Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Exact coherent structures in two-dimensional viscoelastic channel flow JACOB PAGE, University of Cambridge, YVES DUBIEF, University of Vermont, RICH KERSWELL, University of Cambridge — Elasto-inertial turbulence (EIT) is a recently discovered flow state in dilute polymer solutions that is strikingly different to quasi-Newtonian, drag-reduced flows. EIT is largely two-dimensional; its dominant flow features are thin sheet-like structures of polymer stress with attached patches of intense spanwise vorticity. In this talk we explore the mechanics underpinning EIT by searching for exact coherent structures in elasto-inertial planar channel flows. The structures we find are all connected to a recently discovered linear instability (Garg et al, Phys. Rev. Lett. 121, 2018) of the basic state that exists at moderate elasticities $Wi < Re < Wi^3$. Just beyond the point of marginal stability ($Wi \sim 25$, $Re \sim 50$) the global attractor is a relative periodic orbit (RPO) featuring a pair of large amplitude sheets that meet at the centreline. This RPO bifurcates off a strongly subcritical travelling wave that exists for Weissenberg numbers as low as $Wi \sim 10$. We perform branch continuation of this travelling wave upwards in Reynolds number to explore its overlap with EIT. Time permitting, we will also discuss the physical mechanisms at play in the new linear instability.

Jacob Page
University of Cambridge

Date submitted: 31 Jul 2019 Electronic form version 1.4