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A purely elastic upstream instability in channel flows BOYANG QIN, PAULO ARRATIA, University of Pennsylvania — In this talk, the flow of a viscoelastic fluid is experimentally investigated using particle velocimetry methods in a microfluidic device. The microchannel is 100-micron wide and deep and consists of a long (3-cm) straight region followed by a linear array of cylinders. Velocimetry measurements show the presence of flow instabilities far upstream of the linear array of cylinders. Velocity fluctuations are found up to 10 channel widths upstream the perturbation (linear array of cylinders); they extend far beyond the unsteady vortex that develops immediately in front the cylinder and are excited at many time scales. These fluctuations increase as the Weissenberg number (or flow rate) is increased. However, beyond a certain value of Wi, these fluctuations sharply decrease. We believe that the observed decrease in velocity fluctuations at high Wi correspond to a regime in which the flow speed (convection) is larger than the elastic wave speed, that is, the elastic Mach number exceeds unity.

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