Raindrop imprints and asteroid strikes

Anyone who has watched raindrops falling on a beach is likely familiar with the craters the raindrops create in the sand. But impact cratering in granular materials by liquid drops is distinctly different from the well-studied granular cratering by solid spheres and is much less understood. This snapshot from a high-speed video taken by researchers in Xiang Cheng's soft-matter physics group at the University of Minnesota captures a particularly dramatic moment after a falling water drop, 3.9 mm in diameter, violently strikes a bed of 90-micron glass beads. As the drop initially spreads out and then retracts and jumps off the granular bed, it entrains a layer of the fine particles on its surface, which gives rise to an exquisite "liquid marble." A permanent crater is left underneath.

Investigating granular impact dynamics and crater formation for drop energies spanning four orders of magnitude, Cheng and company found a most surprising result: The size of the liquid-drop craters scales with energy in the same way as that of craters formed by asteroid strikes. Moreover, liquid-drop imprints and asteroid imprints on the Moon, Mars, and Mercury exhibit identical aspect ratios despite their vastly different length scales. Those remarkable quantitative similarities suggest that raindrop impacts at the beach and asteroid impacts on Mars may share similar underlying mechanisms. Drawing on physical insights from the planetary sciences, the team developed a simple framework that quantitatively captures the main features of liquid-drop imprints. (R. Zhao et al., *Proc. Natl. Acad. Sci. USA* **112**, 342, 2015; image submitted by Runchen Zhao. For more on asteroid impact dynamics, see the story on page 14.)

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