Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Exact coherent states in purely elastic parallel shear flows[1] TOBY SEARLE, ALEXANDER MOROZOV, University of Edinburgh — Parallel shear flows provide a model system for the understanding of the transition to and structure of incompressible Newtonian turbulence. The turbulent attractor is often thought of as structured by a series of exact solutions to the Navier-Stokes equations, where a turbulent flow "pinballs" between these solutions in phase space. The most intuitive mechanism for the appearance of these structures was formulated by F. Waleffe and is known as "the self-sustaining process." A novel form of turbulence has been discovered in polymeric fluids where the Reynold's number is low, $Re < 1$, and the Weissenberg number (characterising the fluid elasticity) is large. Using an analogy with the Newtonian self-sustaining process, we attempt to construct the purely elastic counterpart for plane Couette flow of polymer solutions. By introducing a forcing term to the coupled Navier-Stokes and Oldroyd-B equations, we observe the formation of purely elastic streaks and consider their linear stability. We find that there exists a previously unrecognised purely elastic analogue of the Kelvin-Helmholtz instability that gives rise to the streamwise waviness of Newtonian coherent structures. We discuss how this instability might close the cycle and lead to a sustained purely elastic coherent structure.

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Date submitted: 31 Jul 2014 Electronic form version 1.4