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Nonlinear traveling waves as a framework for understanding turbulent drag reduction WEI LI, LI XI, MICHAEL GRAHAM, Univ. of Wisconsin-Madison — Nonlinear traveling waves that are precursors to laminar-turbulent transition and capture the main structures of the turbulent buffer layer have recently been found in all the canonical parallel flow geometries. We study the effect of polymer additives on these "exact coherent states" (ECS), in the plane Poiseuille geometry. Many key aspects of the turbulent drag reduction phenomenon are found, including: delay in transition to turbulence; drag reduction onset threshold; diameter and concentration effects. The examination of the ECS existence region leads to a distinct prediction, consistent with experiments, regarding the nature of the maximum drag reduction regime. Specifically, viscoelasticity is found to completely suppress the normal (i.e. streamwise-vortex-dominated) dynamics of the near wall region, indicating that the maximum drag reduction regime is dominated by a distinct, and perhaps intrinsically elastic, flow structure.

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