

The ESA Hera mission: detailed investigation of the NASA DART impact outcome and characterization of the binary asteroid Didymos

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The Hera mission is in development in the Space Safety Program of the European Space Agency (ESA) for launch in October 2024 [1]. It will perform a rendezvous with the binary asteroid (65803) Didymos in early 2027 and over 6 months, it will investigate it as well as the outcome of the successful impact of the NASA DART probe on the small moon called Dimorphos of the Didymos system.

DART was launched on 24 November 2021 at 06:21 UTC and successfully performed an impact at about 6.1 km/s on the 160 meter-size Dimorphos on 26 September 2022 at 23:14 UTC. Two weeks before impact, it deployed the Italian LICIAcube that provided images of the few minutes following the impact. A campaign of observations from Earth and space allowed obtaining distant images of the event and is aimed at measuring the change of the orbital period of Dimorphos around Didymos resulting from the impact.

The great success of the DART impact will be left with many questions. In particular, we need to know the outcome of the impact on Dimorphos' surface, e.g., whether it produced a crater and its size and/or whether it led to a global reshaping of Dimorphos. We also need an accurate measurement of the mass of Dimorphos, which will allow quantifying the momentum enhancement factor, which is a crucial parameter to validate the kinetic impactor technique. We also need to determine in detail the physical, thermal and compositional properties of the asteroid, including for the first time internal properties, which have a great influence on the impact outcome. These are the objectives of the Hera mission, which will allow, with the knowledge provided by DART, having a fully documented deflection test and impact experiment to check our numerical impact models, to be able to extrapolate this deflection test to other scenarios and to improve our understanding of the complex geological properties and response of small asteroids.

To accomplish these objectives, with its mother spacecraft, which includes a JAXA contribution with the Thermal Infrared Imager, and its two cubesats, Hera will perform the first rendez-vous with a binary asteroid, arriving at Didymos about 4 years after DART. Hera will not only contribute greatly to the planetary defense effort by documenting entirely the DART impact, so that numerical impact models can be validated at the real asteroid scale and so that this knowledge can be extrapolated to other scenarios. It will also contribute greatly to our understanding of asteroid processes in the very low gravity regime of a very small asteroid (Dimorphos) as well as to our knowledge of binary asteroids and asteroid geophysics. The mission development is ongoing nominally and the various working groups of the Hera Science Team are working intensively to support this development and be best prepared to the surprises that Hera will offer during its visit to Didymos in 2027.

References

[1] Michel P. et al. 2022. Planetary Science Journal 3:160.

Acknowledgments

We acknowledge funding support from the European Union's Horizon 2020 research and innovation program under grant agreement No. 870377 (project NEO-MAPP), the CNRS through the MITI interdisciplinary programs, CNES and ESA.