2-D Frequency-Controlled Beam-Steering by a Leaky/Guided-Wave Transmission Line Array

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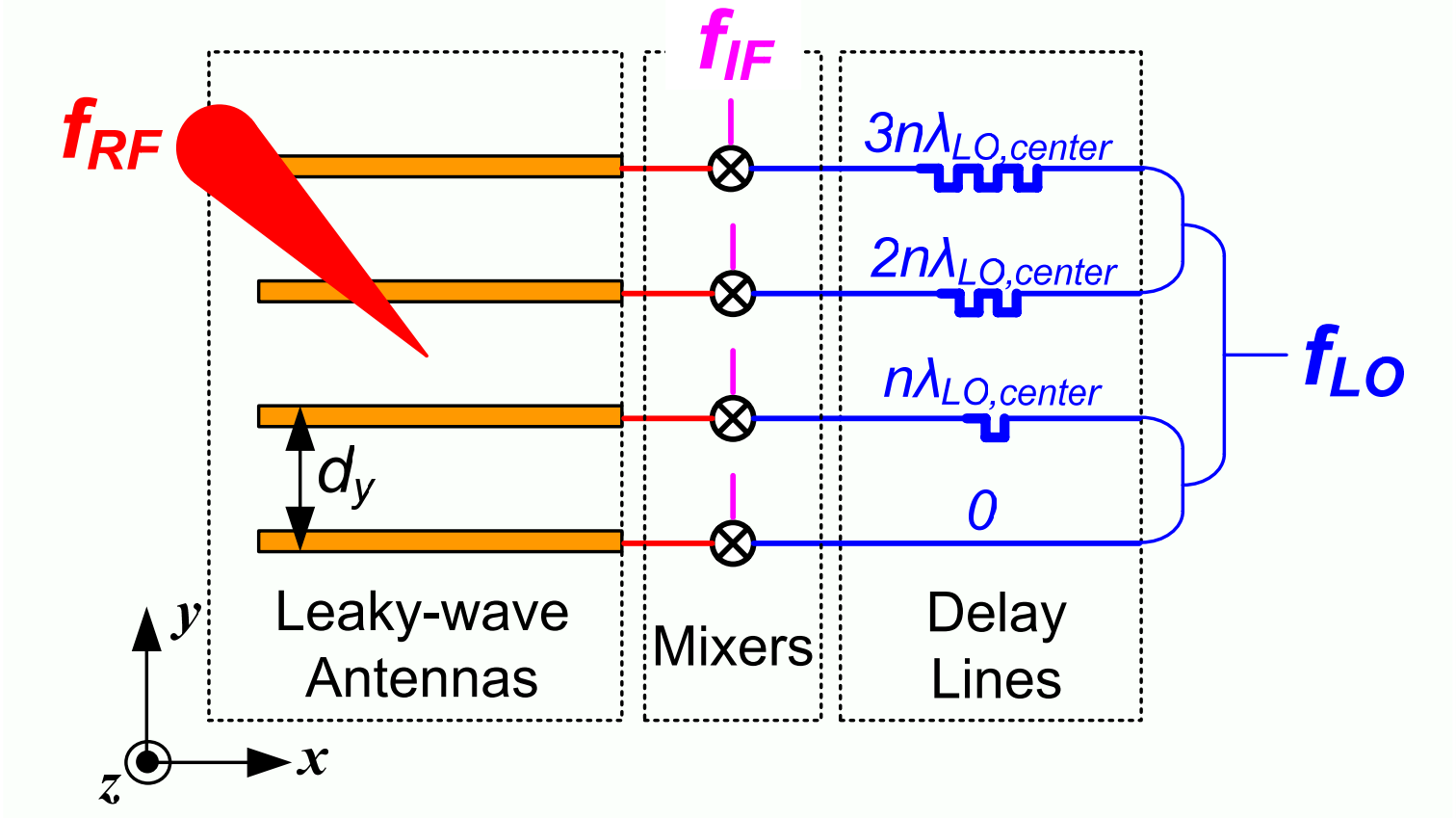
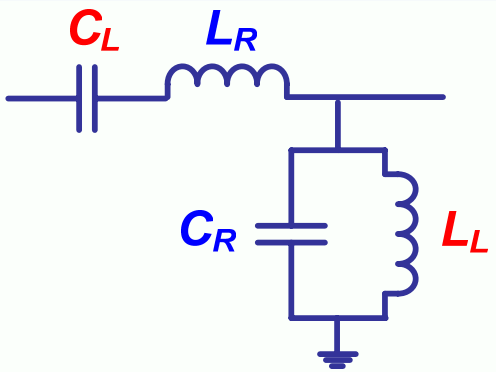
Two-Dimension Beam-Steering - Linear LWA Array



