Abstract Submitted
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Stick-Slip and Granular Force Networks: A Statistical Description[1] R. BEHRINGER, Duke University, P. YU, DLR, T. SHANNON, Duke University, MIT — We probe the nature of granular friction and stick-slip using a novel apparatus that combines photoelastic response at the grain scale, and quantitative measurements of pulling force and kinematics. In the experiments, a slider is pulled across the surface of a granular layer consisting of photoelastic particles. A pulling device moves at constant velocity, V, and acts on the slider through a spring of constant k_s. Non-periodic stick-slip motion results. During stick, the spring loads up, and the force network of the granular material evolves steadily. Slip is preceded by a creep regime involving small rearrangements of the force network. Slip is rapid and consists of one or more 'force chain' failures. Most properties, including energy losses at slip, forces at failure and immediately after slip, slipping times, etc. are characterized by broad distributions. For instance, the slip energy losses, in analogy to the Gutenberg-Richter law for earthquakes, has a probability distribution function that varies as a powerlaw in ΔE with and exponent of $\epsilon = 1.2 \pm 0.1$ The detailed motion of the slider during a slip event may be quite complex, as individual force chains fail, and new chains form to take their place. We present details of distributions and we relate our observations to expectations from a simple friction model and to an elastic failure model. We appreciate input from Paul Johnson (LANL) and Chris Marone (Penn State University).

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