



Two-Dimensional Phaseshifter-less Leaky-Wave Steering Using an Orthogonal Feeding Method

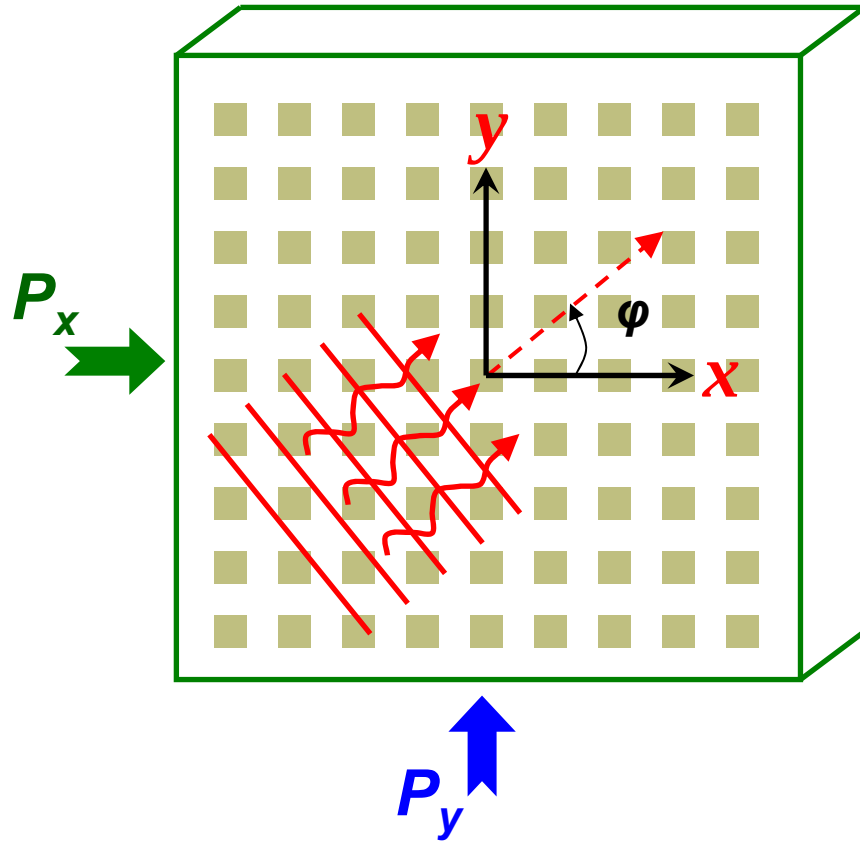
Anthony Lai, Kevin M.K.H. Leong, and Tatsuo Itoh



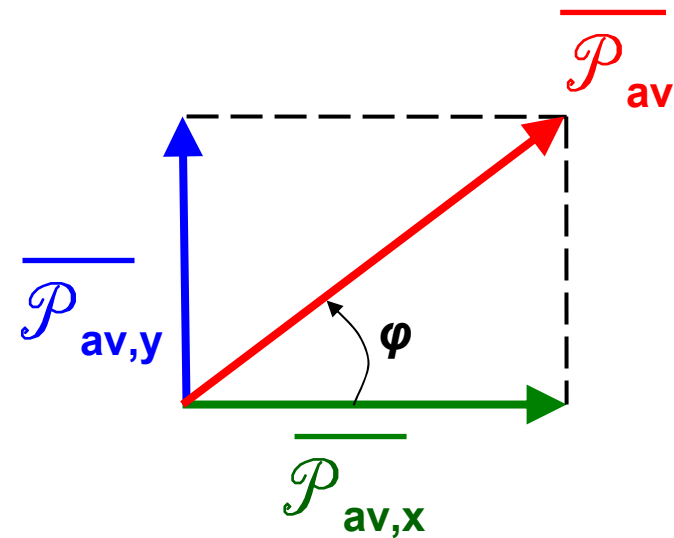
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Orthogonal Edge Feeding

Two-Dimensional Leaky-Wave Steering (Elevation + Azimuth)



