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Reversibility and Chaos in Microscopic Fluid Systems LIAT ROSENFELD, LIN FAN, SINDY K.Y. TANG, Stanford University, TANG RESEARCH GROUP TEAM — In this study, we explore the transition from reversible to chaotic behavior in an oscillatory shear flow of water-in-oil emulsions. Emulsions are complex materials and have many applications in chemical, biological and industrial processes. The many-body, shear-history-dependent nature of the microstructure renders the prediction of the complex material's dynamics and rheology highly nontrivial. The emulsion was injected through a microchannel and was forced to rearrange due to a central constriction in the channel. We study the motion of the individual droplets and their neighbors in order to determine their ability to retain their original position after several cycles of oscillations. We have found that while at the Stokes flow limit, the emulsion exhibit behaviors that vary from complete reversibility to complete irreversibility depending on the volume fraction, velocity and strain rate. We provide the first direct visualization of this phenomenon. This work is an important step in understanding the microscopic rearrangements of droplets and particles near jamming.

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