The ESA Hera Mission: Four Months Before Arrival to the Binary Asteroid Didymos

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The ESA Hera mission [1] is the European contribution to the first asteroid deflection test with the NASA DART mission. The DART probe successfully impacted Dimorphos, the small moon of the binary asteroid Didymos, on September 26, 2022. The orbital period modification of Dimorphos around Didymos, measured by ground-based observatories, was reduced by 33 minutes from its original value of 11h 55 min. The Italian LICIACube obtained some images of Dimorphos within the first few minutes following impact. However, we still do not know Dimorphos' final properties, modified by this impact, because no other spacecraft remained long enough in close proximity to collect such observations. Is there a crater on Dimorphos' surface, and if so, what are its properties? Or, was Dimorphos entirely reshaped? Answers to these questions are crucial for numerical simulations of the DART impact, required to reproduce these final properties to be validated as well as for our general understanding of the impact response of such objects in low-gravity regimes.

Hera will, therefore, perform the investigation starting in November 2026 for at least 6 months. Although we already have images of Dimorphos before impact thanks to DART, we are confident that the images that Hera will take of the same body will have little similarity with those already obtained. This is because an impact with likely global effects took place. Furthermore, Didymos, the primary of the binary system may also look very different compared to pre-DART impact images. It is expected that some fraction of the ejecta from Dimorphos impacted Didymos, which may have modified its morphology and surface properties. Hera will, therefore, reveal an entirely new world, transformed by an event aimed at protecting us from an incoming asteroid, allowing us to assess the efficiency of the kinetic impactor technique. Thanks to its main spacecraft and its two cubesats, we will have detailed knowledge of the system, from the surface to the interior of the two components, including the composition and thermal properties through a spectrometer and a JAXA-contributed thermal infrared imager.

So far, all newly obtained data of asteroids from previous missions have revealed some surprises [2]. Four months before arrival, it is fair to suggest that Hera will also surprise us and will challenge our understanding of these small worlds.

References

[1] Michel P., et al., *Planetary Science Journal* **2022**, *3*, 160-180.
[2] Michel P., et al., *Space Science Reviews* **2025**, *221*, 270.

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