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Planetary Defense from Asteroids and Comets (1)

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THE HERA MILANI MISSION

Abstract

Hera is the European part of the Asteroid Impact Deflection Assessment (AIDA) internationalcollaboration with NASA who is responsible for the DART (Double Asteroid Redirection Test)kinetic impactor spacecraft. Hera will belaunched in October 2024 and will arrive late 2026.The Hera mothercraft will accommodate two 6U CubeSat, Milani and Juventas. The Milani CubeSat is developed by Tyvak International leading a consortium of European Universities, Research Centers and Firms from Italy, Czech Republic, Finland. During the cruise to the Asteroid (+2 years), Milani CubeSat will be hosted inside the Hera mothercraft. At arrival it will be deployed and commissioned while Hera is performing the Dydymos detailed characterization phase, at about 10 to 20km distance from the asteroid. The Milani mission objectives are defined as to add scientific value to the overall Hera mission: i) Map the global composition of the asteroid, ii) Characterize the surface of the asteroid, iii) Evaluate DART impacts effects on asteroid and support gravity field determination, iv) Characterize dust clouds around the asteroid, enhancing the scientific return of the whole Hera mission. The scientific payloads supporting the achievement of these objectives are "ASPECT" (VTT, Finland), a SWIR, NIR and VIS imaging spectrometerand "VISTA" (INAF, Italy), athermogravimeter aiming at collecting and characterizing volatiles and dust particles below 10m.

The Milani mission and the project team is facing challenges such as the use of COTS components in deep space environment, optical navigation implementation to orbit around the asteroid while keeping safe distances from Hera and Juventas, development of Image Processing algorithms, interfaces management with the Hera mothercraft, requiring the development of multiple models across the program. Key technologies were developed such as navigation camera, compact 6DoF cold gas propulsion system, mission specifics interfaces including SPP/PUSC protocol, to communicate with the mothercraft via ISL and via standard serial line. Outcomes of multiple test campaigns (radiation, mechanical, thermal, end-to-end between Milani models and Hera Avionics Test Bench) were used along the program to inject lessons learnt in the subsequent models up to the Flight Satellite.

Milani achieved the Test Readiness Review and will be delivered to ESA in Q1 2024 for SVT with Hera mothercraft prior to the launch scheduled for October 2024. Milani CubeSat is the first foreseeing orbiting around an asteroid, the first deep space CubeSat of the European Space Agency and represents a crucial development milestone of the Agency planetary defense roadmap.