Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Evolution and formation of shear layers in a developing turbulent boundary layer[1] JUNGHOON LEE, JASON MONTY, NICHOLAS HUTCHINS, The University of Melbourne — The evolution and formation mechanism of shear layers in the outer region of a turbulent boundary layer are investigated using time-resolved PIV datasets of a developing turbulent boundary layer from inception at the trip up to $Re_\tau = 3000$. An analysis of a sequence of instantaneous streamwise velocity fluctuation fields reveals that strong streamwise velocity gradients are prevalent along interfaces where low- and high-speed regions interact. To provide an insight on how such regions are associated with the formation of shear layers in the outer regions, we compute conditional averages of streamwise velocity fluctuations based on a strong shear layer. Our results reveal that one possible mechanism for the generation of shear layers in the outer region is due to the mismatch in the convection velocities between low- and high-speed regions. The results also indicate that the angle of the inclined shear layer is developing in time. In addition, the conditionally averaged velocity fluctuations exhibit a local instability along these shear layers, leading to a shear layer roll-up event as the layers evolve in time. Based on these findings, we propose a conceptual model which describes dynamic interactions of shear layers and their associated large-scale coherent motions.

[1]The authors wish to acknowledge the financial support of the Australian Research Council

JungHoon Lee
The University of Melbourne

Date submitted: 01 Aug 2016 Electronic form version 1.4