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Power Spectra of Force Fluctuations in Granular Materials Under Shear
ERIC CORWIN, HEINRICH JAEGER, SIDNEY NAGEL, The James Franck Institute and Department of Physics, The University of Chicago — We measure the time-varying forces at the bottom surface of a granular system sheared at the top. The shear is applied by rotating a roughened piston while maintaining a constant, uniaxial compressive force. We report on the force autocorrelation and the corresponding power spectrum $S$ of the variation of force on individual grains at the bottom surface. These forces are obtained from video tracking of imprints in a pressure-sensitive birefringent layer across the bottom surface. Averaging over concentric annuli we find power-law behavior $S \sim 1/f^\alpha$ over several orders of magnitude in each annulus. The power law exponents $\alpha$ appear to be correlated with the in-plane shear strain rate. In our system friction with the stationary side walls introduces a radial gradient in the shear rate, which is maximum at the outer edge and zero at the center. The corresponding power law exponents suggest strict $1/f$ noise ($\alpha = 1$) at the outer, shearing edge and an increasing index as one approaches the center and the shear rate vanishes.

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