Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Simulations of high Reynolds number wake transition in the presence of viscoelasticity DAVID RICHTER, GIANLUCA IACCARINO, ERIC SHAQFEH, Stanford University — Using our three dimensional, time dependent finite volume code developed to compute non-Newtonian flows over a large range of Reynolds number (Re), we performed simulations of viscoelastic flow past a circular cylinder. Our focus was on elucidating elastic effects on transition to turbulence in the presence of viscoelasticity. The FENE-P constitutive model was used to describe the presence of polymers, and the numerical method employed was such that a large range of rheological parameters (polymer length L, dimensionless Weissenberg number (Wi), and polymer concentration β) could be probed. We present a study of the viscoelastic effects on the inertial wake at high Re. Simulations were performed at Reynolds numbers of both 300 and 3900, and in each case we witness significant viscoelastic stabilization of structures typically seen in Newtonian flows. At $Re = 300$, the characteristic Newtonian mode A and mode B instabilities can either be weakened or completely suppressed based on the polymer extensibility L - an effect which has been further confirmed with linear stability analysis. Furthermore, at $Re = 3900$, even a small concentration of low extensibility polymers has the ability to stabilize the shear layer (which has transitioned for pure Newtonian flow), and revert the wake structure back to one resembling the mode B instability, a state seen in Newtonian flows at much lower Reynolds numbers.

David Richter
Stanford University

Date submitted: 10 Aug 2010 Electronic form version 1.4