HOM and FPC Couplers For LHC Crab Cavity

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LHC Crab Cavity Engineering Meeting,
Dec 13, 2012, Fermilab

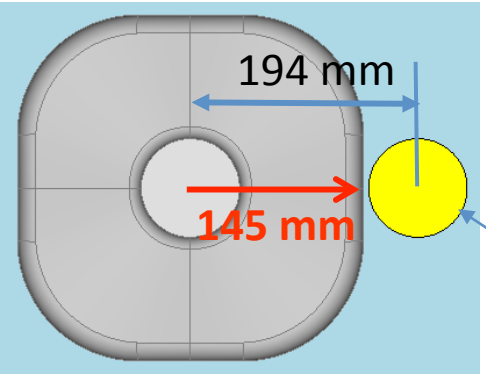
Outline

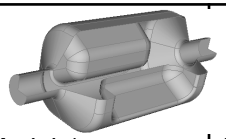
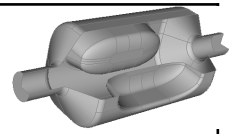
- Coaxial HOM coupler
  - H-pass filter horizontal HOM coupler
  - Coaxial vertical HOM/Acc coupler
- Waveguide HOM coupler (NO LOM)
  - Regular waveguide HOM coupler
  - Ridged waveguide HOM coupler
- FPC coupler
  - Coaxial FPC coupler
  - Waveguide FPC coupler
- Discussions

SLAC-ODU 400-MHz RF Dipole Cavity

Design Requirements:

- 400 MHz frequency
- For either horizontal or vertical crabbing scheme
- Compact: max transverse size: **~145-mm**
- Effective HOM damping
- 3-cavity per beam – total 10-MV deflecting voltage



Parameters	 Model-1	 Model-2
Operating mode Frequency	400 MHz	400 MHz
Operating Mode	TE11 like mode	TE11 like mode
Lowest acc mode Frequency	731 MHz	714 MHz
Lowest vertical HOM Frequency	784 MHz	757 MHz
Lowest horizontal HOM Frequency	594 MHz	612 MHz
Iris aperture (diameter)	84 mm	84 mm
Transverse dimension	295 mm	281 mm
Vertical dimension	295 mm	288 mm
Longitudinal dimension	620 mm	638
Transverse Shunt Impedance	323 ohm/cavity	339 ohm/cavity
Required deflecting voltage per cavity	3.3 MV	3.3 MV
Peak surface magnetic field	55 mT	59 mT
Peak surface electric field	36 MV/m	30 MV/m

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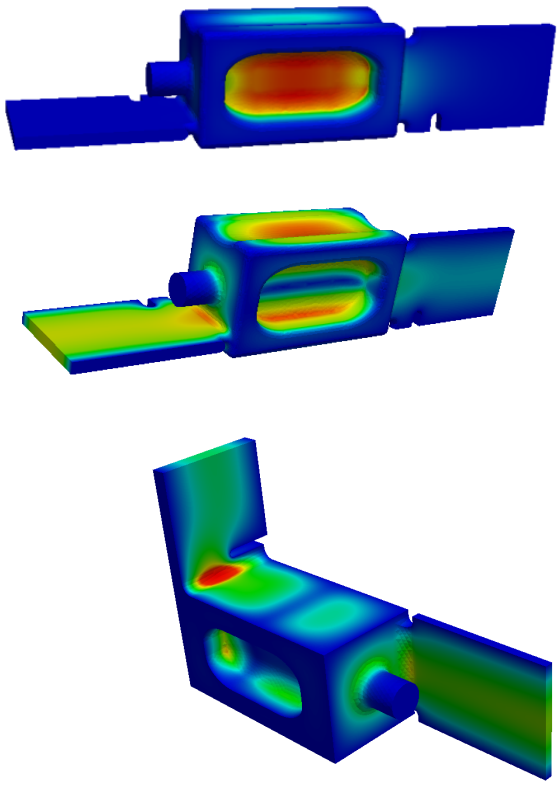
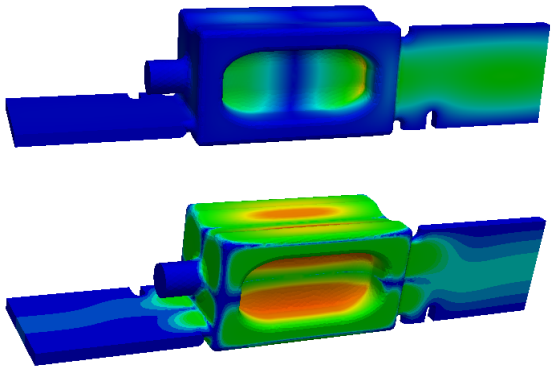
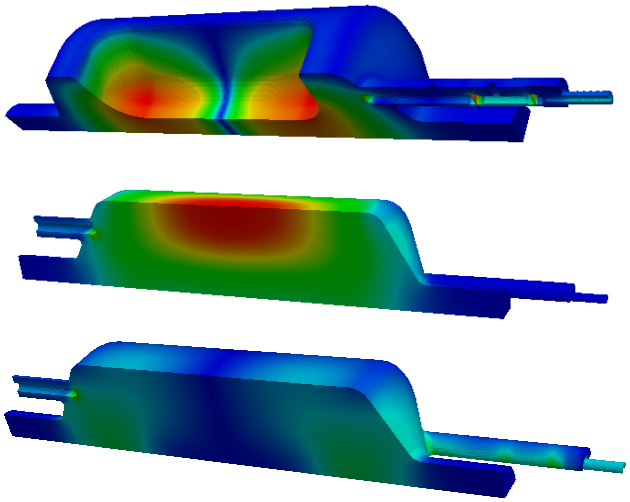
HOM Damping Schemes/requirements

