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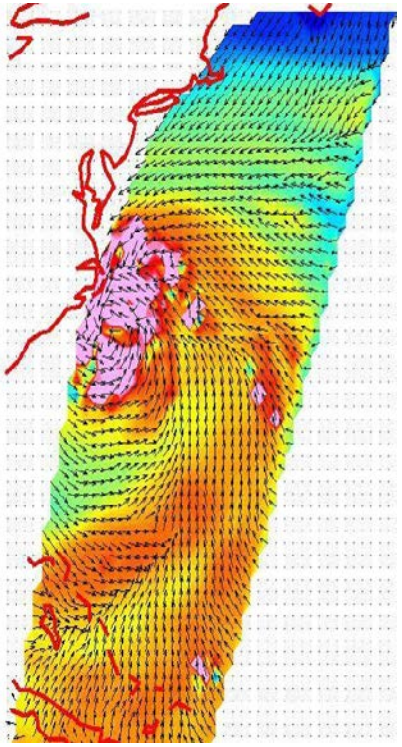
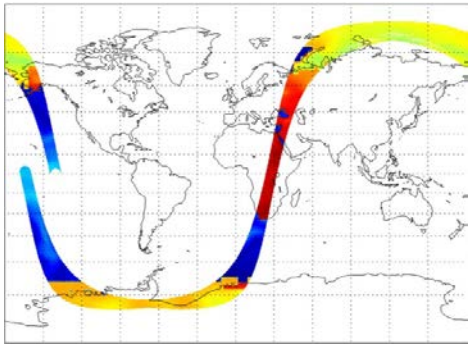
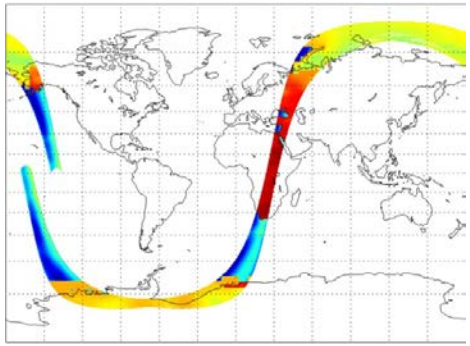
COWVR

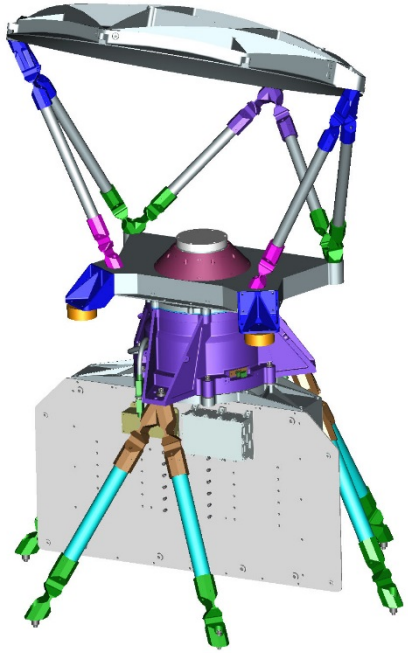
Compact Ocean Wind Vector Radiometer

COWVR Instrument Antenna, Performance Verification and Test Results









Paolo Focardi, David Gonzalez, Jefferson A. Harrell and Shannon Brown

Jet Propulsion Laboratory,
California Institute of Technology

IEEE AP-S/URSI '16

Fajardo, Puerto Rico

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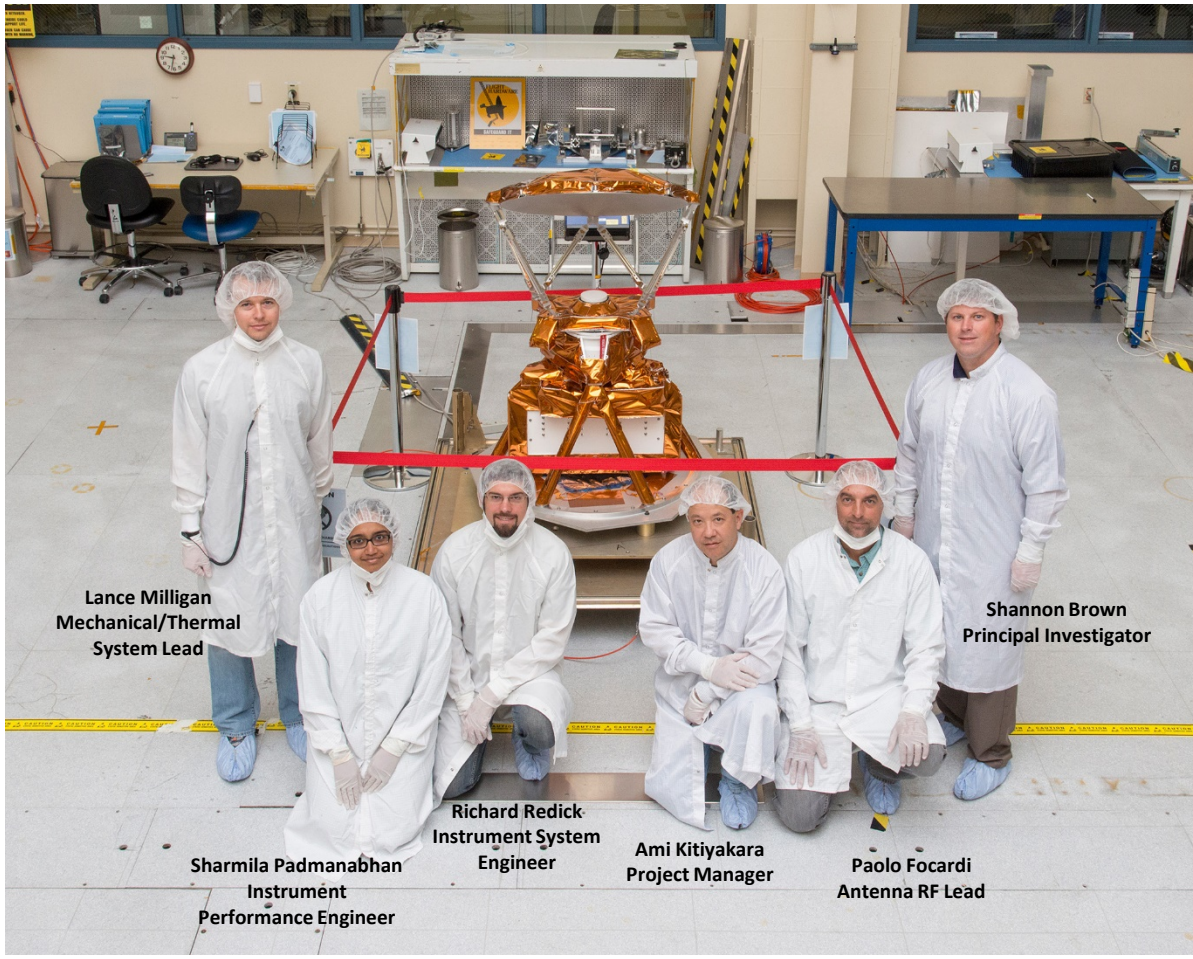
Agenda

- Overview of Antenna System
- Initial RF Model
- Performance Verification
- Improved RF Model
- Latest Results
- Conclusions



COWVR System Engineering Team

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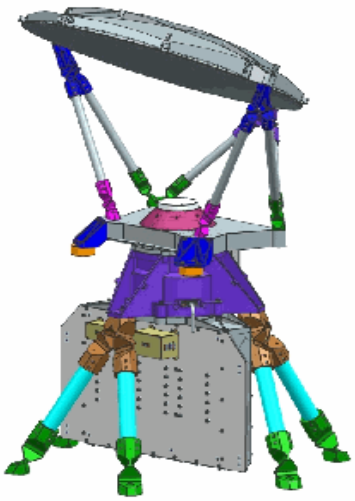
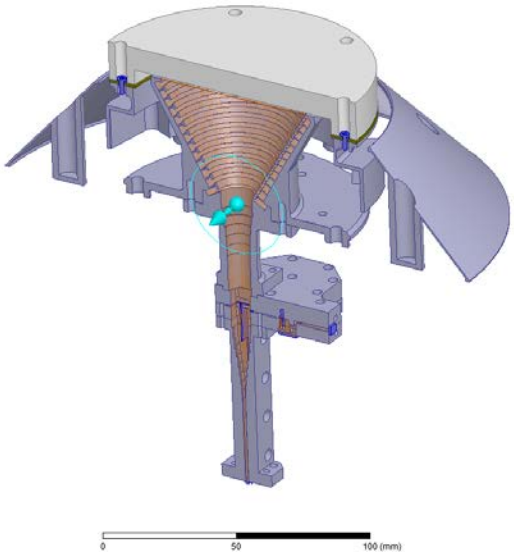
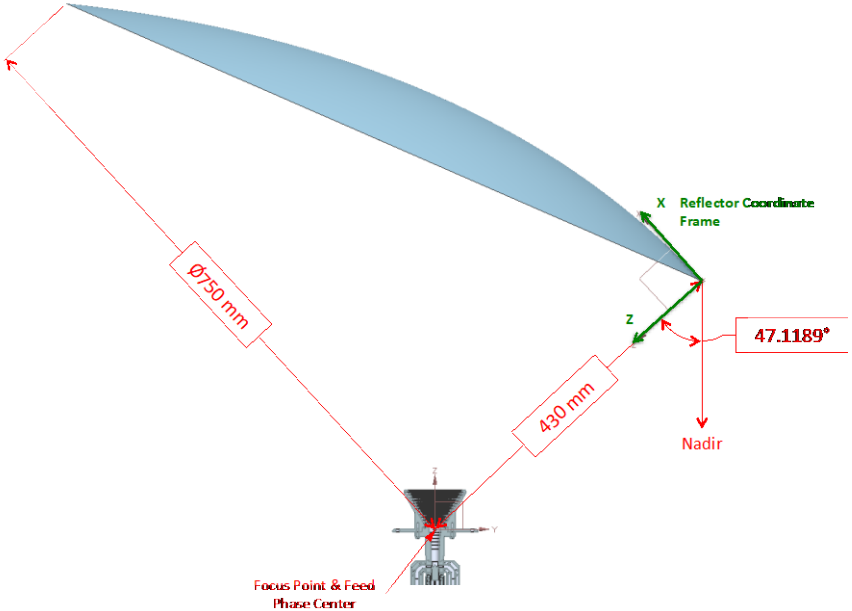
Antenna RF System

- Antenna RF System consists of a single fixed (non-rotating) feed horn illuminating a 75 cm rotating reflector
- Feed design was inherited from Jason 3 covering 18.7 GHz, 23.8 GHz and 33.9 GHz bands
- Entire feed assembly is modeled with HFSS
- Calculated radiation pattern includes surrounding baffle and the EPS Radome
- The baffle was added in order to reduce interaction between reflector and top deck







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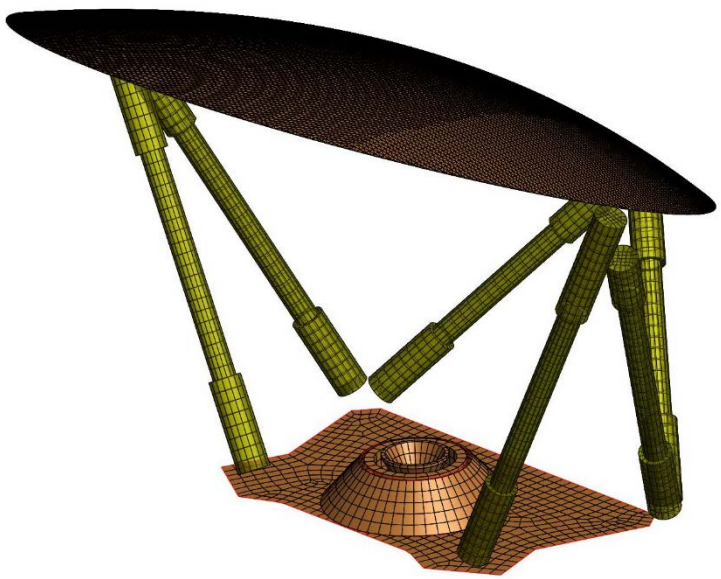
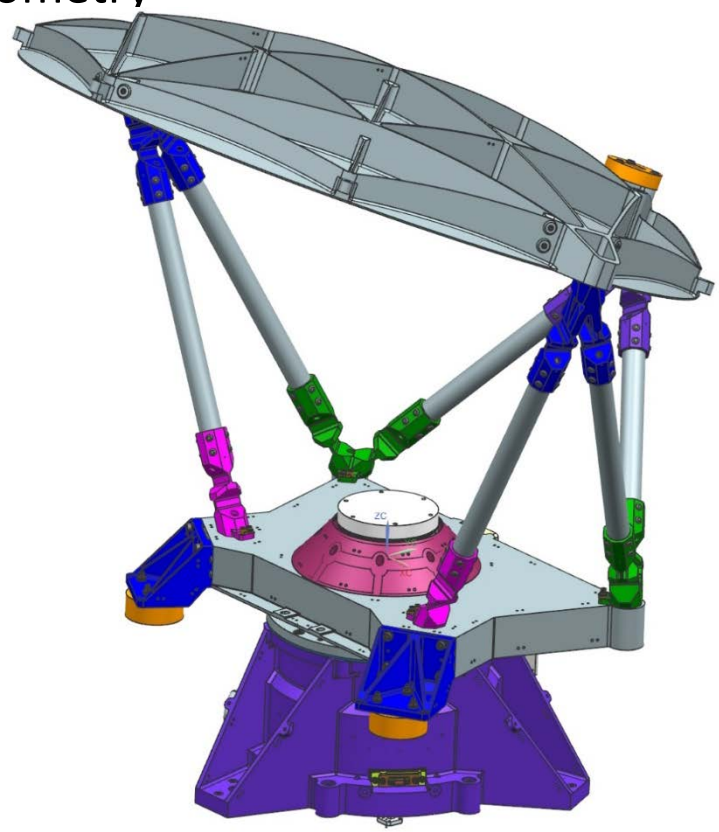
Initial RF Model

