Double Quarter Wave Crab Cavity
–higher order modes

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on behalf of the DQWCC team
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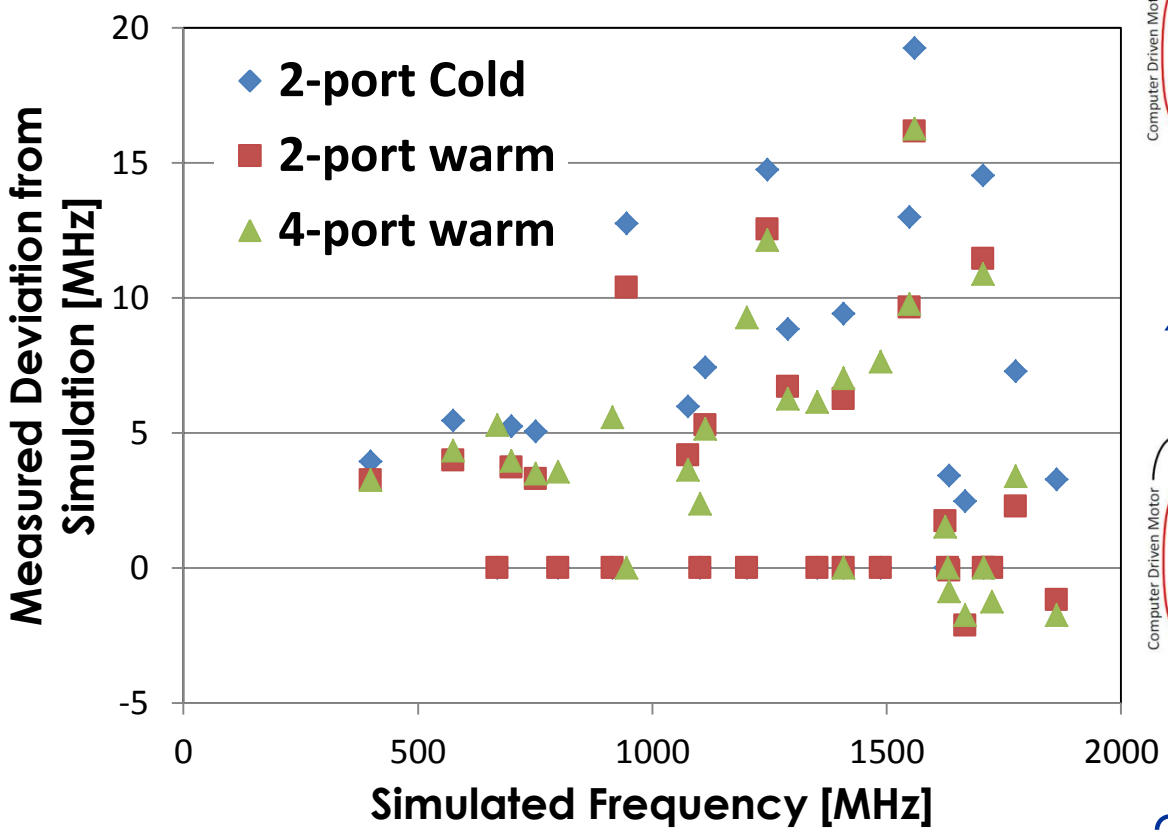
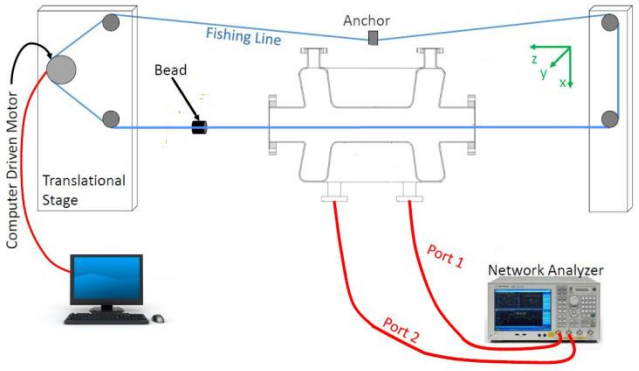
Outline

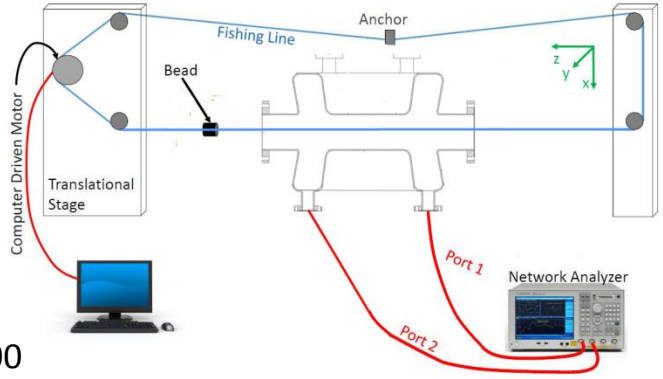
- PoP
  - HOM
  - Beadpull for HOM
- SPS
  - Vertical version
  - Issues with vertical version
  - L-shape version
  - Integration to the cavity
  - HOM power for HiLumi
  - Prototype
- Summary

