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## **Mu2e Delivery Ring HLRF**

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Delivery Ring RF Review

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# Overview

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The Mu2e Experiments High Level Radio Frequency (HLRF) is being done under the Recycler RF AIP. This work consists of the Delivery Ring 2.36 MHz RF Cavities, 8 kW Solid State Amplifiers and a Water Cooling System for the HLRF.

# Cavity Design Requirements

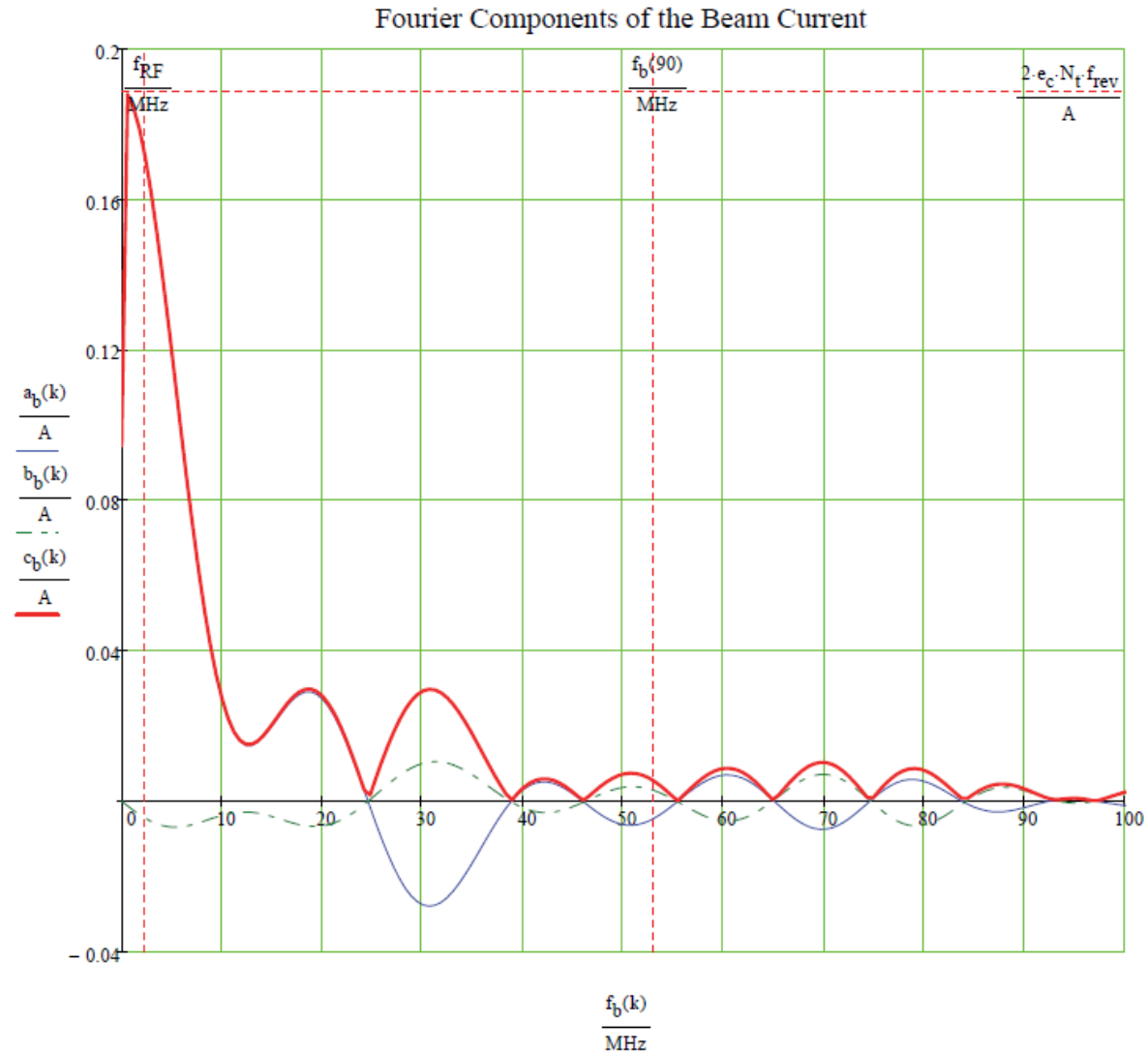
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<b>Parameter</b>	<b>Value</b>	<b>Units</b>
Harmonic Number	4	
Frequency	2.360	MHz
Peak Total Voltage	10	kV
Number of Cavities	1	
R/Q	400	$\Omega$
Q	125	
Duty Factor	100	%