The initial RF Model in GRASP included:

- As-built reflector surface from photogrammetry data
- As-built position and orientation of the feed
- Calculated feed pattern from HFSS model
- Top deck and struts with simplified geometry





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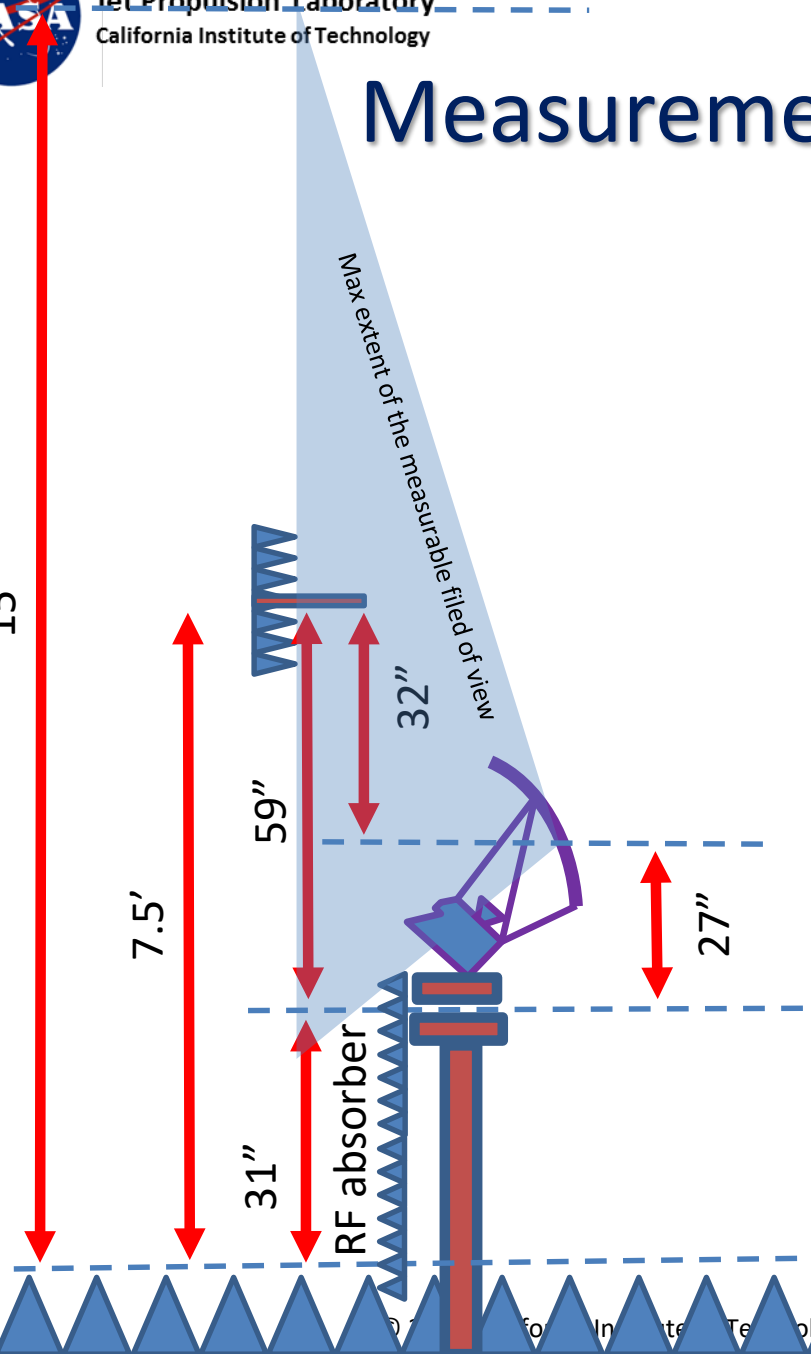
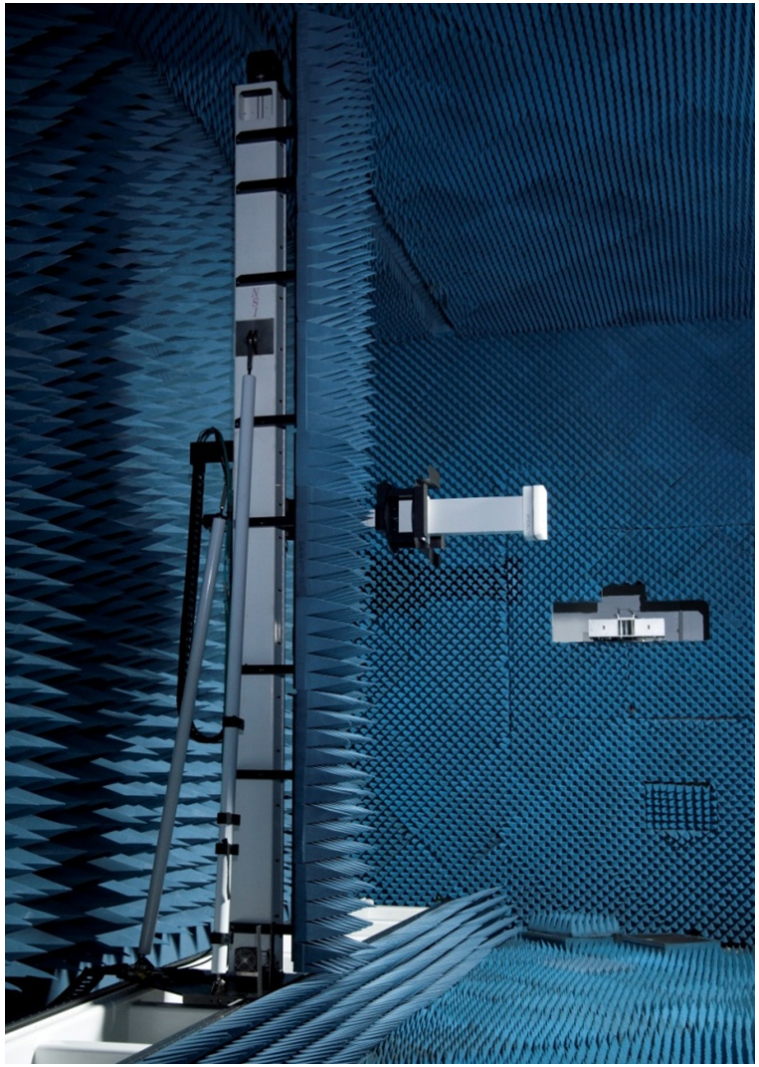
Measurement Range Layout





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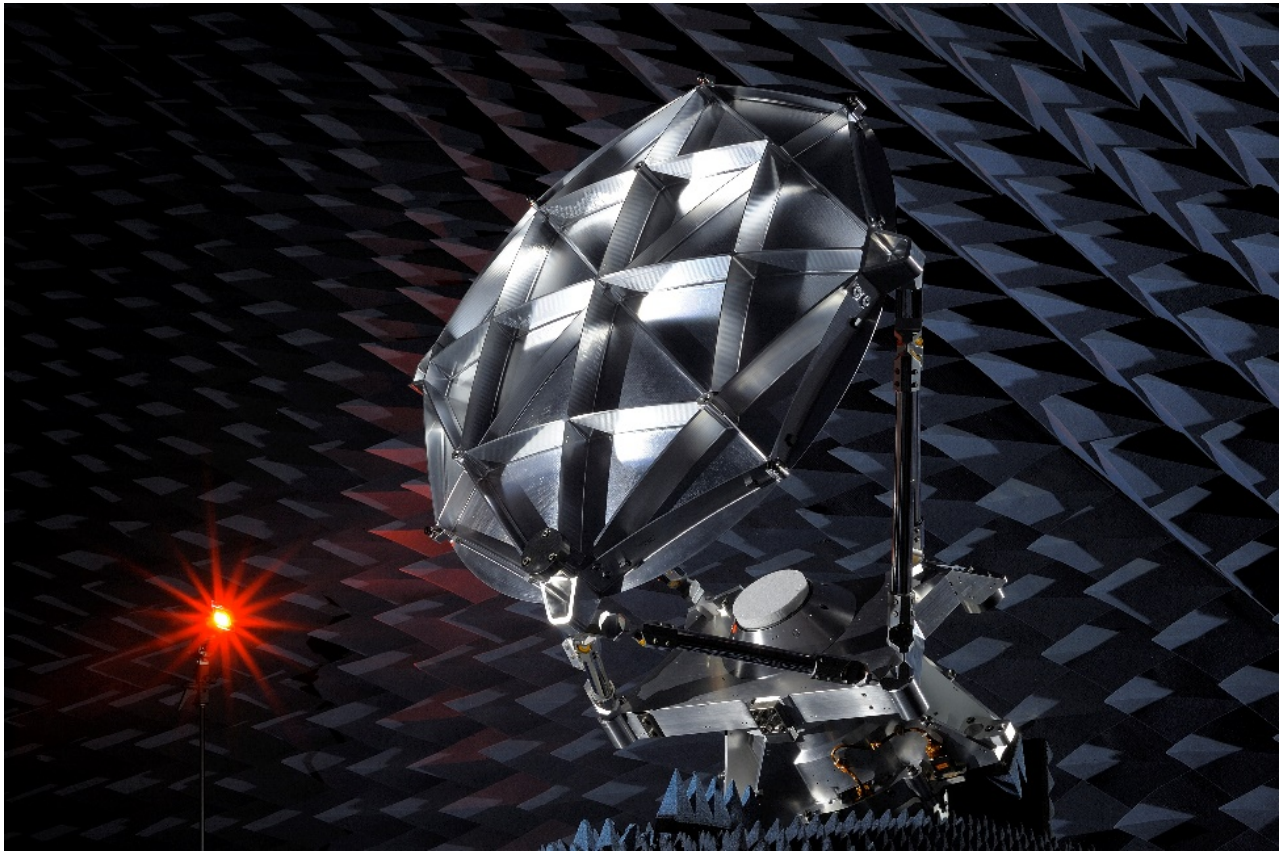
COWVR Instrument During RF Tests



