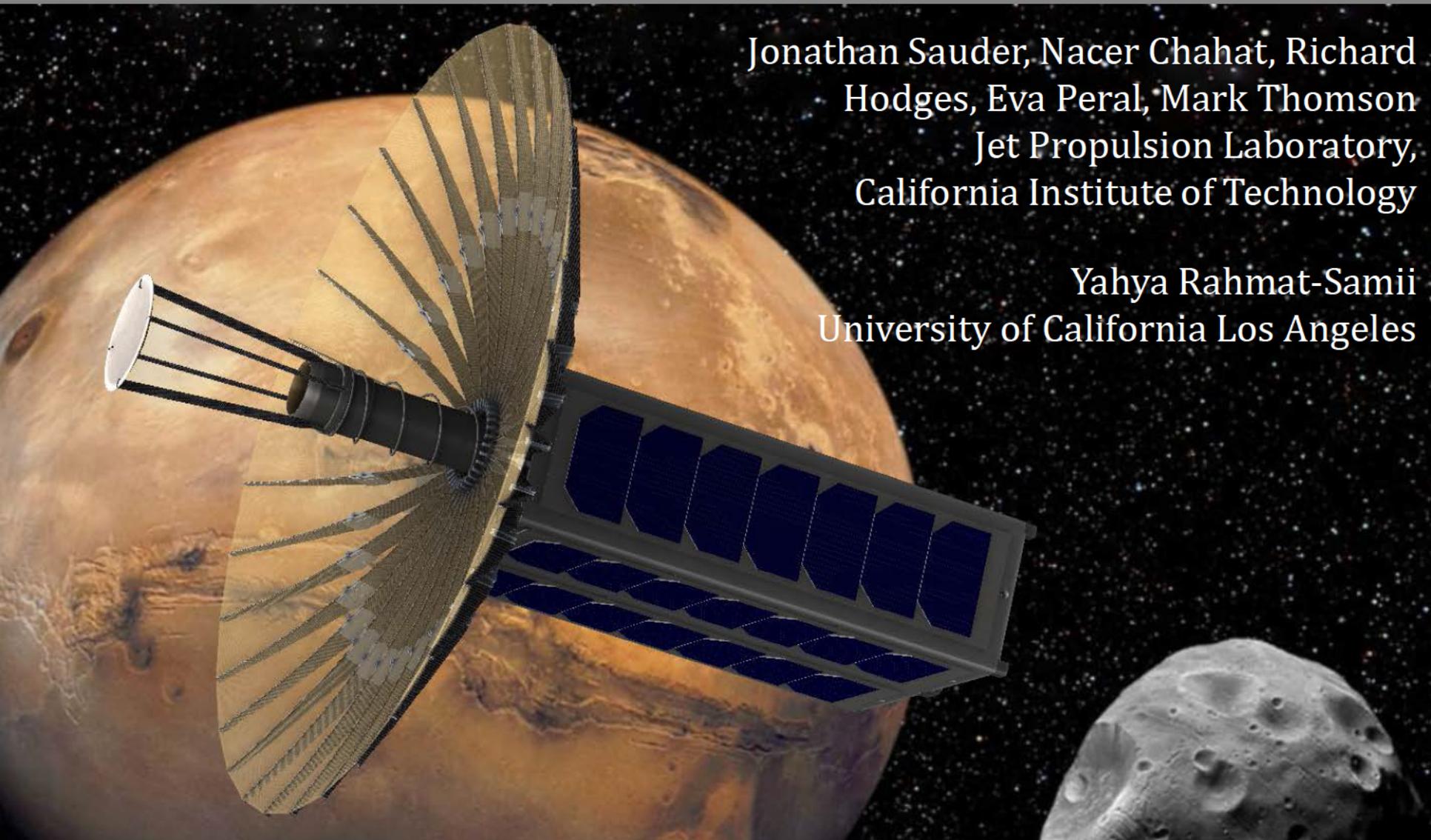




Ultra-Compact Ka-Band Parabolic Deployable Antenna for RADAR and Interplanetary Communications

