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En Route to the Maximum Drag Reduction Asymptote GEORGE CHOUEIRI, JOSE LOPEZ, ATUL VARSHNEY , BJORN HOF, IST Austria — We report the results of an experimental investigation into the stability of viscoelastic pipe flow. We document the developmental stages, starting from a supercritical instability that occurs at Reynolds numbers $O(1)$, provided that the shear stress (and hence the Weissenberg number) is sufficiently large, all the way to the maximum drag reduction (MDR) asymptote for dilute polymer solutions. At onset the amplitude of streamwise velocity fluctuations is found to grow with the square root of the Reynolds number. It is noteworthy that this primary instability is non-hysteretic and appears in the absence of perturbations and curved streamlines. The flow structures observed closely resemble those of the unstable mode discovered in a recent stability analysis. Further from onset, a secondary instability is found where the azimuthal symmetry is broken and inclined streaks of high amplitude appear in the near wall region. These streak patterns resemble the typical flow structures found in MDR turbulence at higher Reynolds numbers.

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