

# Active Array Measurements using the Portable Laser Guided Robotic Metrology System

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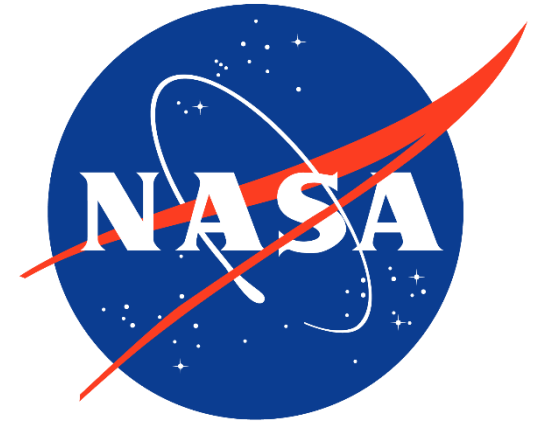
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# Presentation Overview

- Motivation: Enabling Satcom for UAVs Beyond Line of Sight
  - Why is this desired?
  - What are the technical challenges?
  - Conformal, Lightweight Antennas for Aeronautical Communications Technology (CLAS-ACT)
- Development of an In-Situ Measurement System
- Null Sensitivity to Mounting Configuration



# UAS Need for BLOS\* Coverage

## UAS currently using BLOS



Global Hawk/Northrop Grumman



MQ9 Predator/General Atomics

\*Beyond Line of Sight (BLOS)

