Non-Uniform Cantor Ring Arrays

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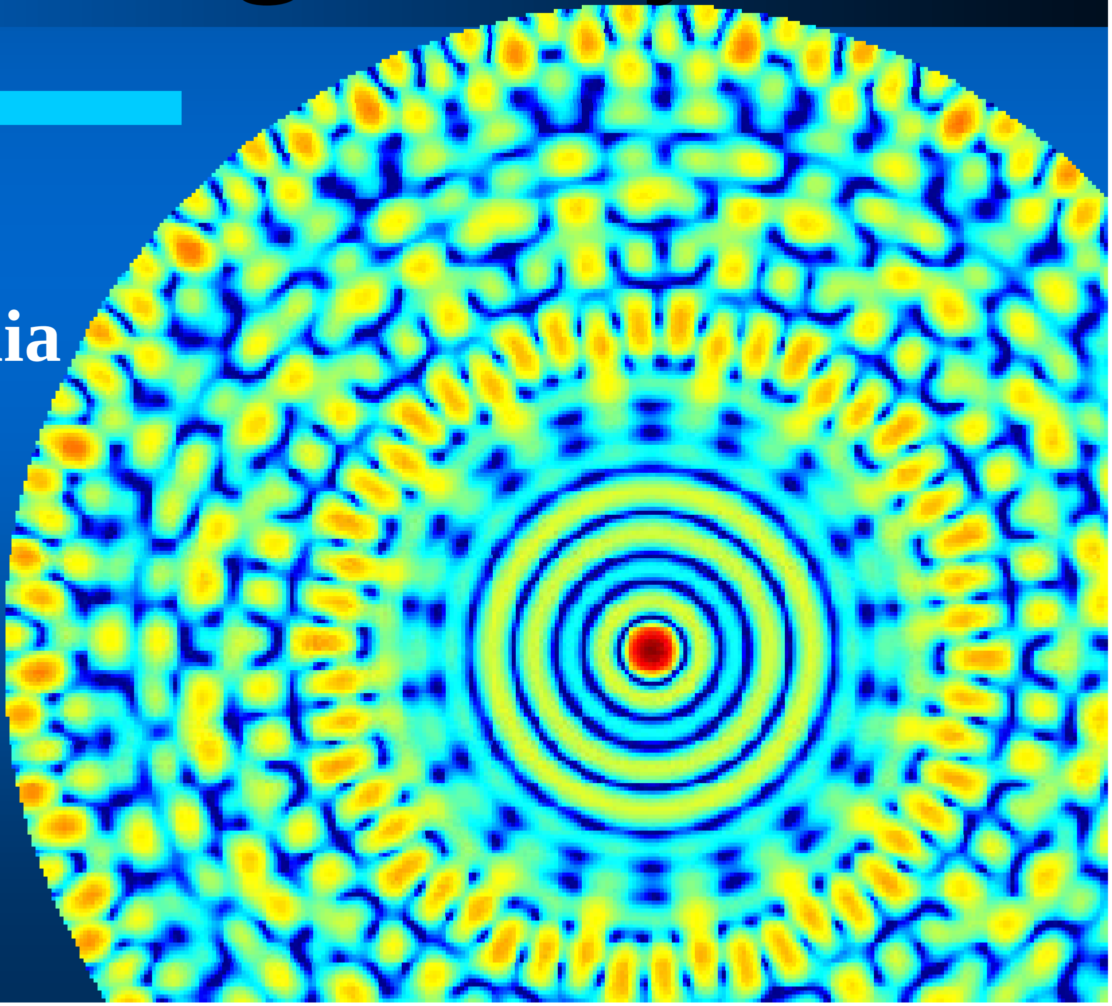

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The Geometry of Nature

- The Euclidean Perspective
  - Circles, rectangles, triangles
  - Spheres, cubes, cylinders, cones

- The Non-Euclidean Geometry of Nature
  - Clouds are not spheres
  - Mountains are not cones
  - A coastline is not a curve
  - Lightning is not composed of straight lines

