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Small Bodies Missions and Technologies (Part 2) (4B)

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THE ESA HERA MISSION TO THE NEAR-EARTH ASTEROID BINARY (65803) DIDYMOS: DOCUMENTATION OF THE NASA DART IMPACT AND FULL CHARACTERIZATION OF THE ASTEROID SYSTEM

Abstract

The Hera mission is in development within the ESA Space Safety Program for launch in October 2024. It will perform a rendezvous with the binary asteroid (65803) Didymos in early 2027 and investigate it over 6 months.

ESA's Hera mission, with NASA's DART mission, will offer the first fully documented asteroid deflection test. DART successfully impacted Dimorphos, the 151 meter-sized moon of Didymos on 26 September 2022. The DART impact resulted in a decrease of 33 minutes from the original 11 hour 55 minute orbital period of Dimorphos around Didymos.

Although the DART mission was extremely successful, many questions remain about the interpretation of its outcome and the full validation of the numerical impact models: (1) What's Dimorphos' mass? Mass is needed for an actual determination of DART momentum transfer efficiency. (2) Is Dimorphos a monolith covered with gravel and boulders or an aggregate? This has great influence on the interpretation of the DART impact outcome. (3) What's Dimorphos' final state, i.e., what's the size of the crater left by the DART impact or was Dimorphos globally or in large parts reshaped ? (4) What's the final binary system's dynamical state? All this knowledge is crucial to fully validate numerical impact models aimed at reproducing the impact and to have an unbiased interpretation of the DART impact outcome.

Answering these questions is the goal of Hera that will perform the first asteroid binary rendezvous. With its mother-spacecraft, which carries five instruments including a thermal-IR imager from JAXA, and its two Cubesats, Juventas and Milani, it will measure the DART impact outcome in great detail, including the crater properties and/or Dimorphos' shape change as well as Dimorphos' mass, from which the transferred momentum can be precisely determined. It will measure Dimorphos' compositional and physical characteristics that play a significant role in its impact response. With the low-frequency radar JuRa onboard Juventas, the first measurements of subsurface and internal properties will be performed. Moreover, Hera will perform the first Cubesat landing on such a small body, providing information on the surface mechanical response in its very low gravity environment. Hera will also answer key questions regarding the formation of small asteroid binaries and small body geophysics.

The mission development is ongoing nominally and the various working groups of the Hera Science Team are working intensively, adjusting their investigations to account for the new and important knowledge provided by DART and LICIAcube data.