# Fourier Analysis of the Delivery Ring Beam

$1 \times 10^{12}$  protons  
 Single Bunch  
 ESME Simulation

$a_b(k)$  = cosine amplitudes  
 $b_b(k)$  = sine amplitudes  
 $c_b(k)$  = overall magnitude



# Requirements

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Beam Current ( $I_p$ ) =  $178.564 \times 10^{-3}$  A

Number of Cavities = 1

R/Q = 400  $\Omega$

Q = 125

Cavity Voltage = 10.0 kV

Cavity Power Loss per Cavity =  $1. \times 10^3$  W

Total Apparent Power =  $1.04858 \times 10^3$  VA  $\angle$  17.5089 degrees

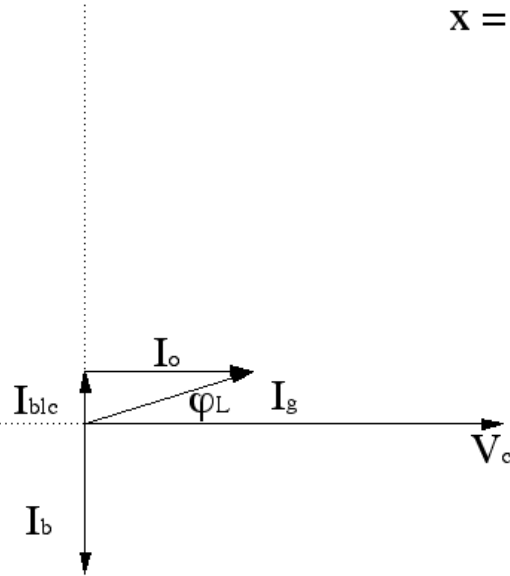
Total Current =  $209.716 \times 10^{-3}$  A  $\angle$  17.5089 degrees

Percent of Induced Mode Compensated = 3.78649 dB = 35.3341 %

Robinson Stable = 4.

# Robinson Stability Diagram

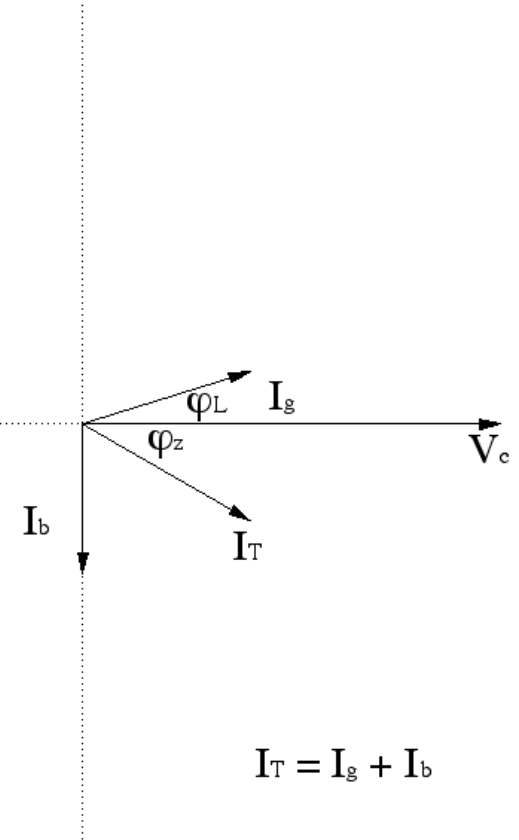
Robinson Stable = 4.00  
35.33% Beam Loading Compensation  
 $x = 0.3533$



