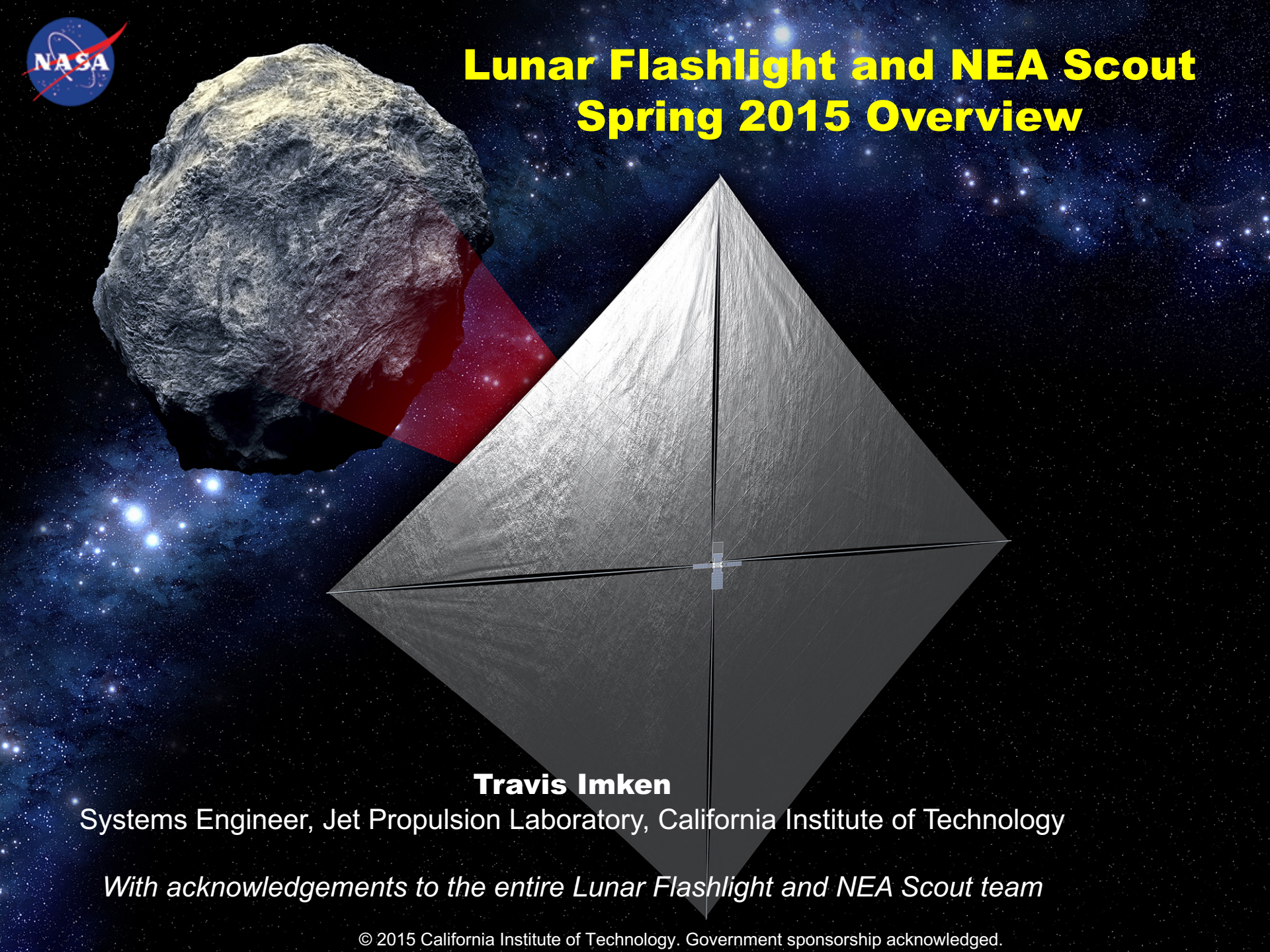


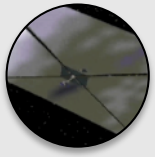
# Lunar Flashlight and NEA Scout Spring 2015 Overview