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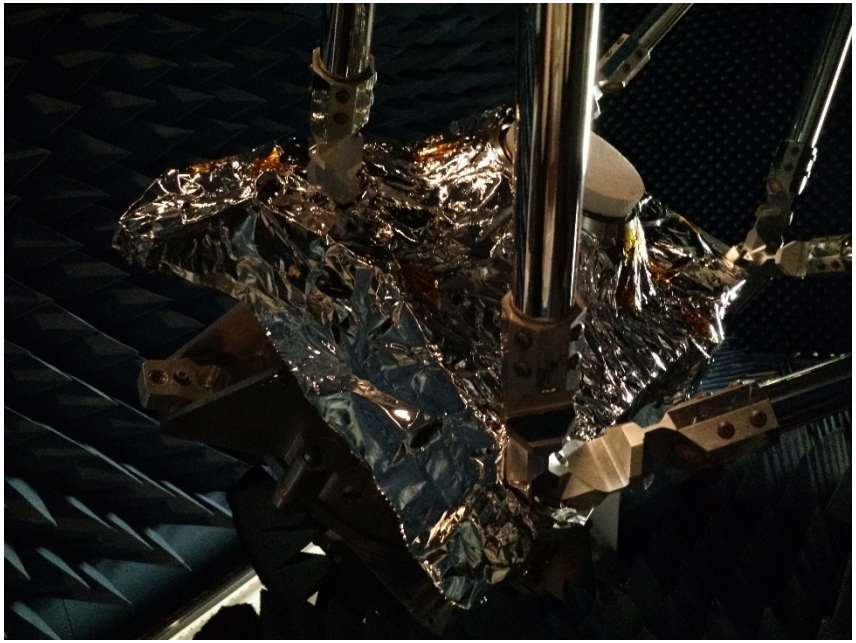
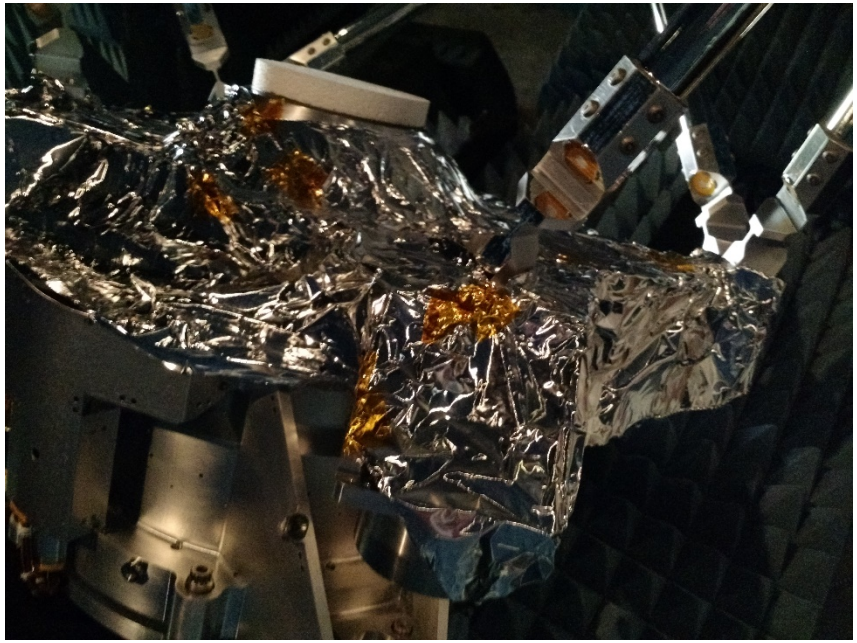
Test Case with Al Foil





- One data set was repeated after installation of Al foil on the top deck in order to simulate the effect of thermal blankets
- Results confirmed that thermal blankets won't affect instrument performance

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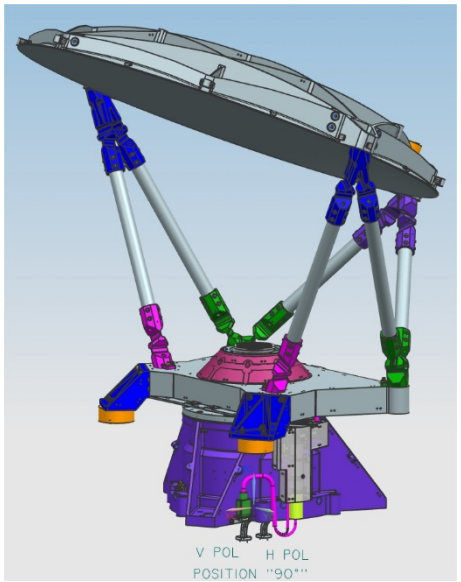
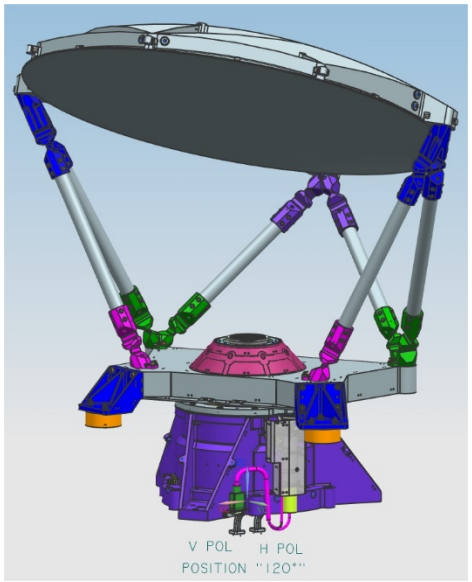
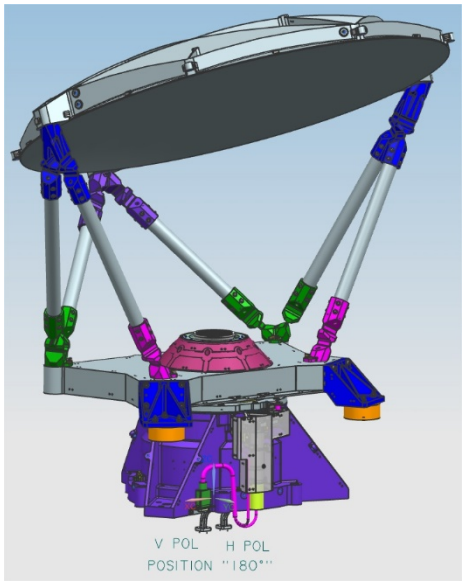
Test Overview

- The performance of the COWVR Instrument, including the SMA and the top deck assembly, was measured with the Planar Near Field Range facility in the 60’ chamber of the JPL Mesa on April 2015
- 3 positions of the top deck (90°, 120° and 180°) were measured, plus one test case for the 180° case with aluminum foil on the top deck to simulate the presence of thermal blankets
- Each position was correlated with metrology data to assess the actual pointing of the instrument in the range reference system







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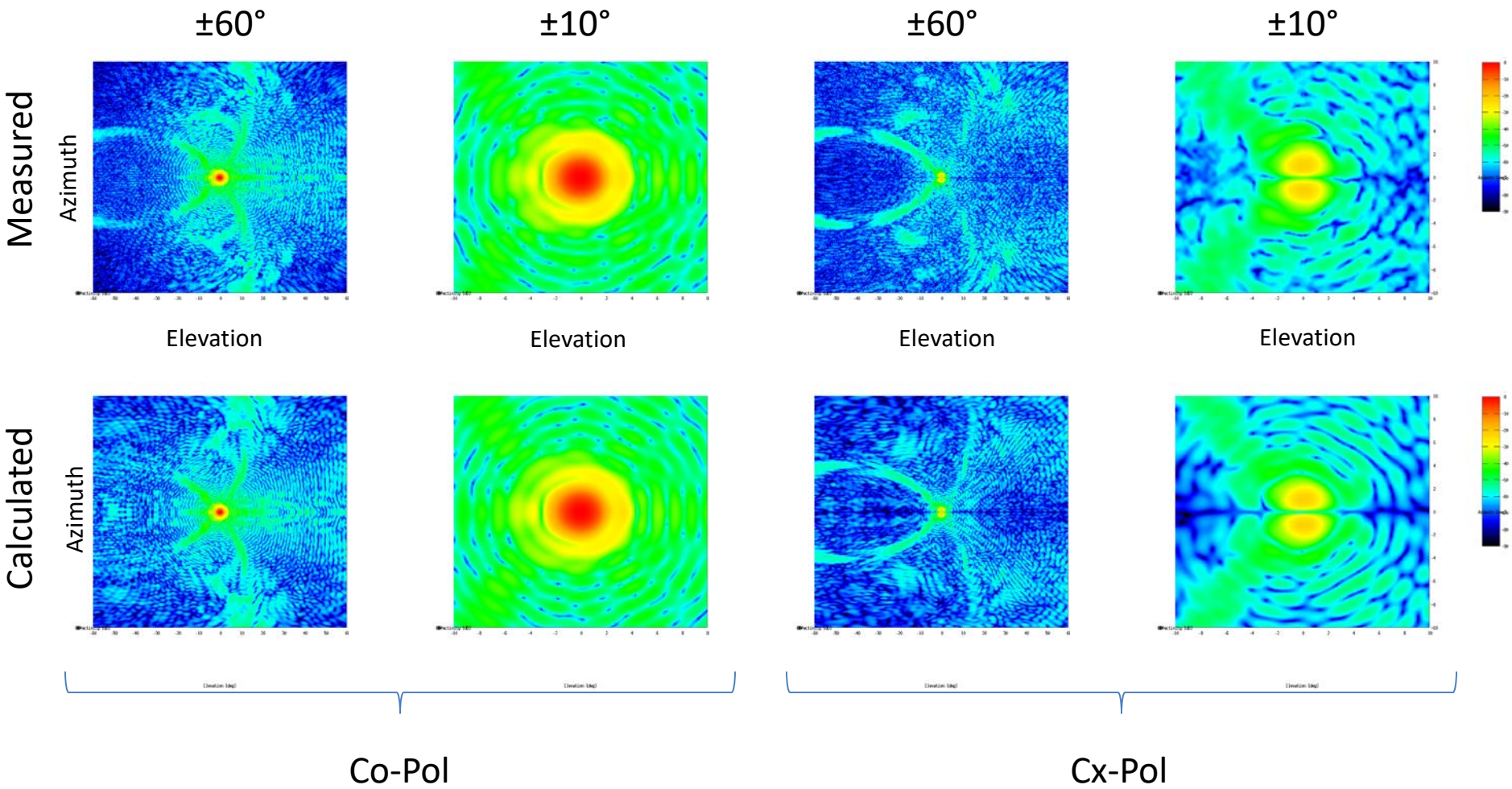
H-Pol Results, 180°, 18.7 GHz



For reference: green = -45dB, light blue = -60dB

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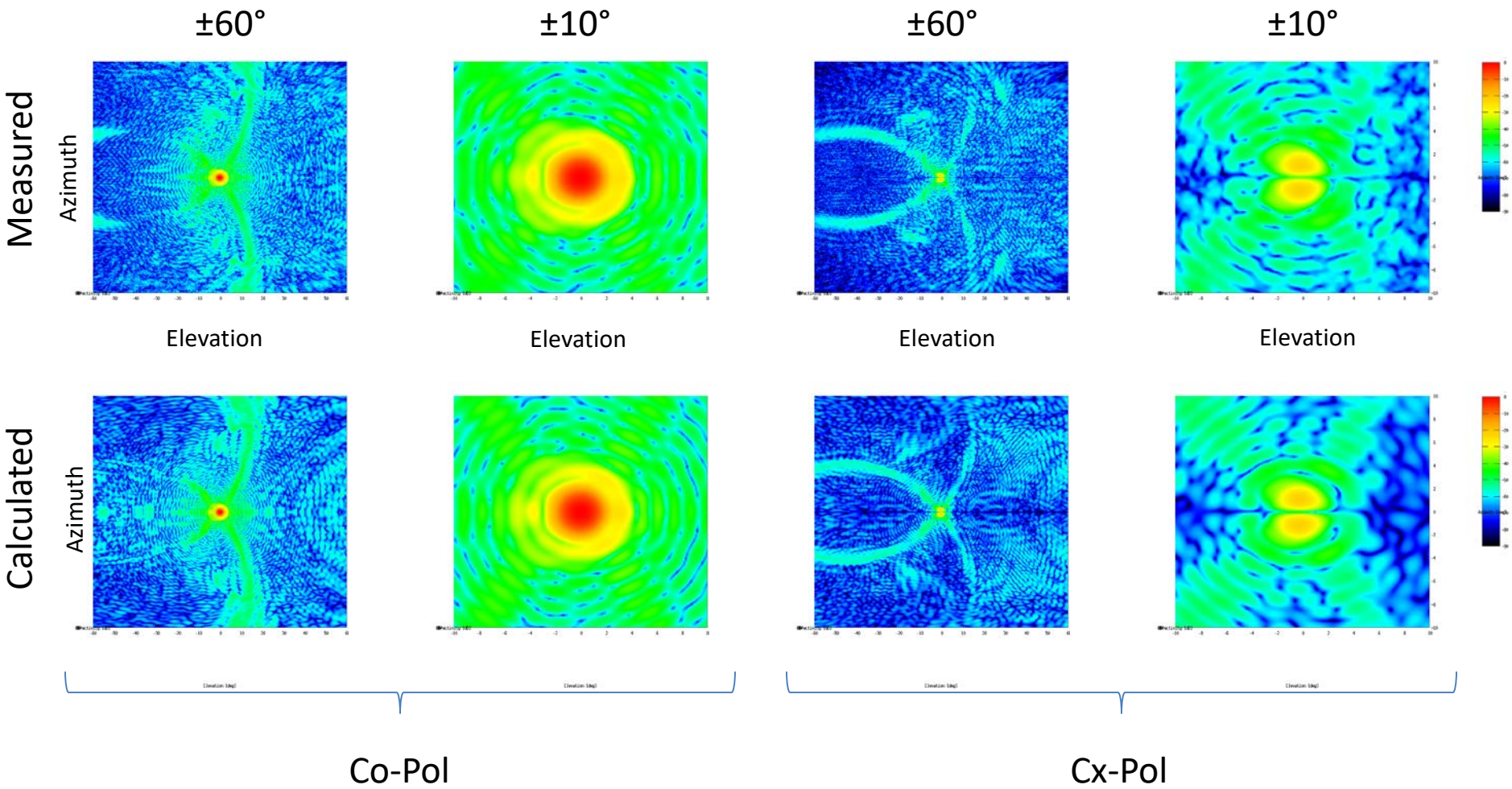
V-Pol Results, 180°, 18.7 GHz



