Non-deployable Miniaturized Quadslot Antenna for CubeSats

By:

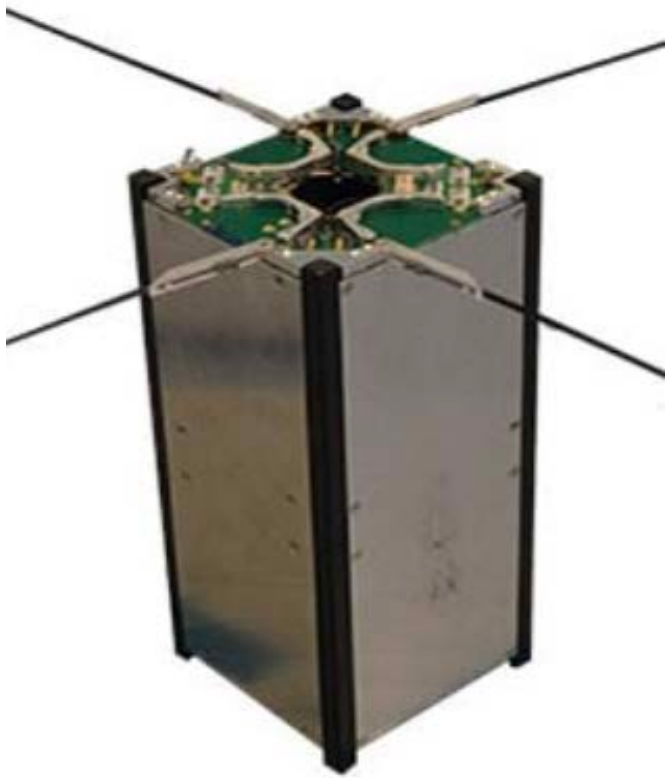
Samantha Romano

Communication is Critical

Requirements and Problems

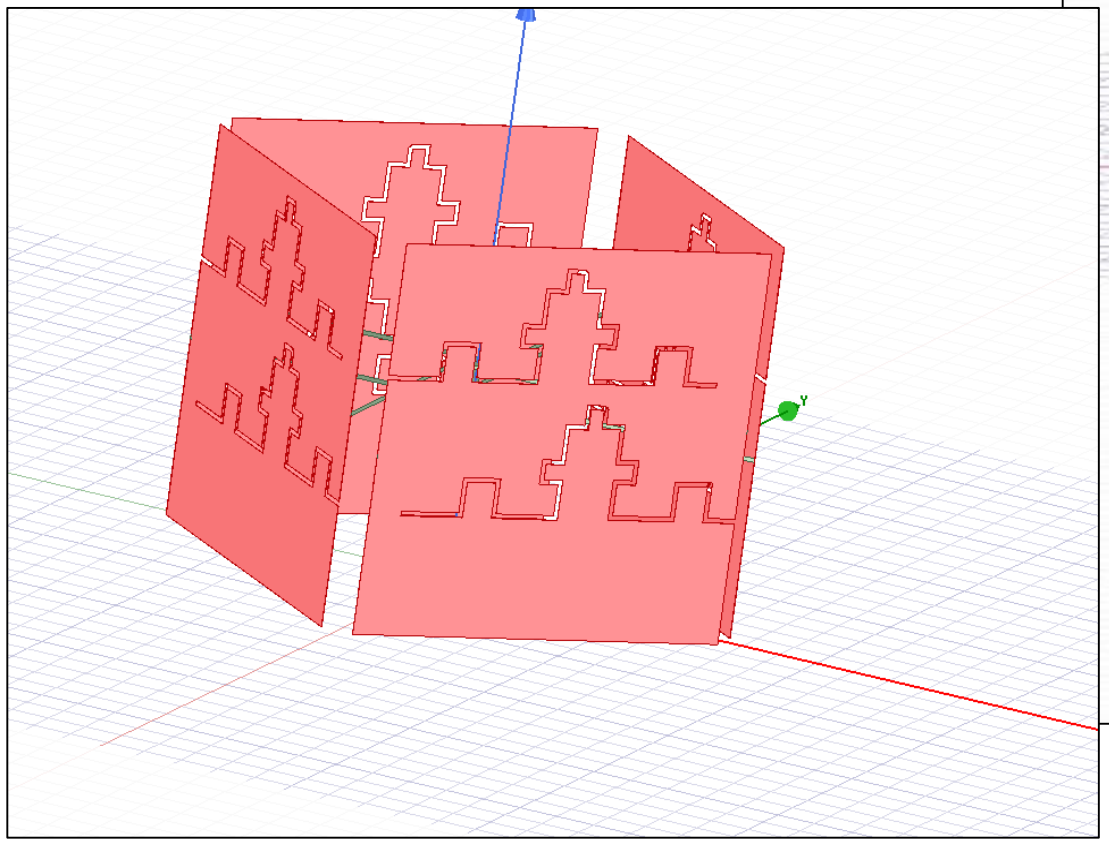
$$\lambda = \frac{c}{f} = \frac{3e8\left[\frac{m}{s}\right]}{437[Mhz]} = 0.68m$$

