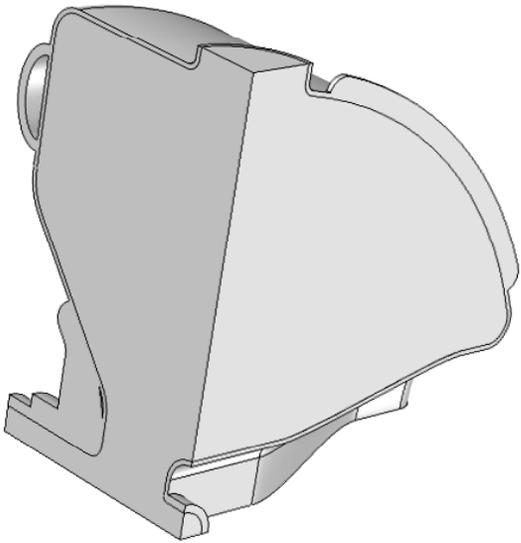


Analysis of Microphonics in SSR1 for Project-X

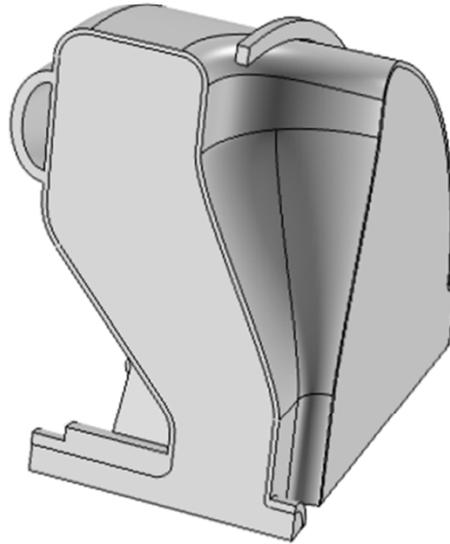
*M. Hassan, D. Passarelli, I. Gonin, S.
Barbanotti, L. Ristori, and S. Yakovlev*

9/27/2011 PXIE Meeting

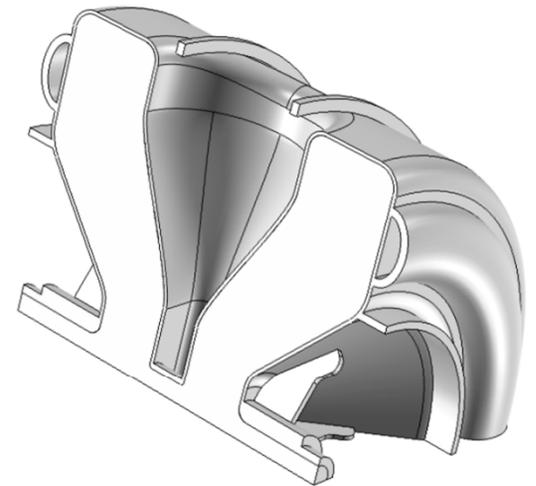
SSR1 Geometry Generations



SSR1-G1
Single Rib on Top



SSR1-G2
Double Rib on Top



SSR1-G3
Two Ribs+ Side Ring

Comsol Simulation

Electromagnetic Waves

- Solving only for the RF domain
- Applying the proper boundary conditions

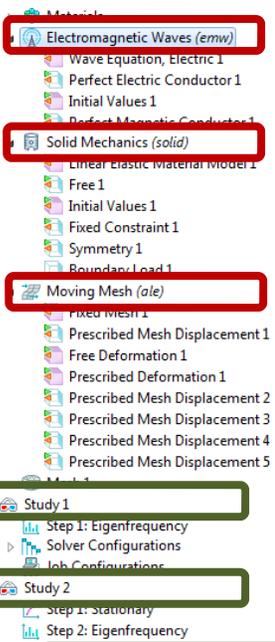
Solid Mechanics

- Solving only for the Cavity Shell
- Applying the proper fixed constraints, symmetries, displacements, and boundary load

Moving Mesh

- Solving for all domains
- Applying the proper prescribed and free mesh deformation/displacement

