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Reversibility and self-organization in non-Brownian suspensions[1]
LAURENT CORTÉ, PAUL CHAIKIN, NYU, JERRY GOLLUB, Haverford College, DAVID PINE, NYU — Many-body systems often exhibit irreversible behavior even though the governing equations of motion are reversible. Nevertheless, it is unusual to encounter a physical system in which the transition from reversible to irreversible behavior can be explored experimentally. Recent experiments in our lab on periodically sheared non-Brownian suspensions show a sharp transition from reversible to irreversible chaotic behavior above a concentration-dependent threshold strain amplitude.[2] The observation of a sharp threshold is puzzling as the initial distribution of particles is random, with no obvious length scale for the onset of irreversibility. We develop a simple model, explored through simulation and mean field theory, that captures the salient behavior of the experiments. For small strain amplitude, the model reveals that random displacements of colliding particles can cause the system to self-organize into a reversible state that avoid further collisions. The model provides new insights into how microstructure can spontaneously develop and how random encounters can help a system evolve towards a stable fixed point.

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[2]D. J. Pine, J. P. Gollub, J. F. Brady & A.M. Leshansky, Nature, **438**, 997-1000 (2005).

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