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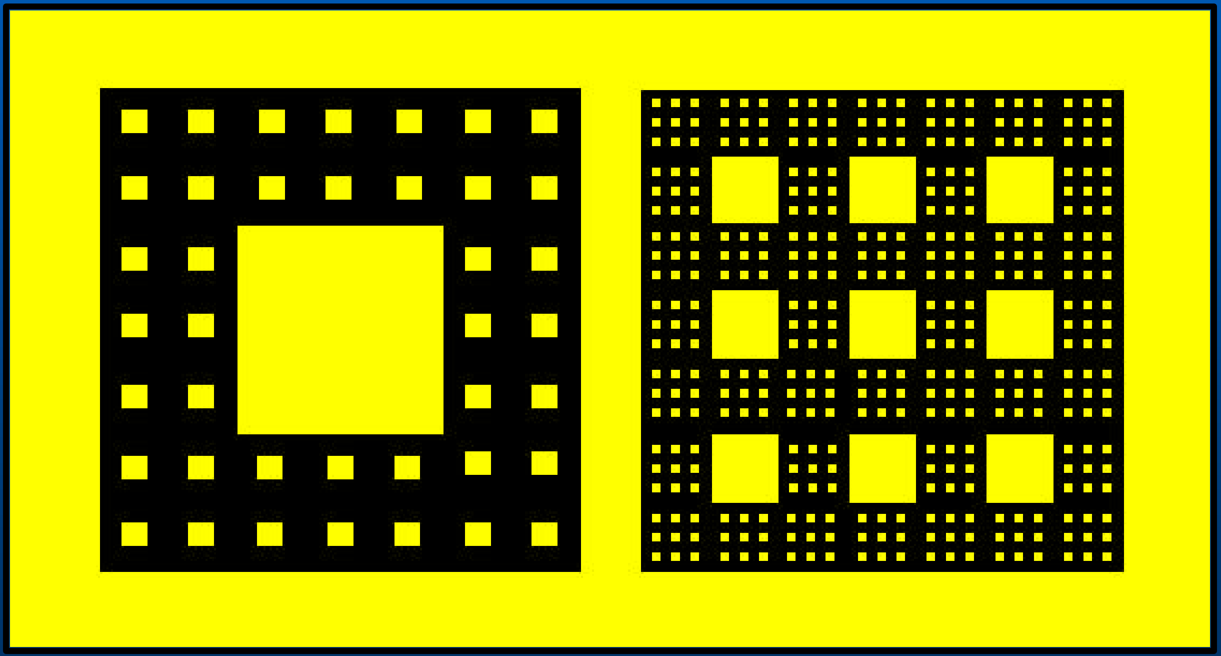
What is a Fractal?