## UAS to benefit from BLOS



L3 Viking 400



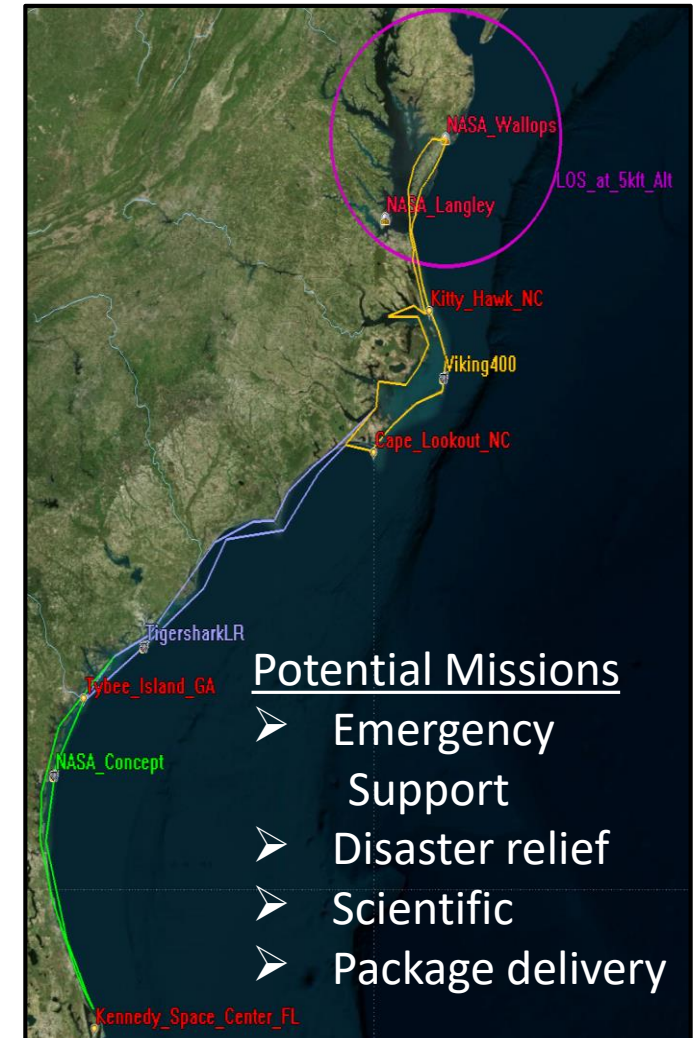
Navmar Tigershark XP



U.S. Navy/ NASA SIERRA



L3Harris HQ-90



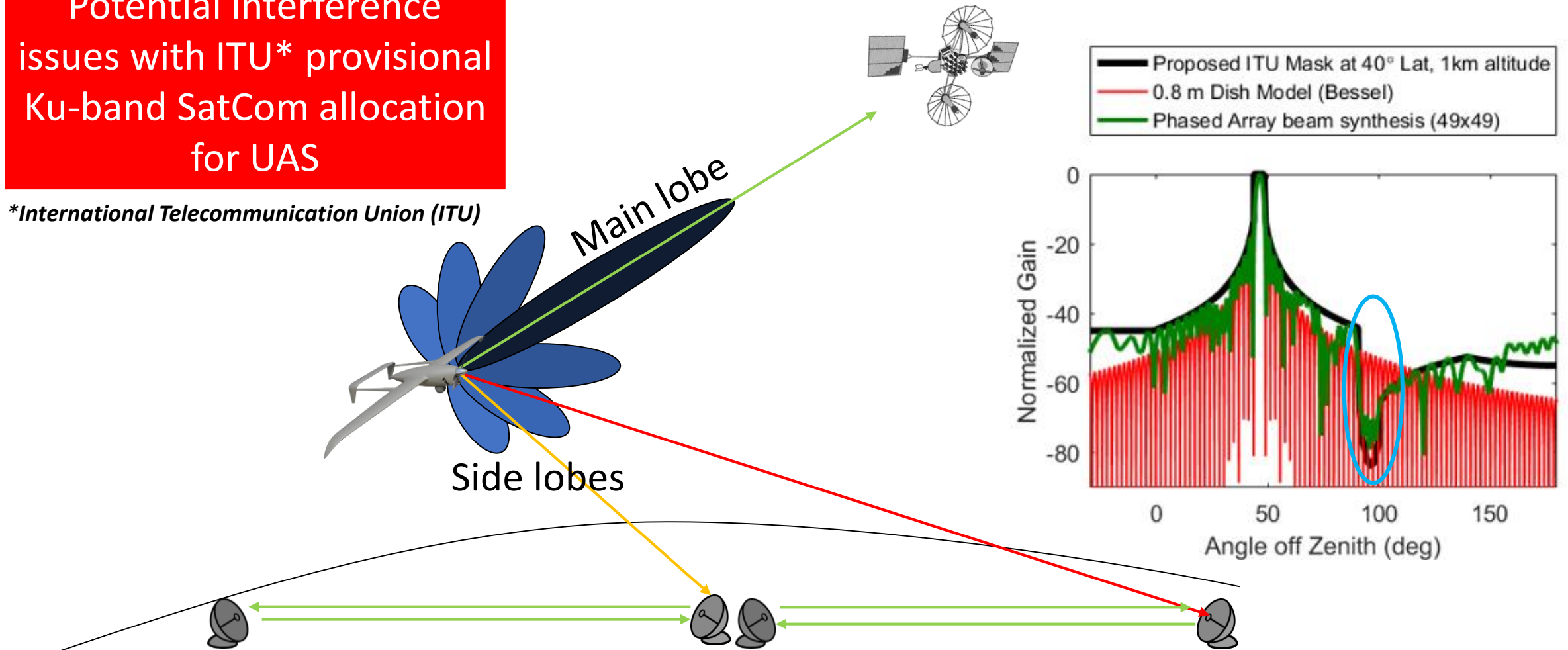
### Potential Missions

- Emergency Support
- Disaster relief
- Scientific
- Package delivery

# Problem with Wide Spread BLOS on UAV

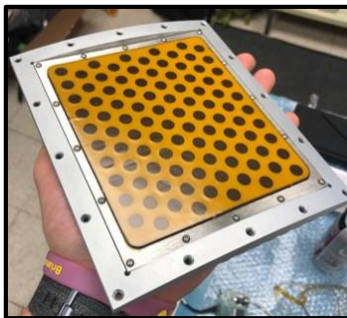
Potential interference issues with ITU\* provisional Ku-band SatCom allocation for UAS

\*International Telecommunication Union (ITU)

