Advanced L band Phased Array Camera for Arecibo (ALPACA)

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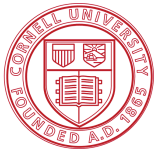

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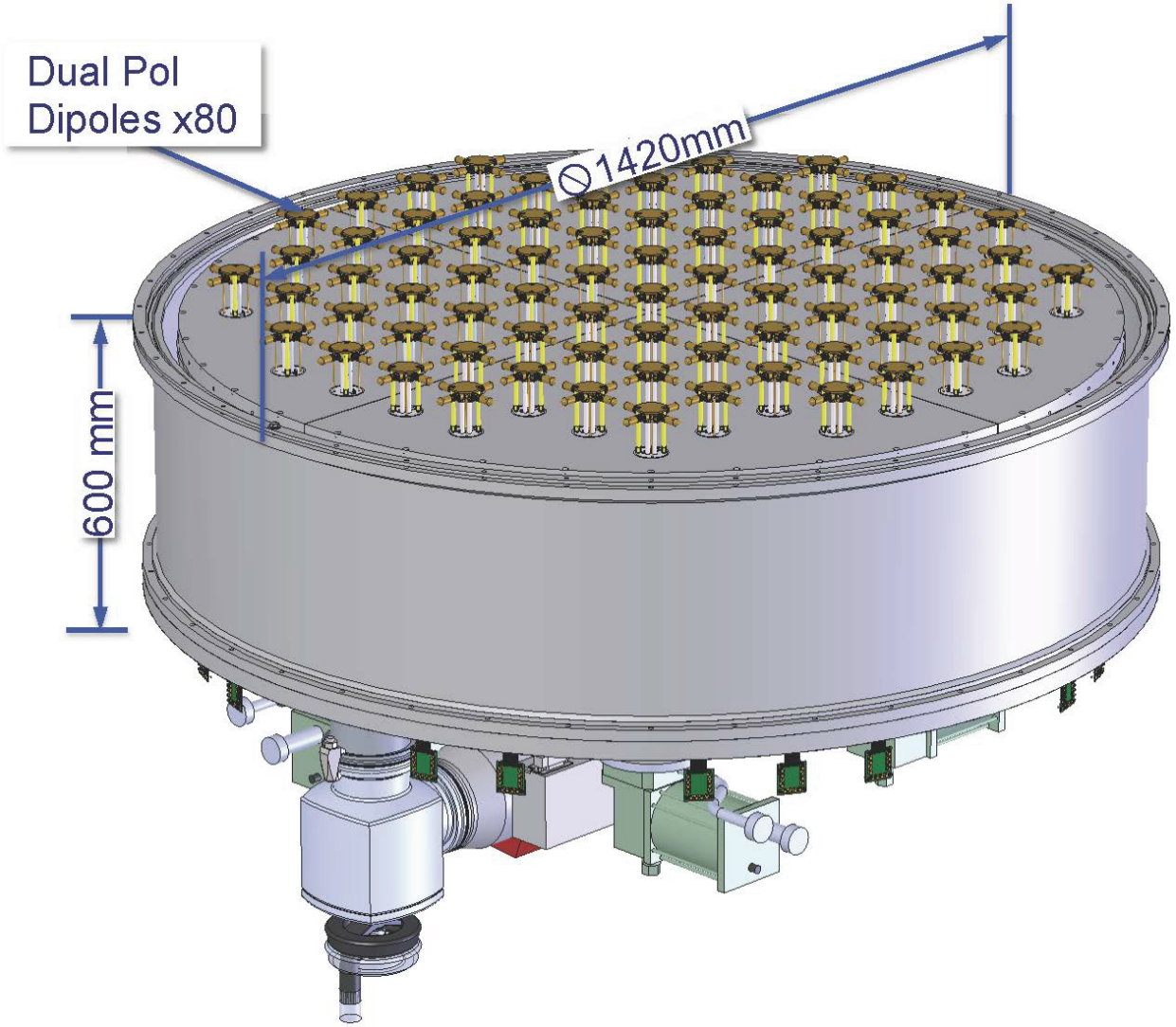
Arecibo Observatory (Puerto Rico)

