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Near-Earth Asteroid Scout

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Sponsoring Program(s)

Human Exploration and Operations Mission Directorate
Advanced Exploration Systems

Project Description

Near-Earth asteroids (NEAs) are easily accessible objects in Earth's vicinity. As NASA continues to refine its plans to possibly explore NEAs with humans, initial reconnaissance with comparatively inexpensive robotic precursors is necessary. Obtaining and analyzing relevant data about these bodies via robotic precursors before committing a crew to visit an NEA will significantly minimize crew and mission risk, as well as maximize exploration return potential. The NASA Marshall Space Flight Center (MSFC) and NASA Jet Propulsion Laboratory are jointly developing the Near-Earth Asteroid Scout (NEAS) utilizing a low-cost CubeSat platform in response to the current needs for affordable missions with exploration science value. The mission is enabled by the use of an 85-m^2 solar sail being developed by MSFC (figs. 1 and 2).

NEAS will be a secondary payload on the Space Launch System (SLS) Exploration Mission 1 (EM-1), the first planned flight of the SLS and the second uncrewed test flight of the Orion Multi-Purpose Crew Vehicle. The NEAS flight system is based on a '6U' CubeSat form factor, with a stowed envelope slightly larger than $10 \times 20 \times 30$ cm and a mass of <12 kg.

The solar sail propulsion system, the primary technology innovation to be flown on the spacecraft, is based on the successful NanoSail-D solar sail developed and flown by MSFC in 2010 (fig. 3). The sail system consists of four 7.3-m stainless steel booms wrapped on two spools (two overlapping booms per spool). The booms will pull the sail from its stowed volume as they deploy. The sail material will be 3 mm CP1, an aluminized polyimide.

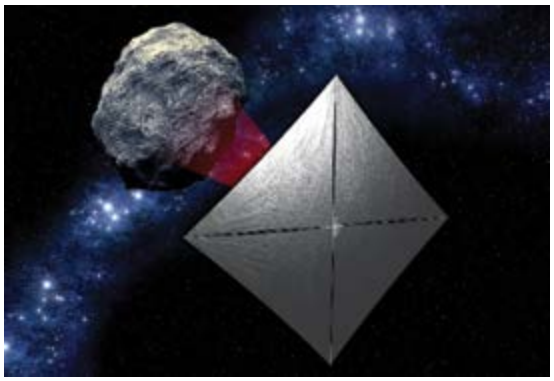

Figure 1: Artist concept of the NEAS encountering and imaging a near-Earth asteroid.

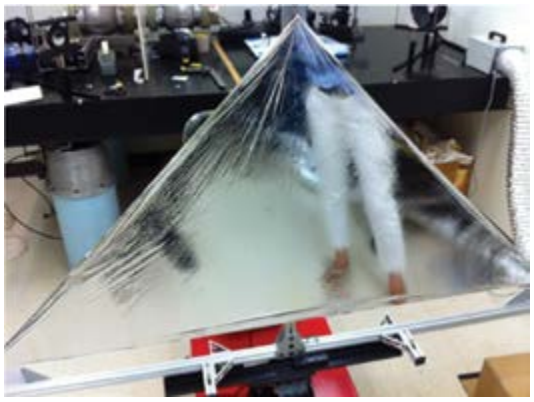

Figure 2: Reflectivity testing of the material that will be used to build the NEAS solar sail.

Figure 3: The fully deployed 10-m^2 NanoSail-D solar sail.