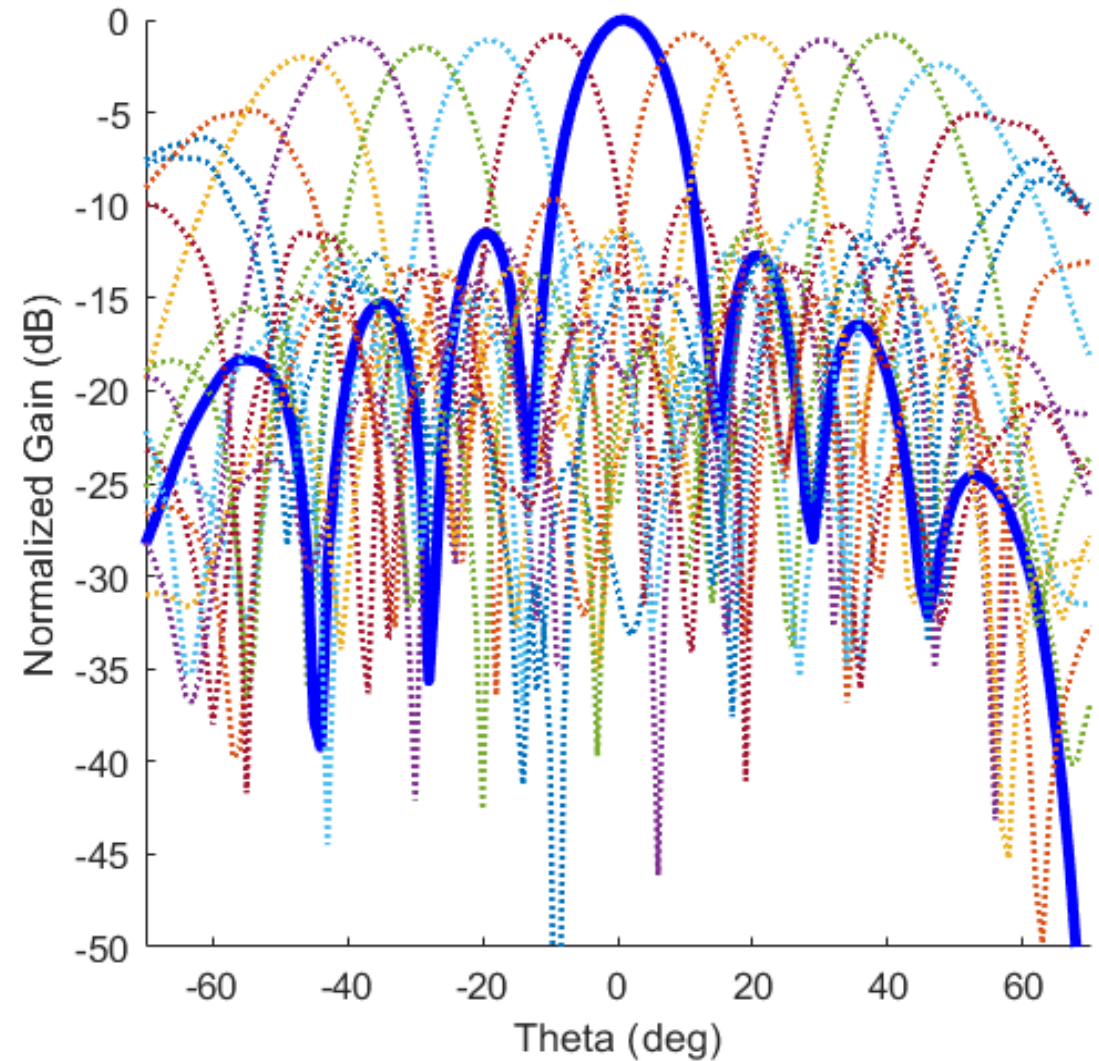


# CLAS-ACT Antenna

- Specifications
  - 64 Element Phased Array
  - Ku-Band
  - Antenna Thickness = 0.205" (without heatsink)
  - Over 100° Scan Angle
- Low SWaP-C
  - COTS silicon based RF IC's
  - Flexible aerogel enables low mass microwave substrate