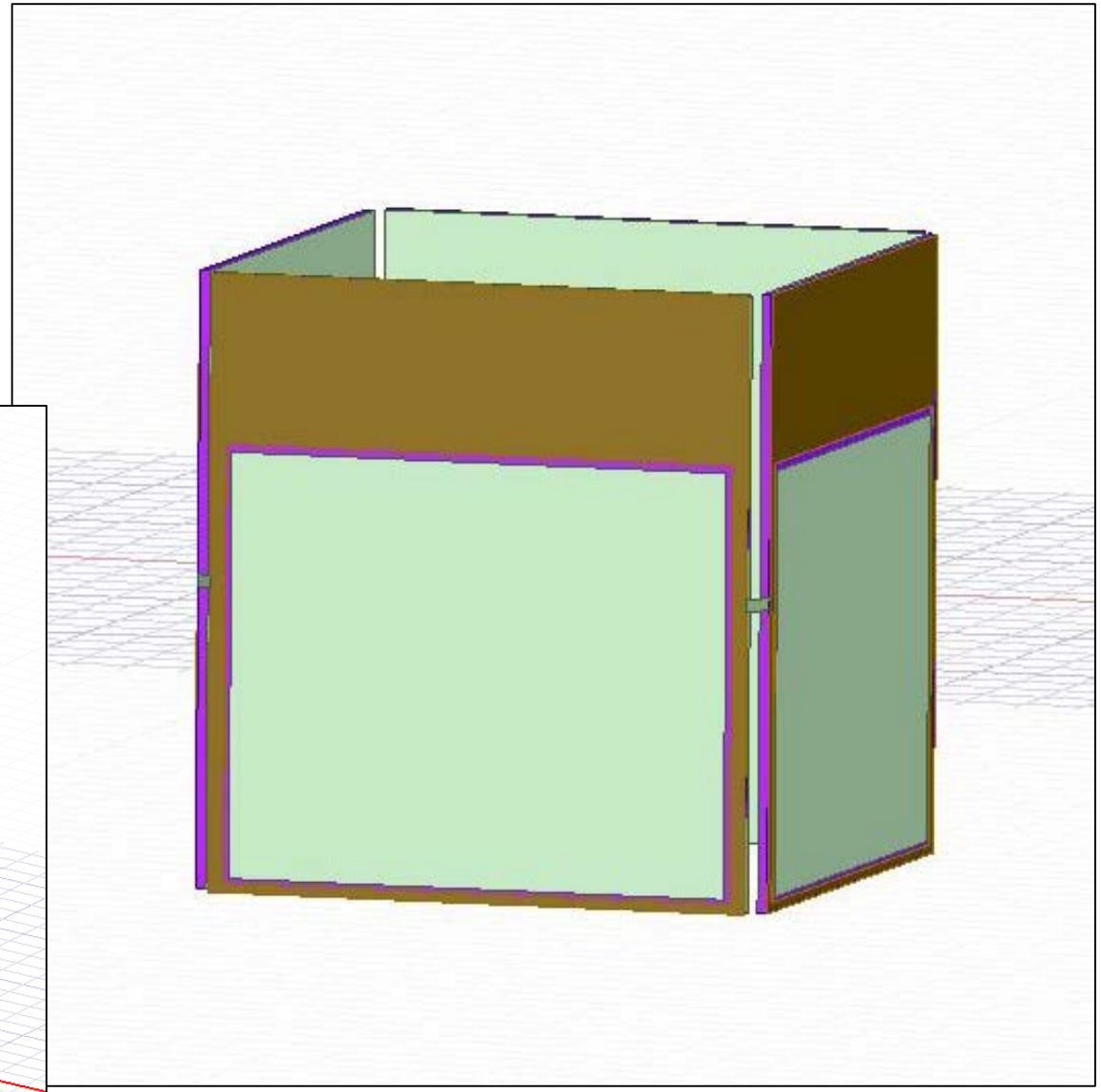
- $1U = 0.1m^3$
- Use half-wavelength or quarter wavelength antenna
  - Still needs to be stored
- Patch Antenna
  - Uses real-estate on the side panel where solar cells need to be for a 1U



