Design of D-band Glass-based Vivaldi Antennas for 6G Applications

Students: Serhat Erdogan
Faculty: Prof. Madhavan Swaminathan

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Liaisons

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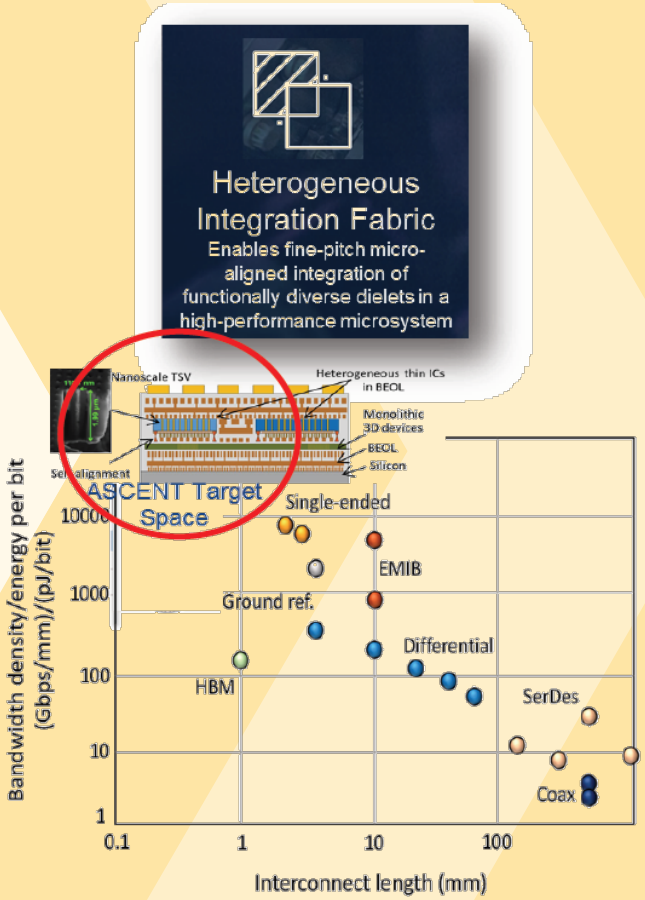
1. Motivation

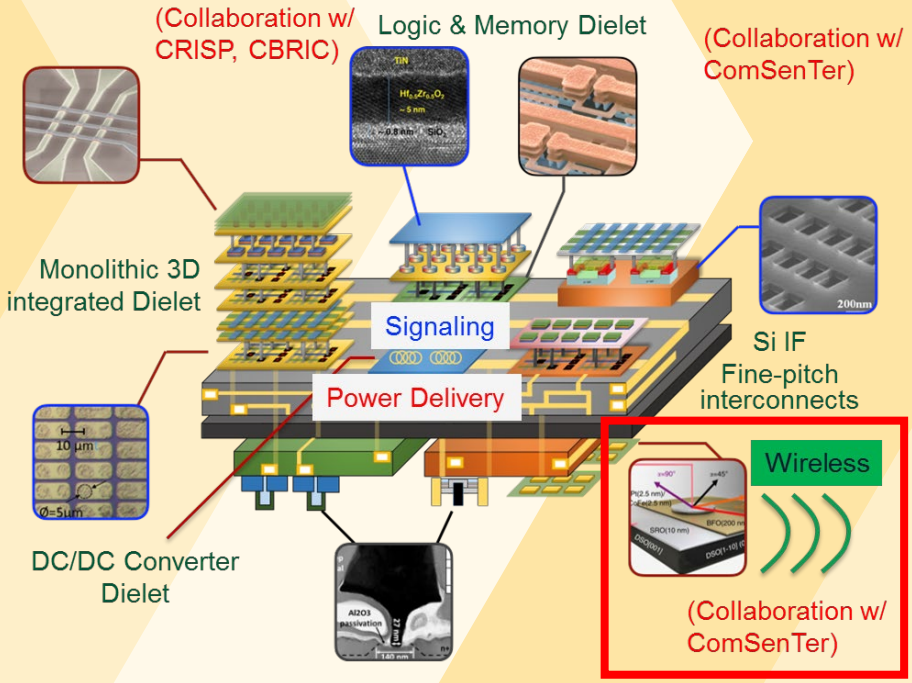
Focus of the ASCENT center is on the **Front End Module** (FEM)

- <u>High gain **integrated antennas**</u>
- Low loss and dense **interconnects** to reduce packaging losses
- High Performance **Switches**
- High Performance **Filters/Amp**



2. Objectives

- Design end-fire antennas that
  - Has high gain
  - Works in D-Band for 6G applications
  - Integratable into package with other high-performance passive interconnects developed in ASCENT

