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Shear Reversibility in Model Granular Systems CARL SCHRECK, Yale University, ROB HOY, University of Southern Florida, MARK SHATTUCK, City College of New York, COREY O'HERN, Yale University — Athermal particulate systems such as foams and granular media are out-of-thermal equilibrium and therefore must be externally driven using shear or vibration to explore different configurations. Of particular interest is being able to predict and control the structural and mechanical properties of athermal systems as a function of the driving mechanism. In this work, we show numerically how particle collisions in cyclically sheared hard sphere systems can lead to microreversibility. We map out the steady-state "phase diagram" as a function of packing fraction (ϕ) and strain amplitude (γ_{max}), and identify "point-reversible" states at low ϕ and γ_{max} in which particles do not collide over the course of a shear cycle, and "loop-reversible" states at intermediate ϕ and γ_{max} in which particles undergo numerous collisions but return to their initial positions at the end of each shear cycle. Loop-reversiblity is a novel form of self organization that gives rise to non-fluctuating dynamical states over a broad range of packing fractions from contact percolation to jamming, i.e. $\phi_P = 0.55$ to $\phi_J = 0.84$ in two dimensions.

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