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Finite turbulence lifetimes in pipe flow JERRY WESTERWEEL, Delft University of Technology, BJOERN HOF, University of Manchester, TOBIAS SCHNEIDER, BRUNO ECKHARDT, University of Marburg — It is generally thought that turbulence in pipe flow is a sustained flow state once the Reynolds number (Re) has passed a critical value. Numerical simulations showed that in the transition region there is a distribution of lifetimes and indicated that the median lifetime diverges near a Reynolds number of about 2250. This would indicate a transition to an attractor in phase space that describes the turbulent flow state. Re-analysis of the original numerical results shows that when an initial formation period of the disturbance is omitted, the lifetime variation with Re is better described by an exponential increase, not a divergence. To distinguish between the two types of behaviour it is necessary to collect lifetime statistics spanning a wide range of lifetimes, extending beyond 2000 D. A pipe flow facility was constructed with a length of 7500 D and lifetime statistics for fixed pipe length as a function of Re were obtained. The shape of the probability distributions P(t,Re) to stay turbulent for a time t at Reynolds number Re is not compatible with a transition to an attractor at finite Re, and supports an exponential increase with Re. This implies that an infinite lifetime is only reached in the limit of infinite Re. The same scaling was observed in extended numerical simulations, and in a re-analysis of plane Couette flow data. The results therefore imply that turbulence in pipes is only a transient event.

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