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The role of finite-amplitude solutions in transition to turbulence in pipe flow

Transition to turbulence in a circular pipe is an old puzzling problem for which a dynamical system description appears most enlightning. We will explain the recent notion of 'laminar/turbulent boundary' in phase-space and what it teaches us about transitional dynamics. Numerical investigation shows that this subspace of phase-space appears to be organised around a complex network of repelling finite-amplitude solutions, among which three-dimensional travelling waves also and relative periodic orbits. We will detail these ideas on pipes of short length and then extend it to more realistic longer pipes, allowing for spatially localised structures ('puffs').