Average Poynting Vector

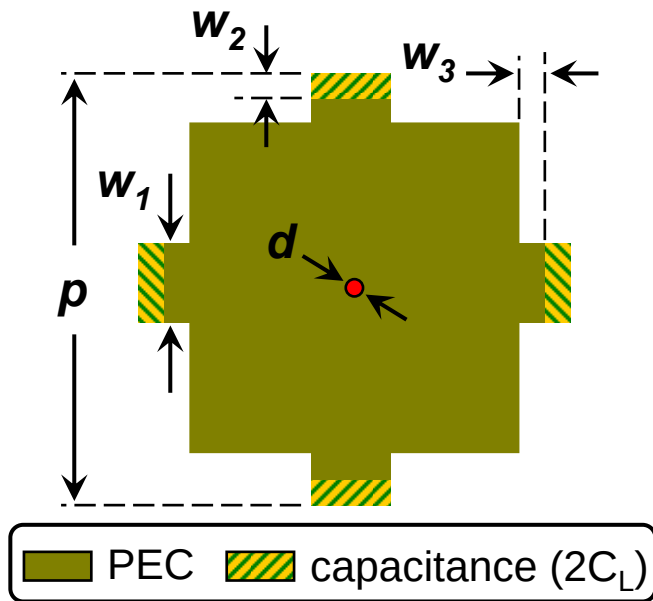


Elevation Steering: Change frequency

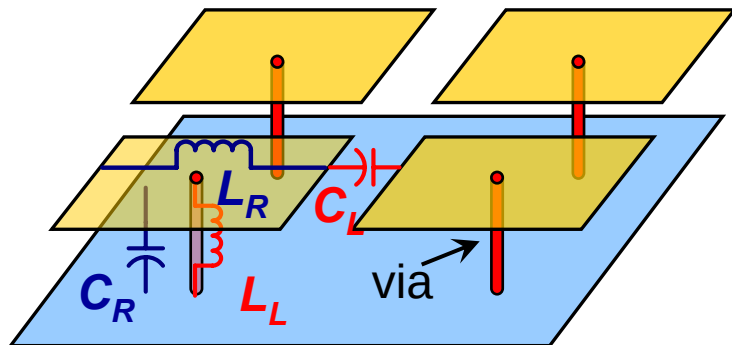
Azimuth Steering: Change power ratio

