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Exploration of the binary asteroid 65803 Didymos by the Hera mission

Michael Küppers (1), Patrick Michel (2), Ian Carnelli (3), Paolo Martino (4) and the Hera Team
(1) ESA-ESAC, Villanueva de la Cañada, Spain (michael.kueppers@sciops.esa.int (2) Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, Laboratoire Lagrange, France (3) ESA HQ, Paris, France, (4) ESA-ESTEC, Noordwijk, The Netherlands

Abstract

Hera is ESA's contribution to the international Asteroid Impact Deflection Assessment (AIDA) cooperation, targeting the demonstration of deflection of a hazardous near-earth asteroid [1,2]. Hera will also be the first in-depth investigation of a binary asteroid and make measurements that are relevant for the preparation of asteroid resource utilisation. Hera is foreseen to rendezvous with the binary near-Earth asteroid (65803) Didymos in 2026, four years after the impact of NASA's Double Asteroid Redirection Test (DART) spacecraft.

1. Introduction

Hera is a small mission of opportunity whose primary objective is to observe the outcome of a kinetic impactor test and thus, to provide extremely valuable information for possible future mitigation of the impact of a hazardous asteroid [1]. It is part of the Asteroid Impact & Deflection Assessment (AIDA) mission, in which the second component is the NASA Double Asteroid Redirection Test (DART) mission, which aims to send an artificial projectile to perform an asteroid deflection test [2]. The outcome will be observed by a cubesat provided by the Italian Space Agency (ASI) and carried to the target asteroid by DART, from ground-based observatories and from later observations by Hera during its rendezvous mission with the target asteroid. AIDA will thus be the first test ever to use a kinetic impactor to deflect an asteroid. The AIDA target is the binary Near-Earth Asteroid (NEA) (65803) Didymos (1996 GT), in particular the secondary component and target of the DART mission, called hereafter Didymoon. Here we discuss the Hera mission, an updated version of the Asteroid Impact Mission (AIM), originally proposed to be at Didymos during the DART impact.
An overview about the Hera mission scenario is given in Figure 1.

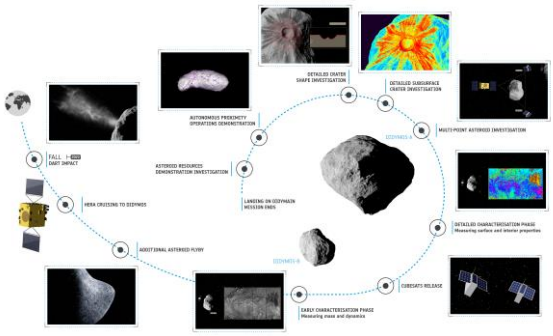

Figure 1: Overview of the Hera mission scenario

2. Exploration of Asteroid Didymos by the Hera mission

Hera will monitor Didymos for several months, accurately measuring its dynamical state and completely mapping the surface with the Asteroid Framing Cameras (the flight spares of the Framing Cameras of the Dawn mission, [3]) and the European Lidar payload. Those instruments will also measure the mass of Didymoon, from the "wobble" motion of Didymos due to the gravity of Didymoon. Radio science, utilizing spacecraft hardware, will gain additional information about the gravity field of both asteroids. A thermal imager will support the investigations of the cameras and provide thermal properties of the target. Hera will additionally carry two 6U cubesats, with three instruments each. The Asteroid Platform Explorer (APEX) cubesat will carry the ASPECT visible and near-IR imaging spectrometer. It will allow the spectral characterisation of the targets, testing hypotheses of the origin of the binary. Observations of fresh, unweathered material in the DART impact crater will uniquely determine the meteorite analogue of Didymos. In addition, APEX will be equipped with a volatile analyser, investigating the elemental

composition of sputtered material from the surface of the asteroids, and a magnetometer searching for any remnant magnetisation. The instrumentation of the second cubesat, Juventas, includess a monostatic radar, designed to constrain the interior structure of both asteroids, providing valuable information for the interpretation of the deflection experiment and testing binary formation models. Finally, as the cubesats are foreseen to land or bounce on Didymoon towards the end of their mission, Juventas will carry accelerometers and a gravimeter to determine local gravity and the surface properties at the landing site.

References

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