Three Multiphysic Modules



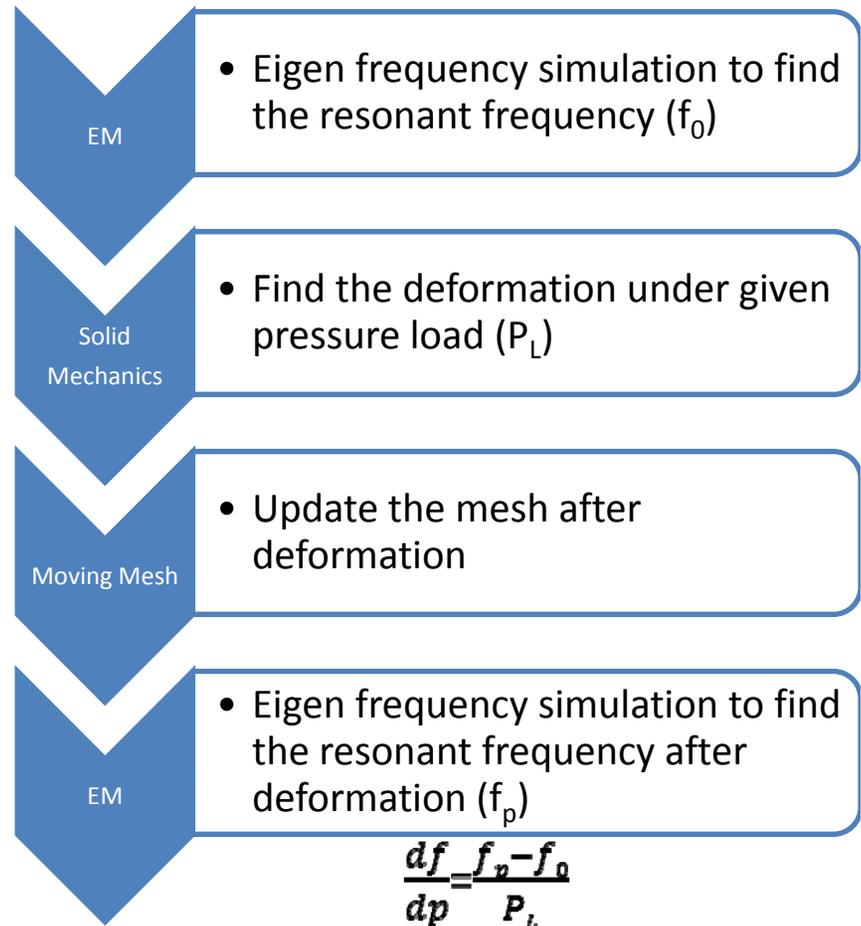
Two Simulation Studies

Study1

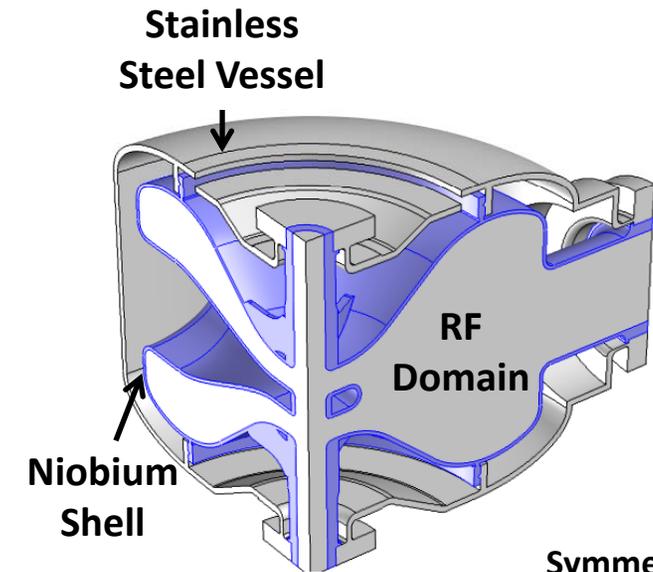
- Eigen-frequency (to find f_0)

