

DART – The Double Asteroid Redirection Test Mission.

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Introduction: DART, the Double Asteroid Redirection Test, is NASA's first spacecraft mission that is dedicated to demonstrating a planetary defense mitigation technology. Managed by NASA's Planetary Defense Coordination Office, the mission's overall goal is to demonstrate kinetic impactor technology relevant to deflecting an asteroid if one were on a collision course with the Earth [1]. The target of the DART mission is the Didymos binary asteroid system, which is not a threat to the Earth but rather provides an ideal target for this first test. The DART spacecraft will impact the smaller 160-meter-diameter secondary member of the asteroid system, Dimorphos, changing its roughly 12-hour period about the larger primary asteroid by several minutes. An experimental test of a kinetic impactor was identified as the highest priority for a space mission in the mitigation area for planetary defense by the *Defending Planet Earth* report of the National Academies of Science [2]. This presentation will provide an overview of the DART mission, its planetary defense objectives, and upcoming major mission events in the next two years.

Mission Overview: The DART launch window opens in November of 2021, and the spacecraft will launch aboard a SpaceX Falcon 9 rocket from Vandenberg Space Force Base, California. The DART spacecraft will autonomously guide itself to impact Dimorphos in late September or early October of 2022, depending on the specific launch date and operational constraints. Prior to its kinetic impact, DART's imager DRACO (Didymos Reconnaissance and Asteroid Camera for Optical navigation) will constrain the shape of Dimorphos and capture high-resolution images of the impact site, streaming the images back to Earth throughout DART's approach to Dimorphos. LICIACube (Light Italian Cubesat for Imaging of Asteroids) [3], contributed by Agenzia Spaziale Italiana, will be released 10 days prior to impact and have its closest approach to Dimorphos about three minutes after DART's impact, obtaining images of the impact event and further characterizing Dimorphos' shape.

The key measurement of how much deflection was produced to Dimorphos' orbital path about Didymos by the DART impact will be made by telescopes on the Earth. The DART impact is purposely selected to occur in the fall of 2022, when the distance between Didymos and the Earth is minimized, enabling the highest quality telescopic observations [1]. This combination of a kinetic impactor spacecraft mission with key measurements obtained from existing Earth-based telescopes allows the DART mission be a highly focused, cost-effective approach for this first demonstration of planetary defense mitigation technologies.

International Planetary Defense Collaboration: DART is just one component of NASA's larger planetary defense program, and international cooperation and collaboration in planetary defense efforts are priorities of that strategy. ESA's Hera mission [4] is scheduled to rendezvous with the Didymos system in 2026, observing the crater produced by DART, measuring the mass of the deflected asteroid, and further advancing our knowledge of kinetic impactor technology to potentially one day avert an asteroid collision with the Earth.

References: [1] Rivkin A. S. (2021) *Planetary Science Journal*, in press. [2] National Research Council (2010) The National Academies Press, <https://doi.org/10.17226/12842>. [3] Dotto E. et al. (2021) *Planetary and Space Science*, 1999, <https://doi.org/10.1016/j.pss.2021.105185> [4] Cheng A. F. et al. (2018) *Planetary and Space Science* 157, 104-115.