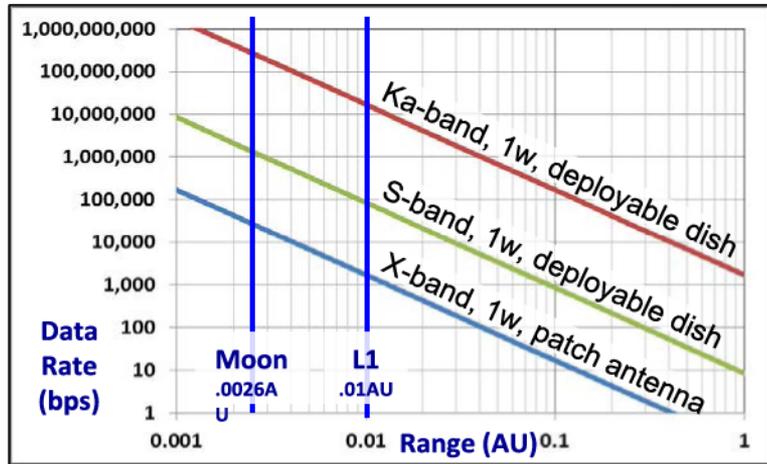
Jonathan Sauder, Nacer Chahat, Richard
Hodges, Eva Peral, Mark Thomson
Jet Propulsion Laboratory,
California Institute of Technology

Yahya Rahmat-Samii
University of California Los Angeles

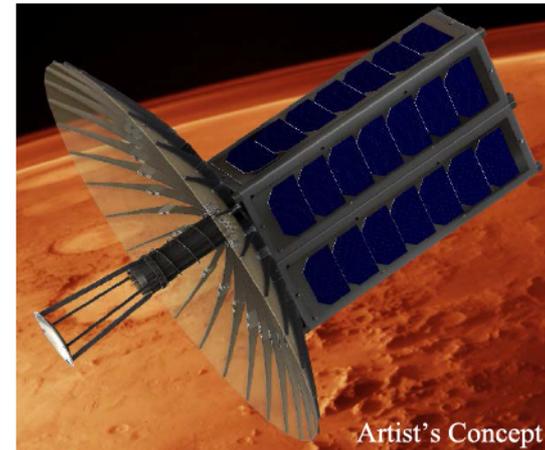


The Need for KaPDA

- **Challenge – Data rates are a limiting factor on CubeSat missions beyond LEO**
- **Objective – High-rate CubeSat communications with DSN**
 - Over 100x increase over state-of-the-art data rate requires a Ka-band deployable high-gain antenna (HGA)
 - Would provide over a 10,000x increase over a X-band patch antenna
- **Solution – A low-cost deployable HGA stowing in ~1.5U**
 - 42 dBi goal at 34 GHz



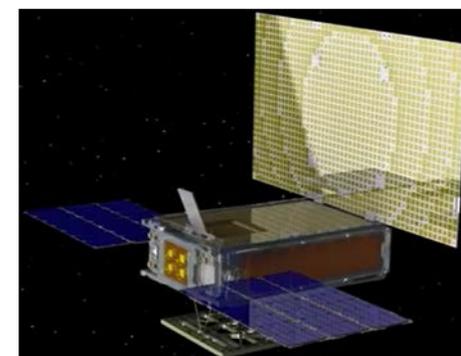
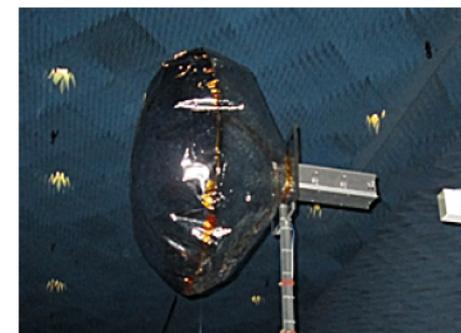
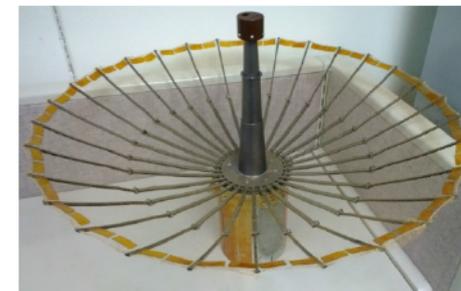
Data Rate Comparison



