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Direct measurement of the Einstein relation in a macroscopic, non-equilibrium system of chaotic surface waves KYLE WELCH, ALEXANDER LIEBMAN-PELAEZ, ERIC CORWIN, University of Oregon — Equilibrium statistical mechanics is traditionally limited to thermal systems. Can it be applied to athermal, non-equilibrium systems that nonetheless satisfy the basic criteria of steady-state chaos and isotropy? We answer this question using a macroscopic system of chaotic surface waves which is, by all measures, non-equilibrium. The waves are generated in a dish of water that is vertically oscillated above a critical amplitude. We have constructed a rheometer that actively measures the drag imparted by the waves on a buoyant particle, a quantity entirely divorced in origin from the drag imparted by the fluid in which the particle floats. We also perform a separate, passive measurement, extracting a diffusion constant and effective temperature. Having directly measured all three properties (temperature, diffusion constant, and drag coefficient) we go on to show that our macroscopic, non-equilibrium case is wholly consistent with the Einstein relation, a classic result for equilibrium thermal systems.

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