Main Instrument Antennas

2024 June 03

Zachary Martin

Overview

Toyon production antennas have been arriving at UChicago's High Bay

We have absolute characterization measurements comparable to company measurements and simulation results

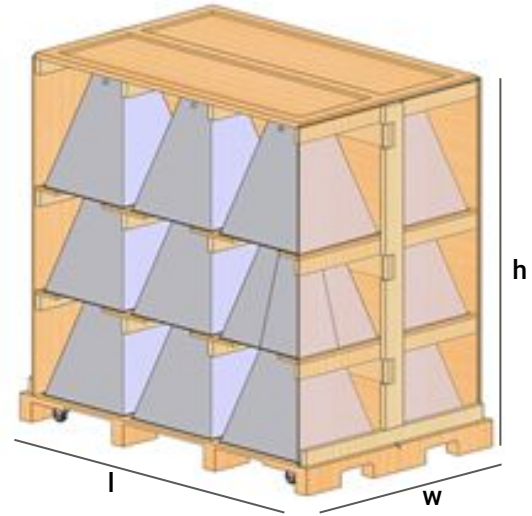
In this presentation, I will cover

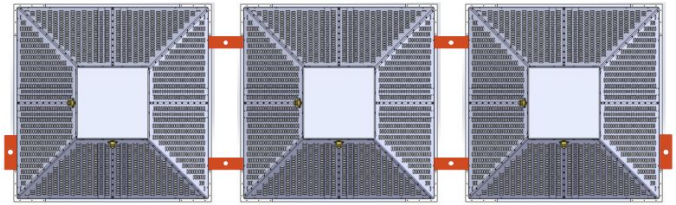
- Return Loss (S11)
- Port-to-Port Isolation
- Gain & Impulse Response
- XFDTD Phase Center
- XFDTD Arraying

Then I will end with the next steps and a timeline

Antenna Crates

- Dimensions: 88” x 58.6” x 80.9” (lwh)
- Weight: 725 lbs (each antenna 4.8 kg)
- 18 antennas per crate; Total 7 crates
- Currently 5 at UChicago, expecting last 2 in June



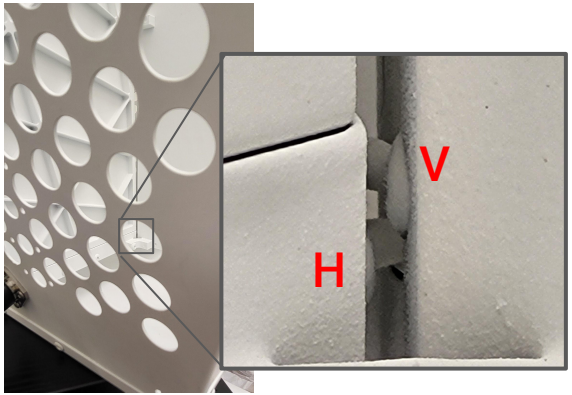


Vertical and Horizontal Port Decision

Port orientation is decided

- When mounted, Vertical port faces downwards, and Horizontal at right (left) from the back (front)
- Same handedness as ANITA IV antennas

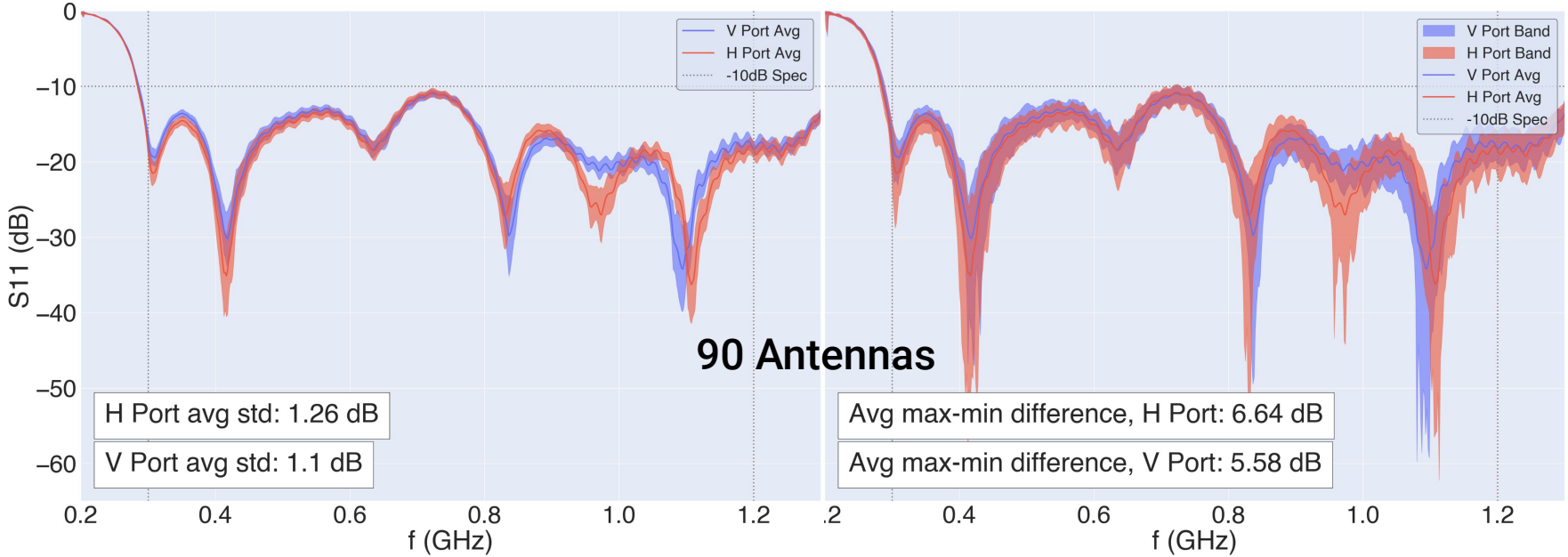
Physical difference: V port feed in front of H port feed



Position label will counter placard

Return Loss (S11)