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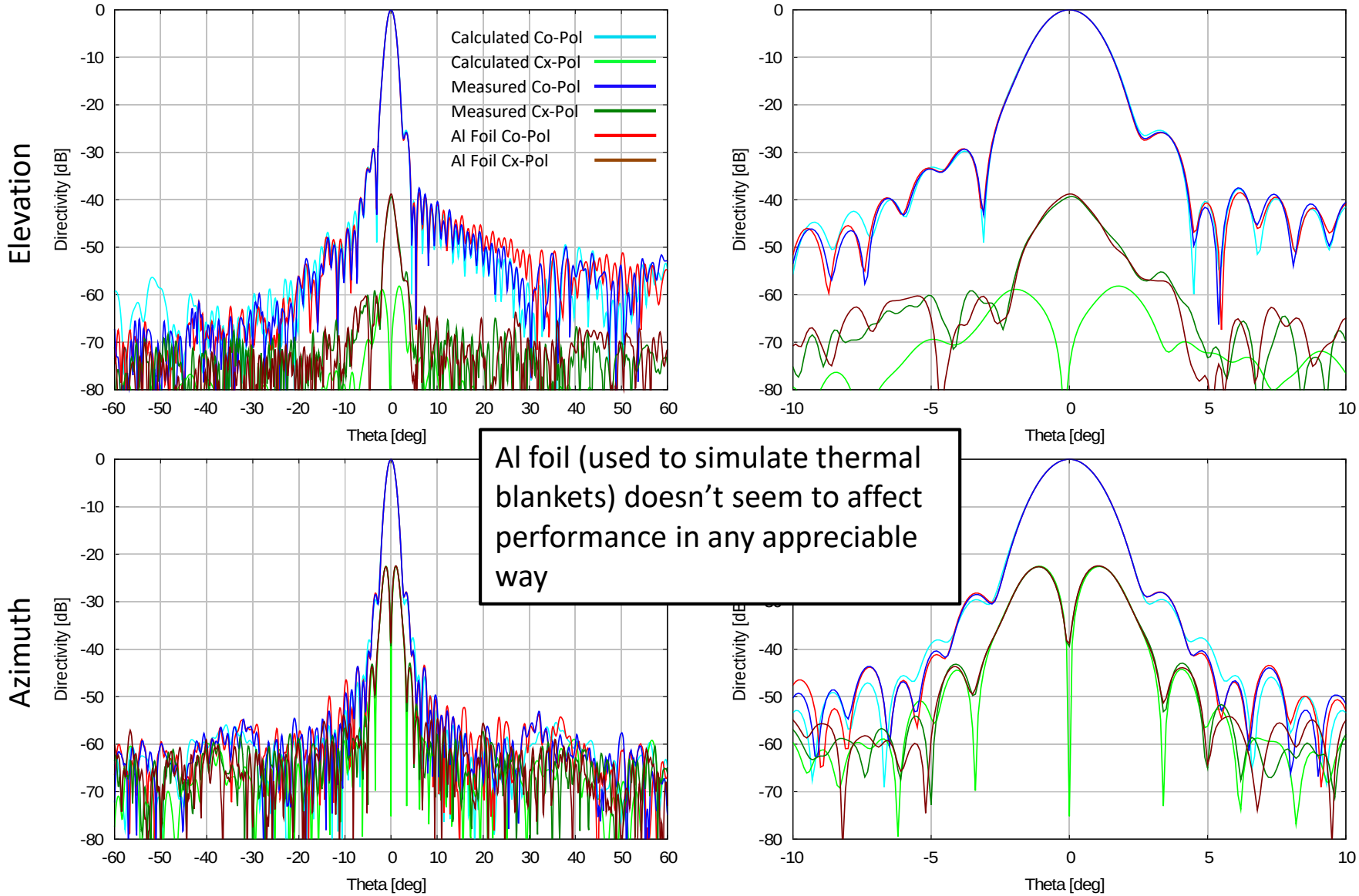
H-Pol Cuts, 180°, 18.7 GHz



Al foil (used to simulate thermal blankets) doesn't seem to affect performance in any appreciable way

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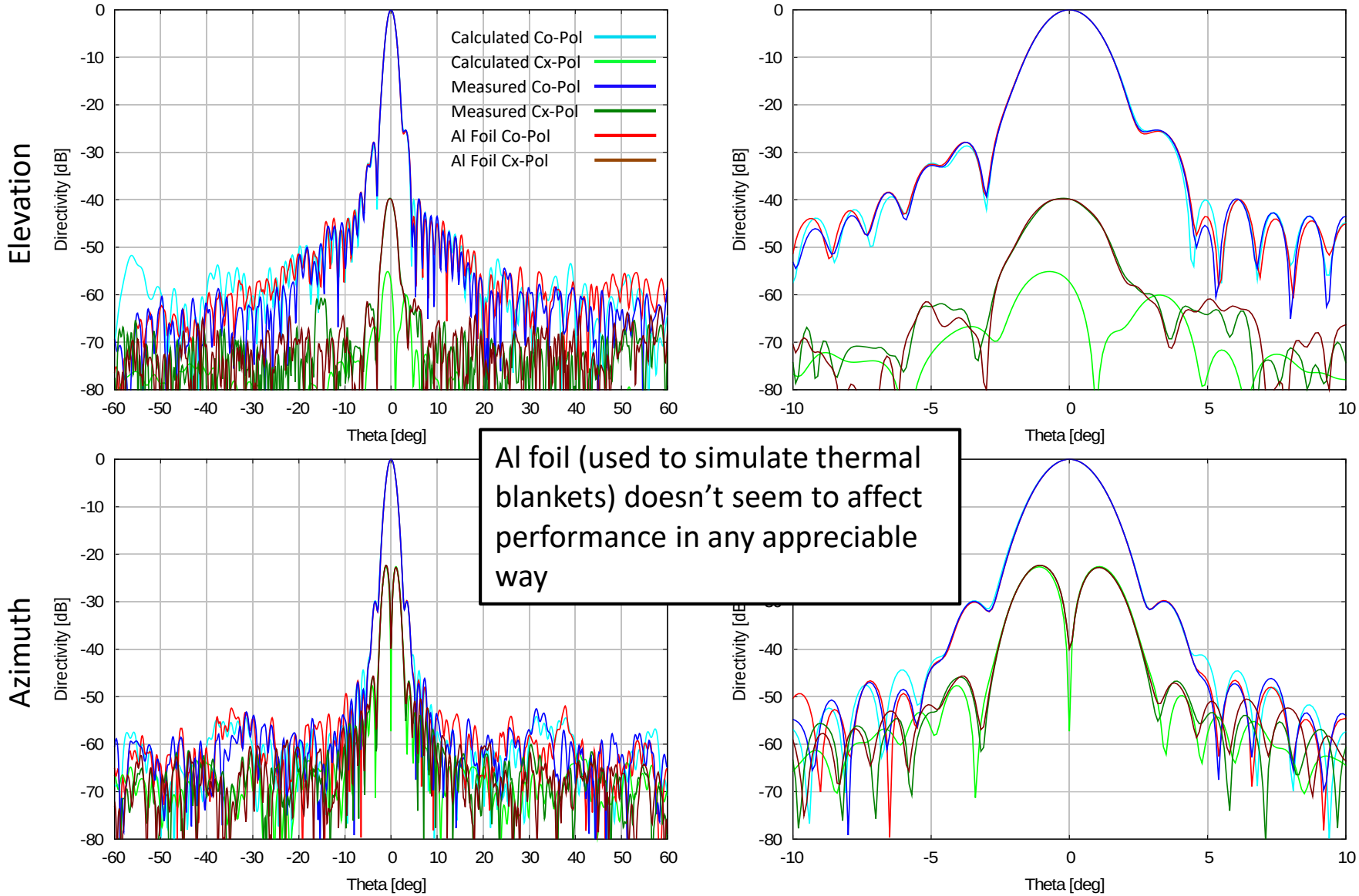
V-Pol Cuts, 180°, 18.7 GHz



Al foil (used to simulate thermal blankets) doesn't seem to affect performance in any appreciable way

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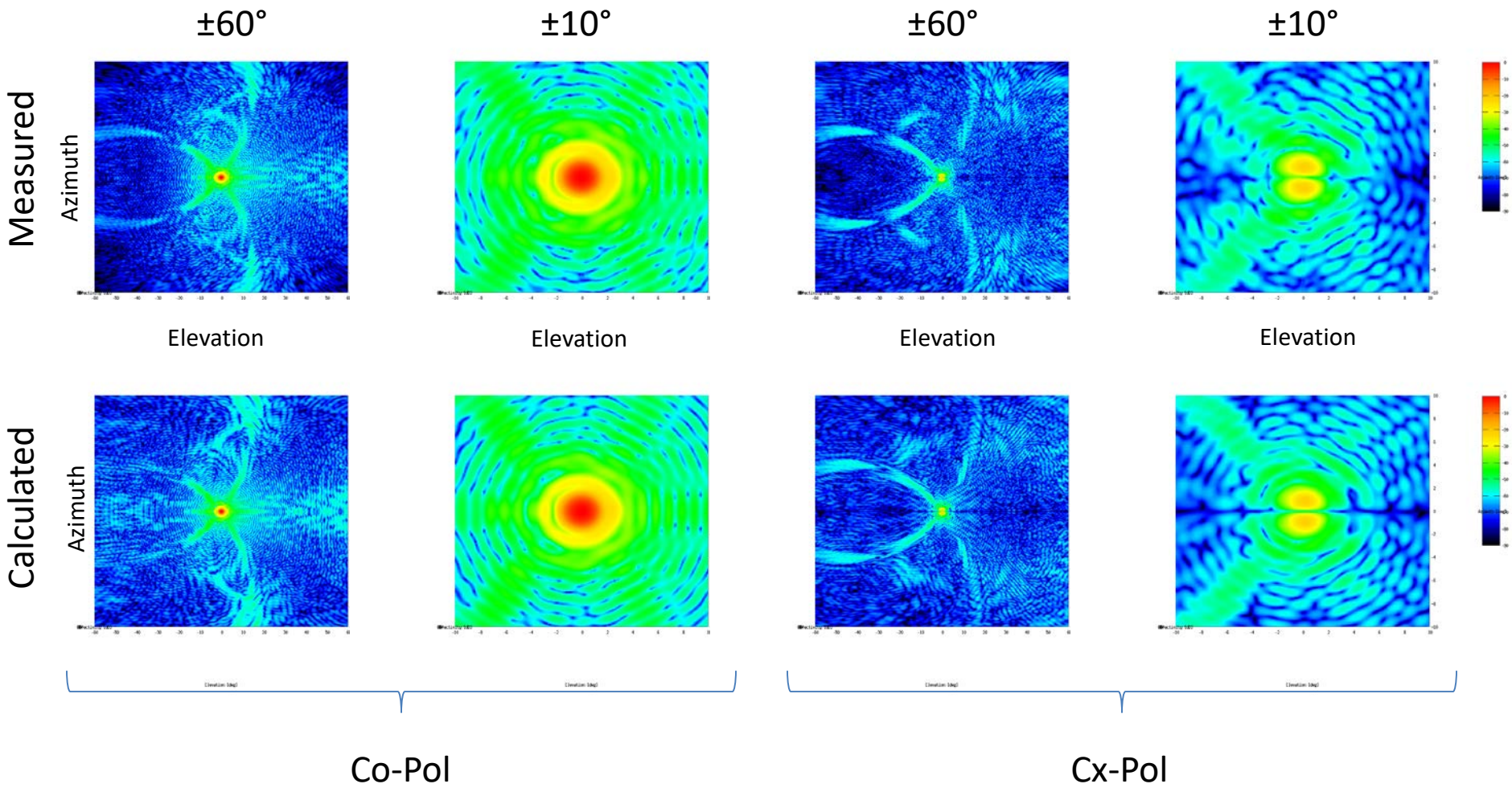
H-Pol Results, 180°, 23.8 GHz



