National Aeronautics and Space Administration

DART

NASA'S FIRST PLANETARY DEFENSE TEST MISSION

The Double Asteroid Redirection Test (DART)

Developed and led for NASA by the Johns Hopkins Applied Physics Laboratory (APL) in Laurel, Maryland, DART demonstrated the planetary defense technique known as kinetic impact on September 26, 2022. The DART spacecraft, which launched on November 24, 2021, slammed into an asteroid and shifted its orbit, taking a critical step in demonstrating one way to protect our planet from a potentially hazardous impact.

DART's target was a binary asteroid system including Didymos (Greek for "twin"), about a half-mile across, and its smaller companion called Dimorphos (Greek for "two forms"), about 530 feet across. DART relied on an autonomous targeting system to aim itself at Dimorphos. The spacecraft, roughly the size of a vending machine, struck the smaller body at about 14,000 miles per hour. A ride-along CubeSat named LICIACube, built by the Italian Space Agency, separated from DART before impact to observe the collision. Telescopes on Earth and in space observed the asteroid system and measured the change in Dimorphos' orbit around Didymos. DART's impact altered Dimorphos' orbit around Didymos by 32 minutes, shortening the orbit to 11 hours and 23 minutes.

APL JOHNS HOPKINS APPLIED PHYSICS LABORATORY

Planetary Defense

On February 15, 2013, a meteor exploded over Chelyabinsk, Russia, creating an airburst and shockwave that struck six cities across the country — and sending a stark reminder that dangerous objects can enter Earth's atmosphere at any time. Astronomers estimate there are tens of thousands of near-Earth asteroids close to 500 feet wide and larger, big enough to cause regional devastation if they actually hit Earth. The Chelyabinsk object was just about 60 feet wide, demonstrating that even small asteroids can be of concern — and making real-world tests of space-based planetary defense systems all the more important.

The Impact

APL built the DART spacecraft and its single instrument, the Didymos Reconnaissance and Asteroid Camera for Optical navigation. Known as DRACO, the camera not only captured images of Didymos and Dimorphos, but also supported DART's onboard, APL-developed autonomous navigation capability, the Small-body Maneuvering Autonomous Real Time Navigation (SMART Nav) algorithms, to direct the spacecraft toward its target.

The flawless operation of those systems positioned DART to unleash a stream of important data. The last close-up images of Dimorphos' surface offer critical insight into the asteroid's structure and composition. The investigation team continues to use data from ground- and space-based observatories to analyze the "ejecta," or the tons of rock displaced and launched into space by the impact.

The recoil from the blast of debris substantially enhanced DART's push against Dimorphos — a little like a jet of air streaming out of a balloon sends the balloon in the opposite direction. And as new information comes in each day, astronomers can better assess whether, and how, a mission like DART could be used to help protect Earth from a collision with an asteroid if we ever discover one headed our way.

The last complete image of asteroid moonlet Dimorphos, taken by the DRACO imager on NASA's DART spacecraft approximately 7 miles (12 kilometers) from the asteroid and 2 seconds before impact. The image shows a patch of the asteroid that is 100 feet (31 meters) across. Dimorphos' north is toward the top of the image.

Credit: NASA/Johns Hopkins APL

The Team

Planetary defense is an international concern; that's why the DART team is drawing on expertise from around the world to evaluate the mission's results and enable planning for future planetary defense efforts.

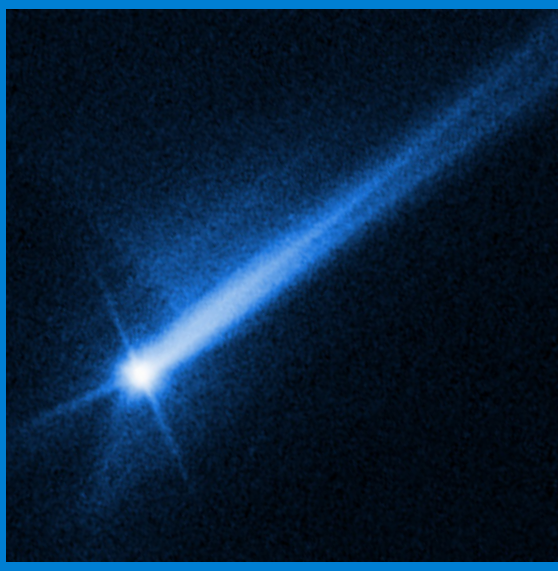
NASA's Planetary Defense Coordination Office supervises NASA-sponsored projects to find and characterize asteroids and comets that pass near Earth's orbit and coordinates development of techniques and technologies to respond to an identified impact threat. In addition to managing the mission and building and operating the DART spacecraft, APL is also coordinating the investigation team.

U.S. partner institutions include NASA Goddard Space Flight Center, Johnson Space Center, Langley Research Center, Glenn Research Center, Marshall Space Flight Center, Kennedy Space Center, and Launch Services Program; Jet Propulsion Laboratory; SpaceX; Aerojet Rocketdyne; Lawrence Livermore National Laboratory; Auburn University; Carnegie Science Las Campanas Observatory; University of Colorado; Las Cumbres Observatory; Lowell Observatory; University of Maryland; New Mexico Tech with Magdalena Ridge Observatory; Northern Arizona University; Planetary Science Institute; and U.S. Naval Academy.

For more information about DART, visit:

nasa.gov/planetarydefense/dart

dart.jhuapl.edu



Imagery from NASA's Hubble Space Telescope from Oct. 8, 2022, shows the debris blasted from the surface of Dimorphos 285 hours after the asteroid was intentionally impacted by NASA's DART spacecraft on Sept. 26. The shape of that tail has changed over time. Scientists are continuing to study this material and how it moves in space in order to better understand the asteroid.

Credits: NASA/ESA/STScI/Hubble

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