Abstract Submitted
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Understanding the Role of Nonlinearity in the Dynamics of Turbulent Couette Flow by Comparing Quasilinear Simulations to DNS[1] BRIAN FARRELL, Harvard University, PETROS IOANNOU, MARIOS-ANDREAS NIKOLAIDIS, National and Kapodistrian University of Athens — Both linear non-normality and nonlinearity are essential to sustaining wall turbulence. Inspired by studies of the statistical state dynamics of wall turbulence, the nonlinearity in the Navier-Stokes equations can be partitioned into a quasilinear component and a perturbation-perturbation nonlinearity component. Using the streamwise mean in this partition optimally separates the quasilinear and nonlinear mechanisms in the turbulence. These mechanisms are parametric growth arising from straining of the perturbations in the turbulence by the fluctuating streamwise mean flow and transient growth of perturbations arising from perturbation-perturbation nonlinearity. Comparing turbulence diagnostics between a quasilinear simulation and its associated DNS separates the mechanisms of parametric growth of perturbations in the turbulence from transient growth of perturbations introduced into the turbulence by perturbation nonlinearity. It is found using this comparison that the parametric mechanism is primarily responsible for maintaining perturbations in both the quasilinear simulation and DNS. It is concluded that the mechanism supporting the turbulence in Couette flow is the parametric mechanism isolated by quasilinear dynamics.

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