PoP HOM



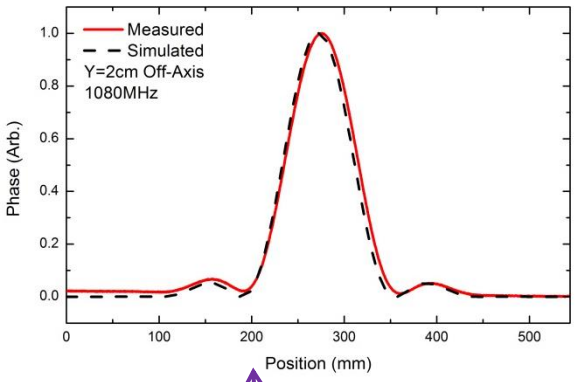


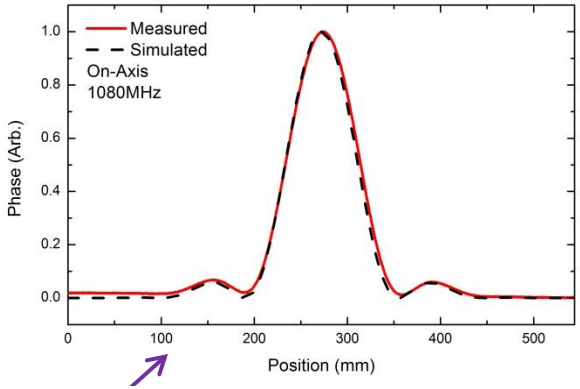
4-port configuration

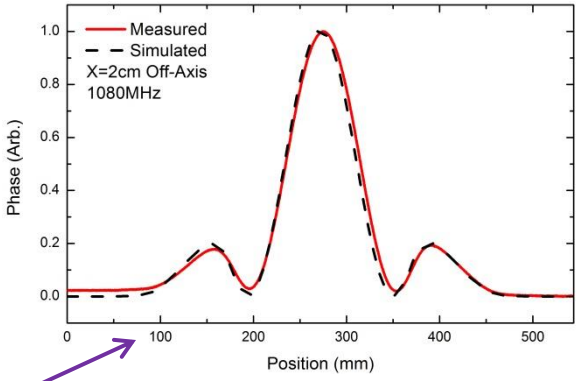


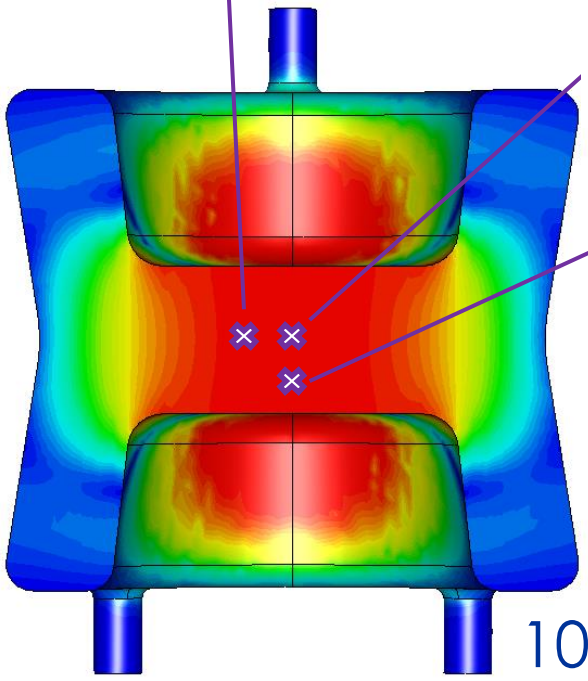
2-port configuration

PoP Bead Pulling



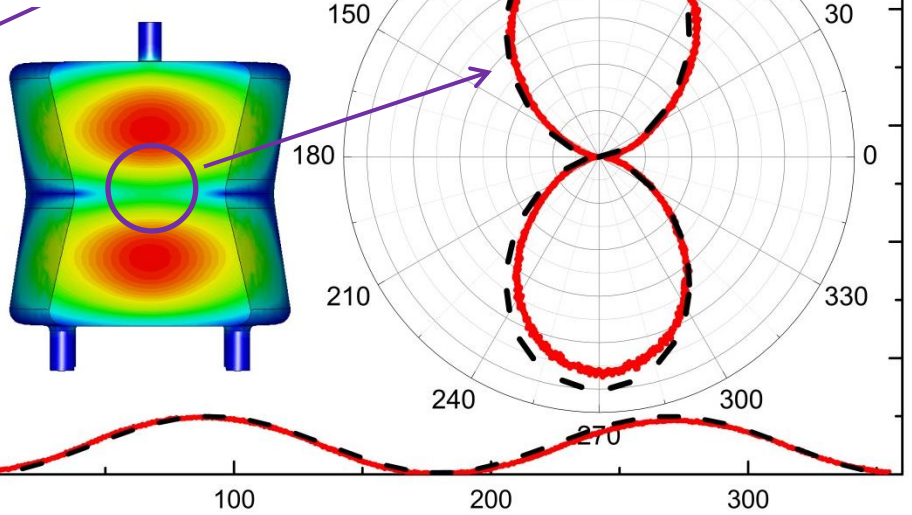






Measured

