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Ongoing and Upcoming Mission Highlights

The payload and operations of the Hera mission

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ABSTRACT

On 26 September 2022, NASA's DART mission [1] successfully impacted on Dimorphos, the secondary of the binary asteroid Didymos. DART released the Light Italian Cubesat for Imaging of Asteroids (LICIACube) two weeks before the impact, and LICIACube flew by the asteroids three minutes after the impact. On approach, DART took images of both asteroids, which, supported by additional imagery from LICIACube, characterized the pre-impact state of the Didymos system. DART changed the orbit of Dimorphos around Didymos, reducing its orbital period by 33 minutes.

DART will be followed by a detailed investigation of the Didymos system and the outcome of the impact by ESA's Hera mission [2]. Hera will be launched in October 2024 and arrive at Didymos in early 2027. The presentation will focus on the payload of the Hera mission and the operations at the asteroid system.

The main objectives of the Hera mission are to:

- Measure the mass of Dimorphos to accurately measure the momentum transfer efficiency of the DART impact.
- Characterise the change of the surface of Dimorphos by DART, including the properties (and existence!) of the DART crater, to improve our understanding of impact physics and to observe unweathered material, recently exposed at the surface.
- Determine the physical properties of Dimorphos, including its internal structure, to allow scaling of the impact to different types of asteroids.
- Measure the dynamical and physical state of the Didymos and Dimorphos system to constrain binary formation scenarios.

Hera is equipped with the following payload:

1. Two Asteroid Framing Cameras (AFCs) for both science and navigation. There resolution is ~10^{-4} rad/pixel, or 40 cm/pixel for close observations from 4 km. They will provide the target global properties as well as local geomorphology and will investigate the crater and impact site. They will also measure the mass of Dimorphos through the “wobble” motion of Didymos.
2. The Planetary ALTimeter (PALT) will measure the distance to the target and shape and topography information complementary to that from AFC images.
3. The Thermal InfraRed Imager (TIRI) will provide information about the thermal properties of the Didymos system and spectral information in the mid-infrared (6 bands from 7 – 14 μm).
4. The Hyperscout-H hyperspectral imager will provide mineralogical information from 25 spectral bands between 665 and 975 nm.
5. Milani, a 6 unit cubesat, will carry a visible to near-IR imaging spectrometer (ASPECT, 500 – 2500 nm) to derive mineralogical information on the composition of the asteroids, and a thermogravimeter (VISTA) to measure the abundance and constrain the composition of ambient dust particles.
6. Juventas, a 6 unit cubesat, will carry a monostatic low-frequency radar (JuRa), and a gravimeter (GRASS) to derive interior and surface properties of the asteroids.
7. The Radio Science experiment will measure the gravity field of the Didymos system. Measurements of the acceleration of the Hera spacecraft by the asteroid pair through the radio link between Earth and Hera will be used as well as the inter-satellite link between Hera and the two cubesats.

We will describe how the goals of Hera will be achieved with the different payload elements.

References

[1] Rivkin A. et al. 2021. Planetary Science Journal 2:173.
[2] Michel P. et al. 2022. Planetary Science Journal 3:160.

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