- $\varphi_x(f_{RF})$: phase/frequency of leaky-wave structure
- $\varphi_y(f_{LF})$: due to Transmission line delay lines
- φ_X and φ_y independent because of heterodyne mixing

Composite Right/Left-Handed Transmission Line



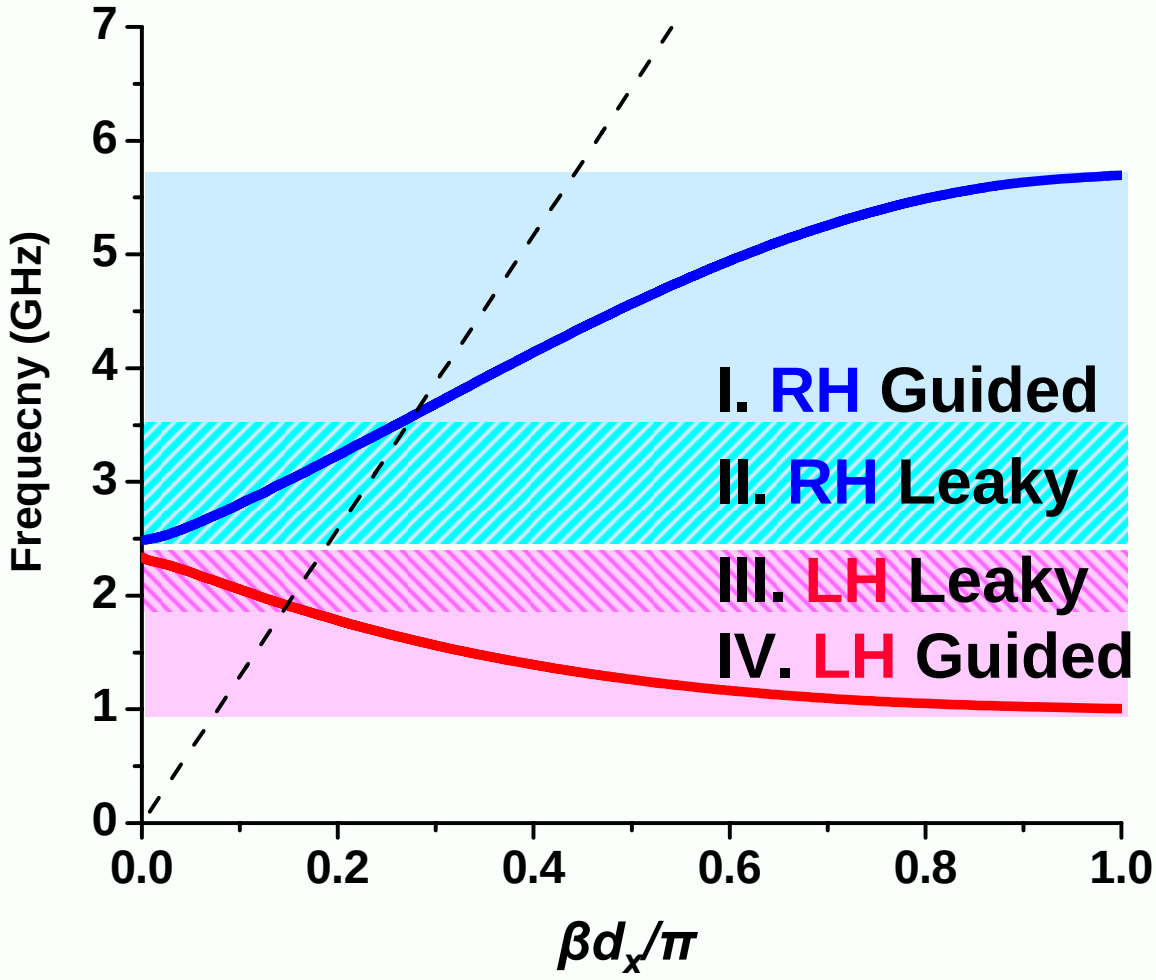
Unit Cell Circuit Model

