PDC2017
Tokyo, Japan

IAA-PDC-17-03-10

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COHESIVE STRENGTH OF 65803 DIDYMOS, THE TARGET OF THE AIDA MISSION

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Keywords: *Asteroids, dynamics; Asteroids, rotation; geological processes; cohesion.*

ABSTRACT

The internal structure and strength of asteroids significantly influence the impact processes on these small bodies and their subsequent collisional evolution [1]. For a planetary defense mission, it is crucial to understand the structural strength of a hazardous asteroid, which has a strong influence on the asteroid's response to most mitigation techniques, before taking action. Growing evidence suggests that asteroids larger than a few hundred meters in diameter are gravitational aggregates, i.e., they are rubble-pile asteroids for which gravity is the principal force holding the body together [2]. However, because the gravity is so small on these small bodies, other forces may also have a significant role on the mechanics and dynamics of

asteroids. Van der Waals cohesive forces could well be a dominant force, and likely improve the strength of rubble-pile asteroids and reduce their chances of breakup by rotational centrifugal or tidal forces [3, 4].

As the target of the proposed Asteroid Impact & Deflection Assessment (AIDA) mission [5, 6], the primary of the near-Earth binary asteroid 65803 Didymos is a well-known fast rotator. This asteroid could possess cohesion in its structure. To gain a better understanding of the effect of cohesion and to support the AIDA mission, we use a high-efficiency SSDEM code, *pkdgrav* [7, 8], to investigate the effect of cohesion on the structural stability and dynamic behavior of the Didymos primary and secondary. Our study provides some constraints on the possible physical properties of this binary system. The results show that the Didymos primary rubble-pile model can maintain its shape with a friction angle of ~39° at the current observed spin period (2.26 h) within the uncertainty of the observed bulk density (< 2.7 g/cc) without cohesion, but needs cohesion of ~10 Pa for the nominal bulk density (2.1 g/cc) used in the reference model of the object by the AIDA team [5]. The relation between the primary's bulk density and the critical cohesion (i.e., the minimum cohesion required to maintain the shape stable) is presented. The secondary can remain structurally stable in its orbit around the primary without requiring cohesion, owing to its presumed tidally locked spin.

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