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Coaxial Resonators for Fundamental Study

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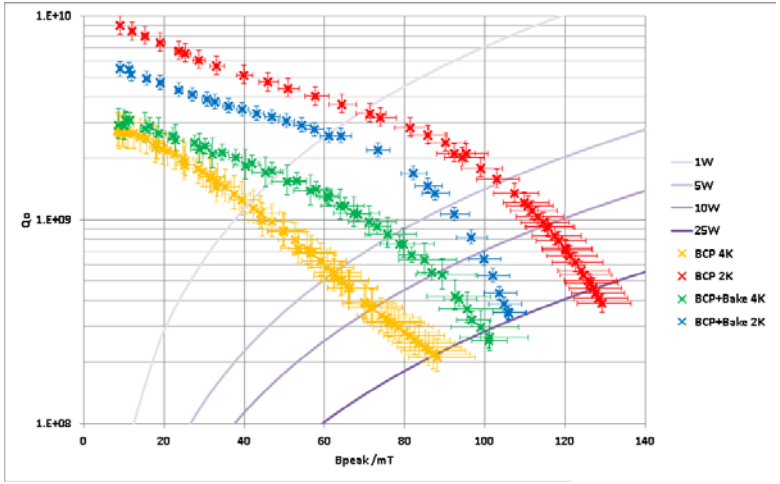
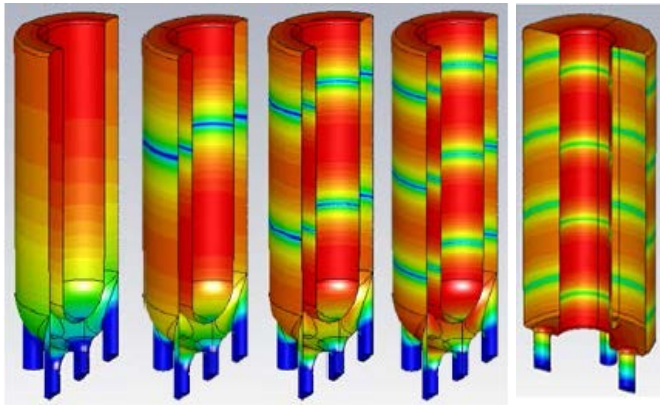
Outline

- Introduction
- Design Requirements
- Cavity Design
- RF ancillaries
- Outlook

Outline

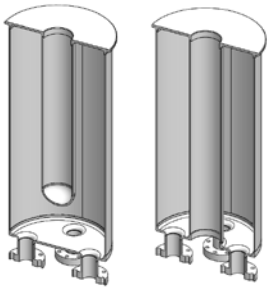
- Purpose
  - Study the medium field Q-slope in low β resonators.
  - What is the role of rf frequency on field dependent resistance
  - What are optimum treatments
- Method
  - Use coaxial test resonators to measure rf performance at different harmonics for the same test cycle
  - Investigate field dependent surface resistance as a function of frequency, temperature and treatments, including heat treatments and doping