Source: https://www.isispace.nl/product/dipole-antenna/

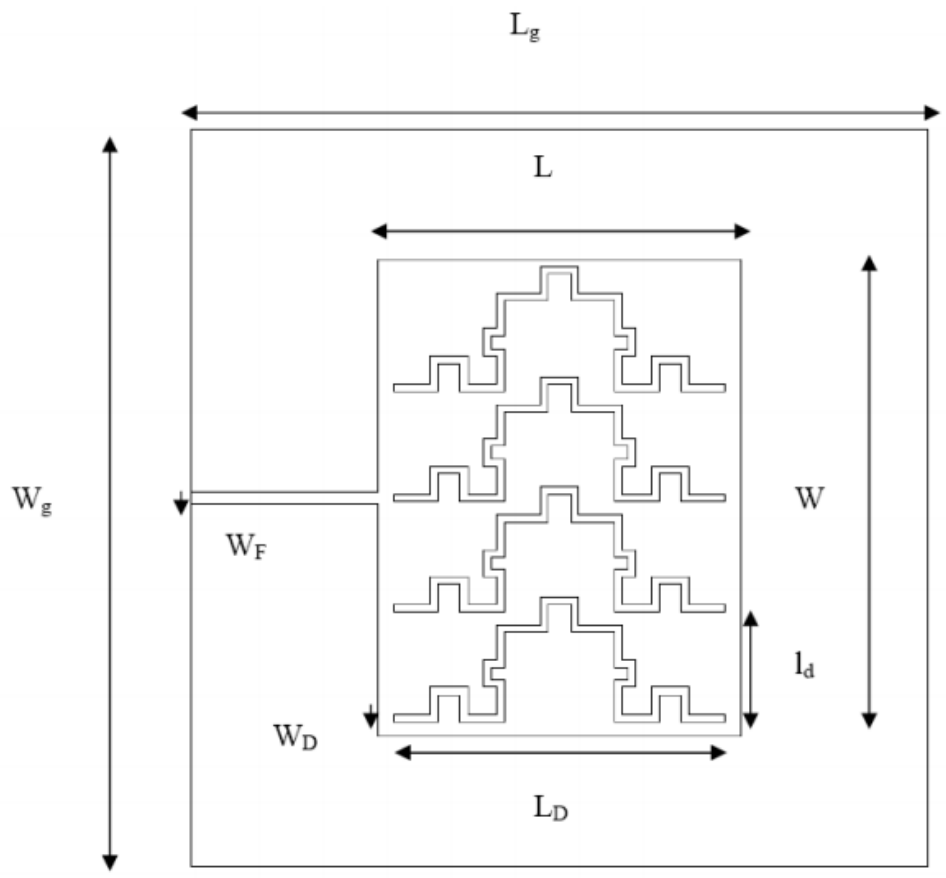
Two Methods





Meander Line Method

- Method uses Koch Fractal Pattern
- Example on the right:
  - Microstrip patch antenna
- Forces the current to take a longer path



Source: "A NEW REDUCED SIZE MICROSTRIP PATCH ANTENNA WITH FRACTAL SHAPED DEFECTS" - A. Kordzadeh and F. Hojat Kashani

Solar Cell Method

- Two separate ground planes
- Built into the existing structure
- Can fit two solar cells
- Center-fed
- E-field horizontally co-pol