Study2

- Stationary (solving only for solid mechanics and moving mesh)
- Eigen-frequency (to find f_p)

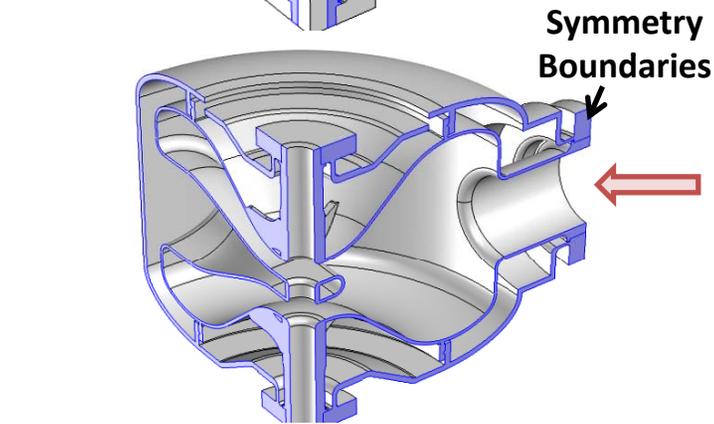
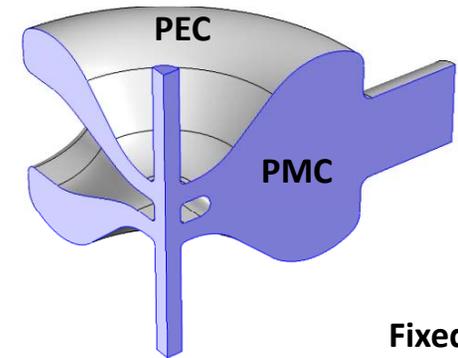


Setup



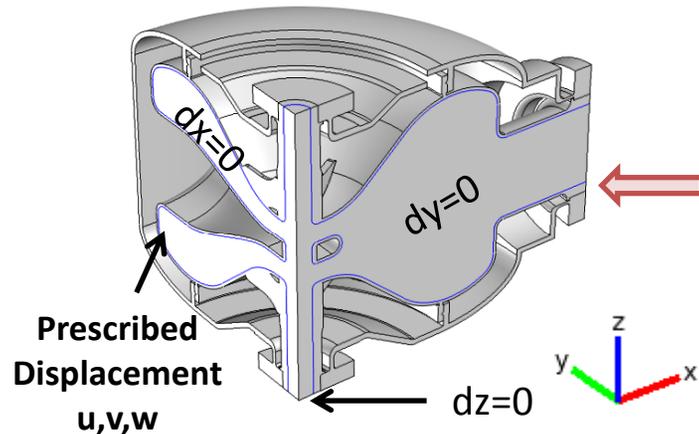
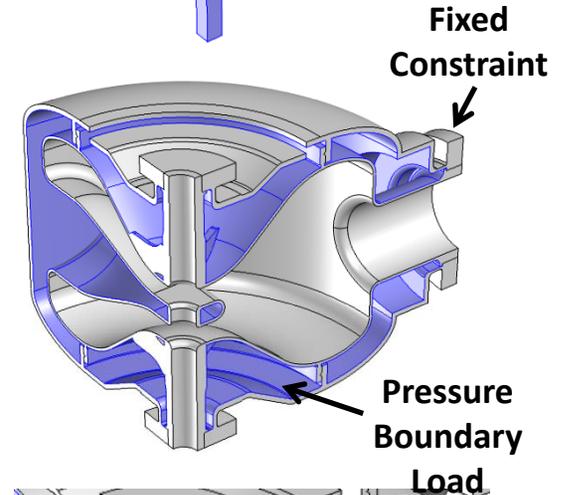
Electromagnetic Waves