I. *RH Guided*
> 3.5 GHz

II. *RH Leaky*
2.5 - 3.5 GHz

III. *LH Leaky*
1.9 - 2.4 GHz

IV. *LH Guided*
< 1.9 GHz



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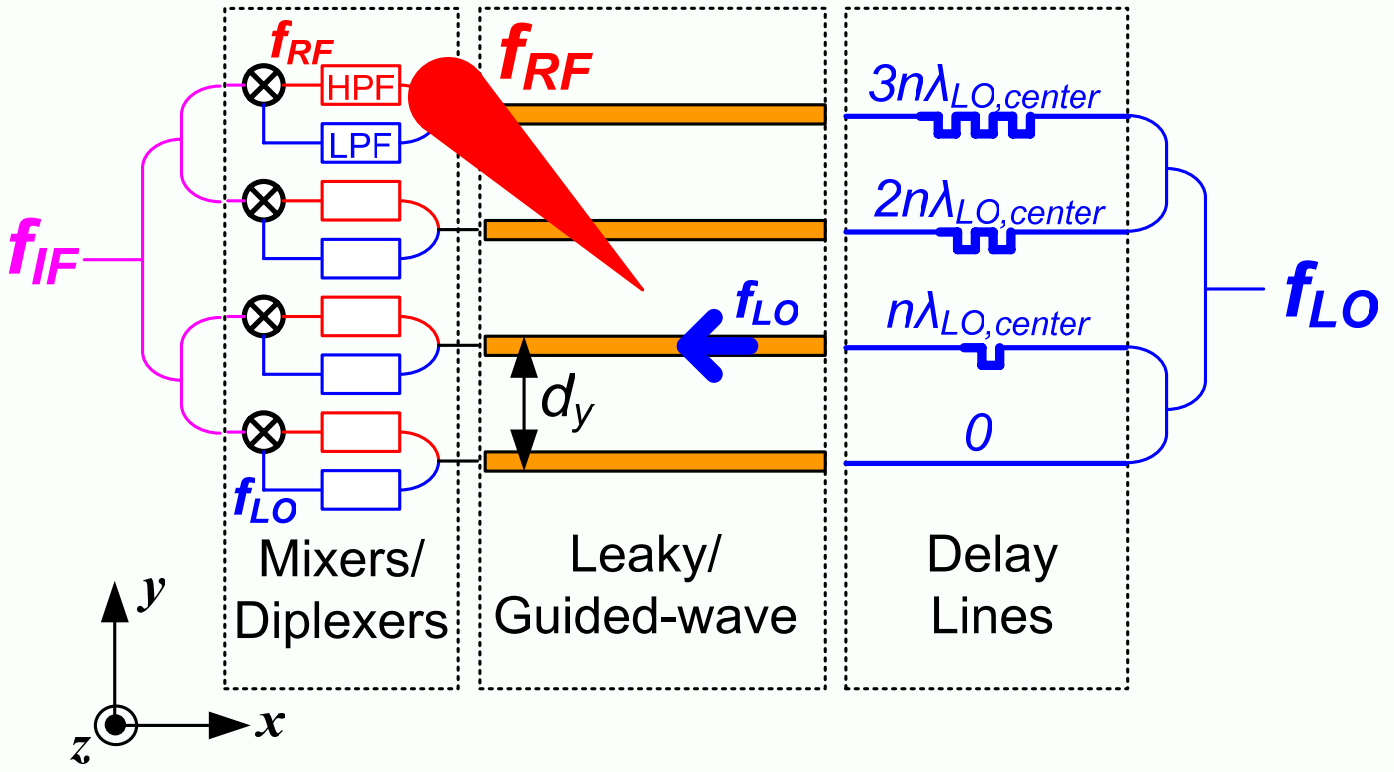
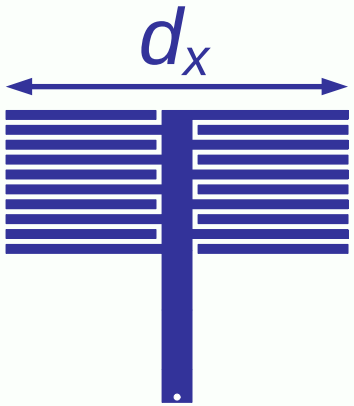
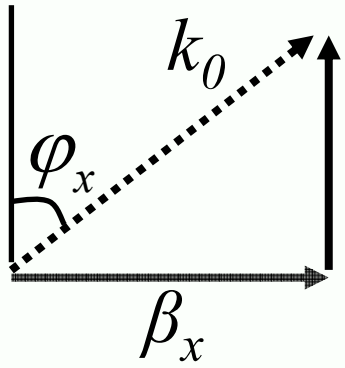


