REACTION OF DIMORPHOS' STRUCTURE TO THE DART IMPACT. P. G. Benavidez[1,2], A. Campo Bagatin[1,2], P.-Y. Liu[2], D. C. Richardson[3], [1]Departamentod de Física, Ingeniería de Sistemas y Teoría de la Señal (Universidad de Alicante, Spain) (paula.benavidez@ua.es), [2] Instituto Universitario de Física Aplicada a las Ciencias y las Tecnologías. (Universidad de Alicante, Spain) (acb@ua.es), [3]Department of Astronomy (University of Maryland, MD, USA)

Introduction: 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 [1]. The target is an asteroid of approximately 160 m in size, named Dimorphos (the secondary of the binary Near-Earth Asteroid (65803) Didymos). Little is known about the shape of the satellite, except it is moderately elongated (b/a<1.2) according to available ground-based estimations. In this work we investigate the possible reaction of Dimorphos to the DART collision to be performed in 2022, under the assumption that it is a spherical gravitational aggregate produced in the formation of the binary system [2, 3]. 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.

Here we report on results obtained so far on the effects of the DART impact on Dimorphos. In particular, we focussed on: a) Changes in spin period and direction of the spin axis, and tracking of their evolution in time. b) Energy distribution of surface particles capable to lift/move over the surface. c) Change in the shape of Didymos.

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. Also, potentially antipodal escaping mass will be checked to refine the overall momentum multiplication factor (‘beta’). Finally, the results may contribute to the interpretation of motion of boulders on the surface of Dimorphos if their tracking will be possible by combination of DART and Hera measurements.

Methodology: 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 spacecraft does, but it delivers to the target only the fraction of kinetic energy ($2.5\cdot10^{-3}$) expected to survive once the shattering (non-elastic) phase has dissipated most of the impact kinetic energy [4]. We use conservative values of the restitution coefficient for inter-particle collision (0.3) corresponding to Earth rocks values. We account for different centre and off-centre possible impact geometry compatible with DART nominal impact angle (20º) with respect to the target orbital plane. Future research will include non-spherical shape for Dimorphos and the presence of the Didymos mass at suitable distance.

Results: Our model of the DART impact in the case of a multi-dispersed distribution of spherical particles with 100,000 (1) and 13,600 (2) particles shows that: i) spin period may be changed by up to -30’ (1), and between +8’ and -90’ (2), depending on different impact geometry. ii) The spin axis may be tilted up to 3 deg. iii) No precession of the spin axis is observed following the post-impact evolution over 150 hours. iv) The energy and momentum wave reach the surface away from the impact area so that mass lift and displacement of sizeable particles over the surface is produced. iv) Low mass escaping does not affect substantially beta estimation.

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References: [1] Michel, P. et al. (2018) Adv. in Space Res., 62, 8, 2261. [2] Campo Bagatin et al. (2001) Icarus, 149-1, 198. [3] Campo Bagatin et al. (2018) Icarus, Volume 302, p. 343-359. [4] Walker, D. W. (2013) Int. J. of Impact Engin. 56, 12.