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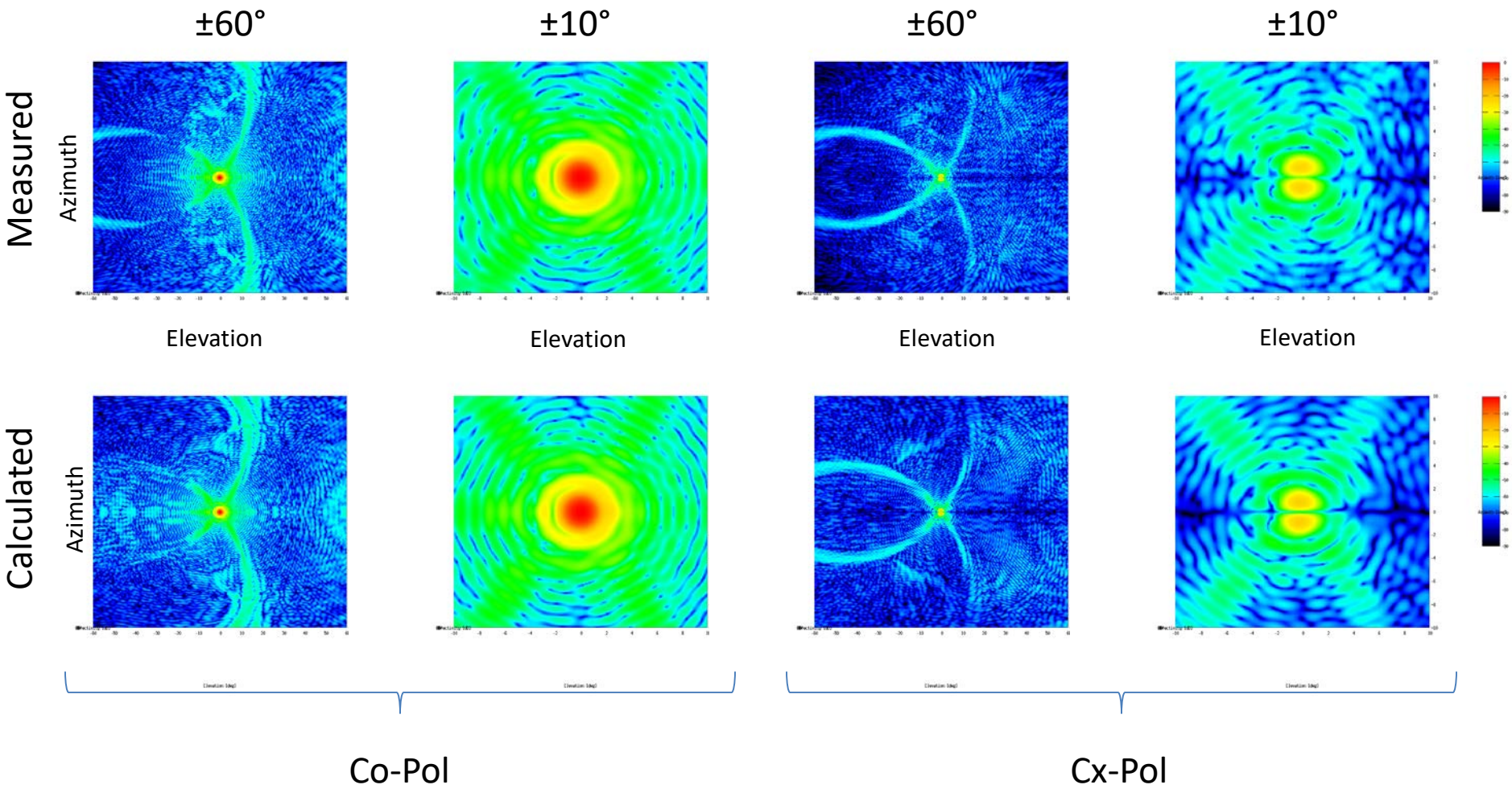
V-Pol Results, 180°, 23.8 GHz



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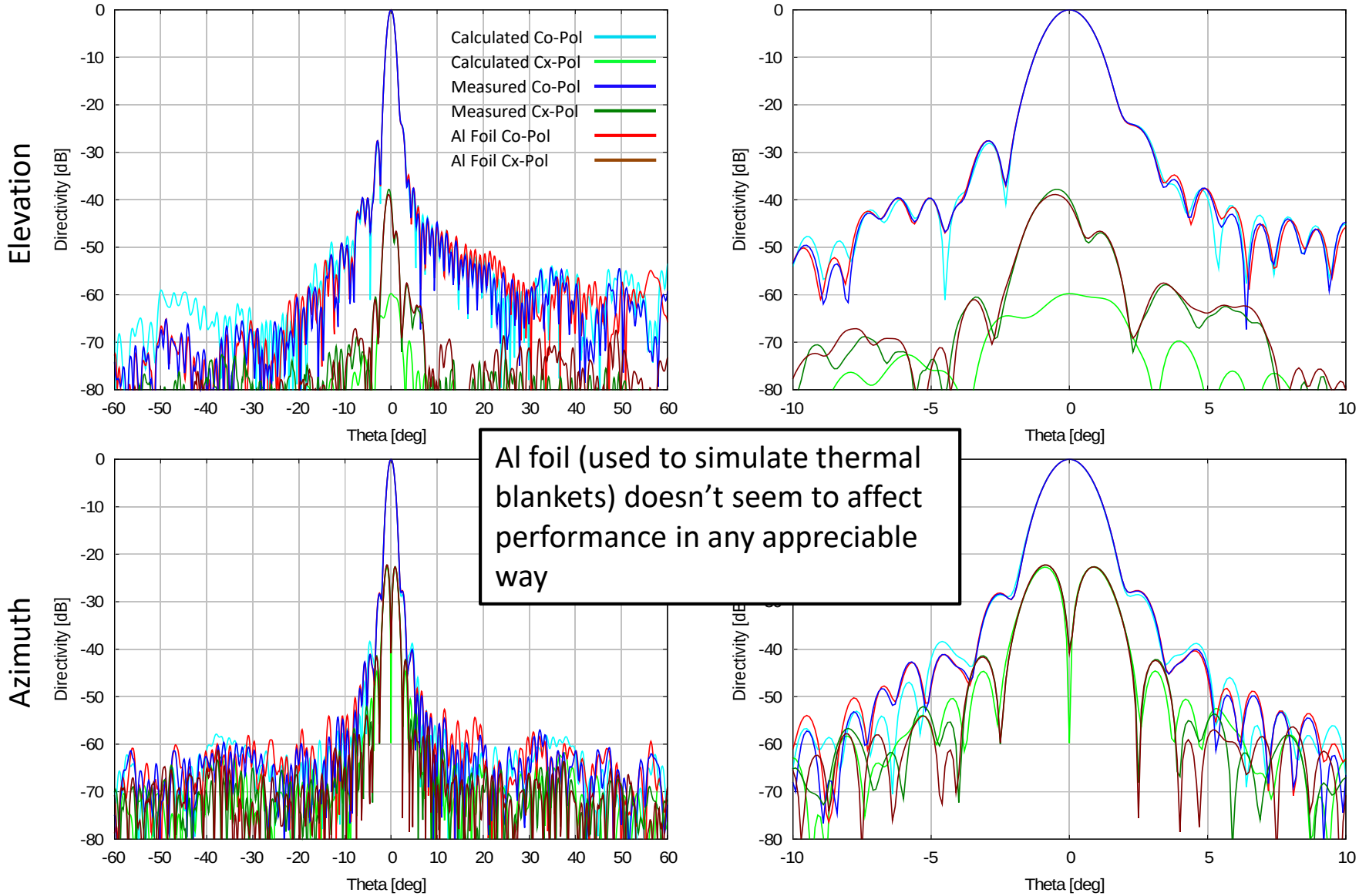
H-Pol Cuts, 180°, 23.8 GHz



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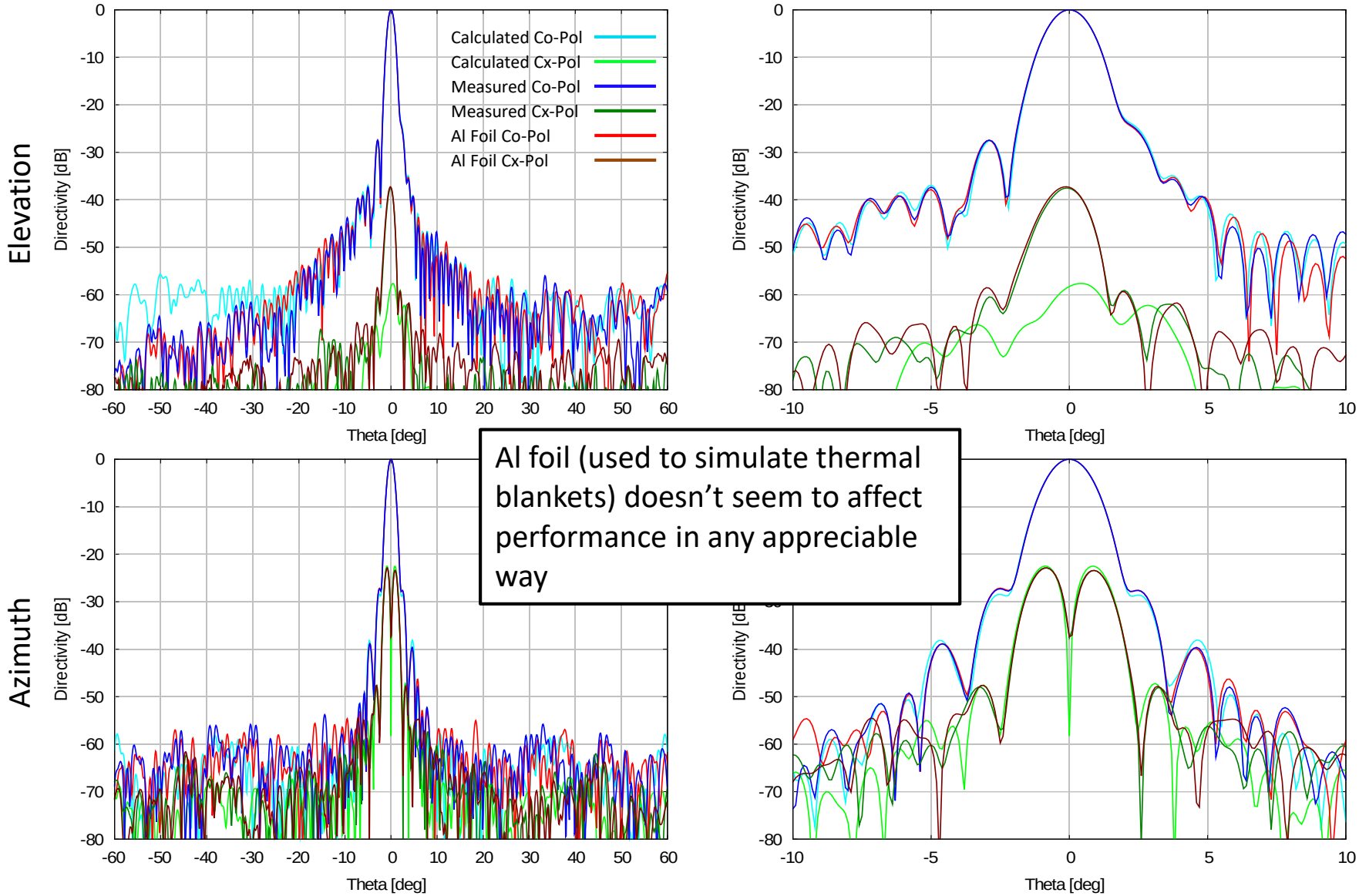
V-Pol Cuts, 180°, 23.8 GHz



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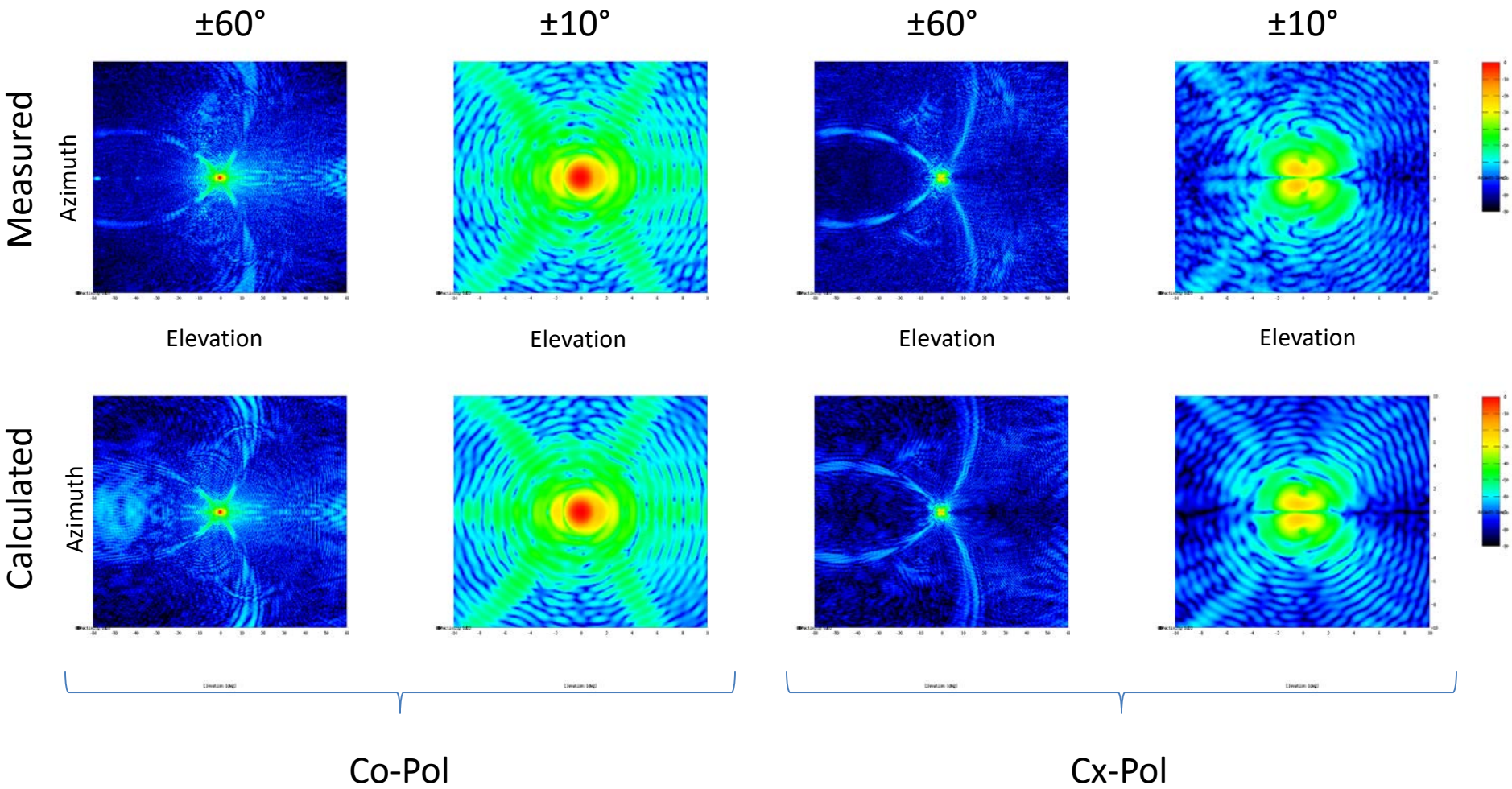
H-Pol Results, 180°, 33.9 GHz



