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Near Earth Asteroid Scout Mission Update

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Near Earth Asteroid Scout Mission Overview

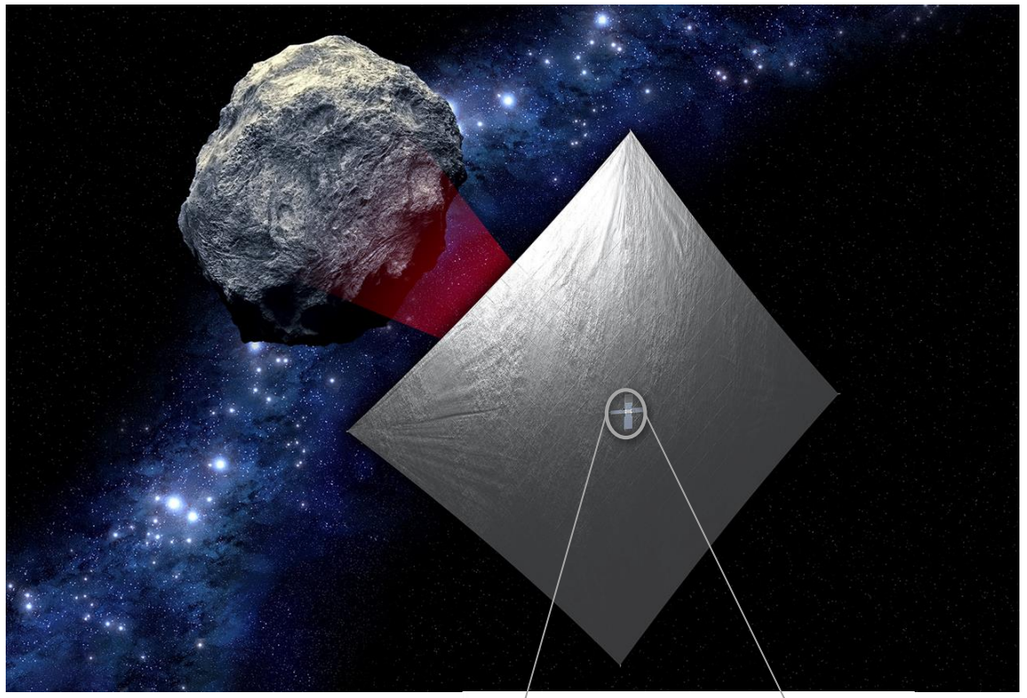
The Near Earth Asteroid Scout Will

- Image/characterize a NEA during a slow flyby (~m/s)
- Demonstrate a low cost asteroid reconnaissance capability

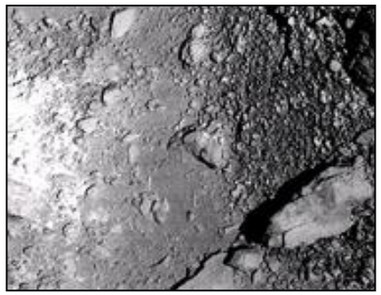
Key Spacecraft & Mission Parameters

- 6U CubeSat
- ~86 m^2 solar sail propulsion system
- Manifested for launch on the Space Launch System (EM-1/2020)
- 1 AU maximum distance from Earth

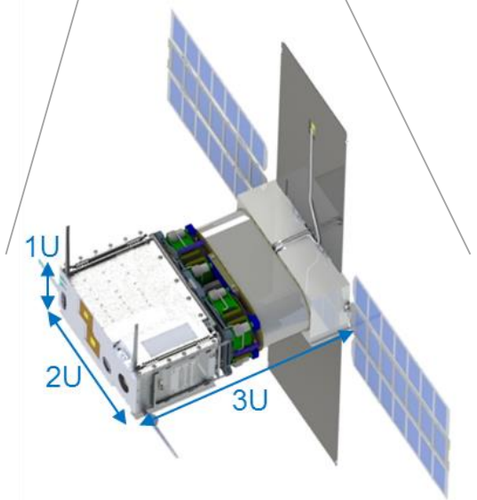
Leverages: combined experiences of MSFC and JPL with support from GSFC, JSC, & LaRC



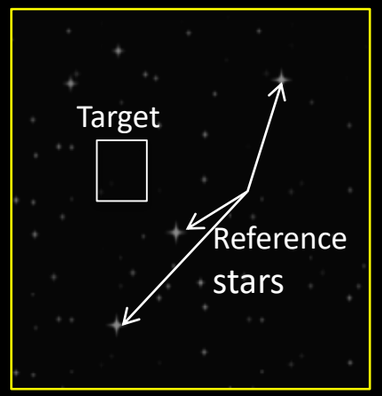
Target Reconnaissance with medium field imaging
Shape, spin, and local environment



Close Proximity Imaging
Local scale morphology, terrain properties, landing site survey