All received antennas are within S11 spec

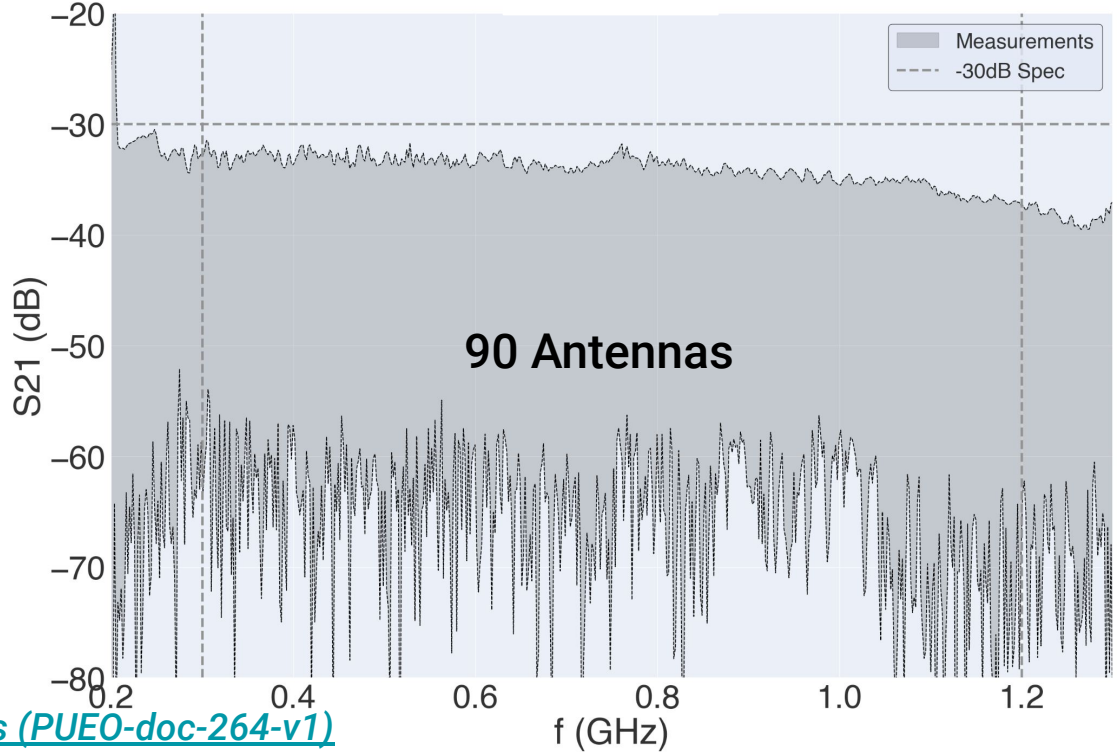


Thanks to Scott Mackey and Natalie Orrantia for help on these measurements

[Measurement Details (PUEO-doc-264-v1)]

Port-to-Port Isolation (Single Antenna S21)

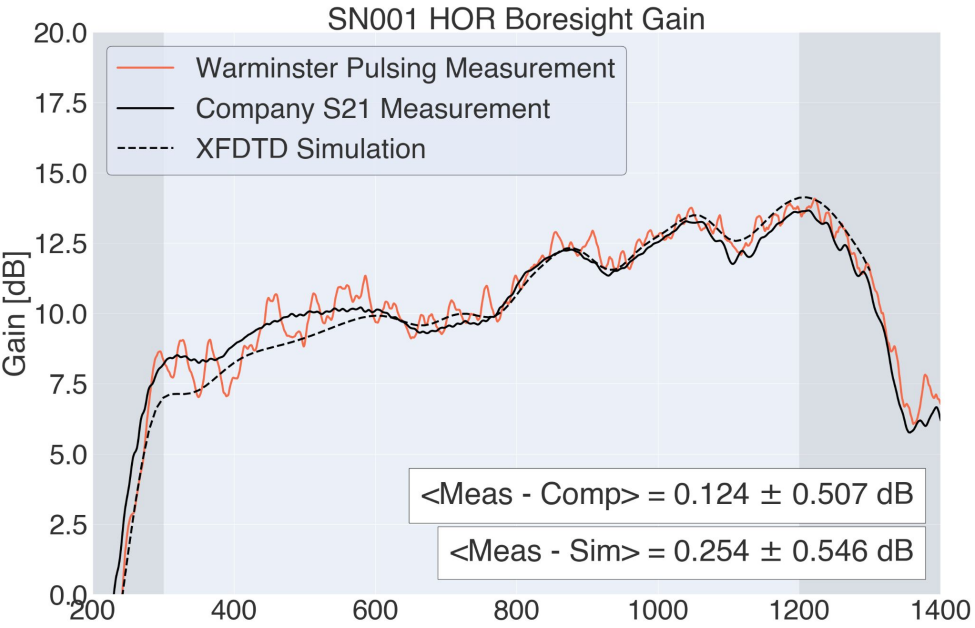
All received antennas are within port-to-port isolation spec