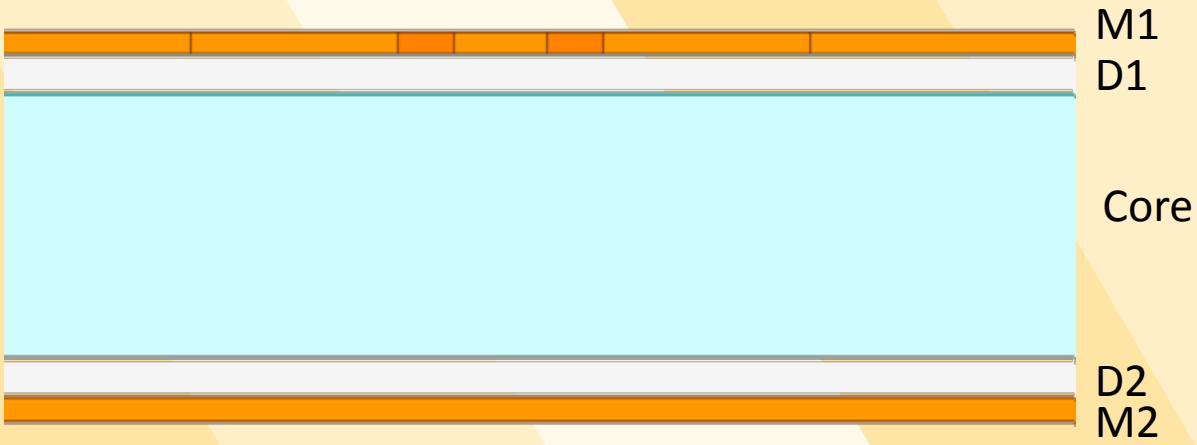


3. Literature Review

Antenna Topology	Peak Gain (dBi)	Frequency	Dimensions	Material
On Chip Quasi-Yagi [1]	3.5 – 5.1	135-165 GHz	2 mm x 2 mm	LCP
Substrate Integrated Cavities-Fed Slot Antenna Array [2]	20.5 dBi	130-145 GHz	9.6 mm x 8.6 mm x 0.818 mm	LTCC
D-band Quasi-Yagi antenna [3]	5.2 dBi	115-125 GHz	1.17 mm x 0.95mm x 0.4mm	Glass
Broadband Bow-Tie Antennas in eWLB Package [4]	6 dBi	107 GHz–130 GHz	4.6mm × 3.2mm x 0.5mm	Silicon

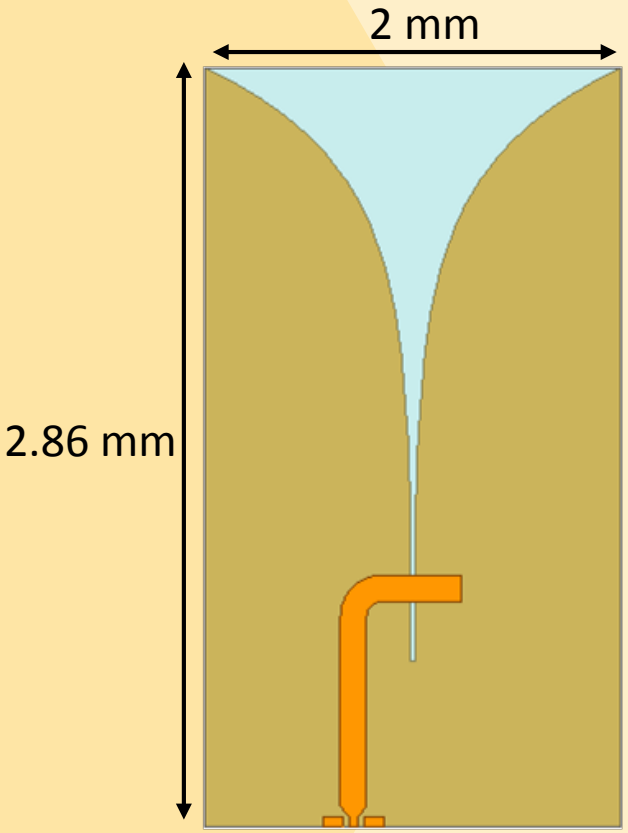
[1] W. T. Khan et al., "A D-Band Micromachined End-Fire Antenna in 130-nm SiGe BiCMOS Technology," in IEEE Transactions on Antennas and Propagation, vol. 63, no. 6, pp. 2449-2459, June 2015.
[2] J. Xiao, X. Li, Z. Qi and H. Zhu, "140-GHz TE_340 -Mode Substrate Integrated Cavities-Fed Slot Antenna Array in LTCC," in *IEEE Access*, vol. 7, pp. 26307-26313, 2019
[3] A. Bisognin et al., "D-band Quasi-Yagi antenna in IPD process," 2013 7th European Conference on Antennas and Propagation (EuCAP), Gothenburg, 2013, pp. 330-331.
[4] F. Ahmed, M. Furqan and A. Stelzer, "120-GHz and 240-GHz Broadband Bow-Tie Antennas in eWLB Package for High Resolution Radar Applications," 2018 48th European Microwave Conference (EuMC), Madrid, 2018, pp. 1109-1112.