Simulated



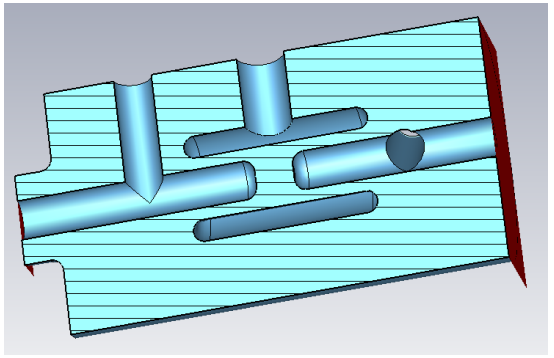
1080 MHz

@Carlos Marques

HOM System: previous version

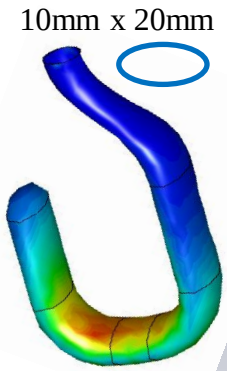
- Filter design

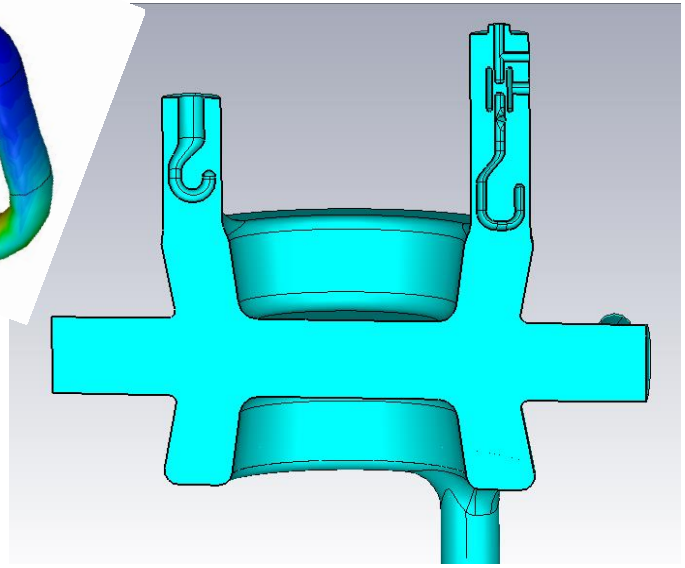
wide stop band (<80dB, several tens of MHz) at 400MHz, high pass at frequency 570MHz~2GHz