- Solving only for the RF domain
- Applying the proper boundary conditions



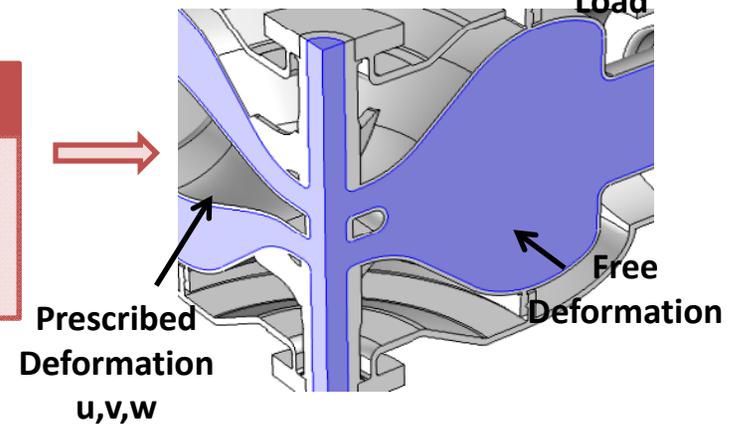
Solid Mechanics

- Solving only for the Cavity Vessel
- Applying the proper fixed constraints, symmetries, displacements, and boundary load



Moving Mesh

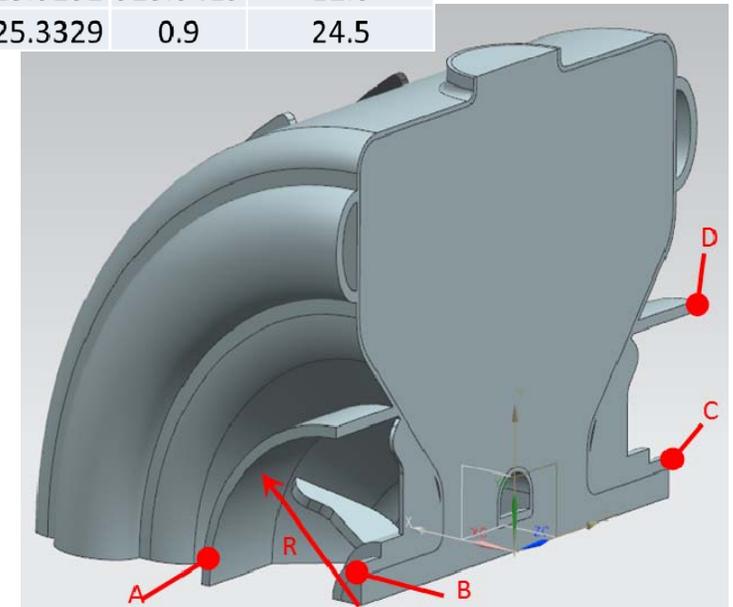
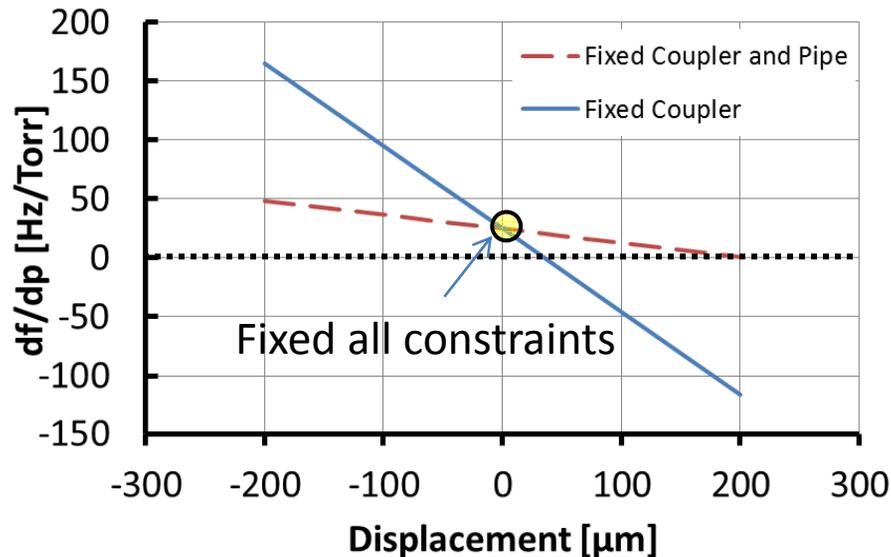
- Solving for all domains
- Applying the proper prescribed and free mesh deformation/displacement