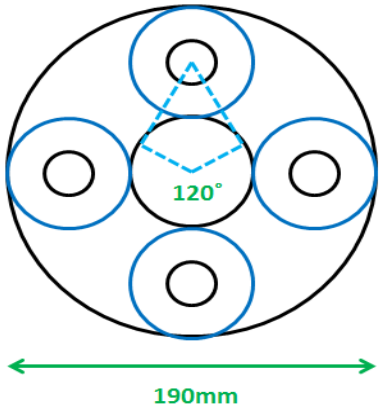
Design Requirements

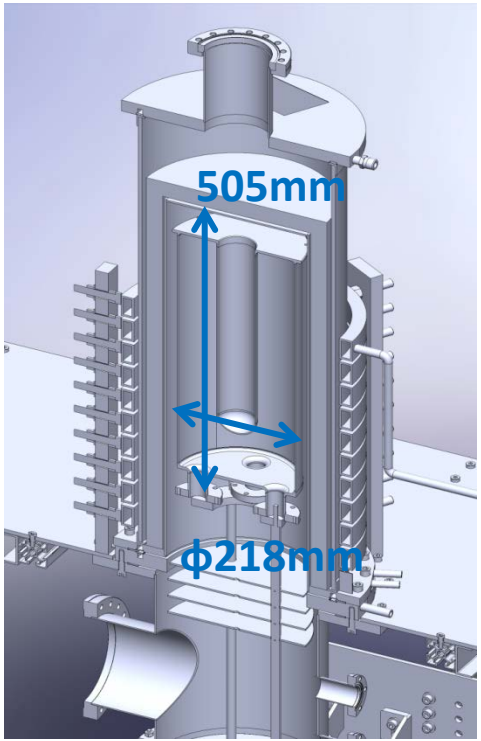
- The cavities are designed as the coaxial equivalent of a 1.3GHz single cell cavity for TEM R&D
- TRIUMF has an rf induction oven for experimental heat treatments – the oven is sized to host 1.3GHz single cells and the new coaxial test cavities
- Uniform inner conductor is required.
  - A common T-map insert can be employed to characterize the surface losses locally in addition to the global Q-measurement.
- The design is simplified.
  - No beam ports, cavity jacket, nor stiffeners
  - Require cleaning ports for BCP and HPR



General Design

- Cavity dimensions
  - QWR Φ200x470mm
  - HWR Φ200x449mm
- Inner conductor
  - Cylinder geometry
  - Ellipsoid cap for QWR
- Cleaning ports
  - HPR can cover the entire RF surface
  - Will be used for BCP
  - Will be used as RF ports for test