ALPACA Front End Array



Preliminary design: Don Campbell, Steve Parshley, German Cortes (Cornell University)

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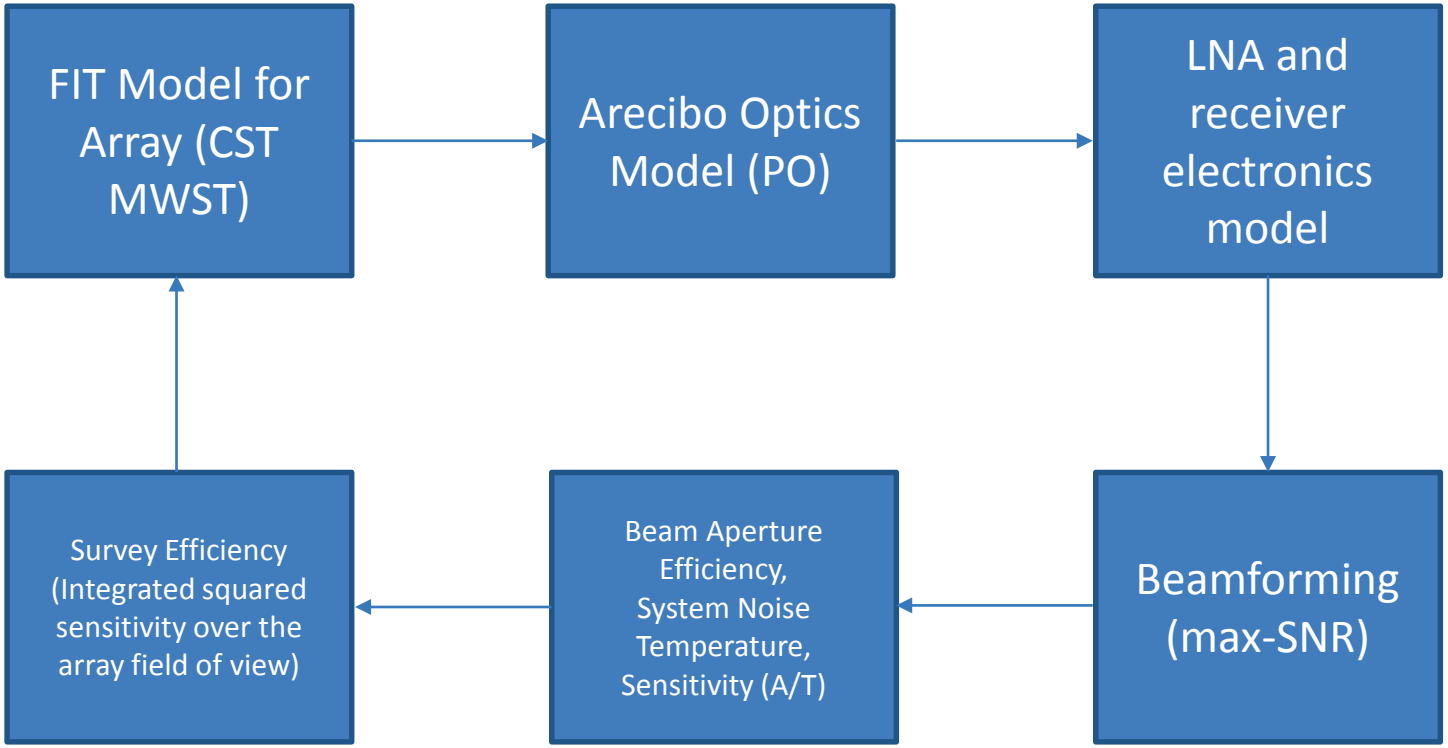
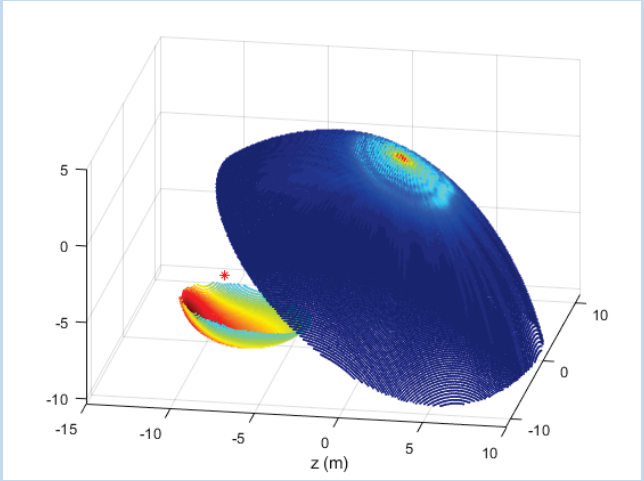
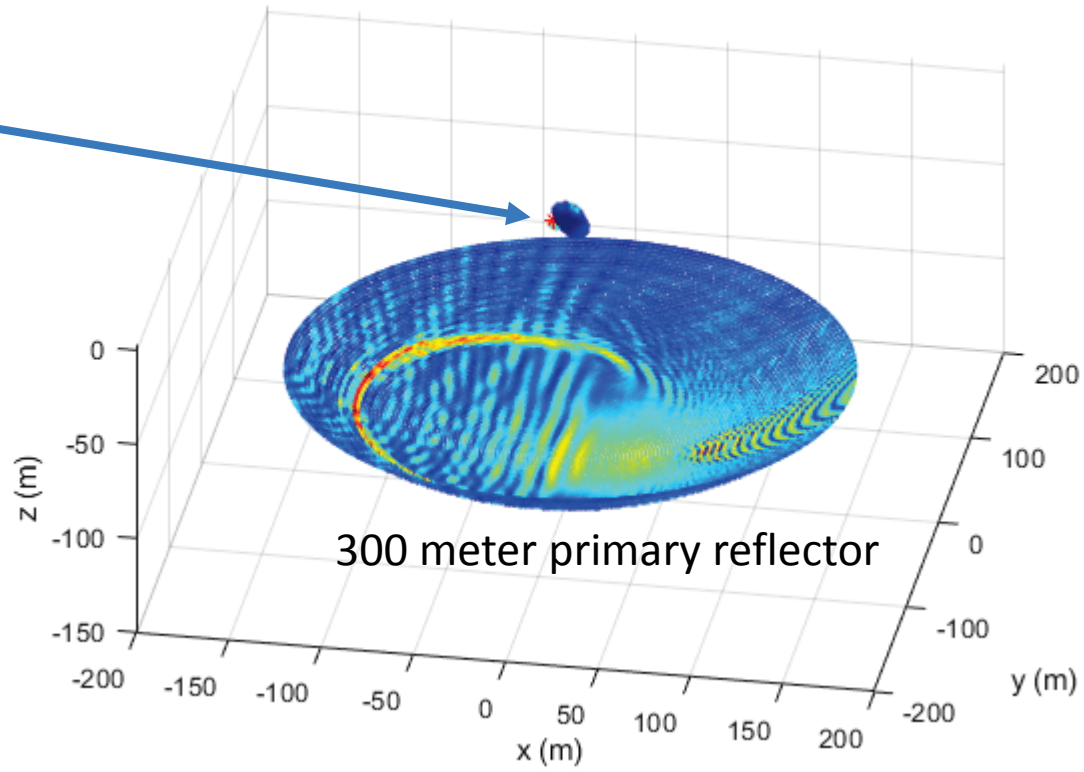
ALPACA Array Design Study



