Dual Feed Omni-directional Antenna for Adaptive Polarization and MIMO Transceivers

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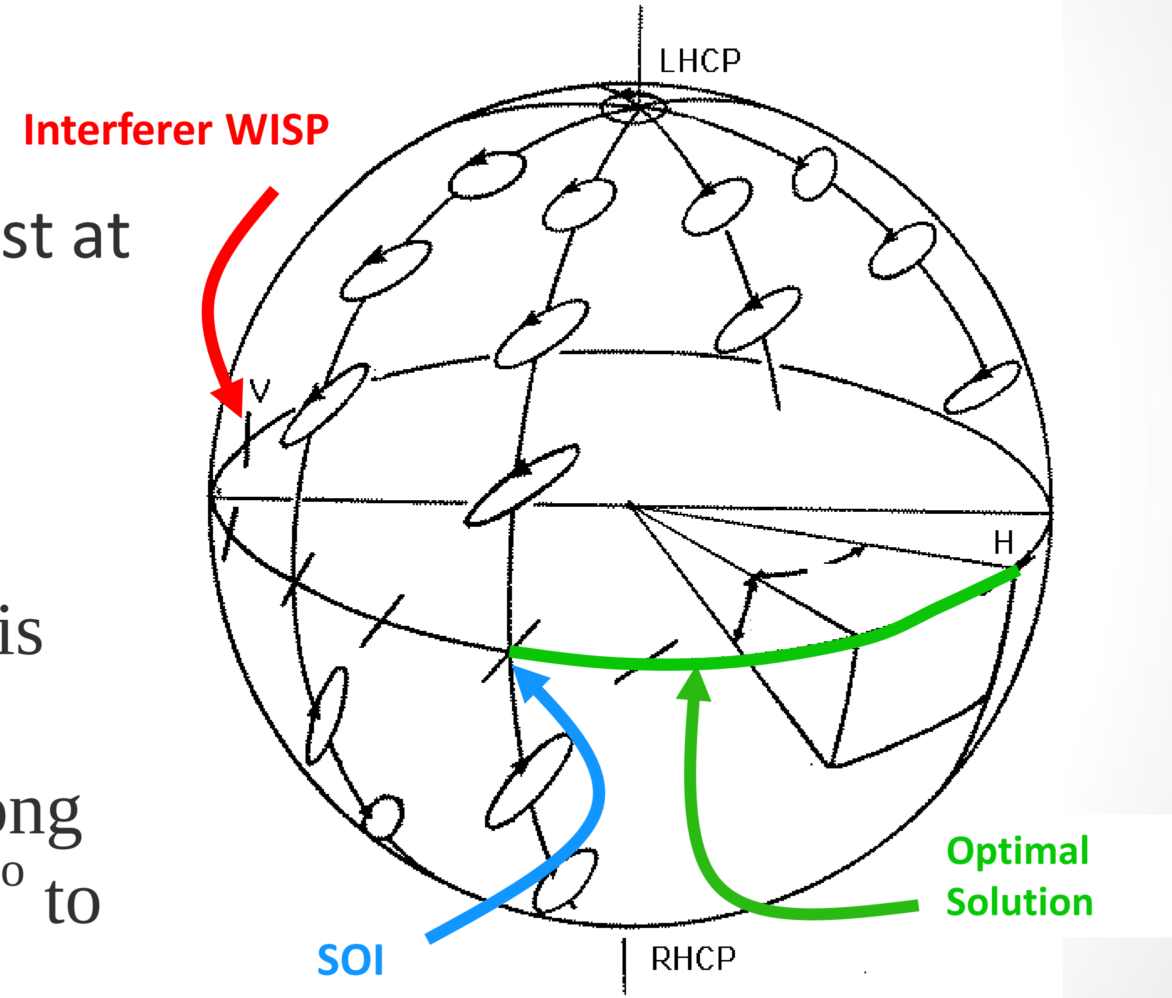
Motivation

- Adaptive Polarization (AP) can:
  - Reduce Polarization Dependent Loss (PDL)
  - Null Dominant Interferers
  - Improve MIMO system capacity
- Current Multi-Feed Multi-Polarized arrays are typically directional
- Arrays with deep pattern nulls cannot achieve the maximum AP improvements
- Goal: Develop low-cost omni-directional AP antenna for both MIMO and SISO systems

Polarization Review

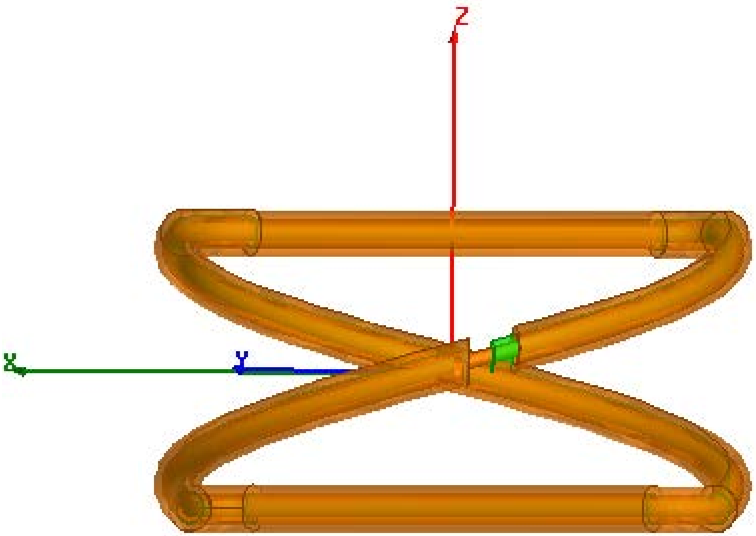
- Signal of Interest at 45°
- Strong Vertical Interferer
- Optimal SINR is achieved at a polarization along the arc from 45° to horizontal