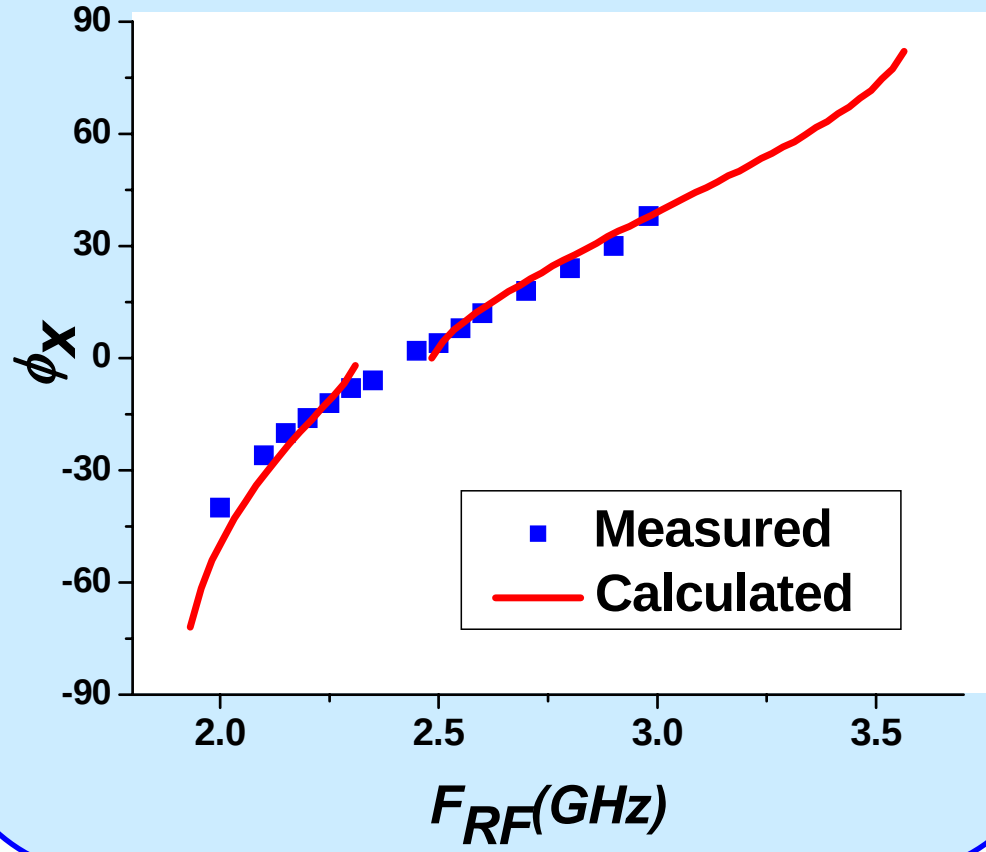
- Composite Right/Left-handed transmission line acts as Leaky/Guided-wave structure
- Utilize the guided-wave structure to act as feed line
- Simplifies feeding of mixer section

