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Noise induced chaos in optically driven colloidal rings. YAEL ROICHMAN, GEORGE ZASLAVSKY, DAVID G. GRIER, New York University — Given a constant flux of energy, many driven dissipative systems rapidly organize themselves into configurations that support steady state motion. Examples include swarming of bacterial colonies, convection in shaken sandpiles, and synchronization in flowing traffic. How simple objects interacting in simple ways self-organize generally is not understood, mainly because so few of the available experimental systems afford the necessary access to their microscopic degrees of freedom. This talk introduces a new class of model driven dissipative systems typified by three colloidal spheres circulating around a ring-like optical trap known as an optical vortex. By controlling the interplay between hydrodynamic interactions and fixed disorder we are able to drive a transition from a previously predicted periodic steady state to fully developed chaos. In addition, by tracking both microscopic trajectories and macroscopic collective fluctuations the relation between the onset of microscopic weak chaos and the evolution of space-time self-similarity in macroscopic transport properties is revealed. In a broader scope, several optical vortices can be coupled to create a large dissipative system where each building block has internal degrees of freedom. In such systems the little understood dynamics of processes like frustration and jamming, fluctuation-dissipation relations and the propagation of collective motion can be tracked microscopically.

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