- Hook coupler design

471 Qext at 579.8MHz (1st HOM),
507 Qext at 682.6MHz (2nd HOM),
233 Qext at 697.3MHz (3rd HOM).



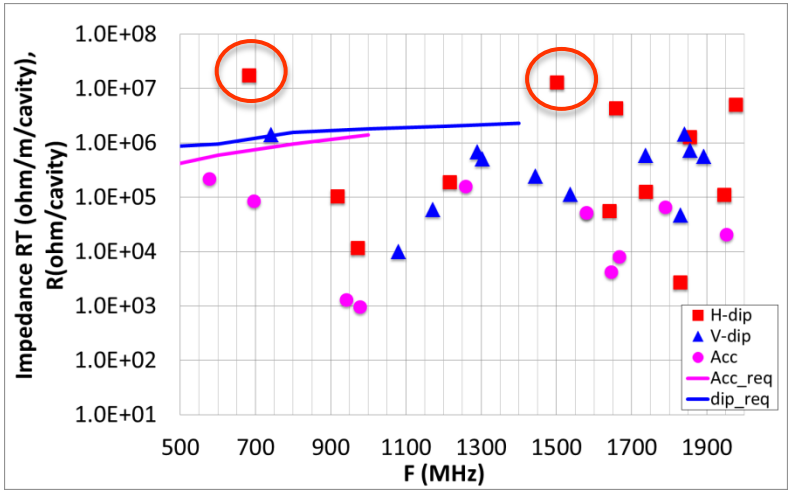


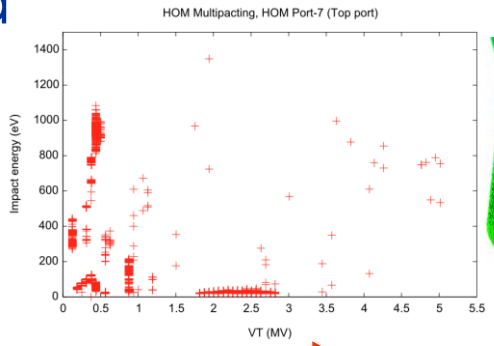
- HOM mapping

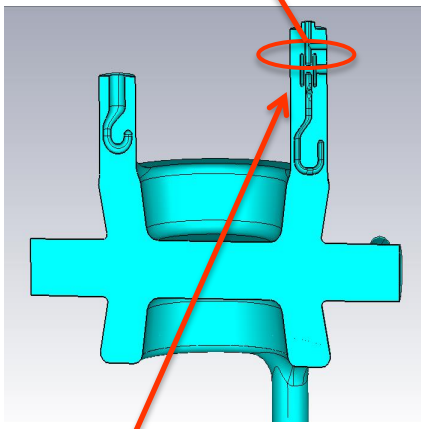
frequency, Qext, R/Q, mode configuration etc., up to 2GHz are calculated by Silvia (without filter) and Zenghai (with filter).

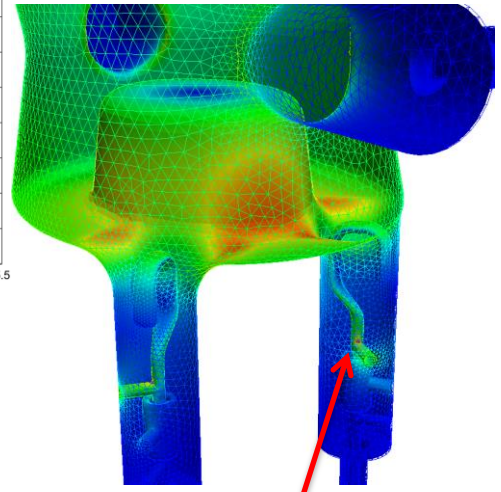
HOM System: issues with previous version

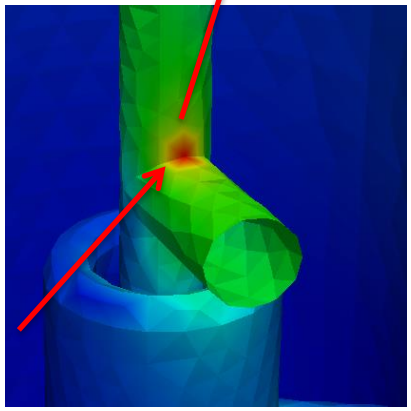
- 3cm longer than required
- Some high Qext modes
- High magnetic field area
- Possible multipacting
- Loss on the gaskets







