Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Oscillations of a cantilevered micro beam driven by a viscoelastic flow instability[1] ANITA DEY, YAHYA MODARRES-SADEGHI, University of Massachusetts Amherst, ANKE LINDNER, ESPCI, CNRS, University Paris Diderot, JONATHAN ROTHSTEIN, University of Massachusetts Amherst — We will present the results of our study of the flow of a viscoelastic polymer solution past a cantilevered beam in a confined geometry. The flow of viscoelastic fluids, unlike Newtonian fluids, can become unstable even at infinitesimal Reynolds numbers due to purely elastic flow instabilities that occur at large Weissenberg numbers. With increasing Weissenberg number, we will show that elastic instabilities occur in the vicinity of a flexible beam and begin to interact with the beam. We will report these interactions for cantilevered beams with varying elastic modulus, beam length and rigidity. Over a range of Weissenberg numbers, we will show that the flow field transitions from a stable detached vortex upstream of the beam to a time-dependent unstable vortex shedding. The shedding of the unstable vortex upstream of the beam will be shown to couple with the flow-induced beam deformation triggering oscillations of the beam. The critical onset of the flow transitions, mechanism of vortex shedding, and dynamics of the cantilevered beam oscillations will be presented for beams with varying flexibility. The oscillations of the flexible beam will be shown to have distinct regimes: a clear single vortex shedding regime and another regime characterized by a 3D chaotic flow instability.

[1]NSF Grant CBET-1705251, ERC Consolidator Grant No. 682367 and the Institut Pierre-Gilles de Gennes, program ANR-10-EQPX-34.

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Date submitted: 29 Jul 2019 Electronic form version 1.4