Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Elastic turbulence in high Reynolds number polymer drag reduced flows YVES DUBIEF, School of Engineering, University of Vermont, Burlington VT, CHRISTOPHER WHITE, Dept. of Mechanical Engineering, University of New Hampshire, Durham NH — The present study discusses the existence of small scale dynamics resembling elastic turbulence in polymeric transitional and maximum drag reduction (MDR) flows. The observed flow patterns are driven by elastic stress and occur in regions of very low turbulence found before and after the breakdown of nonlinear instabilities in polymeric transitional flows leading to MDR. A state of polymer-dominated spanwise instabilities was found, resulting in a structure of the wall shear quite different than the structures observed in transitional Newtonian flow. Similar instabilities are observed in the wake of the head of hairpin vortices in simulated MDR flows, an extended region of extensional flow of the order of the Kolmogorov scale in the normal direction . The important Reynolds number is not that of flow ($Re_\tau = 300$ and 600 for the Newtonian flows) but that of the local turbulent flow, which according to Kolmogorov approaches unity in the above mentioned flows, a reasonable magnitude for elastic turbulence. The existence of small scale elastic turbulence in transitional and MDR flows explains the phenomenon of early turbulence first observed in the 70s and challenges the notion that, in drag reduced flows, the energy flows only from large to small scales and never goes back from polymers to flow.

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Date submitted: 05 Aug 2011 Electronic form version 1.4