Near Earth Asteroid Scout Science Overview



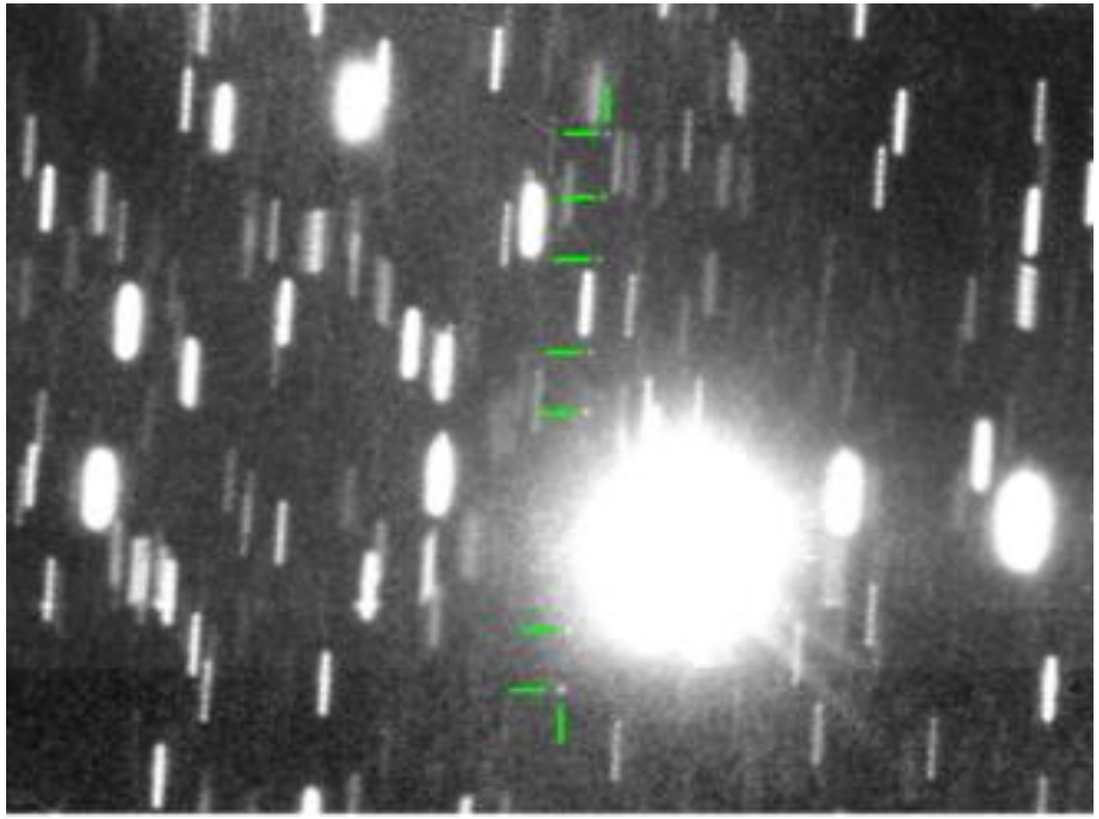
1. Target Detection and Approach:
50K km, Light source observation
SKGs: Ephemeris determination and composition assessment

2. NEA Reconnaissance
<100 km distance at encounter
50 cm/px resolution over 80% surface
SKGs: volume, global shape, spin properties, local environment

3. Close Proximity Science
High-resolution imaging,
10 cm/px over >30% surface
Strategic Knowledge Gaps (SKGs):
Local morphology
Regolith properties

JPL

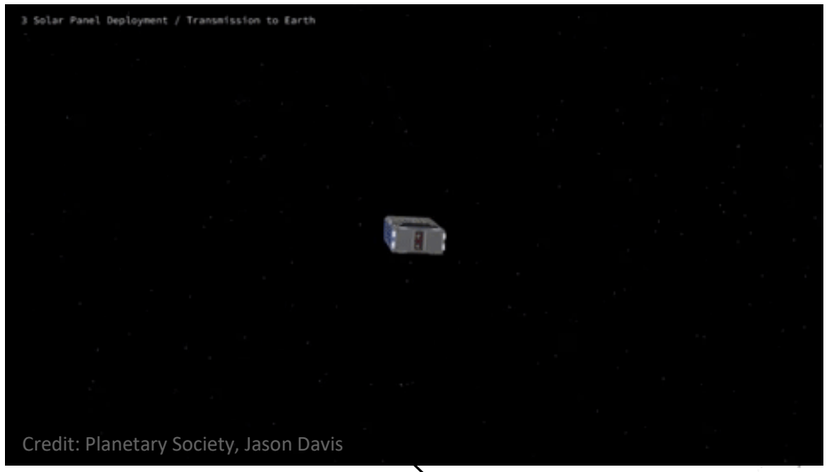
Baseline Target Asteroid: 1991 VG



Near-Earth Asteroid 1991VG (marked with green lines) on 2017 May 30. This is a composite of several images obtained with the ESO VLT. The images have been combined in 7 stacks tracking the position of the asteroid, resulting in the object appearing as 7 dots as it moves in front of the background stars. The stars appear trailed due to the motion of the asteroid during each series. Credit Hainaut/Micheli/Koschny

