Near Earth Asteroid Scout: Exploring an Asteroid Using A Smallsat

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Solar Sail Missions Flown (as of October 2019)

- **NanoSail-D (2010)**
  - NASA
  - Earth Orbit
  - Deployment Only
  - 3U CubeSat
  - 10 m²

- **IKAROS (2010)**
  - JAXA
  - Interplanetary
  - Full Flight
  - 315 kg Smallsat
  - 196 m²

- **LightSail-1 (2015)**
  - The Planetary Society
  - Earth Orbit
  - Deployment Only
  - 3U CubeSat
  - 32 m²

- **CanX-7 (2016)**
  - Canada
  - Earth Orbit
  - Deployment Only
  - 3U CubeSat
  - <10 m²

- **InflateSail (2017)**
  - EU/Univ. of Surrey
  - Earth Orbit
  - Deployment Only
  - 3U CubeSat
  - 10 m²
Current and Planned Solar Sail Missions

**CU Aerospace (2018)**
Univ. Illinois / NASA

- **Earth Orbit**
- **Full Flight**
- **In Orbit; Not yet deployed**

- **3U CubeSat**
  - **20 m²**

**LightSail-2 (2019)**
The Planetary Society

- **Earth Orbit**
- **Full Flight**
- **In Orbit; Successful**

- **3U CubeSat**
  - **32 m²**

**Near Earth Asteroid Scout (2020)**
NASA

- **Interplanetary**
- **Full Flight**

- **6U CubeSat**
  - **86 m²**

**Solar Cruiser (2024)**
NASA

- **L-1**
- **Full Flight**

- **90 Kg Spacecraft**
  - **>1200 m²**
Near Earth Asteroid Scout

The Near Earth Asteroid Scout Will
• Image/characterize a NEA during a slow flyby
• Demonstrate a low cost asteroid reconnaissance capability

Key Spacecraft & Mission Parameters
• 6U cubesat (20cm X 10cm X 30 cm)
• ~86 m² solar sail propulsion system
• Manifested for launch on the Space Launch System (Artemis 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
Potential New Asteroid Target: 2013 WA44

- OCC = 3 (Observations possible in December 2020 to refine and improve)
- Approximate Size: 32m – 142m
- Rotational Period: ~21 minutes
- Flight Time: ~1.5 years
Near Earth Asteroid Scout Mission Overview

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

**Close Proximity Science**
- High-resolution imaging, 10/px over >30% surface
- SKGs: Local morphology, Regolith properties

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

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

Target

Reference stars
Flight System Overview

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<th>Payload</th>
<th>• Context Camera</th>
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| Mechanical & Structure | • "6U" CubeSat form factor  
|                 | • <14 kg total launch mass  
|                 | • Modular flight system concept |
| Propulsion      | • ~86 m² 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 2.0 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 (x3) & 100 mNm-s RWAs  
|                 | • Active mass translation system  
|                 | • VACCO R-236fa (refrigerant gas) ‘warm gas’ RCS system  
|                 | • Nano StarTracker, Coarse Sun Sensors & MEMS IMU for attitude determination |

A fully functional planetary spacecraft in a shoebox
NEA Scout Approximate Scale

Deployed Solar Sail

School Bus

Folded, spooled and packaged in here

Human

6U Stowed Flight System
NEA Scout’s center of mass (CM) and center of pressure (CP) are not collinear with the estimated thrust vector. This creates a *disturbance torque*. 
Assembly, Integration, and Test (AI&T) Overview

Solar Sail Assembly

Flight System Integrated

Upper Assembly

Lower Assembly

Functional and Environmental Testing

Install into MSA

Integrate Dispenser & Flight System & Acceptance Test

Dispenser Vendor

DSN Compatibility Test / ETE Testing

SHIP/HANDOVER

SHIP

SHIP