**Travis Imken**
Systems Engineer, Jet Propulsion Laboratory, California Institute of Technology

*With acknowledgements to the entire Lunar Flashlight and NEA Scout team*

# Lunar Flashlight and NEA Scout Introduction

- **Lunar Flashlight and NEA Scout are two of NASA HEOMD's Advanced Exploration Systems (AES) payloads flying on SLS EM-1**
- **Primary selection criteria:**
  - Relevance to Space Exploration Strategic Knowledge Gaps (SKGs)
  - Life cycle cost
  - Synergistic use of previously demonstrated technologies
- **Both missions are in Phase A**

| **Payload**<br>**NASA Centers** | **Strategic Knowledge Gaps Addressed** | **Mission Concept** |
|---|---|---|
| Lunar Flashlight<br>JPL/MSFC  | Lunar resource potential<br>• Quantity and distribution of water and other volatiles in lunar cold traps | Locate ice deposits in the Moon's permanently shadowed craters |
| Near Earth Asteroid (NEA) Scout<br>MSFC/JPL  | Human NEA mission target identification<br>• NEA size, rotation state (rate/pole position)<br>How to work on and interact with NEA surface<br>• NEA surface mechanical properties | Flyby/rendezvous and characterize one NEA that is candidate for a human mission |

# NEA Scout Overview

## Why NEA Scout?

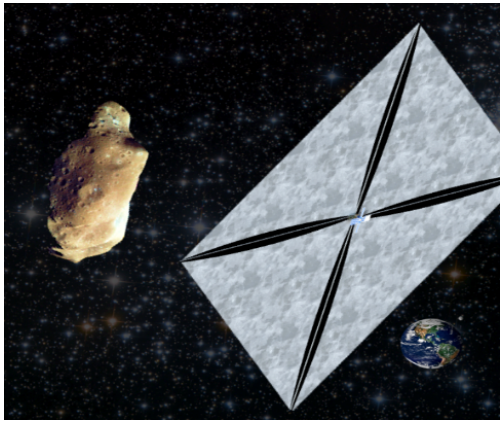
- Detect and rendezvous with a Near Earth Asteroid (NEA) target
  - Characterize the physical properties of the unresolved NEA target
  - Flyby and characterize the physical properties of the resolved NEA target


**Measurements:** *NEA volume, spectral type, spin mode and orbital properties, address key physical and regolith mechanical SKG*

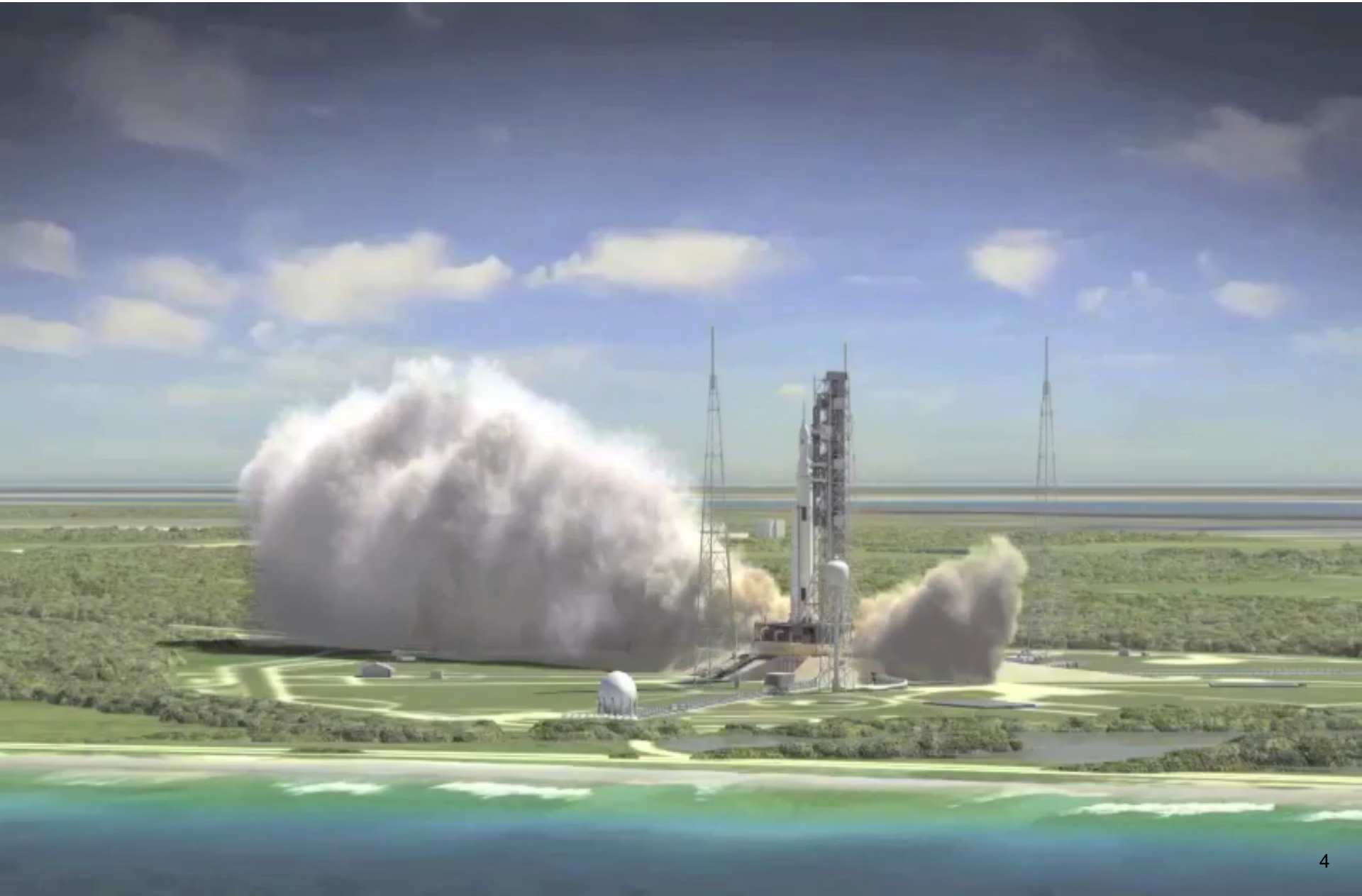
- ≥80% surface coverage imaging at ≤50 cm/px
- Spectral range: 400-900 nm (incl. 4 color channels)
- ≥30% surface coverage imaging at ≤10 cm/px