Two-Dimensional CRLH Realization

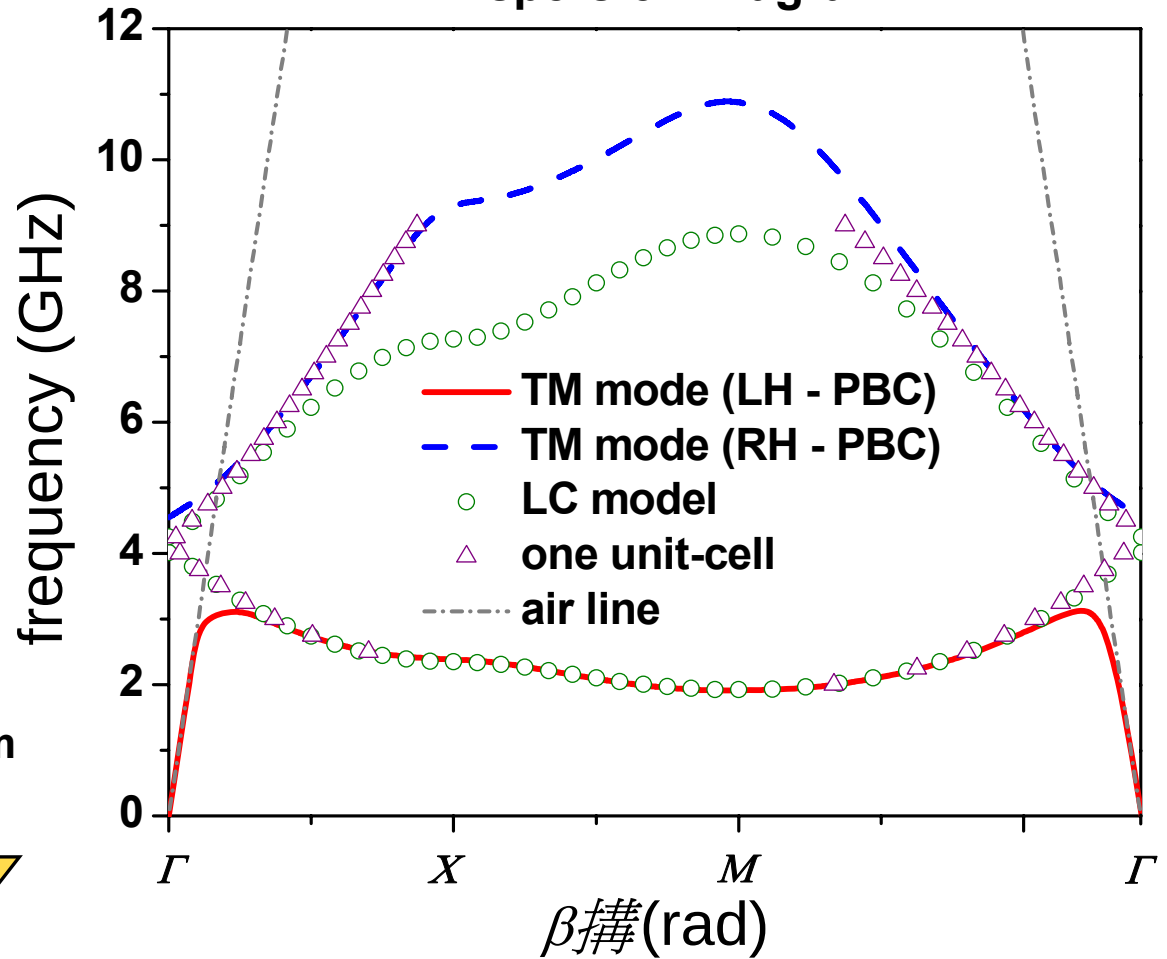
Unit-Cell



Duroid: $h=1.27$ mm, $\epsilon_R=10.2$
 $w_1=1.0$ mm, $w_2=0.2$ mm, $w_3=0.2$ mm
 $d=0.24$ mm, period, $p = 5.2$ mm