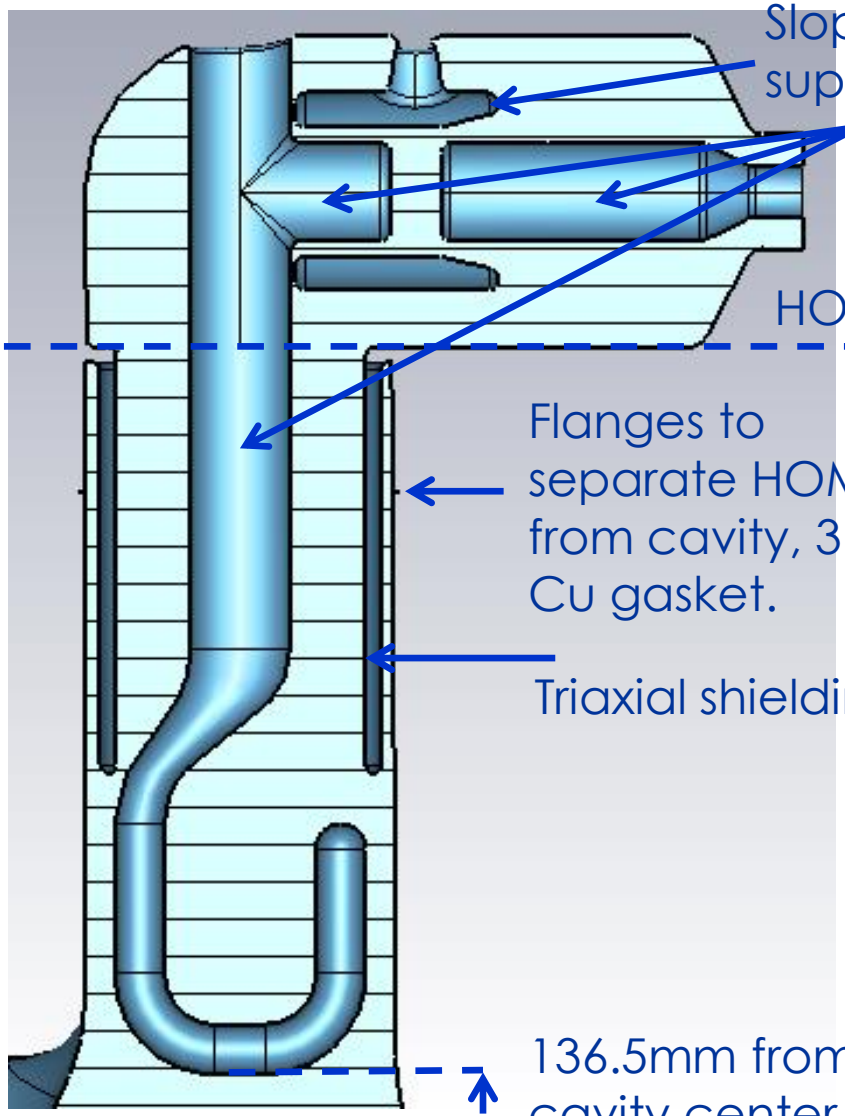


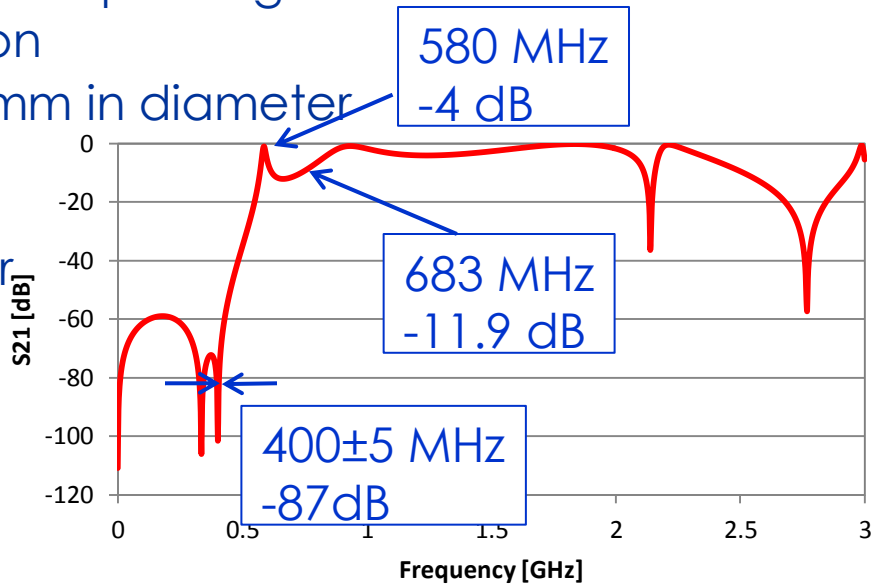


81mT@
3.4MV

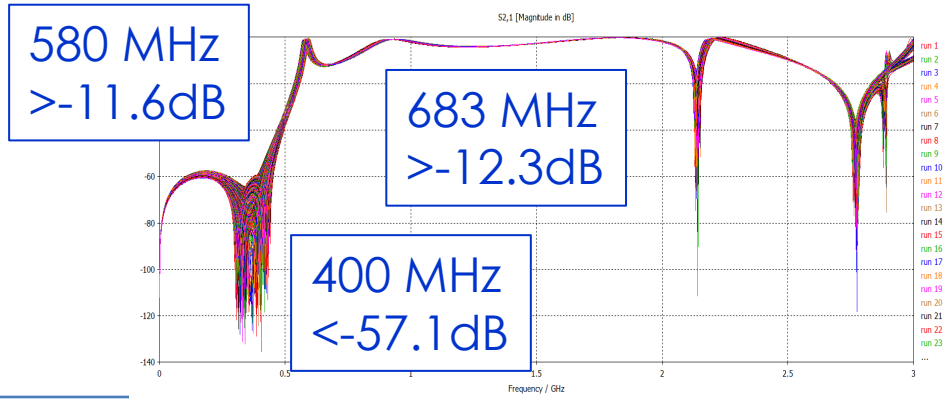
3mm thick Cu gasket
7 Watts @3.4MV

