Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Near equilibrium in intermittently turbulent oscillatory boundary layer flows DIMITRIOS K. FYTANIDIS, MARCELO H. GARCIA, PAUL FISCHER, University of Illinois at Urbana-Champaign — Direct Numerical Simulation results, produced using the spectral element solver Nek5000, have been used to examine the mean flow structure of oscillatory boundary layer flows in the intermittently turbulent regime. Comparison with unidirectional developing boundary layers results reveal similarities in the way that flow approaches a state that mimics the characteristics of the fully developed unidirectional turbulent boundary layer. The analysis of turbulence statistics revealed the existence of near-equilibrium conditions which result in the presence of a logarithmic velocity profile. The shape and defect parameter values are examined as diagnostics to reach the near-equilibrium conditions. The present analysis elucidates inconsistencies in the literature regarding the values of the velocity profile's slope and intersects in temporary accelerating boundary layers. In addition, the present analysis explains the presence of negative phase shift between free-stream velocity and bed shear maxima which is the result of a late and incomplete transition to a fully turbulent state.

Dimitrios K. Fytanidis
University of Illinois at Urbana-Champaign

Date submitted: 10 Aug 2020 Electronic form version 1.4