$$I_g = I_o + I_{blc}$$

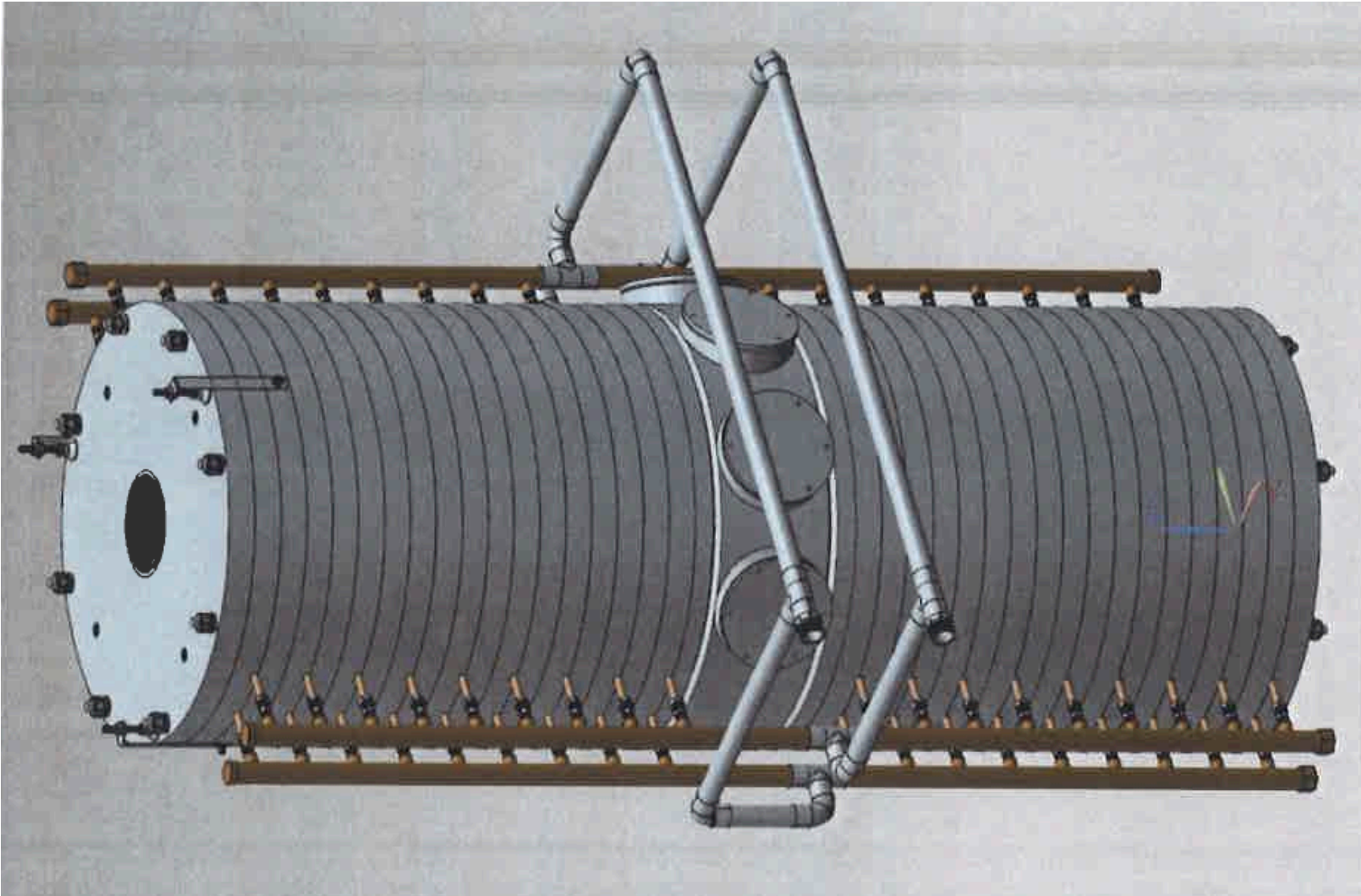
$$I_o = V_c / R$$

$$I_{blc} = j x I_b$$

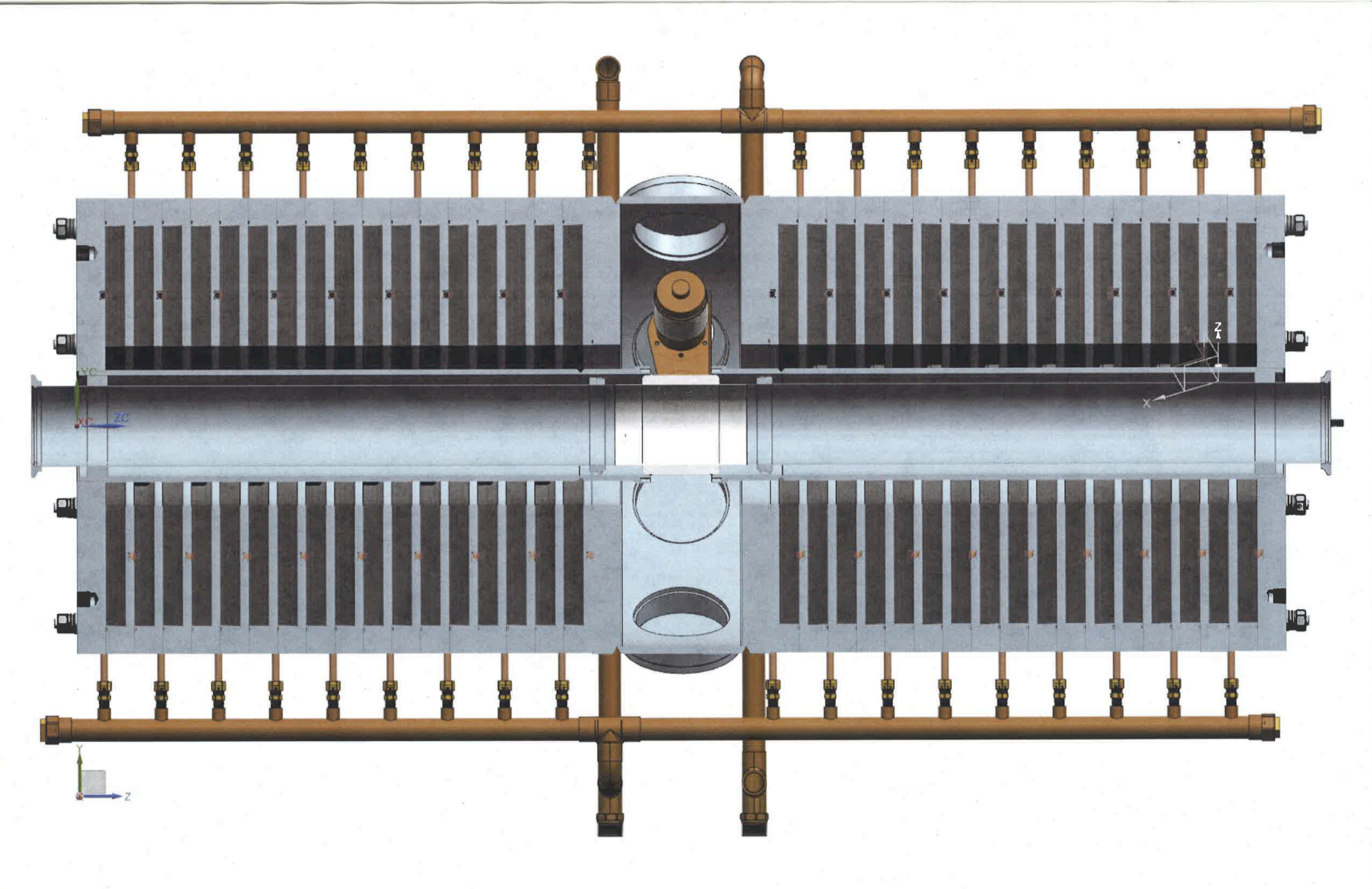


$$I_T = I_g + I_b$$