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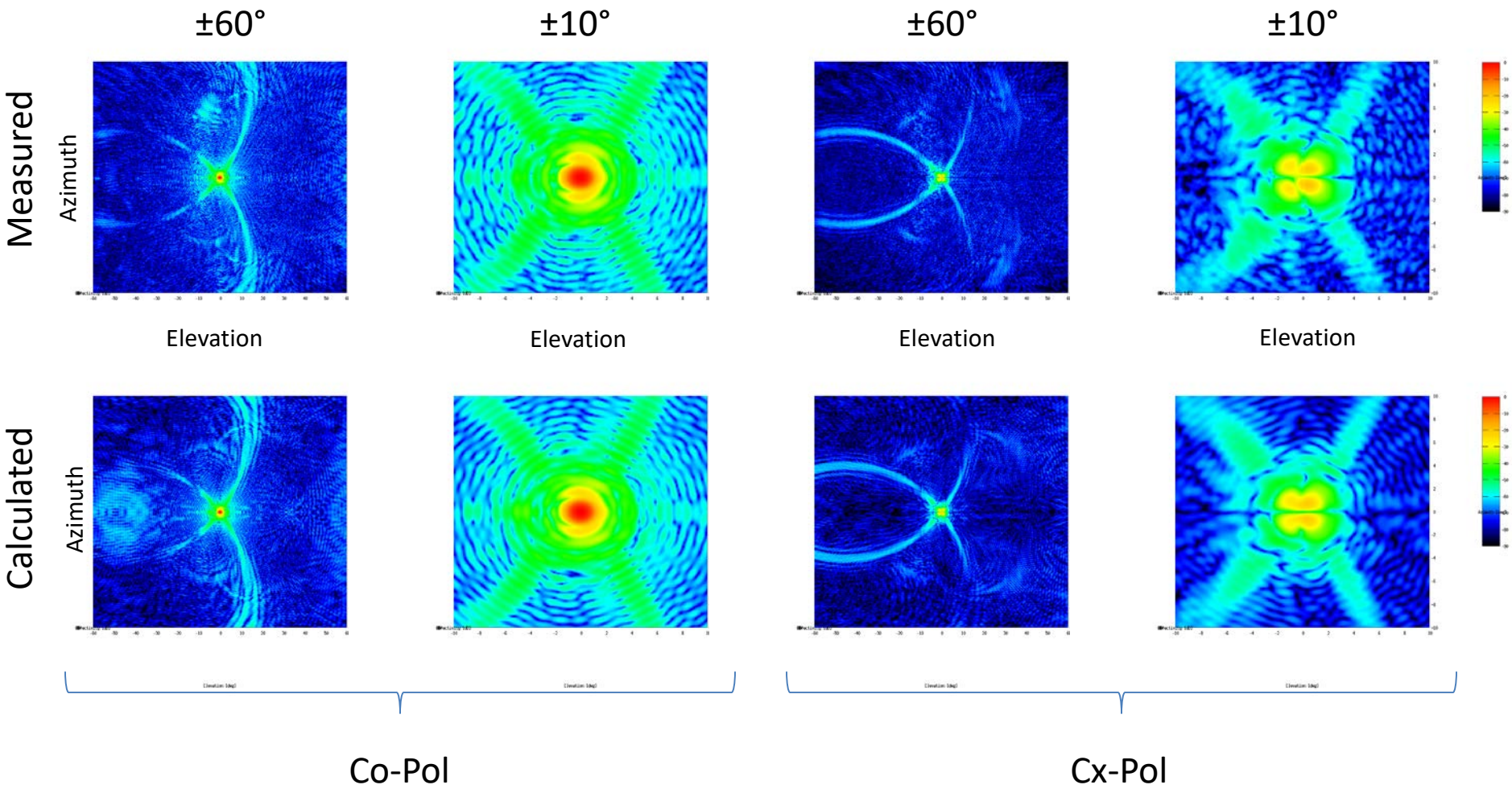
V-Pol Results, 180°, 33.9 GHz



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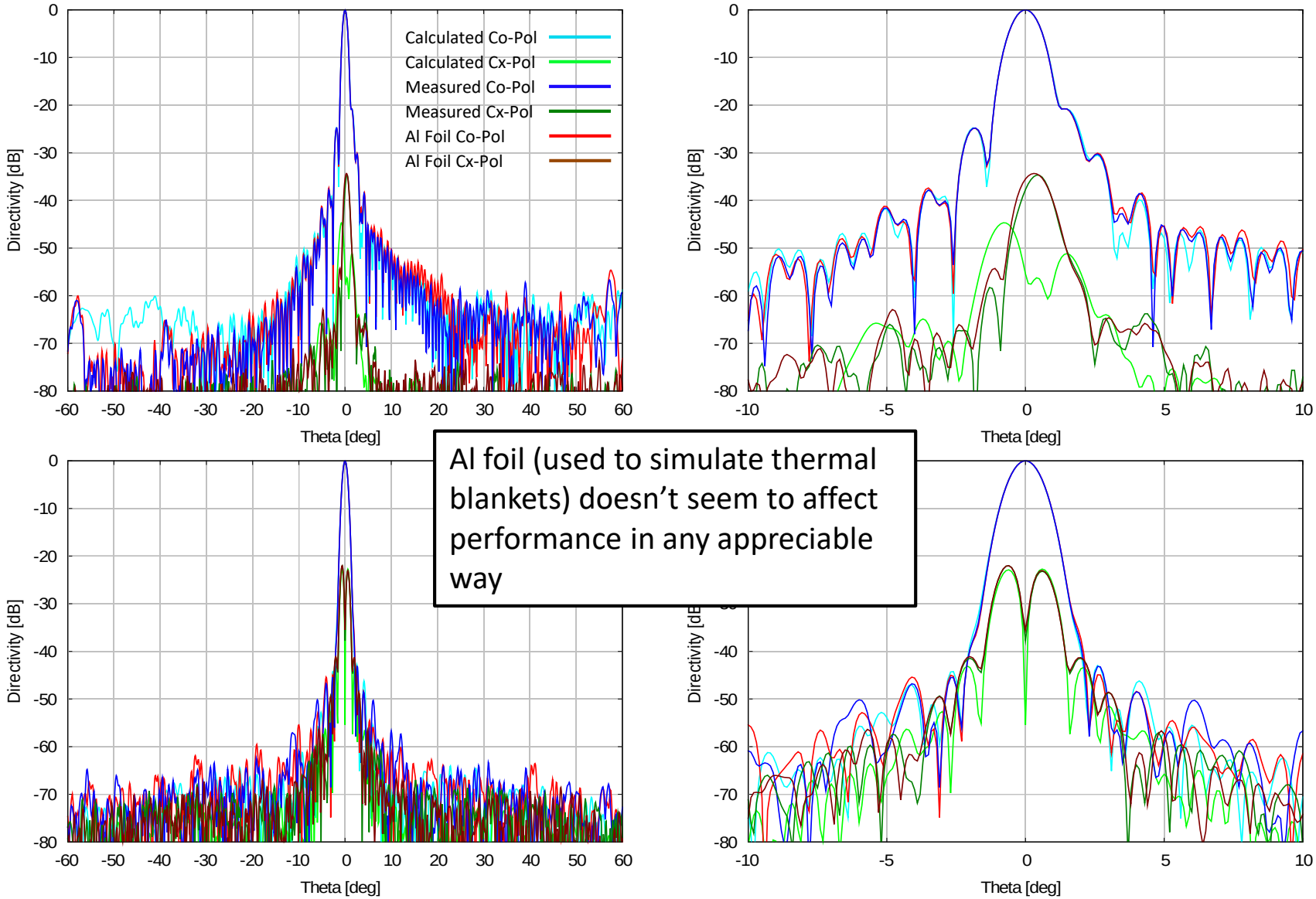
H-Pol Cuts, 180°, 33.9 GHz

Elevation

Azimuth



Al foil (used to simulate thermal blankets) doesn't seem to affect performance in any appreciable way

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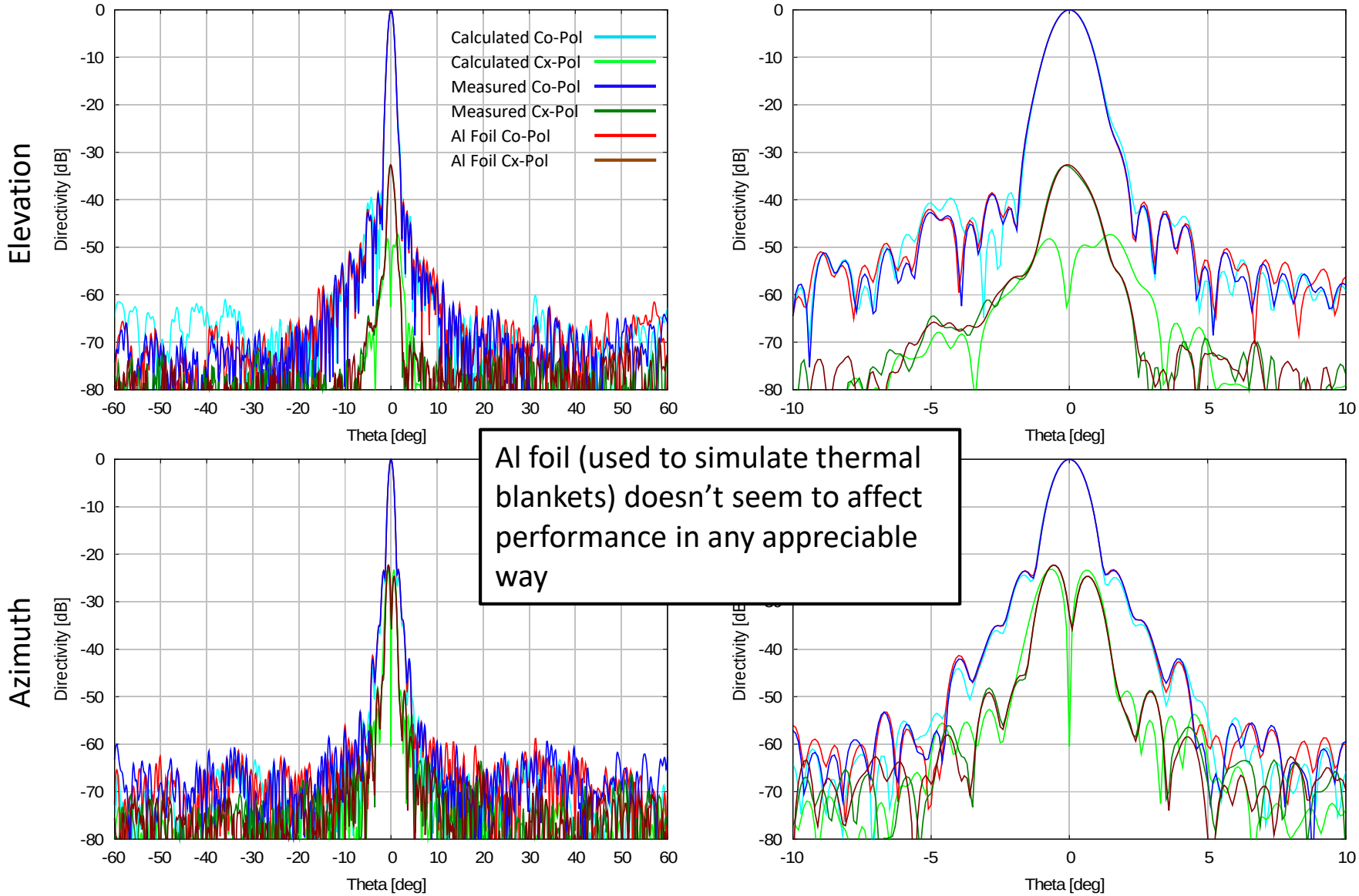
V-Pol Cuts, 180°, 33.9 GHz