4. Test Vehicle on 100um Stackup

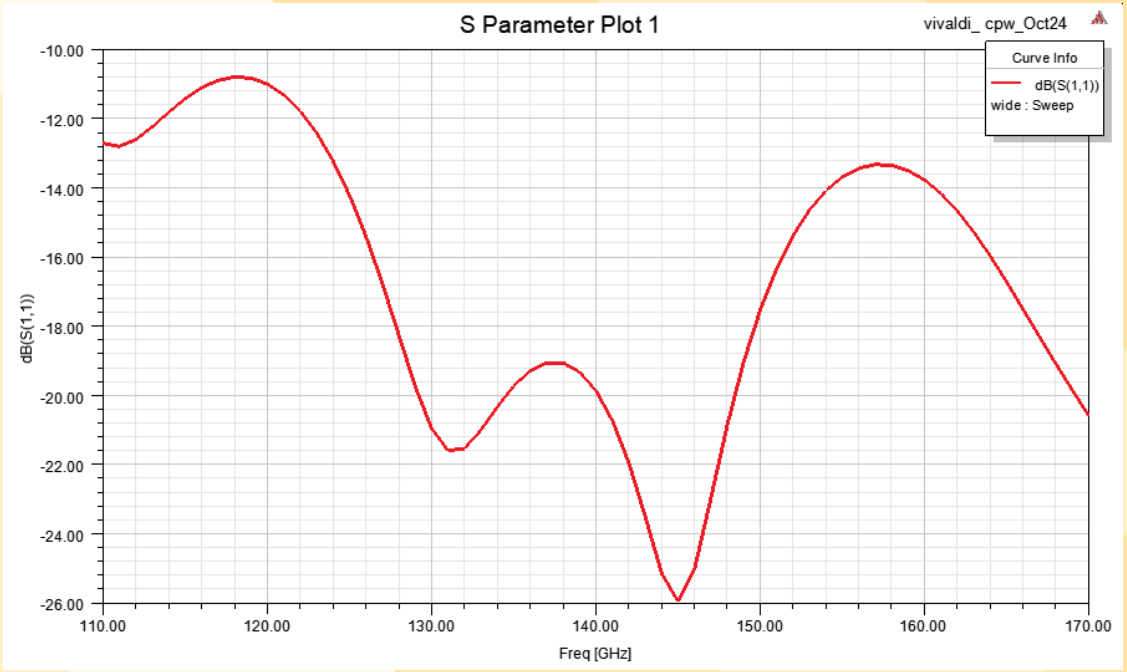


Layer	Material	Thickness
M1	Copper	6 um
D1	ABF GL102	15um
Core	AGC EN A1 Glass	100 um
D2	ABF GL102	15 um
M2	Copper	6 um

