NANORACKS

# Operations: Working Your Experiment

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George Washington University
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# Operations Responsibilities

- Operations is most well known for the operations phase, but our work entails so much more than that

- Our team is involved in all phases
  - Development
  - Testing
  - Procedure Development
  - Crew Training
  - Real-Time Operations
  - Anomaly Resolution

# Development

- When your contract is signed, we work on a Concept of Operations
  - Could be a simple as plugging a module into a platform
  - Gets more complex from there

# Testing

- Ops Team performs a test of the hardware on our engineering model platforms as soon as it's available
  - The sooner we have it, the better we can provide feedback concerning necessary modifications

# Procedure Development

- Dependent on the complexity of the operation, a crew procedure might need to be developed
  - This process involves the Marshall Payload Ops Center, the Crew Office, the customer, and NanoRacks
- Must allow time in the development process for this cycle

# Procedure Development



Parameters 1. Cycle

| Cycle | Unstow | Location 1 | Location 2 |
|---|---|---|---|
| 1 | NanoRacks CubeSat Quad Deployer (two) S/N 1003, 1004 P/N NRCSD-1-Q | Quad Deployer S/N 1003 | Quad Deployer S/N 1004 |
| 2 | NanoRacks CubeSat Quad Deployer (two) S/N 1005, 1006 P/N NRCSD-1-Q | Quad Deployer S/N 1005 | Quad Deployer S/N 1006 |
| 3 | NanoRacks CubeSat Quad Deployer (two) S/N 1007, 1008 P/N NRCSD-1-Q | Quad Deployer S/N 1007 | Quad Deployer S/N 1008 |

OBJECTIVE:

Install NanoRacks CubeSat Deployer hardware onto the MPEP (Multipurpose Experiment Platform).

TOOLS:

Static Wrist Tether
3/16" Hex Head, 1/4" Drive
(10-50 in-lbs) Trq Wrench, 1/4"
6" Ext, 1/4" Drive
#1 Phillips Screwdriver

PARTS:

**NanoRacks CubeSat Quad Deployer (two) S/N 1003, 1004 P/N NRCSD-1-Q**
NanoRacks CubeSat Deployer Electronics Box S/N 1002 P/N NRCSD-501
NanoRacks CubeSat Deployer MLI P/N NRCSD-503
NanoRacks CubeSat Power/Data Cable 1 S/N 1002 P/N NRCSD-505
NanoRacks CubeSat Power/Data Cable 2 S/N 1002 P/N NRCSD-507
Large Mounting Plate P/N NR-NRCSD-D0001-301
Small Mounting Plate P/N NR-NRCSD-D0001-302
Secondary Latch Cable 1 P/N NRCSD-SLC-01

1. Setup Camcorder for HD downlink with view of JEM Air Lock Slide Table. Video recording is required.
JEM AL As required, refer to PTV 104 HIGH DEFINITION DOWNLINK – AVN443 HD ENCODER (US SODF: ISS PTV: Scenes)

2. NANORACKS CUBESAT DEPLOYER ELECTRONICS BOX INSTALLATION
On SSIPC GO,

2.1 ✓Static Wrist Tether – donned





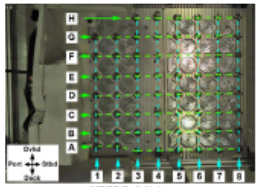



Figure 1. MPEP Bolt Holes

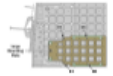


Figure 2. Large Mounting Plate Installation

2.2 Install the Large Mounting Plate onto the MPEP using bolt holes A3, A6, D3 and D6, threading fasteners (four) by hand approximately 4 turns (Figure 2).

2.3 Torque Large Mounting Plate fasteners (four) to 30 in-lbs in a diagonal pattern A3, D6, A6, D3 [(10-50 in-lbs) Trq Wrench, 1/4", 6" Ext, 1/4" Drive, 3/16" Hex Head, 1/4" Drive].

