Abstract Submitted
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Turbulent channel flow under moderate polymer drag reduction JOHN ELSNAB, JASON MONTY, University of Melbourne, CHRISTOPHER WHITE, University of New Hampshire, MANOOCHEHR KOOCHESFAHANI, Michigan State University, JOSEPH KLEWICKI, University of Melbourne — Streamwise velocity profiles and their wall-normal derivatives are used to investigate the properties of turbulent channel flow under the moderate polymer drag reduction (DR) conditions of 6-27%. Velocity data were obtained over a friction Reynolds number (Re) from 650-1800 using the single velocity component version of molecular tagging velocimetry (MTV). This adaptation of the MTV technique captures instantaneous profiles at high spatial resolution (>800 data points per profile), thus generating well-resolved derivative information. The mean velocity profiles indicate that the extent of the logarithmic region diminishes with increasing polymer concentration, while the logarithmic profile slope increases for drag reductions greater than about 20%. The measurements allow reconstruction of the mean momentum balance for channel flow that provides additional insights regarding the physics described by previous numerical simulation analyses that examined the mean dynamical structure of polymer laden channel flow at low Re. The present findings indicate that the polymer modifies the onset of the inertial domain, and that the extent of this domain shrinks with increasing DR. Once on the inertial domain, self-similar behaviors occur, but modified (sometimes subtly) by the modified distribution of characteristic y-scaling behavior of the Reynolds stress motions.

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