Mechanical properties of asteroids from surface morphological analysis

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The surface morphology of an asteroid provides valuable clues to its history and physical properties, as these characteristics often reflect its internal structure and mechanical behavior [1,2,3]. Geological processes, including impacts [4], thermal stress[5], space weathering, and erosion[6], leave visible markers on the asteroid's surface. In particular, surface features such as craters, ridges, boulders, fractures, and dust-covered regions, are directly linked to the asteroid's bulk mechanical properties. For instance, the presence and distribution of boulders and fractures help determine parameters like friction angle, density, and the cohesion of materials making up the asteroid. Additionally, observing regions where loose regolith accumulates can reveal areas with low shear strength and minimal cohesion. The size, shape, and depth of craters reflect the asteroid's cohesion, tensile strength, and internal structure [7]. Investigating these features is crucial for understanding asteroid formation and evolution. Additionally, this information is valuable not only for planetary defense strategies but also for sample-return missions, as an asteroid's mechanical properties greatly impact how materials can be collected from its surface.

Recent space missions, notably those to asteroids Ryugu, Bennu, and the Didymos-Dimorphos binary system [8,9,10], have provided detailed imagery and observational data that allow scientists to examine asteroid surfaces closely. These high-resolution images reveal various morphological features that not only hint at past geological processes but also provide insight into the asteroids' current mechanical properties.
Here, we focus on the latest results obtained from DART-LICIACube on the binary asteroid Didymos-Dimorphos, and the implications on the mechanical properties discovered [7,11,12,13,14].

References
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