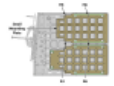


Figure 3. Small Mounting Plate Installation

2.4 Install the Small Mounting Plate onto the MPEP using bolt holes E3, E6, H3 and H6, threading fasteners (four) by hand approximately 4 turns.

2.5 Torque Small Mounting Plate fasteners (four) to 30 in-lbs in a diagonal pattern E3, H6, E6, H3 [(10-50 in-lbs) Trq Wrench, 1/4", 6" Ext, 1/4" Drive, 3/16" Hex Head, 1/4" Drive] (Figure 3).

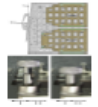
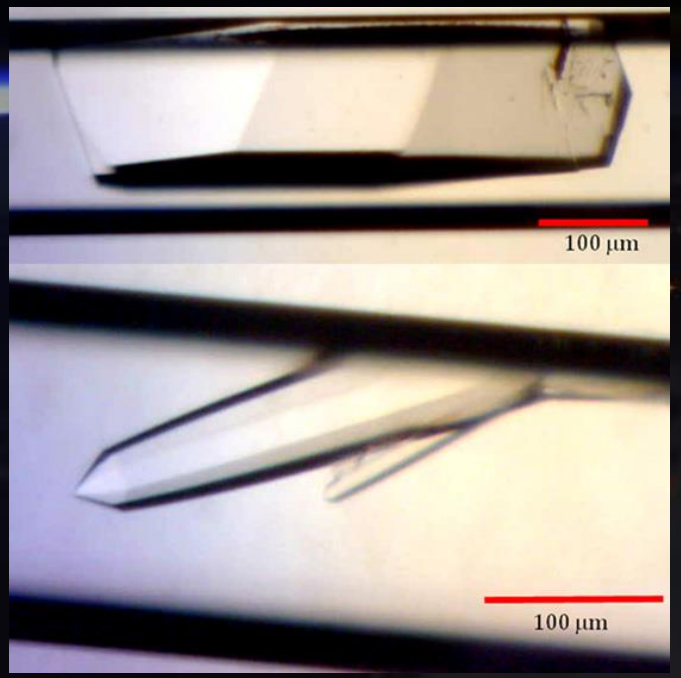


Figure 4. Plungers on Small and Large Mounting Plates

# Procedure Development

- A good procedure that has been properly reviewed on the ground can usually result in success on orbit




# Crew Training

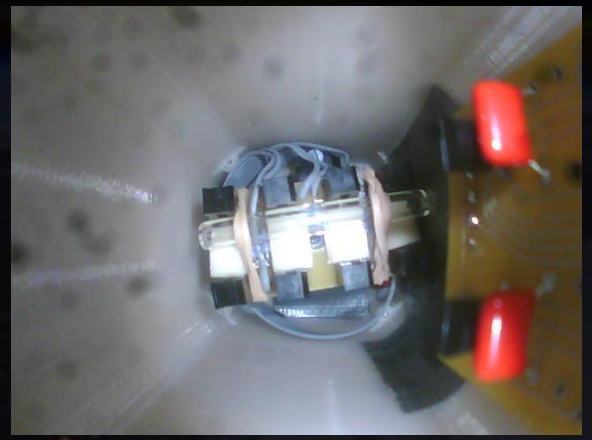
- Over the last three years, NASA has changed it's model towards crew training for payload procedures
  - Crew no longer receives training prior to flight
  - Other solutions have been found
- On-orbit training for payloads is now the norm
  - Procedural reviews prior to the operation
  - Training videos
- Moving towards automation to limit crew time used

# Real Time Operations

- NanoRacks Operations Team monitors crew activities when necessary
- Downlink data on a daily basis
- We turn the data over as soon as possible

