Statistical behavior of plane Couette flow at the laminar–turbulent transition

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Though the mechanisms involved in the transition to turbulence in wall flows are now better understood [1], statistical properties of the transition itself are yet unsatisfactorily assessed. Poiseuille pipe flow (Ppf) —to be reviewed by Bjorn Hof— and plane Couette flow (pCf), both lacking linear instability modes, have attracted considerable interest recently [2–6]. These flows become turbulent through the nucleation and growth or decay of *turbulent domains* that, on the one hand, can be interpreted within the framework of low dimensional dynamical systems theory as transient chaotic states associated to *stochastic repellors*. On the other hand, limitations due to finite observation times and/or system size may play a role and correlative spatiotemporal processes cannot be ruled out in the transitional regime.

In the pCf case, the problem has been explored *via* numerical simulations of a model focusing on the in-plane (x, z) space dependence of a few velocity amplitudes with reduced cross-stream (y) dependence [6]. The model is closer to Navier–Stokes equations than previously considered coupled map reductions and there is evidence that it is well suited to the low-R transitional range. After a brief review of experimental results [5], I will present my most recent findings, discuss them in view of those for Ppf [2, 4], and attempt to make a connection with the theory of *first order phase transitions*, as suggested long ago by Y. Pomeau [7].

References

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