EPSC Abstracts
Vol. 13, EPSC-DPS2019-1805-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Response of the internal structure of Didymos B to the DART impact

Adriano Campo Bagatin (1), Rafael Alemañ (1), Paula Benavidez (1), Derek C. Richardson (2).

(1) Universidad de Alicante, Spain, (2) University of Maryland, USA
(acb@ua.es)

Abstract

Among the more technically available practical methods of deflecting a potentially hazardous asteroid (PHA) is kinetic impact, whereby the momentum change imparted to the object by the cratering impact of a targeted spacecraft or other projectile affects the required minor orbital change to avert impending disaster. NASA's Double Asteroid Redirection Test (DART) element of the Asteroid Impact and Deflection Assessment (AIDA) mission aims to perform the first dedicated full-scale demonstration of asteroid deflection by kinetic impact by flying an impactor spacecraft into the satellite of the binary near-Earth asteroid (NEA) Didymos (Didymos B thereinafter) and measuring the resulting deflection through ground-based optical and radar observations of a change in the orbital period the binary [1]

1. Introduction

Didymos B is approximately 160 m in size but little is known about its shape with a moderately elongated shape (b/a<1.2) compatible with available ground-based estimations.

The internal structure of Didymos is fundamentally unknown, and so is that of its satellite. Nevertheless, most asteroids smaller than many tens of km are believed to be gravitational aggregates formed by collisional processes in the main asteroid belt [2, 3] or in-orbit reaccumulation of fragments departing primary surdace due to its large spin [4] Knowledge of the structure of the satellite also provides crucial information about the process generating binary asteroids. Only future close inspection and measurement of physical properties of the Didymos system by space probes (as the Hera mission by ESA, 5) can convey suitable information on internal structure of both components.

2. Methodology

Here we investigate the possible reaction of Didymos B to the DART collision under the assumption that it has a gravitational aggregate structure formed by multiple irregularly shaped blocks. We perform numerical simulations of the collision event by using a discrete-element *N*-body numerical code (PKDGRAV). Given that this code cannot be used to study the shattering phase, we set up our numerical experiments to start when that phase is over and collisional momentum and remaining kinetic energy starts to propagate through the body. We consider that momentum is conserved in the collision and that only part of the collisional energy carried by DART is transferred as kinetic (translation and rotation) energy of the blocks forming Didymos B structure. Laboratory collisional experiments indicate that the fraction of kinetic impact energy surviving to collision is in the 1-10% range. We account for different -off-centre- possible impact geometry compatible with DART nominal impact angle and report on preliminary results of the effects of DART impact on the internal structure of Didymos B.

3. Summary and Conclusions

The process of gravitational re-accumulation of fragments following asteroid collisions offers a general mechanism to explain asteroid (and possibly comet) morphology, including contact binaries and possibly asteroid pairs and clusters, while it suggests a possible scenario for the formation of asteroid binary systems.

Acknowledgements

We acknowledge The Ministerio de Economía, Industria y competitividad through grant AYA2016-79500-R.

References

[1] Cheng, A., et al. (2018). AIDA DART asteroid deflection test: Planetary defense and science objectives. *Planetary and Space Science, Volume 157, p. 104-115.*

[2] Campo Bagatin et al. (2001). How Many Rubble Piles Are in the Asteroid Belt? *Icarus, Volume 149, Issue 1, pp. 198-209 (2001).*

[3] Campo Bagatin et al. (2018). Internal structure of asteroid gravitational aggregates. *Icarus, Volume 302, p. 343-359.*

[4] Walsh, K.J. (2015). Formation and Evolution of Binary Asteroids. *Asteroids IV, UAP. Binzel, De Meo, Michel eds., p. 375-395.*

[5] Michel, P. et al. (2018). European component of the AIDA mission to a binary asteroid: Characterization and interpretation of the impact of the DART mission. *Advances in Space Research, Volume 62, Issue 8, p. 2261-2272*