- Self-similarity
- Dimension
- Lacunarity



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Cantor Set

Stage 0

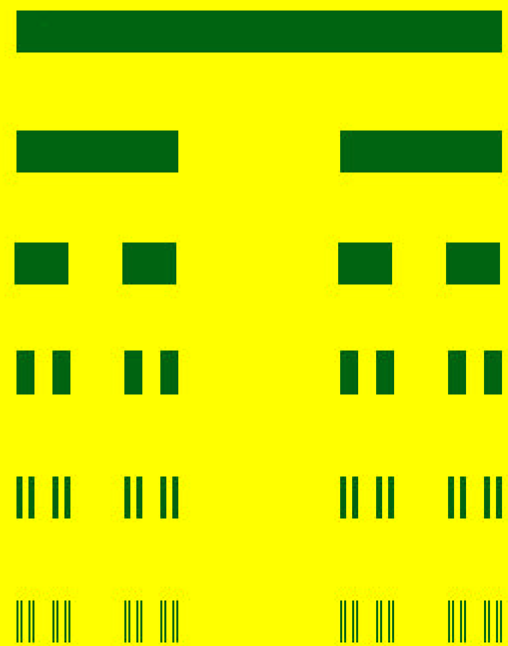
Stage 1

Stage 2

Stage 3

Stage 4

Stage 5



$$D = \frac{\ln(N(e))}{\ln(1/e)} = \frac{\ln(2)}{\ln(3)} = 0.63093$$

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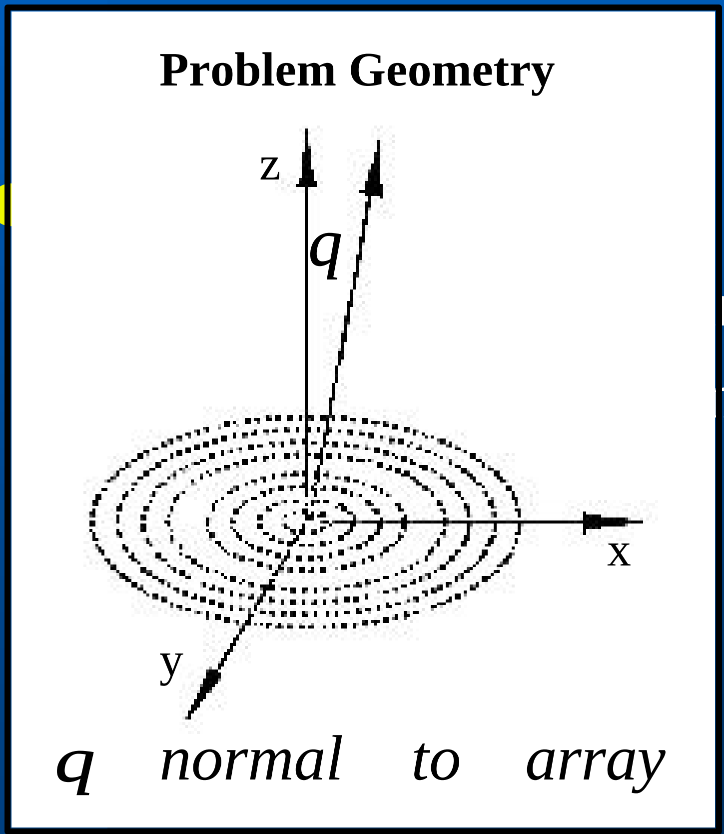
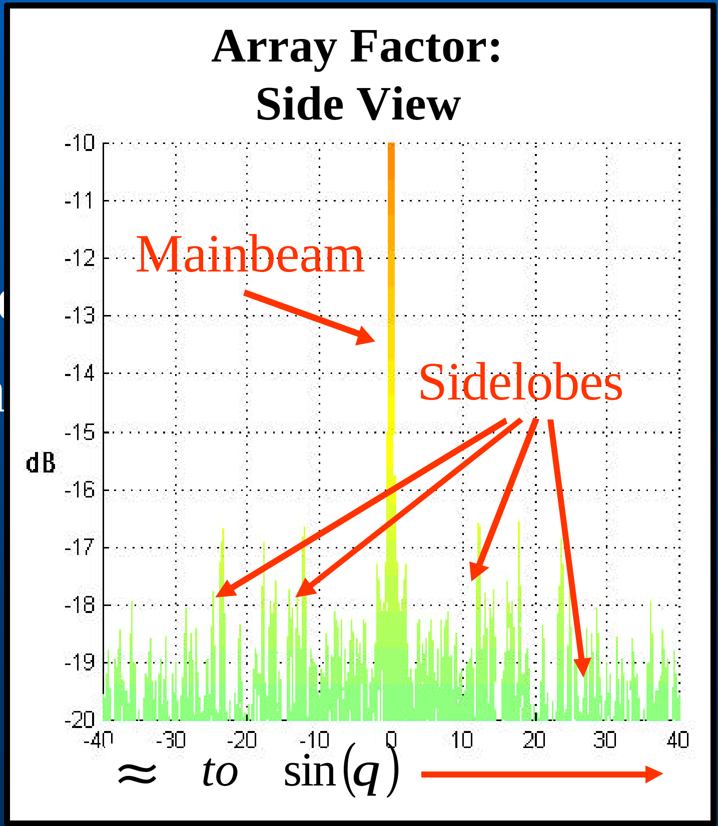
Antennas and Arrays

- Single Antenna → Broad Radiation Pattern
  - Television networks
  - Radio stations
- Array → Point-to-Point and Preferred Coverage
  - Flight towers for pinpointing location of planes
  - Medical imaging and scanning