- Diameter ~ 5 -12 meters
- Rotation period between a few minutes and less than 1 hour
- Unlikely to have a companion
- Unlikely to retain an exosphere or dust cloud
  - Solar radiation pressure sweeps dust on timescales of hours or day
- Note: target will change with new trajectory baseline from SLS (in process of selecting)

Concept of Operations Overview



Credit: Planetary Society, Jason Davis

NEA

<1 km

<28 km

<50,000 km
Target distance

Proximity

Data Downlink

Target Reconnaissance

Target Search and Approach

Lunar Fly-by 2+

Cruise

Lunar Fly-by 1

Separation from SLS

- ~1-2 additional lunar flybys to target departure
- Additional loitering possible for off-nominal launch dates
- Instrument calibration @Moon

- Minimum Ops, Periodic Tracking
- Rehearsal of science activities

- Minimum science success criteria addressed

- Slow target flyby
- Full success criteria addressed

- Sub-pixel imaging of target
- On-board image co-adding to achieve detection SNR
- Ephemeris and color addressed

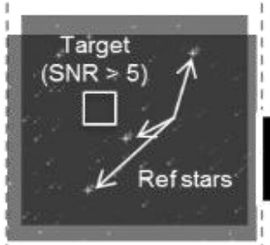
- <1 AU Earth dist.
- ~1 kbps DTE (34 m DSN)
- On-board science processing

- De-tumble
- Initial Health Check
- ~10m/s dV to target 1st lunar fly-by

- Sail deployment
- Sail characterization
- Maneuver to 2nd lunar fly-by

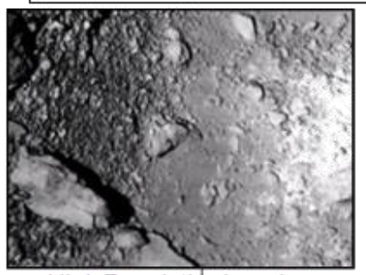

Instrument Calibration


Sail Characterization



Target Scan Imaging
(Image Stacking)


Imaging of the resolved target


High Resolution Imaging
(10 cm/pixel)


SLS EM-1 Launch


Earth

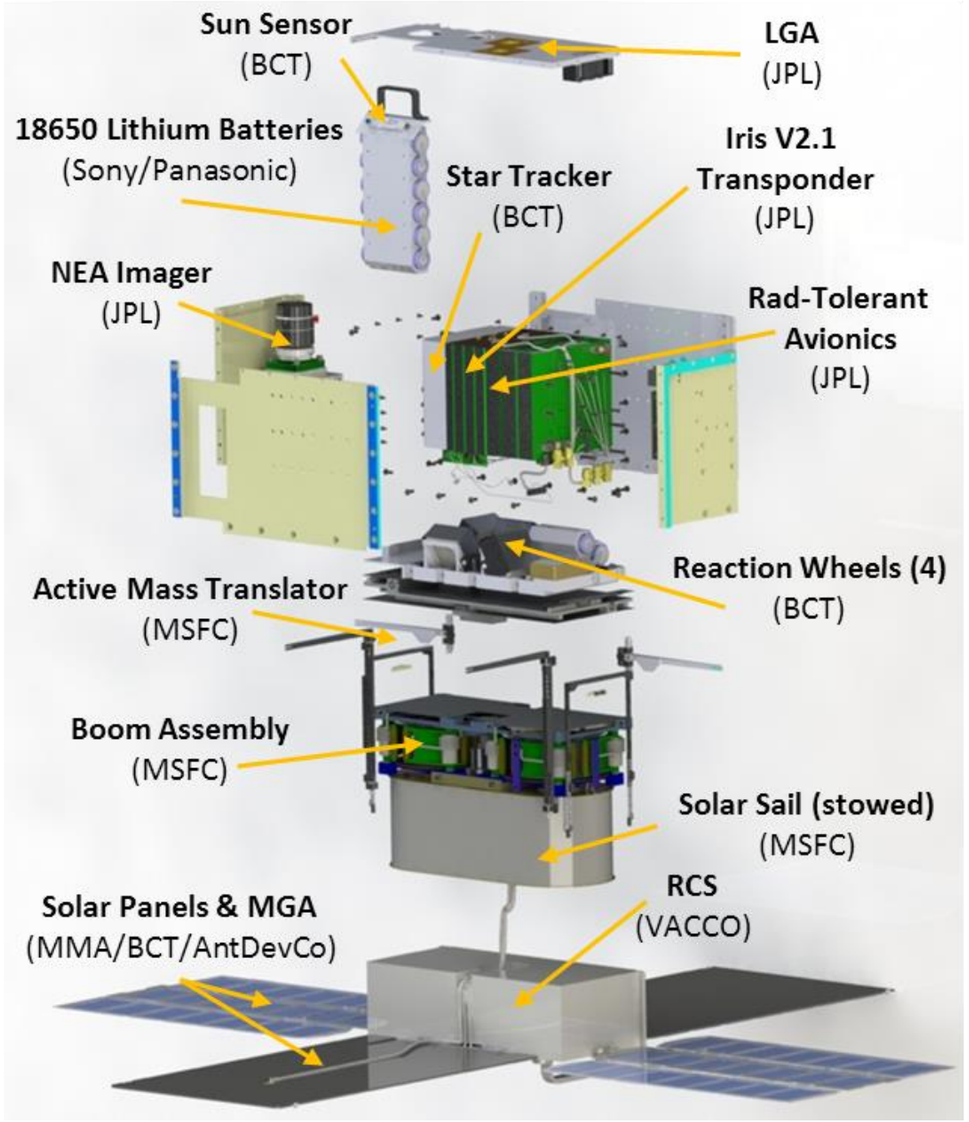
L+4 days | L+42 days | L+766 days | L+784 days | C/A~L+784days | L+810 days

