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**Minimum material strength of binary asteroid Didymos-Dimorphos from the perspective of structural stability**

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##### ABSTRACT

The binary asteroid 65803 Didymos-Dimorphos system is the target of the first asteroid deflection test (NASA Double Asteroid Redirection Test, DART) and of the first rendezvous mission with a binary asteroid system and internal structure investigation (ESA Hera). The cohesive strengths of both the fast-spinning primary (Didymos) and the secondary (Dimorphos) are key factors that could significantly affect the impact outcome and stability of this system [1, 2]. To support the preparation and data interpretation of these missions and gain a better understanding of the formation and evolution of this system, we investigate the structural stability and cohesive strengths of both Didymos and Dimorphos according to current observational constraints.

Based on the assumption that the Didymos’ current fast rotation is driven by the YORP spin-up effect, we explicitly simulated the spin-up process of Didymos from a slow spin state to its current spin state using a high-efficiency soft-sphere-discrete-element-model code, *pkdgrav* [1, 3]. Several Didymos rubble-pile models with a shape matching the radar shape model [4] were constructed by using different particle arrangements and size distributions. Dimorphos is modeled as either a point mass or a rubble-pile ellipsoid. By assessing the creep stability of the rubble pile structures at the end of the simulations, we can obtain the minimum required material strength to keep the shape of each rubble-pile body.

Our previous studies [5, 6] have shown that in the absence of the secondary, Didymos requires a small amount of bulk cohesion (~10 Pa) to maintain its structural stability at its current fast spin state. In this study, we include the secondary and explore the mutual tidal effect on the structural stability and evolution of this system.

The preliminary results show that, due to the tidal effect of Dimorphos, there is an increment in the minimum required bulk cohesion on the order of 0.1–1 Pa for the considered Didymos rubble pile models. The exact amount depends on the rubble-pile configuration and the associated failure mode. For the case where the rubble pile tends to fail internally, a larger increment is needed; for the case where the rubble pile tends to fail through surface shedding, the tidal effect of Dimorphos on the minimum required cohesion of Didymos is negligible. Our numerical experiments also show that the rubble-pile Dimorphos can be stable with a friction angle of ~40 deg without cohesion (in the case of synchronous rotation).

As a next step, we will investigate in depth the tidal evolution of this system via full-two-rubble-pile modeling based on the material parameters derived from the current study. Comparisons with measurements by the DART and Hera missions will allow constraining the mechanical properties and history of this binary asteroid.

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***Comments:***

*Oral preferred.*

*This contribution could be included into the DART-Hera missions session.*