## Key Technical Constraints:

- 30 month maximum mission duration
- Target must be within ~1 AU distance from Earth due to telecom limitations
- Slow flyby with target-relative navigation on close approach



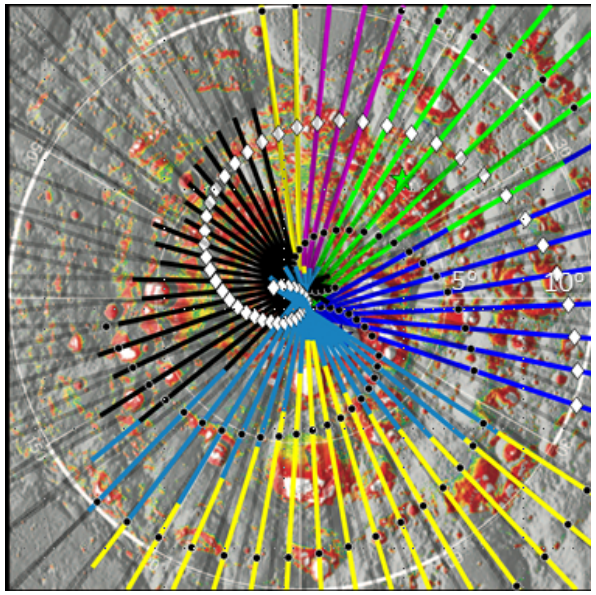
# NEA Scout Animation



# Lunar Flashlight Overview

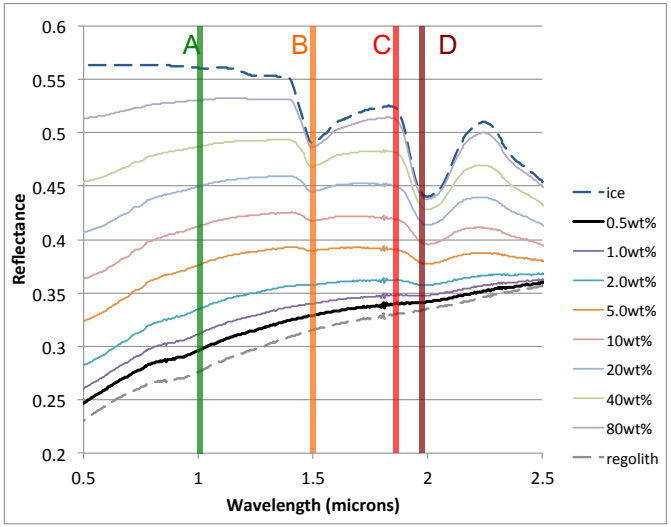
## Why Lunar Flashlight:

- Illuminate permanently-shadowed regions and detect water ice absorption bands in the near-infrared.
- Repeat this measurement over multiple points to create a map of surficial ice concentration that can be correlated to previous mission data




## Measurements: *Lunar water ice in permanently shadowed cold craters.*

- Spectra (1-2 km spot, ground tracks), in 1-2 μm region using a JPL spectrometer
- Using the difference in reflected-light ratios, between dry and ice-bearing regolith, to indicate the presence and quantity of water ice
- Multiple passes over lunar south polar region with potential ice deposits.




## Key Technical Constraints:

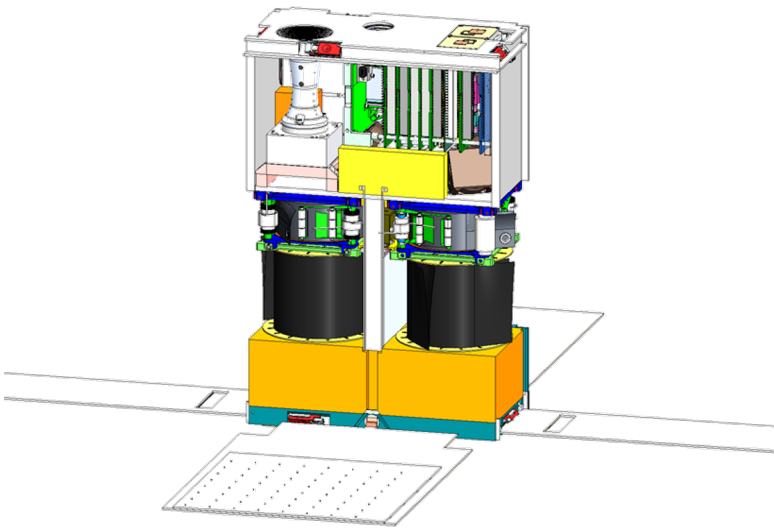
- 30 month maximum mission duration
- Solar sail acceleration limits
- Surface illumination strategies

# Lunar Flashlight Animation

# Common Design

## Driving Design Features

- Both missions must survive 2.5 years
- Radiation mitigation and tolerance
- Thermal design and management
- Power generation and battery health
- Limited mass and volume resources

