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Self-sustained elastoinertial Tollmien-Schlichting waves[1] ASHWIN SHEKAR, University of Wisconsin - Madison, RYAN MCMULLEN, BEVERLEY MCKEON, Caltech, MICHAEL GRAHAM, University of Wisconsin - Madison — Direct simulations of 2D channel flow of a viscoelastic fluid at Re=3000 reveal the existence of a family of attractors that closely resembles the linear Tollmien-Schlichting (TS) mode, and exhibits localized stress fluctuations at the critical layer position. At the parameter values chosen, this solution branch represents a solution family that is nonlinearly self-sustained by viscoelasticity and connected through an unstable solution branch to 2D elastoinertial turbulence (EIT). This "baby-EIT" state displays tilted sheetlike structures that originate with the hyperbolic stagnation points of the "Kelvin cat's eye" kinematics of the TS wave. Tilted sheets of polymer stretch are also a feature of EIT. Further, at Re=10000, we show that the attractor associated with the viscoelastic extension of the Newtonian nonlinear TS branch is directly connected to 2D EIT. At intermediate levels of viscoelasticity, this attractor goes from intermittently displaying TS-like structures to EIT-like structures, shedding insights into viscoelastic self-sustenance. These results suggest that, in the parameter range considered here, the transition leading to EIT is mediated by nonlinear amplification and self-sustenance of perturbations that excite the TS mode.

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