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Evolution of the Reynolds shear stresses in highly accelerated turbulent boundary layers GUILLERMO ARAYA, LUCIANO CASTILLO, FAZLE HUSSAIN, Texas Tech University — Turbulent boundary layers subjected to severe acceleration or strong Favorable Pressure Gradients (FPG) are of great fundamental and technological importance; examples of the latter include nozzle design, underwater bodies and drag reduction applications. Scientifically, they pose great interest from the point of view of scaling laws, the complex interaction between the outer and inner regions, and relaminarization phenomena. Direct Numerical Simulations (DNS) of highly accelerated turbulent boundary layers are performed by means of the Dynamic Multi-scale Approach (DMA) recently developed by [Araya et al. JFM, vol. 670, pp. 581-605, 2011]. It is shown that the Reynolds shear stress monotonically decreases and exhibits a logarithmic layer in the meso-layer region during the laminarization process. In addition, the local maxima of streamwise velocity fluctuations in wall units remain almost constant in the very strong FPG region, which prevents the flow to become completely laminar. Furthermore, the re-distribution of Reynolds shear stresses due to sweeps and ejections in the FPG region is performed and a physical mechanism is proposed.

Guillermo Araya
Texas Tech University

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