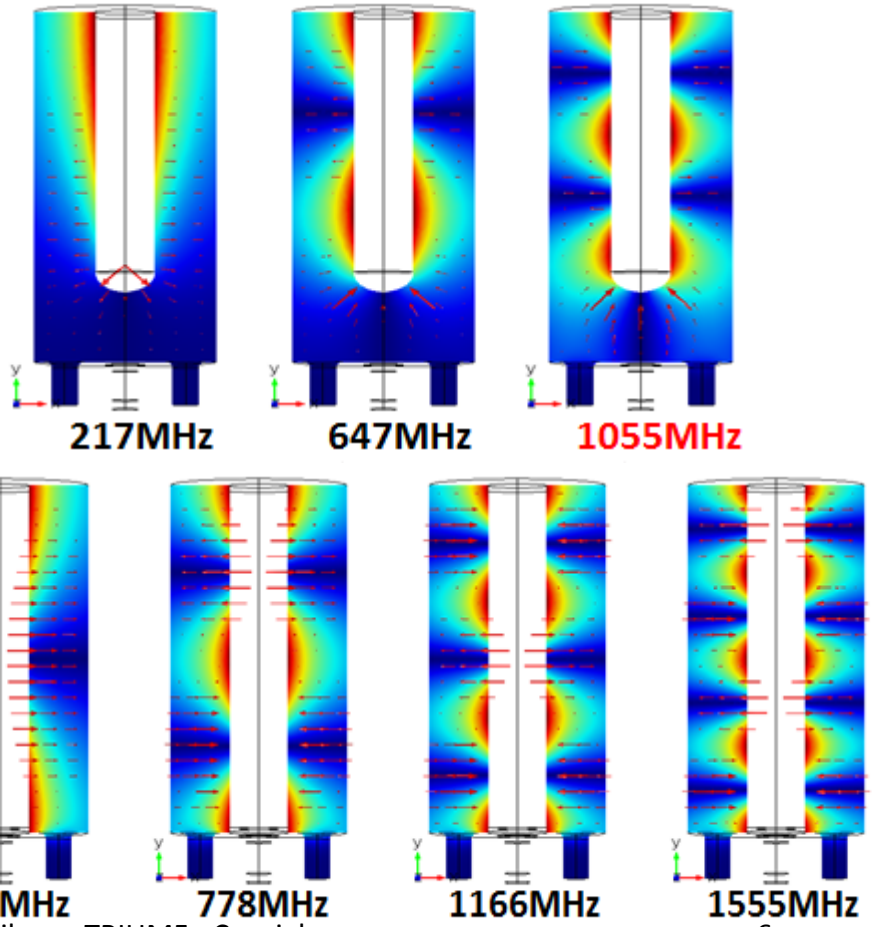


Coaxial Cavity in Oven

Lowest Modes

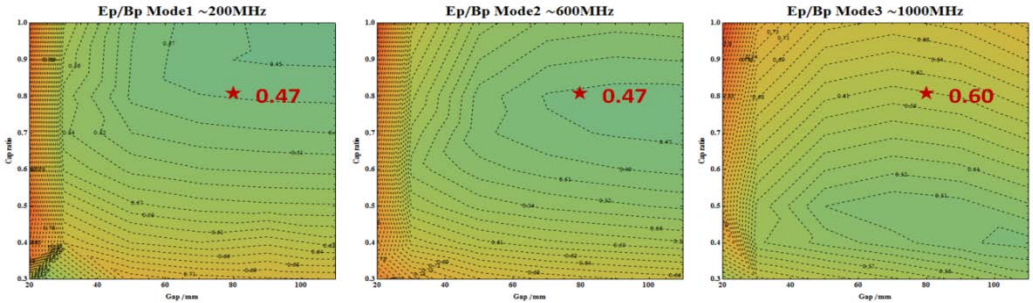
This geometry gives a lower frequency range of 200MHz for the QWR and 400MHz for the HWR

Mode\Freq	QWR	HWR
1	217	389
2	647	778
3	1055	1166
4		1555

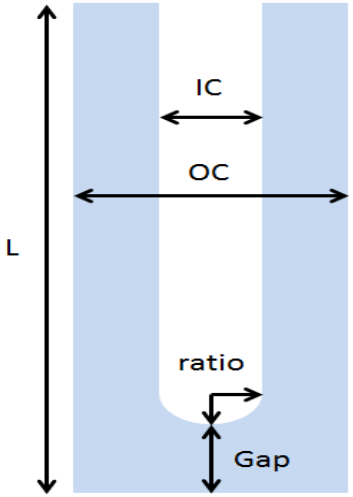


Lowest Modes

- Critical dimensions are swept to reduce Ep/Bp for the 2 lowest QWR modes
- Peak field ratio (E_{peak}/B_{peak})
  - QWR
    - Ep/Bp=0.47MV/m/mT for 200MHz and 600MHz modes

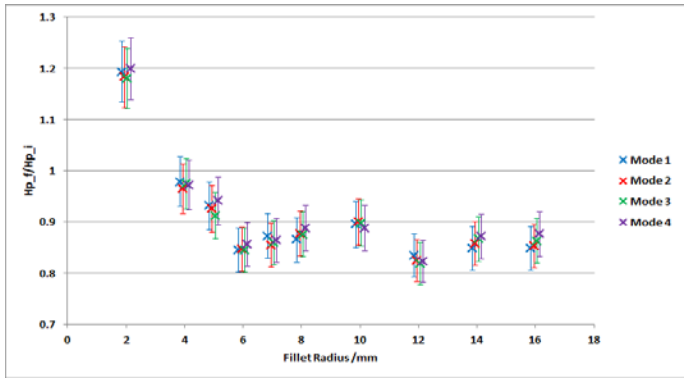


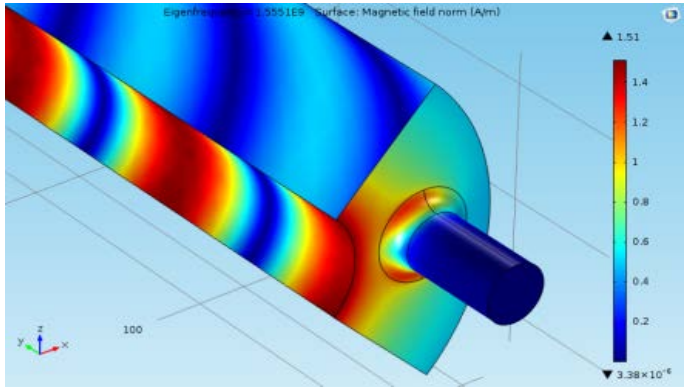
  - HWR
    - Ep/Bp=0.3 MV/m/mT as theoretical value