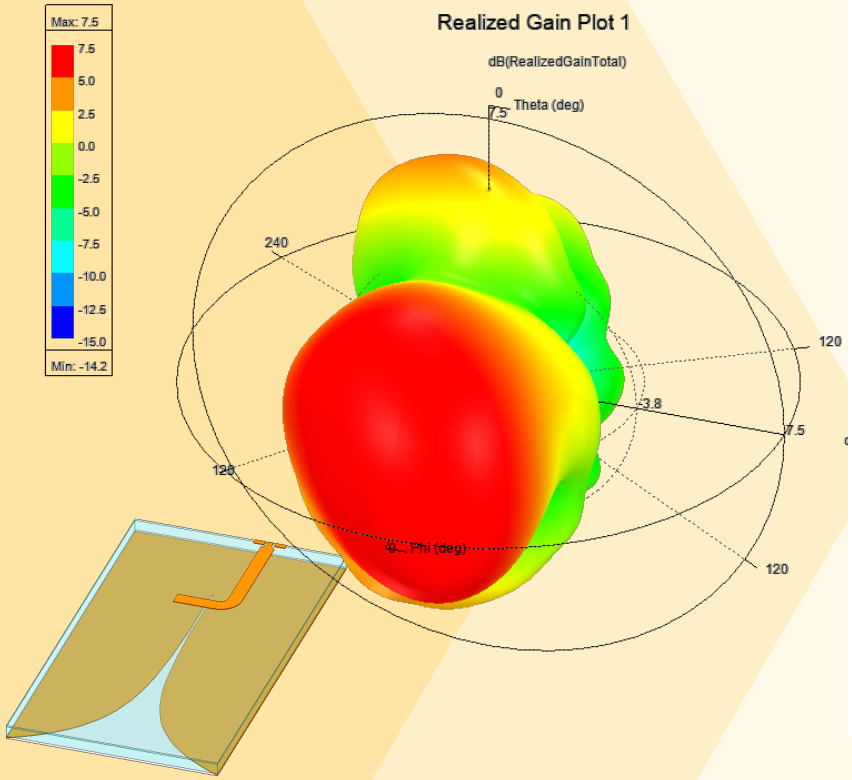
5. Single Element Vivaldi Antenna

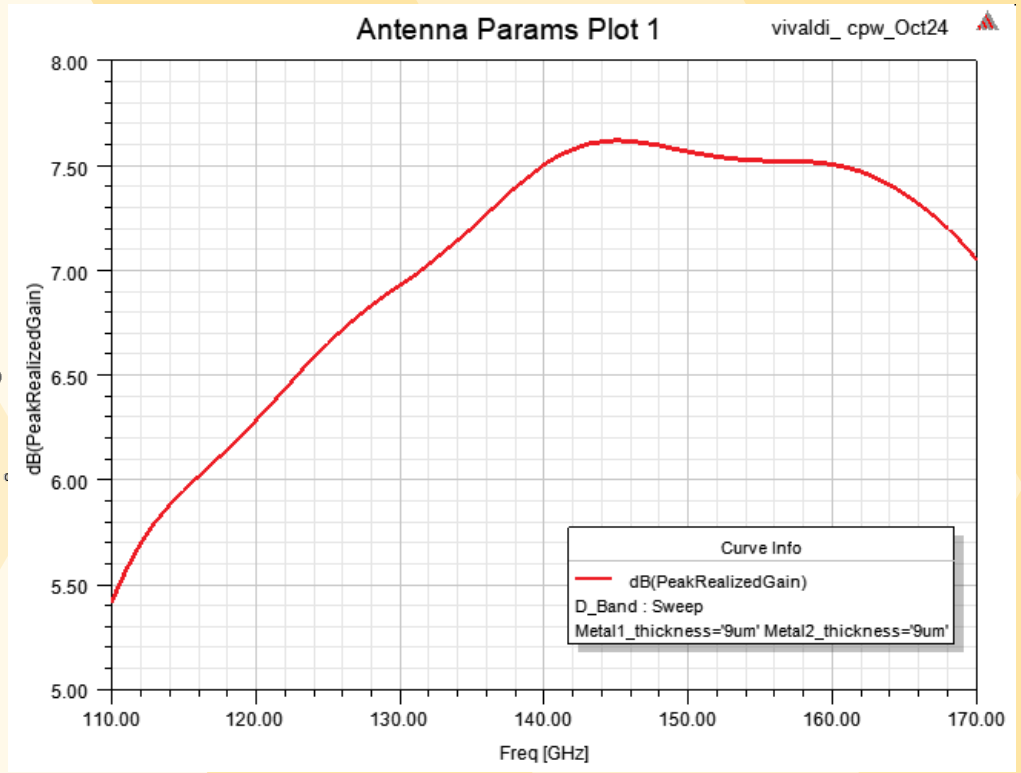


Glass thickness: 100um



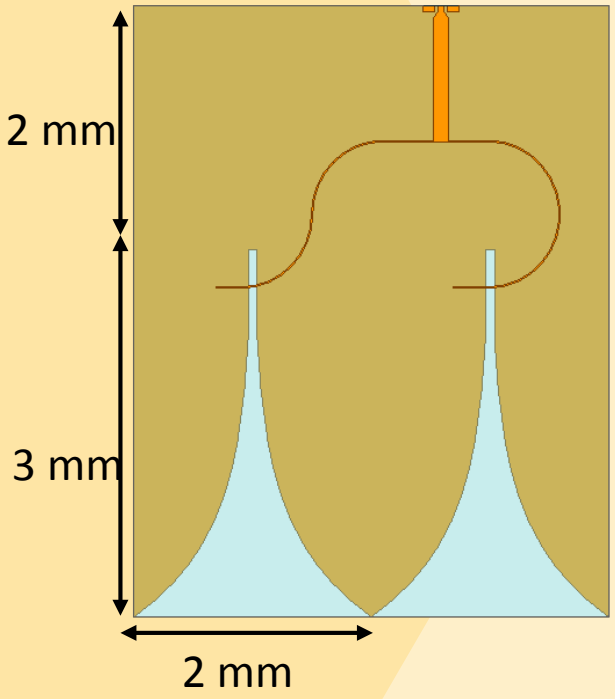