Array Factor





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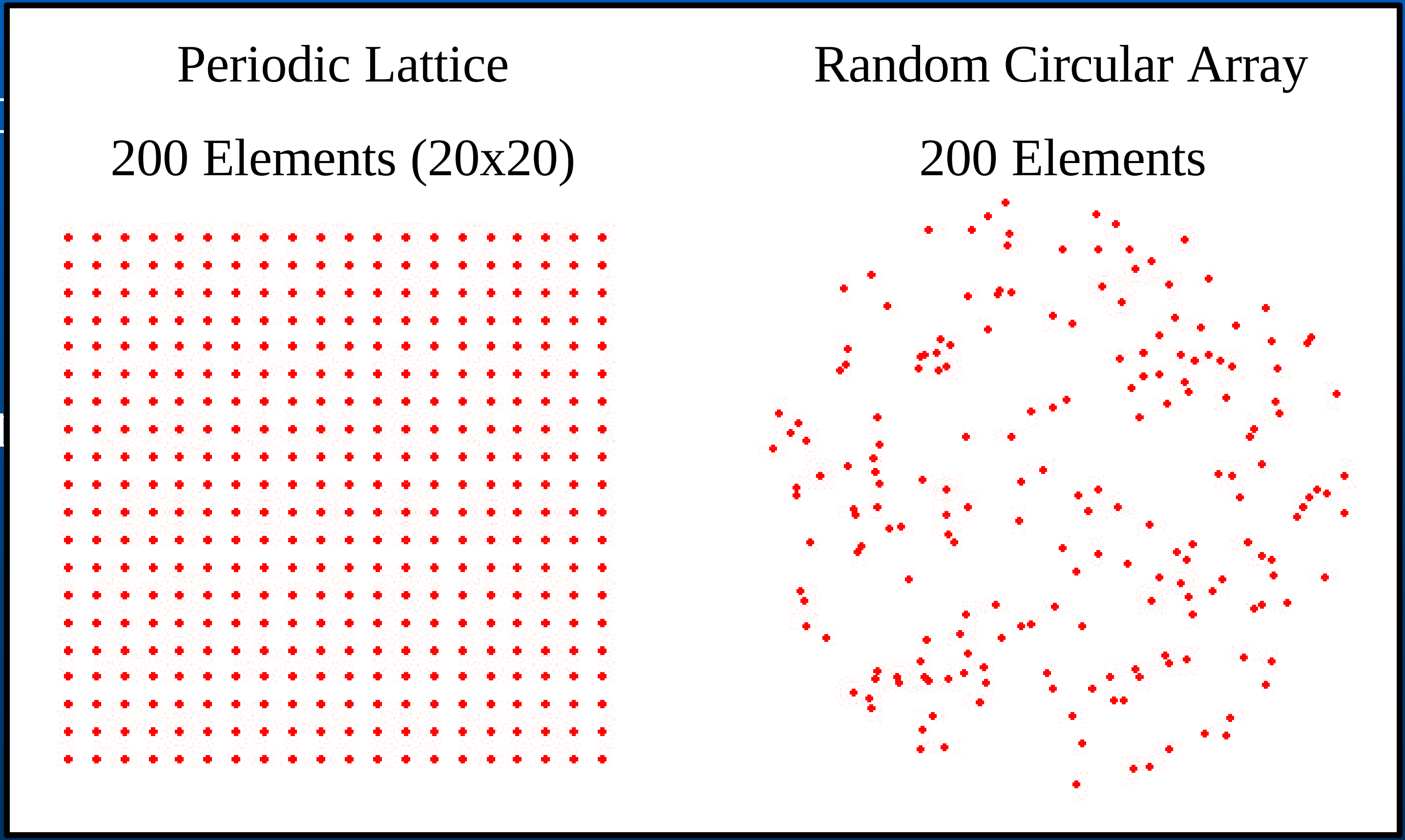
Traditional Array Configurations

- Alc
- Ra



Fractal Arrays

- Random Fractals => Low Sidelobes + Robustness
- Combine order and disorder to restrict randomness (tethering)

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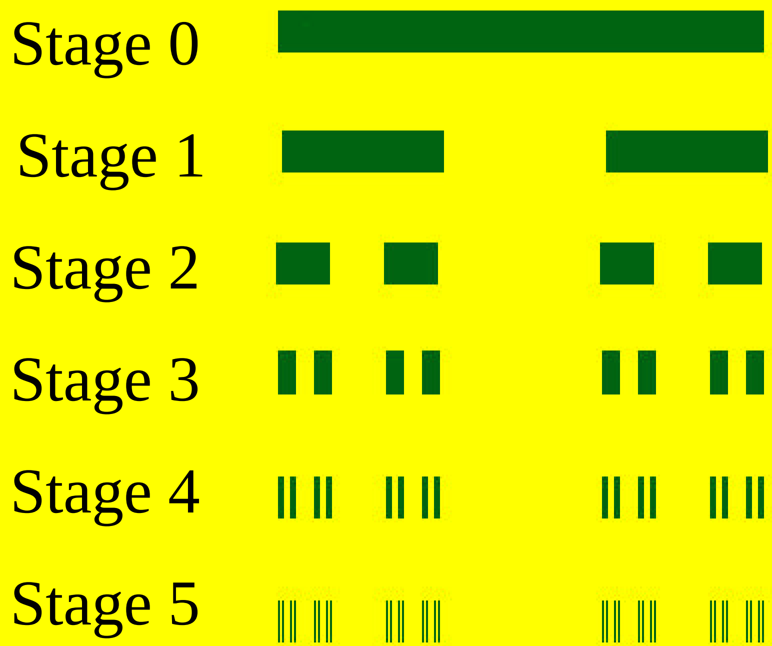
Creating Cantor Arrays



