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Using chaotic Faraday waves to create a two-dimensional pseudo-thermal bath for floating particles with tunable interaction potentials
KYLE WELCH, ISAAC HASTINGS-HAUSS, RAGHUVEER PARTHASARATHY, ERIC CORWIN, Materials Science Institute and Department of Physics, University of Oregon — Whether chaos in actively driven systems can be described by an effective temperature is an unresolved question in the study of nonlinear physics. We use chaotic Faraday waves to create a two-dimensional pseudo-thermal bath to investigate tunable interactions between floating particles. By vertically oscillating a liquid with an acceleration greater than g we excite the Faraday instability and create surface waves. Increasing this acceleration above some critical value causes this instability to become chaotic with fluctuations over a broad range of length scales. Particles placed on the surface are buffeted by random excitations in analogy to Brownian motion. We can change the "temperature" of the pseudo-thermal bath by manipulating the driving frequency and amplitude, a feature of the system we verify using real-time tracking to follow the diffusive movement of a single particle. With an eye toward creating complex self-assembling systems we use this system to measure the tunable interaction potential in two-, three-, and many-particle systems and to probe the effects of particle size, shape, symmetry, and wetting properties.

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