Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Spectral Characteristics of High Re Zero Pressure Gradient Turbulent Boundary Layers HASSAN NAGIB, KAPIL CHAUHAN, Illinois Institute of Technology, MICHAEL HITES, New Mexico State University, Las Cruces — One-dimensional spectra from data over the Re_θ range between 4,100 and 23,700 in a zero pressure gradient turbulent boundary layer are studied. Detailed spectra computed from long time series of the streamwise velocity reveal a bi-modal distribution of energy in the buffer layer close to the wall. This confirms that the large scale, low frequency, motions of the boundary layer are important in the dynamics of the near wall region. The spectra exhibit distinct trends in the inner, outer and overlap region of the boundary layer, over limits that are consistent with those found from the mean velocity profile. Near the wall, the high frequencies/small scales are characterized by the length ν/u_τ and velocity u_τ, reflecting the classical inner scales of mean velocity. Away from the wall, low frequencies/large scales spectra scale with the length scale δ and velocity scale u_τ, which are again consistent with the classical outer scales of mean velocity. Based on the inner and outer scalings, a spectral model is developed, which exhibits all the characteristics found in experimental measurements across the boundary layer. Results for Reynolds number trends of k^{-1} law, filtered time series and burst frequency will also be presented.

Hassan Nagib
Illinois Institute of Technology, Chicago

Date submitted: 01 Aug 2006 Electronic form version 1.4