# Pictures from Valley Christian School Modules

FerroFluids

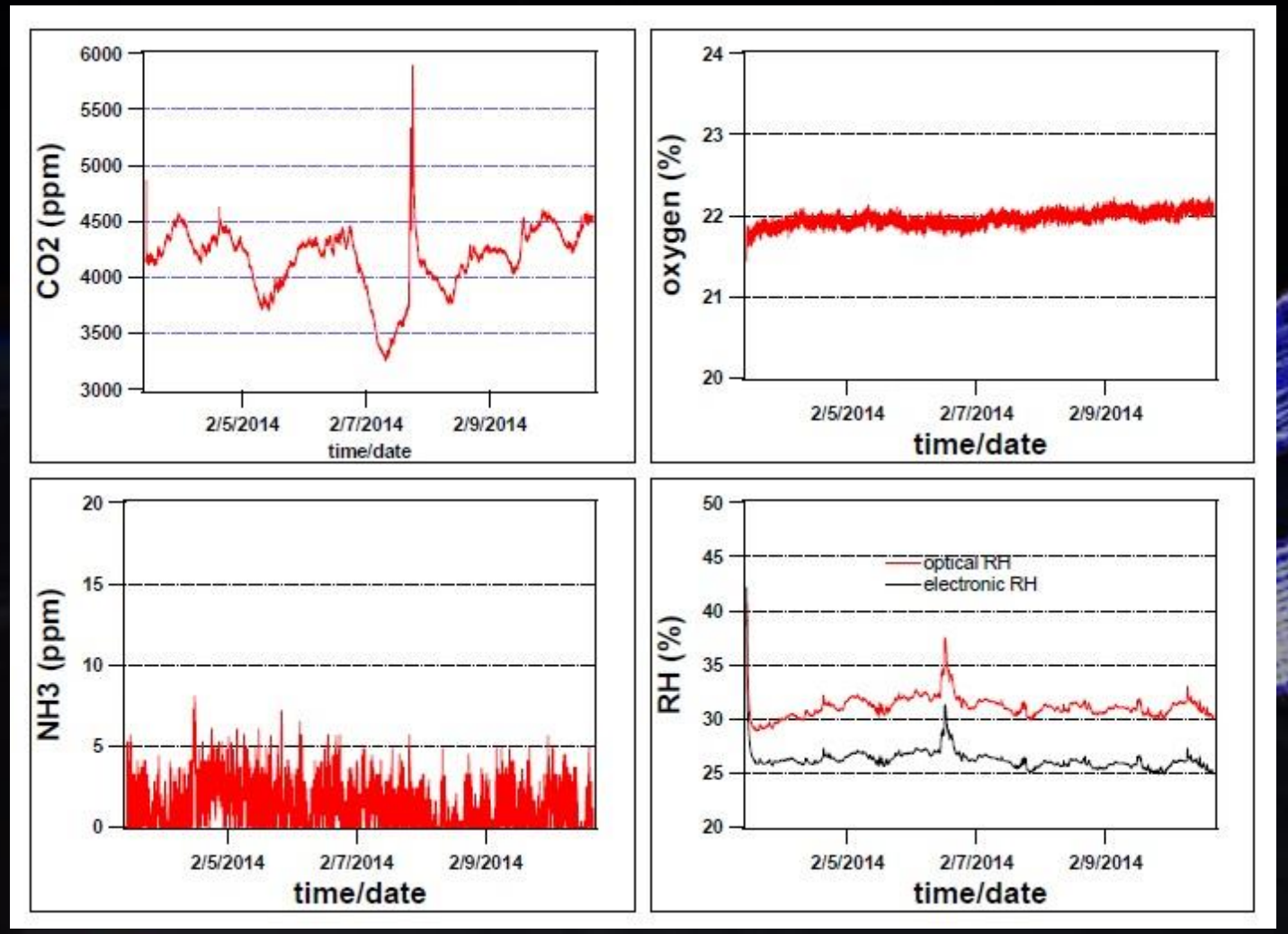


Mini Robot

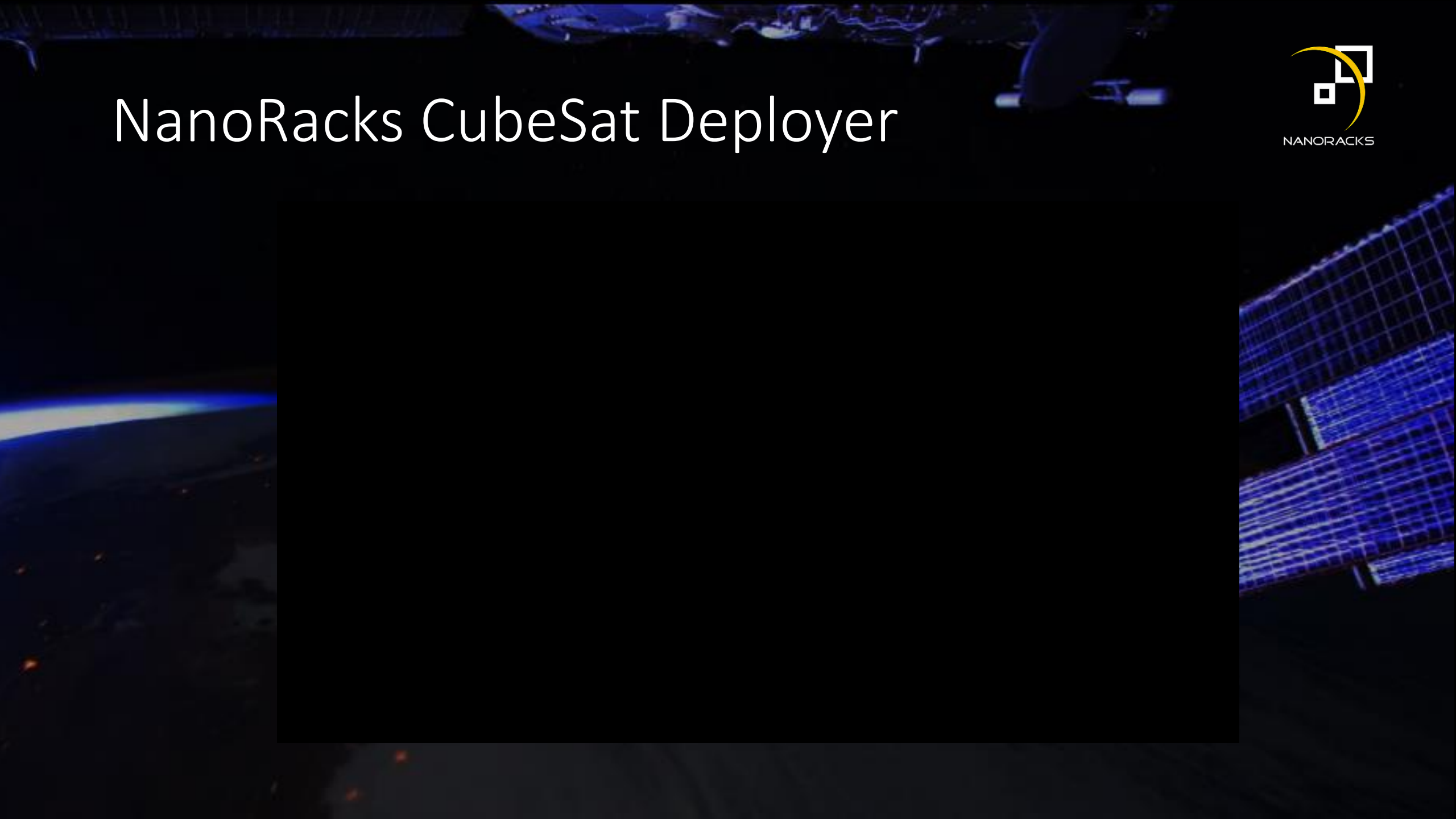
Plant Growth

Crystal Growth

# Multi-Gas Monitor Data



# NanoRacks CubeSat Deployer



# Anomaly Resolution

- Space Research is HARD
- The Operations Team is responsible for investigating the problem and finding a solution
- Done in coordination with the ISS Program Office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Any Questions?