A Multi-Parameter Atmospheric Profiling Radar for ACE (ACERAD)

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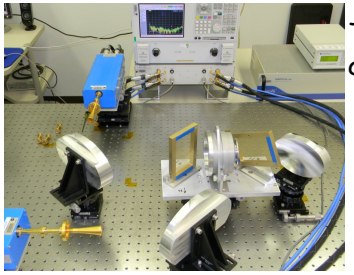
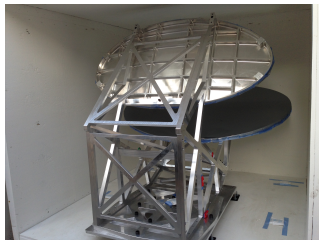
Objective

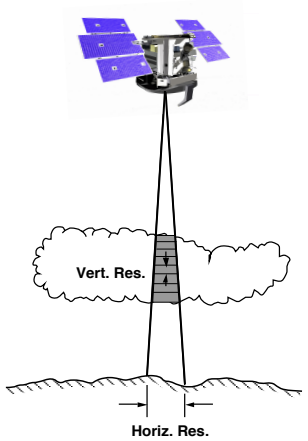
- Design a dual-frequency (35/94 GHz) Doppler radar system for cloud and precipitation measurements.
  - This radar is a candidate instrument for the Aerosol-Cloud-Ecosystems (ACE) measurement concept.
- Develop a detailed design of the antenna and front end for this radar.
- Verify the performance of a scaled antenna and prototype quasi-optical front end through laboratory testing.
- Study feasibility, performance, and utility of an Extremely High Frequency (EHF) channel above 200 GHz.



Testing of quasi-optics



As-built Dragonian antenna



ACERAD cloud measurement concept

Accomplishments

- Completed space borne radar design, including system-level design, RF subsystem design, block diagram and simulation of FPGA-based digital processor; design meets sensitivity goals of -15 dBZ at Ka-band and -36 dBZ at W-band
- Developed and demonstrated dual-polarized quasi-optical front end with low path losses (< 2 dB) and excellent isolation between transmit and receive and between orthogonal polarizations (> 40 dB)
- Designed, developed, and tested dichroic (frequency-selective surface) for separating/combining Ka and W-band signals; reflecting at Ka-band while transmitting W-band with very small reflection (return losses measured at < -25 dB in both polarizations and over temperature); vibration testing showed no shift in resonant mechanical frequency
- Designed and analyzed performance of 2.5 m x 5 m Dragonian reflector for ±2° cross-track scanning at Ka-band
- Fabricated sub-scaled model of antenna (0.625 m x 1.25 m) and demonstrated good performance (sidelobes < -25 dB) in near-field testing with feed at focus; maintained performance when feed was displaced for ±3.8° beam pointing
- Developed tripler blocks and power-combined triplers for output powers from 20 to near 60 mW at 280 GHz

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$TRL_{in} = 3$ $TRL_{out} = 5$