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Transient Memories in Non-Equilibrium Disordered Systems JOSEPH PAULSEN, SIDNEY NAGEL, University of Chicago
— Some non-equilibrium systems can store information of their external driving in an unexpected manner. They "learn" multiple driving amplitudes that can subsequently be read out. Notably, only one memory is retained after many driving cycles, even if all of the amplitudes are continually fed in. This behavior has been observed in diverse scenarios such as traveling charge-density waves [1] and simulations of sheared suspensions [2]. Here we explore this latter system experimentally using a suspension of neutrally buoyant non-Brownian particles in a very viscous fluid that is sheared cyclically in a Couette cell geometry. Starting from a random configuration, the particle trajectories are irreversible at first but, as had been shown [3], eventually settle into a configuration where they retrace their paths exactly during each cycle. We show that the resulting configuration comprises a memory of the driving amplitude, which can be read out by measuring the degree of particle reversibility versus shear amplitude. We also discuss this system's capacity for storing multiple memories.

[1] S. N. Coppersmith et al., PRL 78, 3983 (1997).
[2] N. C. Keim, S. R. Nagel, PRL 107, 010603 (2011).
[3] L. Corté, P. M. Chaikin, J. P. Gollub, D. J. Pine, Nature Phys. 4, 420 (2008).

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