6. Simulation Results

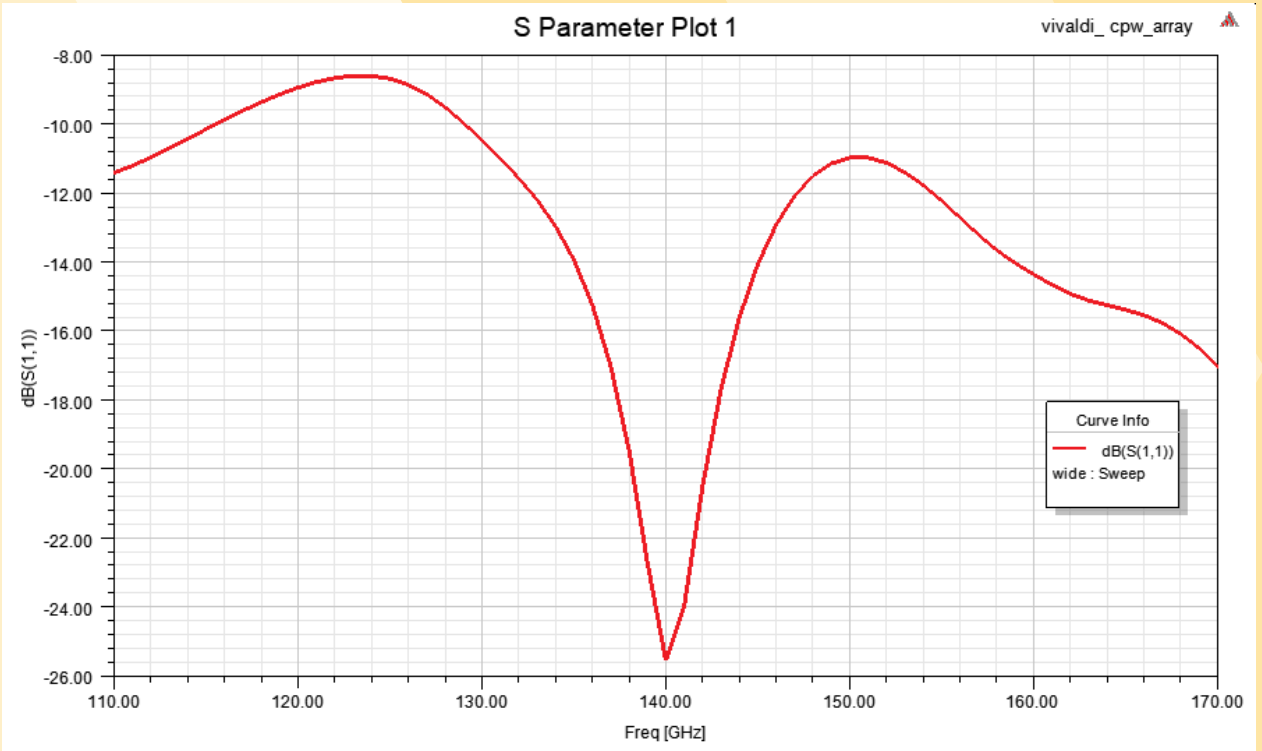




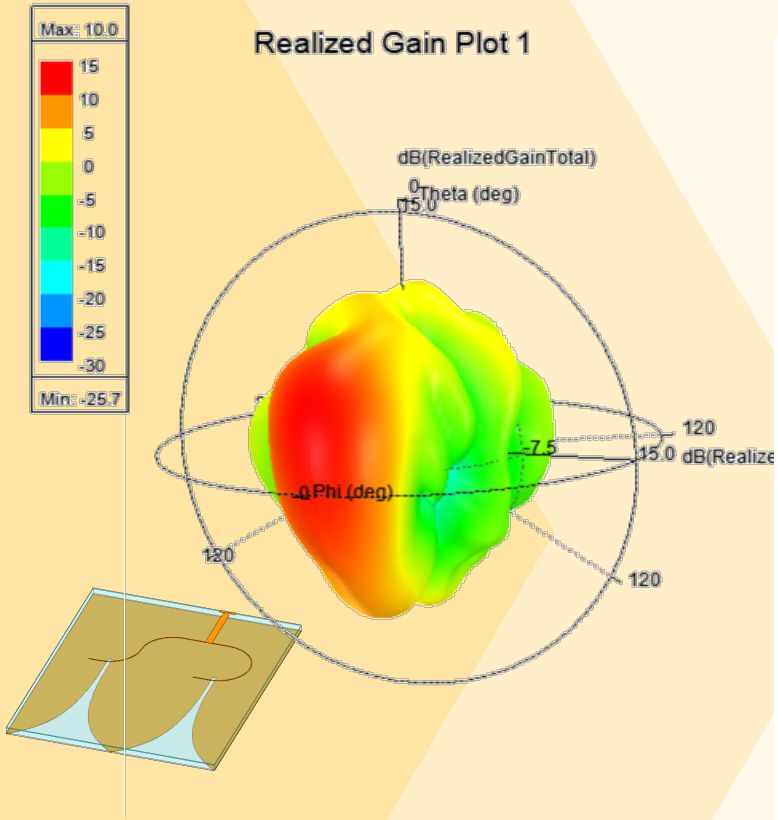
Realized gain 7.5 dBi @ 140 GHz

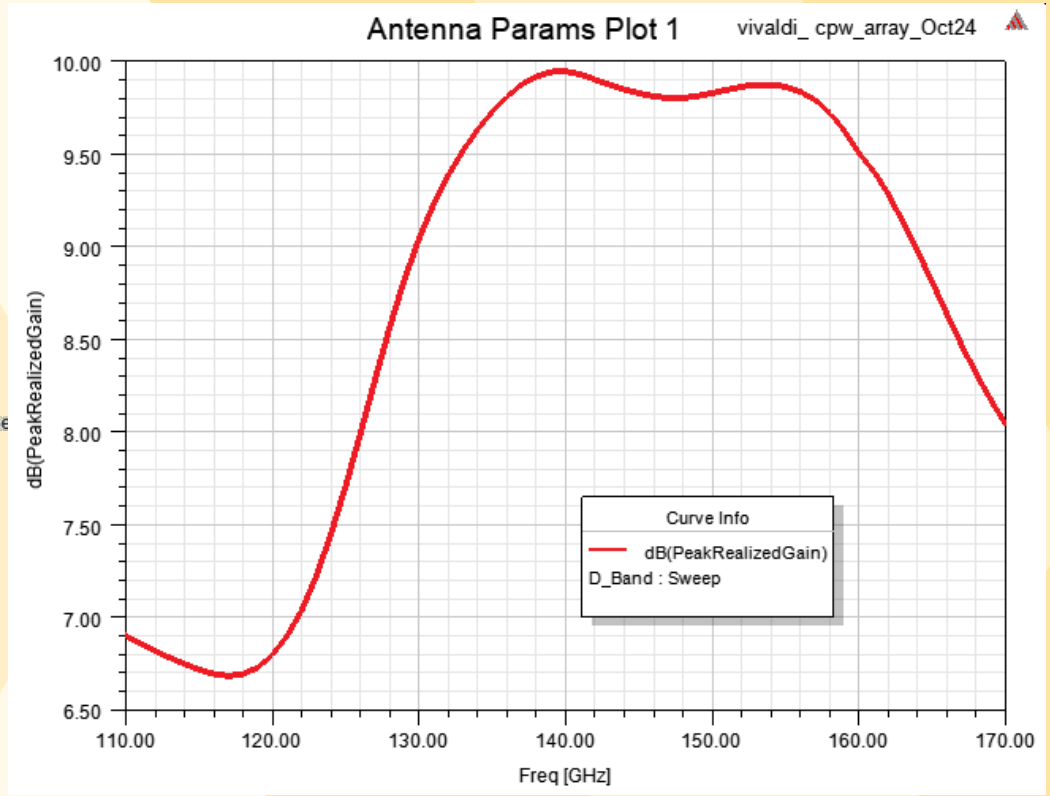
