Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

An "inverse-Orr" mechanism for spanwise vorticity amplification in viscoelastic fluids JACOB PAGE, Imperial College London, TAMER ZAKI, Johns Hopkins University, Imperial College London — The linear dynamics of spanwise vorticity fluctuations in homogeneous shear flow of a viscoelastic fluid are examined. A weak Gaussian vortex is superposed onto the mean shear and its time evolution is computed for Oldroyd-B and FENE-P fluids. Unlike the Newtonian case where the vortex is purely advected, the polymeric flow exhibits intriguing behaviors: (i) At high elasticity, the vortex splits into a co-rotating pair which propagate in opposing horizontal directions. (ii) For weaker elasticities, the vortex splitting takes place at early times but the evolution is dominated by an algebraic amplification of vorticity. Both the splitting and amplification are explained using the linear equations for spanwise vorticity and polymer torque for the Oldroyd-B fluid. The splitting results from the ability of the fluid to support vorticity wave propagation along the tensioned mean-flow streamlines. The spanwise vorticity amplification occurs due to a kinematic mechanism that generates polymer torque. This mechanism is an "inverse-Orr" effect where amplification occurs as the disturbance is tilted into the shear. In the case of finite polymer extensibility, similar qualitative features are retained although decay sets in earlier as polymer chains become significantly stretched.

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Date submitted: 31 Jul 2014 Electronic form version 1.4