Theoretical Scanning Range – X-Z Plane

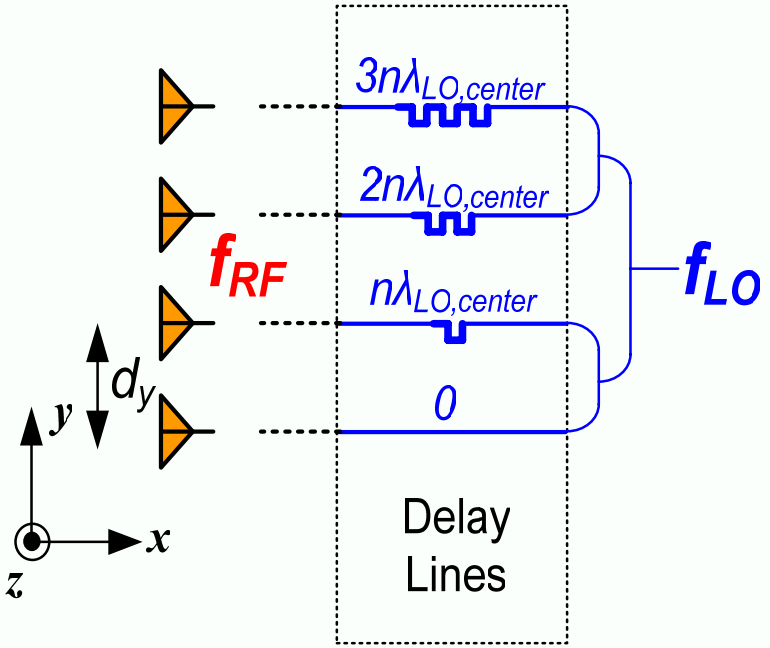




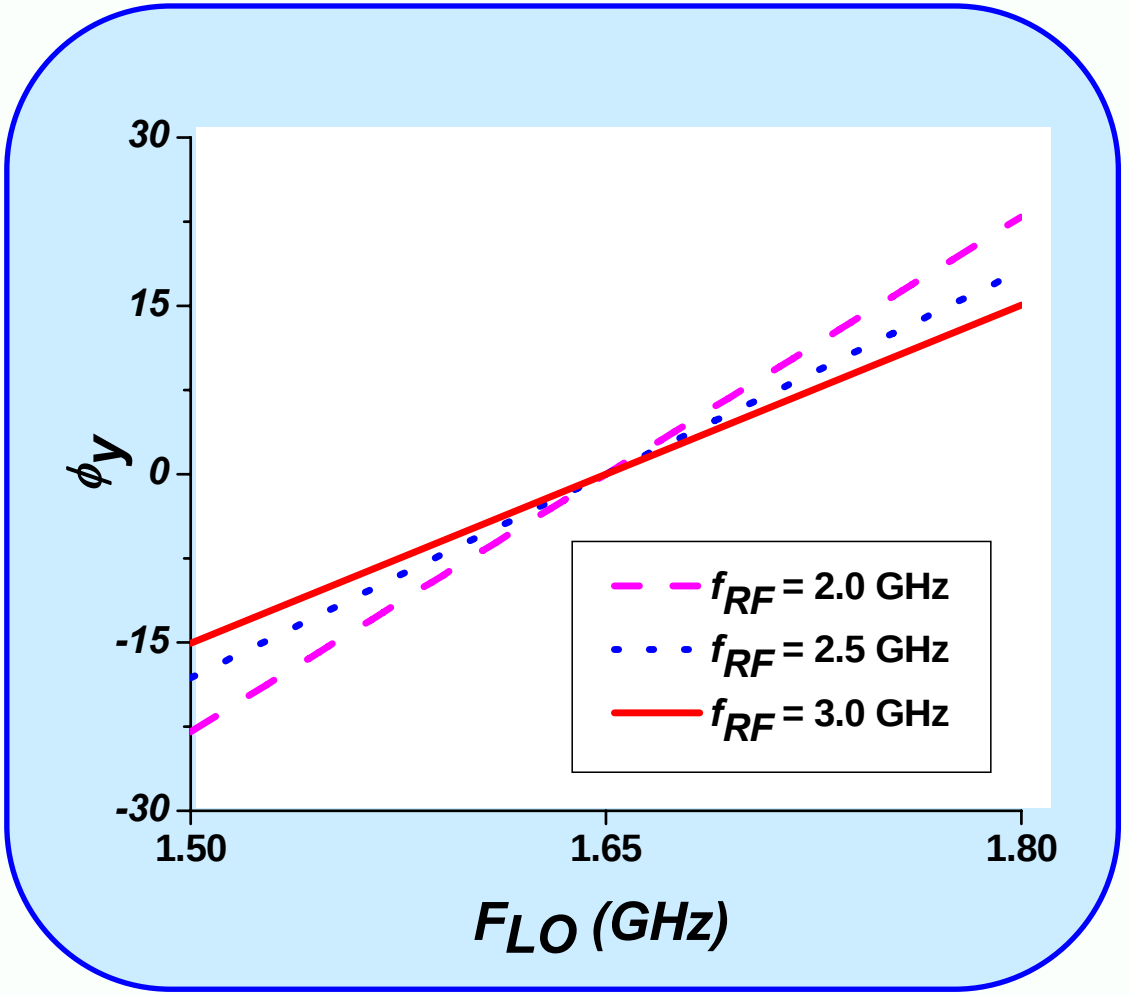
$$\sin\varphi_x = \frac{\beta_x\left(f_{RF}\right)}{k_0\left(f_{RF}\right)}$$