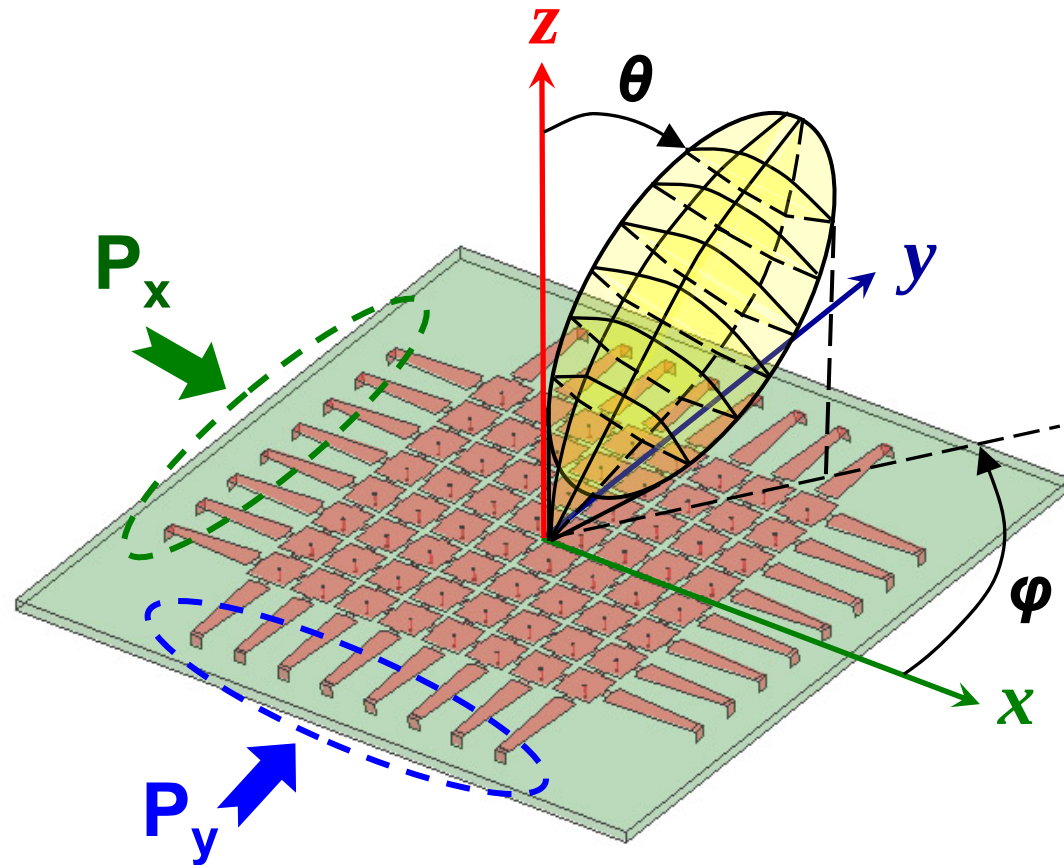
Dispersion Diagram



Extracted Parameters

$C_L = 0.75$ pF	$C_R = 2.00$ pF
$L_L = 0.70$ nH	$L_R = 2.10$ nH

Two-Dimensional Leaky-Wave Steering (8x8)



Elevation Steering

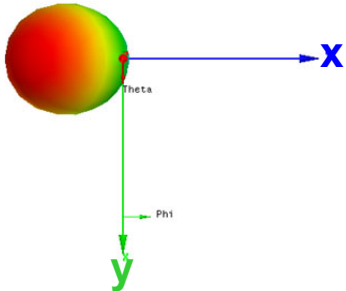
$$\theta(\omega) = \sin^{-1} \left(\frac{\beta(\omega)}{k_o} \right)$$

Azimuth Steering

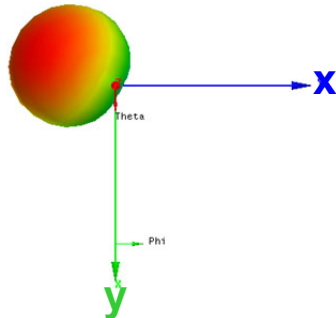
$$\varphi(\omega) \approx \tan^{-1} \left(\frac{P_y}{P_x} \right)$$

