

# Beam Loading in Beta=0.92 Cavity

$$P_g = \frac{V_c^2}{R_a} \cdot \frac{(1+\beta)^2}{4\beta} \cdot \frac{1}{\cos^2\psi} \left\{ \left[ \cos\phi + \frac{I_o R_a}{V_c (1+\beta)} \cos^2\psi \right]^2 + \left[ \sin\phi + \frac{I_o R_a}{V_c (1+\beta)} \cos\psi \sin\psi \right]^2 \right\}$$

shunt impedance  $R_a$ , the coupling coefficient  $\beta$ , the beam current  $I_o$ , the cavity tuning angle  $\psi$ , the accelerating voltage  $V_a = V_c \cos\phi$ , and the desired synchronous phase angle  $\phi$  are specified. From

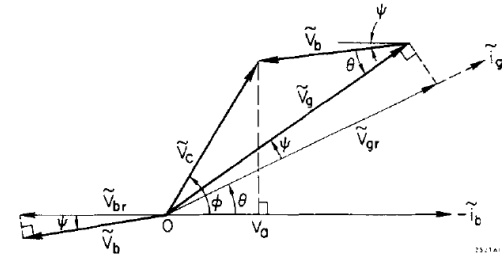
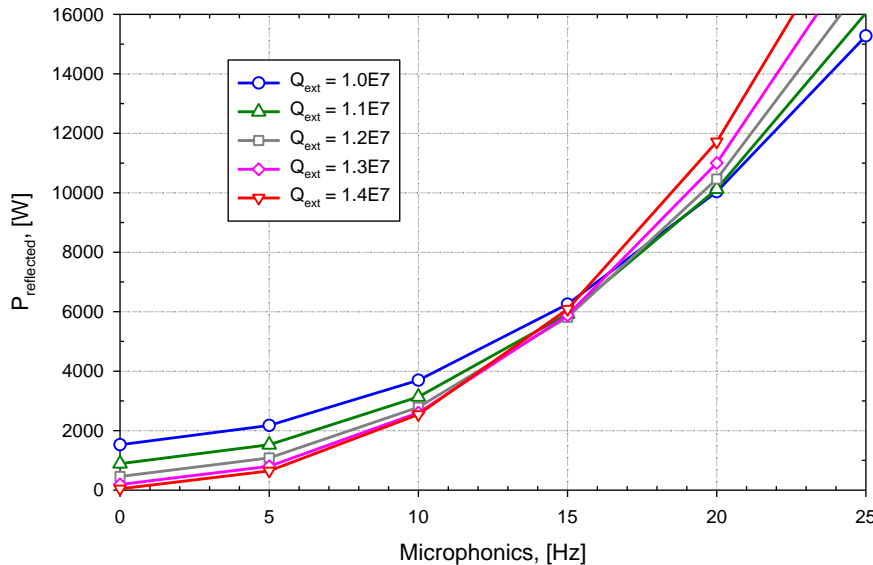
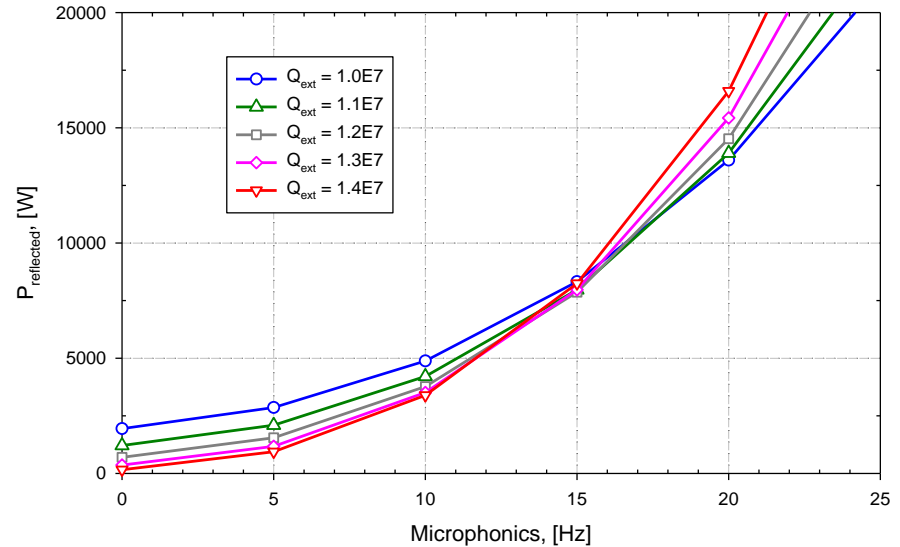