# Delivery Ring Cavity Design

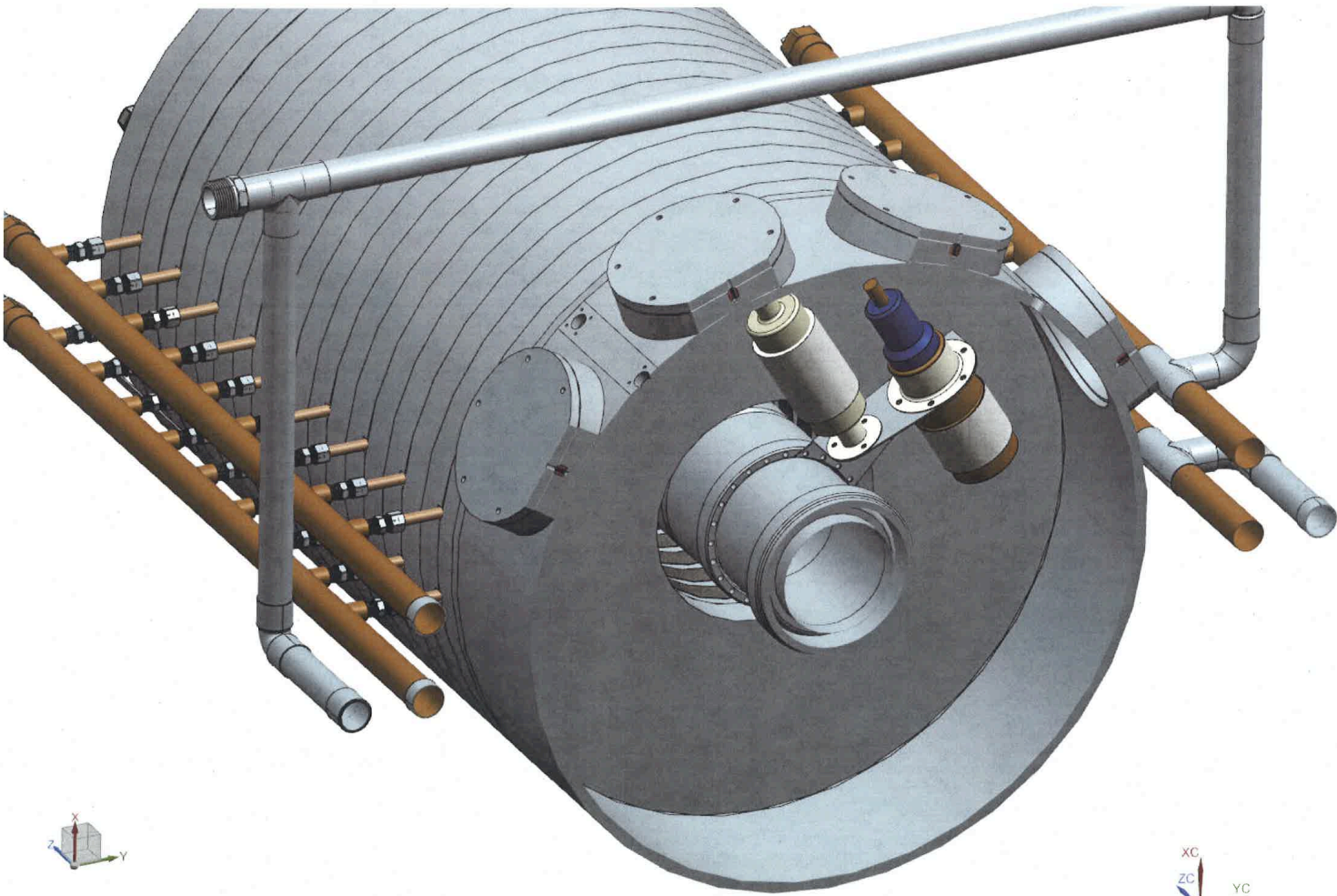


# Delivery Ring Cavity Design

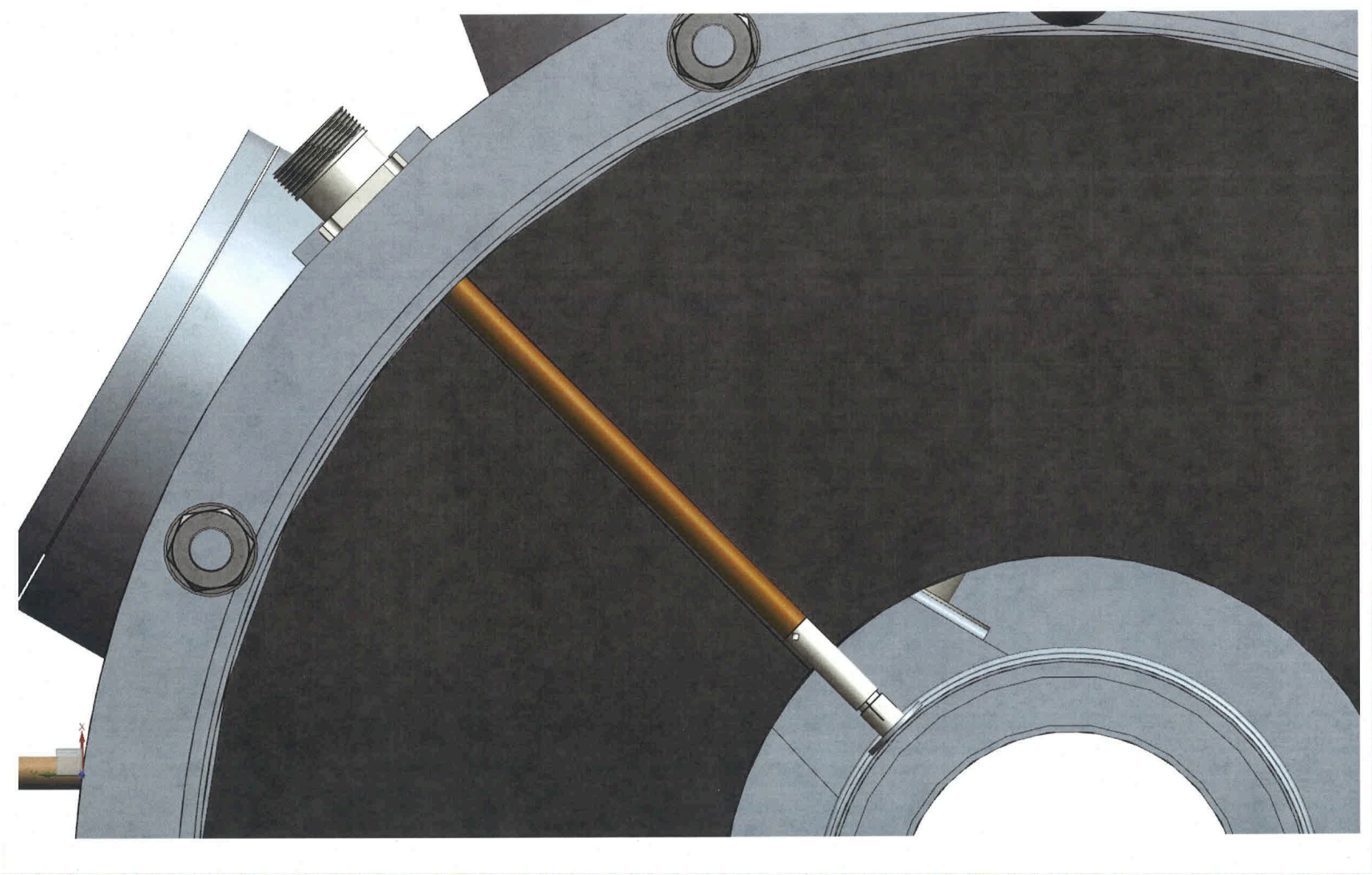




