Abstract Submitted
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Critical layers, Tollmien-Schlichting waves and elastoinertial turbulence[1] ASHWIN SHEKAR, University of Wisconsin-Madison, RYAN MCMULLEN, BEVERLEY MCKEON, Caltech, MICHAEL GRAHAM, University of Wisconsin-Madison — We describe direct numerical simulations (DNS) and linearized analyses of channel flow turbulence in a FENE-P fluid in the elastoinertial turbulence (EIT) regime. Simulations at low (transitional) Reynolds numbers are shown to display localized polymer stretch fluctuations very similar to structures arising from linear stability (Tollmien-Schlichting (TS) modes) and resolvent analyses: i.e., critical-layer structures localized where the mean fluid velocity equals the wavespeed. Self-sustained nonlinear TS waves display stagnation points that generate sheets of large polymer stretch. These kinematics may be the genesis of similar structures in EIT. We also describe a new self-sustaining elastoinertial state which we term the lower branch attractor (LBA), which has very small amplitude and whose structure closely resembles that of the linear TS mode. A tentative bifurcation scenario describing our observations is described. We also identify the mimimal flow unit for EIT, which at low Reynolds number continues to exhibit localized stress fluctuations. Finally, resolvent analysis and transient simulations of the linearized problem shed light on the origins of the mechanisms leading to amplification of fluctuations and thus to the bypass-transition nature of the onset of EIT.

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