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Author: Dr. Andy Cheng
The Johns Hopkins University Applied Physics Laboratory, United States

DOUBLE ASTEROID REDIRECTION TEST: FIRST PLANETARY DEFENSE MISSION

Abstract

The NASA Double Asteroid Redirection Test (DART) mission will be the first space experiment to demonstrate asteroid deflection by a kinetic impactor. DART will impact Dimorphos, the secondary member of the (65803) Didymos system, in late September – early October, 2022 in order to change the binary orbit period. DART will carry to Didymos a 6U cubesat called LICIACube, contributed by the Italian Space Agency, to document the DART impact and to observe the impact ejecta. The ESA Hera mission will rendezvous with the Didymos system in late 2026, roughly four years after the DART impact. Hera will perform a detailed characterization, measure the mass of Dimorphos and image the DART impact crater. The Asteroid Impact and Deflection Assessment (AIDA) collaboration includes the DART, LICIACube, and Hera teams, with the objectives including support of international collaboration in planetary defense, demonstration and validation of the kinetic impactor technique, and improved understanding of the impact process and the momentum transfer by kinetic impact. DART is the first hypervelocity impact experiment on an asteroid at full scale relevant to planetary defense, where the impact conditions and the projectile properties are fully known.

DART will demonstrate asteroid deflection by kinetic impact, by hitting the moon Dimorphos of the Didymos system, changing the binary orbit, and measuring this deflection. The determination of momentum transfer efficiency for kinetic impact on an asteroid is an important planetary defense objective to improve modelling and simulation capabilities. The primary measurements of asteroid deflection made by the DART mission are the ground-based telescopic measurements of the orbital period change from the DART impact. In addition, the DART spacecraft observations consist of approach imaging to measure Didymos light curves to determine rotation and orbital characteristics, further approach imaging to measure the sizes and shapes of Didymos and Dimorphos, and terminal approach imaging to determine the impact site location and local surface geology. LICIACube will observe the structure and evolution of the DART impact ejecta plume and image the non-impact hemisphere of Dimorphos. We will present a status update for DART, currently in spacecraft integration and test preparing for launch in 2021, and discuss DART determinations of the momentum transfer efficiency and new modeling results of DART impact outcomes.