Approximate time line

Deploy | Earth-Moon Departure | Cruise | Search/Approach | Recon | Proximity | Downlink

Flight System Overview

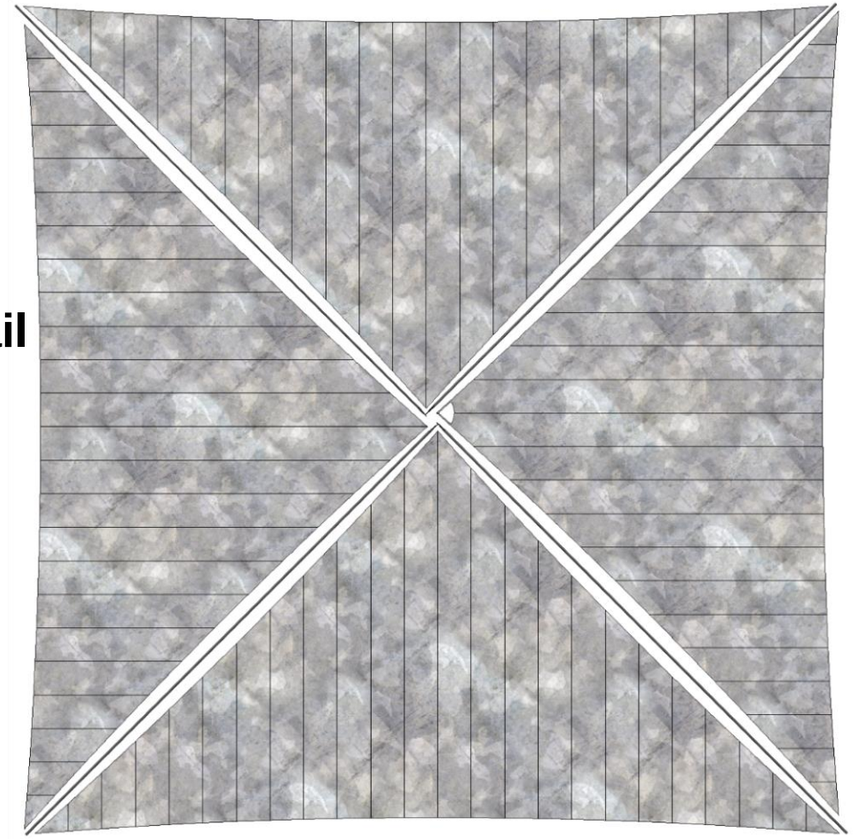
Payload	• Updated OCO3 Context Camera
Mechanical & Structure	• “6U” CubeSat form factor • <14 kg total launch mass • Modular flight system concept
Propulsion	• ~86 m^2 aluminized CP-1 solar sail (based on NanoSail-D2)
Avionics	• Radiation tolerant architecture
Electrical Power System	• Trifold deployable solar arrays with GaAs cells (~51.2 W EOL at 1 AU solar distance) • 6.2 Ah Battery • 10 -12.3 V unregulated, 5 V/3.5 V regulated
Telecom	• JPL Iris 2.1 X-Band Transponder; 4 W RF output power supports doppler, ranging, and D-DOR • 2 pairs of INSPIRE-heritage LGAs (RX/TX) • 8x8 element microstrip array MGA (TX); ~1 kbps to 34m DSN at 0.8 AU
Attitude Control System	• 15 mNm-s (x4) • Active mass translation system • VACCO R-236fa (refrigerant gas) Reaction Control System • Nano StarTracker, Coarse Sun Sensors & MEMS IMU for attitude determination



