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Stretching Statistics in the Transition to Nonperiodic Flow[1]
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We experimentally study the mixing properties of fluid flow exhibiting chaotic advection. The system we use is a two dimensional fluid layer above a spatially random magnet array electromagnetically driven by a time periodic current. As the amplitude of the forcing is increased, the flow shows a transition from periodic to nonperiodic behavior. Using particle tracking velocimetry, we obtain time resolved velocity fields with high spatial resolution. These fields are used to reconstruct the Lagrangian trajectories, i.e. flow map, over time intervals less than the forcing period. Using the flow map, stretching fields (Voth et. al. PRL 88 254501) and spatially local Lyaponov exponents are determined. Statisitcal properties of the stretching are used to characterize the mixing properties of the system. The mixing properties as a function of Reynold's number are used to highlight the transition from periodic to turbulent flow.

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