HOM System: L shape filter



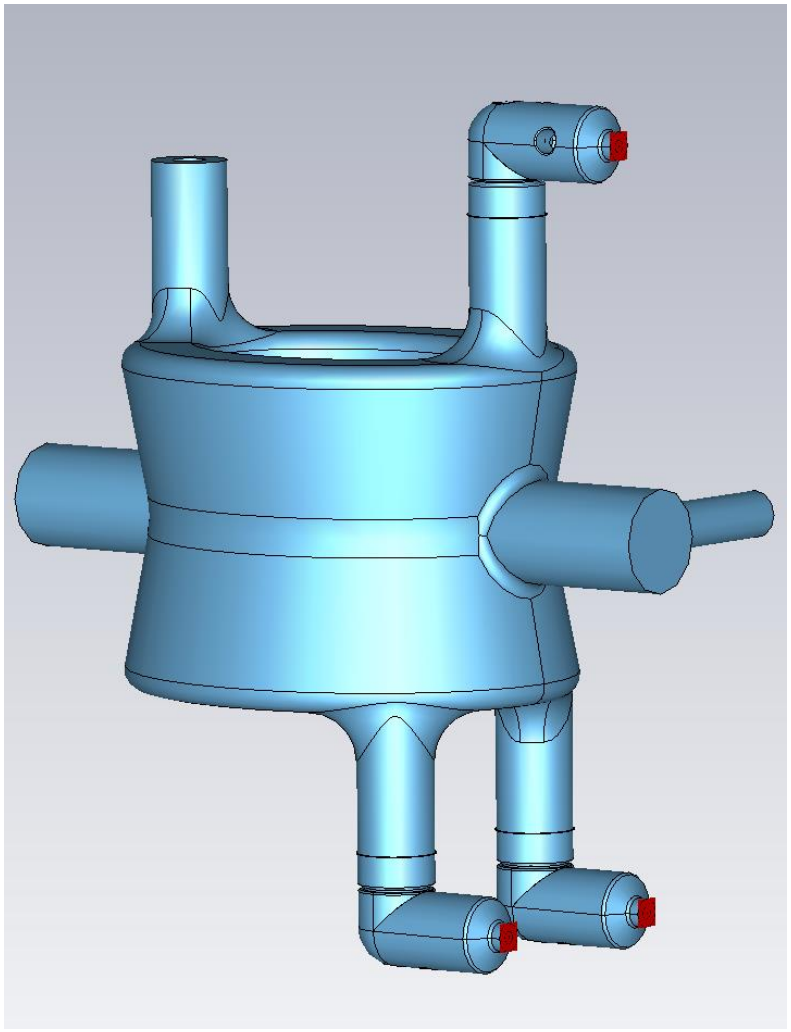


With 0.3mm assembling error and 0.1mm machining error

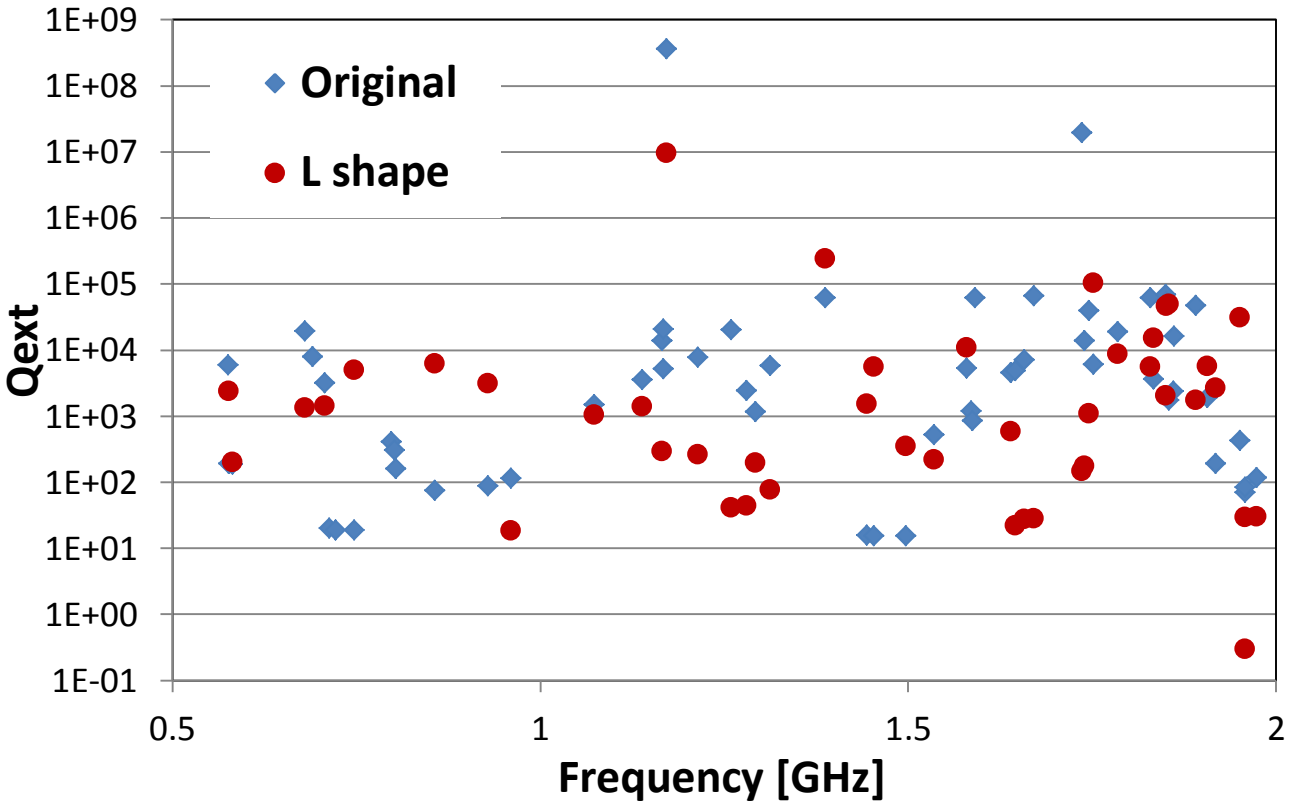


HOM System: Integration

- Compact enough to fit into cryomodule
- Peak magnetic field on HOM is 72% of that on cavity.
- Loss on the Cu gaskets: 150mW@3.34MV
- Multipacting analysis is on going