8x8 Unit-Cells: HFSS Azimuth Simulation

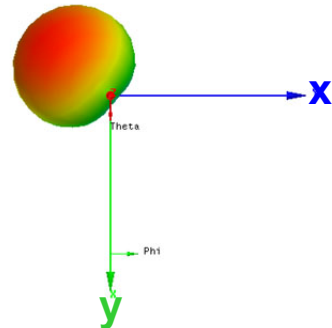
$$P_y:P_x = 1:0$$



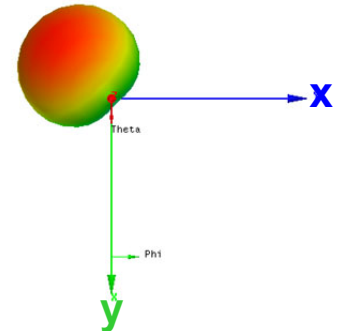
$$P_y:P_x = 1:0.4$$



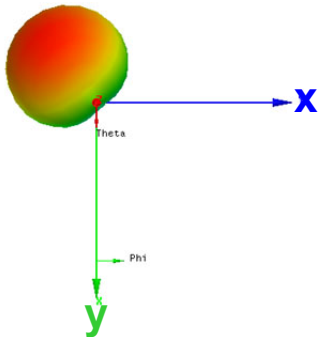
$$P_y:P_x = 1:0.8$$



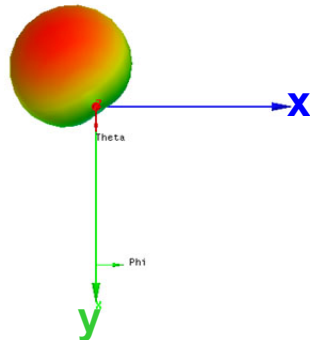
$$P_y:P_x = 1:1$$



