EPSC Abstracts
Vol. 14, EPSC2020-411, 2020, updated on 28 Jun 2022
https://doi.org/10.5194/epsc2020-411
Europlanet Science Congress 2020

Effects of the DART (NASA) mission collision on the structure and spin state of the secondary of the Near-Earth asteroid (65803) Didymos binary system.

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AIDA (Asteroid Impact & Deflection Assessment) is an international collaboration between NASA and ESA which involves both DART (Double Asteroid Redirection Test, NASA) and Hera (ESA) missions. The target is an asteroid of approximately 160 m in size, namely the secondary of the binary Near-Earth Asteroid (65803) Didymos. Little is known about the shape of the satellite, with a moderately elongated shape (b/a<1.2) compatible with available ground-based estimations. In this work we investigate the possible reaction of the target to the DART collision to be performed in 2022, under the assumption that it is a gravitational aggregate produced in the formation of the binary system. The very structure of the target is unknown, therefore we model it by (1) mono- and multi-dispersed distributions of spherical basic elements and by (2) considering irregular components. We perform numerical simulations of the collision event by using a discrete-element N-body numerical code (PKDGRAV-SSDEM). We do not perform simulations of the shattering phase, we instead concentrate on the effect of the collision on the target, after the shattering phase implying material damage (melting, vaporization, heating and deformation), is over. Therefore, our synthetic projectile carries the same nominal momentum as the DART mission does, but it delivers to the target only the kinetic energy expected to survive once the shattering (non-elastic) phase has dissipated most of the impact kinetic energy. We account for different centre- and off-centre- possible impact geometry compatible with DART nominal impact angle with respect to the target orbital plane.

Here we report on results obtained so far on the effects of the DART impact on the structure of the Didymos satellite, including changes in its spin period and direction of the direction of the spin axis, as well as change of shape.

Moreover, we look at the velocity field of surface particles to infer if any motion is expected away from the impact point and regolith particles can be ejected from locations far from it.

Such predictions may be of interest in the study of the post-impact dynamics of the system –that will be determined by the Hera mission measurements. This, in turn will help in the interpretation of the results of the outcome of the DART impact mission, including the determination of the momentum multiplication (beta) factor.