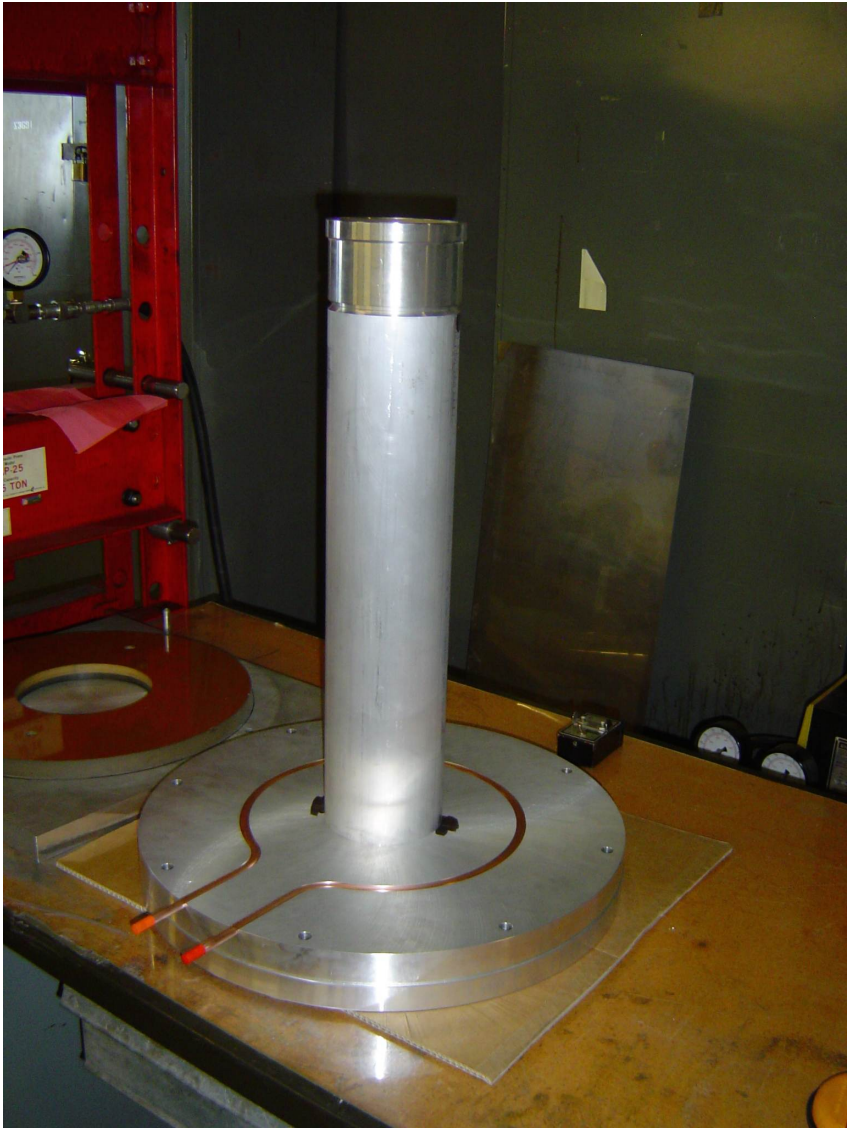
# Delivery Ring Cavity Design



# Delivery Ring Cavity Design



# Delivery Ring Cavity Cooling Ring



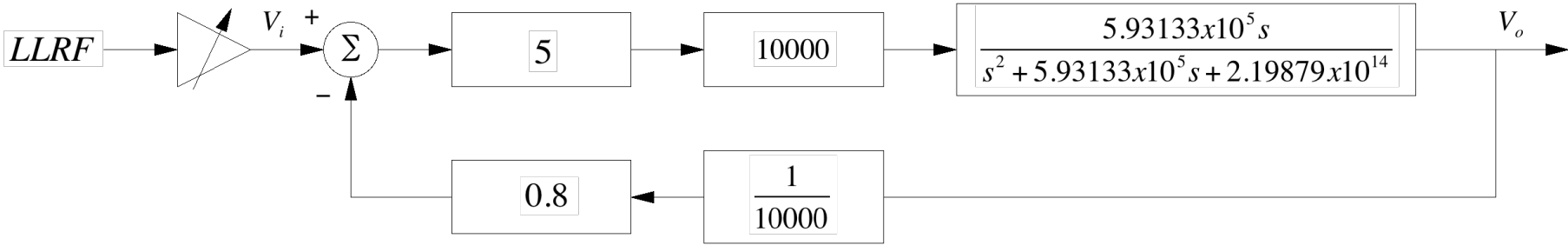
