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Scaling of energy amplification in the weak and strong elastic limits of viscoelastic shear flows ISMAIL HAMEDUDDIN, TAMER ZAKI, DENNICE GAYME, The Johns Hopkins University — We investigate energy amplification in viscoelastic parallel shear flows in terms of the steady-state variance maintained in the velocity and polymer stresses when either quantity is excited with white noise. We derive analytical expressions that show how this amplification scales with both Reynolds (Re) and Weissenberg (Wi) numbers. The analysis focuses on the streamwise-constant fields in the limits of high and low elasticity. By introducing stochastic forcing in both the velocity and the polymer stress dynamics, we show that at low elasticity the scaling retains a form similar to the well-known $O(Re^3)$ relationship but with an added elastic correction. At high elasticity, however, the scaling is $O(Wi^3)$ with a viscous correction. Our results demonstrate that energy amplification in a viscoelastic flow can be considerable even at low Re, correlating well with recent observations of elastic turbulence in creeping flows. We also note that forcing in the polymer stress dynamics can contribute significantly to the energy amplification.

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