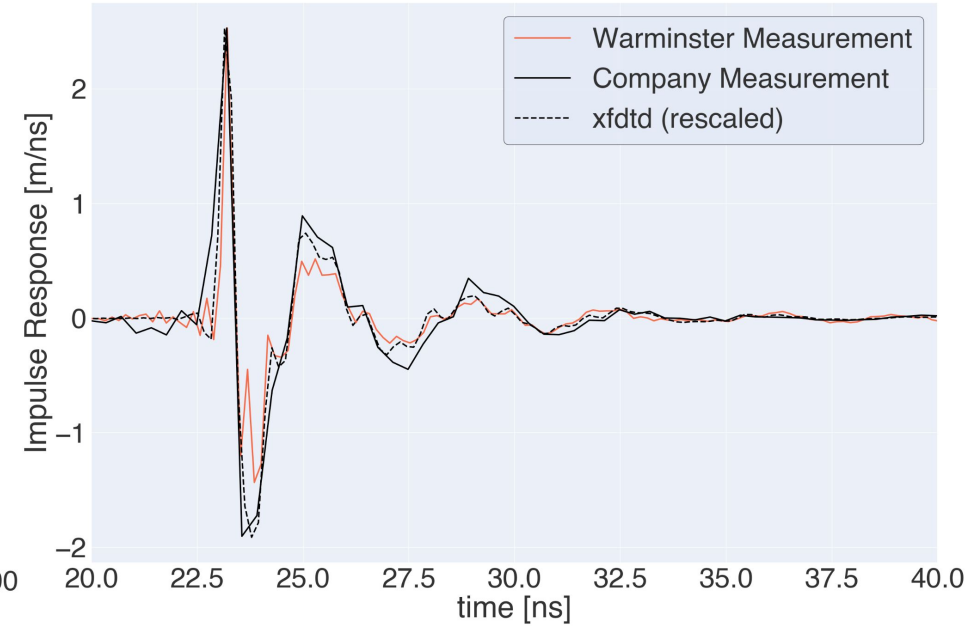


[Measurement Details (PUEO-doc-264-v1)]

Boresight Gain & Impulse Response

Warminster results consistent with simulations and company

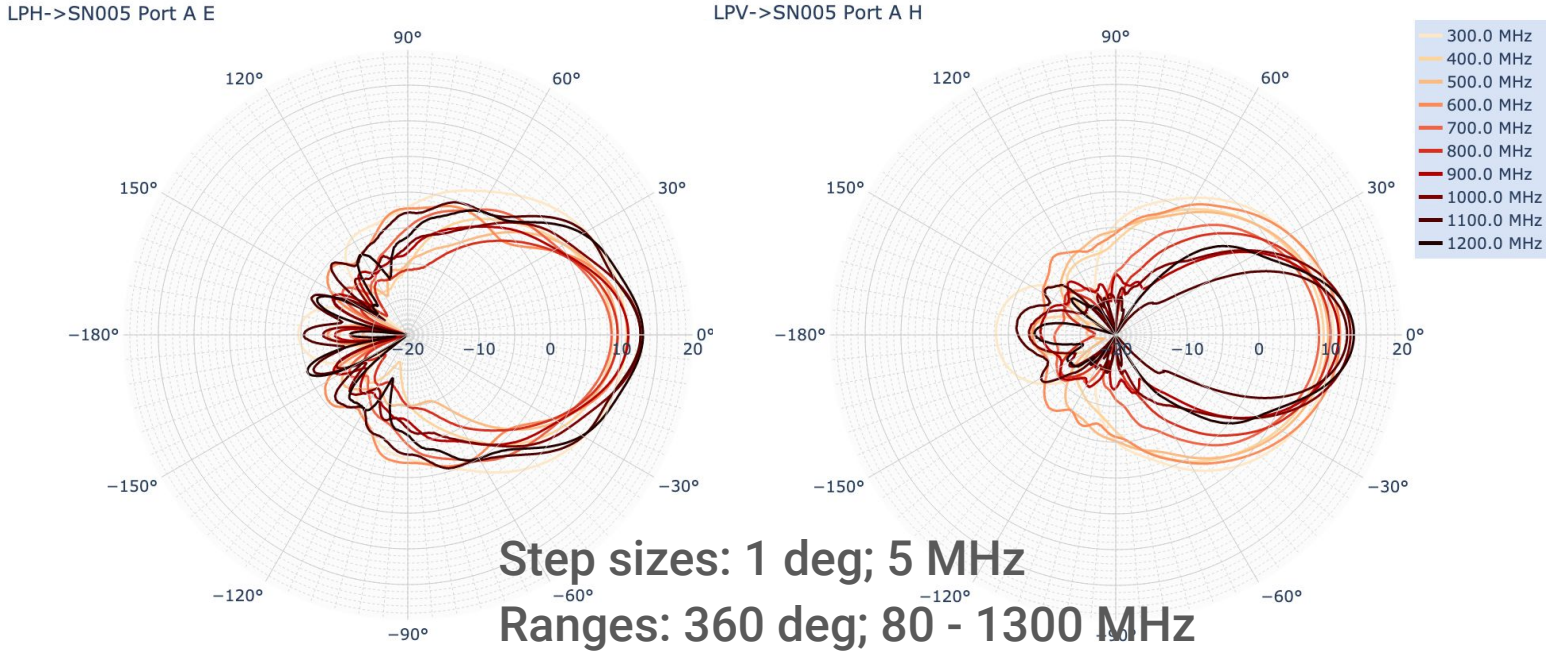




[Calculation Details (PUEO-doc-364-v1)]

Gain Patterns

Consistent with XF patterns within 1.5 dB up to 40°



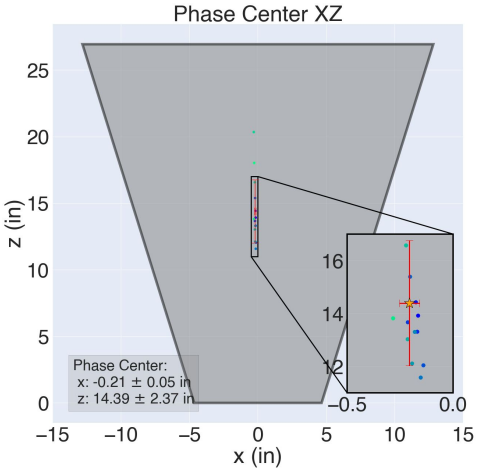
Step sizes: 1 deg; 5 MHz
Ranges: 360 deg; 80 - 1300 MHz

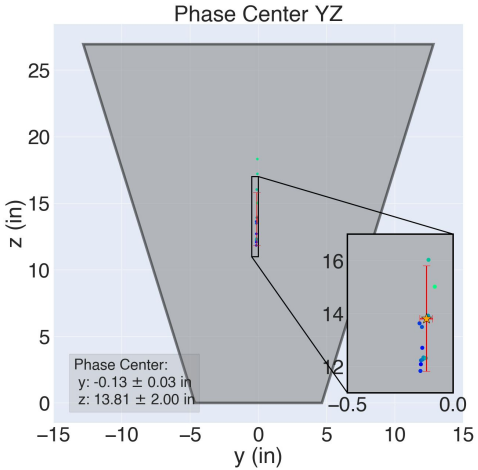
More results and details (PUEO-doc-335-v1)

