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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
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eering, Washington University, St. Louis, MO 63130 — Hi-fidelity DNS channel
flow simulations of polymer induced drag reduction up to the maximum drag reduc-
tion (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., maxi-
mum 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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