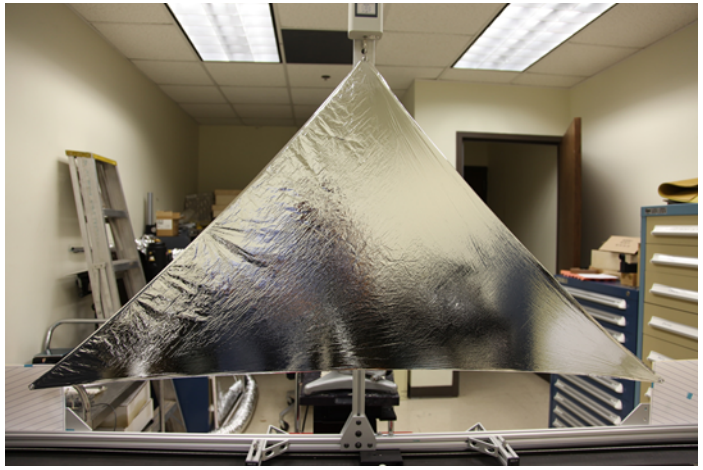


## Deep Space Avionics

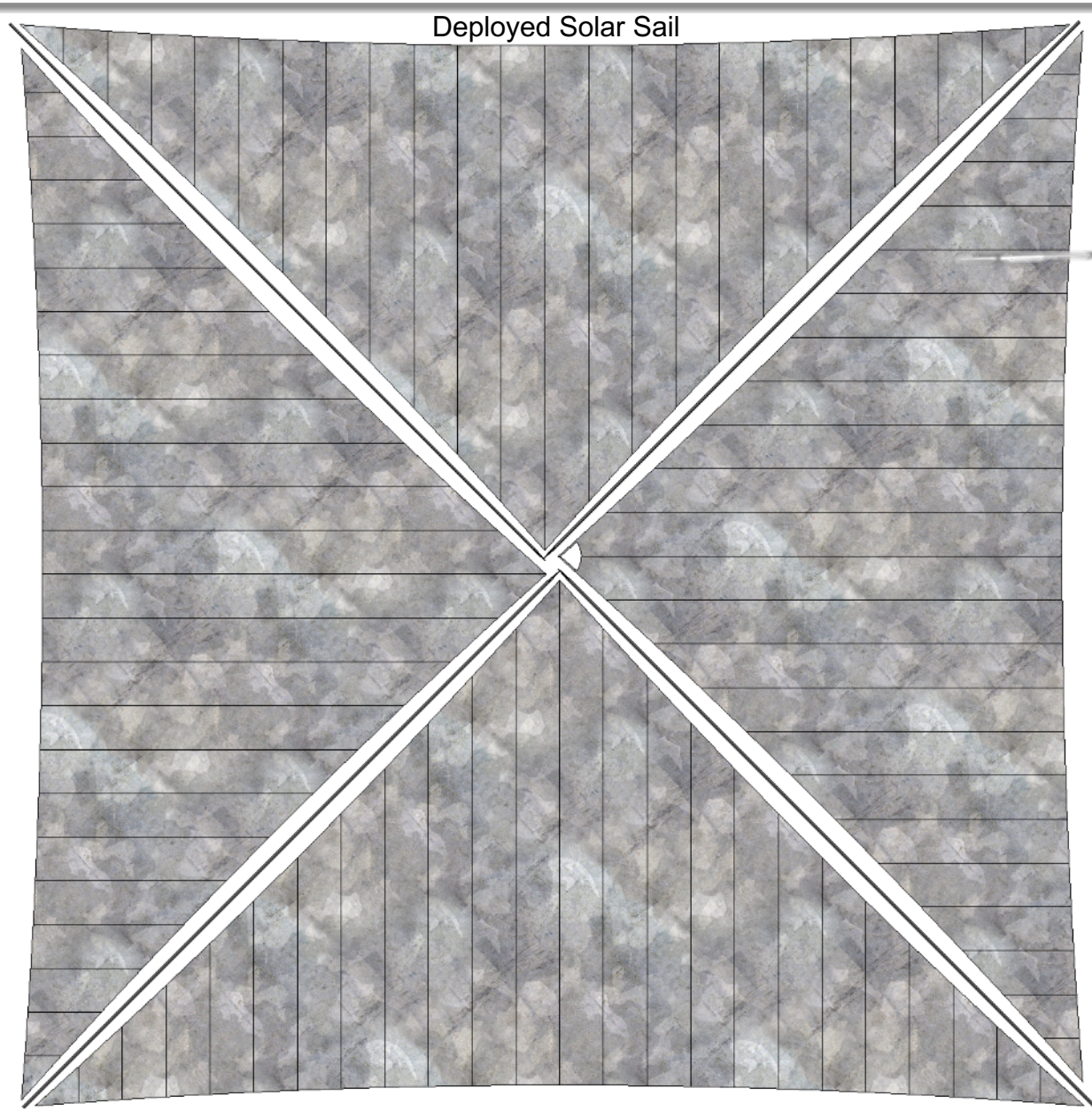
- C&DH – Rad-tolerant LEON-3 architecture
- Power – 35 to 45W power, 18650 batteries
- Comm – Iris V2 deep space X-band transponder
  - 1 to 2 Kbps data rate depending on distance
- ACS – Reaction wheels, SRU, IMU, sun sensors
- Propulsion – COTS cold gas for TCM ΔV and desat