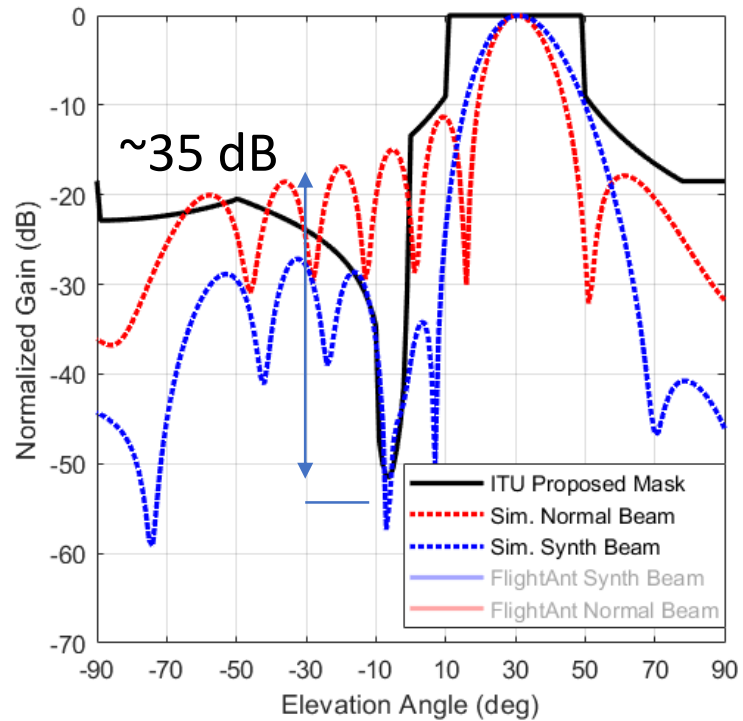
CLAS-ACT  
Antenna



Far Field Scan Angle Measurements

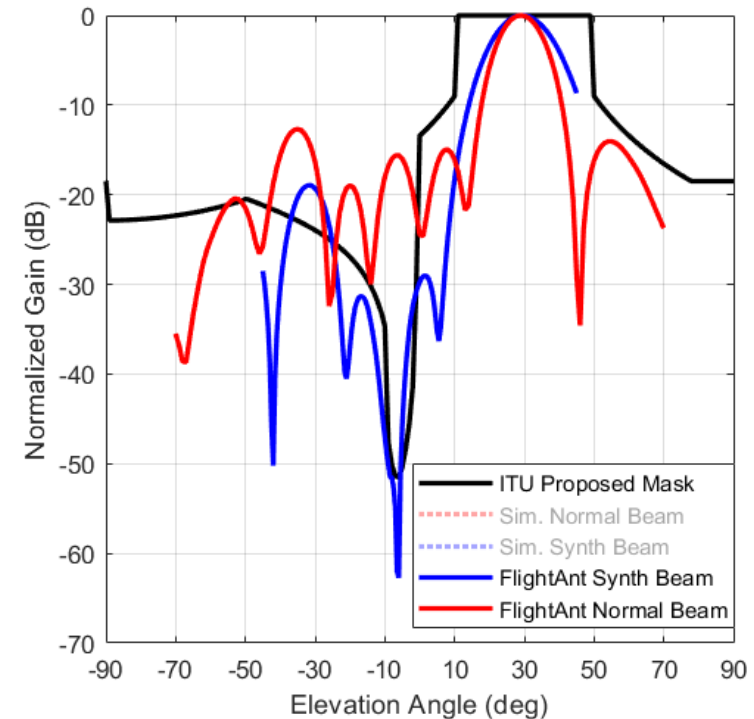
# Beam Synthesis Results

## Beam Synthesis Simulation



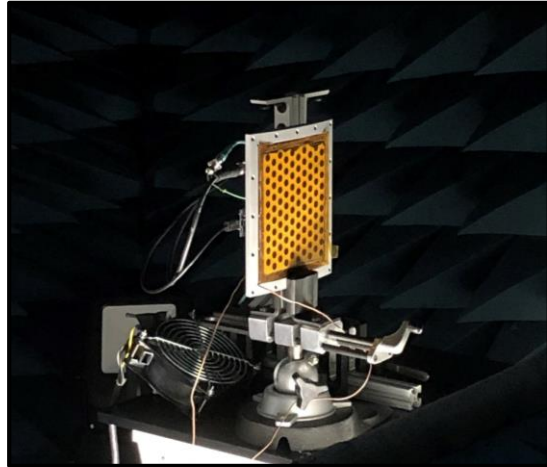
Simulations show feasibility of > 20 dB side lobe reduction at critical angles

## Antenna Pattern of Beam Synthesis in Far Field Antenna Range



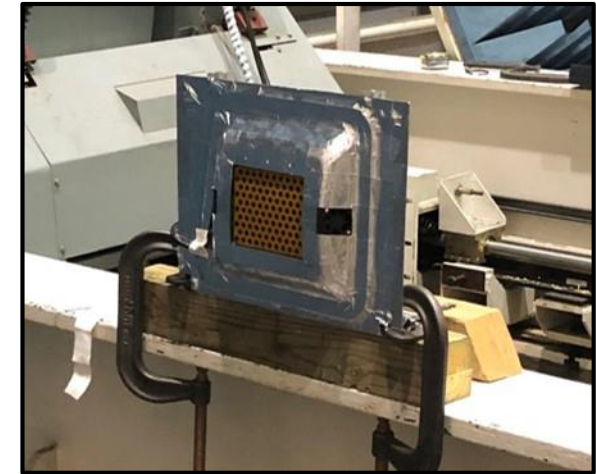
Side lobe reduction demonstrated in antenna range

# Traceability Challenge



Antenna in Glenn Research Center Far Field Range

Will we consistently meet the interference mask?