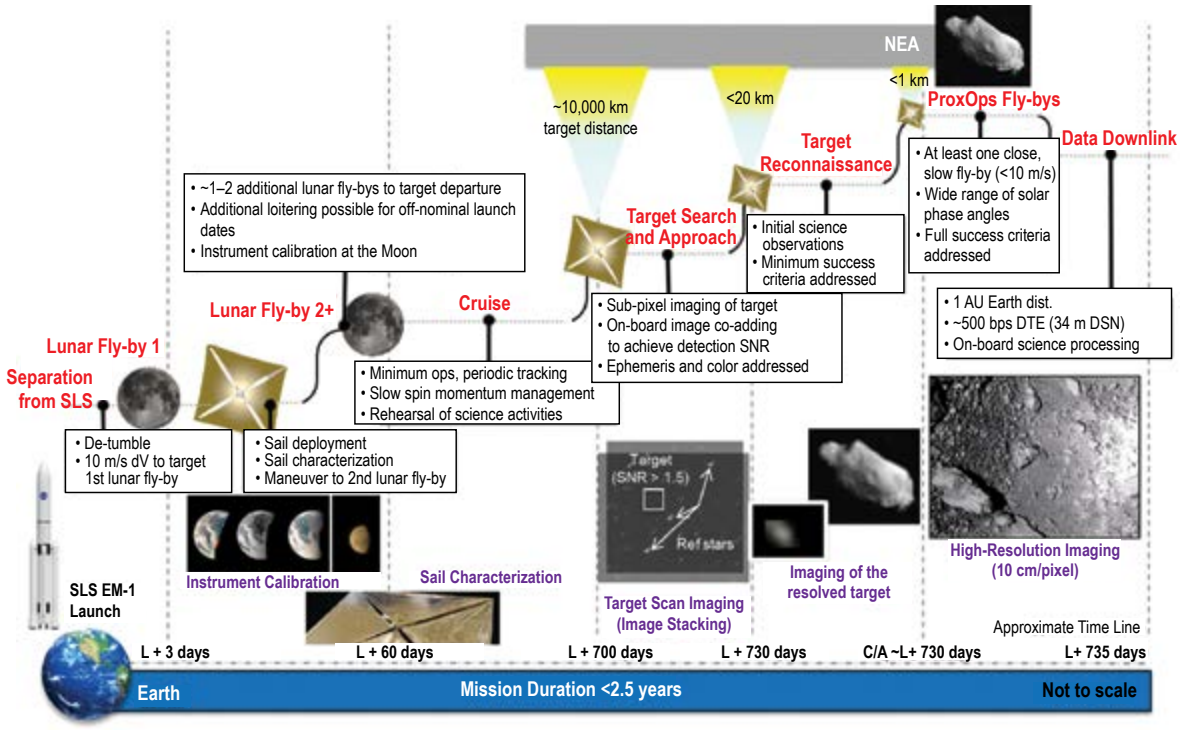

Figure 4: Summary of the concept of operations for NEAS.

Anticipated Benefits

NEAS will be a milestone for low-cost asteroid science with the exploration of the first NEA in the 1- to 100-m-size range. This class of object is poorly characterized due to the challenges that come with detecting, observing, and tracking small NEAs from Earth for extended periods of time. It has been thought that objects in the 1- to 100-m-size range are fragments of bigger objects. However, it has also been suggested that these objects could actually be rubble piles. Hence, the characterization of NEAs that are >20 m in diameter is also of great relevance to inform mitigation strategies for planetary defense. Finally, the NEAS's target still represents a relevant proxy whose characterization will help inform the planned Asteroid Redirect Mission.

Potential Applications

In developing a long-lived, deep-space capable nanosatellite bus and solar sail propulsion system, the NEAS flight system straddles the line between current interplanetary spacecraft and traditional Earth-orbiting CubeSats in terms of cost, risk, and capabilities. The NEAS solar sail propulsion system will also be used in the Advanced Exploration Systems Lunar Flashlight project that will use light reflected from the sail to search for volatiles at the lunar south pole. NEAS enables a novel way to explore near-Earth asteroids and the Moon, and paves the way for future low-cost planetary exploration.

Notable Accomplishments

NEAS successfully completed its Mission Concept Review and System Requirements Review in August 2014. Solar sail packaging was characterized, reflectivity testing was conducted, and the boom deployer system designed.

References

Alhorn, D.; Casas, J.; Agasid, E.; et al.: "NanoSail-D: The Small Satellite That Could," 25th Annual AIAA/USU Conference on Small Satellites, Ogden, UT, August 8–11, 2011.

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