Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Arrangement of scale-interaction and large-scale modulation in high Reynolds number turbulent boundary layers WOUTIJN J. BAARS, NICHOLAS HUTCHINS, IVAN MARUSIC, University of Melbourne — Interactions between small- and large-scale motions are inherent in the near-wall dynamics of wall-bounded flows. We here examine the scale-interaction embedded within the streamwise velocity component. Data were acquired using hot-wire anemometry in ZPG turbulent boundary layers, for Reynolds numbers ranging from $Re_\tau \equiv \delta U_\tau/\nu \approx 2800$ to 22800. After first decomposing velocity signals into contributions from small- and large-scales, we then represent the time-varying small-scale energy with time series of its instantaneous amplitude and instantaneous frequency, via a wavelet-based method. Features of the scale-interaction are inferred from iso-correlation maps, formed by correlating the large-scale velocity with its concurrent small-scale amplitude and frequency. Below the onset of the log-region, the physics constitutes aspects of amplitude modulation and frequency modulation. Time shifts, associated with the correlation extrema—representing the lead/lag of the small-scale signatures relative to the large-scales—are shown to be governed by inner-scaling. Wall-normal trends of time shifts are explained by considering the arrangement of scales in the log- and intermittent-regions, and how they relate to stochastic top-down and bottom-up processes.

Woutijn Baars
University of Melbourne

Date submitted: 30 Jul 2015 Electronic form version 1.4