IC=60 mm
OC=180 mm

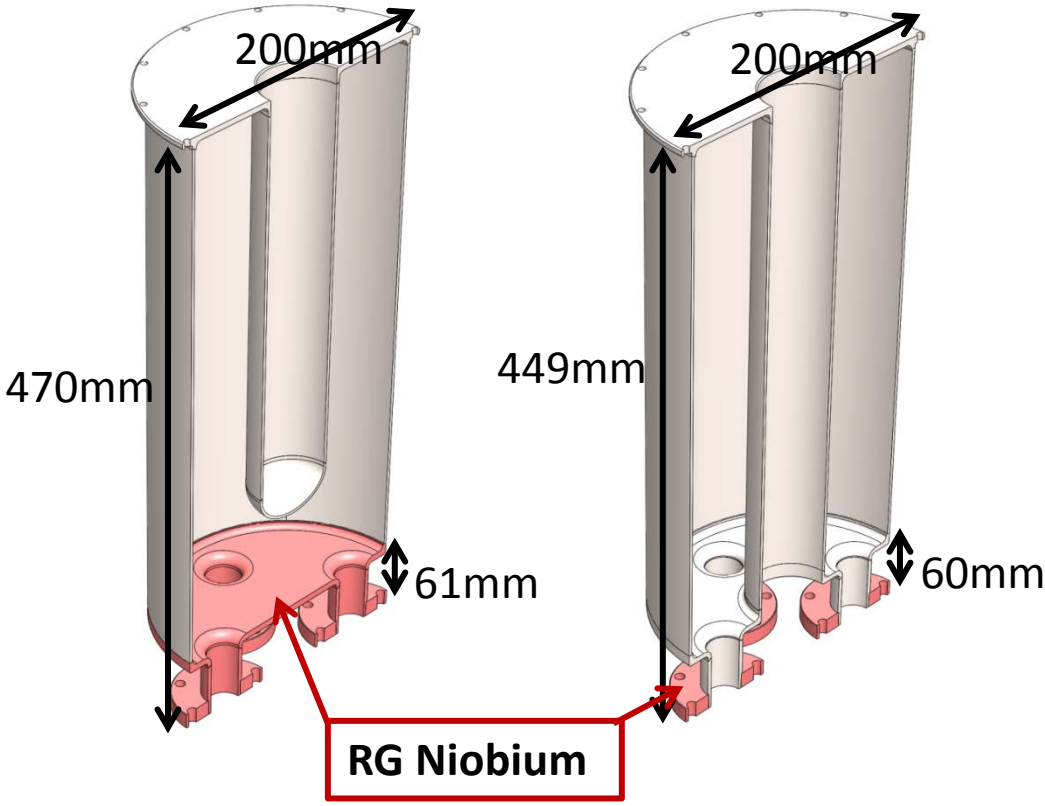
- Avoid local field enhancement (HWR)
- Reduce power loss on SS blanks (HWR)
  - Extend the length of ports
  - The ratio of power losses on SS blanks and niobium is 1% or less for all TEM modes
- Modes separation (QWR & HWR)
  - The minimal difference is 38MHz for 3rd TEM mode and lower TE112 mode in HWR