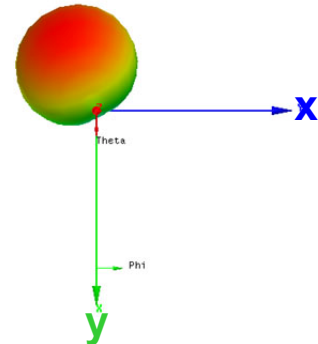
$$P_y:P_x = 0.8:1$$



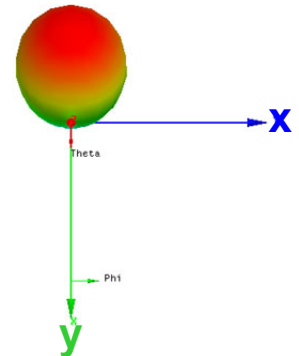
$$P_y:P_x = 0.6:1$$



$$P_y:P_x = 0.4:1$$



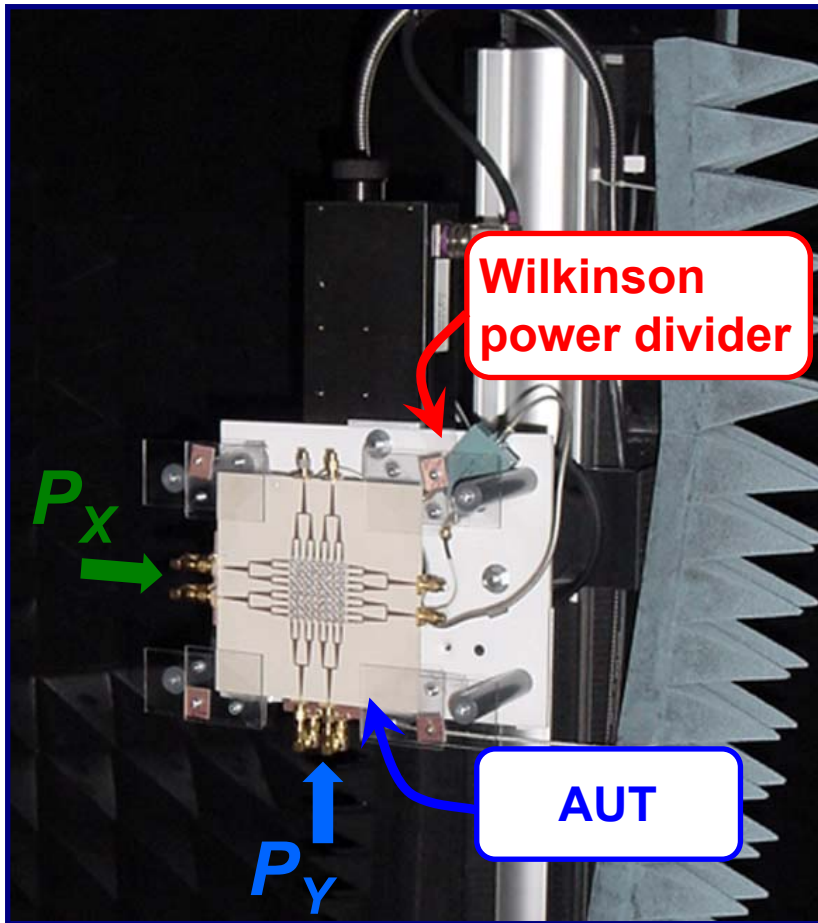
$$P_y:P_x = 0:1$$



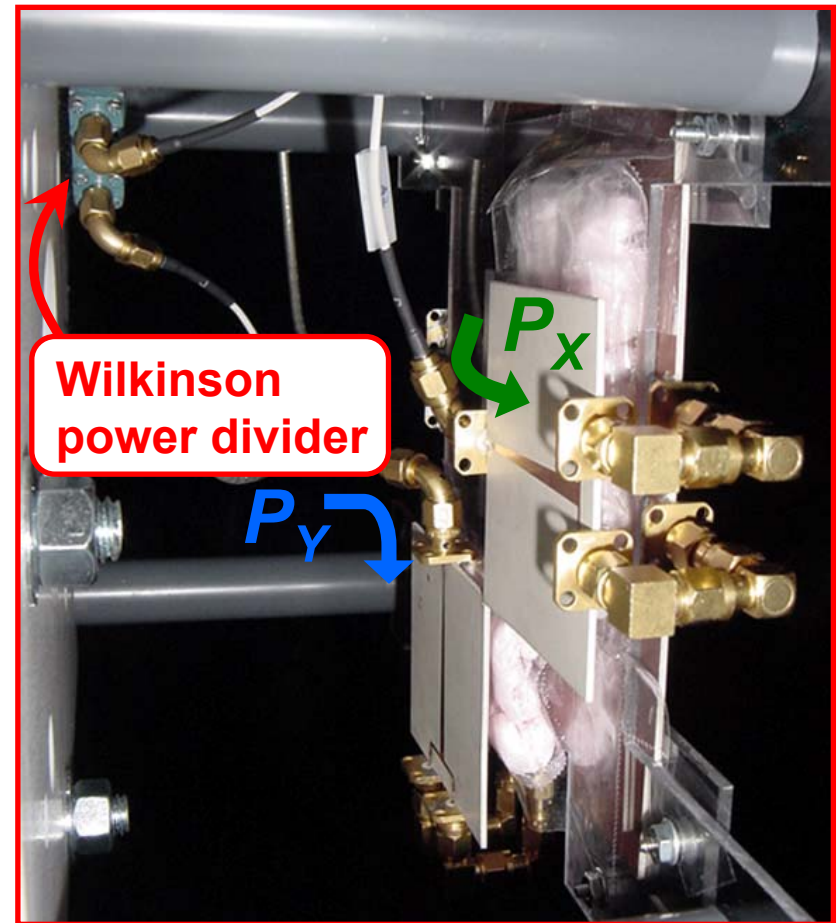
(LH region operation: $f = 3.5$ GHz): Backward elevation angle

