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Extreme value statistics and finite-size scaling at the ecological extinction/laminar-turbulence transition HONG-YAN SHIH, NIGEL GOLDENFELD, Department of Physics, University of Illinois at Urbana-Champaign —

Experiments on transitional turbulence in pipe flow seem to show that turbulence is a transient metastable state since the measured mean lifetime of turbulence puffs does not diverge asymptotically at a critical Reynolds number. Yet measurements reveal that the lifetime scales with Reynolds number in a super-exponential way reminiscent of extreme value statistics, and simulations and experiments in Couette and channel flow exhibit directed percolation type scaling phenomena near a well-defined transition. This universality class arises from the interplay between small-scale turbulence and a large-scale collective zonal flow, which exhibit predator-prey behavior. Why is asymptotically divergent behavior not observed? Using directed percolation and a stochastic individual level model of predator-prey dynamics related to transitional turbulence, we investigate the relation between extreme value statistics and power law critical behavior, and show that the paradox is resolved by carefully defining what is measured in the experiments. We theoretically derive the super-exponential scaling law, and using finite-size scaling, show how the same data can give both super-exponential behavior and power-law critical scaling.

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