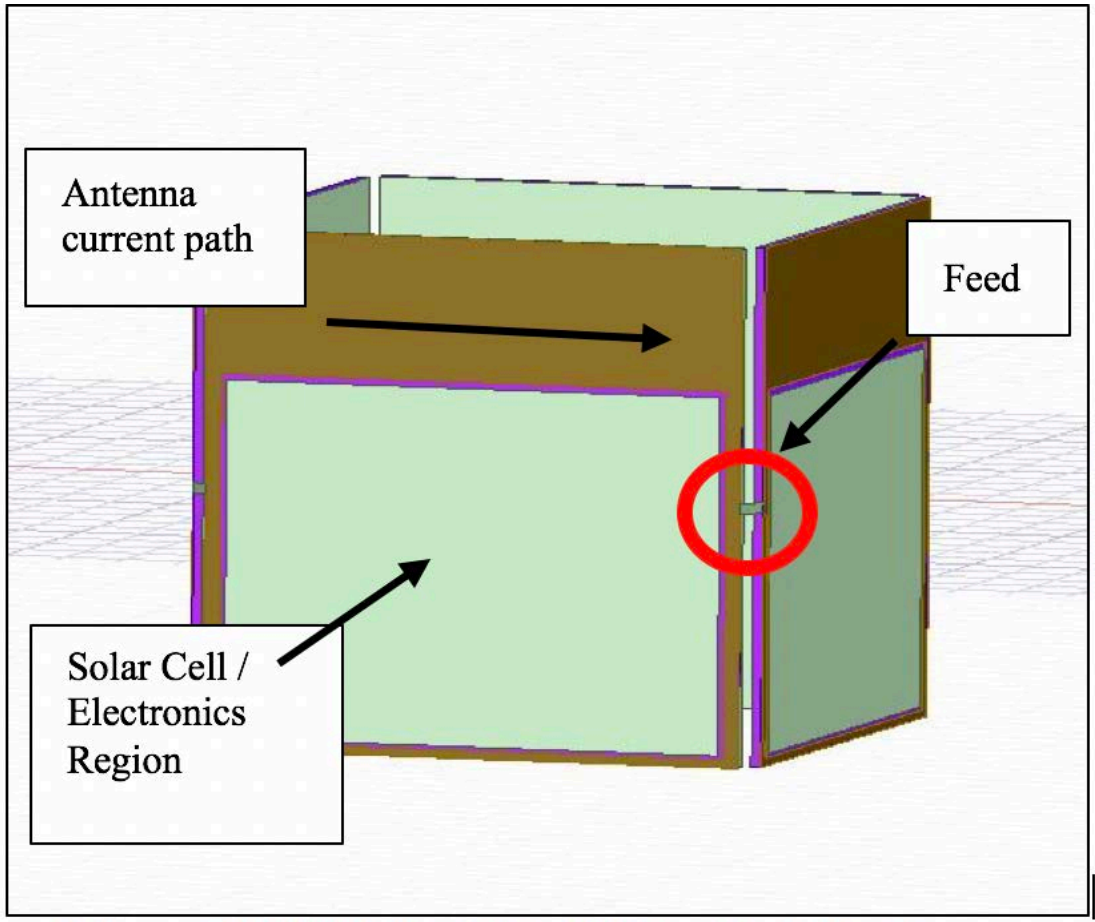


Figure 1 HFSS Model of Solar Cell Prototype.

