Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Onset of turbulent mean dynamics in boundary layer flow CURTIS HAMMAN, TARANEH SAYADI, PARVIZ MOIN, Center for Turbulence Research, Stanford University — Statistical properties of turbulence in low Reynolds number boundary layers are compared. Certain properties are shown to approach an asymptotic state resembling higher Reynolds number flow much earlier during transition than previously thought. This incipient turbulence is less stochastic and more organized than developed turbulence farther downstream, but the mean dynamics and production mechanisms are remarkably similar. The onset of turbulence in our recent simulations is also similar to that observed in the bypass transition of Wu & Moin where continuous freestream turbulence, rather than small-amplitude linear waves, triggers transition. For these inflow disturbances, self-sustaining turbulence occurs rapidly after laminar flow breakdown without requiring a significant development length nor significant randomization. Slight disagreements with FST-induced bypass transition are observed that correlate with the extra strain a turbulent freestream would impose upon the near-wall dynamics. Nevertheless, the turbulence statistics are similar shortly after the skin-friction overshoot independent of upstream receptivity. This early onset of deterministic turbulence provides support for reduced-order modeling of turbulent boundary layers based on non-linear stability mechanisms.

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Date submitted: 06 Aug 2012 Electronic form version 1.4