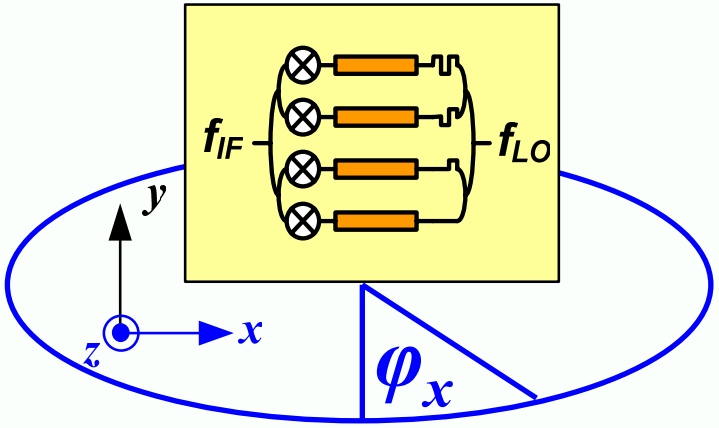
Theoretical Scanning Range – Y-Z Plane



$$\sin\varphi_y = \frac{2n\pi}{k_0(f_{RF})d_y}\,\frac{f_{LO}-f_{LO,center}}{f_{LO,center}}$$

