Turbulence transition in pipe flows

Prof. Dr. Bruno Eckardt

(Fachbereich Physik, Philipps-Universität Marburg)

According to textbook wisdom, flow down a pipe becomes turbulent near a Reynolds number of about 2000. This simple statement misses many subtleties of the transition: the absence of a linear stability of the laminar flow, the sensitive dependence on perturbations that sometimes succeed and sometimes fail to induce turbulence, and the unexpected observation that the turbulent state, once achieved, is not persistent but can decay. All these observations are compatible with the formation of a strange saddle in the state space of the system. I will focus on three aspects: on the appearance of 3-d coherent states, on the information contained in lifetime statistics, and on the spatiotemporal aspects of the turbulent state in the transition region. The properties observed in pipe flow suggest a generic structuring of state space in flows where turbulent and laminar flow coexist.