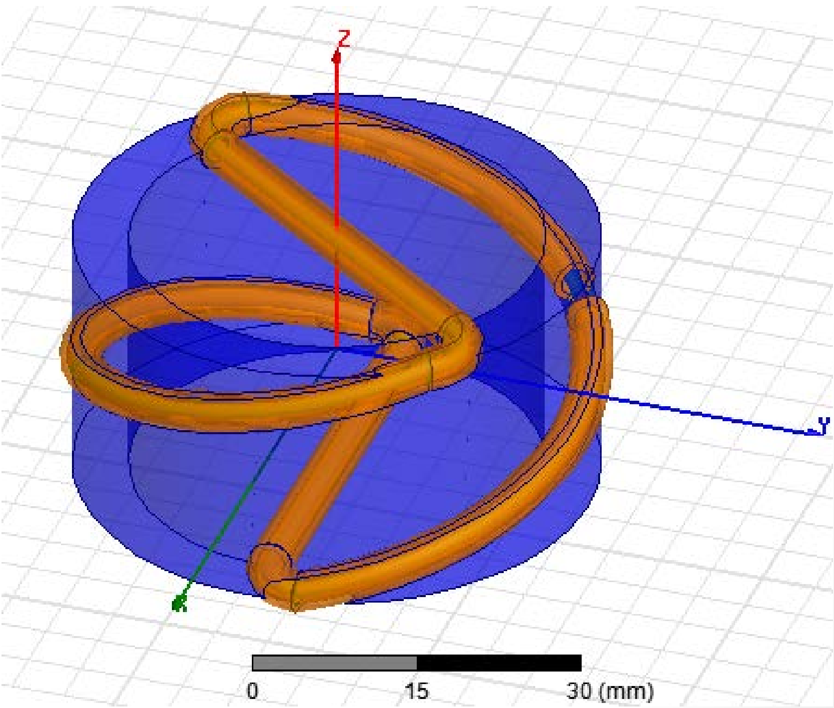


Gonzaga Design (OMPHA)

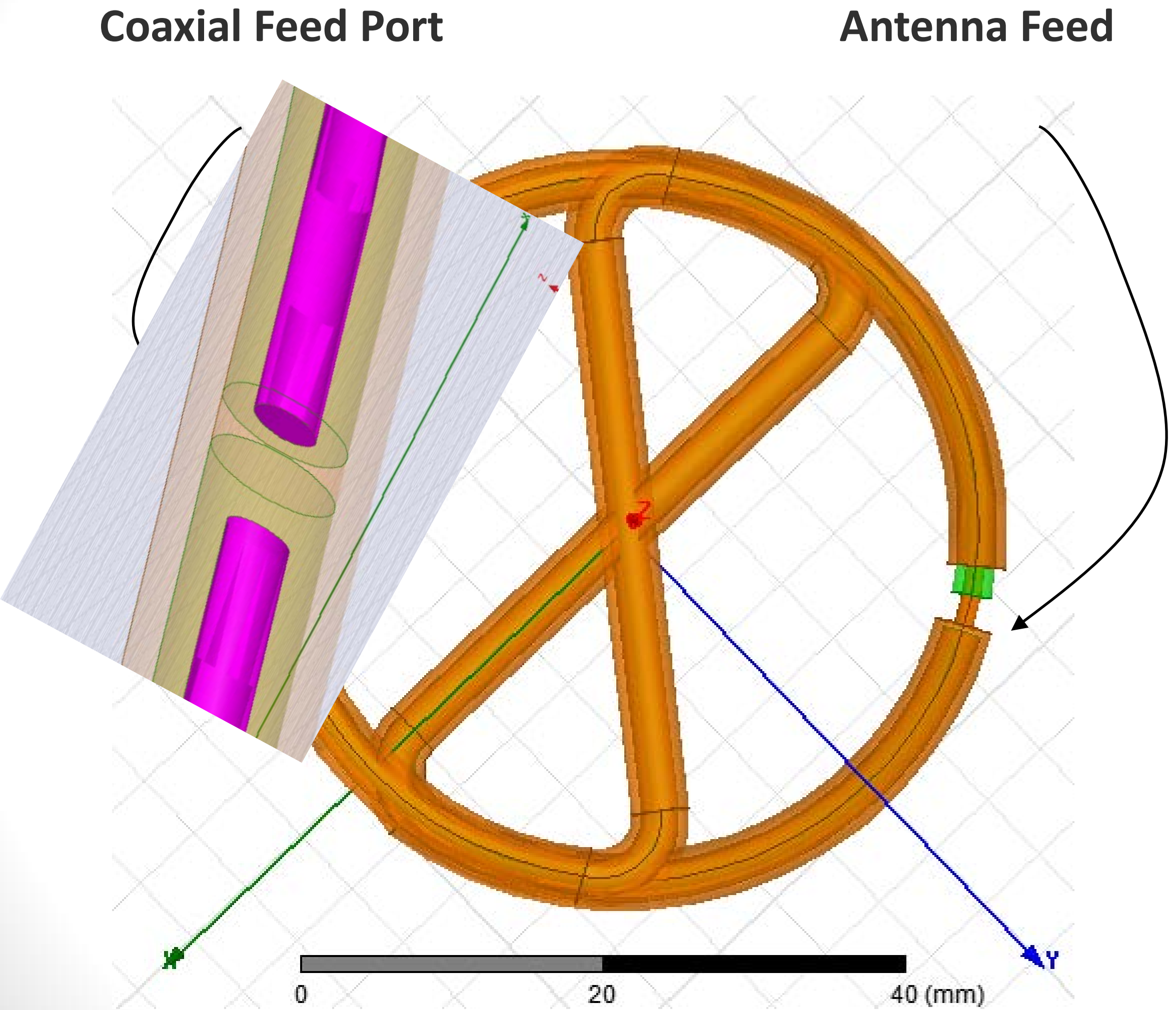
- Omni-directional Multiple Polarization Helical Antenna
- Two-element helical antenna
- Cross-polarized elements allow any polarization to be created
- 3D model captured and simulated with full wave electromagnetic solver
- Prototypes were produced and tested at Gonzaga’s Smart Antenna and Radio Lab