Ka-band High Gain Antenna at Mars

Existing CubeSat Antennas

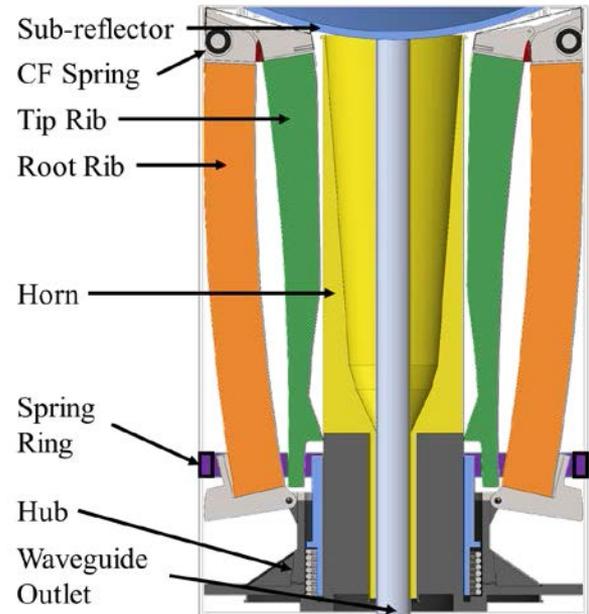
- **Existing parabolic and parabolic like antennas**
 - **Gore-wrap composite reflector**
 - **Reflector transformed from the CubeSat body**
 - **Inflatable cone/cylinder shaped reflector**
 - **Reflectarray**
 - **Mesh Antennas**
- **All are designed for S-band operation**
 - **Except for reflectarray**
- **Ka-band provides data rate advantages**
 - **But requires greater surface accuracy**
- **Mesh design was the most practical to upgrade**
 - **Specifically ANEAS parabolic deployable antenna**
 - **USC/ISI launched ANEAS in Sept. 2012**
 - **Architecture fits CubeSat form factor**



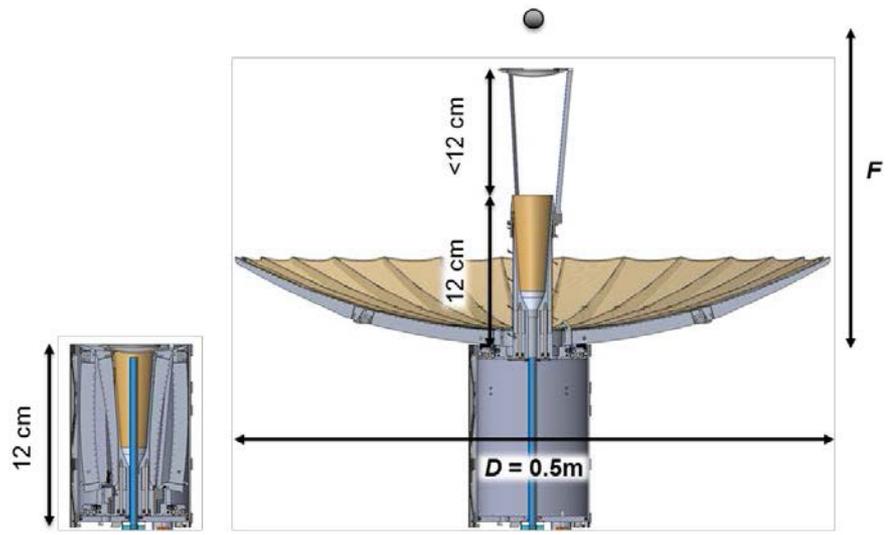
Existing Antenna Concepts

General Architecture

- **Antenna configuration drove architecture**
 - Cassegrainian design was improved for gain
- **Similar folding rib geometry to ANEAS**
 - Required additional sub-reflector, horn, and waveguide