Fig. 3.13. Diagram showing the vector addition of generator and beam-loading voltages in an RF cavity.

$I = 2\text{ma}, \phi = 10 \text{ deg}$

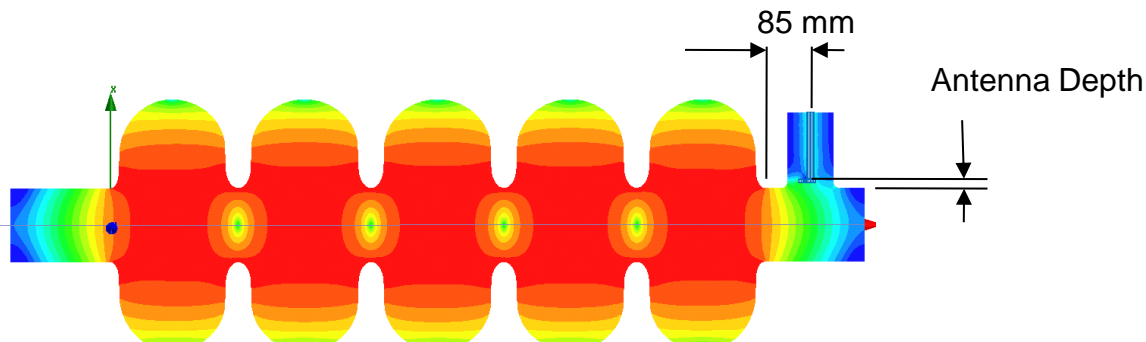


$I = 2\text{ma}, \phi = 15 \text{ deg}$

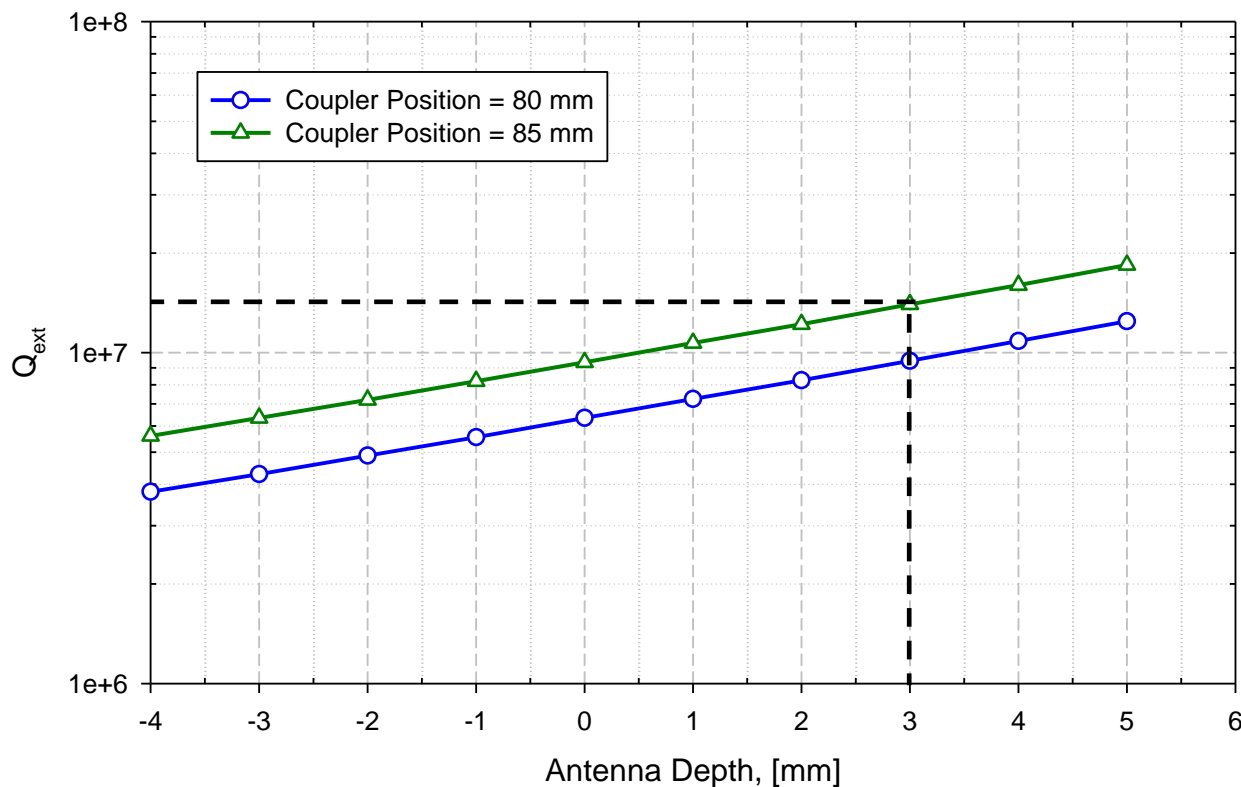
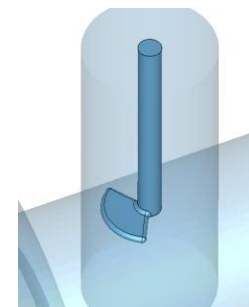


If microphonics amplitude is  $< 15 \text{ Hz}$  then  
**optimum  $Q_{ext} \sim 1.3E7 - 1.4E7$**

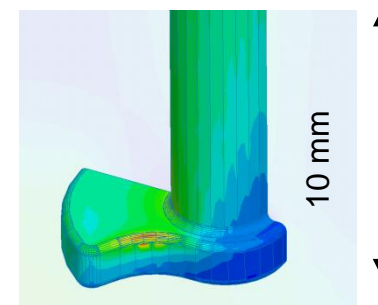
# $Q_{\text{ext}}$ tuning for Beta=0.92 Cavity and 118mm Beam Pipe



