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THE ESA HERA MISSION TO THE NEAR-EARTH ASTEROID BINARY DIDYMOS: PLANETARY DEFENSE AND SCIENCE RETURN

Abstract

The Hera mission is under development in the ESA Space Safety Program for launch in 2024. Hera will contribute to the first deflection test of an asteroid, in the framework of the international NASA- and ESA-supported Asteroid Impact and Deflection Assessment (AIDA) collaboration.

The impact of the NASA DART spacecraft on the natural satellite called Dimorphos of the binary asteroid 65803 Didymos in late September 2022 will change its orbital period around Didymos. As Didymos is an eclipsing binary, and close to the Earth on this date, the change can be detected by Earth-based observers. Before impact, DART will deploy the Italian LICIACube that will provide images of the first instants after impact. ESA's Hera spacecraft will rendezvous Didymos four years after the impact. It will perform the measurements necessary to understand the effect of the DART impact on Dimorphos, in particular its mass, its internal structure, the direct determination of the momentum transfer and the detailed characterization of the crater left by DART.

Hera will also provide unique information on many current issues in asteroid science. In fact, each space mission to an asteroid, whether its requirements are driven by planetary defense, science or mining objectives, has a science return that is always extremely high. The reason is that our knowledge of these fascinating objects is still very poor, especially for the smallest ones.

The recent data obtained by the JAXA Hayabusa2 and NASA OSIRIS-REx missions have revolutionized our understanding of carbonaceous-type Near-Earth Objects. Hera has definitely the potential to do similar as it will rendezvous for the first time with a binary asteroid. Its secondary has a diameter of only 160 m in diameter. So far, no mission has visited such a small asteroid. Moreover, for the first time, internal and subsurface properties will be directly measured. From small asteroid internal and surface structures, through rubble-pile evolution, impact cratering physics, to the long-term effects of space

weathering in the inner Solar System, Hera will have a major impact on many fields. How do binaries form? What does a 160 m-size rock in space look like? What are its internal properties? And what will be the size and the morphology of the crater left by DART, which will provide the first impact experiment at full asteroid scale using an impact speed close to the average speed between asteroids? These questions and many others will be addressed by Hera as a natural outcome of its investigations focused on planetary defense.

Hera is thus an amazing European contribution to the international planetary defense and asteroid exploration era.

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