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Dynamics and structures of transitional viscoelastic turbulence in channel flow ASHWIN SHEKAR, SUNG-NING WANG, MICHAEL GRAHAM, Department of Chemical and Biological Engineering, University of Wisconsin-Madison — Introducing a trace amount of polymer into turbulent flows can result in a substantial reduction of drag. However, the mechanism is not fully understood at high levels of drag reduction. In this work we perform direct numerical simulations (DNS) of viscoelastic channel flow turbulence using a scheme that guarantees the positive-definiteness of polymer conformation tensor without artificial diffusion. Here we present the results of two parametric studies with the bulk Reynolds number fixed at 2000. First, the Weissenberg number (Wi) is kept at 100 and we vary the viscosity ratio (ratio ratio of the solvent viscosity and the total viscosity). Maximum drag reduction (MDR) is observed with viscosity ratio <0.95. As we decrease the viscosity ratio, i.e. increase polymer concentration, the mean velocity profile is almost invariant. However, this is accompanied by a decrease in velocity fluctuations but the flow stays turbulent. Turbulent kinetic energy budget analysis shows that, in this parameter regime, polymer becomes the major source of velocity fluctuations, replacing the energy transfer from the mean flow. In the second study, we fix the viscosity ratio at 0.95 and trace the Wi up to this regime and present the accompanying changes in flow quantities and structures.

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