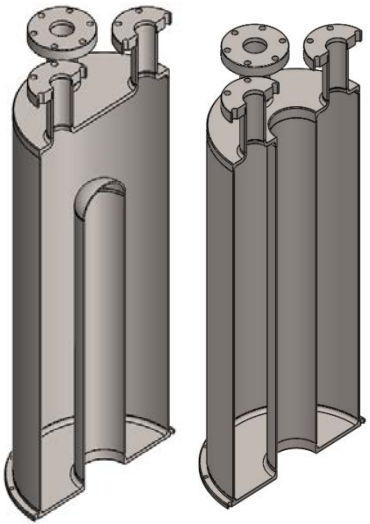


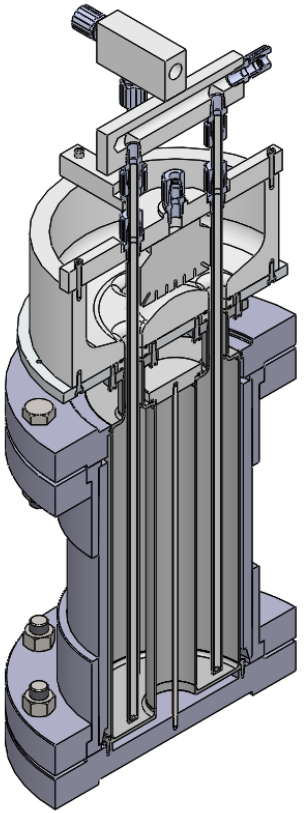
Fabrication

- All Niobum structure with reactor used in low loss areas to reduce cost
- Cavities fabricated at Ningxia