- Waveguide to damping
- Coaxial high-pass filter coupler





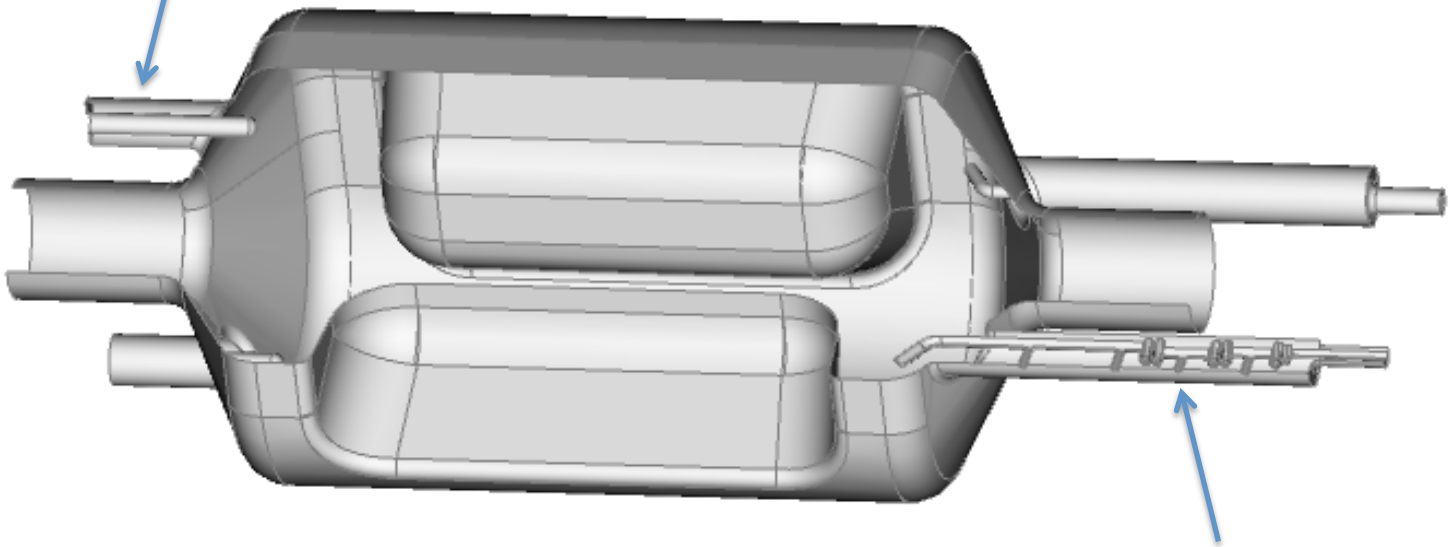


Requirements:

- Strong damping (achievable with both schemes)
- Need to be able to handle high power (acc modes)