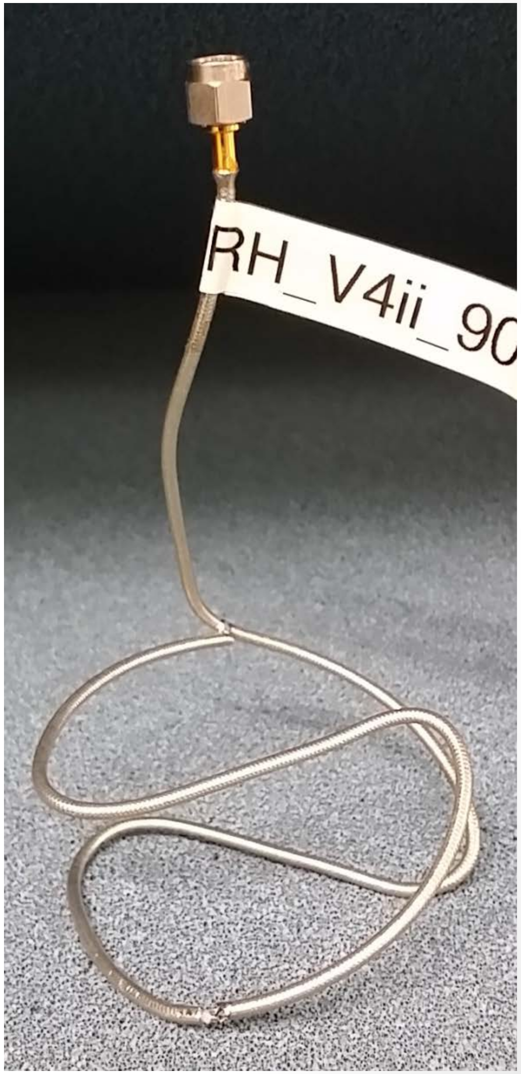
Omni-directional Circular Polarization Helical Antenna





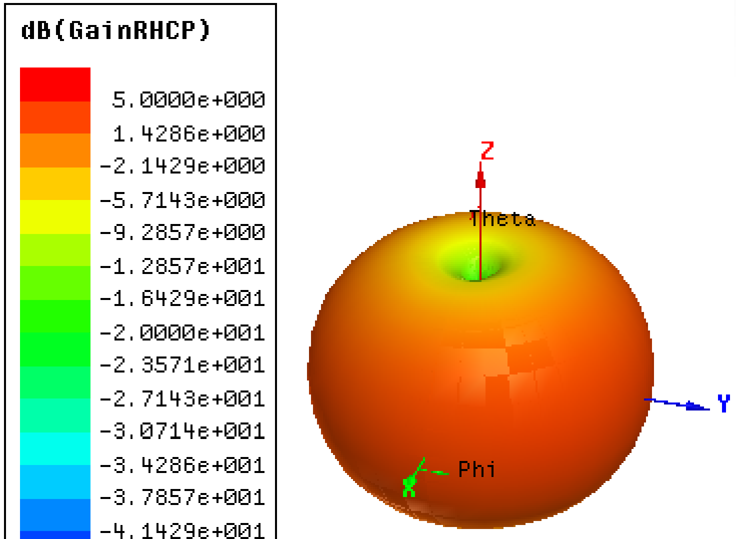
Helical Antenna Feed

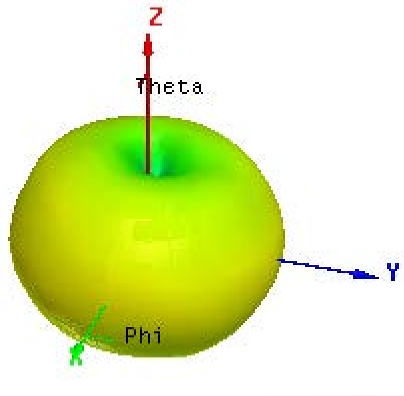




Simulated Element Results

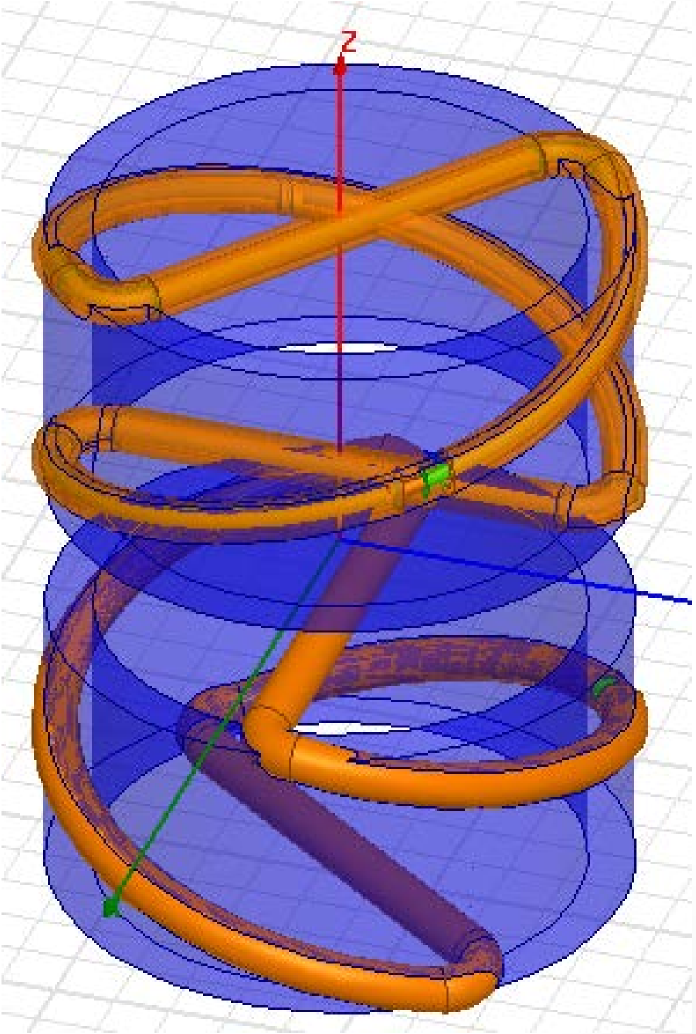
- Single element results
  - 1.5 dBi gain at horizon
  - Azimuthal gain ripple less than 3dB
  - Cross polarization rejection 10 to 12dB
  - Axial ratio <2dB in 360°
  - Center frequency at 902
  - Return loss -8.75dB





