Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

The maximum drag reduction asymptote BJÖRN HOF, DEVRANJAN SAMANTA, Max Planck Institute for Dynamics and Self Organization, CHRISTIAN WAGNER, Saarland University — Addition of a small amount of long chain polymers to a Newtonian solvent can lead to a dramatic drag reduction in turbulent flows. This effect has been extensively studied since its discovery in the late 1940's. The drag reduction at first is proportional to the polymer concentration (Weisenberg number) but then saturates to the maximum drag reduction (MDR) asymptote. It is commonly believed that drag reduction results from an adjustment of the turbulent flow structure due to the action of the polymers. We here present experimental results of turbulent pipe flows using dilute polyacrylamid solutions at relatively large Weisenberg numbers ($\sim$10). Our results show that for relatively low polymer concentrations transition to turbulence is postponed to higher Reynolds numbers. However when the Weisenberg number is increased further we find that the subcritical transition to turbulence, typical for Newtonian pipe flow disappears. Instead a supercritical instability is found at much lower Reynolds numbers which gives rise to a disordered flow. The observed drag of this disordered flow is identical to the well known MDR asymptote.

Björn Hof
Max Planck Institute for Dynamics and Self Organization

Date submitted: 11 Aug 2011 Electronic form version 1.4