120° Sector Antenna Tip



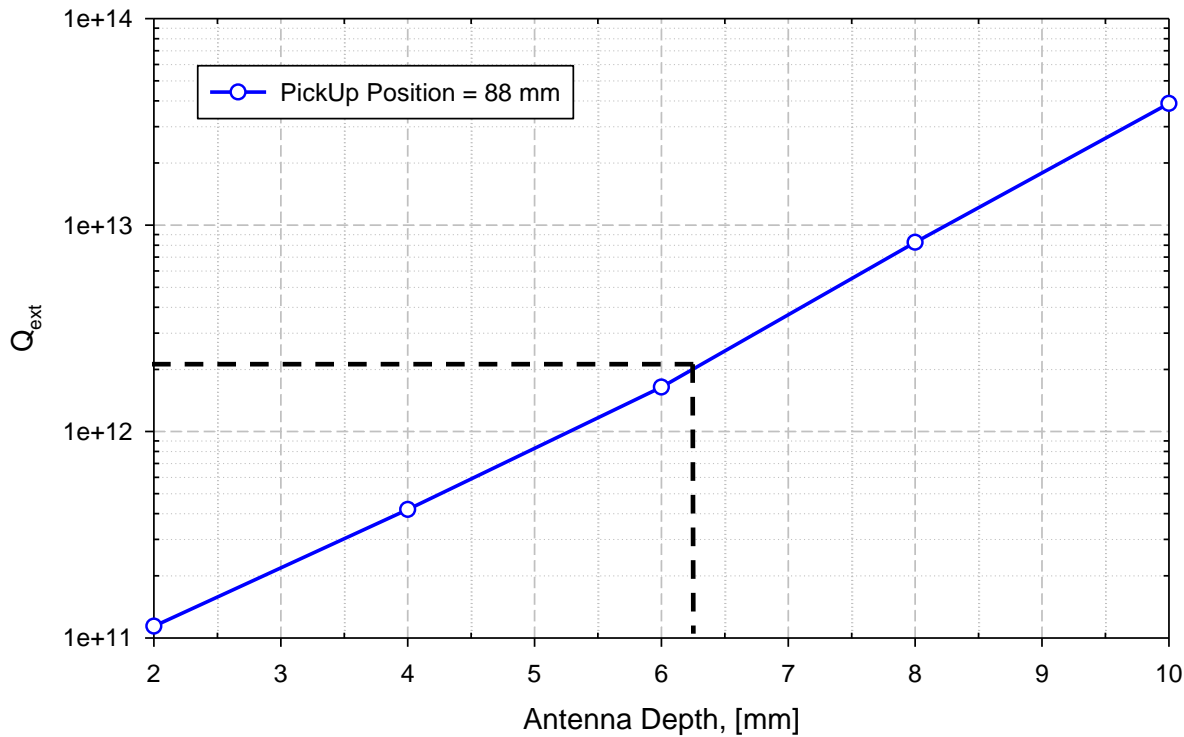
Surface Magnetic Field



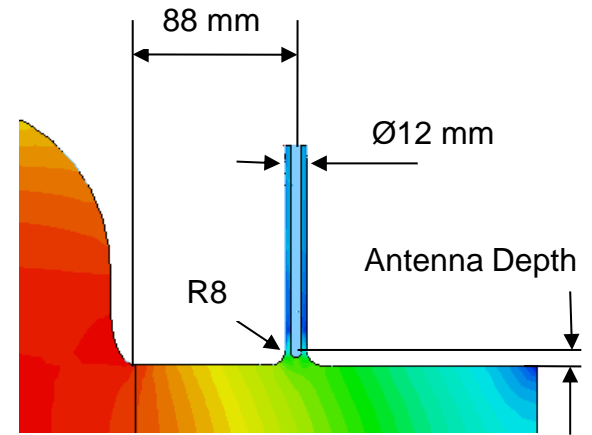
$$P_{\text{loss}} < 1 \text{ W}^*$$