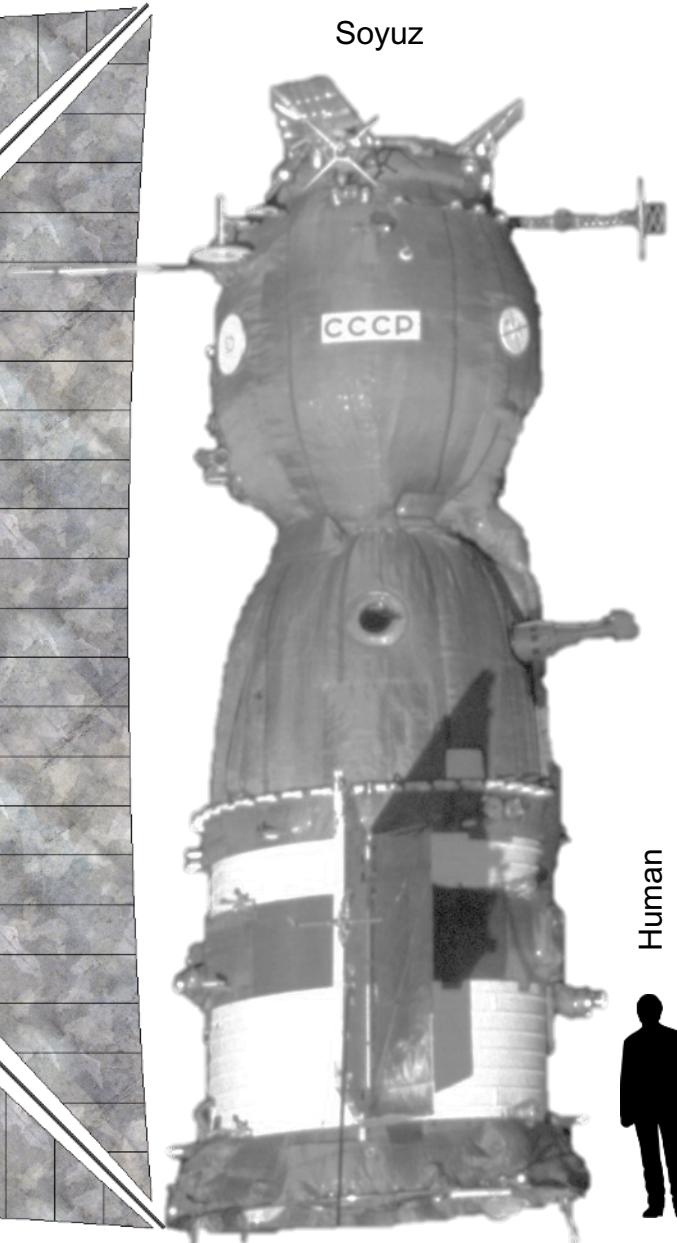
## Solar Sail

- MSFC developed solar sail
- ~80m² area made up of four quadrants
- Deployer, booms, and sail contained within 2U
- Used for propulsion (both) and science (LF)



# Solar Sail


Deployed Solar Sail


Soyuz
CCCP
Human
6U Stowed Flight System

# Updates since ISSC 2014

## Milestones

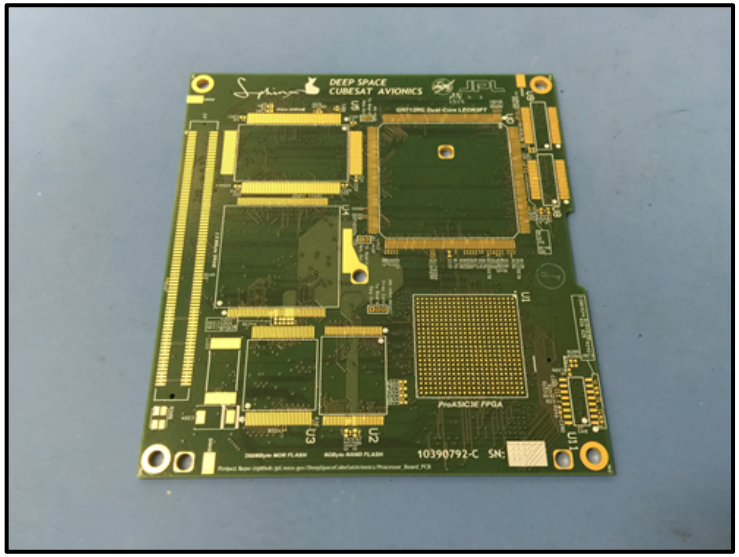
- Joint SRR/MCR in August ’14
- Status review in January ‘15
- AES mid-year review in April ‘15

