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Planetary Defense from Asteroids and Comets (1)

Author: Dr. Nancy Chabot
The John Hopkins University Applied Physics Laboratory, United States, nancy.chabot@jhuapl.edu

Dr. Justin Atchison
The John Hopkins University Applied Physics Laboratory, United States, justin.atchison@jhuapl.edu
Ms. Rylie Bull
Johns Hopkins University Applied Physics Laboratory, United States, Rylie.Bull@jhuapl.edu
Dr. Andrew Rivkin
The John Hopkins University Applied Physics Laboratory, United States, Andrew.Rivkin@jhuapl.edu
Dr. Terik Daly
The John Hopkins University Applied Physics Laboratory, United States, terik.daly@jhuapl.edu
Dr. Ronald Ballouz
Johns Hopkins University Applied Physics Laboratory, United States, Ronald.Ballouz@jhuapl.edu
Dr. Andy Cheng
The John Hopkins University Applied Physics Laboratory, United States, Andy.Cheng@jhuapl.edu
Dr. Olivier Barnouin
Johns Hopkins University Applied Physics Laboratory, United States, Olivier.Barnouin@jhuapl.edu
Dr. Carolyn Ernst
Johns Hopkins University Applied Physics Laboratory, United States, Carolyn.Ernst@jhuapl.edu
Dr. Angela Stickle
The John Hopkins University Applied Physics Laboratory, United States, Angela.Stickle@jhuapl.edu
Dr. Jodi Berdis
Johns Hopkins University Applied Physics Laboratory, United States, jodi.berdis@jhuapl.edu
Dr. Dawn Graninger
Johns Hopkins University Applied Physics Laboratory, United States, Dawn.Graninger@jhuapl.edu
Ms. Sarah Hefter
Johns Hopkins University Applied Physics Laboratory, United States, Sarah.Hefter@jhuapl.edu

# KEYNOTE: A MISSION TO DEMONSTRATE RAPID-RESPONSE FLYBY RECONNAISSANCE FOR PLANETARY DEFENSE

**Abstract**

The 2023 U.S. Decadal Survey for Planetary Science and Astrobiology recommended that "the highest priority planetary defense demonstration mission to follow DART and NEO Surveyor should be a rapid-response, flyby reconnaissance mission targeted to a challenging NEO, representative of the population ( 50-to-100 m in diameter) of objects posing the highest probability of a destructive Earth impact." This recommendation followed a 2017 recommendation from the United-Nations-endorsed Space Mission Planning Advisory Group that identified a 50-m-diameter object as the smallest for which a reconnaissance mission is recommended, and in 2021, the same guidance was adopted in the United States Report on Near-Earth Object Impact Threat Emergency Protocols. A 50-m object impacts the Earth roughly every thousand years, more frequently than larger objects, and is capable of local devastation with the potential for regional effects. Even following the successful completion of NEO Surveyor operations, roughly half of

the 50-m NEO population will be left undiscovered. As a result, 50-m impactors may not be found with long warning times, and a rapid-response flyby mission may be the only reconnaissance possible.

We have begun to use the high-level Decadal Survey recommendation to define the requirements for a planetary defense rapid-response flyby reconnaissance demonstration mission. As commonly noted in the community, in planetary defense, you don't pick the asteroid – the asteroid picks you. Thus, a planetary defense flyby reconnaissance demonstration mission is not about just flying by an asteroid, but rather it is about developing a robust capability for the objects that are most likely to require a short-warning-time, space-based response to provide critical information to decision makers. We use this overarching motivation to define four major requirements:

1. Enable a flyby of >90% of the potential asteroid threat population.
2. Demonstrate the flyby reconnaissance for a 50–100 m NEO.
3. Obtain the information needed to determine if and where the object would impact the Earth.
4. Determine key properties of the asteroid to inform decision makers.

Here we will share the driving requirements for the mission design, payload, and operations that are derived from these four overarching objectives. From this work, we anticipate that navigation may be one of the largest technical challenges for this concept, given the fast flyby speed, high approach solar phase angle, and small, potentially low-albedo, object. However, we don't have the luxury of choosing the asteroid, so addressing this challenge is necessary to advance our planetary defense preparedness capabilities.