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Simulations of vibration-driven regolith segregation in the low-gravity asteroid environment

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Abstract

Since the release of the first *in situ* images of asteroid surfaces by various space missions, several studies have attempted to understand the origin of visible evidence of possible regolith motion, accumulation, and segregation on asteroid surfaces (for example, boulders on the surface of asteroid Itokawa [1]). A plausible explanation for these phenomena that has recently been explored is that motion is caused by seismic waves, engendered by numerous micro-meteoroid impacts that asteroids undergo in their lifetime. In fact, vibrations induced by small impacts have already been considered in the study of regolith segregation, and more specifically in the case of the so-called Brazil nut effect (BNE) on asteroids [2, 3]. To further investigate this, we perform numerical simulations with an extension of the *N*-body code PKDGRAV [4] used by Matsumura et al. [2]. Our interest is in going beyond the classic BNE scheme (a single intruder of bigger size in a granular bed) and in looking into potential size and/or density segregation of regolith materials, and the dependency of the outcomes on material parameters. In order for our simulations to better represent actual asteroid surface conditions, we have introduced periodic boundary conditions, i.e., we have removed the simulated container of the granular bed, and at the same time, any artifacts that may arise by its presence. Preliminary results of our simulations will be presented. Going forward, we aim to establish scaling laws for regolith segregation in micro-gravity environments, which take into account material properties. To better apply our results in an asteroid-related context, we plan additionally to use realistic impact-generated seismic profiles (e.g., [5]) instead of the continuous sinusoidal shaking implemented until now.

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