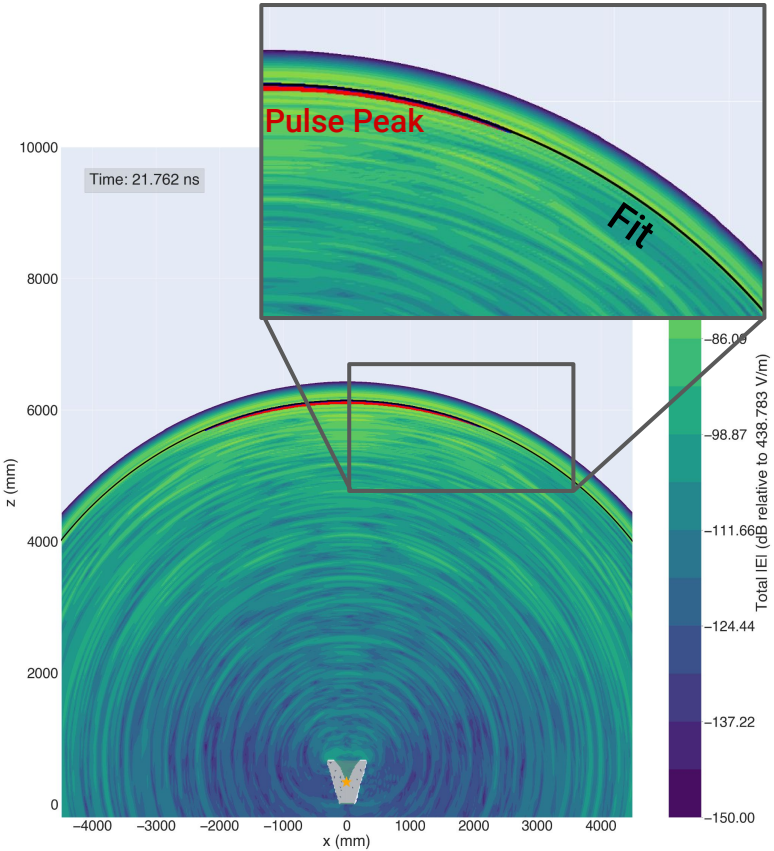
XFDTD: Phase Center

Emitted pulse at far field fitted to circle in co-pol ridge plane
→ Circle center is the approx. phase center (at all frequencies)

Boresight axis phase center coordinate is ~12 ± 2 in (from front)



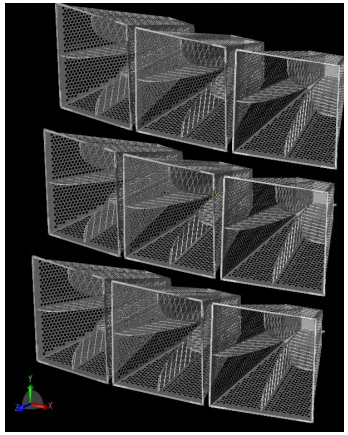


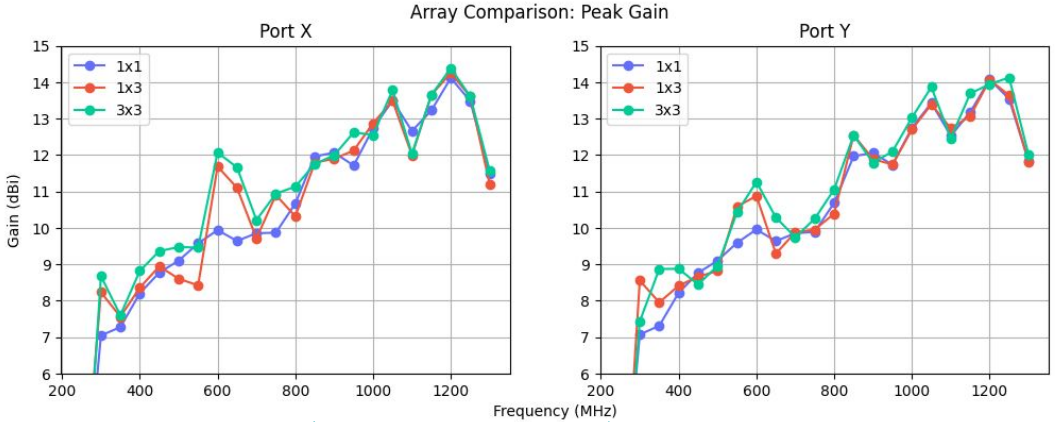


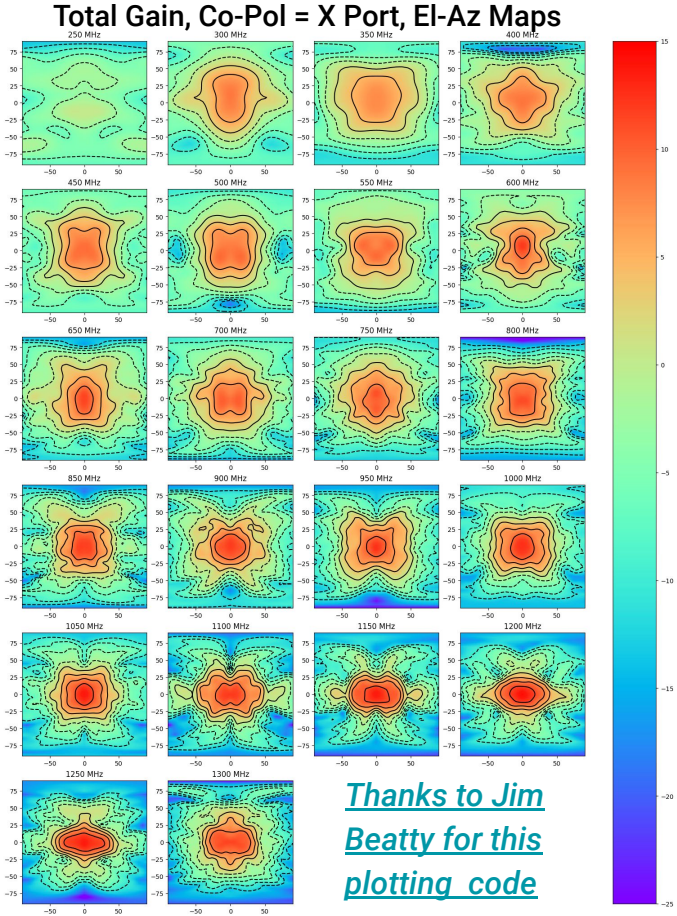
[More details (PUEO-doc-278-v1)]

