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Experimental Observation of Exact Coherent Structures in a Weakly Turbulent Quasi-Two-Dimensional Flow[1] BALACHANDRA SURI, JEFFREY TITHOF, RAVI KUMAR PALLANTLA, ROMAN GRIGORIEV, MICHAEL SCHATZ, Center for Nonlinear Science and School of Physics, Georgia Institute of Technology — The dynamical systems approach to fluid turbulence relies on understanding the role of *unstable*, non-chaotic solutions – such as equilibria, traveling waves, and periodic orbits – of the Navier-Stokes equations. These solutions, called Exact Coherent Structures, exist in the same parameter regime as turbulence, but being unstable, are observed in experiments only as short transients. In this talk, we present experimental evidence for the existence and dynamical relevance of unstable equilibria in a weakly turbulent quasi-two-dimensional (Q2D) Kolmogorov flow. In the experiment, this Q2D flow is generated in an electromagnetically driven *shallow* layer of electrolyte. The numerical simulations, however, use a strictly 2D model which incorporates the effects of the finite thickness of the fluid layer in the experiment. During its evolution, there are instances when the dynamics of a weakly turbulent flow slow down, rather dramatically. Using experimental flow fields from such instances, and by means of a Newton-Solver, we numerically compute several unstable equilibria. Additionally, using numerical simulations, we show that the dynamics of a turbulent flow in the neighbourhood of an equilibrium are accurately described by the unstable manifold of the equilibrium.

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