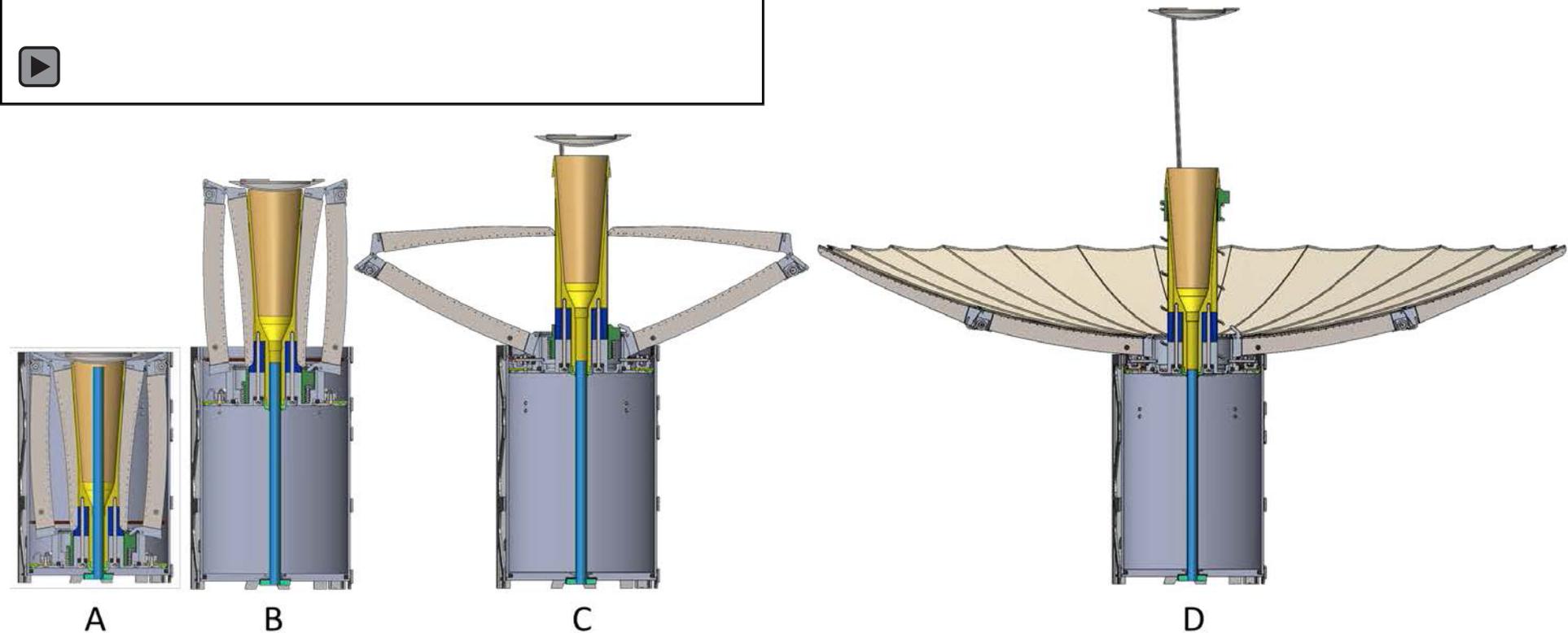
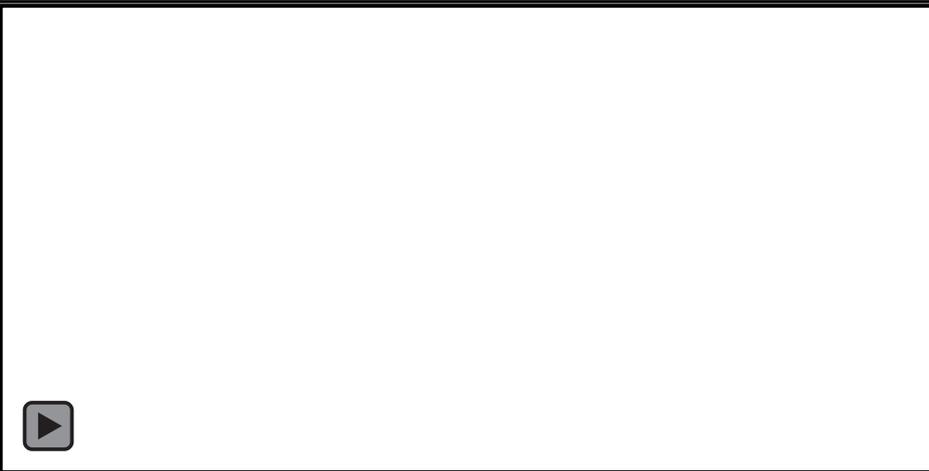
Key KaPDA Components