XFDTD: Arraying

- 1-2 dB increase in peak gain around 500-700 MHz band
  - Confirmed with 1x3 measurement in high bay
- Squinting occurs at some frequencies (eg. 550, 700, 1300 MHz)







[More results & details (PUEO-doc-321-v4)]

[Thanks to Jim Beatty for this plotting code]

Antenna Response for PUEOSim

We have

- Self-Measured Single Antenna Data
- Toyon-Measured Single Antenna Data
- XFDTD Simulated Single Antenna Data
- XFDTD Simulation Antenna Array Data

Which one to implement into PUEOSim?

Next

Get updated antenna responses for PUEOSim

Spot-check measurements for incoming antennas

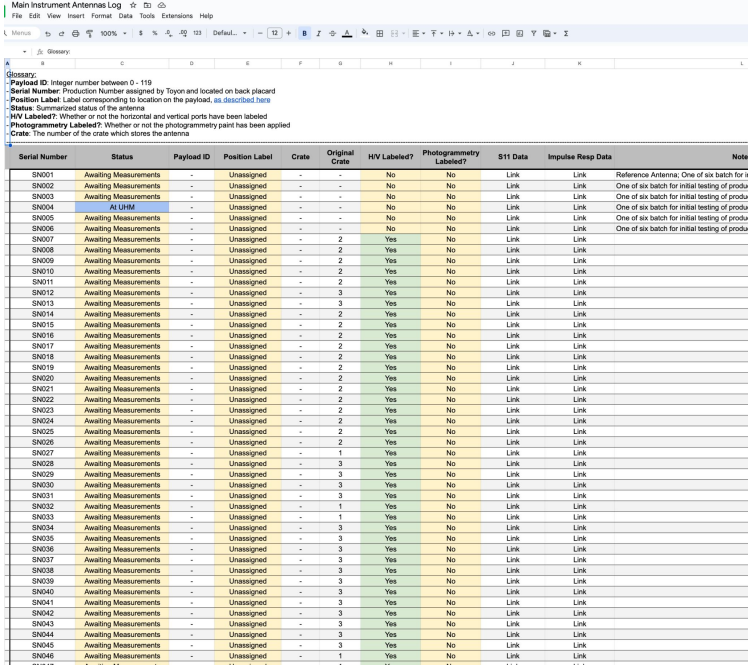
- S11, 0° - 30° gain responses

Label and Logging

- Port labeling, Position labeling
- Data will be uploaded to github & midway (UChicago)

Toolkit for measurement analysis:

- https://github.com/ZackAshM/rftoolkit



Main Instrument Antennas Log

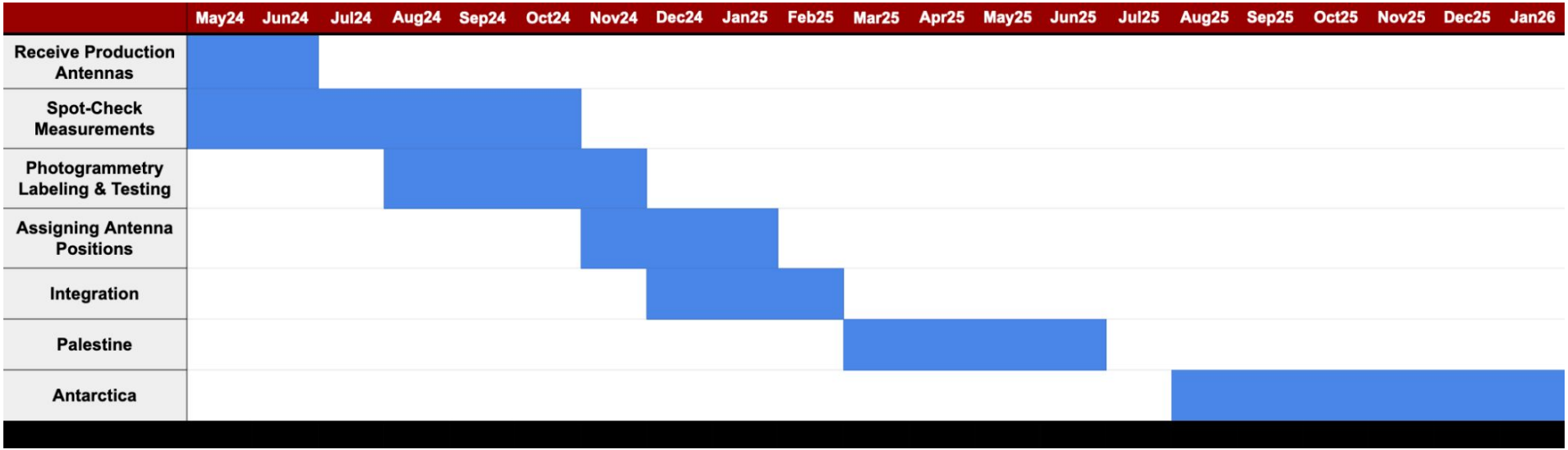
File Edit View Insert Format Data Tools Extensions Help

Glossary:

