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The science return of the ESA Hera mission to the binary asteroid Didymos

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The Hera mission has been approved for development and launch in the new ESA Space Safety Programme by the ESA Council at Ministerial Level, Space19+, in November 2019. Hera will both offer a high science return and 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 (Doube Asteroid Redirection Test) spacecraft on the natural satellite of Didymos in October 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. ESA's Hera spacecraft will rendezvous Didymos four years after the impact. Hera's instruments will perform the measurements necessary to understand the effect of the DART impact on Didymos' secondary, in particular its mass, its internal structure, the direct determination of the momentum transfer and the detailed characterization of the crater left by DART. This new knowledge will also provide unique information on many current issues in asteroid science.

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. For instance, collisions play a fundamental role in our Solar System history, from planet formation by collisional accretion to cratering of solid surfaces and asteroid family formation by collisional disruption. The fully documented hypervelocity impact experiment provided by DART and Hera will feed collisional models with information obtained at actual asteroid scale and for an impact speed (~6 km/s) that is close to the average impact speed between asteroids in the main belt. Moreover, Hera will perform the first rendezvous with an asteroid binary, characterize the smallest object ever visited (165 m in diameter) and provide the first direct measurement of an asteroid interior. Additionally, studies using Hera data will in turn affect our understanding of the asteroid population as a whole. The scientific legacy of the Hera mission will extend far beyond the core aims of planetary defense.

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