\* for  $P_{\text{inp}} = 35 \text{ kW}$  and  $Q_{\text{ext}} = 1.4\text{E}7$

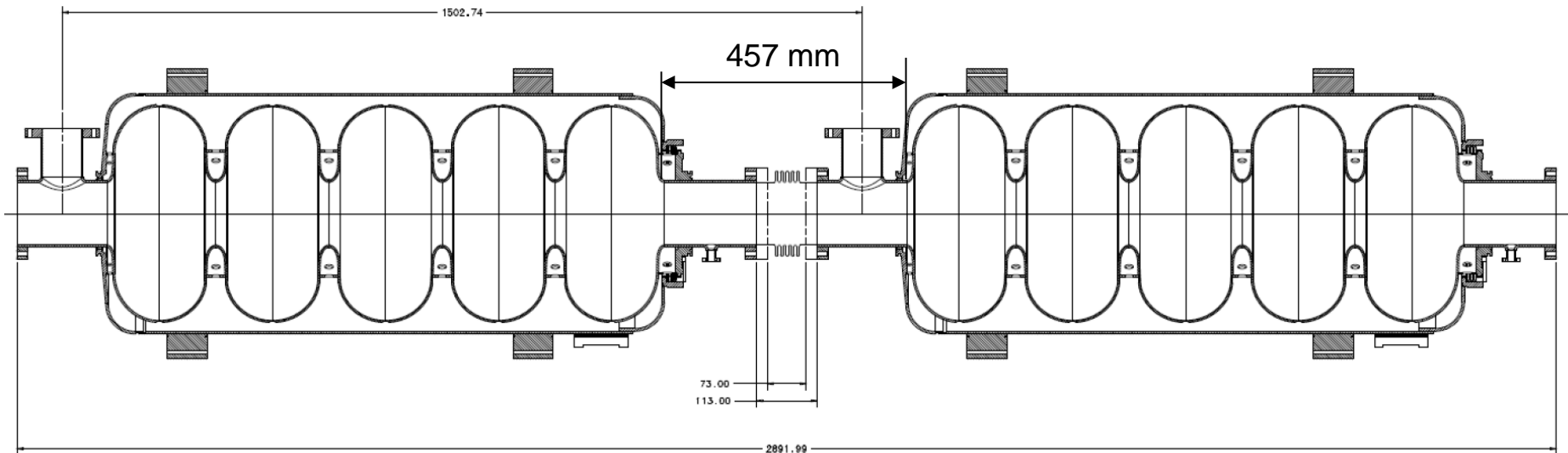
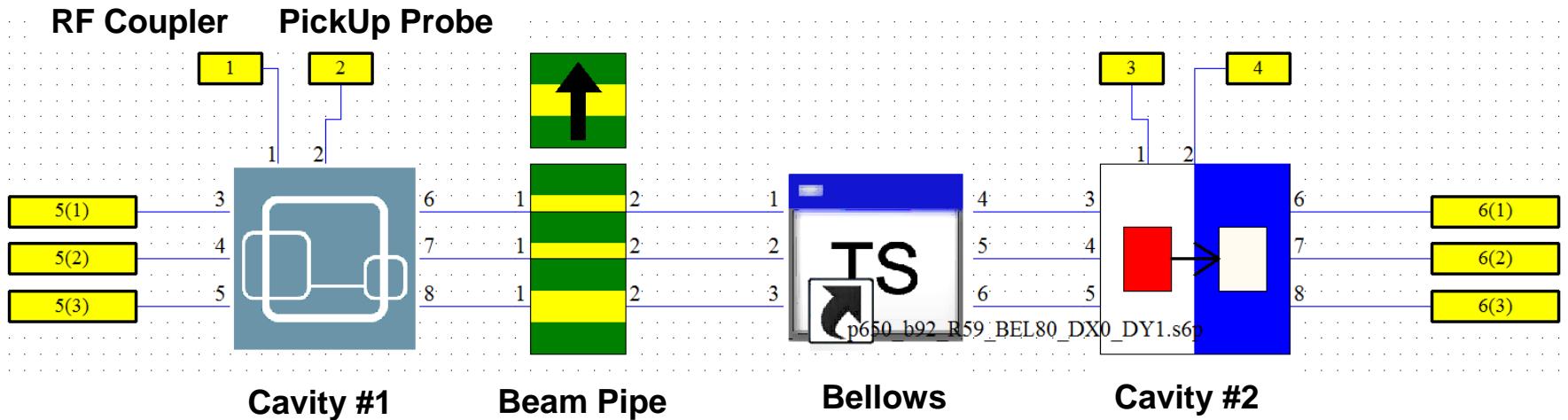
# Pickup Probe $Q_{\text{ext}}$ for Beta=0.92 Cavity