- **Payload ID**: Integer number between 0 - 119
- **Serial Number**: Production Number assigned by Toyon and located on back placard
- **Position Label**: Label corresponding to location on the payload, as described here
- **Status**: Summarized status of the antenna
- **H/V Labeled?**: Whether or not the horizontal and vertical ports have been labeled
- **Photogrammetry Labeled?**: Whether or not the photogrammetry paint has been applied
- **Crate**: The number of the crate which stores the antenna

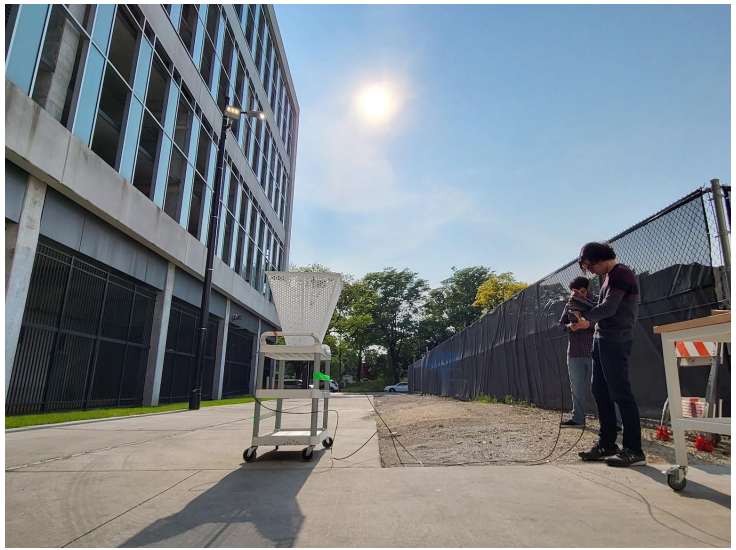
Serial Number	Status	Payload ID	Position Label	Crate	Original Crate	H/V Labeled?	Photogrammetry Labeled?	S11 Data	Impulse Resp Data	Note
SN001	Awaiting Measurements	-	Unassigned	-	-	No	No	Link	Link	Reference Antenna; One of six batch for i
SN002	Awaiting Measurements	-	Unassigned	-	-	No	No	Link	Link	One of six batch for initial testing of produ
SN003	Awaiting Measurements	-	Unassigned	-	-	No	No	Link	Link	One of six batch for initial testing of produ
SN004	At UHM	-	Unassigned	-	-	No	No	Link	Link	One of six batch for initial testing of produ
SN005	Awaiting Measurements	-	Unassigned	-	-	No	No	Link	Link	One of six batch for initial testing of produ
SN006	Awaiting Measurements	-	Unassigned	-	-	No	No	Link	Link	One of six batch for initial testing of produ
SN007	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN008	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN009	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN010	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN011	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN012	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN013	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN014	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN015	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN016	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN017	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN018	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN019	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN020	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN021	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN022	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN023	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN024	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN025	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN026	Awaiting Measurements	-	Unassigned	-	2	Yes	No	Link	Link	
SN027	Awaiting Measurements	-	Unassigned	-	1	Yes	No	Link	Link	
SN028	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN029	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN030	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN031	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN032	Awaiting Measurements	-	Unassigned	-	1	Yes	No	Link	Link	
SN033	Awaiting Measurements	-	Unassigned	-	1	Yes	No	Link	Link	
SN034	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN035	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN036	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN037	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN038	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN039	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN040	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN041	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN042	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN043	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN044	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN045	Awaiting Measurements	-	Unassigned	-	3	Yes	No	Link	Link	
SN046	Awaiting Measurements	-	Unassigned	-	1	Yes	No	Link	Link	

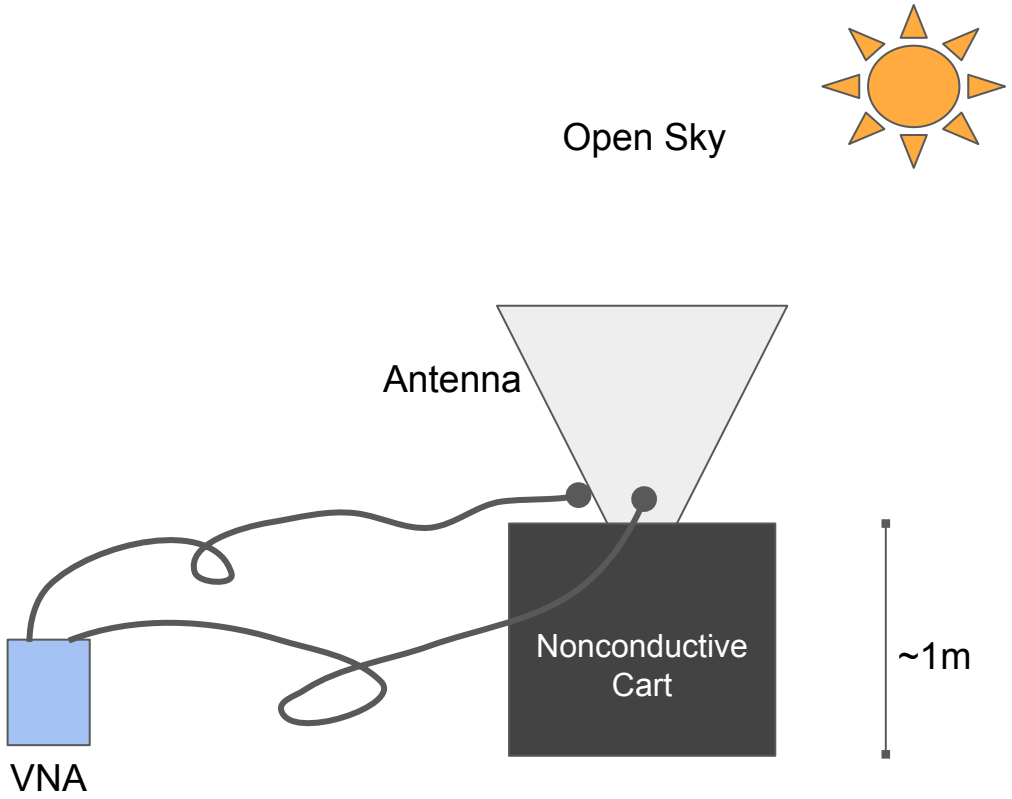
Timeline


May24
Jun24
Jul24
Aug24
Sep24
Oct24
Nov24
Dec24
Jan25
Feb25
Mar25
Apr25
May25
Jun25
Jul25
Aug25
Sep25
Oct25
Nov25
Dec25
Jan26
Receive Production Antennas
Spot-Check Measurements
Photogrammetry Labeling & Testing
Assigning Antenna Positions
Integration
Palestine
Antarctica