NEA Scout Approximate Scale

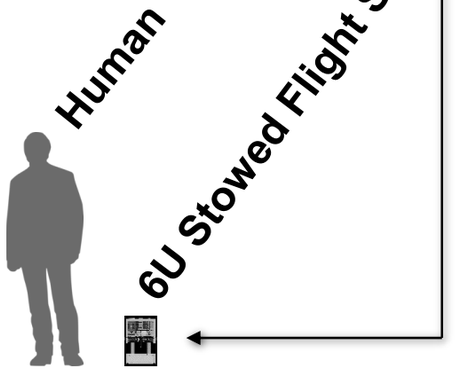
Credit: NASA MSFC

Deployed Solar Sail

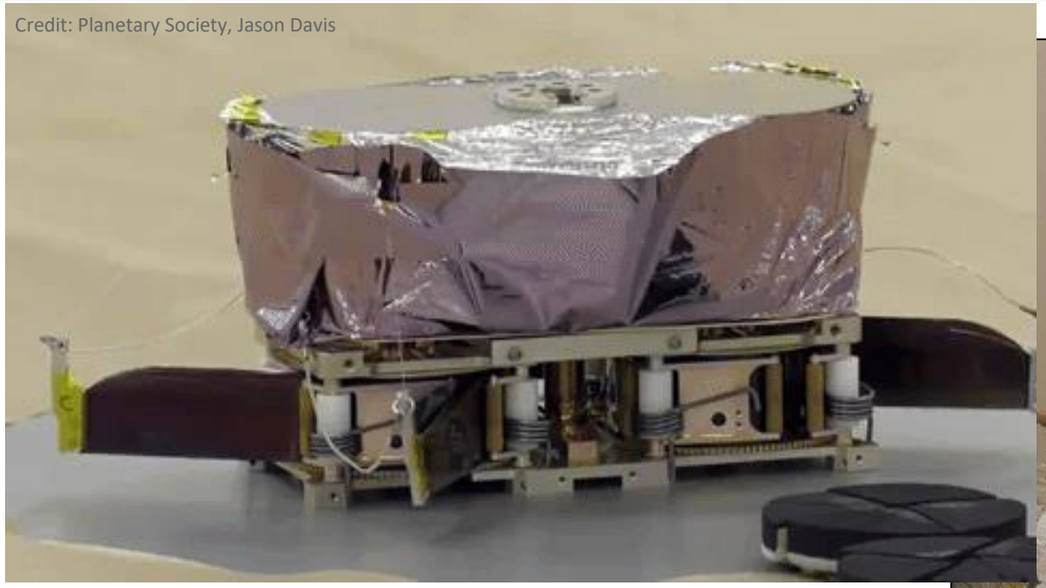


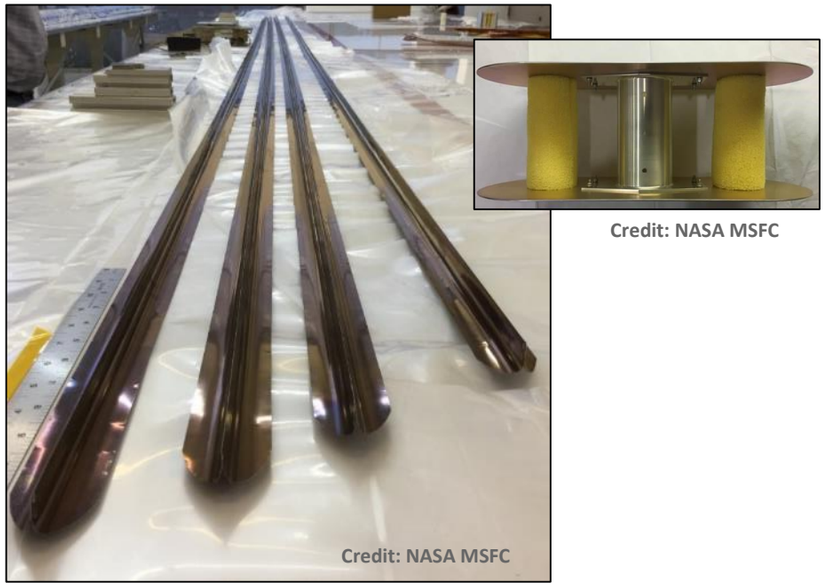
Folded, spooled and packaged in…

School Bus



Solar Sail Construction and Deployment