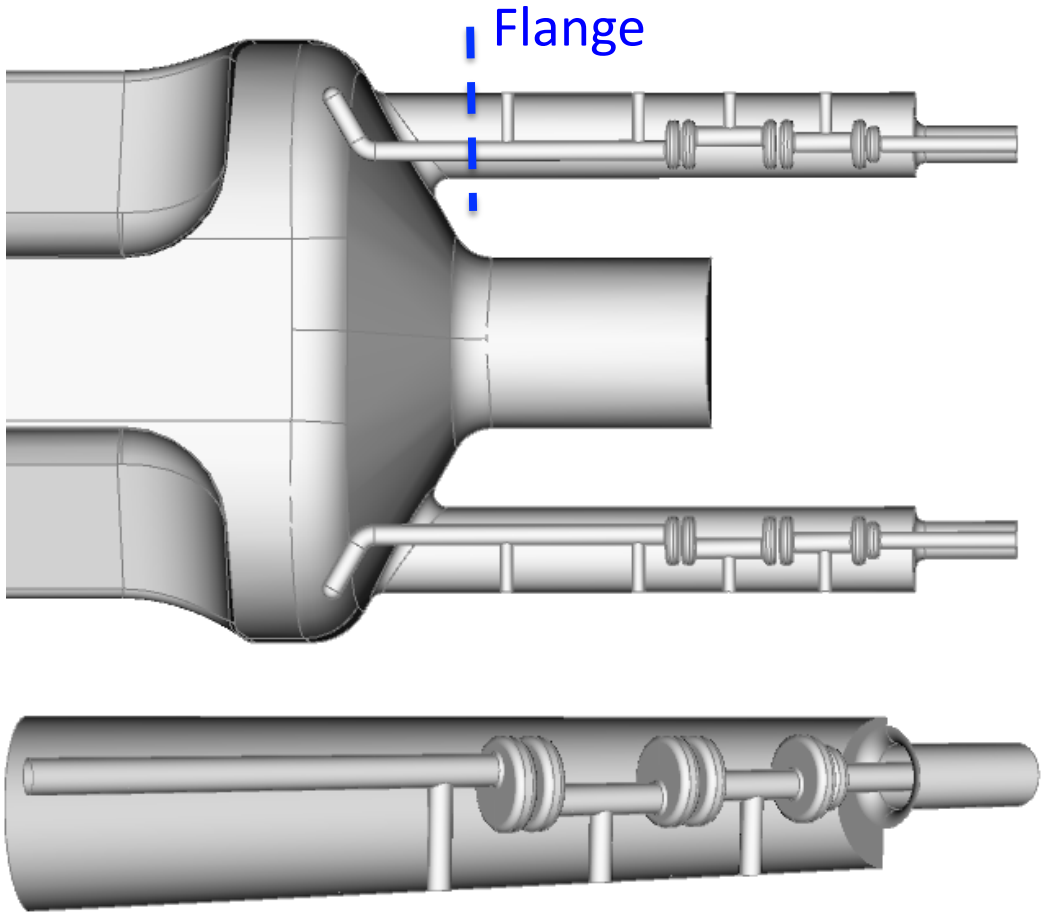
3-Stage High-Pass Filter HOM Coupler

Probe antenna for
vertical and acc HOM

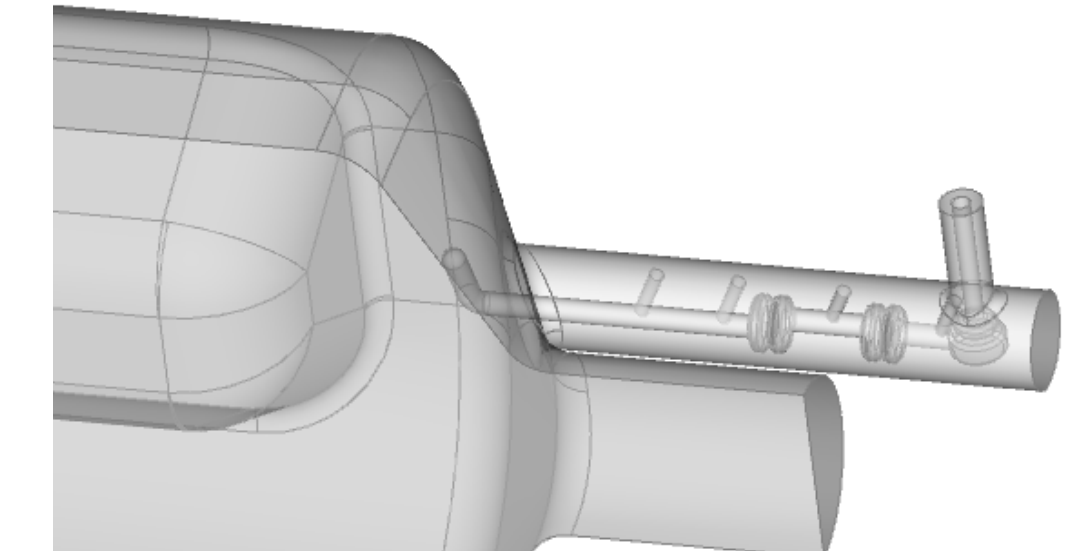


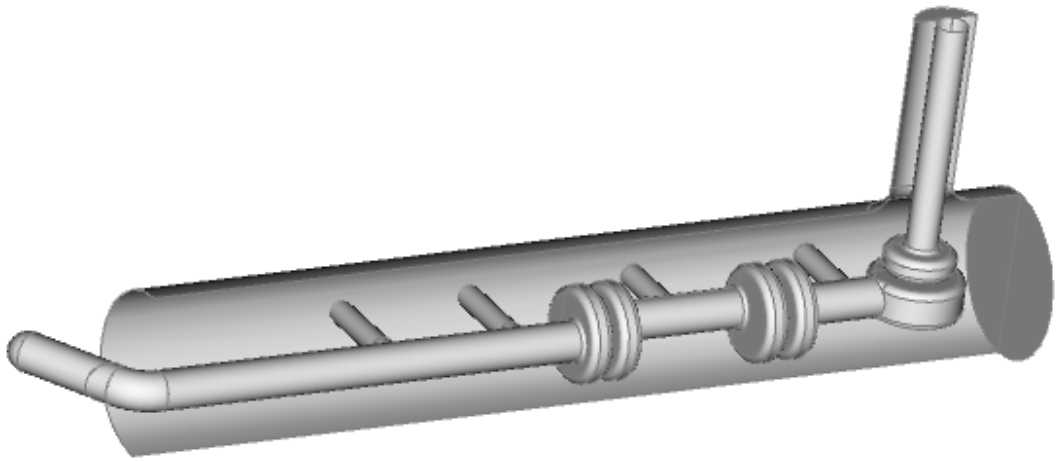
Hook shaped
antenna for
horizontal HOM

3-Stage High-Pass Filter Horizontal HOM Coupler



3-Stage High-Pass Filter Horizontal HOM Coupler

