



# CANYVAL-X

## CubeSat Astronomy by NASA and Yonsei using Virtual Telescope Alignment eXperiment

### Mission Goal: CubeSat Demonstration of Virtual Telescope Alignment Technology in Space

#### Mission Description

CANYVAL-X is a technology demonstration CubeSat mission with a primary objective of validating technologies that allow two spacecraft to fly in formation along an inertial line-of-sight (i.e., align two spacecraft to an inertial source). Demonstration of precision dual-spacecraft alignment achieving fine angular precision enables a variety of cutting-edge heliophysics and astrophysics science.

#### Project Status

The George Washington University Micro-propulsion and Nanotechnology Lab

- Developed mCAT analog electronics and control design, based on system developed for BRICSAT mission.
- Delivered mCAT thruster heads

Yonsei University

- Designed, built, and tested the 1U and 2U spacecraft and are currently integrating the mCAT.
- Spacecraft environmental testing at KARI.
- Developed ground system to conduct mission operations and alignment experiment.

NASA

- Delivered Miniature Fine Sun Sensor – provides attitude measurement for 2U spacecraft.
- Completed George Washington University Micro Cathode Arc Thruster (mCAT) flight electronics, performed system testing, and delivered mCAT - provides thrust for 2U cubesat.
- Conducting an assessment of CANYVAL-X's GN&C in regards to formation acquisition and alignment.
- Traveled to Yonsei to collaborate with team.

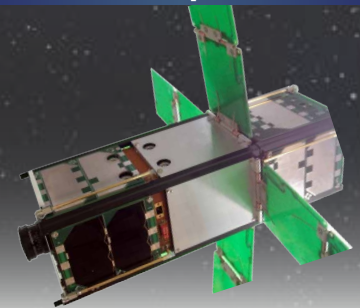
Launch on Falcon9 in mid-2016.

#### Partnership

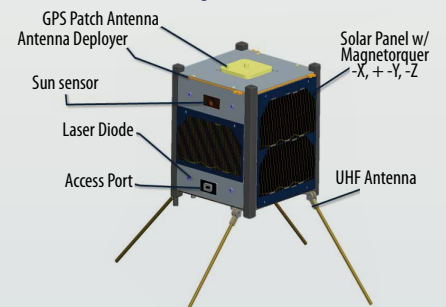
NASA, Yonsei University, and The George Washington University are collaborating to develop the mission.



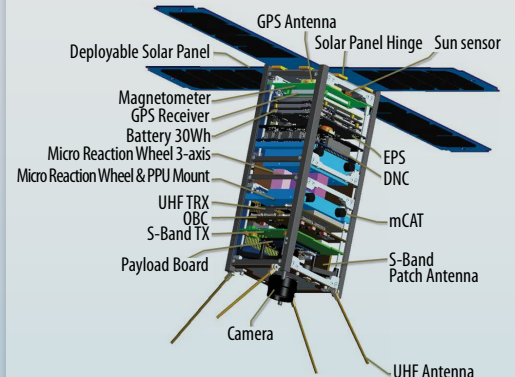
#### CANYVAL-X Spacecraft



**1U Passive Target CubeSat (JERRY)**



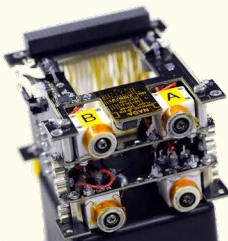
**2U Actively Controlled CubeSat (TOM)**



#### NASA Delivered Hardware

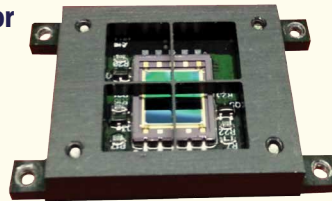
**mCAT**  
(GWU/NASA)