Al foil (used to simulate thermal blankets) doesn't seem to affect performance in any appreciable way

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H-Pol Gain/Directivity

OMT performance affected H-pol Gain measurement at 34.8 GHz

Frequency [GHz]	Measured Gain [dBi]	Calculated Gain [dBi]	Measured Directivity [dB]	Calculated Directivity [dB]
18.325	39.74		40.50	
18.700	39.50		40.63	40.55
19.075	39.90		40.82	
23.55	41.82		42.66	
23.80	41.58		42.70	42.66
24.05	42.05		42.76	
33.00	44.36		44.92	
33.45	44.47		45.39	
33.90	44.76		45.57	45.55
34.35	44.39		45.58	
34.80	41.58		44.94	

Measured H-Pol Directivity is within 0.08dB of the calculated values

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V-Pol Gain/Directivity

OMT roll off is less pronounced in V-Pol at 34.8 GHz

Frequency [GHz]	Measured Gain [dBi]	Calculated Gain [dBi]	Measured Directivity [dB]	Calculated Directivity [dB]
18.325	39.70		40.46	
18.700	39.77		40.61	40.56
19.075	40.00		40.80	
23.55	41.83		42.66	
23.80	41.96		42.69	42.67
24.05	42.11		42.74	
33.00	44.37		44.95	
33.45	44.65		45.39	
33.90	44.97		45.59	45.50
34.35	44.94		45.58	
34.80	44.55		45.32	

Measured V-Pol Directivity is within 0.09dB of the calculated values

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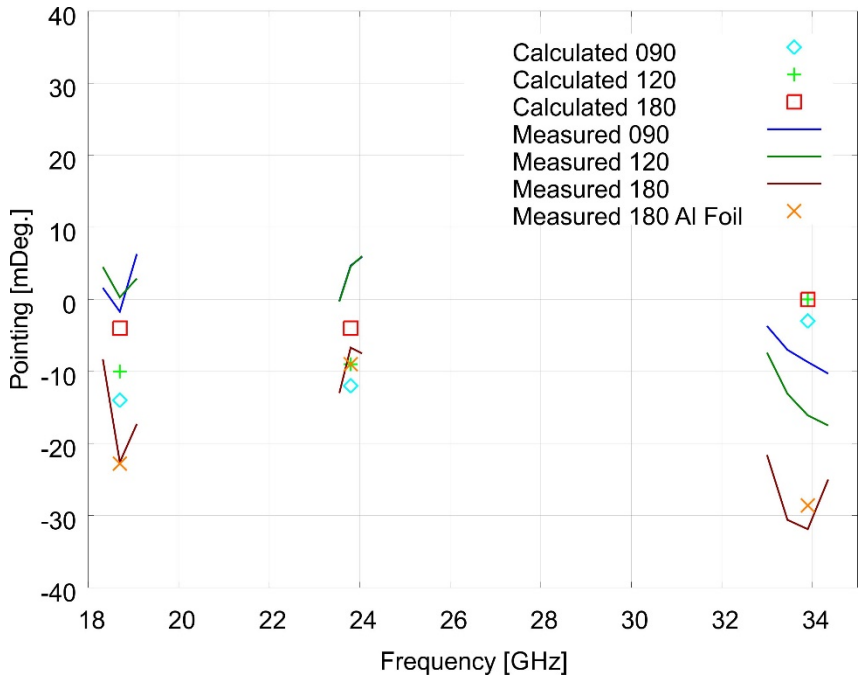
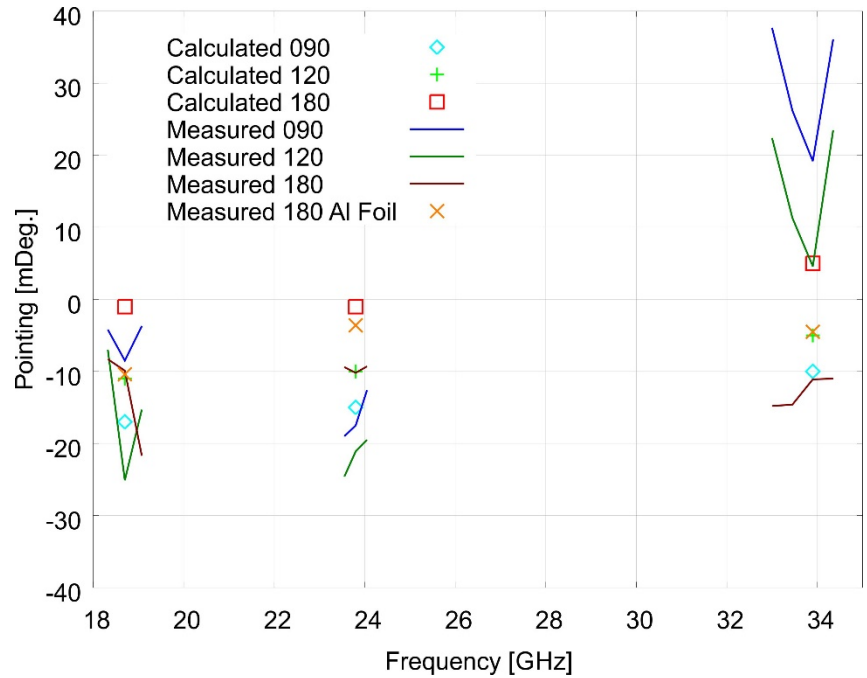
Pointing, Elevation

Metrology data has been used to calibrate measured pointing values

H-Pol



V-Pol



- Last frequency point at 34.8 GHz has been omitted due to OMT roll off
- In the lower two bands Pointing is always within a few m° of calculated values
- In the higher band there is more variability due to mechanical instability

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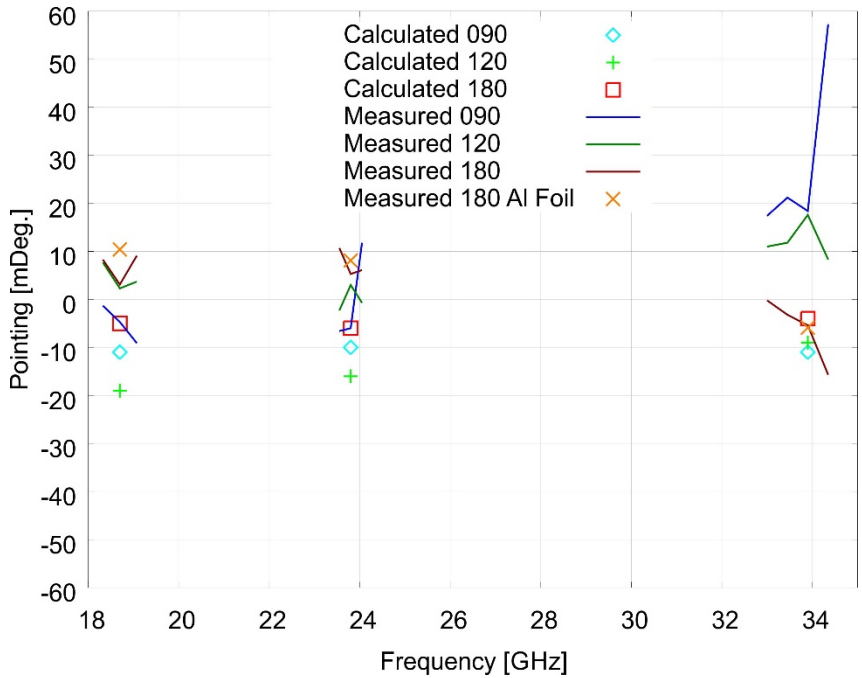
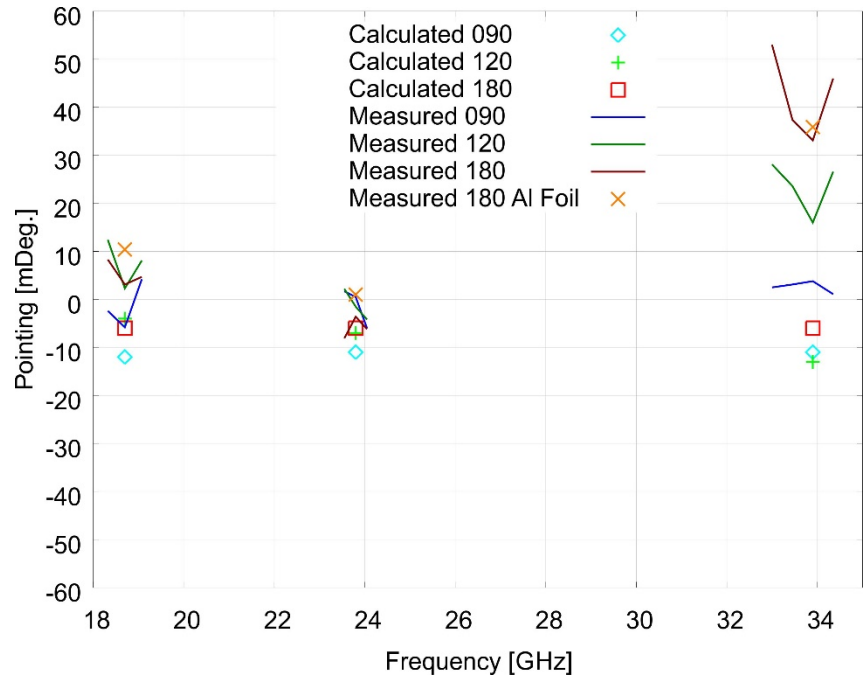
Pointing, Azimuth

Metrology data has been used to calibrate measured pointing values

H-Pol



V-Pol



- Last frequency point at 34.8 GHz has been omitted due to OMT roll off
- In the lower two bands Pointing is always within a few m° of calculated values
- In the higher band there is more variability probably due to mechanical instability