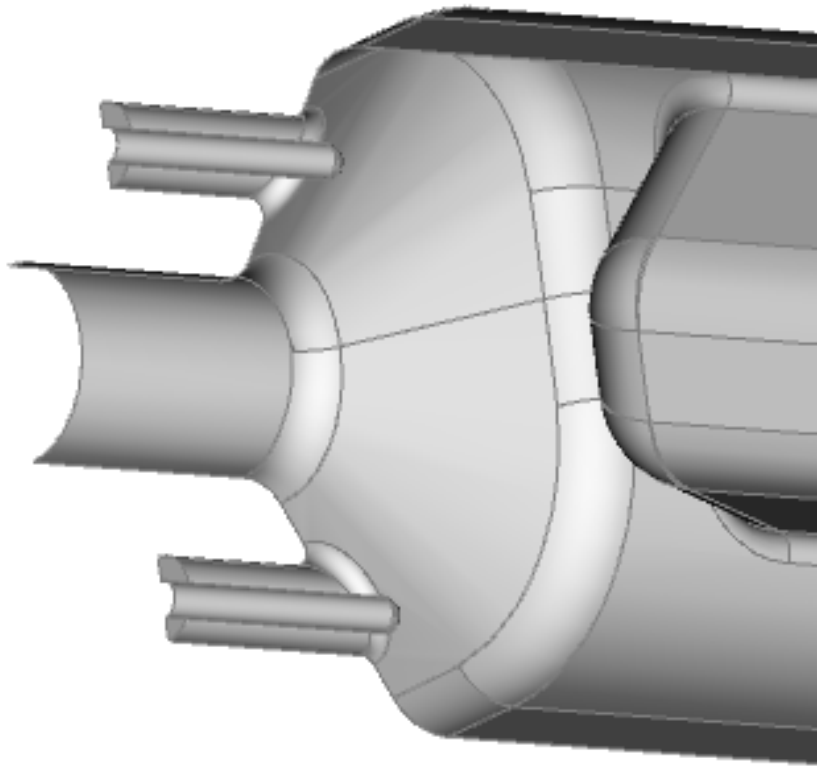




Pick up in vertical direction

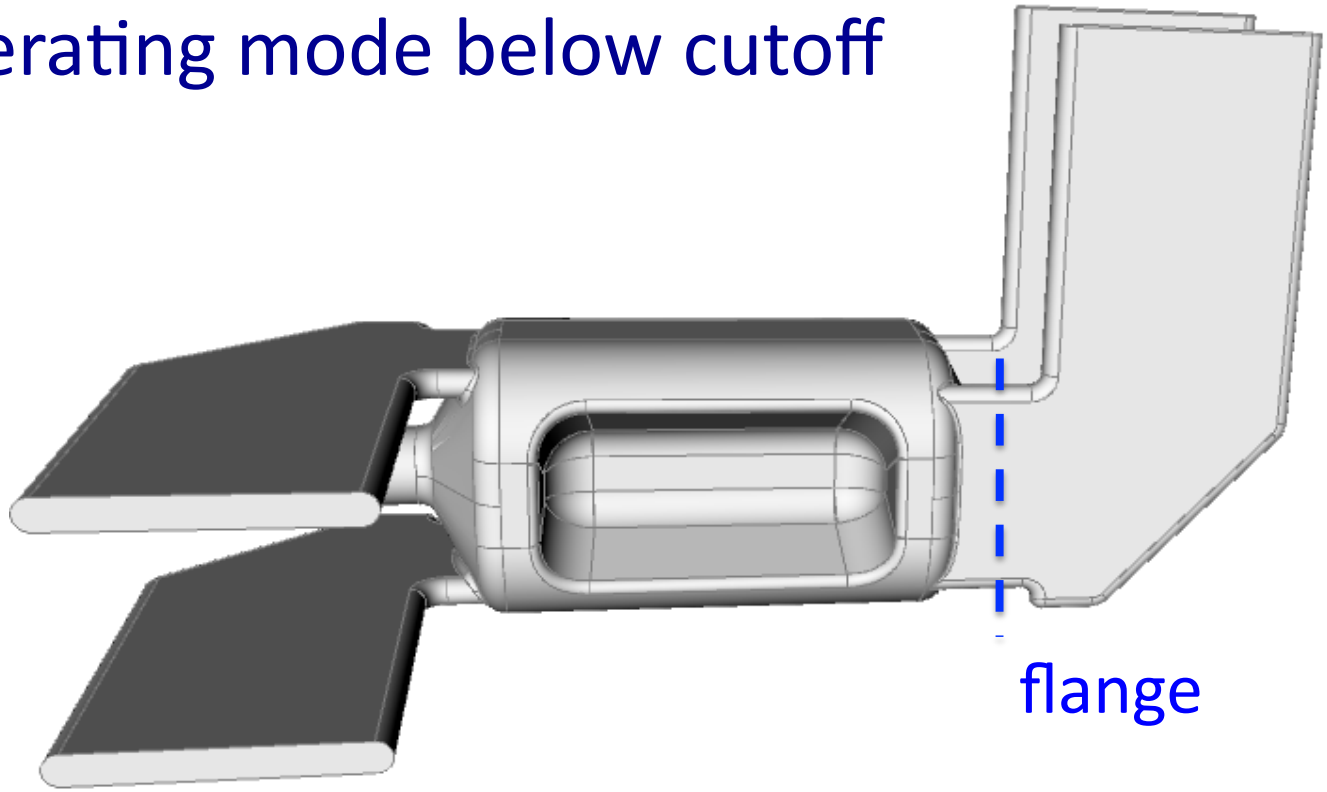
Probe Vertical HOM/Acc Coupler

Need to turn 90 degrees vertically to loads

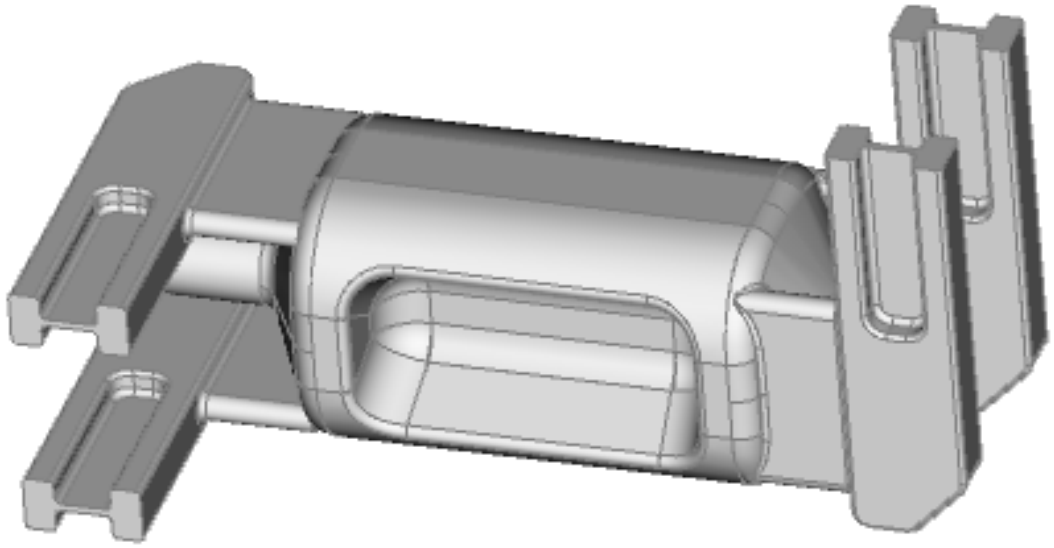


Waveguide HOM Coupler

- 280mmX30mm
- Operating mode below cutoff