Investigation of the displacement effects on SSR1-G3

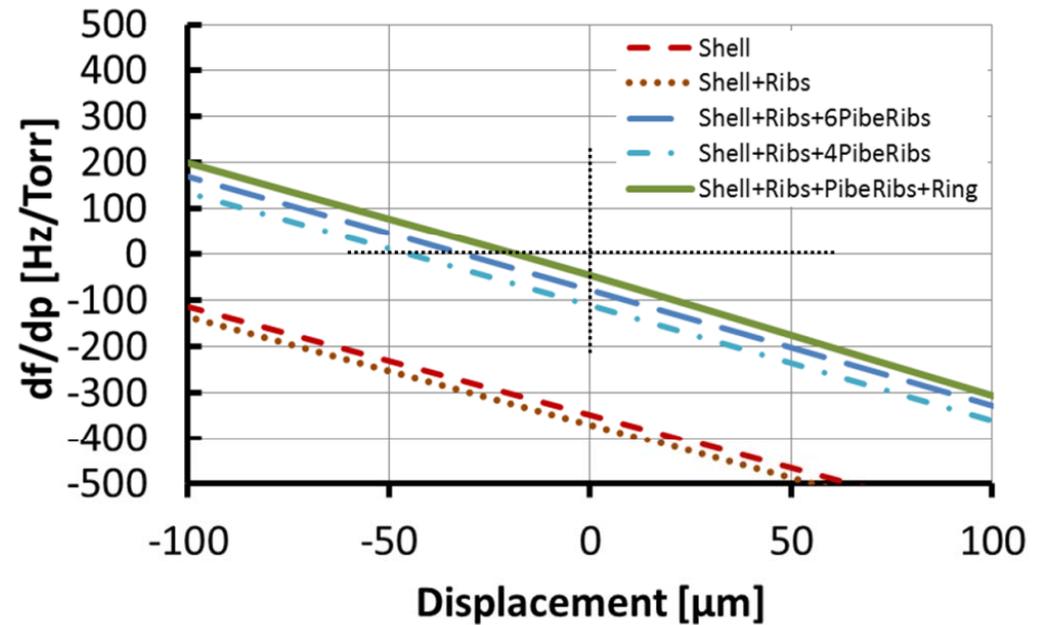
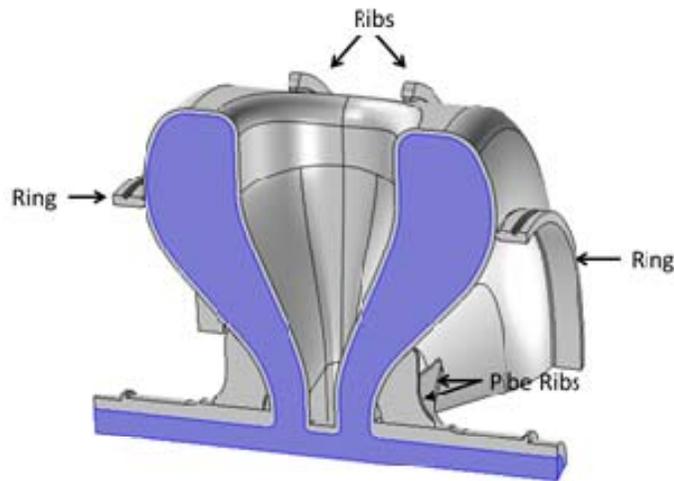
Fixed Beam Pipe Constraints