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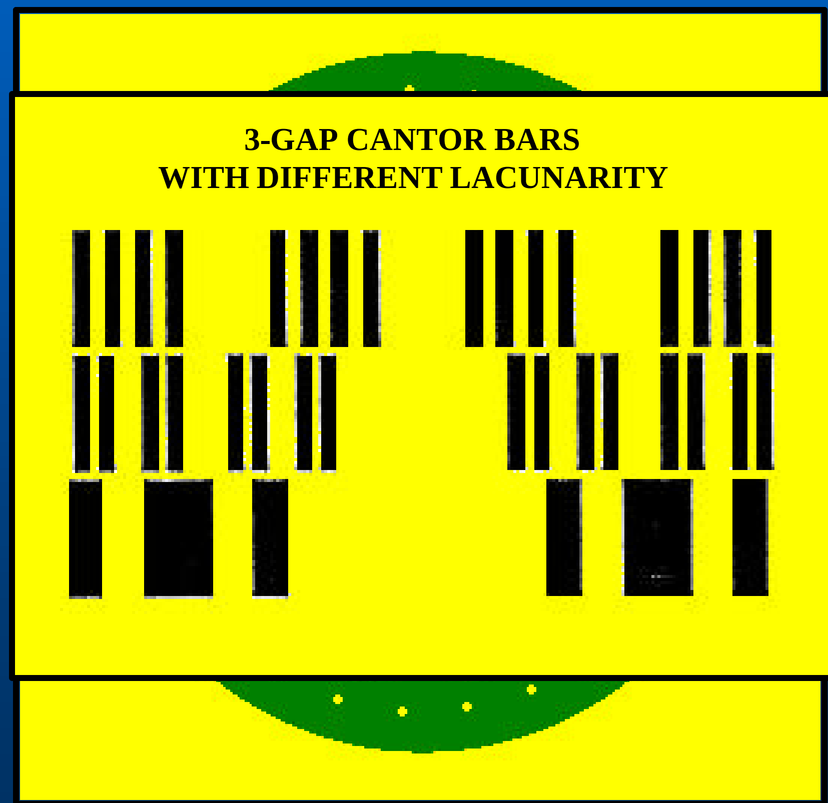

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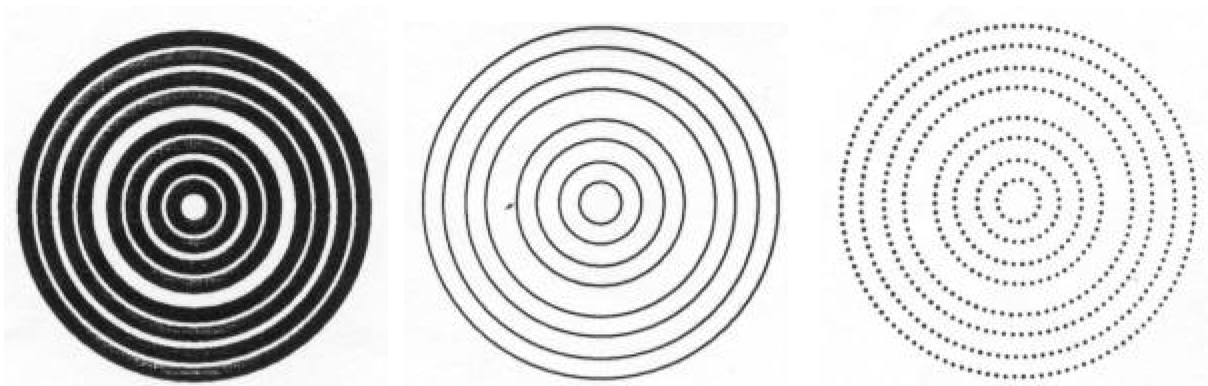
Motivation and Reference Points

