Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Influence of solution rheology on the extent of polymer induced drag reduction in turbulent channel flow: A direct numerical simulation (DNS) study CHANG-FENG LI, RADHAKRISHNA SURESHKUMAR, BAMIN KHOMAMI, The Materials Research Laboratory, Department of Chemical Engineering, Washington University, St. Louis, MO 63130 — Hi-fidelity DNS channel flow simulations of polymer induced drag reduction up to the maximum drag reduction (MDR) limit have been performed using a fully spectral method in conjunction with a number of kinetically theory based elastic dumbbell models for description of the polymer chain dynamics. The simulation results in turn have been used to develop a scaling that describes the interplay between fluid rheology (i.e., maximum chain extension and fluid relaxation time) and the extent of drag reduction as a function of Reynolds number. In addition, turbulence statistics are analyzed and correlations between the polymer body force, velocity fluctuations and vortical structures have been developed with particular emphasis on the high drag reduction (HDR) and the MDR regime. Based on these observations a mechanism for polymer induced drag reduction as well as an eddy viscosity model is proposed.

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Date submitted: 11 Aug 2005 Electronic form version 1.4