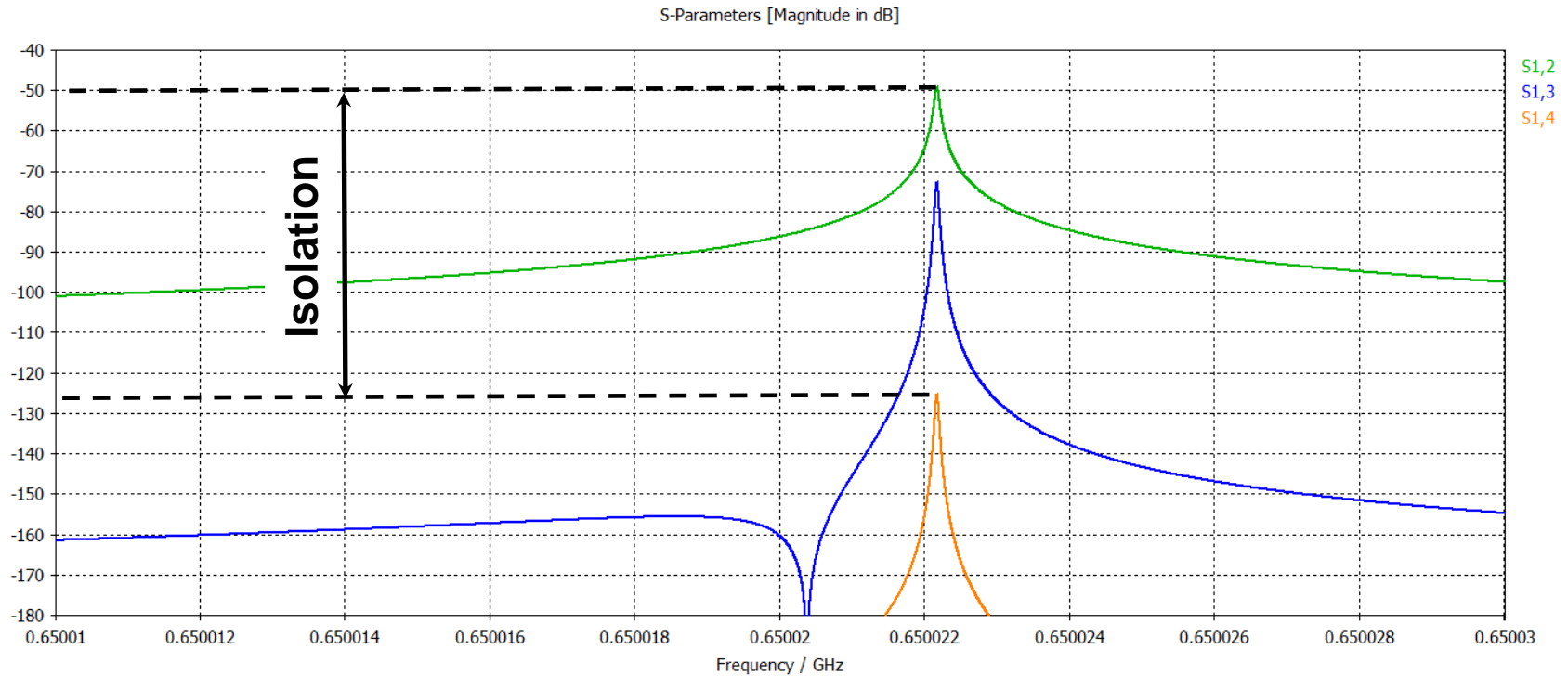
## 50 $\Omega$ Pickup Probe



# Cavities Cross Coupling for $\varnothing=118\text{mm}$ Beam Pipe



# Cavities Cross Coupling for $\varnothing=118\text{mm}$ Beam Pipe

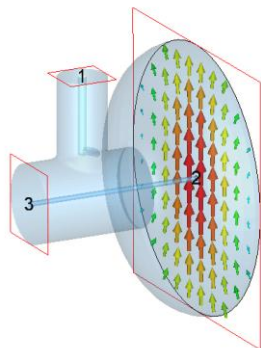


For 118 mm beam pipe and 457 mm space between cavities, the cross coupling for operating mode is

