Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

**An experimental approach to directed percolation in pipe ow.**[1]

GREGOIRE LEMOULT, CNRS - Normandie Universite, VASUDEVAN MUKUND, JOSE LOPEZ, IST Austria, HONG-YAN SHIH, Department of Physics, University of Illinois at Urbana- Champaign, GAUTE LINGA, JOACHIM MATHIESEN, Niels Bohr Institute, University of Copenhagen, NIGEL GOLDENFELD, Department of Physics, University of Illinois at Urbana- Champaign, BJORN HOF, IST Austria

— The circumstance that pipe flows are turbulent in practice, while theoretical arguments imply they should remain laminar, has posed a major challenge in fluid mechanics. Recent mounting evidence that the onset of turbulence can be explained as a directed percolation phase transition finally offers a solution to the problem. However the extremely large time scales intrinsic to the transition in pipe flow make direct observations and a characterization of the universality class virtually impossible. We here 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 clearly shows that longer range interactions between turbulent clusters, which had recently been found in experiments, strongly reduce the scaling range. At Reynolds numbers modestly close to the transition point the turbulent puff pattern enters a crystalline state that does not resemble the stochastic characteristics of a directed percolation process. Even closer to the transition point however, when considering excessive spatial and temporal scales, the stochastic nature is recovered. As shown the transition in pipe flow hence indeed falls into the directed percolation universality class.

[1]This work was supported by the following grants from the Simons Foundation (Grant number 662985, NG and Grant number 662960, BH)

Gregoire Lemoult
CNRS - Normandie Universite

Date submitted: 10 Aug 2020 Electronic form version 1.4