Delivered  
Sept 2015

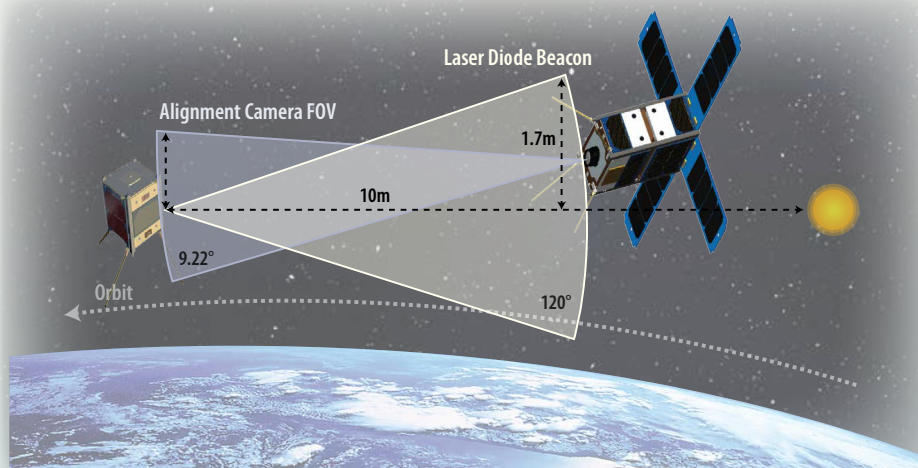


**Fine Sun Sensor**  
(NASA)

Delivered  
June 2015



#### Virtual Telescope Inertial Alignment





# CANYVAL-X

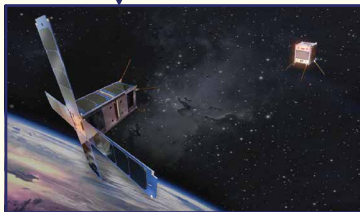
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## Road Map to Cutting Edge Science

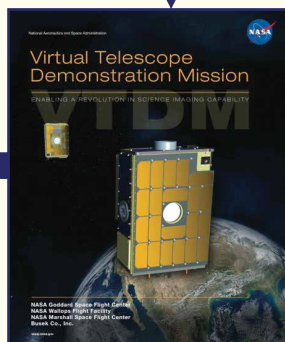
### Ground/Lab Demo of Component Technologies



CANYVAL-X matures formation alignment technology enabling the next-generation of distributed space virtual telescopes.

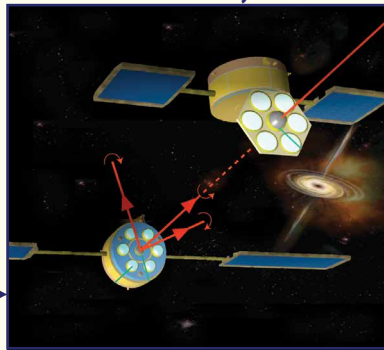


### In-space alignment experiment



### In-space science-class virtual telescope

### Astronomy



### Heliophysics



Credit: ESA

## Mission and GNC Specification

Properties	Value	
	JERRY	TOM
Mission Life Time	3-6 month	
Payload	3 Laser Diodes	Visible Camera (NanoCam)
Payload Performance	Half Intensity Beam Angle = $\pm 60^\circ$ Minimum angle ( $15.5^\circ$ ) intensity > 96%	2048 x 1536 pixels CMOS sensor 35mm lens/F1.9, 9.22° FOV
GN&C	(Magnetorquer, sun sensor)	mCAT, Sun Sensor, Nano-Cam, Reaction Wheels, Mag TorqRods
Data Rate	Up/Downlink: 4.8 kbps (UHF)	Uplink: 4 Bkbps (UHF) Downlink 100 kbps (S-band)
Mass	1.0 kg	2.7 kg
Relative Distance	> 10m (Collision Avoidance)	
Orbit Control	GWU	20cm (1 DOF mCAT x4+3axis Reaction Wheel)
Orbit Determination	Each Axis $\pm 10$ cm (GPS)	
Attitude Control	5° (Magnetorquer) 10m x tan(5°)=88cm	1° (Reaction Wheel) 10m x tan(1°)=18cm

## CANYVAL-X Teams

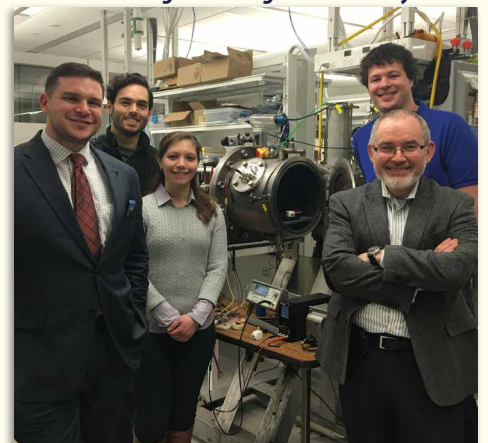
### NASA



### Yonsei



### The George Washington University



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