Array in 3D Printed Mount

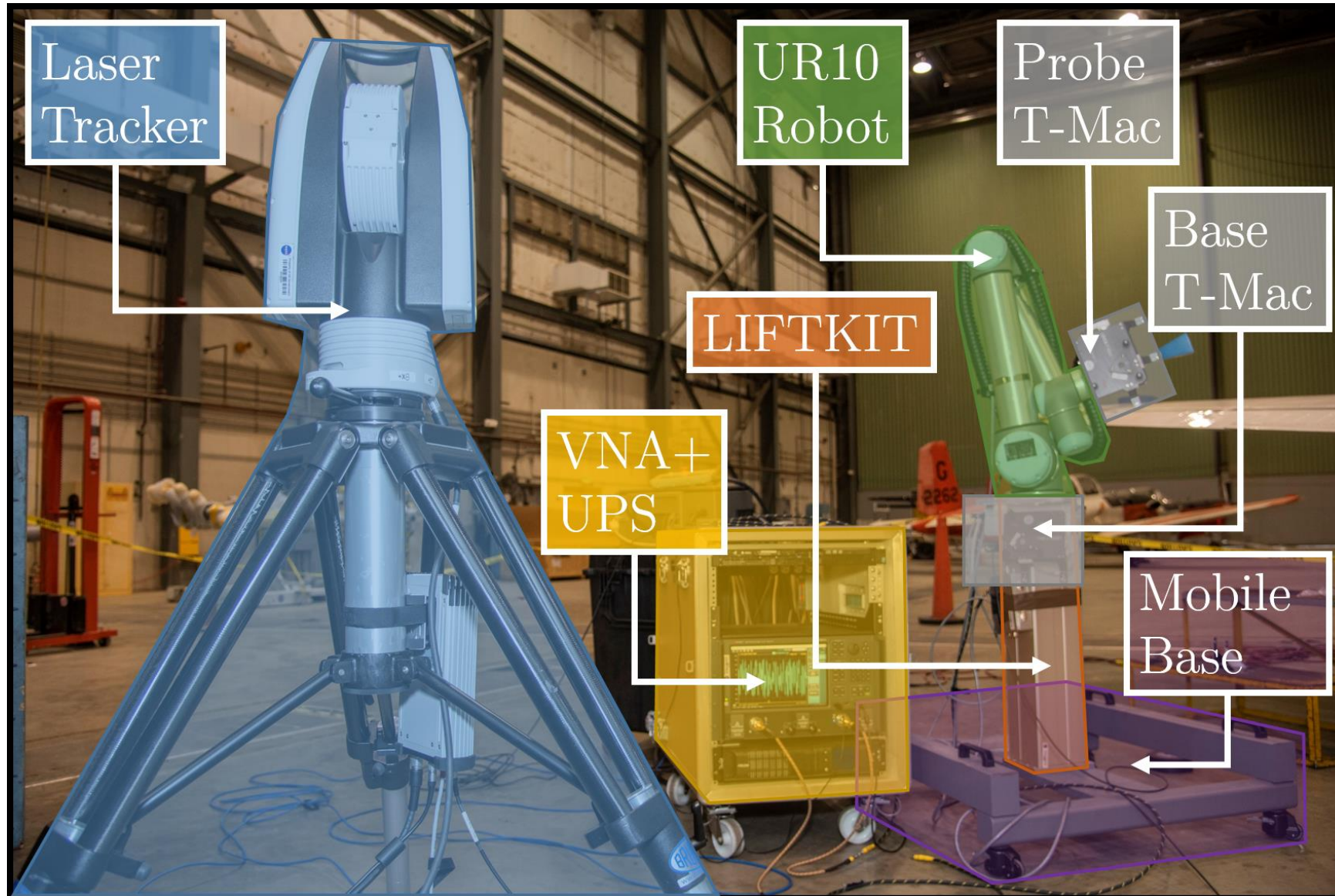


Array Mounted to T34-C in Hanger at Armstrong Flight Research Center



T34-C in Flight

# Portable Laser Guided Robotic Metrology (PLGRM) System



