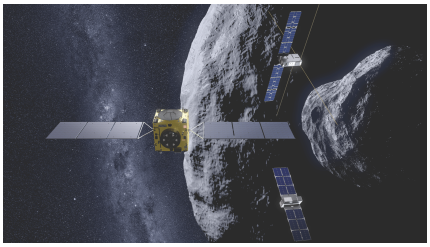
THE DYNAMIC GEOPHYSICAL ENVIRONMENT OF DIDYMOS BINARY ASTROID SYSTEM



Didymos binary asteroid system will be investigated by the ESA's Hera mission within the context of the Asteroid Impact and Deflection Assessment (AIDA) international collaboration. AIDA is a technology demonstration of the kinetic impactor concept to deflect a small asteroid and to characterize its physical properties. Due to launch in 2024, Hera would travel to the binary asteroid system Didymos. It will explore the binary asteroid and the crater formed in 2022 by the kinetic impact the NASA's Double Asteroid Redirection Test (DART).

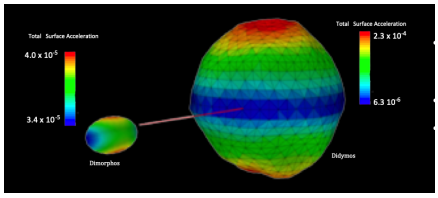
Introduction

ESA's Hera mission will carry two 6U CubeSats, one of which is the Juventas CubeSat developed by GomSpace Luxembourg with the Royal Observatory of Belgium as principal investigator. The spacecraft will attempt to characterize the internal structure of Didymos' secondary body, Dimorphos, over a period of roughly 2 months using a low-frequency radar, JuRa. During this period, Juventas will also perform radio science measurements using its Inter-Satellite-Link to characterize the mass and mass distribution of Dimorphos. Afterwards, Juventas will attempt to land on Dimorphos, during which the spacecraft is expected to perform several bounces. Once landed, Juventas will use its gravimeter GRASS to obtain measurements of the surface acceleration on Dimorphos for a nominal duration of two orbits. Through the monitoring of dynamics for landing and bouncing impacts as well as measurements from the GRASS gravimeter payload while on the surface, Juventas will determine surface mechanical properties and provide further information on subsurface structure and dynamical properties of Dimorphos.

HERA will carry also a thermal infrared imager where Royal Observatory of Belgium is involved with operations and scientific data analysis. The thermal imager will investigate thermophysical properties by mapping thermal inertia and compositional variations of them. Thermal Imager will contribute to verifying Yarkovsky and YORP (B-YORP) effects, orbital and rotational evolution in relation to thermophysical modeling.

Study

The study will focus on the modelling of dynamic geophysical environment of Didymos binary system. The dynamical properties such as rotation as well as the gravity and thermal environment will be investigated. By combining its mass, spin rate, thermal environment and shape the geophysical environment of Didymos Binary system will be investigated.



The geopotential combines the gravitational potential with the rotational potential in a didymos-fixed frame to measure relative potential energy across the surface, and its gradient yields the combined gravitational and centrifugal accelerations at any given location in a frame rotating with didymos. The maximum surface acceleration are at the poles and smoothly decreases across the surface to the equator, where it reaches a minimum. The average gravitational force expected on the Dimorphos surface is around 5×10^{-5} m s^{-2} (or 5mGal). Apart from the self-gravitation of the body, centrifugal forces and the acceleration due to the main body of the system contribute to the surface acceleration. The temporal variations of local gravity vector at the landing site will be used to constrain the geological substructure (mass anomalies, local depth and lateral variations of regolith) as well as the surface geophysical environment (tides, dynamic sloped and centrifugal forces).

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