LadHyX Seminar – October 21, 11:00, Amphi Lagarrigue and Zoom

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Making pipe flow transition complex again !

The idea of characterizing the laminar/turbulent transition in shear flows as a phase transition dates back over 30 years. However, proving it remained elusive until very recently. This is largely due to the extremely large spatial and time scales at play close to the transition point. Using dedicated experiments, we could show that the transition to turbulence in the Taylor-Couette system is a second order phase transition belonging to the directed percolation universality class. We could measure the associated exponents in both a quasi 1D and 2D experiment.

Whether this view is common to all shear flows, specially pressure driven ones, remains unknown. In pipe flow in particular, time scales at the onset of turbulence are orders of magnitude larger, making direct observations and a characterization of the universality class virtually impossible.

We circumvent these limitations by measuring all processes relevant to turbulence proliferation in experiments and by subsequently implementing them in a simple one dimensional model. The model shows that longer range interactions between turbulent clusters, which had recently been found in experiments, strongly reduce the scaling range. However, when considering excessive spatial and temporal scales, the stochastic nature is recovered and the transition in pipe flow can be described as phase transition falling into the directed percolation universality class.