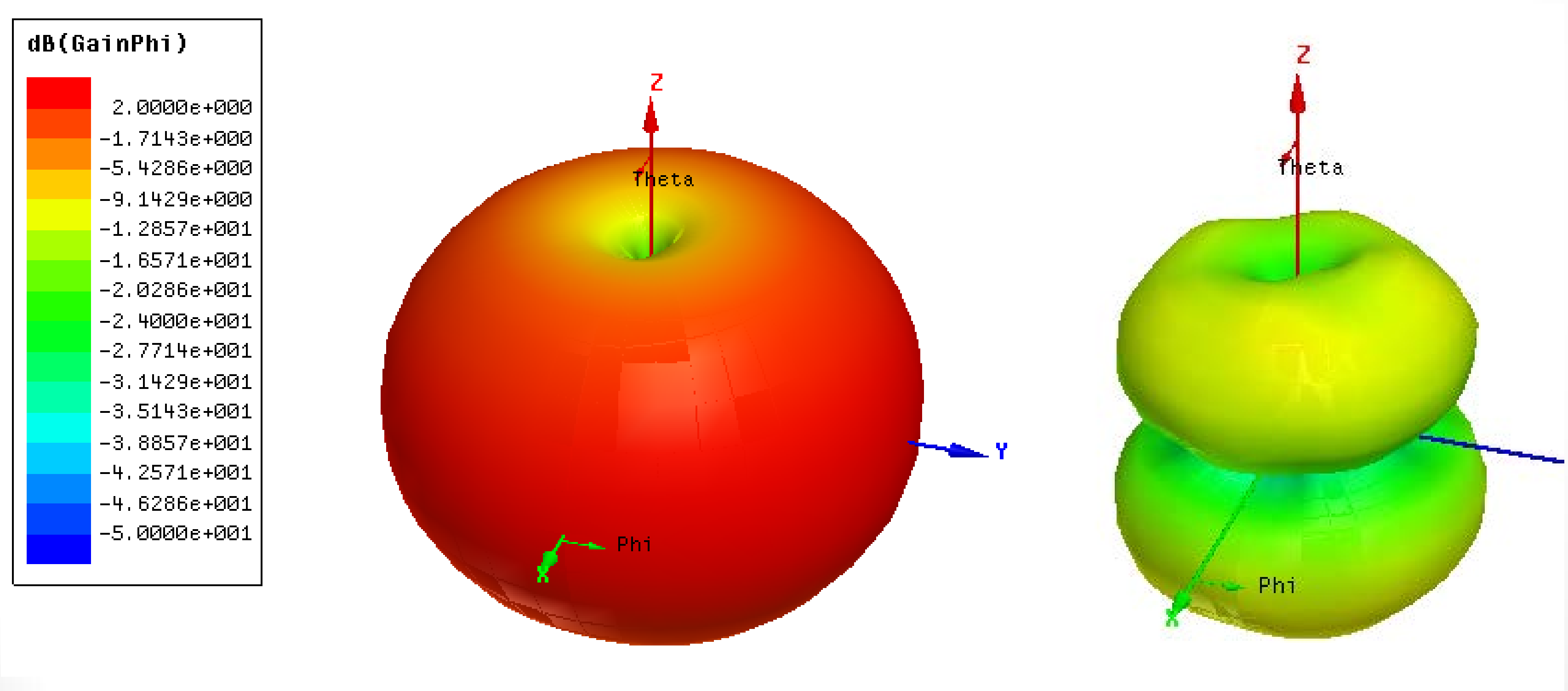
Simulated Array Design

- Array of two orthogonal elements
  - RH & LH circular polarization
- Array combination less that ½ wavelength
  - Supports co-linear arrays for increased gain
- Simulation Software
  - Ansys High Frequency Structure Simulator (HFSS)