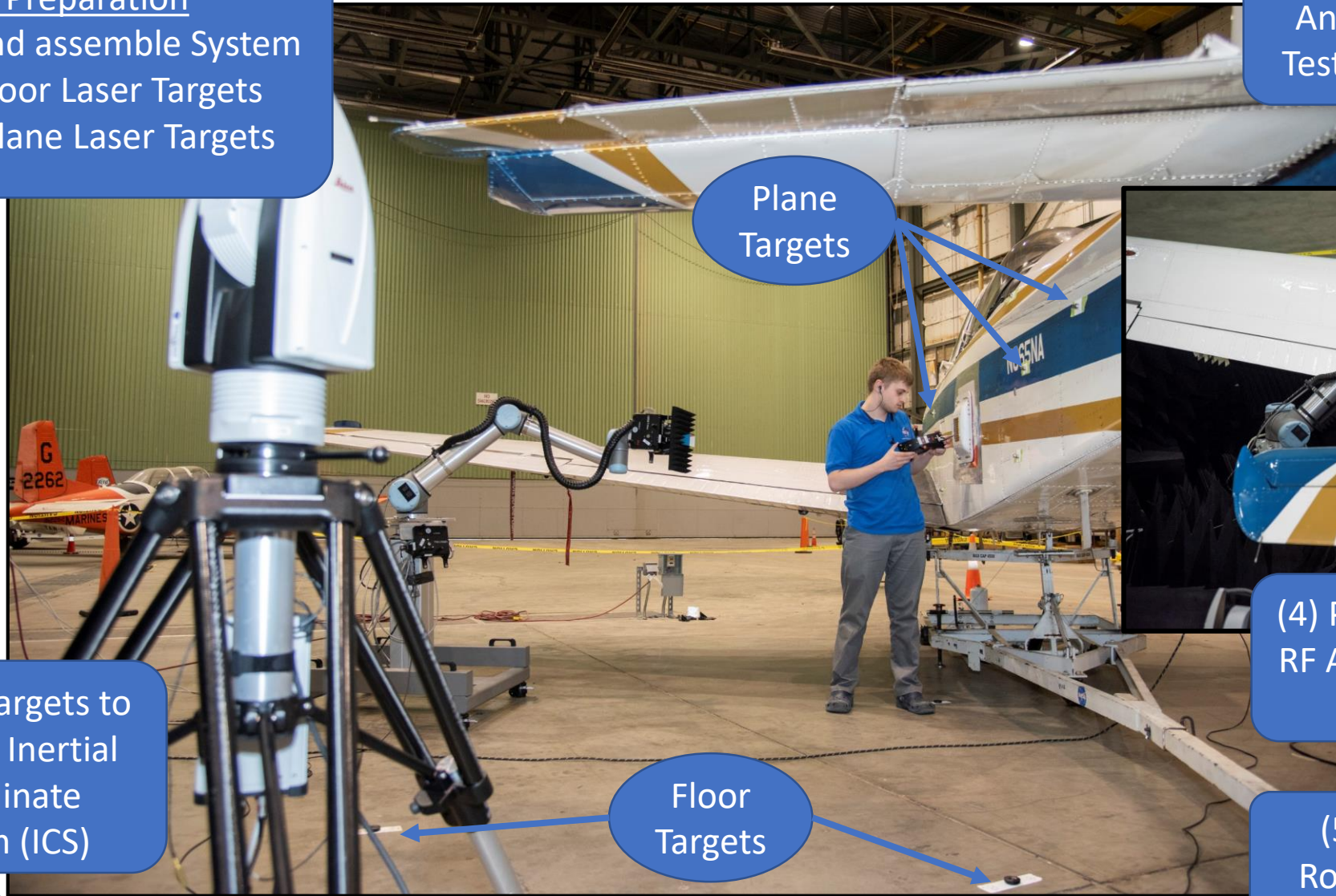


# Measurement Process

## (1) Preparation

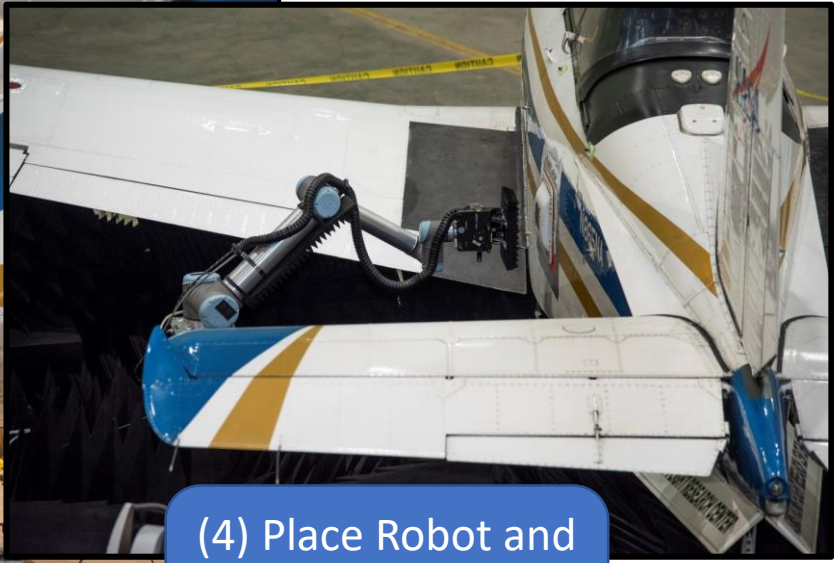
Unpack and assemble System  
Place Floor Laser Targets  
Attach Plane Laser Targets