Radiation Measurement Setup

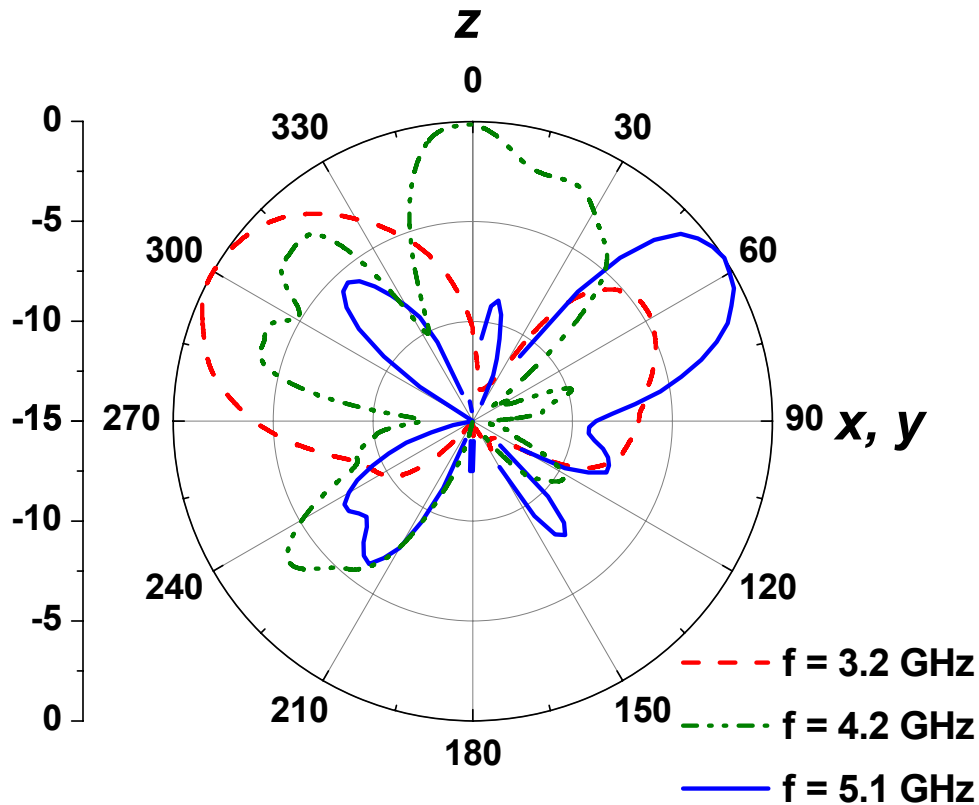
Front View



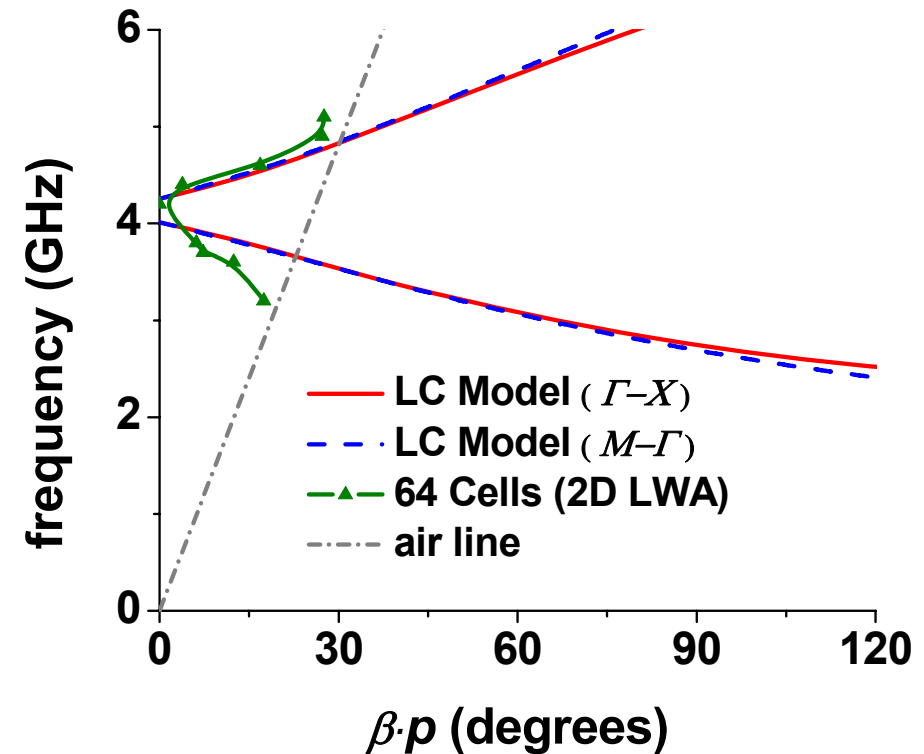
Back View



Measured Far-Field Pattern



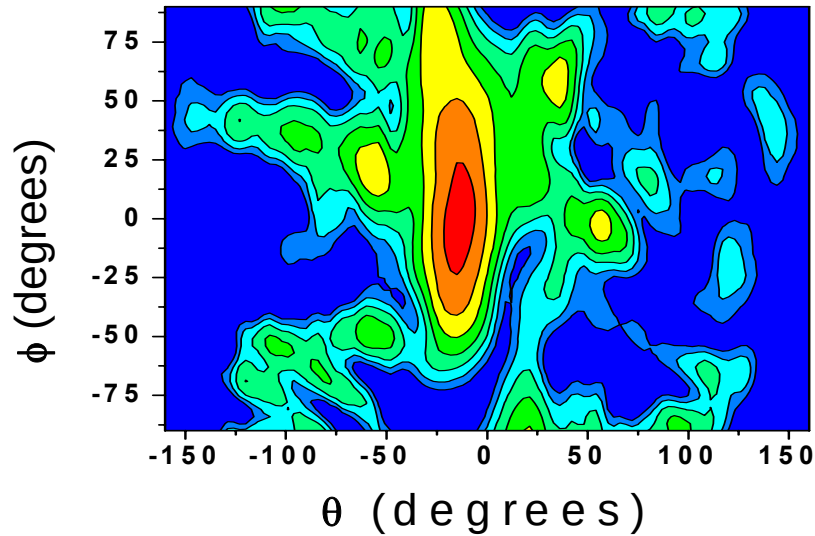
Dispersion Diagram



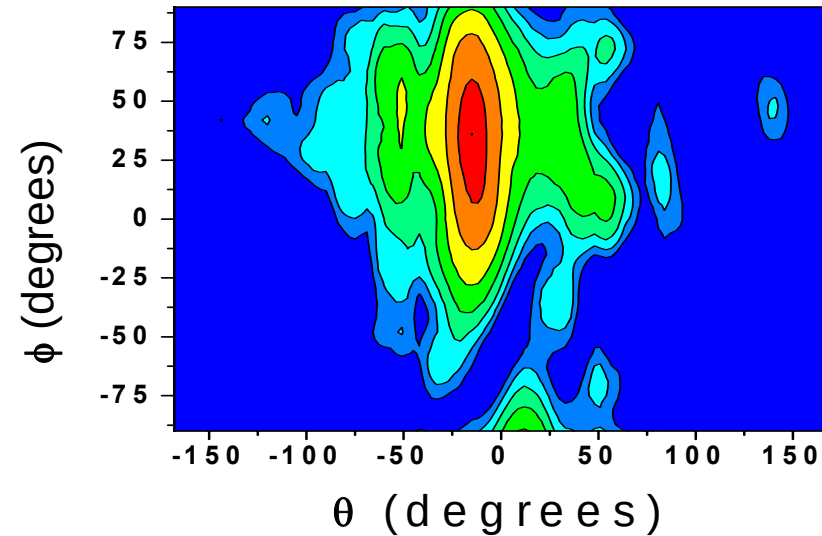
