Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Quadrant Analysis of Zero and Adverse Pressure Gradient Turbulent Boundary Layers using High Spatial Resolution 2C-2D PIV Measurements[1] MUHAMMAD SHEHZAD, Lab. for Turbulence Research in Aerospace Combustion, Department of Mechanical and Aerospace Engineering, Monash University, Melbourne, Australia, JEAN-MARC FOUCAUT, CHRISTOPHE CUVIER, Universit Lille Nord de France, LML-Laboratoire de Mcanique de Lille, Lille, France, CHRISTIAN WILLERT, German Aerospace Center (DLR), Institute of Propulsion Technology, Kln, Germany, CALLUM ATKINSON, JULIO SORIA, Lab. for Turbulence Research in Aerospace Combustion, Department of Mechanical and Aerospace Engineering, Monash University, Melbourne, Australia — High spatial resolution particle image velocimetry (PIV) has been used in an experiment in a $2m$ wide, $1m$ high and $20m$ long LML boundary layer wind tunnel to measure the instantaneous velocity fields of ZPG-TBL at $Re_{\delta_2} = 7,750$ and APG-TBL at $Re_{\delta_2} = 9,840$ ($\beta = 2.01$) and $Re_{\delta_2} = 16,240$ ($\beta = 2.27$). High spatial resolution enables the capture of TBL from the viscous sublayer to the end of the log layer. We study the effect of mild APG on the individual contribution of the four quadrants of fluctuations in the streamwise and the wall-normal velocities towards Reynolds shear stress. It is found that near the wall ($y^+ < 30$), contributions of the first and third quadrants relative to the second quadrant are higher than relative to the fourth quadrant but in opposite direction in all three cases of TBL. Above $y^+ = 30$, these relative contributions are nearly 45% in ZPG-TBL and 50% in APG-TBL. Below $y^+ = 10$, all four quadrants contribute more towards the total Reynolds shear stress with increasing APG.

[1]Australian Research Council Discovery Grant

Muhammad Shehzad
Lab. for Turbulence Research in Aerospace
Combustion, Department of Mechanical and Aerospace Engineering, Monash University, Melbourne, Australia

Date submitted: 10 Aug 2020 Electronic form version 1.4