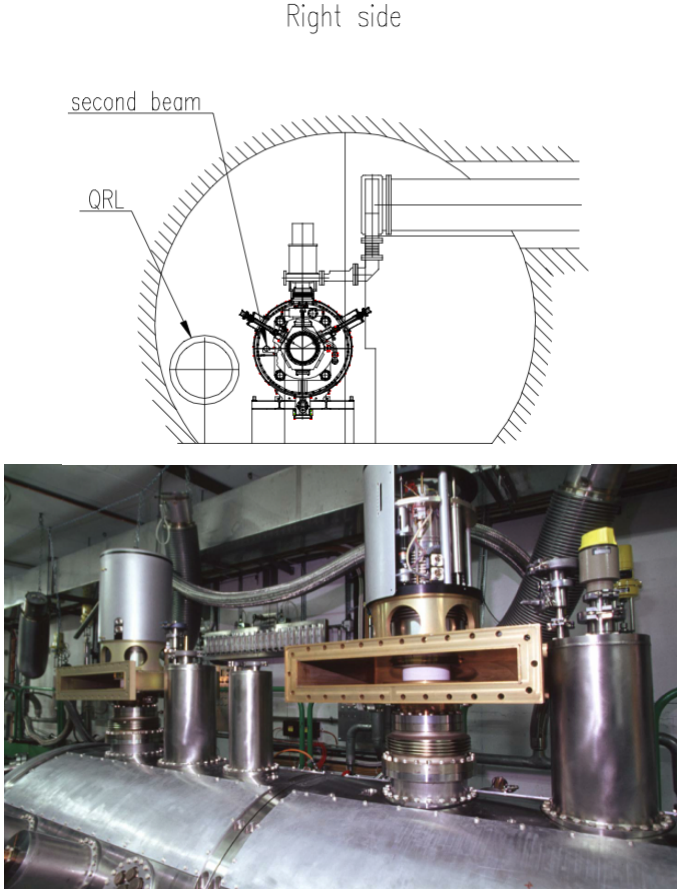
Ridged Waveguide HOM Coupler



- Waveguide dimension: 125mmX60mm, gap=8mm
- Waveguide cutoff: 530MHz, no filter needed
- One HOM can be used as waveguide FPC

LHC Main Cavity Adjustable Coupler

- Waveguide-to-coax-to-cavity



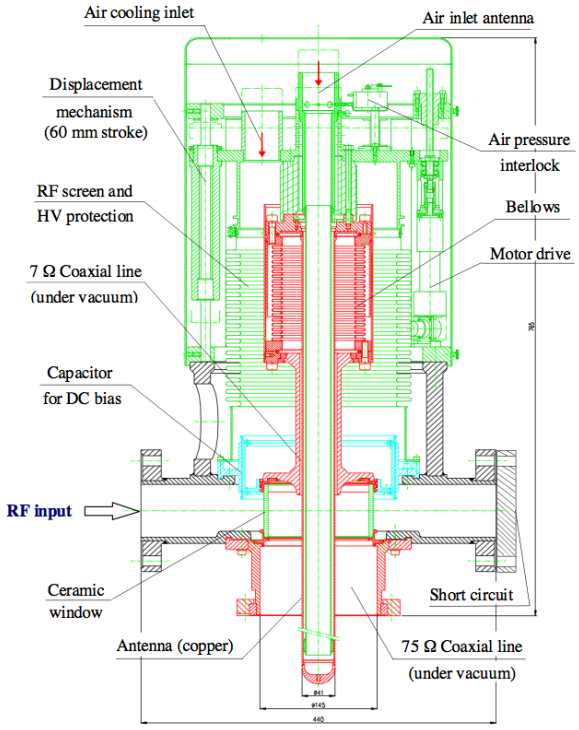
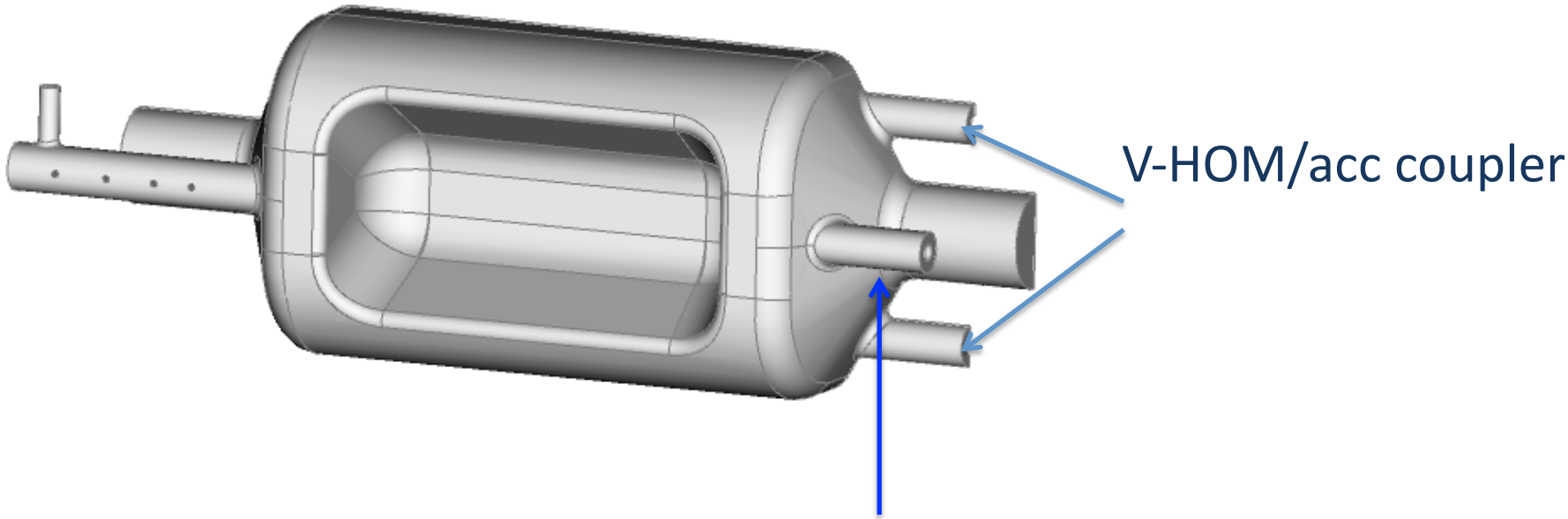