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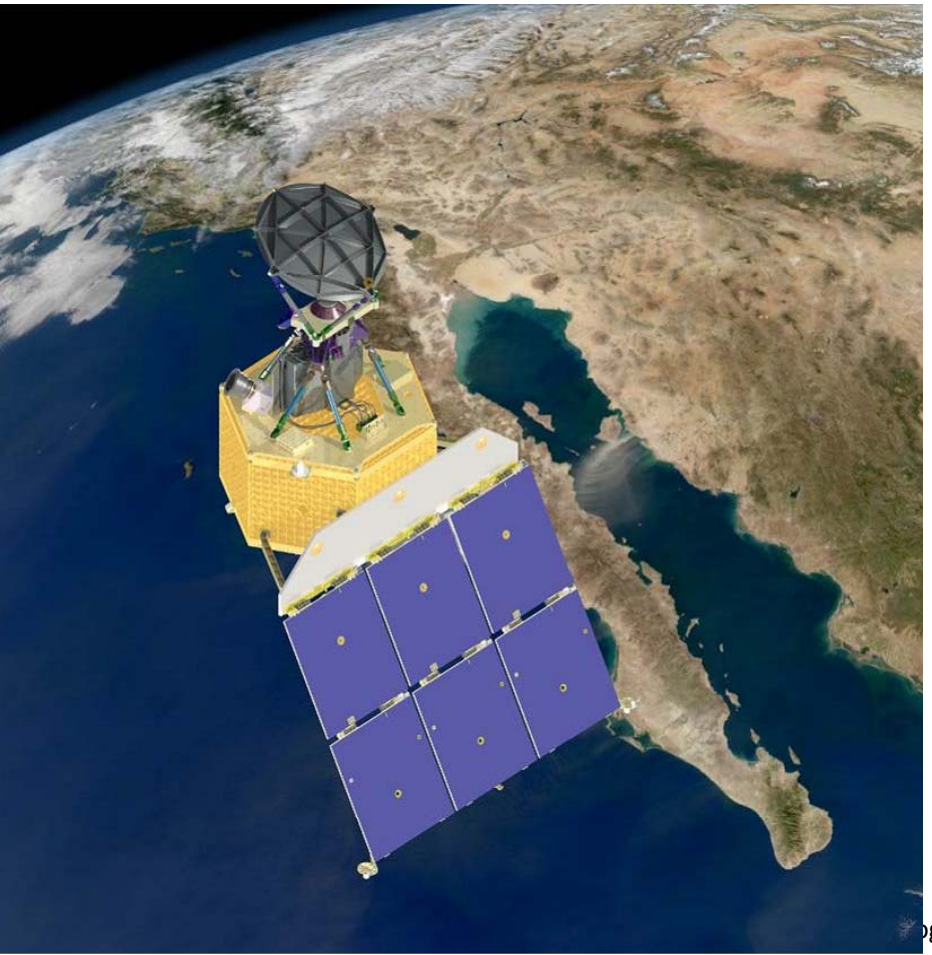
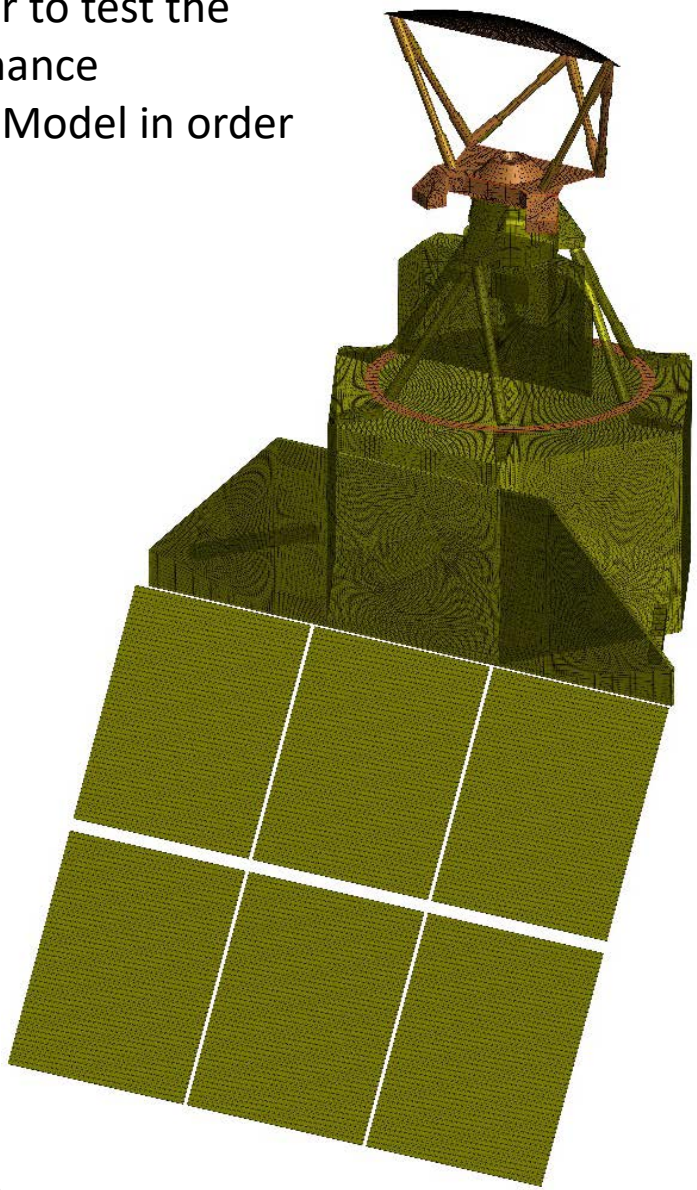
Improved RF Model

- A Larger RF Model was also made in GRASP in order to test the effect of the Solar Array on the instrument performance
- TICRA's help was instrumental in optimizing the RF Model in order to be able to run it on a single machine





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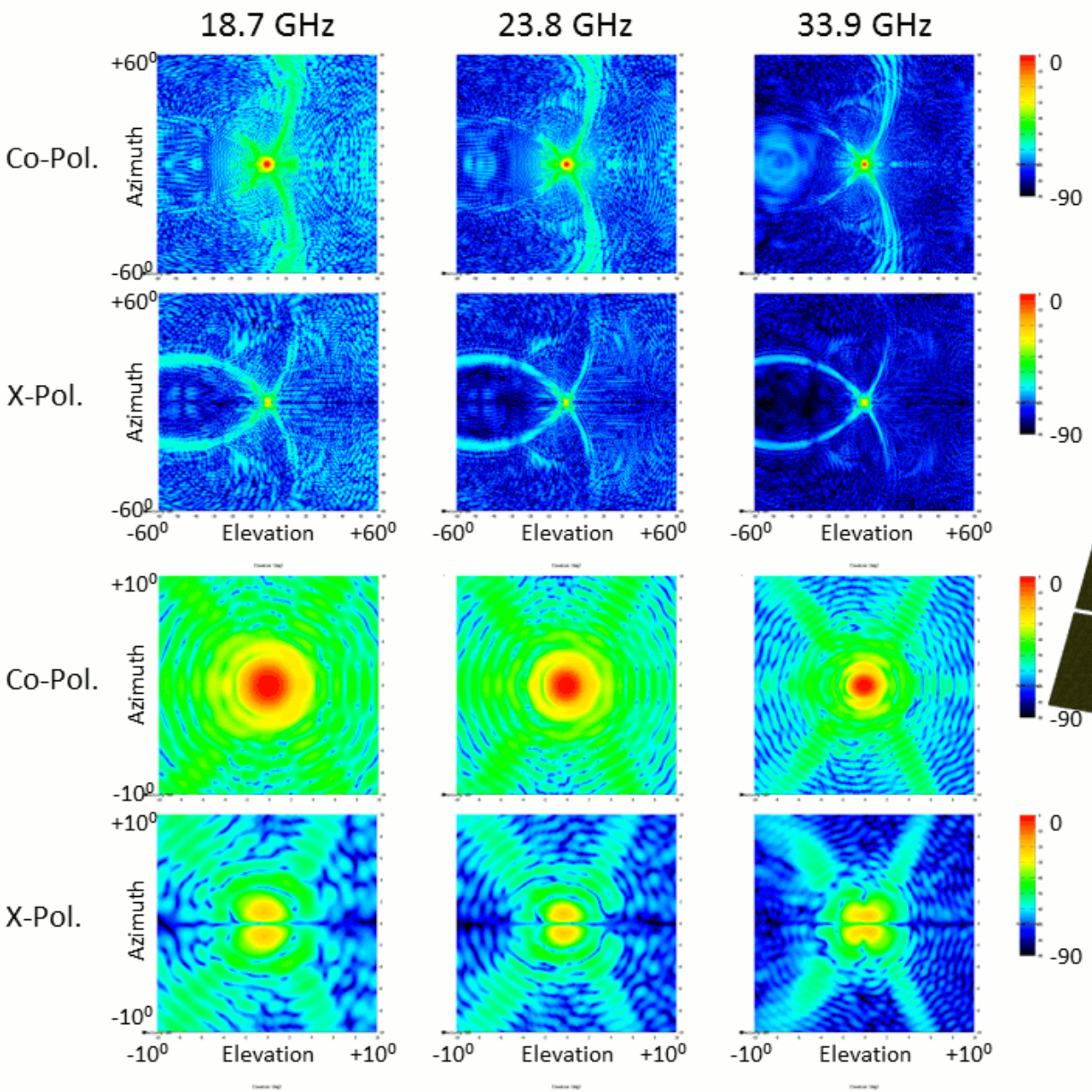
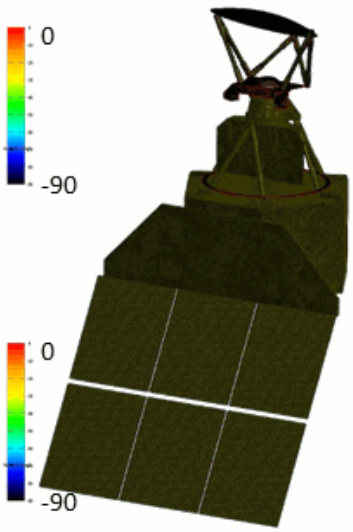
V-Pol Data



Vertical Polarization

0,0°



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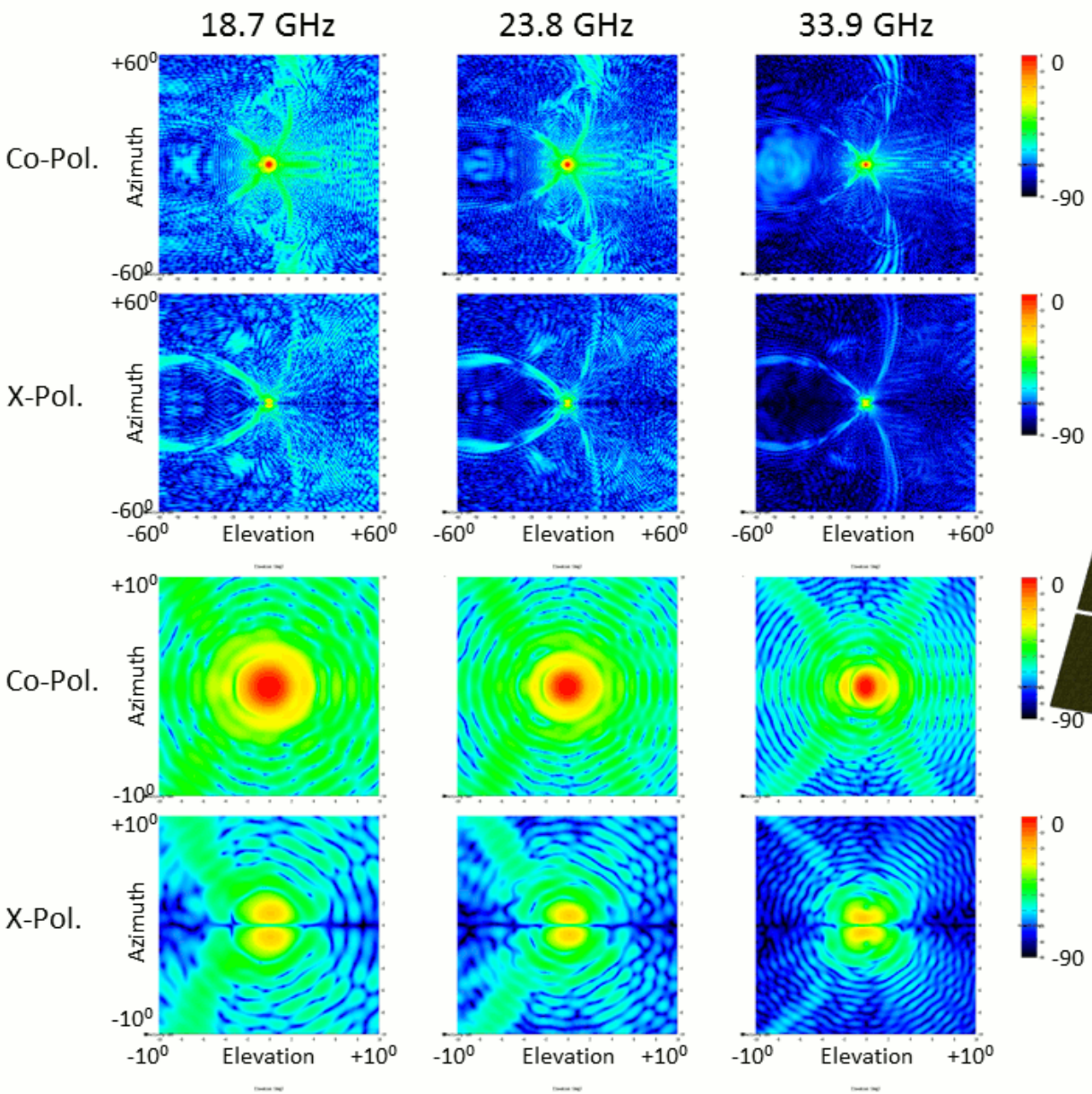
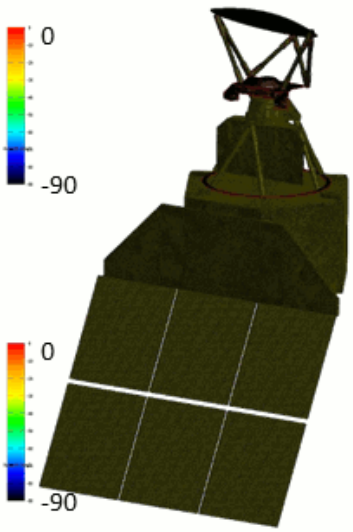
H-Pol Data



Horizontal Polarization

0,0°



Conclusions

- These results confirm once again the high level of accuracy already demonstrated by the latest RF Models
- Overall, they show a very good agreement over a very large dynamic range (60dB)
- All features of the radiation patterns were predicted with extreme accuracy
- Directivities were measured to within less than 0.1dB of predicted values
- Pointing also shows good agreement with predicted values, even though there is a larger variability at the higher band due to mechanical instability of the GSE
- These results, along with those from other projects like AQUARIUS and SMAP, confirm that relying on calculations for instrument calibration represents a small risk for current and future projects

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