Arecibo Optics Model



Focal point
Tertiary reflector
Secondary reflector



Model steps:

- Embedded element patterns (FIT, CST)
- Propagate to tertiary reflector
- Propagate to secondary (PO)
- Propagate to primary (PO)
- Propagate to far field (PO)
- Use reciprocity to determine received voltages at the element terminals for a plane wave incident on the primary reflector

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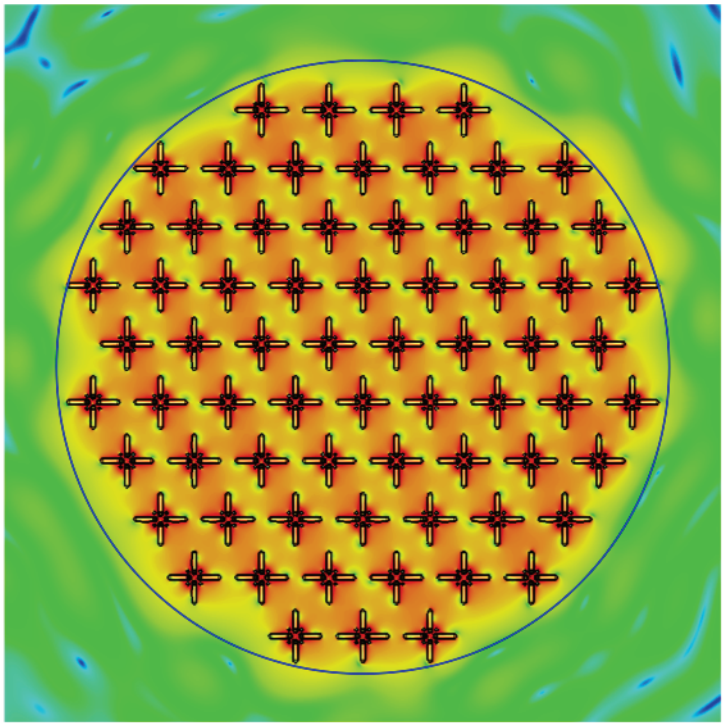
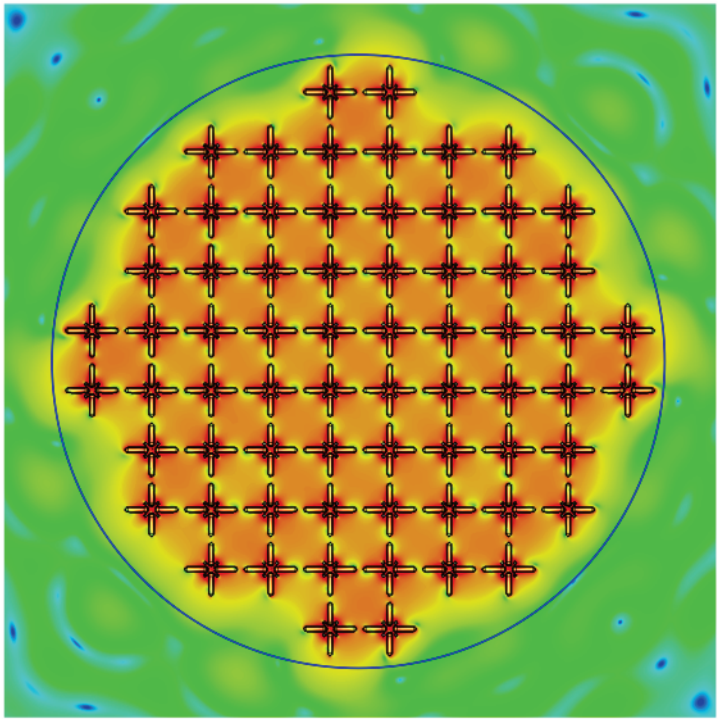
Rectangular and hexagonal array design options

