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Increasing lifetimes and the growing saddle of shear flow turbulence TOBIAS M. SCHNEIDER, Max Planck Institute for Dynamics and Self-Organization, BRUNO ECKHARDT, Fachbereich Physik, Philipps-Universitaet Marburg, TOBIAS KREILOS, Max Planck Institute for Dynamics and Self-Organization & Fachbereich Physik, Philipps-Universitaet Marburg — In linearly stable shear flows turbulence spontaneously decays on a characteristic transient lifetime. The lifetime sharply increases with Reynolds number so that a possible divergence marking the transition to sustained turbulence at a critical point has been discussed, yet the mechanism underlying the increase has not been understood. We present a mechanism by which the lifetimes increase: a locally attracting orbit forms a "turbulent bubble" via a route-to-chaos sequence of bifurcations, followed by a boundary crisis in which the chaotic attractor turns into a chaotic saddle. The complexity of the turbulence supporting saddle hence increases and it becomes more densely filled with unstable periodic orbits, increasing the time it takes for a trajectory to leave the saddle and decay to the laminar state. We demonstrate this phenomenon in the state space of plane Couette flow and show that characteristic lifetimes vary non-smoothly and non-monotonically with Reynolds number.

Tobias M. Schneider
Max Planck Institute for Dynamics and Self-Organization

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