# Delivery Ring Cavity Assembly



# Delivery Ring 2.36 MHz Cavity – Cavity #6

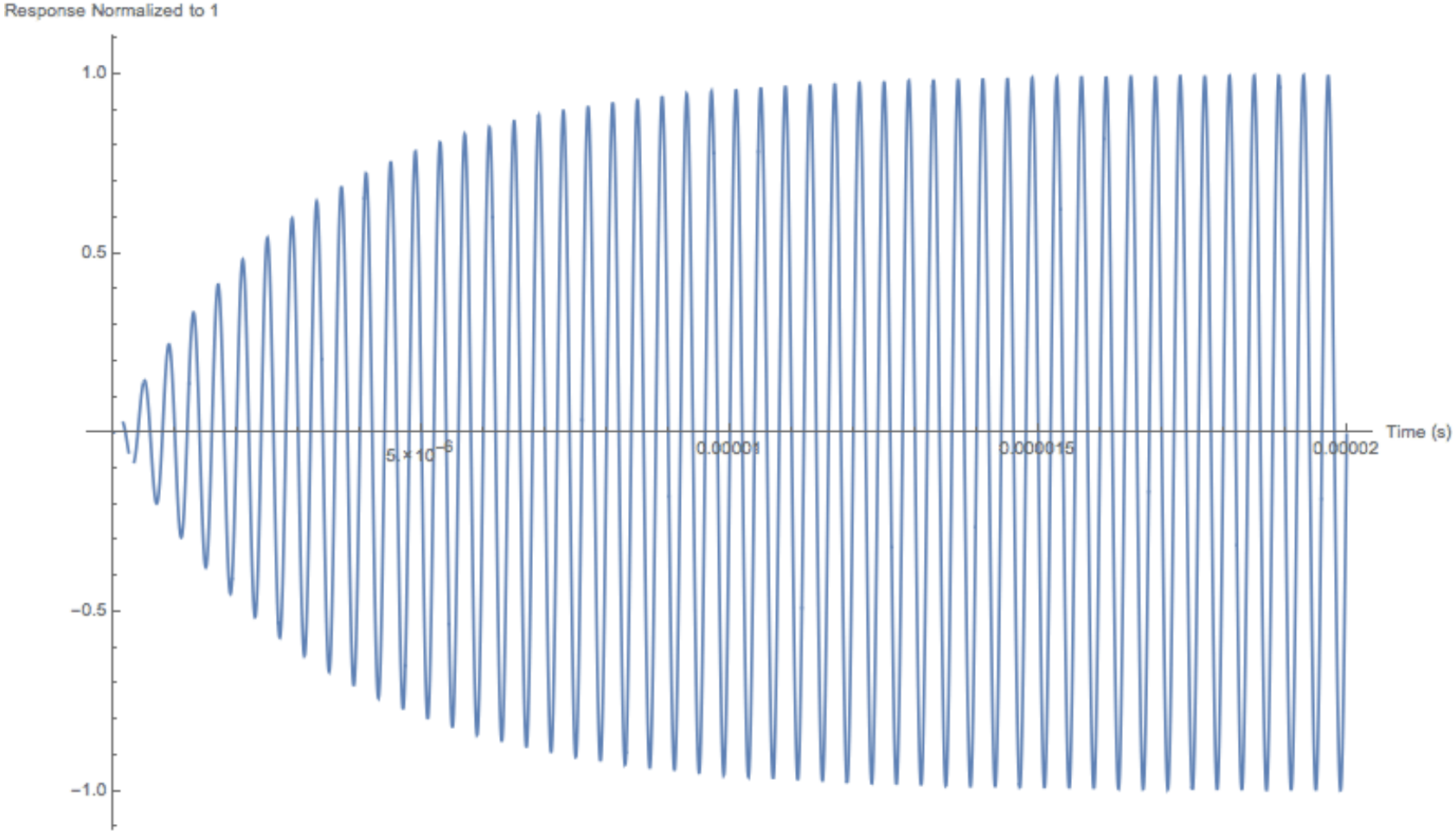


