# Ka-Band Highly-Constrained Deployable Antenna for RaInCube

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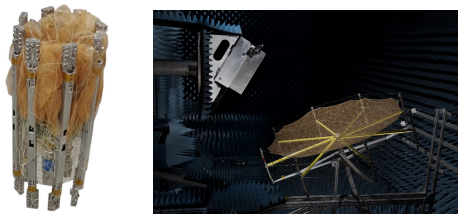
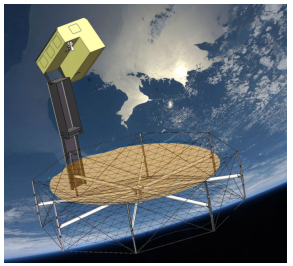
## Objective

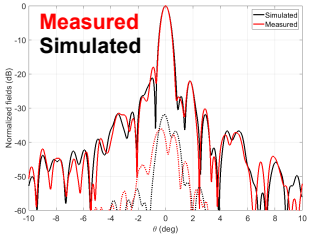
- Develop lightweight, deployable antennas that will be used for RaInCube (Radar In a CubeSat (RIC)), a mission concept for fast temporal profiling of rainfall and snowfall using a constellation of compact precipitation radars on CubeSats/SmallSats.
  - For 6-12U CubeSat (RIC-6U):
    - Design, fabricate, and test a 1 m reflector antenna with ~47 dB of gain at 35.7GHz (stowed volume 10 x 10 x 30 $cm^3$).
  - For 50-kg SmallSat (RIC-S50):
    - Design a 2 m reflector antenna with 52 dB of gain at 35.7GHz (stowed volume 20 x 20 x 50 $cm^3$).
- This compact deployable antenna concept can be adapted to other microsatellite and nanosatellite sensing applications.



Engineering prototype of the 1 m, 35.7 GHz offset mesh reflector antenna in stow (L) and deployed (R) positions.



Conceptual design of the 1 m and 2 m, 35.7 GHz offset mesh reflector antenna system.




Measured vs. simulated far-field patterns of 1.0m antenna at 35.7 GHz.

Optimized profiled feed horn

## Accomplishments

- Completed the detailed RF design of the overall mesh reflector antenna and its feed horn system for RIC-6U.
- Developed, optimized, prototyped and tested a compact low mass (64.03 g) profiled feed horn with better than 20 dB return loss within the Ka-band operating frequency.
- Characterized the performance of a newly developed mesh surface material through detailed simulations and RF testing.
- Designed, built and tested a 1 m offset-fed deployable mesh reflector antenna. Verified surface figure accuracy and repeatability to the 0.2-mm level (rms) through several antenna deployment tests and the use of a newly developed laser metrology system.
- This antenna achieved a measured gain of 49.2 dB at 35.7 GHz, with 60% aperture efficiency.
  - Measured antenna pattern and gain results were in excellent agreement with simulations.
- Developed and detailed the design of a compact 2 m offset mesh reflector antenna (RIC-S50) with predicted gain of 55dB and multi-beam capabilities. Radiation patterns of this antenna were simulated with desired beam overlaps.

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| RIC-6U: | **$TRL_{in}$= 3** | **$TRL_{out}$= 5** |
| RIC-S50: | **$TRL_{in}$= 2** | **$TRL_{out}$= 3** |