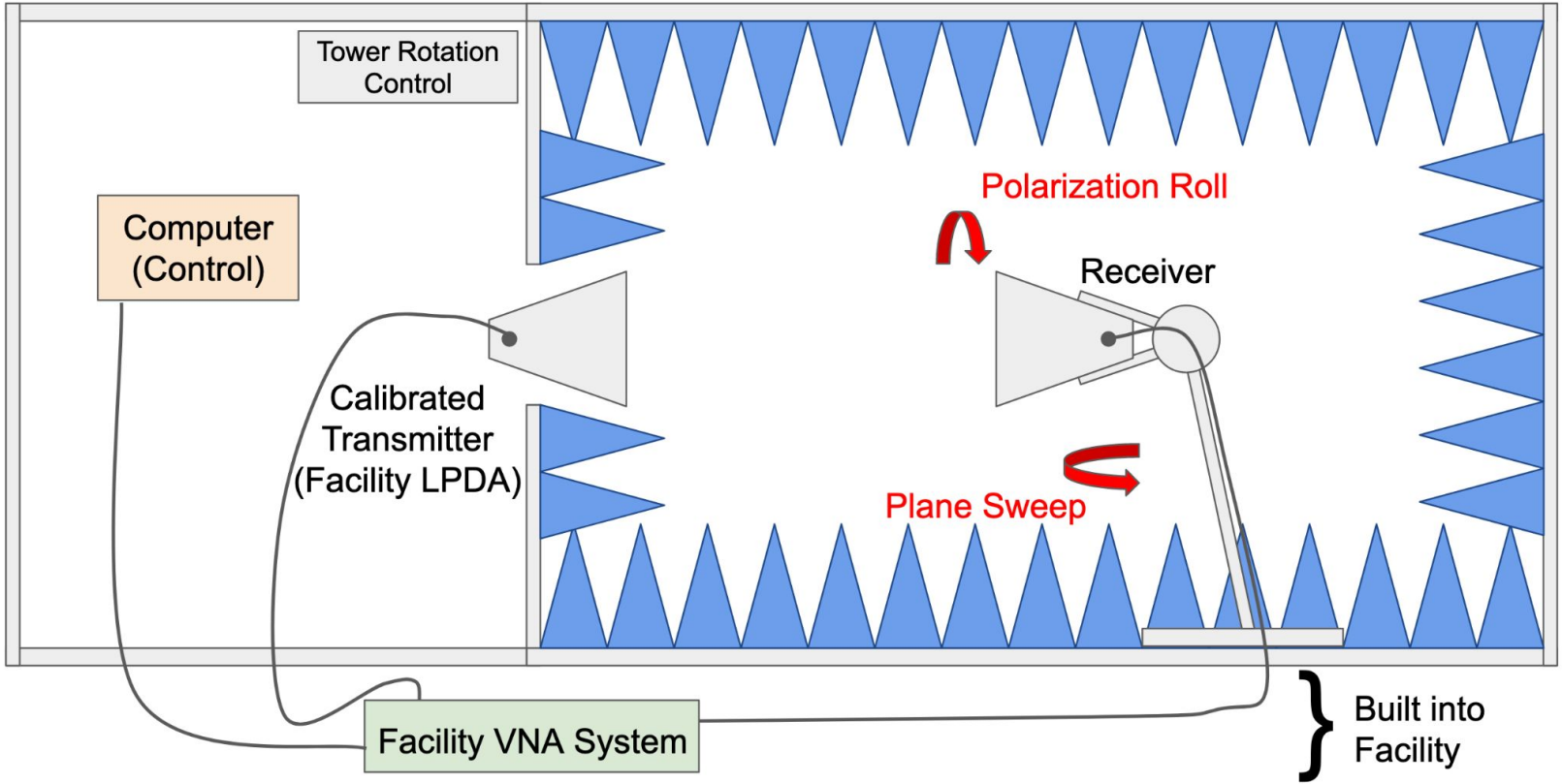
Backup / Extra Slides

S11 & Port-to-Port Isolation Measurement Setup

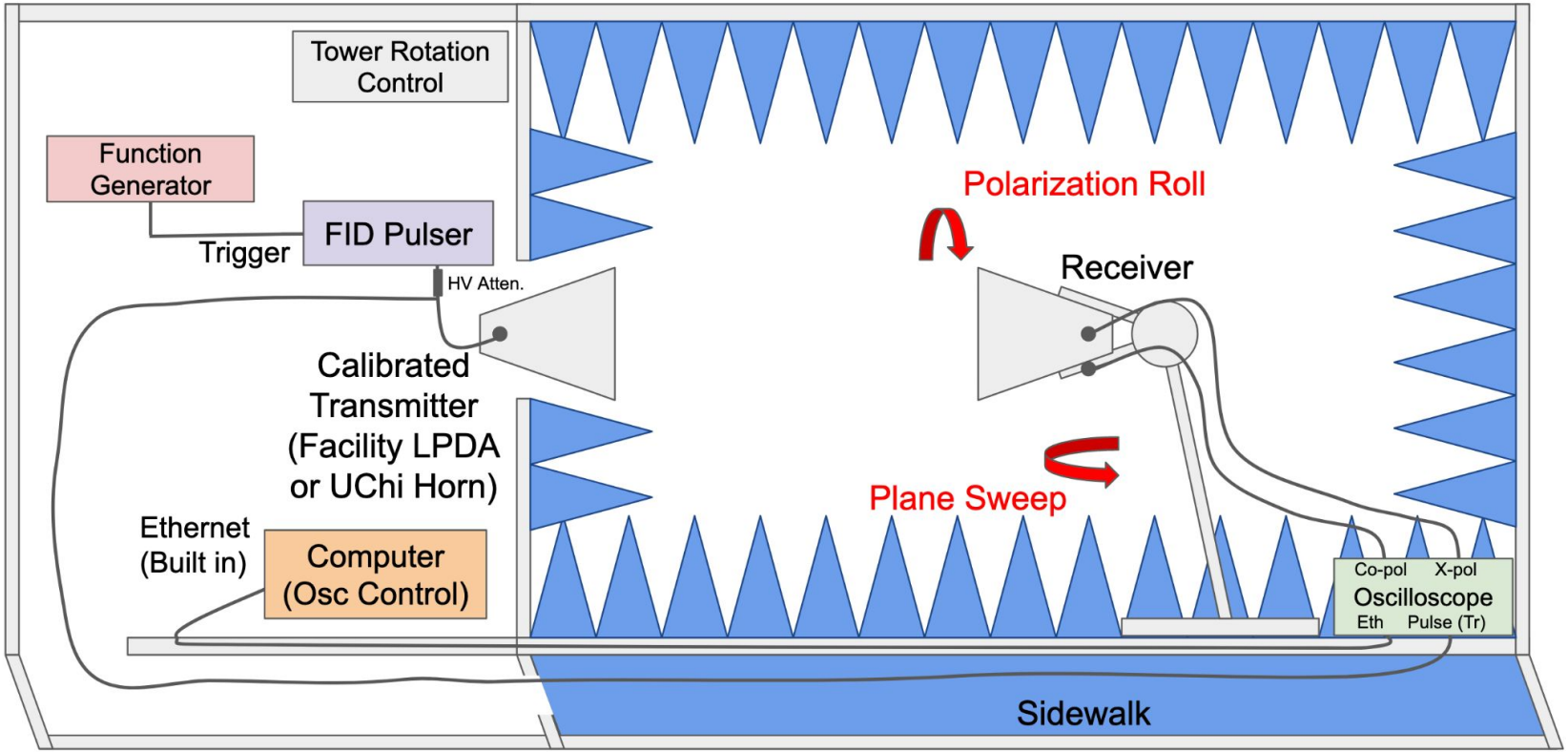




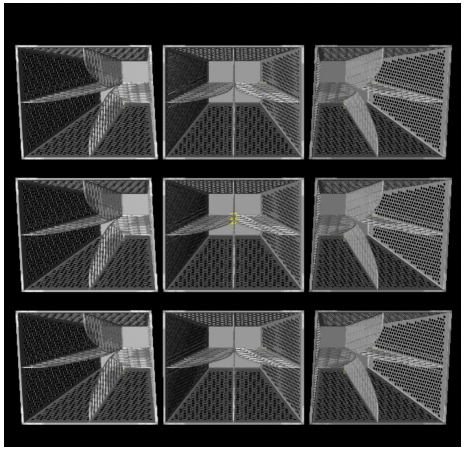
Gain Sweep Measurement Setup @ Warminster

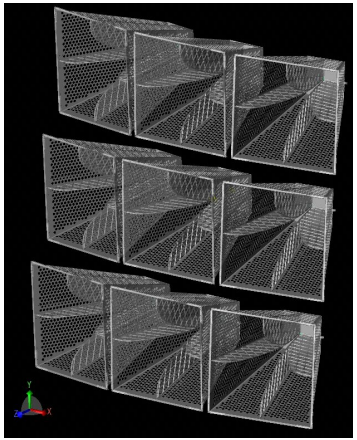


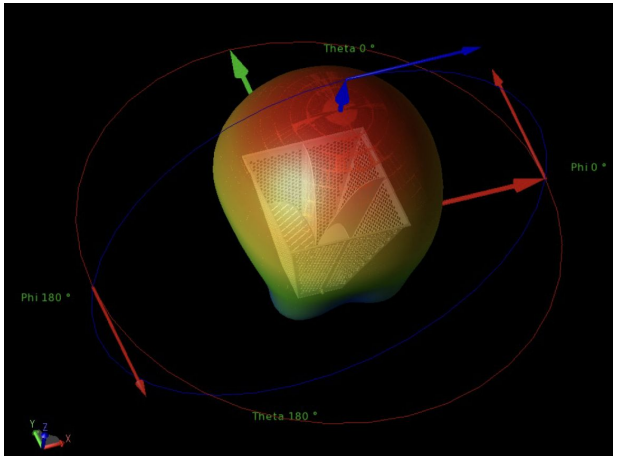
Impulse Response Measurement Setup @ Warminster

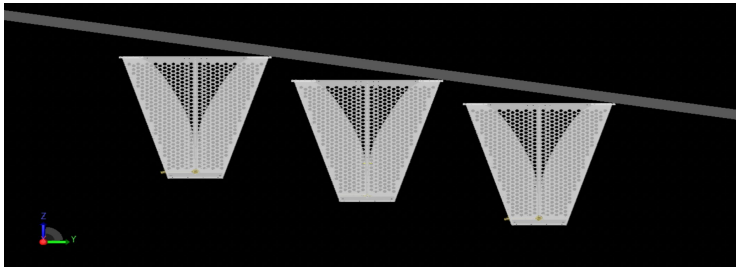


XFDTD Simulation Set Up









- Theta and phi coords are split in 5 deg grid
- Phi defined: 0 at +x, increasing for rotation about +z (in picture)
- Theta defined: 0 at +z, increasing for rotation about +y (in picture)
- This is consistent with previous presentations on xf sims: Jim Beatty, Peter Gorham
- 3x3 array is canted 10deg down, side antennas are rotated accordingly to payload radius