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Small Bodies Missions and Technologies (Part 2) (4B)

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INVESTIGATING NON-GRAVITATIONAL EFFECTS ON BINARY ASTEROIDS USING HERA MISSION DATA

Abstract

The ESA Hera mission is scheduled for launch in 2024 with the arrival at the binary asteroid (65803) Didymos in 2027. The rendezvous of Hera will follow the NASA DART impact performed on the small secondary Dimorphos. Although the mission is classified as a planetary defense and technological demonstration one, the science return will be extremely high. Such results will be obtained through a data exploitation of different instruments, e.g. radio-links (RSE and ISL), cubesats (Milani and Juventus), cameras (AFC), thermal infrared imager (TIRI). The Working Group 4 (Data Analysis, Exploitation, Interpretation) has identified some High-Level Products (HLP) among which the one we present here, called Non-Gravitational Acceleration (NGA). We want to perform an accurate estimation of the accelerations and to infer the effects on the binary system due to non gravitational forces; such forces are now considered as important as gravitational perturbations and collisions for the understanding of the asteroids evolution and binary formation. In particular, we are interested in the Yarkovsky, YORP (Yarkovsky-O'Keefe-Radzievskii-Paddack) and Binary YORP (BYORP) effects. The Yarkovsky and YORP effects are thermal radiation forces and torques that cause small objects to undergo semi-major axis drift, the Yarkovsky one, and spin vector modifications, the YORP one, as a function of their spin, orbit, and material properties. Being thermal effects, the measurements of the thermal properties of the target and its surface temperature distribution obtained are fundamental. The Yarkovsky effect is also important to perform a long term impact monitoring, in order to asses the impact hazard. The BYORP effect is the thermally induced acceleration or deceleration on a tidally locked satellite around a primary asteroid, which may cause a secular change in the semi-major axis and eccentricity of the mutual orbit. In order to obtain the estimations of NGAs we have: a) to perform a precise Orbit Determination (OD) of the S/C to obtain the global position of the binary and relatives positions with a great accuracy; this would also make it possible to better constrain the rotation state of the primary and secondary; b) to develop

a thermophysical model tuned based on the intensity distribution of the thermal radiation observed by TIRI. In this work we will show how to deal with the problem and some results on simulated data.