Constrains (A,B,C,D)	Effective Displacement	f_0 [MHz]	f_d [MHz]	f_p [MHz]	df/dp [Hz/Torr]
A=-100um D=+100um; B,C: fixed	-200 μm	325.3361	325.354	325.3728	48.3
A=-50um D=+50um; B,C: fixed	-100 μm	325.3361	325.3451	325.3639	36.6
A, B,C, D: fixed	0	325.3399	N/A	325.3588	25.2
A=50um D=-50um; B,C: fixed	100 μm	325.3322	325.3232	325.3419	12.8
A=-100um D=+100um; B,C: fixed	200 μm	325.3143	325.3329	0.9	24.5



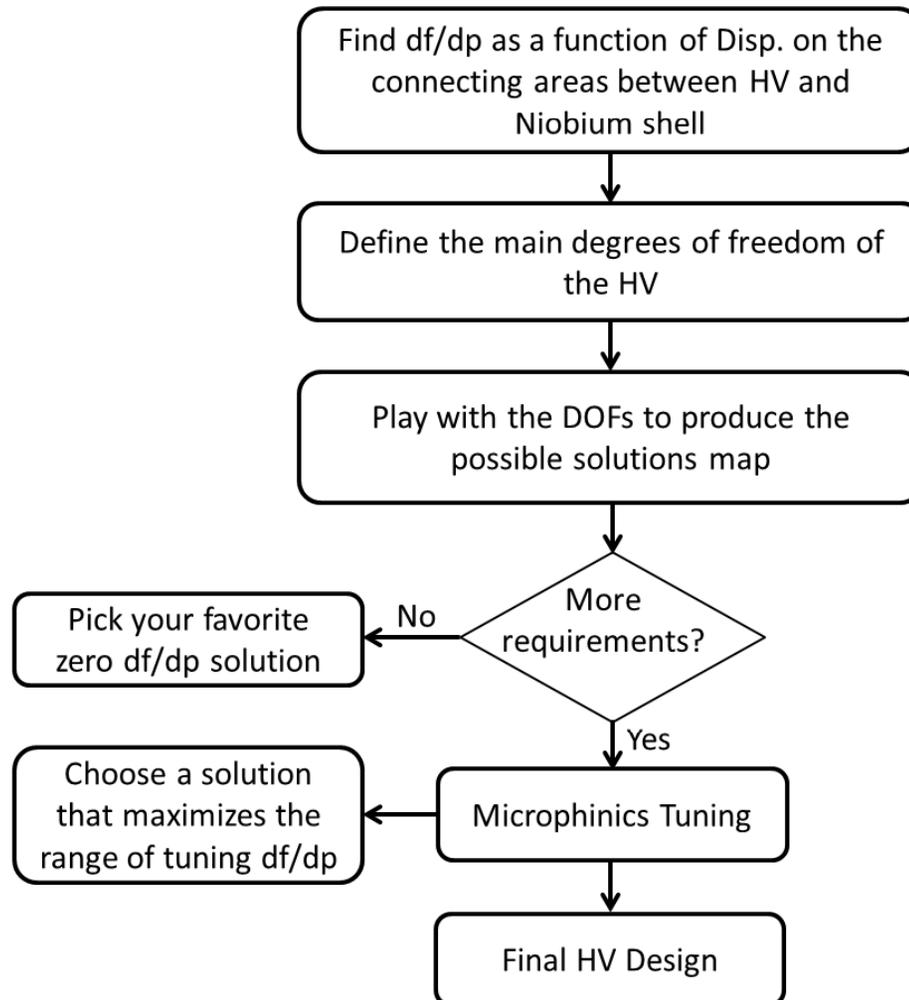
- Different constraints would imply another linear relation with different line slope that passes through the fixed all constraints point
- The larger the slope of the linear relation the better as it would get the zero df/dp closer from the fixed all constraints point