Simulated Array Results

- Horizontal polarization resulting from equal phase & amplitude excitation

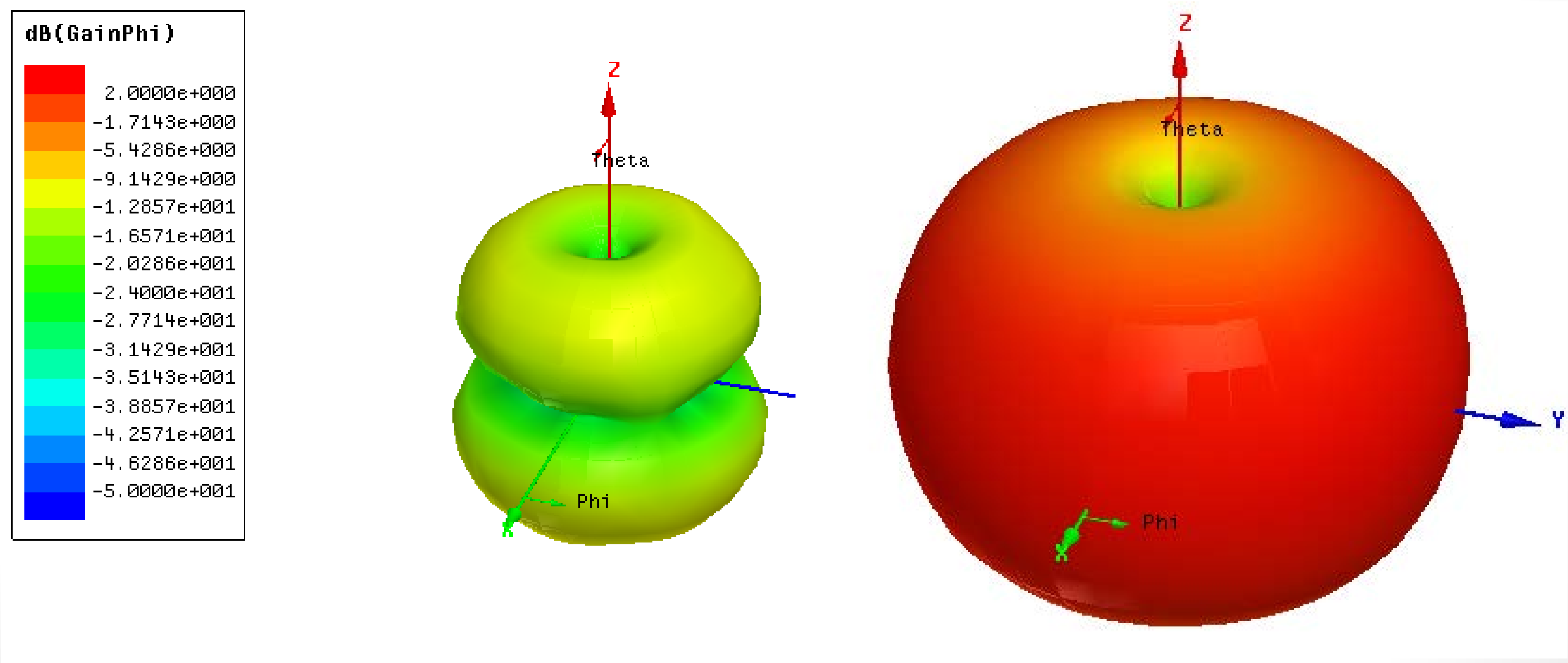


Horizontal

Vertical cross-pol

Simulated Array Results

- Vertical polarization resulting from 180º phase & equal amplitude excitation

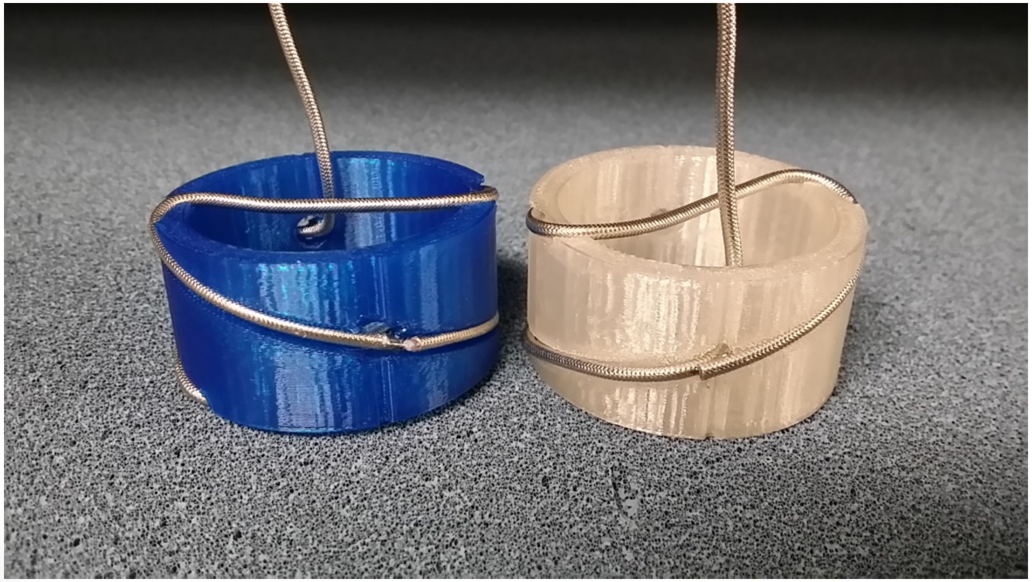


Horizontal cross-pol

Vertical

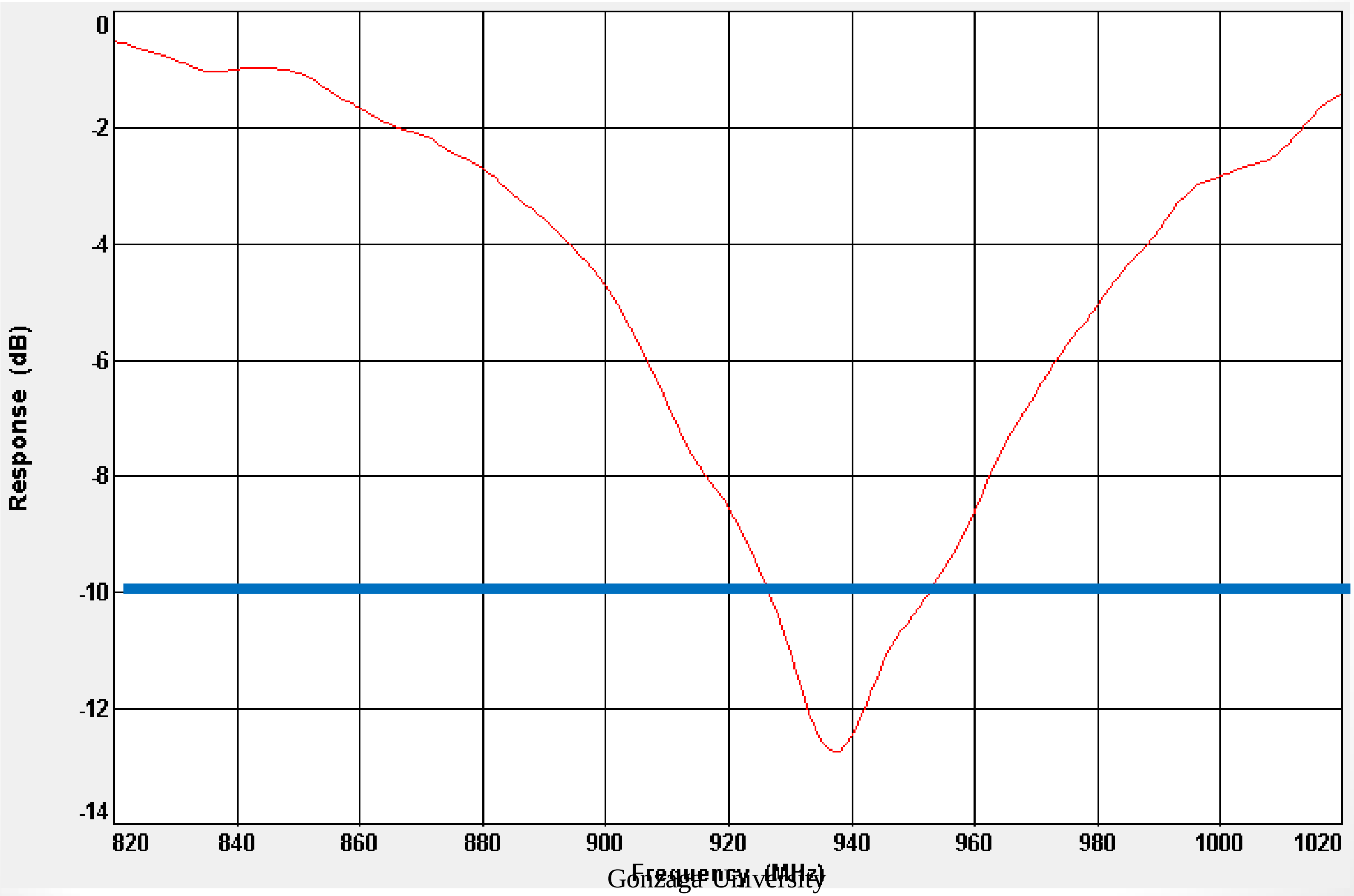
Prototypes

- Individual RH & LH elements
  - On 3D printed forms
- Arrayed for Adaptive Polarization
- Tested in Anechoic chamber



