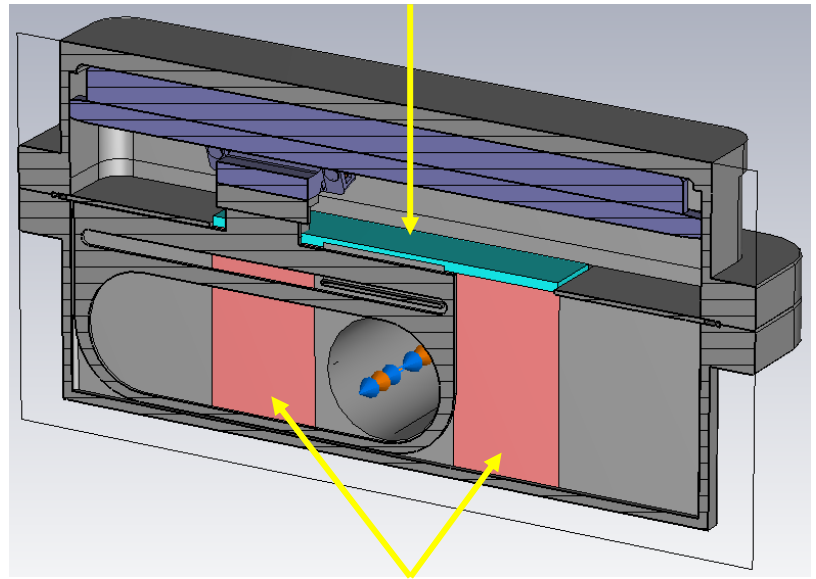
Model with ferrites



Ferrites (TT2-111 R)

Model with combined absorbers

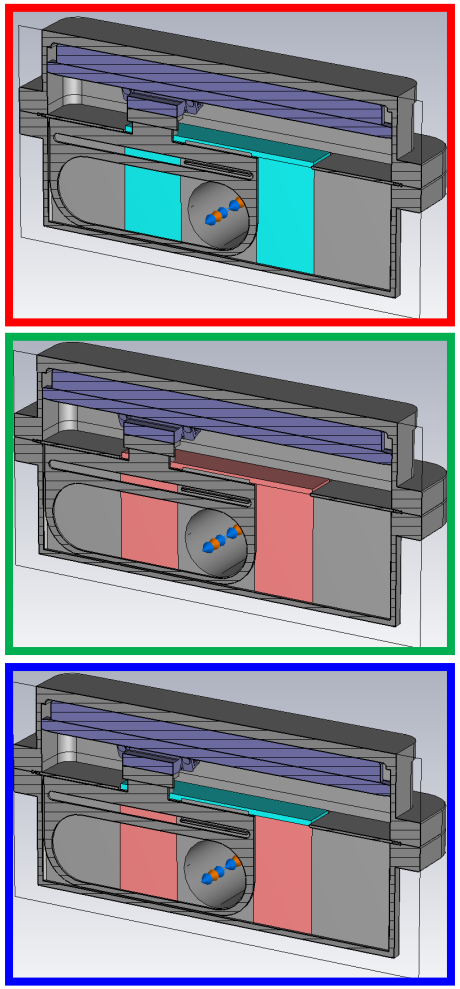
50 Ω NEG coated ceramic (macor)

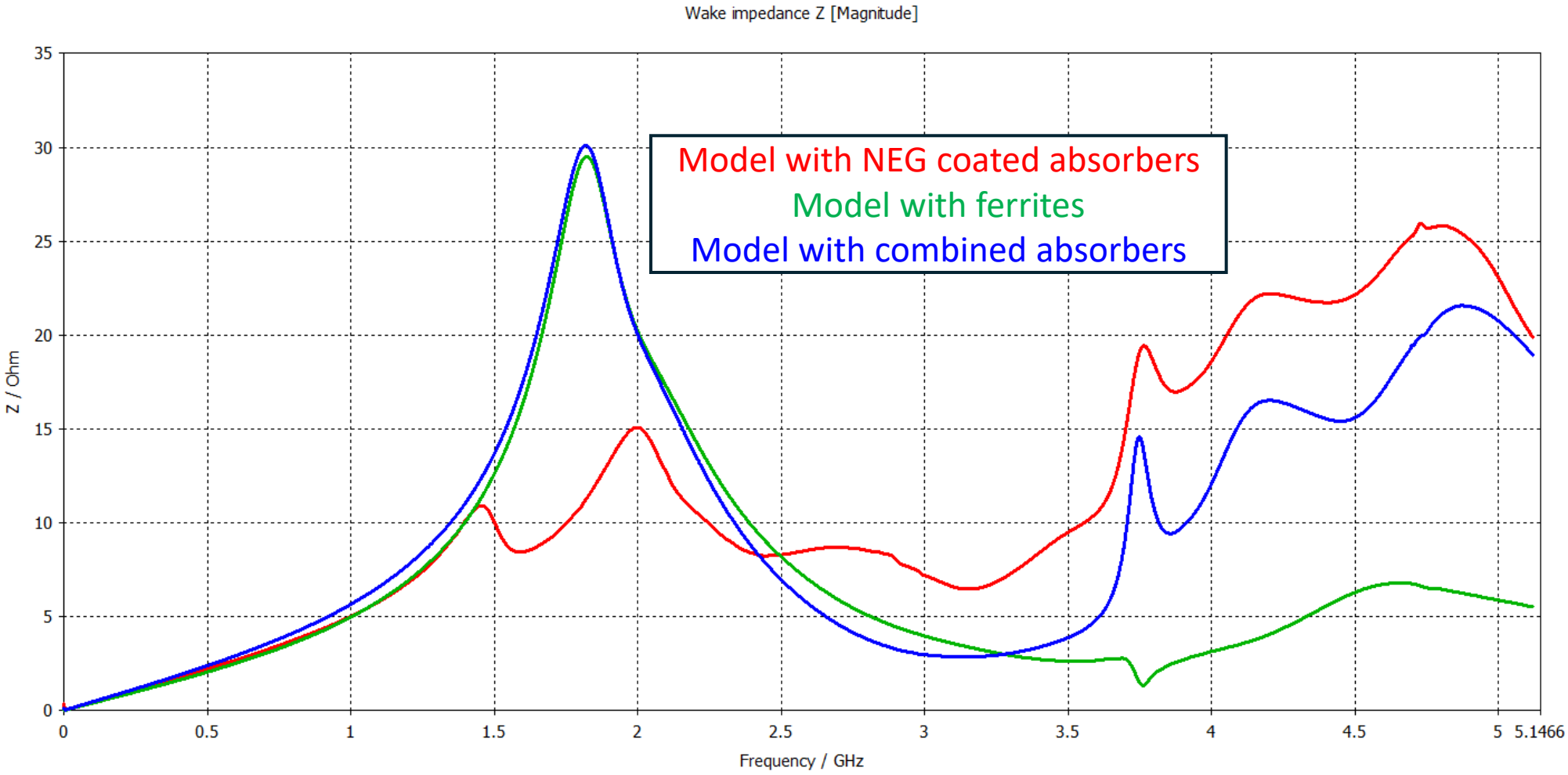


Ferrites (TT2-111 R)

Modified Bottom Chamber (2)

Impedance responses of modified model with different absorbers





Updated Model