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Shear-jammed states in granular materials[1] DAPENG BI, Brandeis University, JIE ZHANG, Indiana University - Purdue University Fort Wayne, R.P. BEHRINGER, Duke University, BULBUL CHAKRABORTY, Brandeis University — For frictionless particles with purely repulsive interactions, there is a critical packing fraction ϕ_J below which no jammed states exist. Experiments by Zhang & Behringer on physical granular systems show jammed states in the regime of $\phi < \phi_J$ can be created by the application of shear stress. Compared to the states above ϕ_J, the shear-jammed states are mechanically more fragile, but they resist shear. These shear-jammed states cannot exist under isotropic stress. Rather, their formation require the anisotropic contact network as a backbone which is created by an applied shear stress. The anisotropic components of the stress tensor and contact network fabric tensor form a classic hysteresis loop suggesting an analogy to ferromagnetic behavior and critical phenomena. These new states must be incorporated into a more general jamming picture. We also carry out extensive analysis on shear-jammed states and find local stress fluctuations are controlled by their respective global pressures. To explain the scaling of local stress fluctuations, we construct a mean-field model based on the entropy of stress configurations.

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