Credit: Planetary Society, Jason Davis


Credit: NASA MSFC

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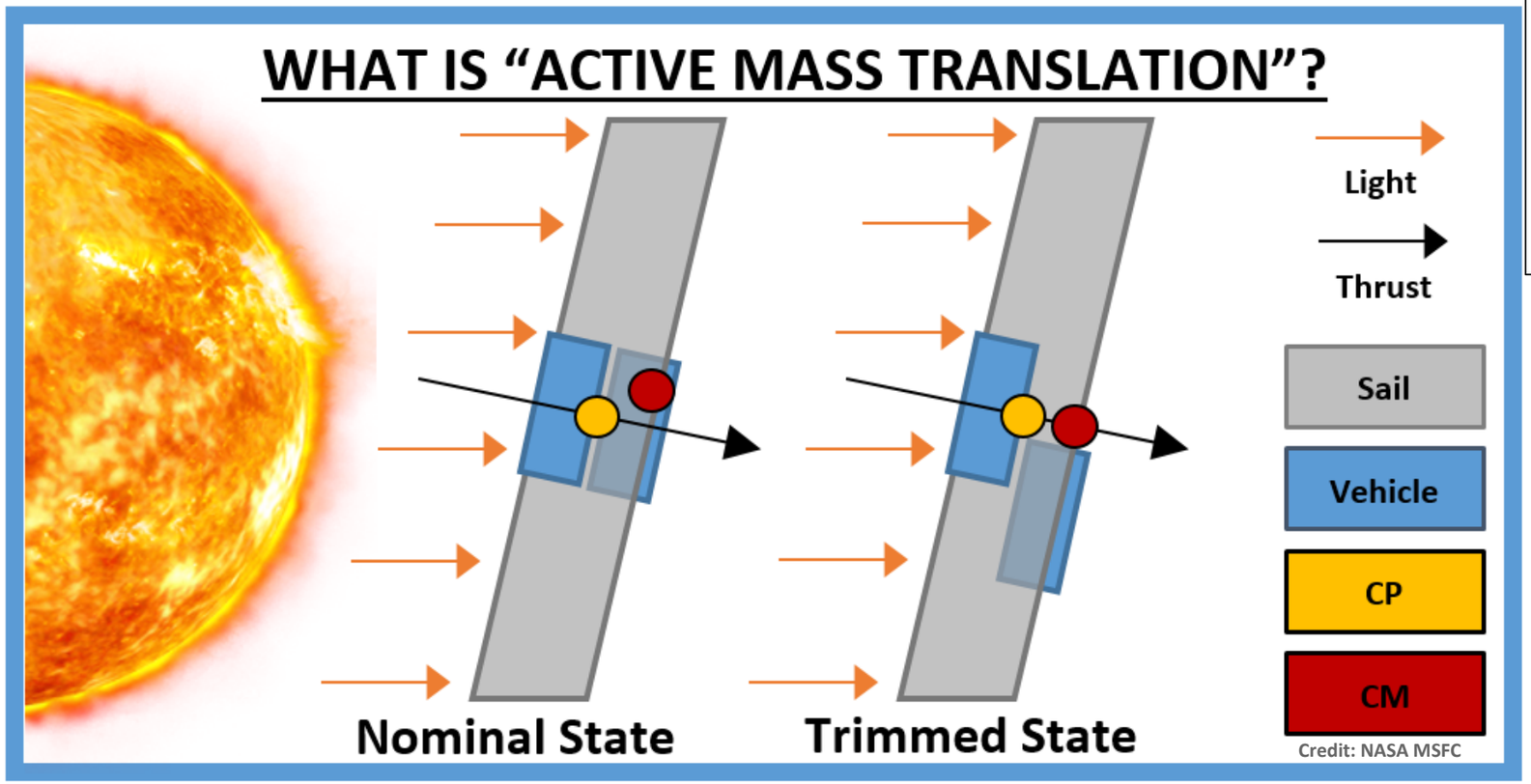
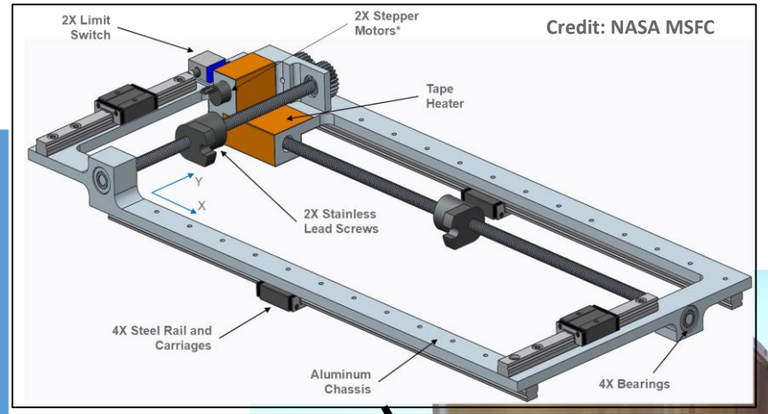
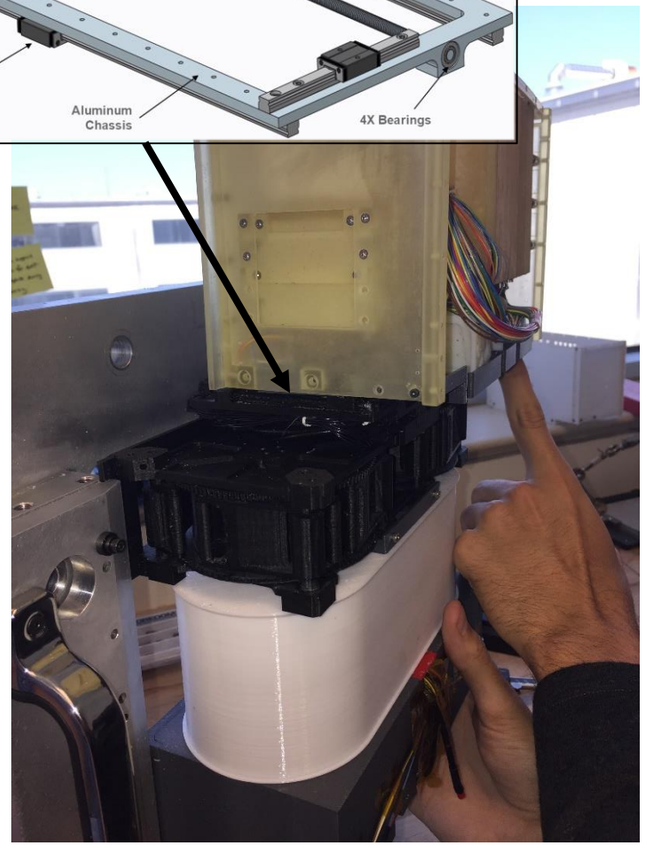
Active Mass Translator





