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Transition to turbulence in a quasi-2D Kolmogorov flow JEFFREY TITHOF, BALACHANDRA SURI, RADFORD MITCHELL, A.J. PRYOR, ROMAN GRIGORIEV, MICHAEL SCHATZ, Center for Nonlinear Science and School of Physics, Georgia Institute of Technology — We describe a combined experimental and numerical study of quasi-2D flows to search for unstable, exact solutions to Navier-Stokes known as Exact Coherent Structures (ECS), which may provide a foundation for a simplified dynamical description of turbulence. We focus on a system that closely approximates Kolmogorov flow by inducing shear in a thin fluid layer using electromagnetic forces. PIV is used to obtain time series of velocity fields from images of the visualized flows in the lab; time series of velocity fields are calculated numerically for flows with forcing similar to that in the experiments. Discrepancies arising from differences in lateral boundary conditions between experiments (no slip) and simulations (periodic) are addressed in two separate ways: (1) experimentally studying a large system to approximate the effects of periodic boundary conditions and (2) adding padding regions in the simulations to mimic finite system size. We describe in detail the sequences of bifurcation leading to turbulence in both experiments and simulations.

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