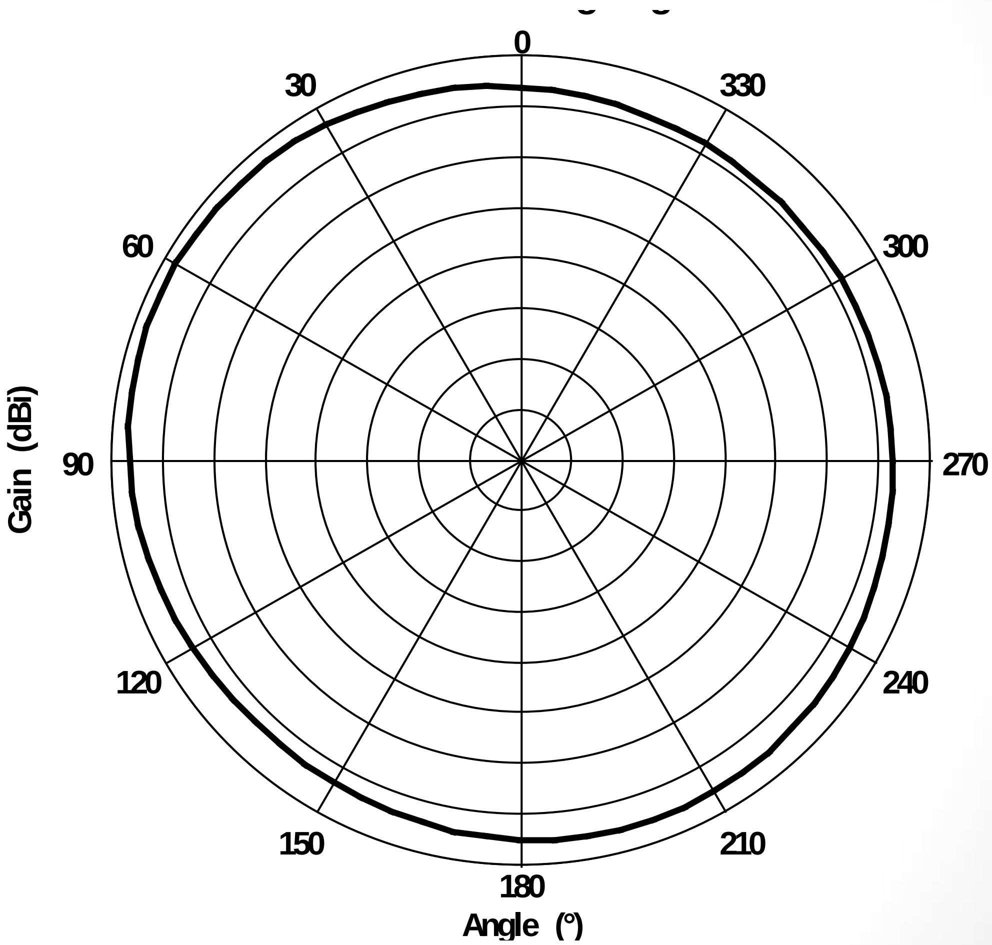
Measured Single Helix

S11 from 820 to 1020 MHz

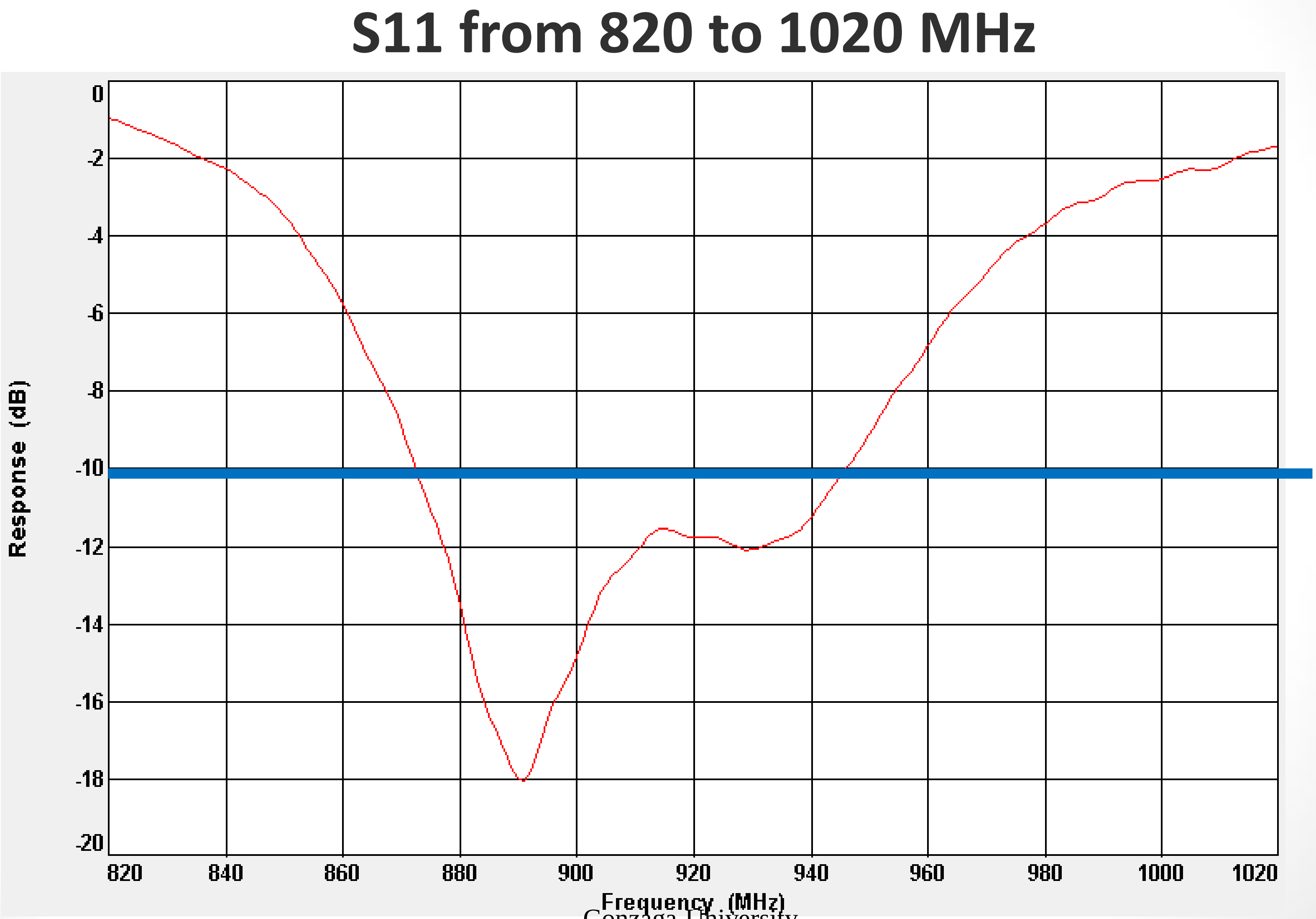


Measured Single Helix

- Azimuthal cut for LHCP Gain
- 2dB per div
- Plot maximum set at 2dBi



Measured Double Helix



Measured Double Helix

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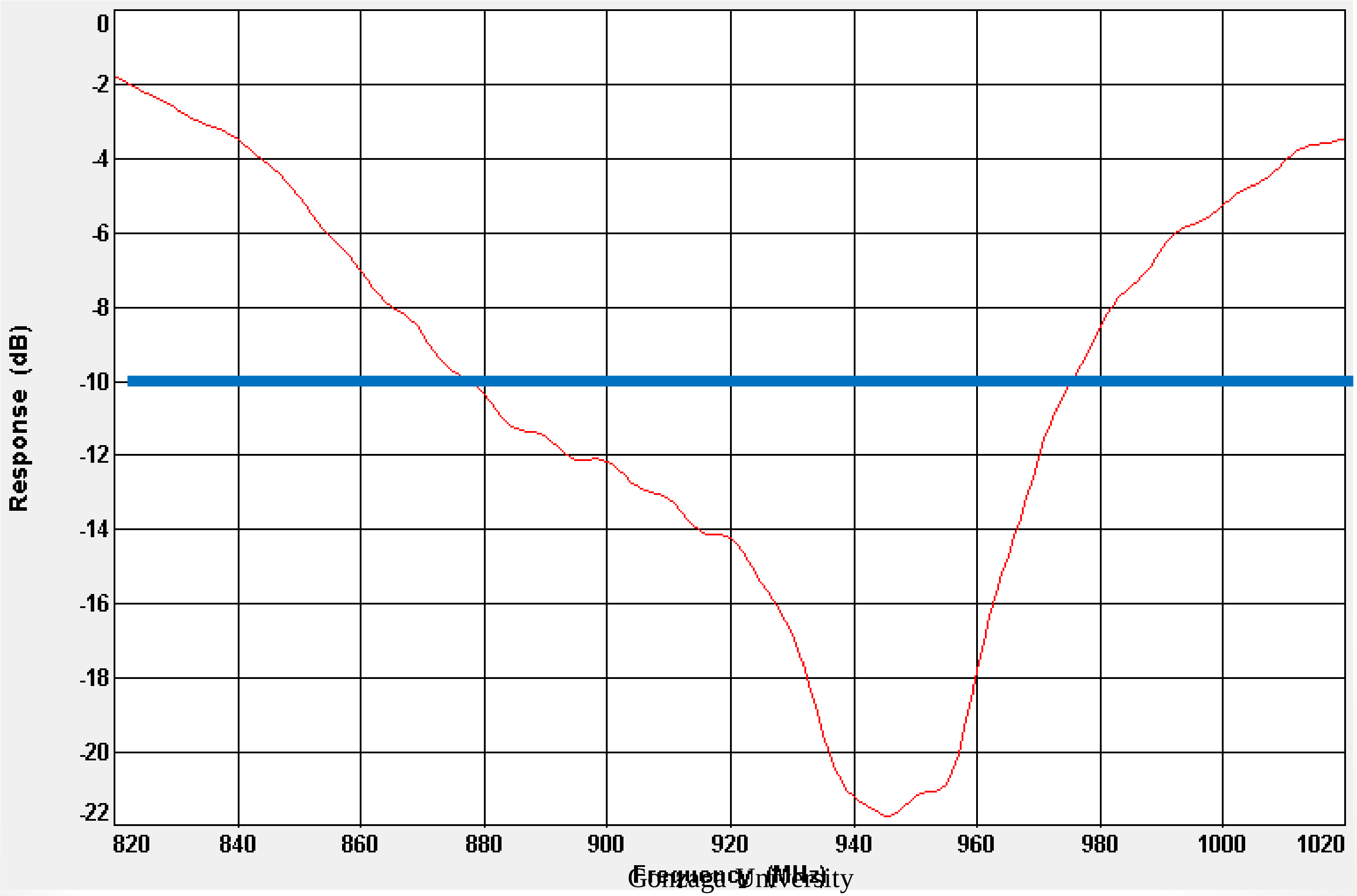
