THE ESA HERA MISSION TO THE BINARY ASTEROID (65803) DIDYMOS: READY FOR LAUNCH IN OCTOBER 2024.
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Introduction: The Asteroid Impact and Deflection Assessment (AIDA) international cooperation supports the development and data interpretation of the European Space Agency's (ESA) Hera mission [1] and the NASA's DART mission [2], which offer the first fully documented asteroid deflection test aimed at advancing our understanding of planetary defense against potential asteroid impacts. Following the success of the DART impact on Dimorphos [3], the smaller component of the binary asteroid (65803) Didymos, on September 26, 2022, Hera will be launched in October 2024 from Cap Canaveral, with a Falcon 9 launcher from the company Space X. It will arrive at Didymos in October 2026, and will start its 6 months investigation of the asteroid in December 2026.

Objective: The primary objective of the Hera mission is to study the aftermath of the kinetic impactor demonstration carried out by NASA's DART on the binary asteroid system Didymos, consisting of the primary body (approximately 780 meters in diameter) and its moonlet, Dimorphos (approximately 150 meters in diameter). By conducting a detailed analysis of the local and/or global changes on Dimorphos due to the impact and measuring the efficiency of the deflection caused by DART, Hera aims to enhance our comprehension of the fundamental processes governing asteroid impacts and dynamics.

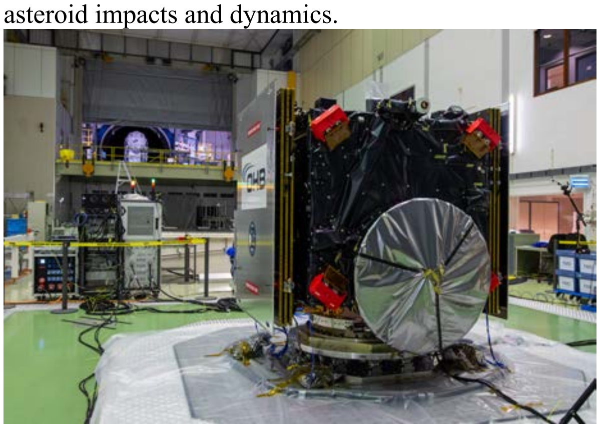

Figure 1: The Hera spacecraft at ESTEC on the Test Centre's 640kN QUAD shaker, whose metal plate is moved vertically by a quartet of water-cooled electrodynamic shakers. The forward-facing side of Hera hosts the mission's 1.13-m-diameter main antenna. Also seen are four of the red-tag-covered thrusters found on all corners of the spacecraft, which will manoeuvre Hera through space (Copyright: ESA-SJM Photography).

Scientific Instruments: Hera is equipped with two asteroid framing cameras (AFCs), a hyperspectral imager (Hyperscout), a thermal infrared imager provided by JAXA (TIRI), a laser altimeter (PALT) and a monitoring camera that will observe the deployment of the two Cubesats called Juventas and Milani, which are carried by Hera to perform investigations at closer proximity before eventually landing on the small moon. Milani is equipped with a near-infrared imager (ASPECT) and a dust detector and analyzer (VISTA), while Juventas carries a low-frequency radar (Jura) that will measure for the first time the internal properties of an asteroid, and a gravimeter (GRASS). A Radio Science Experiment (RSE) and an Inter-Satellite Link (ISL) will contribute to the determination of the mass and gravity field of Dimorphos, which is key to measure the momentum transferred by the DART impact. The instruments are designed to capture detailed images of the asteroid's surface, analyze its composition, its interior and map the topography with high accuracy. Furthermore, Hera's payload will facilitate the collection of crucial data on the asteroid's rotational dynamics.

A mission of "firsts": Hera will perform the first rendezvous with a binary asteroid, the first internal probing of a small asteroid using radar techniques and the first landing of a Cubesat on an asteroid as small as 150 meters in diameter. It will also, for the first time, measure in detail the outcome of an impact experiment in an impact energy regime at asteroid scale. The 6 months of investigation promise to provide breakthroughs in our understanding of the geophysics and behavior of small asteroids, as well as binary asteroid formation.

Significance in Planetary Defense: Understanding the dynamics of asteroid deflection is paramount for developing effective strategies to mitigate potential Earth impact threats. The Hera mission, as a follow-up to DART, contributes vital data to refine models predicting the behavior of kinetic impactors. This information is invaluable for assessing the efficiency of asteroid deflection techniques and informing future planetary defense initiatives. Furthermore, the Hera mission underscores the importance of international collaboration in addressing such a global problem. By joining forces with NASA's DART mission, the Hera mission exemplifies the cooperative spirit required for advancing our scientific knowledge and developing practical solutions to protect our planet from potential asteroid hazards.

Conclusion: Hera represents a significant leap forward in the field of planetary defense, offering a unique opportunity to study the effects of a kinetic impact on an asteroid system. The insights gained from Hera's observations will not only deepen our understanding of asteroid geophysics and dynamics but also contribute to the ongoing efforts to safeguard our planet from potential cosmic threats.

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References: [1] P. Michel et al. (2022) *Planet. Sci. J.*, 3, 160. [2] A. S. Rivkin et al. (2021) *Planet. Sci. J.*, 2, 173. [3] A. F. Cheng et al. (2023) *Nature,* 616, 457-460.