$$\theta(\omega) = \sin^{-1} \left(\frac{\beta(\omega)}{k_o} \right)$$

Measured Far-field @ 3.80 GHz

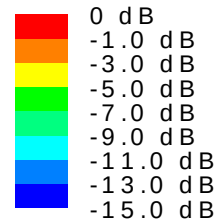
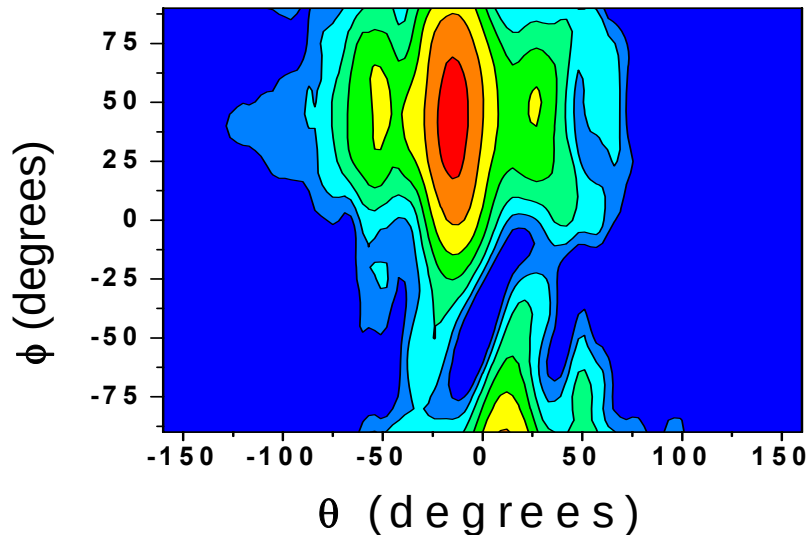
$P_y:P_x = 0.16:1$



$P_y:P_x = 0.4:1$



$P_y:P_x = 1:1$



Summary

$P_y:P_x$	Φ	θ
0.16:1	3°	-15°
0.4:1	33°	-15°
1:1	43°	-15°