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Transition to sustained turbulence in pipe flow: a second order phase transition? MUKUND VASUDEVAN, BJÖRN HOF, The Institute of Science and Technology Austria — In a recent study, the critical point for sustained turbulence in a pipe was estimated to be Re $\approx$ 2040, by balancing the times scales for turbulence growth and decay processes. This work brought into focus the spatio-temporal aspects of the transition and suggested the possibility that the transition is a second order non-equilibrium phase transition. The present contribution aims to experimentally characterize the transition to sustained turbulence in pipe flow in greater detail and explore the analogy to a phase transition. However, the long time scales near the critical point ($\sim 10^7$ advective time units) pose a challenge in realizing this. We circumvent this problem by constructing a set-up with a quasi-periodic pipe, that exploits the memoryless nature of the turbulence spreading and decay processes in the vicinity of the critical point. In conjunction with an accurate control of the Reynolds number, it is then possible to monitor the spatio-temporal dynamics for arbitrarily long times, and obtain quantities such as the equilibrium turbulent fraction. We present evidence to support the idea that the transition to sustained turbulence in pipe flow is a phase transition of second order and provide first estimates of some of the associated critical exponents.

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