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Connecting exact coherent states to turbulent dynamics in channel flow[1] JAE SUNG PARK, MICHAEL D. GRAHAM, University of Wisconsin-Madison — The discovery of nonlinear traveling wave solutions to the Navier-Stokes equations or exact coherent states has greatly advanced the understanding of the nature of turbulent shear flows. These solutions are unstable saddle points in state space, while the time evolution of a turbulent flow is a dynamical trajectory wandering around them. In this regard, it is of interest to investigate how closely the turbulent trajectories approach these invariant states. Here, we present connections between turbulent trajectories and one intriguing solution family in channel flow. A state space visualization of turbulent trajectories is presented in a three-dimensional space. The lifetime of the trajectories is well represented by closeness to two distinct solutions resembling in many ways the active and hibernating phases of minimal channel turbulence (Xi & Graham PRL 2010). The connections are then examined by comparing mean profiles and flow structures. More importantly, the connections are confirmed by calculating the L_2 distance between the trajectories and the traveling waves. Lastly, paths of an intermittent bursting phenomenon are identified in state space and the relationship between bursting paths and the traveling waves or hibernating turbulence is further discussed.

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