Figure 1: Cross section of the LHC variable coupler

Coaxial FPC coupler (a)

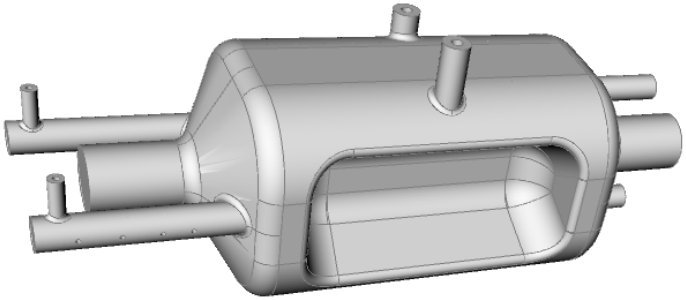
(a)



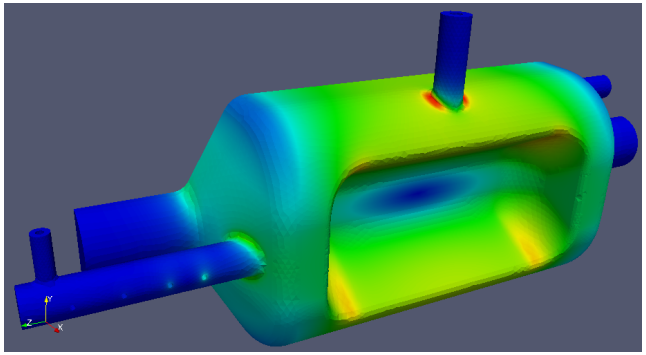
- Coaxial FPC coupler in horizontal plane.
- Coax part need to turn 90 degrees away from beam direction so parts of larger dimensions (window, waveguide) can fit (LHC or TTF-III)

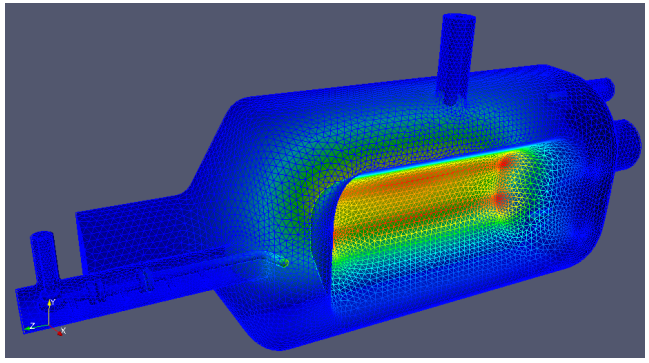
Coaxial FPC coupler on The Side

(b)

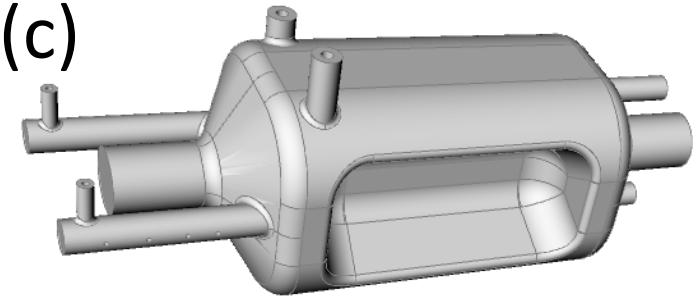


Field enhanced

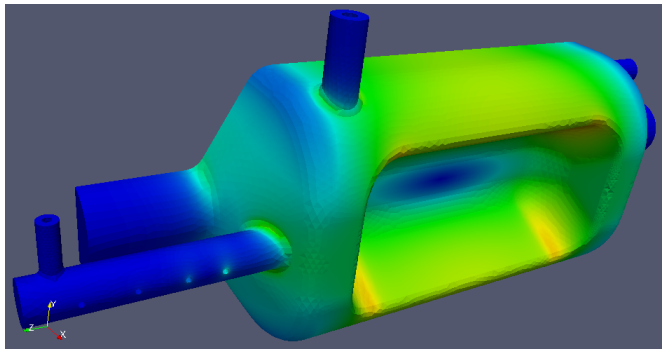


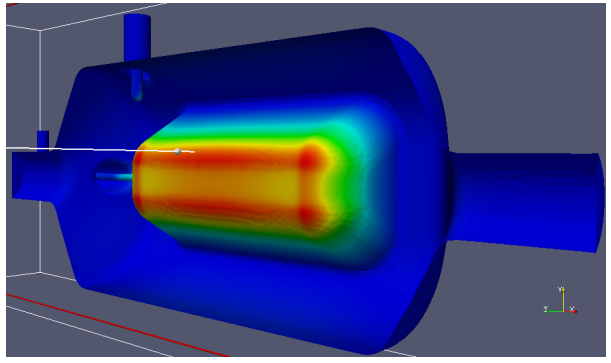


(c)



Qext=3.7e5/coupler, Low field

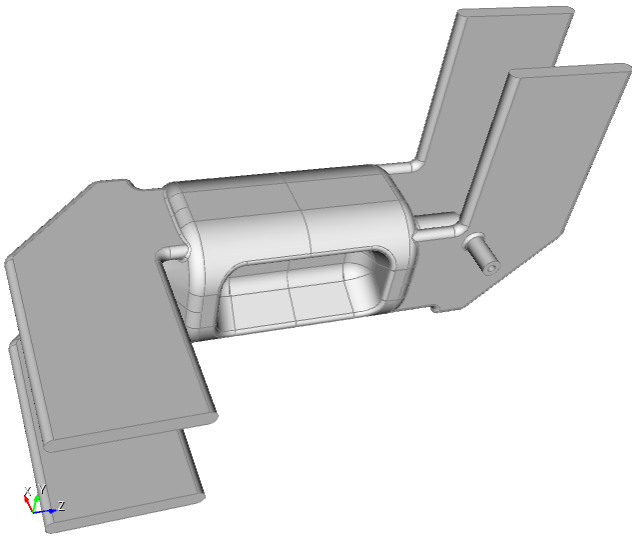




Field asymmetry need to be evaluated !