(3) Locate  
Antenna Under  
Test (AUT) within  
ICS



Plane  
Targets

Floor  
Targets



(4) Place Robot and  
RF Absorbing Foam  
around AUT

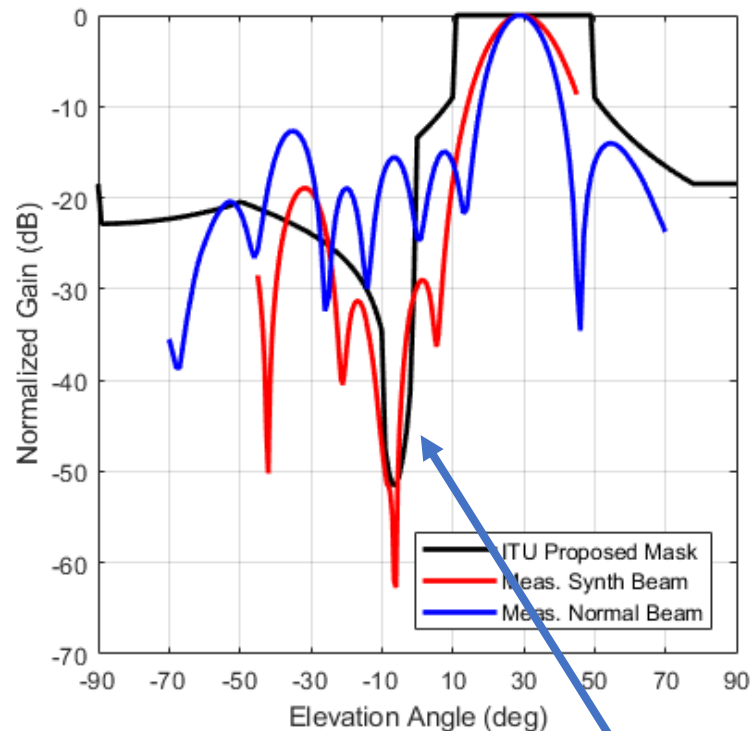
(5) Locate the  
Robot within ICS

(2) Use Targets to  
define a Inertial  
Coordinate  
System (ICS)

