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Travelling waves and their stability in elasto-inertial plane Poiseuille flow[1] TOBY SEARLE, ALEXANDER MOROZOV, University of Edinburgh — Purely elastic turbulence occurs in polymer solutions and other viscoelastic fluids when the Reynold's number is very small ($Re < 1$) and the Weissenberg number is large. Recent numerical modelling and experimental study has revealed another form of turbulence somewhere between that controlled by inertia and that governed by the elasticity of the fluid. Flows in this elasto-inertial regime support coherent structures that are unlike the usual Newtonian ones, and turbulence sets in at a lower Reynold's number. It is thought that these structures are similar to those present in purely elastic turbulence. We use 2 dimensional exact solutions in plane Poiseuille flow of an Oldroyd-B fluid to investigate this elasto-inertial regime. First we find viscoelastic travelling wave solutions via numerical continuation from their Newtonian counterparts. We investigate how these solutions are affected by the addition of the polymeric fluid and perform a linear stability analysis in the spanwise direction. We find that these viscoelastic travelling-wave solutions are in fact unstable to 3 dimensional perturbations, and discuss how these instabilities differ from those found in Newtonian turbulence.

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