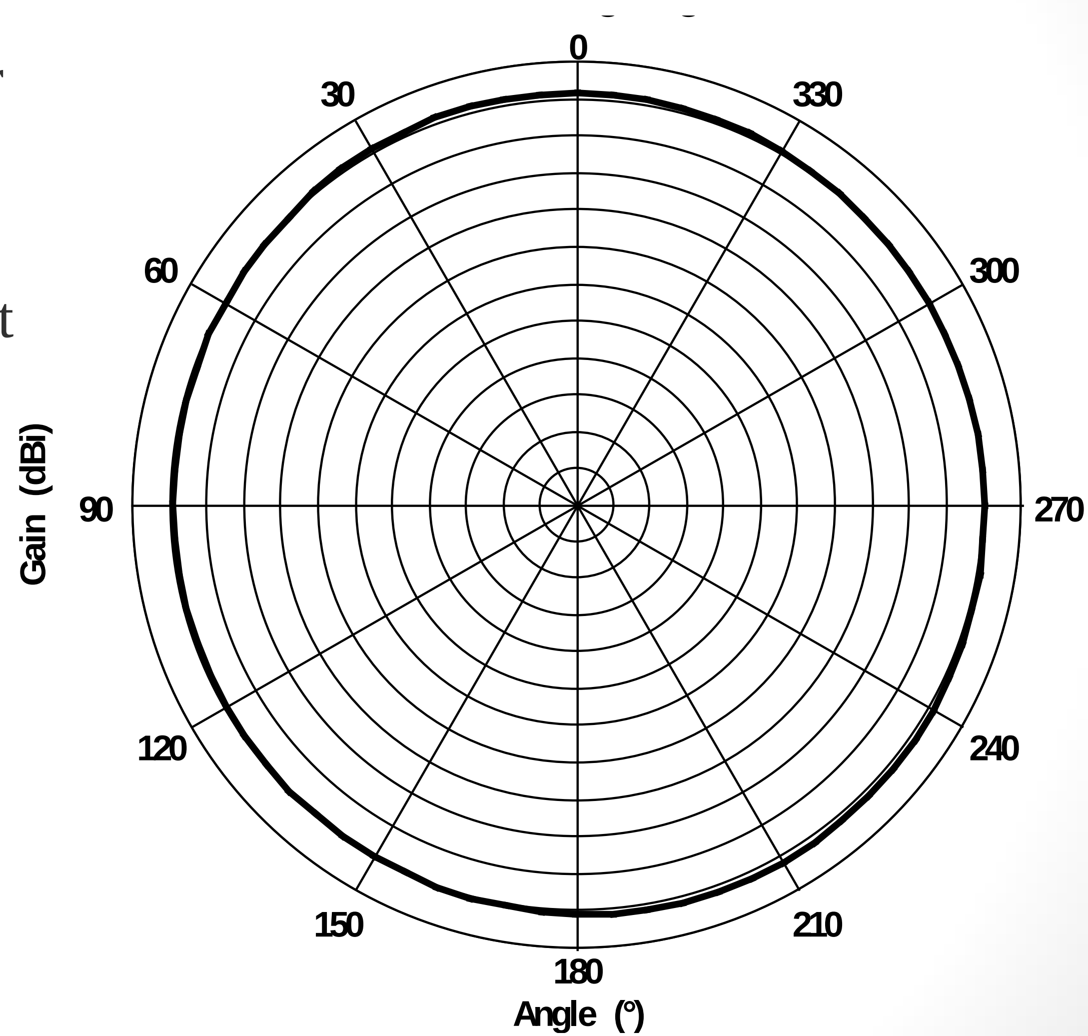
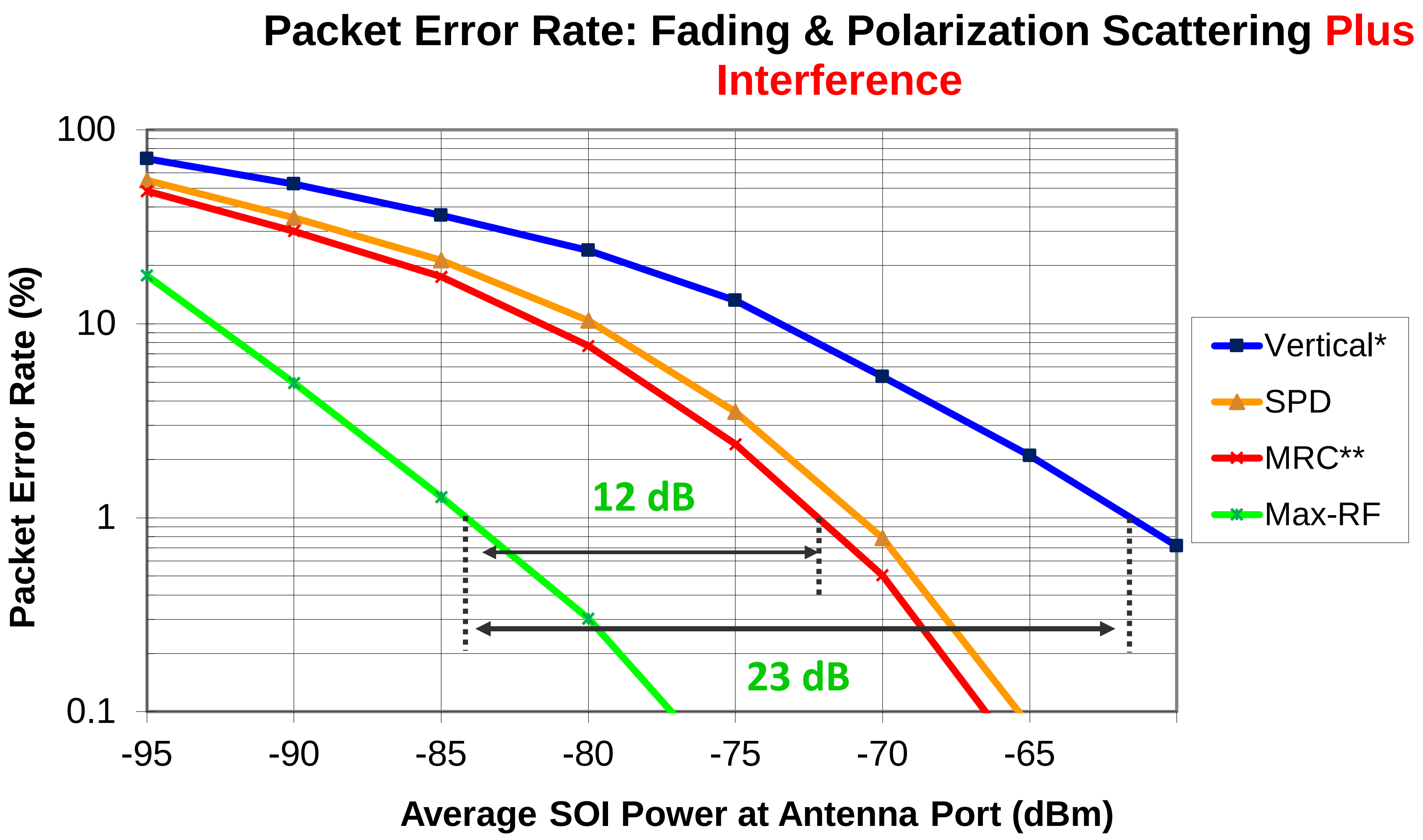


Measured Double Helix

- Azimuthal cut for Horizontal Gain
- 2dB per div
- Plot maximum set at 2dBi



AP Results for Smart Grid



Conclusion

- Benefits of this antenna:
  - Easily arrayed
  - Excellent azimuthal performance
  - Physical apertures much less than ½ wavelength
  - Enables adaptive polarization systems
- Future efforts will:
  - Improve simulation accuracy to more closely match prototypes
  - Reduce size through dielectric loading
  - Construct co-linear and beamforming arrays
  - Improve measurement performance
  - Improve bandwidth

Thank You! Questions?

Antenna Demonstration At Gonzaga Booth

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