7. 1x2 Vivaldi Array





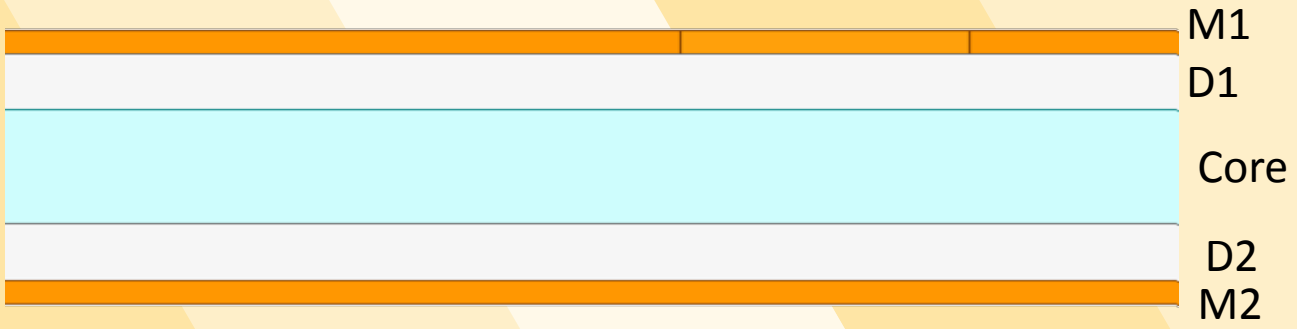
8. 1x2 Vivaldi Array Simulation Results





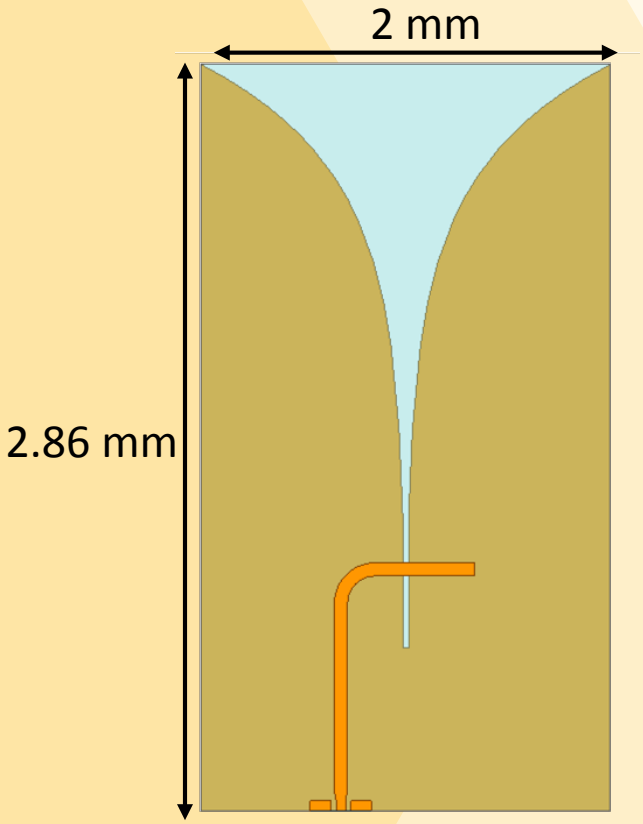
Realized gain: 10 dBi @ 140 GHz