Layout: HEX N=69 s=135mm

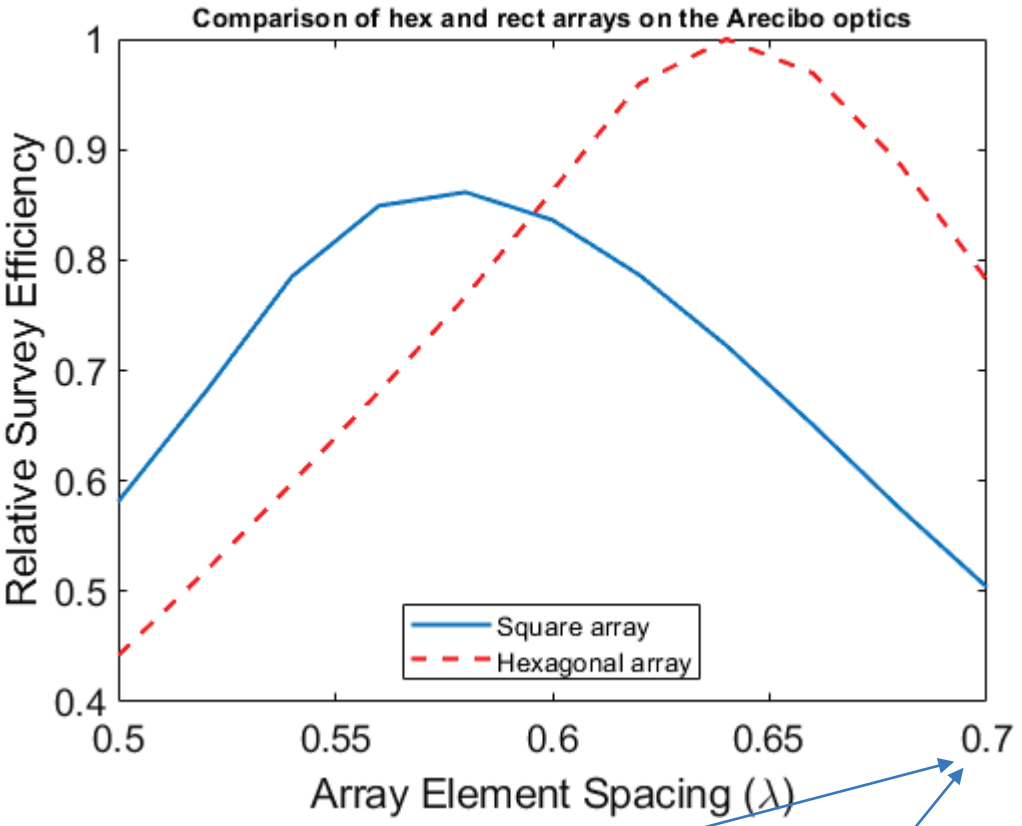


Layout: SQ N=68 s=120mm



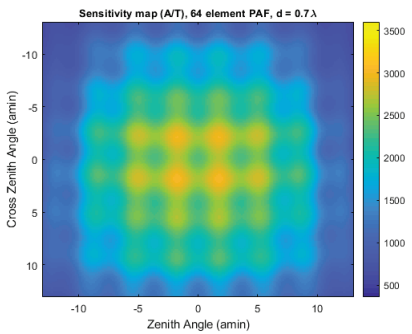
Comparison of hex and rectangular feed geometries

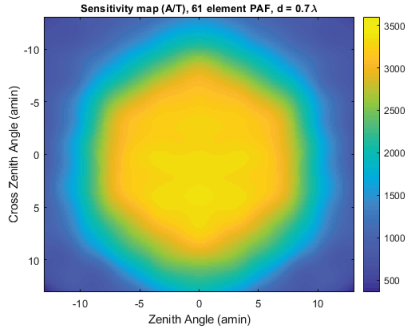
- Hex and rectangular array feed geometries over element spacing
- Hex is a more efficient tiling of the plane, so element spacing can be wider
  - Hex array: wider spacing reduces cost and possibly lowers mutual coupling
  - Square array has advantages for cross pol performance, and coupling is smaller for certain element pairs than for the hex layout



Square array

Hex array





Modeling Codes

- ALPACA Phased Array Feed
  - ~1 meter diameter
  - CST Microwave Studio – full wave method based on the finite integration technique (FIT)
  - 8 days
- Arecibo Optics
  - Primary, secondary, and tertiary reflectors
  - ~300 m diameter
  - Physical optics high frequency asymptotic approximation
    - On primary reflector, points per wavelength = 0.5
  - 20 hours