Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Viscoelastic and elastomeric active matter: linear instability and nonlinear dynamics EWAN J. HEMINGWAY, Durham University, M. E. CATES, University of Cambridge, M. C. MARCHETTI, Syracuse University, S. M. FIELDING, Durham University — We consider a continuum model of active viscoelastic matter, whereby a model of an active nematic liquid-crystal is coupled to a minimal model of polymer dynamics with a viscoelastic relaxation time τ_c. To explore the resulting interplay between active and polymeric dynamics, we first generalise a linear stability analysis (from earlier studies without polymer) to derive criteria for the onset of spontaneous flow. Perhaps surprisingly, our results show that the spontaneous flow instability persists even for divergent polymer relaxation times. We explore the novel dynamical states to which these instabilities lead by means of nonlinear numerical simulations. This reveals oscillatory shear-banded states in 1D, and activity-driven turbulence in 2D, even in the limit $\tau_c \to \infty$. Adding polymer can also have calming effects, increasing the net throughput of spontaneous flow along a channel in a new type of "drag-reduction", an effect that may have implications for cytoplasmic streaming processes within the cell.

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Date submitted: 06 Nov 2015

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