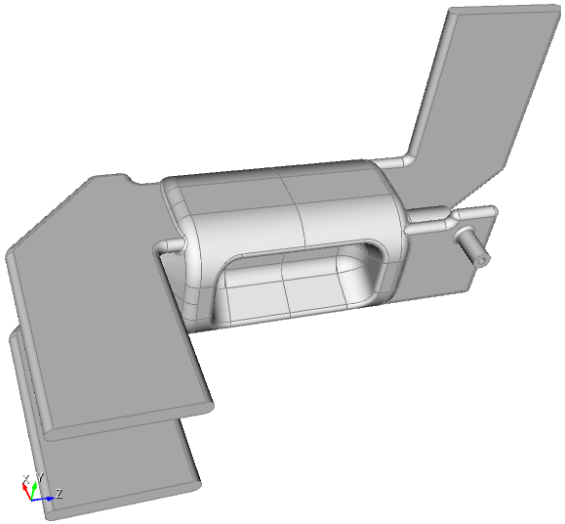
Waveguide HOM/LOM + FPC

(a)



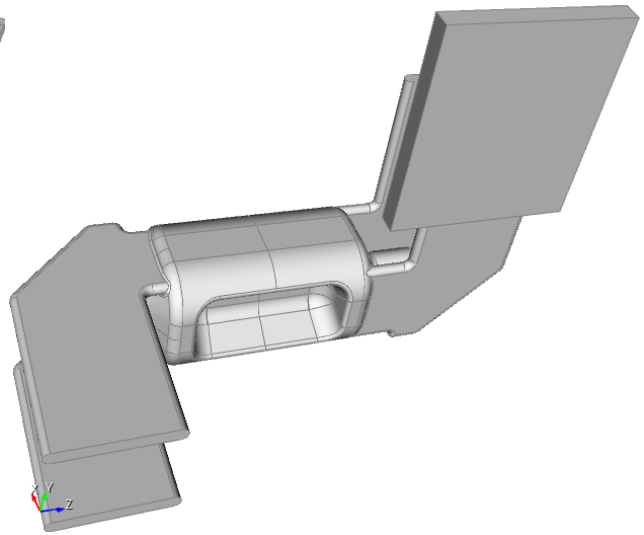
Both waveguides as HOM couples. Coaxial probe for FPC

(b)



One horizontal HOM coupler. Waveguide stub to coaxial FPC

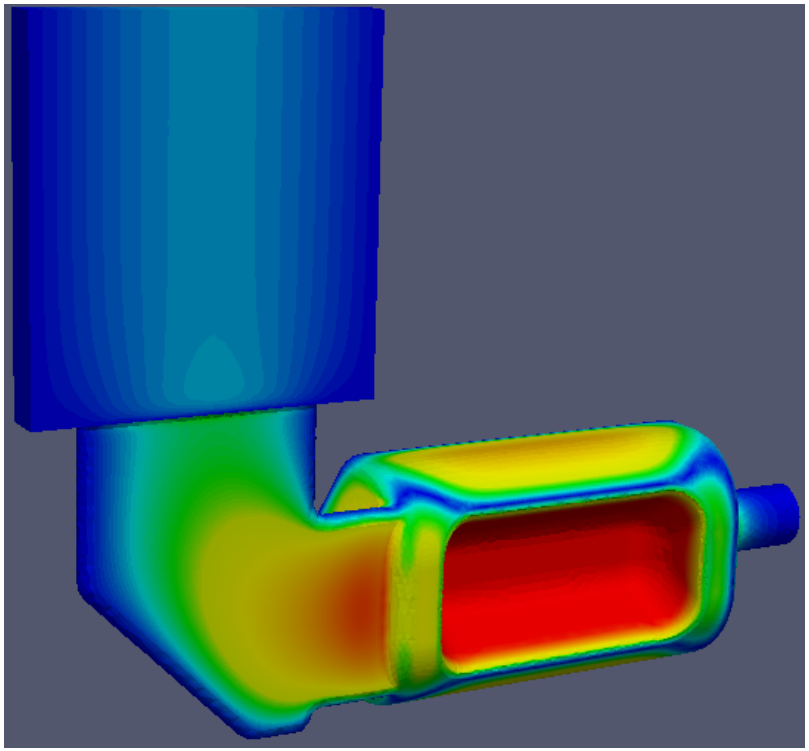
(c)



