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Laboratory Experiments on Splashes Generated by Slow Impacts into Granular Beds

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Abstract

Splashes from slow impacts into granular materials play an important role in the sculpting of asteroid surfaces and for the structures formed in wind blown sands. Here we present results from two experiments that explore the ejecta generation and material redistribution from slow impacts into a granular bed. The impactors are selected to have the same size and material as the grains that make up the target. We find that for small grains the ejecta will stay close to the impact site under conditions realistic for a small asteroid. We further find that buckling introduced by the impact can create ejecta away from the impact site.

1. Dissipative Impact

In experiments with 150µm glass beads we find that ejecta generated by slow impacts will remain close to the impact site for realistic asteroid conditions. This is in contrast to more elastic impacts that happen when the target material is less granular in nature (i.e. big rock), and such granular beds become effective traps for small particles. This might be relevant for the proposed ballistic sorting effect to explain the size segregation observed on Itokawa [Shinbrot2017].

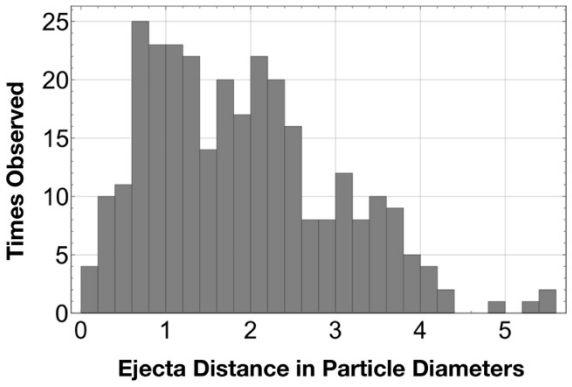

Figure 1: Distance of ejecta particles' final positions relative to the impact site.

2. Buckling Eruption

A further feature we observe in granular impacts for cm sized particles is that the ejecta not always emerge from the center of the impact site. This is because forces in granular media are highly localized in so called force chains. In experiments with photoelastic particles [Daniels 2017] we observe, that the impact energy can be redirected into forming a dilated zone away from the impact site. This creates a buckle which eventually will erupt to expel the observed ejecta.

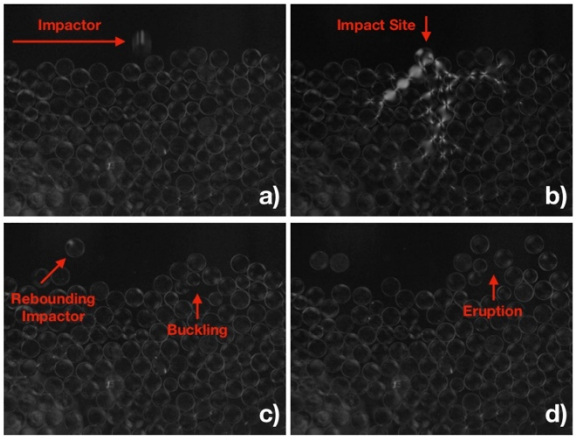

Figure 2: A cm sized impactor hitting a bed of photoelastic particles at ~10m/s and creating a buckling induced splash away from the impact site.

Acknowledgements

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References

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[Shinbrot2017] T. Shinbrot, T. Sabuwala, T. Siu, M. V. Lazo, and P. Chakraborty, Phys. Rev. Lett. 118, 111101 (2017)