Radiation Pattern and E-Field

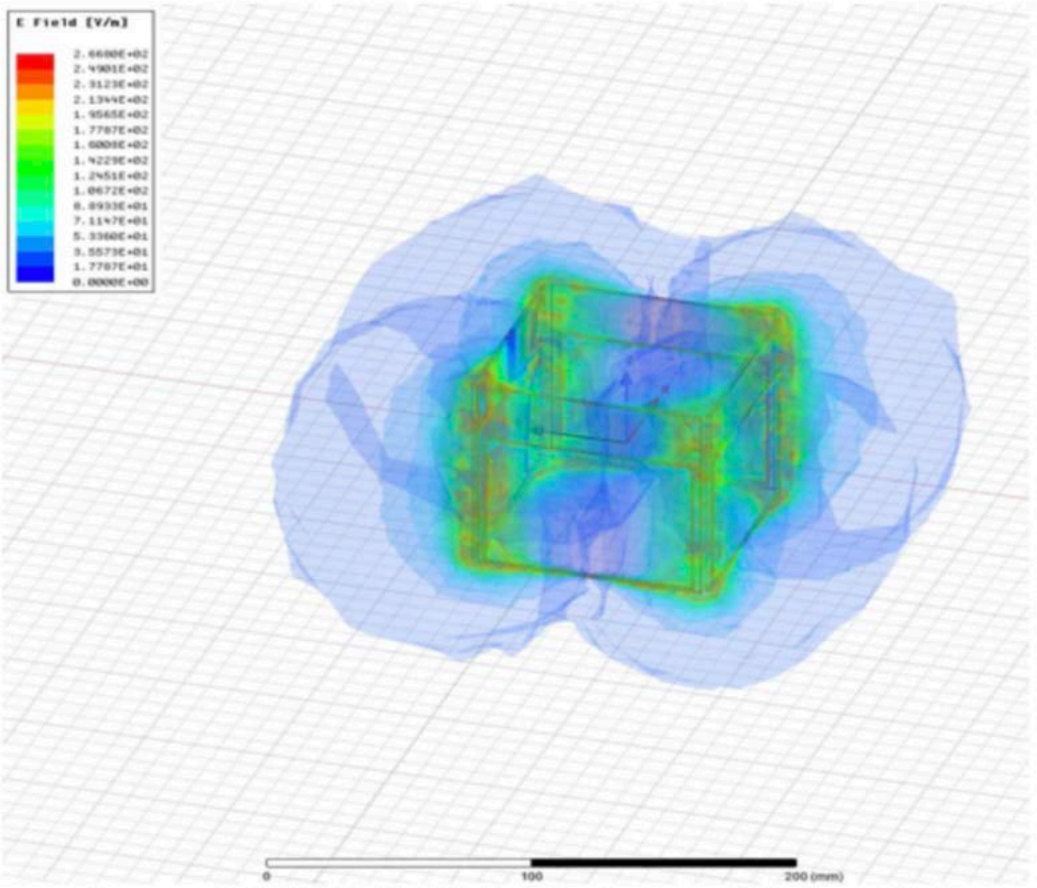


Figure 2 HFSS E-Field Pattern of Solar Cell Prototype.