# Block Diagram for Direct RF Feedback



Closed Loop Gain = 5

# Cavity Output Response with a Closed Loop Gain of 5



Rise Time to 90% = 7.3  $\mu$ s

# TOMCO 8 kW Solid State Amplifier



Two Amplifiers  
are Scheduled  
for Delivery in  
December of 2015

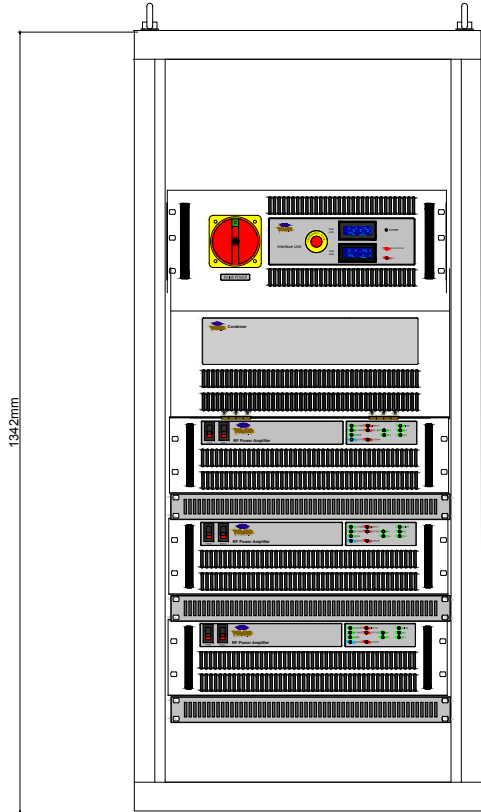


Figure 1: Proposed Rack layout 8kW 3.5MHz