Jaggard and Jaggard's Cantor Ring Arrays



FINITE WIDTH | INFINITESIMAL WIDTH | DISCRETE

Base Case: Cantor Ring Array (N = 556)

3-gap Cantor Bar, Stage 2, D = 9/10

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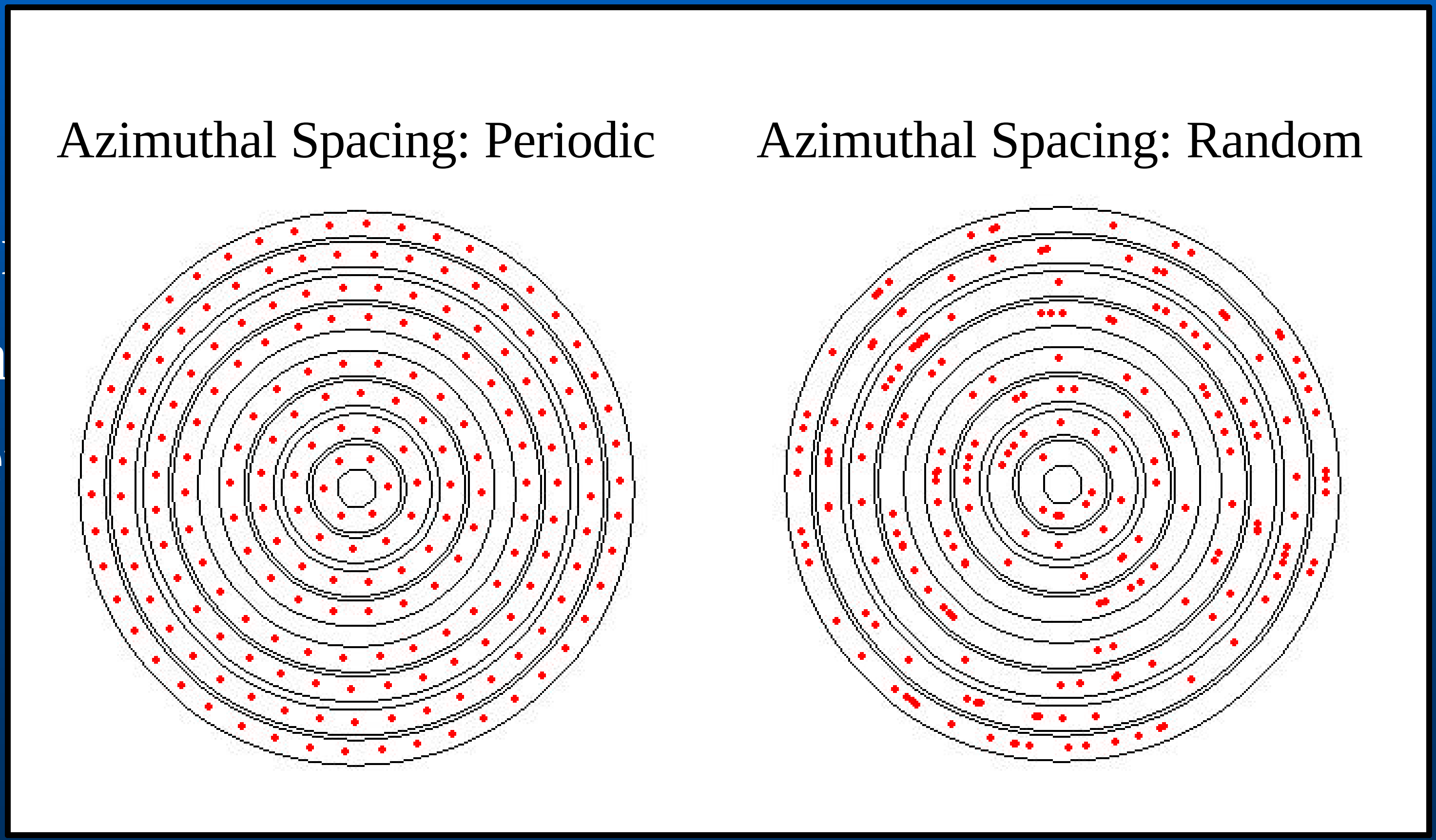
Goals