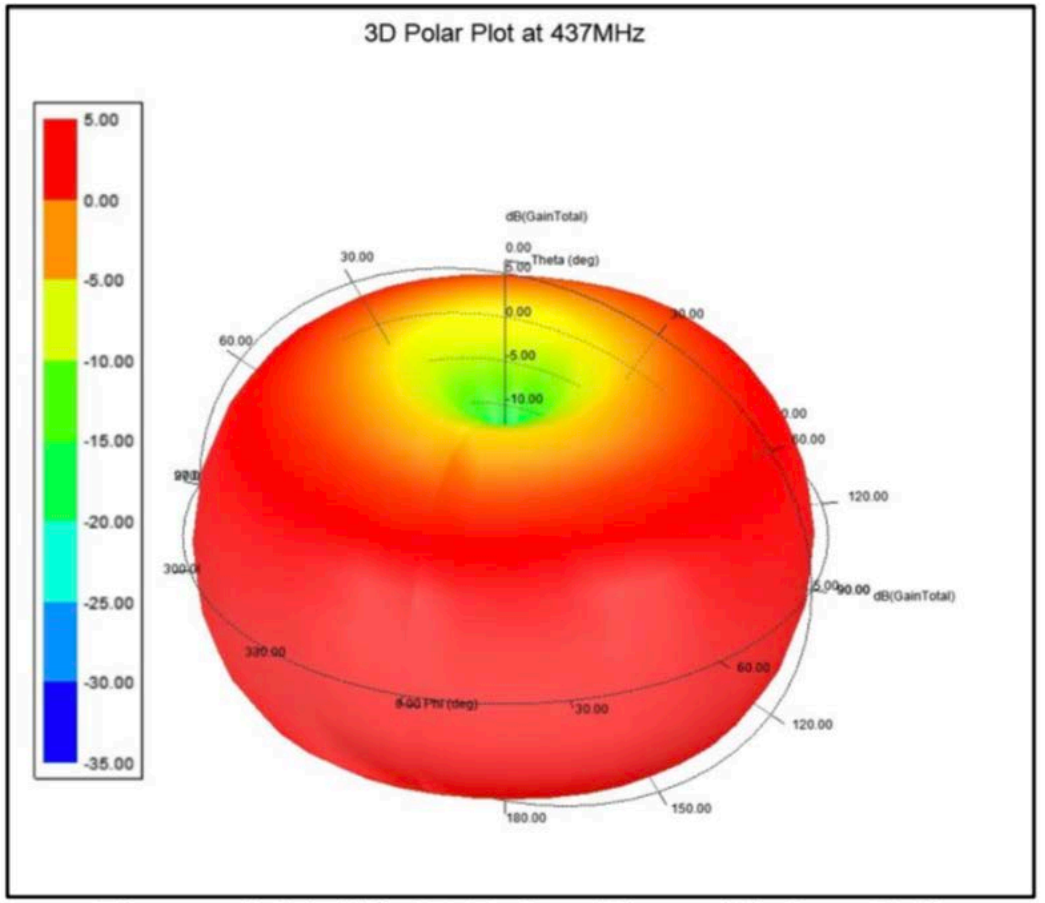


Figure 3 HFSS 3D Polar Plot of Solar Cell Prototype.

Solar Cell Prototype Results

- Anechoic Chamber S21 Test
  - QuadSlot as Antenna 1 (Blue)
  - Broadband Dipole as Antenna 2
- S11 at 469Mhz
  - -12.1dB
- S21 at 469MHz
  - Accounting for insertion loss, closer to 4dB
  - Broadband dipole had a -3dB difference against ideal

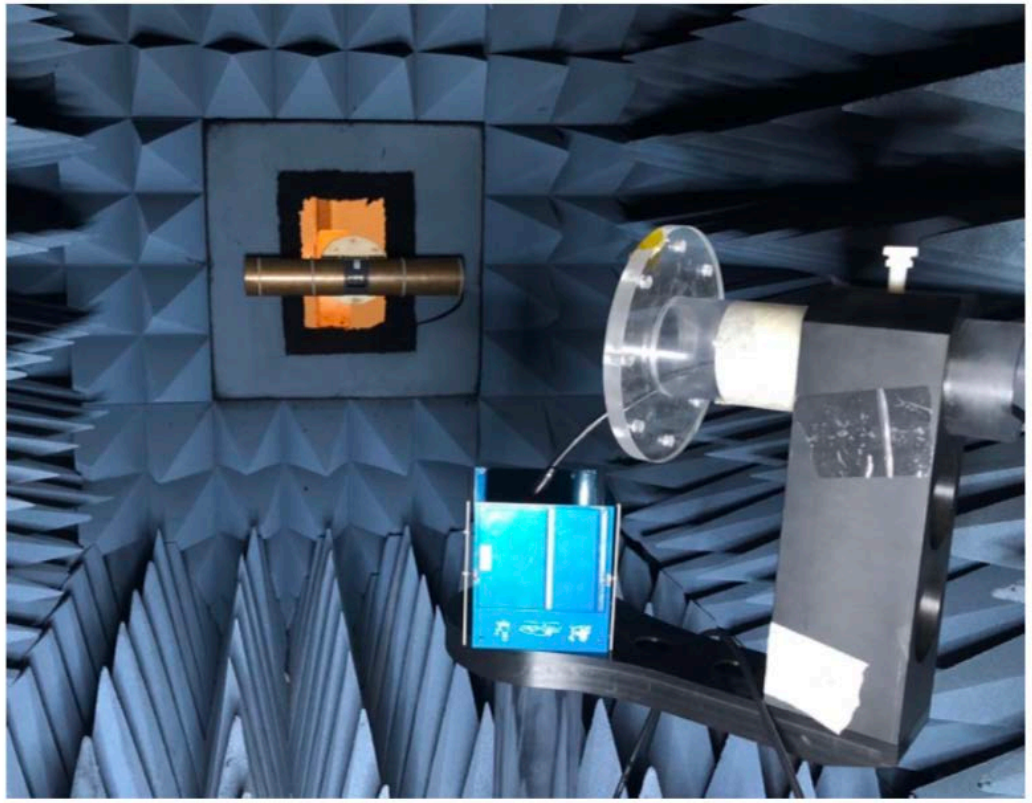


Figure 11 Prototype 2 in the Anechoic Chamber at Cal Poly SLO.

Conclusion and Acknowledgments

- Flexibility & variability given your mission requirements and needs
- Cost effective
- Easy to incorporate
- Retains most of the side panel for other purposes

- Thank you to the PolySat Team and advisors: Dr. Puig-Suari, Dr. Bellardo, and Dr. Kaliski