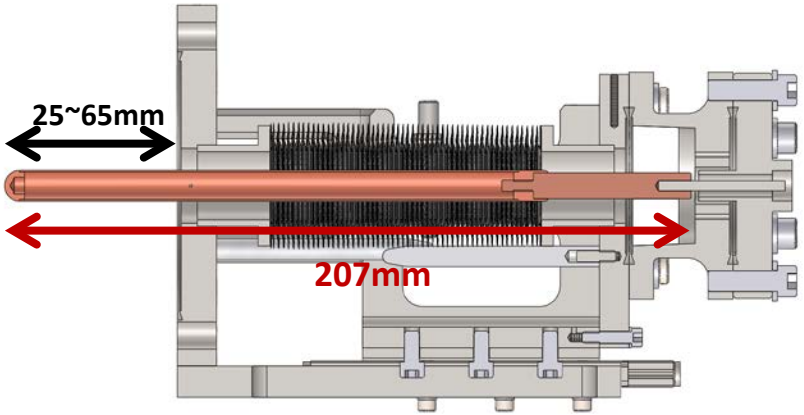


BCP fixtures are now prepared with etching to begin next week

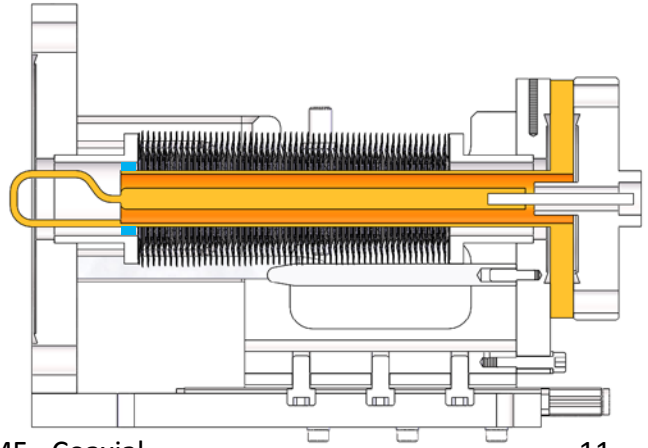




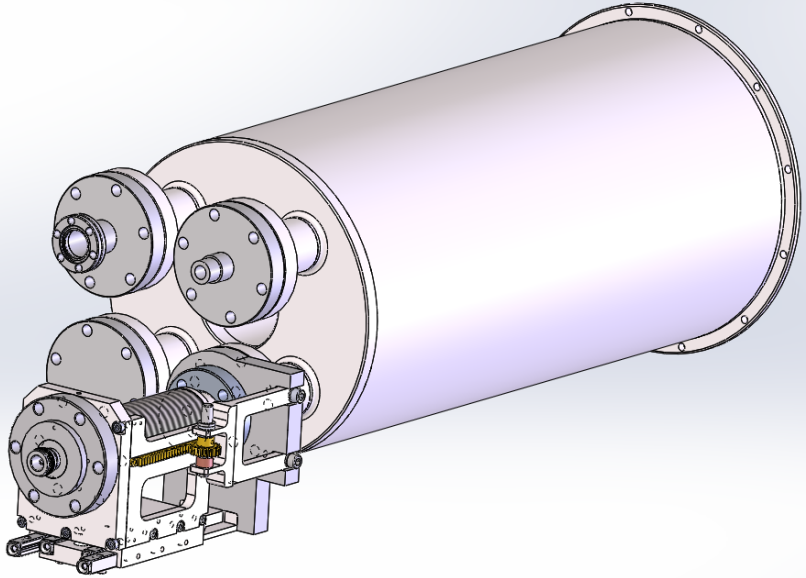
Two new variable rf couplers have been prepared and are being assembled.