Test Vehicle on 30um Glass Stackup

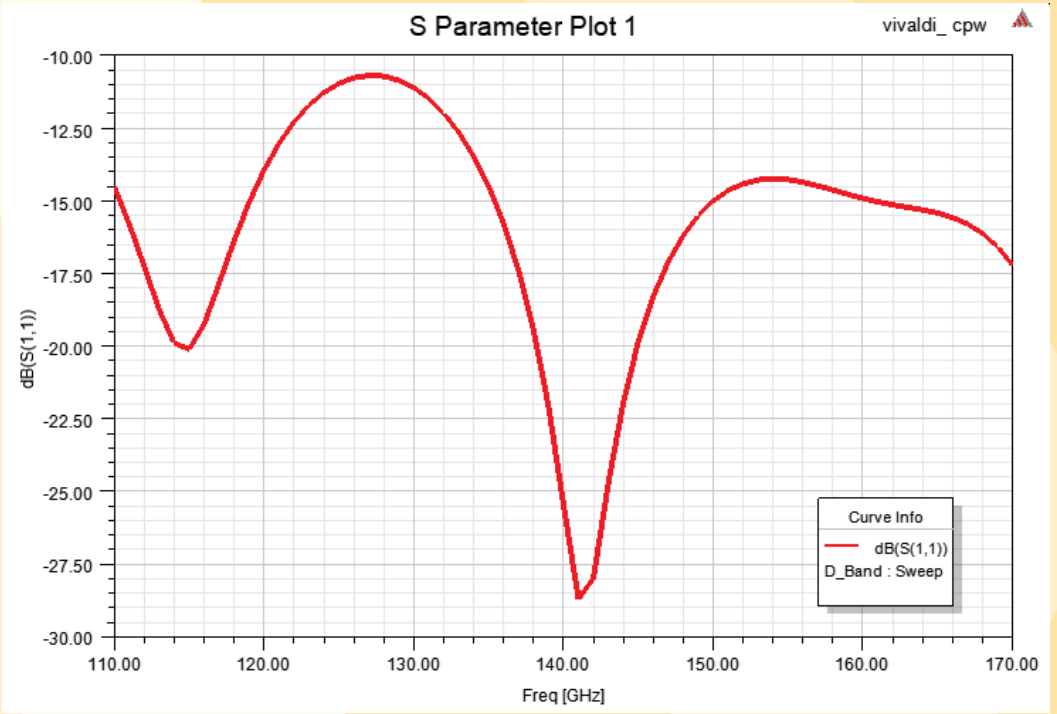


Layer	Material	Thickness
M1	Copper	6 um
D1	ABF GX 92	15um
Core	Schott AF32	30 um
D2	ABF GX 92	15 um
M2	Copper	6 um

