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Self-sustaining vortex perturbations in smooth shear flows[1]
JUHYUNG KIM, JEAN C. PEREZ, WENDELL HORTON, Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712, USA, GEORGE D. CHAGELISHVILI, R. G. CHANISHVILI, J.G. LOMINADZE, Abastumani Astrophysical Observatory, A. Kazbegi 2a, Tbilisi 0160, Georgia, JOHN C. BOWMAN, Department of Mathematical and Statistical Sciences, University of Alberta, Edmonton, Alberta, Canada, T6G 2G1 — The nonlinear dynamics of coherent cyclonic and anticyclonic vortices in plane flow with constant shear is investigated numerically using a Fourier pseudospectral code. The flow is asymptotically linearly stable, but is highly nonnormal, allowing transient perturbations to gain energy from the background shear flow. This linear transient growth interplays with nonlinear processes and can lead to change the asymptotic behavior. We show that a fixed background shear flow can maintain finite amplitude cyclonic vortices indefinitely in time through a positive feedback mechanism between the nonlinear interactions and the external shearing of the vortex flow. A plasma laboratory experiment is suggested based on the results of this investigation.

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