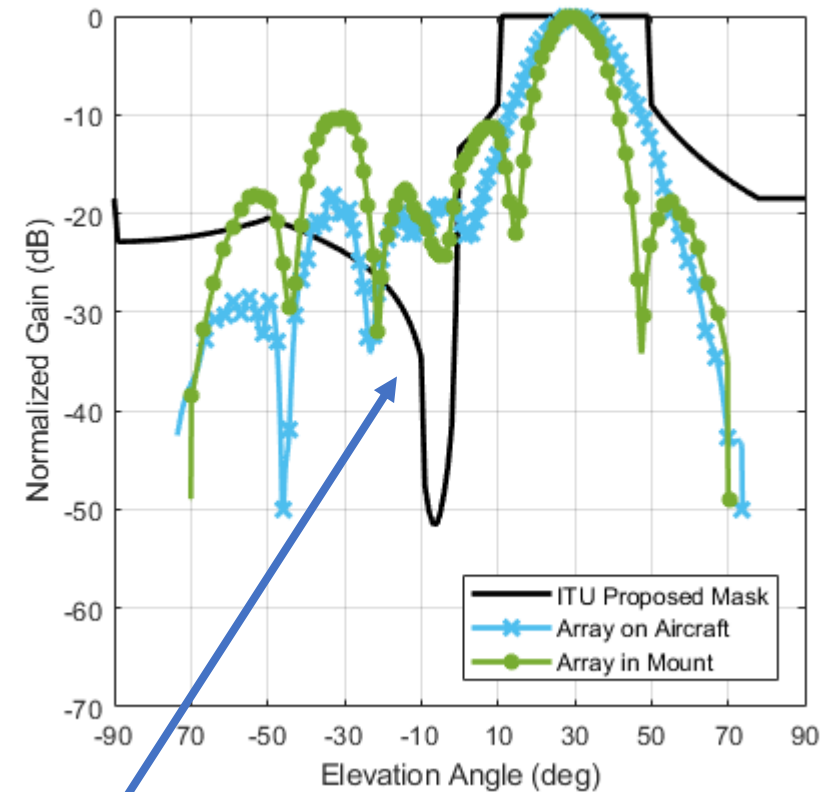


# Far Field Results from In-Situ Measurements

## Antenna Pattern of Beam Synthesis in Far Field Antenna Range

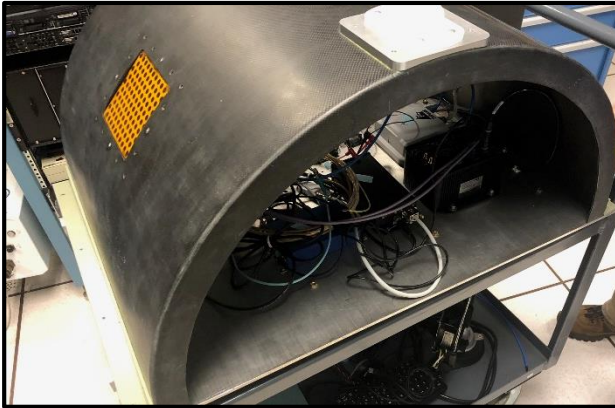


## Antenna Pattern of Beam Synthesis In-Situ

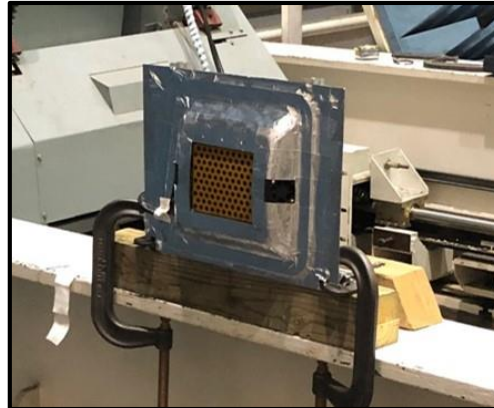


Null Eliminated by Mounting Configuration

# Impact of Mounting on Antenna Pattern



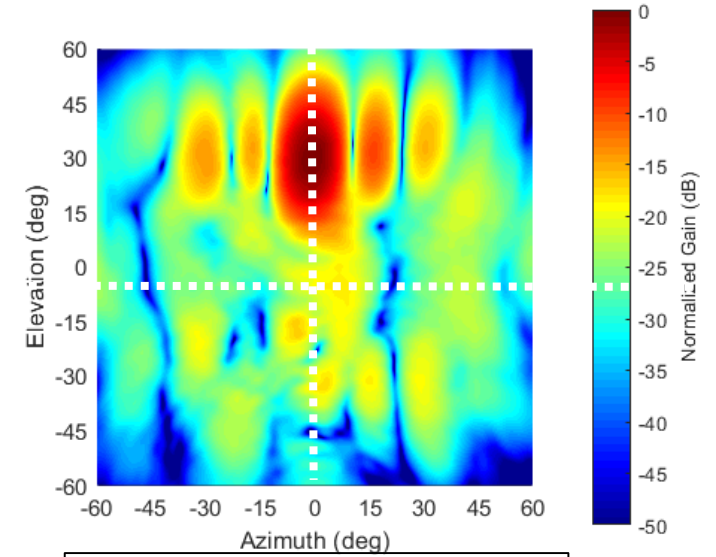
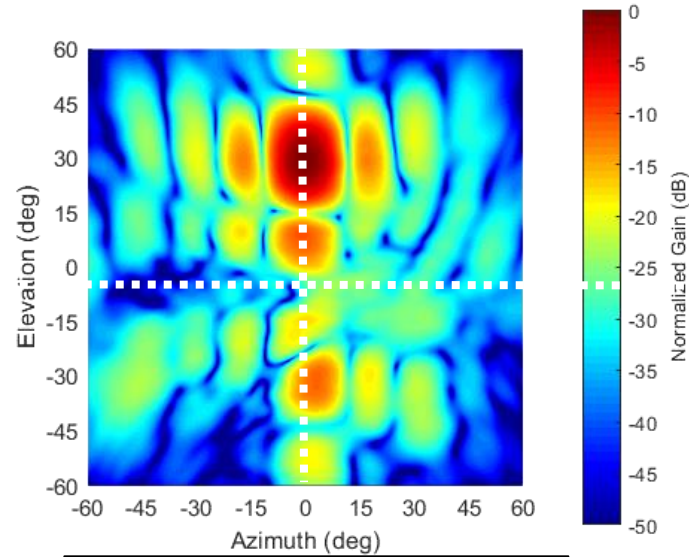
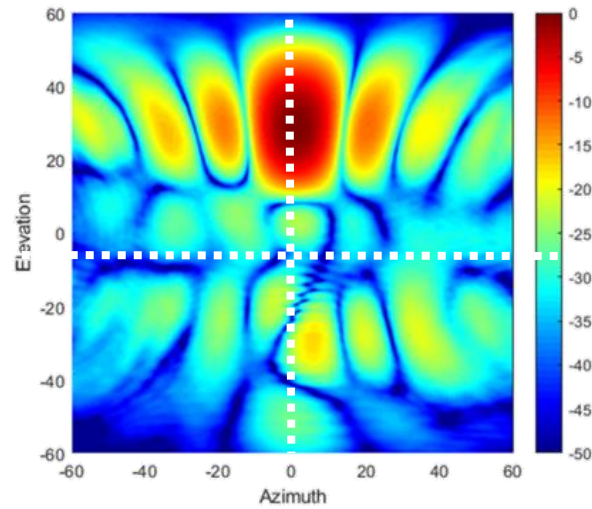
Global Hawk/Ikhana



T34C Mount Only



On T34C Luggage Door



# Conclusions

- Phased Arrays show potential for optimal usage in a congested environment
- Performance masks to limit interference are challenging but possible
- Antennas nulls are sensitive to mounting configuration
- Portable metrology system enables characterization and optimization on the platform
- Future Work: Developing techniques for platform specific optimization

Questions?