Lessons from SSR0

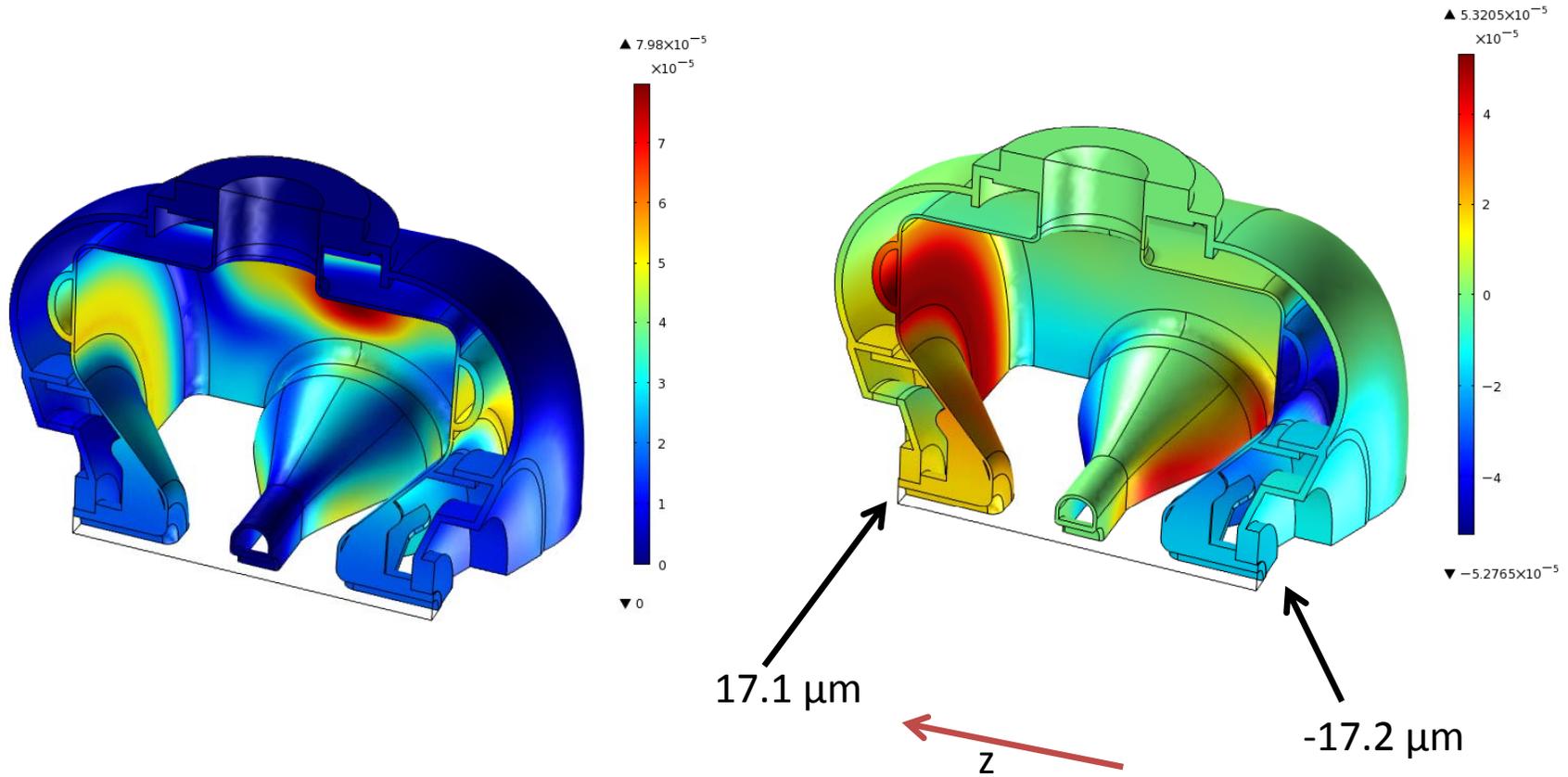


- Pipe Ribs are very important to reduce df/dp
- Ring between the shell and the Helium vessel would simplify the vessel design

Design procedure to minimize df/dp



SSR1-G3 with Helium Vessel



Comsol 131702
 $f_0=325.3295\text{MHz}$
 $f_1=325.3332\text{MHz}$
 $df/dp \sim 4.9\text{ Hz/torr}$

Conclusion

- Microphonics of SSR1 has been reduced to about 5Hz/Torr
- A general procedure for minimizing the microphonics in spoke cavities has been proposed
- What is next?