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# Rapid Reconnaissance and Characterization of Potentially Hazardous Asteroids and Comets with Solar Sailcraft

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Rapid reconnaissance and characterization of asteroids and comets is one of the stated priorities for planetary defense in the 2023 decadal survey on planetary science and astrobiology[1]. Traditional asteroid reconnaissance spacecraft like OSIRIS-REx, Lucy, or Psyche have years long development cycle to launch, extensive post-launch trajectory arrival times, and cost hundreds of millions of dollars. With short warning times of a few years or less, that does not leave much time to develop a spacecraft, fly the mission, and collect necessary characterization data to inform mitigation activities and disaster planning accordingly. We propose the

use of an articulated vane solar sail spacecraft or sailcraft to accomplish an asteroid or comet reconnaissance mission as a flyby or rendezvous that would be faster to respond and cheaper to develop and operate compared to traditional spacecraft missions.

Sailcraft provide propellant free propulsion that can reach high velocity and short arrival times to inclined orbits that chemical or low thrust propulsion spacecraft cannot achieve in some cases. This new type of fractionated solar sail that has been under development for the past decade highlighting improved attitude control and less structural mass than the large sheet sailcraft designs. The flexibility of the mission design space is significant given the low overall sailcraft mass, allowing a constellation to be built and launched into station-kept orbits at several distances from the Sun for optimized rapid deployment toward a newly discovered asteroid. The sailcraft would perform routine scientific tasks at their respective heliocentric stations and configure into a rapid reconnaissance mission at the discovery of a new object.

In this paper we investigate several planetary defense rapid reconnaissance mission scenarios using simulated Earth impact asteroid and comet trajectories[2] with short warning times to determine how effective a sailcraft mission architecture is for timely flybys or rendezvous. We also discuss current sailcraft development, cost, and realistic added mission objectives to maximize the science return.

References:


1. National Academies of Sciences, Engineering, and Medicine. 2023. Origins, Worlds, and Life: A Decadal Strategy for Planetary Science and Astrobiology 2023-2032. Washington, DC: The National Academies Press. https://doi.org/10.17226/26522.

2. NASA Jet Propulsion Laboratory, “Hypothetical Impact Scenarios,” https://cneos.jpl.nasa.gov/pd/cs/


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