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Viscoelastic nonlinear traveling waves and drag reduction in plane Poiseuille flow WEI LI, MICHAEL GRAHAM, University 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 to exist in all the canonical parallel flow geometries. We present a study of the effect of polymer additives on the dynamical behavior of these "exact coherent states" (ECS) in the plane Poiseuille geometry using direct numerical simulation, focusing on Reynolds numbers slightly above transition. In experiments with a given fluid, Reynolds and Weissenberg numbers (Wi) are linearly related. In this situation, we study the dynamical behavior (i.e. birth, evolution and death) of viscoelastic ECS along some experimental paths (El=Wi/Re=const), which represent different flow behaviors as Re (and Wi) increases. These results are then compared with our previous static approach (i.e. finding steady states in a traveling wave frame), with regard to many key aspects of the turbulent drag reduction: delay in transition to turbulence; onset of drag reduction, diameter and concentration effects, and the nature of maximum drag reduction regime.

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