- Design discrete Cantor ring arrays comparable to continuous case
- Design arrays superior to or comparable to periodic and random cases with regard to:
    - Number of elements
    - Sidelobe level
    - Visible range
    - Robustness
    - Mainbeam quality

Azimuthal Element Configurations

- Pe
- Ra
- Te



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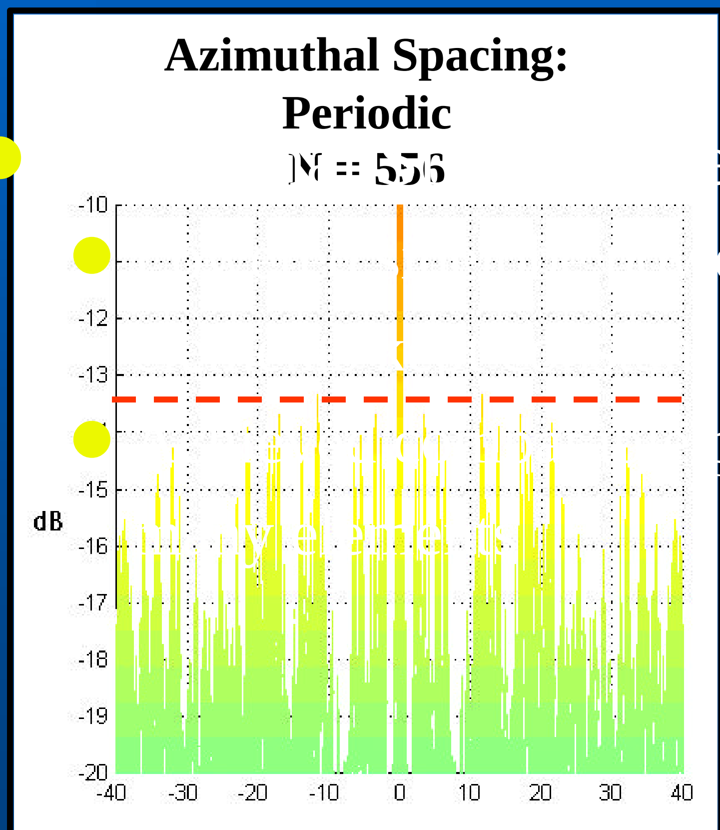
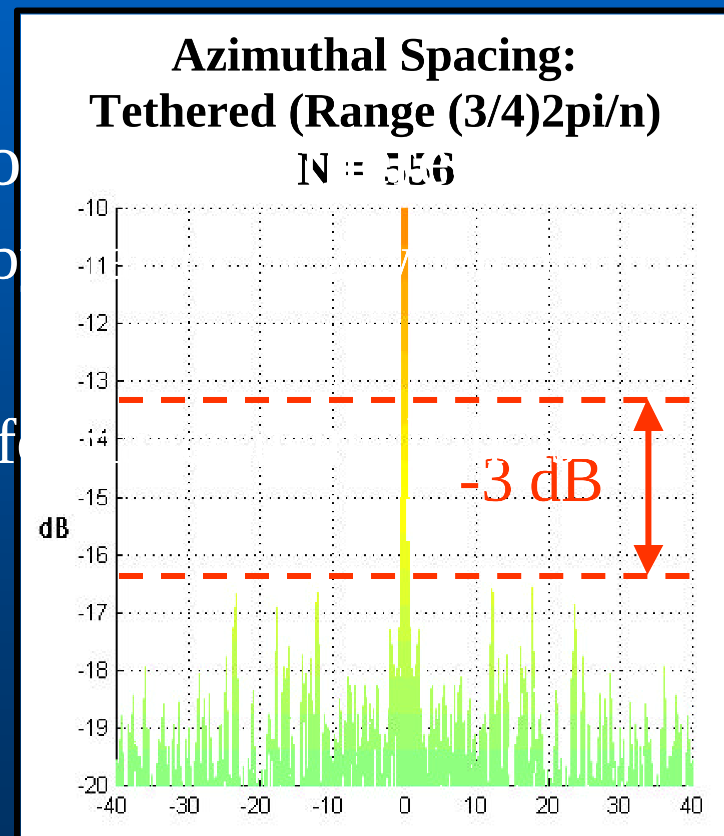
Project Results





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Next Steps

- Other Element Configurations
  - Tapered
  - Inverse-tapered
  - Fractal in azimuthal direction