HOM System: improving coupling

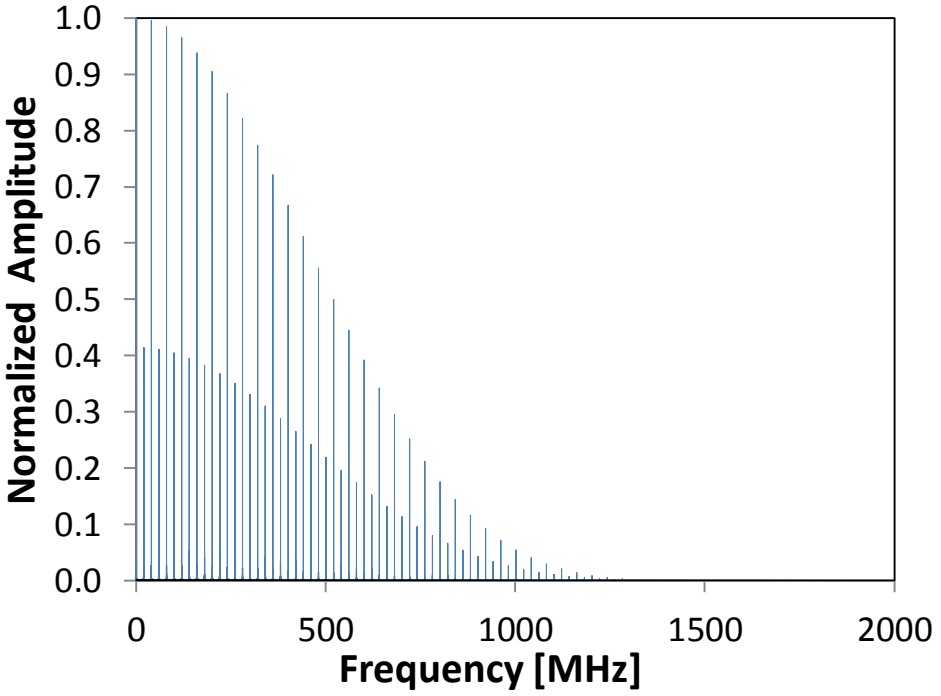


- Coupling to the HOMs is improved
- Impedance calculation will continue

HOM System: Power estimation

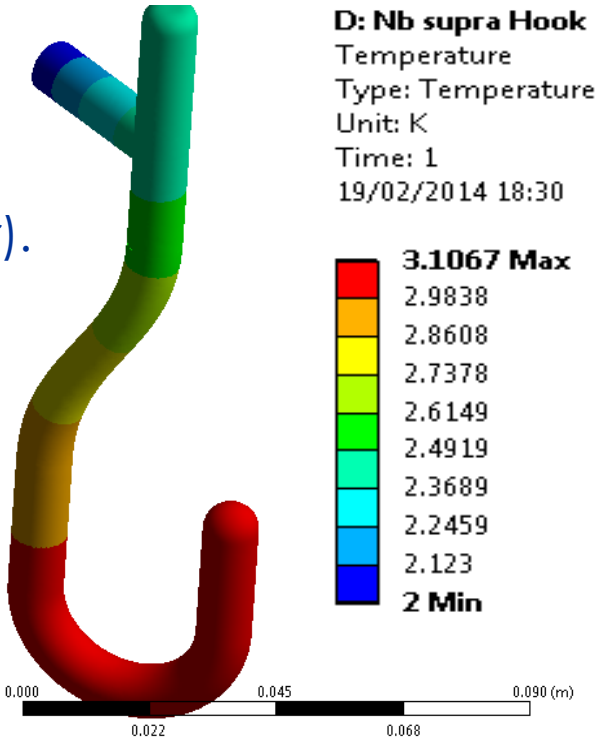
	F (MHz)	579	683	697	742	919	943	973	980
	Mode Type	m	h	m	v	h	m-shift	h-wg-mix	m
	Qext	2119	17858	7034	2422	255	124	89	124
Impedance	Longitudinal	212239		83215			1274		939
	Horizontal		1198213			5360		569	
	Vertical				91161				

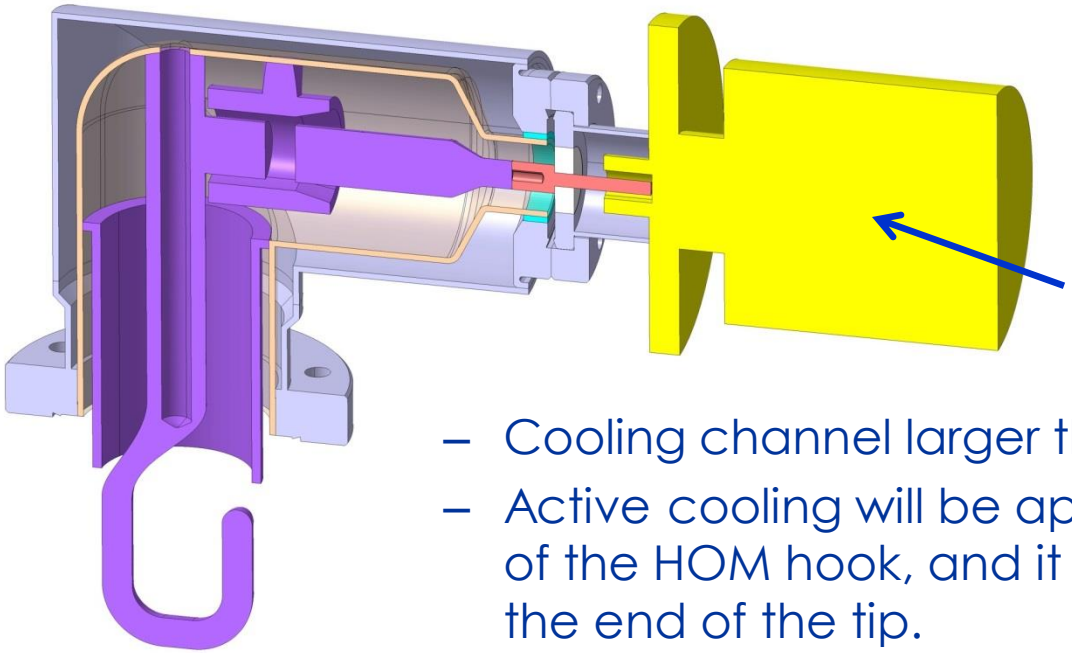
- The HOM power is estimated to be 114 Watts.
- Assuming the HOM frequencies shift in ±1 MHz range, in the worst case the power is 1003 Watt, 93% from mode at 742 MHz. (assuming the worst case that the beam is 5 mm offset)



HOM System: Thermal analysis

- Assumes cavity operating **at nominal deflecting voltage** of 3.3 MV.
- Assumes only cooling by **conduction with tube wall at 2K** (cooling circuits will be designed later).
- Dissipated power in **HOM hook** made of SC niobium is 5mW, which leads to maximum temperature of 3K.





connector of the coax cable to an outside load

- Cooling channel larger than the previous version.
- Active cooling will be applied in the straight section of the HOM hook, and it is possible to extend it till the end of the tip.

HOM System: prototyping

- 3-D printing + Cu coating.
- Acetone etching for smoother surface.
- Evaluating different ways to deal with joint loss.
- Will figure out the ports connection based on new design.

Summary

- PoP has been studied to understand the HOMs in DQWCC
- HOM system for SPS has been optimized (clearance, cooling capacitance, peak magnetic field, joint loss, multipacting, impedance budget etc)
- HOM power has been estimated
- Prototyping of the HOM system is on-going

Thank you!