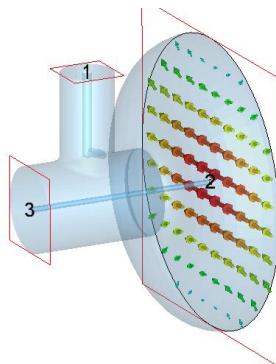
**< 60 dB or < 0.1% amplitude**

# Cavities Cross Coupling for $\varnothing=118\text{mm}$ Beam Pipe

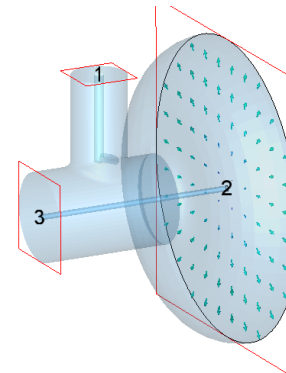
TE<sub>11</sub> Mode (Vert)



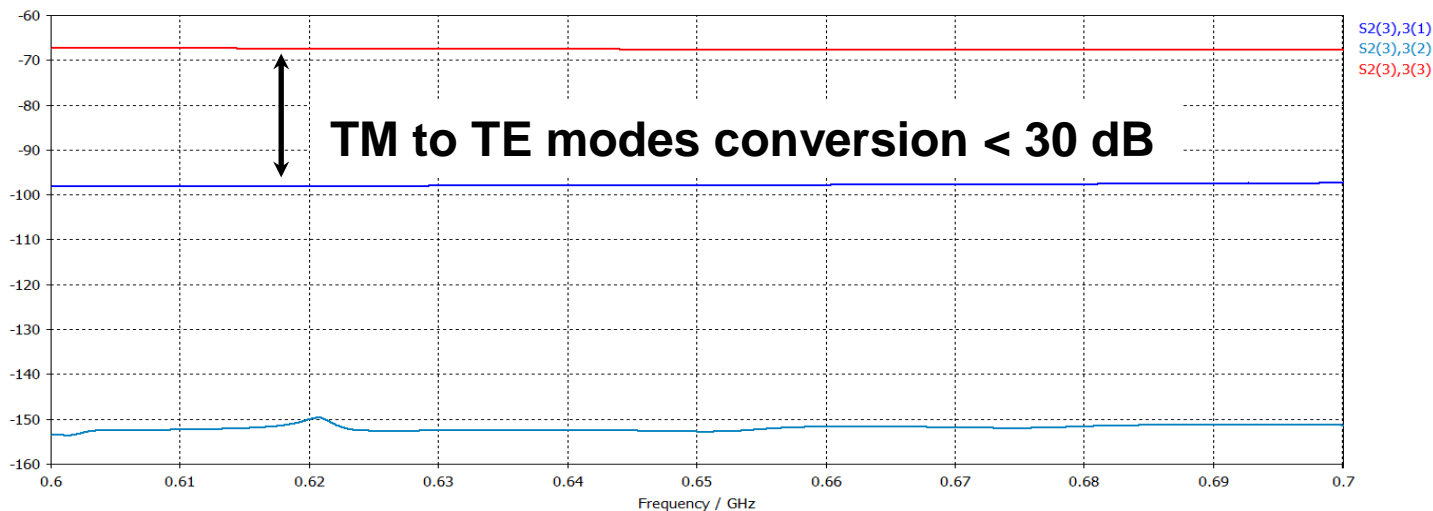
TE<sub>11</sub> Mode (Hor)



TM<sub>01</sub> Mode (Operating)



S-Parameter [Magnitude in dB]



Cavities cross coupling due to conversion to dipole modes is negligible !

The double step TM→TE→TM conversion is < 60 dB while the attenuation difference for the 450mm beam pipe length is ~ 40 dB only.