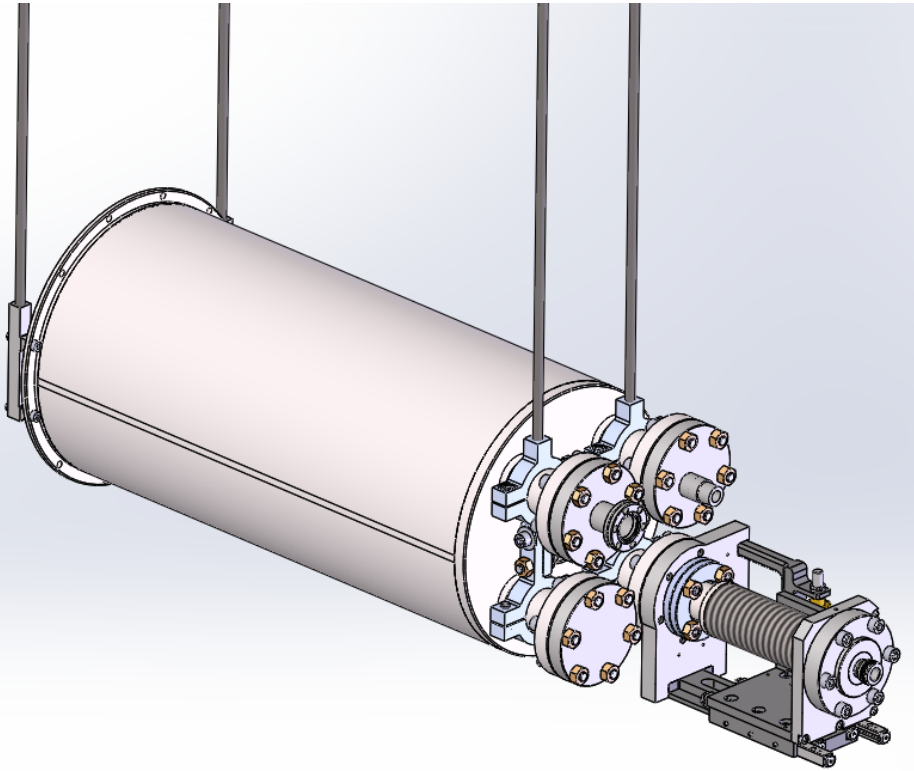


Antenna for QWR and loop for HWR



Cold test fixtures are in hand

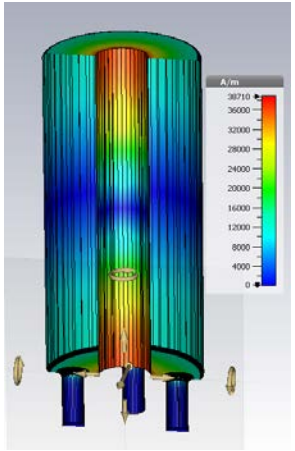


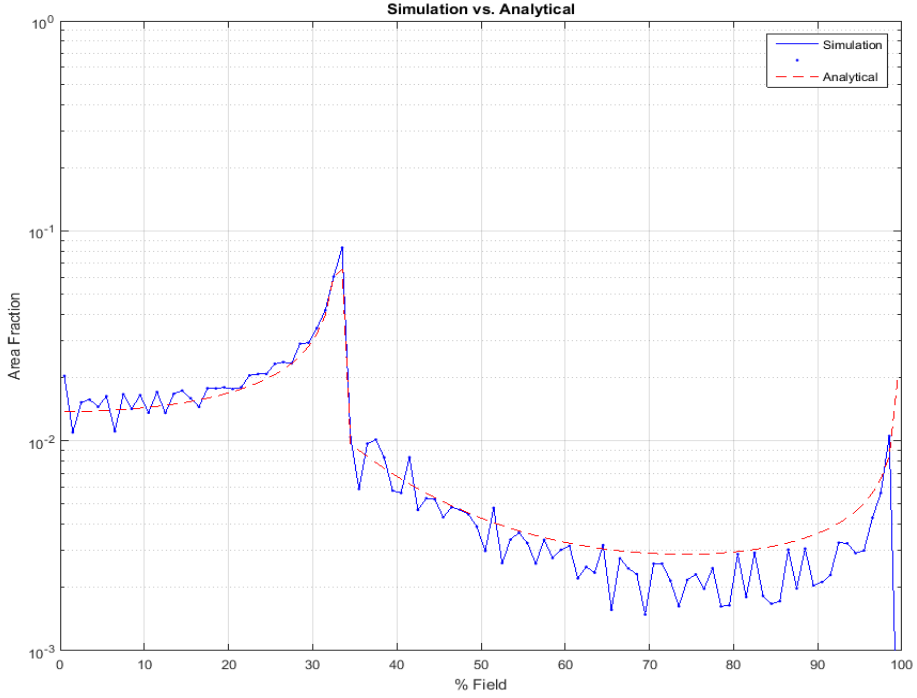


Extracting Rs(B)

- Coaxial resonators have a wide distribution of magnetic field amplitude across the rf surface

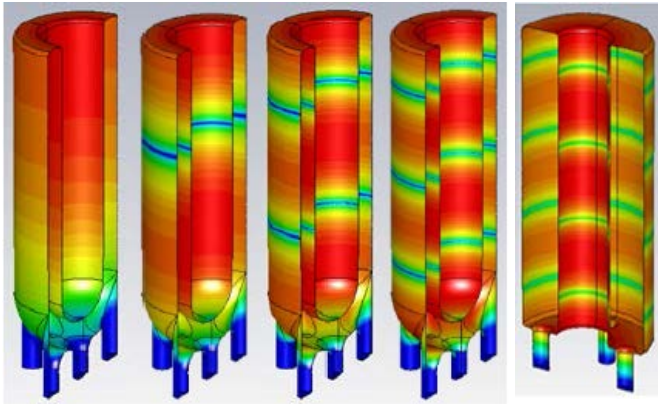
- This has to be taken into account when extracting Rs(B) from Q measurements (details of distribution will vary slightly from mode to mode in QWR)





Summary

- Coaxial cavities have been fabricated and our being prepared for first cold test next month
- Goal is to test the cavities at the fundamental and higher harmonics to characterize field dependent rf losses as a function of rf frequency
- A UHV rf induction oven is now available for heat treatment studies



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Thank you!
Merci!

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Resonate Frequency

Mode	Frequency /MHz	Mode Type
1	**217**	TEM
2	**647**	TEM
3	892	TE111
4	1055	TEM
5	1103	TE112
6	1361	TEM*
7	1400	TE113
8	1600	TE211
9	1604	TEM*

Mode	Frequency /MHz	Mode Type
1	**389**	TEM
2	**778**	TEM
3	905	TE111
4	1128	TE112
5	**1166**	TEM
6	1424	TE113
7	**1555**	TEM
8	1602	TE211
9	1738	TE212