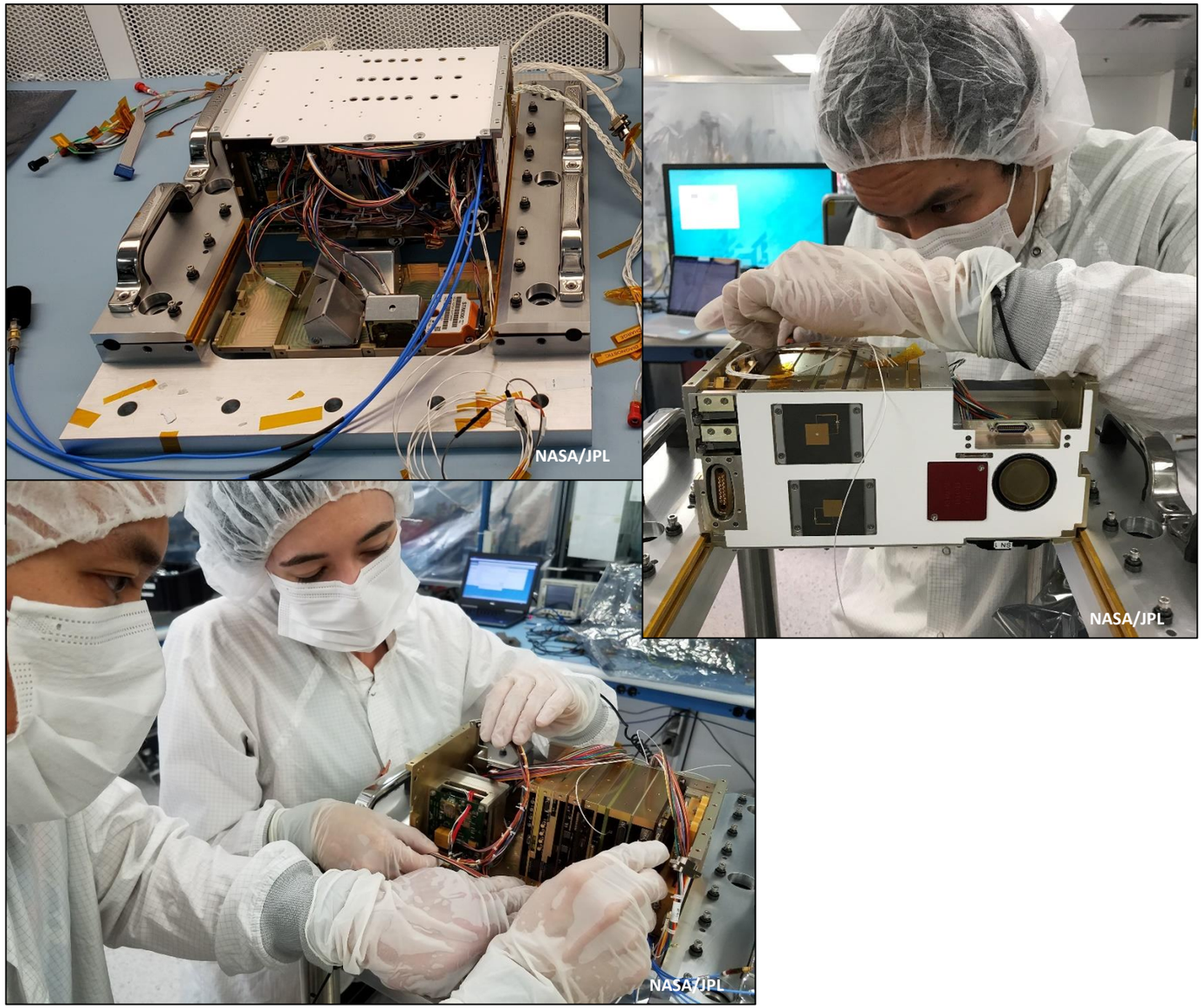


The AMT will move one portion of the NEA Scout relative to the other.
This translation of mass will alter the inertial properties of the vehicle and align the Center of Pressure (CP) and Center of Mass (CM)

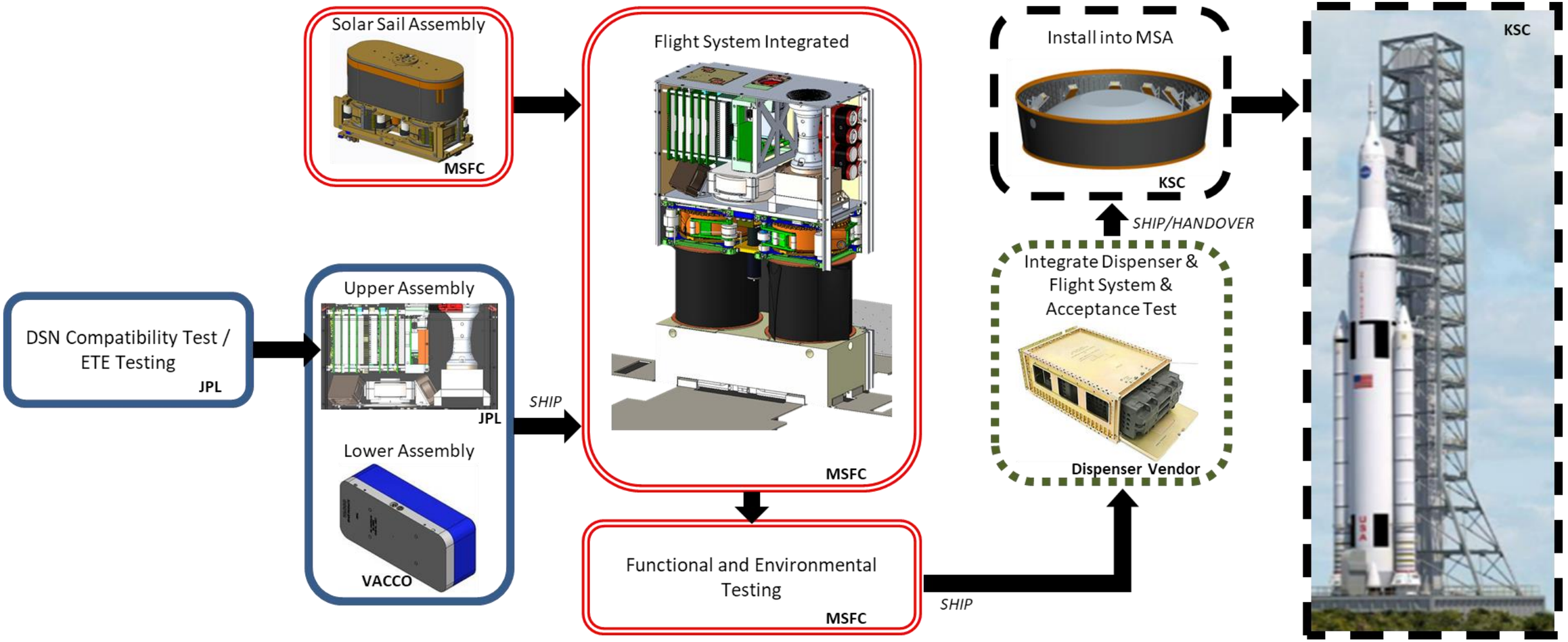
Check-out of AMT translation on a 3D printed model

Avionics Box Assembly and Testing

- All flight hardware in-hand
  - Camera
  - Iris radio (just passed DSN compatibility testing!)
  - Star tracker, reaction wheels, IMU, sun sensor
  - JPL Sphinx rad-hard processor
  - Custom interface board
  - EPS, battery
  - Interface board
  - Chassis
- Mechanical fit checks completed
- Final flight assembly and functional test campaign before delivery to full spacecraft integration (summer 2019)



Assembly, Integration, and Test (AI&T) Overview



Questions?