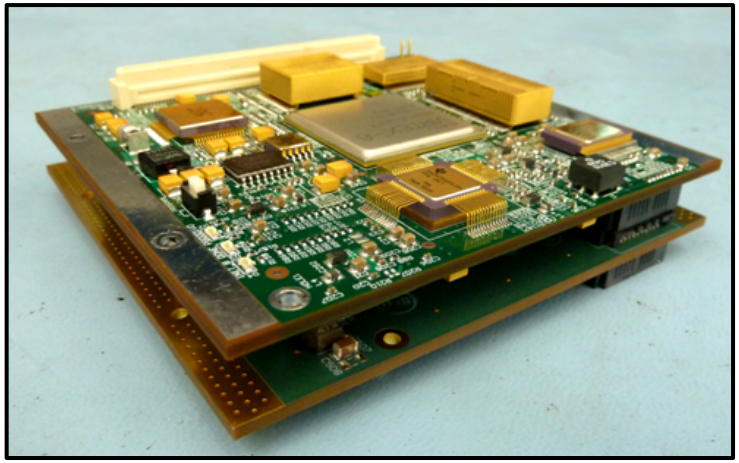
## Improving the design

- Parts list review of JPL and COTS components, select radiation testing on critical items
- Maturation of passive thermal management for instruments and subsystems
- Refined CAD design for machinability, cable harnessing, and assembly strategies

## Hardware developments

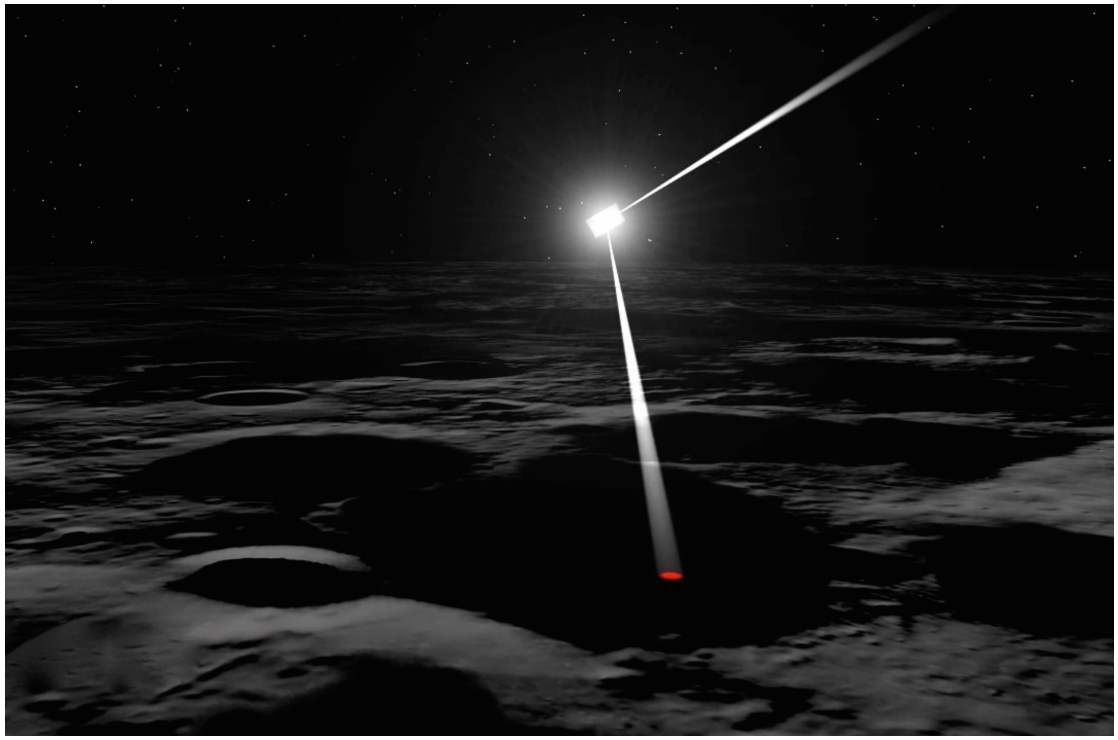
- CDH board (‘Sphinx’) assembled and being functionally verified
- Iris V2 is maturing for MarCO, some components in house and undergoing testing
- Compact packaging solutions for ACS components and RF assemblies
- Upcoming radiation and performance testing on candidate power boards



# Looking Forward

- Phase 1 safety review (PDR level of maturity) in June ’15
- FlatSat of electrical components will start to come together this FY
- Upcoming ACS component and software testing in the JPL Small Satellite Dynamics Testbed
- Expected SLS launch in 2018



# Questions?