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Experimental tests of dynamical and statistical relevance of exact coherent structures in turbulent small-aspect-ratio Taylor-Couette flow¹
WESLEY TOLER, CHRISTOPHER J CROWLEY, JOSH PUGHE-SANFORD, KENDRA SANDS, MICHAEL F SCHATZ, ROMAN O GRIGORIEV, Georgia Inst of Tech — Recent work suggests that the dynamics of turbulent wall-bounded flows are guided by unstable solutions to the Navier-Stokes equation that have nontrivial spatial structure and temporally simple dynamics. These solutions, known as exact coherent structures (ECS), are presumed to play a key role in a fundamentally deterministic description of turbulence, however experimental evidence for dynamical and statistical relevance of ECS is lacking. Here we examine an experimental Taylor-Couette flow in a small-aspect-ratio geometry ($\Gamma = 1$, radius ratio $\eta = 0.71$). We show that the turbulent flow shadows a number of ECS of a particular type (relative periodic orbits) obtained numerically. We also show that statistical quantities, such as the mean flow profile, for the turbulent flow and various ECS are similar but not identical.

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