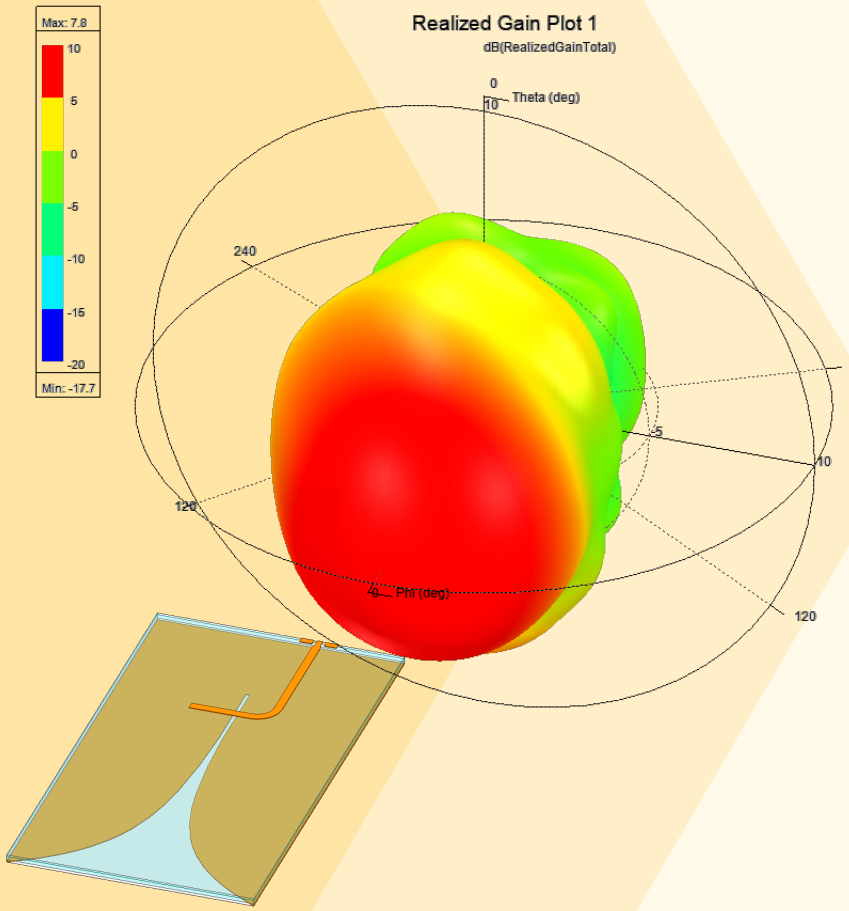
10. Single Element Vivaldi Antenna

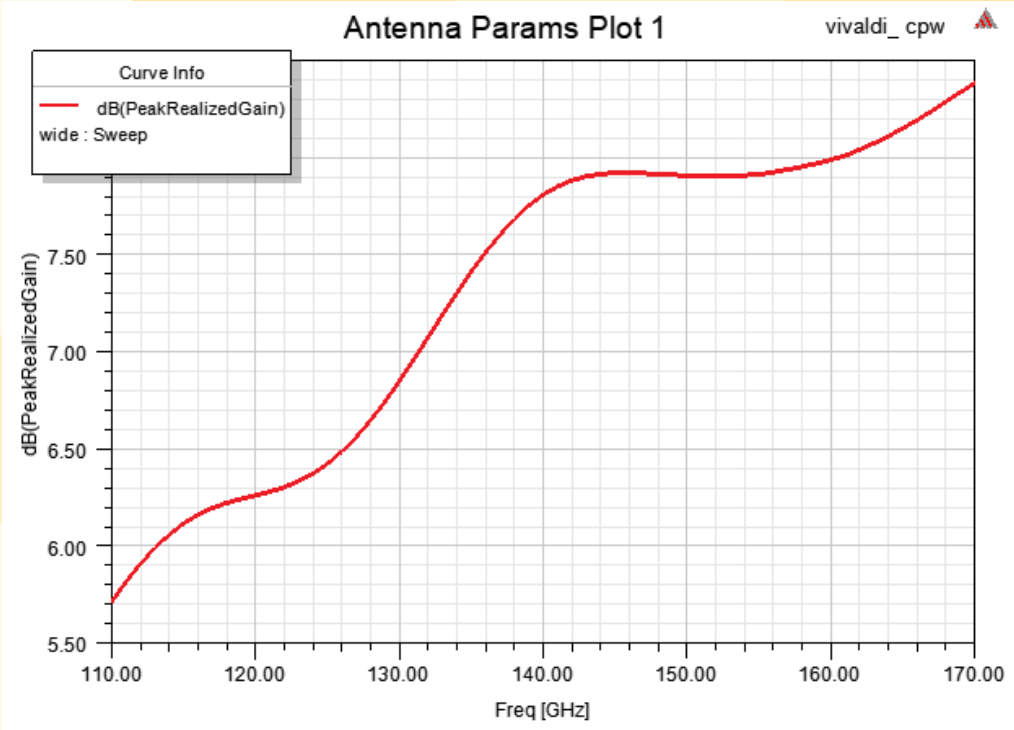


Glass thickness: 30um



11. Simulation Results





Realized gain 7.8 dBi @ 140 GHz

12. Future Work and Timeline

- Measure the performance of the manufactured antennas and compare with simulations
- Work on different feeding structures such as SIW
- Investigate different structures to enhance gain