Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

A Reduced Nonlinear Model of Wall-Bounded Shear Flow Turbulence BRIAN FARRELL, Harvard University, PETROS IOANNOU, MARIOS NIKOLAIDIS, National and Kapodistrian University of Athens, ADRIAN LOZANO-DURAN, JAVIER JIMENEZ, E.T.S. Ingenieros Aeronauticos, DENNICE GAYME, VAUGHAN THOMAS, Johns Hopkins University — The roll/streak is the dominant structure in the dynamics of wall-bounded shear flow turbulence. It appears that this structure arises from a nonlinear instability, the various proposed mechanisms for which are referred to as self-sustaining processes. However, even once the nonlinear instability is identified there remains the problem of understanding how this instability is regulated to maintain the observed turbulent state. Here both of these questions will be addressed by adopting the perspective of statistical state dynamics (SSD), specifically its reduced nonlinear (RNL) implementation. RNL comprises the joint evolution of the streamwise constant mean flow (first cumulant) and second order perturbation statistics (second cumulant). This restriction greatly reduces the complexity of the dynamics while retaining a realistic SSP. The perturbations supporting the SSP in RNL arise from parametric instability of the time-dependence streak the statistical stability of these perturbations being enforced by a feedback mediated control process operating between the mean flow and the perturbations. In this talk it will be shown how the maintenance and regulation of RNL turbulence allows insight into the mechanism of turbulence in wall-bounded shear flow.

Brian Farrell
Harvard University

Date submitted: 31 Jul 2015 Electronic form version 1.4