KaPDA Cassegrainian Configuration

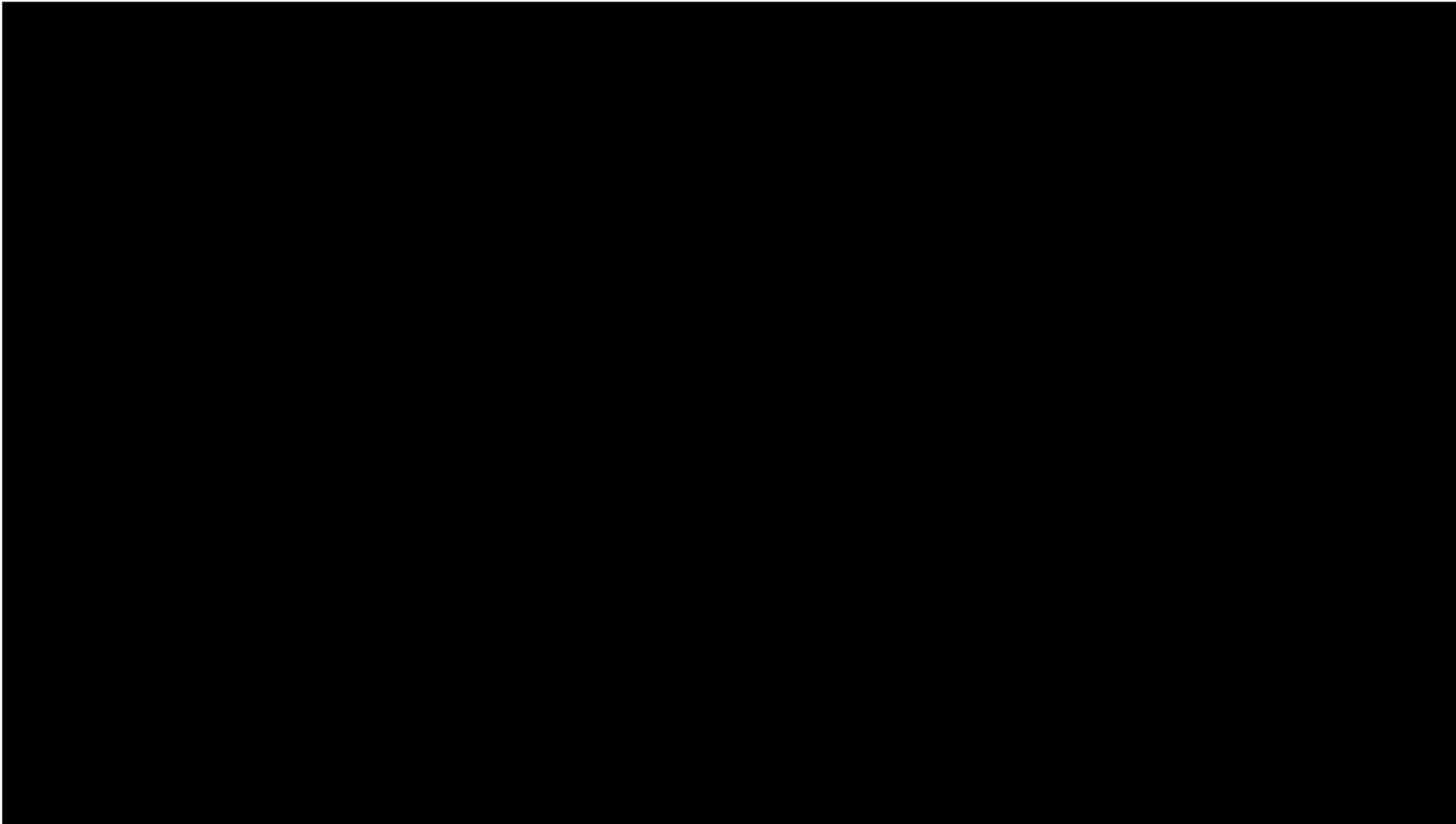


Deployment Sequence





Video of Deployment

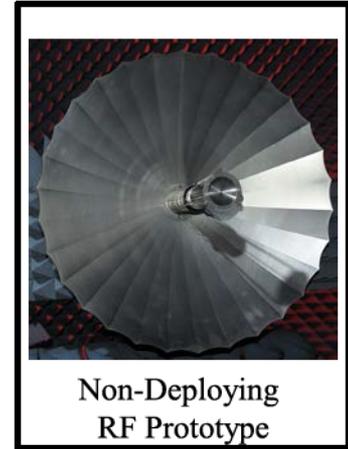
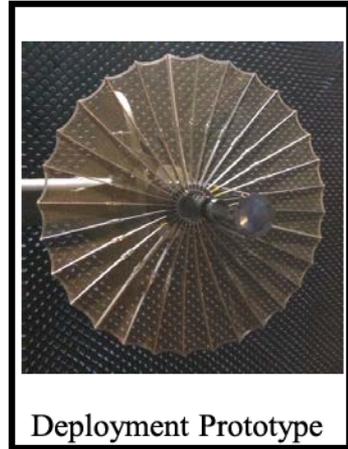


KaPDA Progress and Status

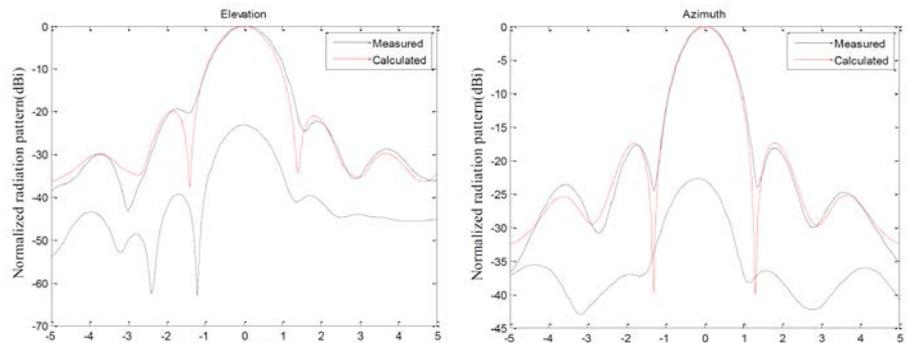
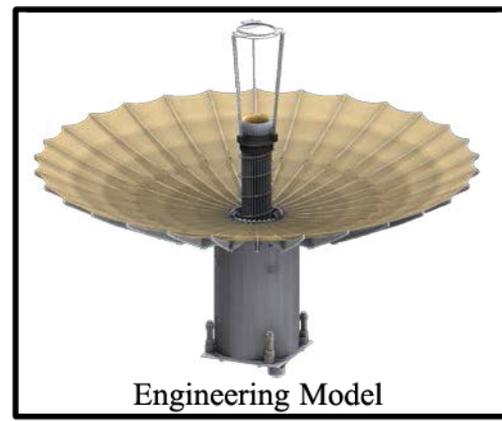
Quantity	Units	Goal	CBE	Measured
Stowed Size	U (10x10x10 cm ³)	1.5	1.54	1.54
Deployed Diam.	meter	0.5	0.51	0.51
Gain	dB	42	42.6	42.5*
Beam width	degrees	1.2	1.2	1.2*
Surface Accuracy	mm	0.40	--	0.22*
Mass	kg	3.0	1.9	1.2
Thermal	° C	-17 to 35	-26 to 62	--

Table of Parameters
 * Pre-deployment Data

June 2015



Dec 2015



RF Test Results

KaPDA Enabling CubeSat RADAR

- **First technology infusion opportunity for KaPDA**
 - **Uses KaPDA for atmospheric science**





KaPDA Enabling CubeSat Radar