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Scaling of liquid-drop impact craters in granular media[1]
RUNCHEN ZHAO, QIANYUN ZHANG, HENDRO TJUGITO, MING GAO, XIANG CHENG, University of Minnesota — Granular impact cratering by liquid drops is a ubiquitous phenomenon, directly relevant to many important natural and industrial processes such as soil erosion, drip irrigation, and dispersion of micro-organisms in soil. Here, by combining the high-speed photography with high precision laser profilometry, we investigate the liquid-drop impact dynamics on granular surfaces and monitor the morphology of resulting craters. Our experiments reveal novel scaling relations between the size of granular impact craters and important control parameters including the impact energy, the size of impinging drops and the degree of liquid saturation in a granular bed. Interestingly, we find that the scaling for liquid-drop impact cratering in dry granular media can be quantitatively described by the Schmidt-Holsapple scaling originally proposed for asteroid impact cratering. On the other hand, the scaling for impact craters in wet granular media can be understood by balancing the inertia of impinging drops and the strength of impacted surface. Our study sheds light on the mechanism governing liquid-drop impacts on dry/wet granular surfaces and reveals a remarkable analogy between familiar phenomena of raining and catastrophic asteroid strikes.

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