Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Studying the Topology and Dynamics of Elasto-inertial Channel Flow Turbulence Using the Invariants of the Velocity Gradient Tensor and Dynamic Mode Decomposition[1] JULIO SORIA, Mechanical Engineering Dept, Monash University, Australia, VINCENT TERRAPON, Aerospace & Mechanical Engineering Dept, University of Liege, Belgium, YVES DUBIEF, School of Engineering, University of Vermont, VT — Direct numerical simulations (DNS) of the transition to and fully developed elasto-inertial turbulence (EIT) of a polymer solution in a channel flow has been used as a basis for the study of the topology and dynamics of these flows. The Reynolds number in these DNS ranged from 500 to 5000. The topology of these flows was studied through the joint probability density functions (JPDFs) of the second and third invariants of the velocity gradient tensor (VGT), Q_A and R_A respectively and the JPDFs of the second invariants of the rate-of-strain tensor and the rate-of-rotation tensor, Q_S and Q_W respectively. The results suggest that these transitional and fully developed EIT flows are predominantly made up of vortex sheets. Dynamic mode decomposition has been undertaken on the second invariant of the VGT, Q_A, which reveals that the most amplified mode is a two-dimensional structure located in the near-wall region. A "discontinuity" is observed close to the wall, which corresponds closely to the location of extrema of the mean polymer extension and is hypothesized to be a critical layer.

[1]Conducted during the 2012 CTR Summer Program

Yves Dubief
School of Engineering, University of Vermont, VT

Date submitted: 07 Aug 2012 Electronic form version 1.4