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Avalanches, and evolution of stress and fabric for a cyclically sheared granular material[1] DENGMING WANG, Lanzhou University, JONATHAN BARES, DONG WANG, BOB BEHRINGER, Duke University — Granular materials yield for large enough shear stress, leading to avalanches. We seek to understand the relation between macroscopic avalanches and the the microscopic granular structure. We present an experimental study of a 2D granular material subjected to cyclic pure shear, which we visualized by a photo-elastic technique. We start from a stress-free sample of frictional particles in the shear-jamming regime ($\phi_S \leq \phi \leq \phi_J$). We apply multiple cycles of pure shear: shear in one direction, followed by a reversal to the original boundary configuration. The strain is made in small quasi-static steps: after each small step, we obtain polarized and unpolarized images yielding particle-scale forces and locations. Statistical measures of the avalanches are in reasonable agreement with recent mean-field avalanche models by Dahmen et al. (Nature Physics 7, 554 (2011)) The system structure evolves slowly to reduce the stress at the extrema of strain, similar to the relaxation observed by Ren et al. (Phys. Rev. Lett. 110, 018302 (2013)) in a simple shear experiment. To understand how this relaxation occurs, we track the stress and fabric tensors and measures of the strain field over many cycles of shear.

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