One horizontal HOM coupler. Waveguide to waveguide FPC

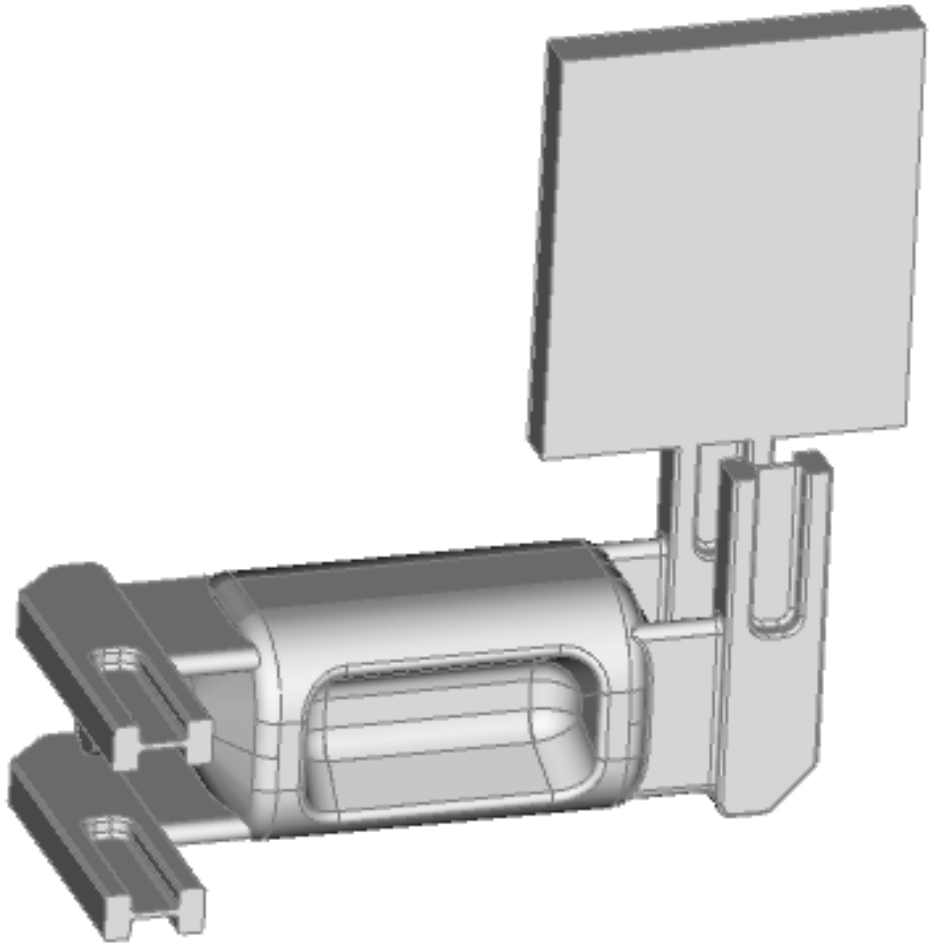
Waveguide FPC Coupler

- Regular waveguide attached to “cut off” HOM waveguide - coupling via evanescent field



Qext = 3.5e5 (/coupler)

Ridged Waveguide HOM Coupler + FPC Coupler



Cornell 500-MHz Waveguide Input Coupler

SUPERCONDUCTING ACCELERATOR MODULES FOR THE TAIWAN LIGHT SOURCE

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L.H. CHANG, C.T. CHEN, M.C. LIN, G.H. LUO, R. SAH, CH. WANG, SRRC
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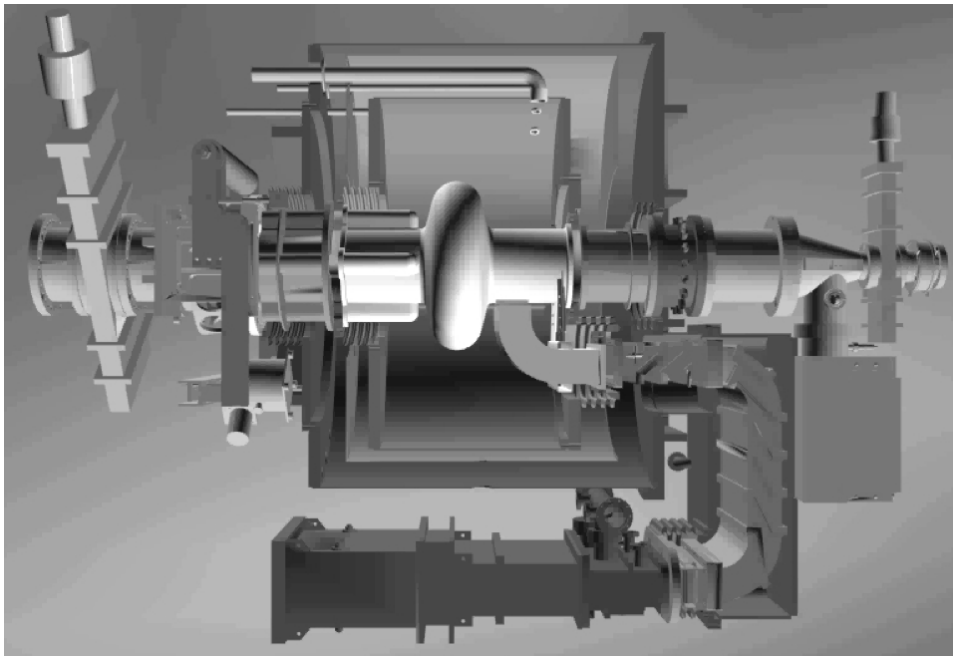
Abstract

A machine-upgrade program is being undertaken to increase the performance capabilities of the Taiwan Light Source [1]. This program has two major goals: Provide photon beams with significant better stability and store up to 500 mA of electron beam, while maintaining the beam lifetime. In order to achieve these goals, the current DORIS cavities will be replaced by superconducting cavities of the CESR III design [2]. This cavities were chosen because of their effective damping scheme of the higher order modes, the negligible power dissipation in the cavity walls and the possibility to operate at high gradients and to transfer high power to the beam. Two turn key SRF modules each one containing one CESR III type cavity are under construction at ACCEL. One SRF module will be installed to deliver up to 100 kW of RF power to the 500 mA beam and providing a gap voltage of at least 1.6 MV. The second SRF module will be kept on readiness on a test stand. The ability to install a functional cavity on a short notice will provide maximum machine reliability.

Figure 1: Superconducting 500 MHz cavity

specified below 35 W. The total cryogenic heat load at 4.5 K is specified to be below 71 W.

2 MAIN FEATURES OF THE ACCELERATOR MODULE



Discussions

- Different ideas of couplers discussed
  - No local field enhancement
  - Multipacting need to be simulated
  - High power handling need to be evaluated
- Ridged waveguide HOM coupler seems a alternative compact choice
  - No filter
  - Can be integrated with a waveguide FPC coupler
- Damping scheme will affect cryomodule design
  - Selection of coupler
  - Test coupler on NC cavity model