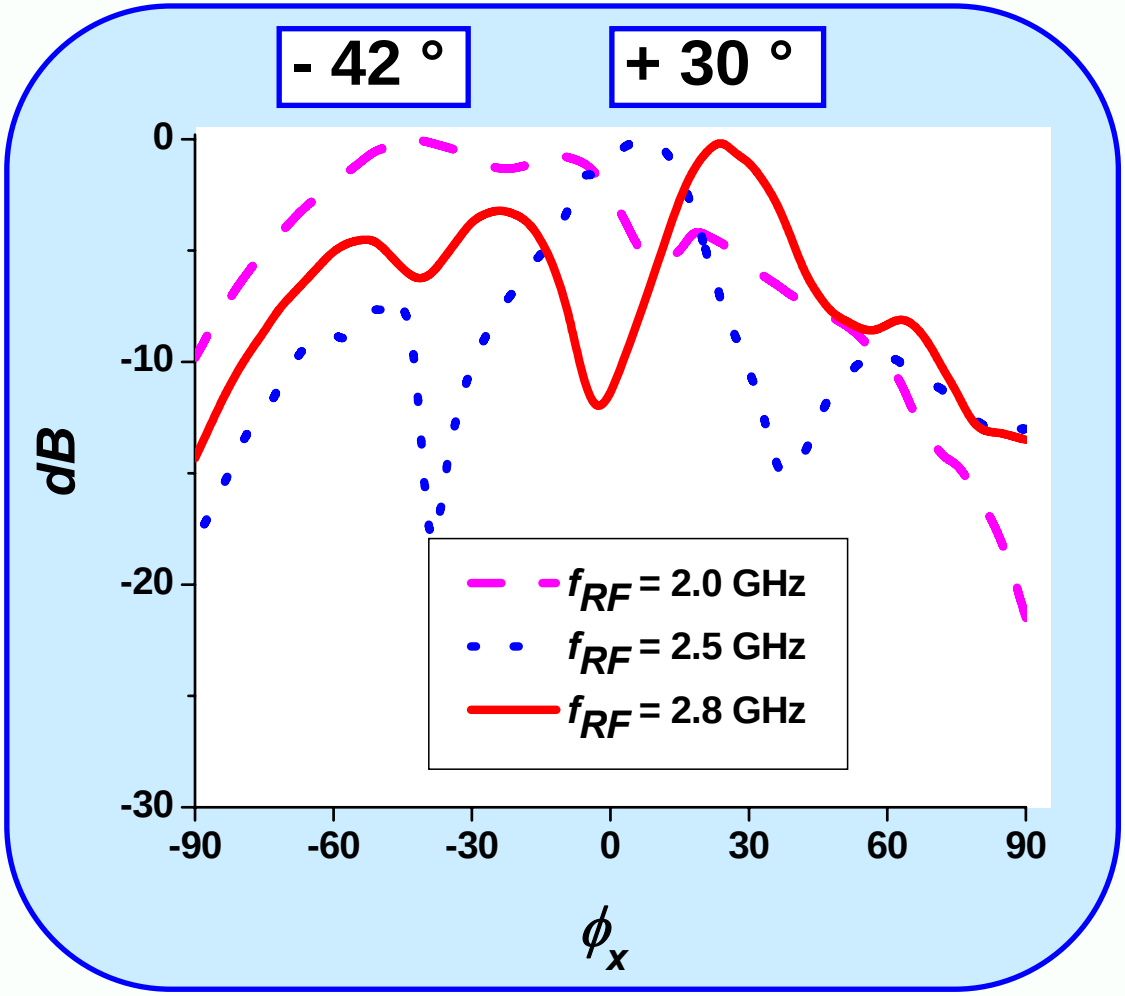


Radiation Patterns – X-Z Plane

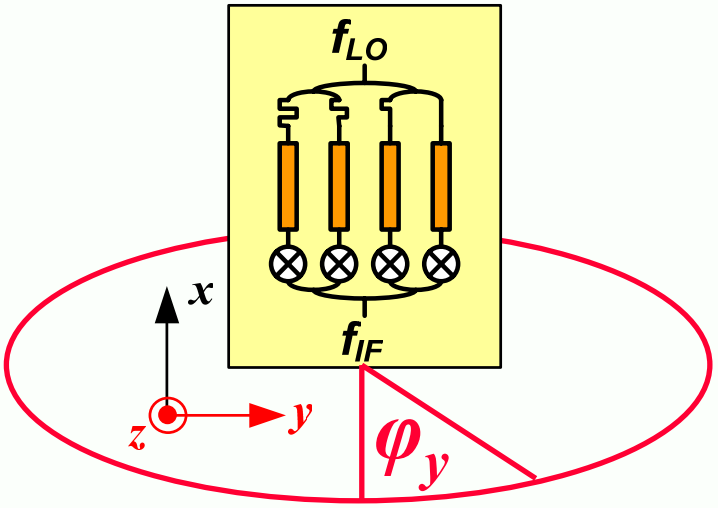


- 30°

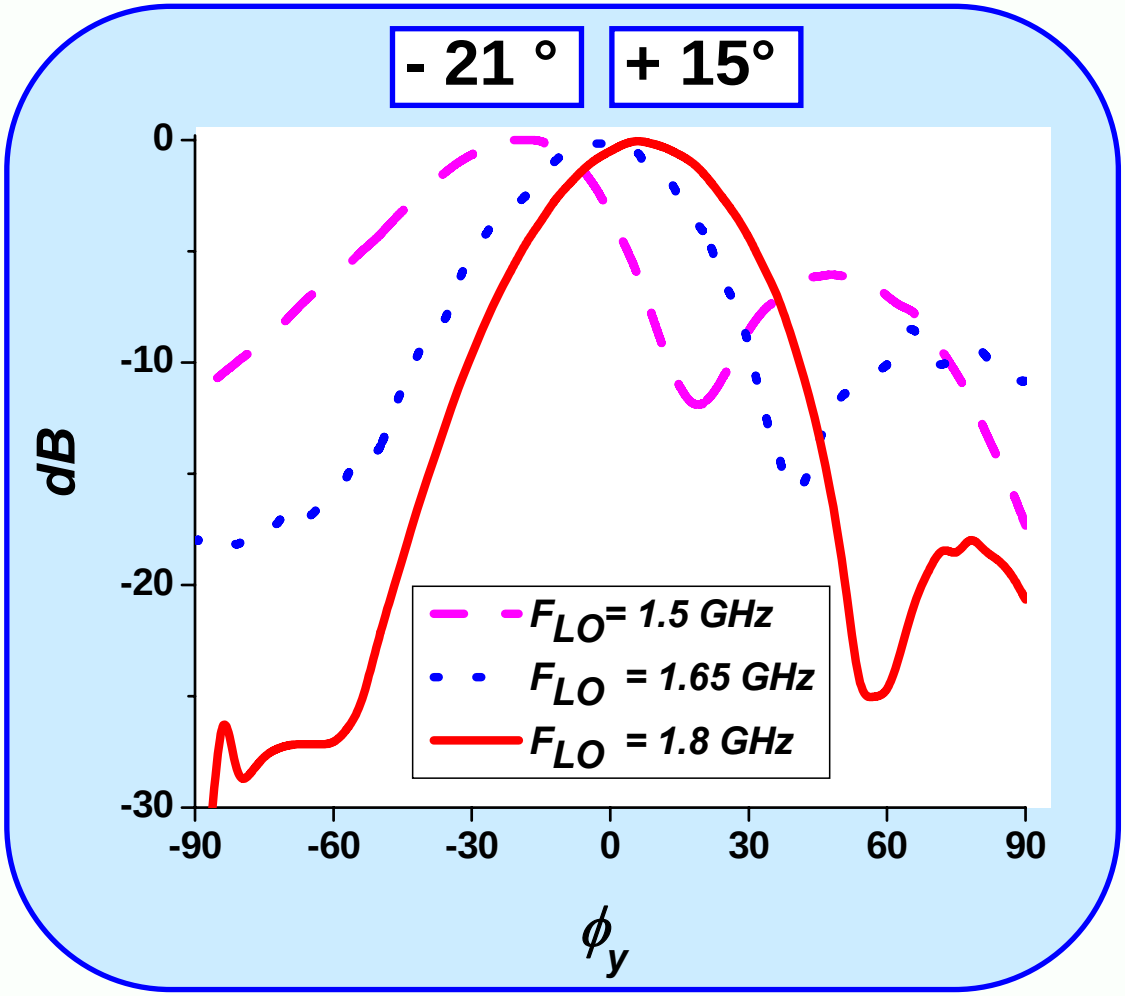
Measured for constant LO of 1.65 GHz



Radiation Patterns – Y-Z Plane



Measured for constant RF of 2.5 GHz



Total 2D Beam-Steering Performance

Theoretical Scanning Range

- Constant LO (1.5, 1.65, 1.8 GHz)
- Constant RF (2, 2.5, 2.8 GHz)

Measured Scanning Range

- For (LO, RF) points
  (1.5, 2) , (1.5, 2.5) , (1.5, 2.8)
  (1.65, 2) , (1.65, 2.5) , (1.65, 2.8)
  (1.8, 2) , (1.8, 2.5) , (1.8, 2.8)