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On The Physical Mechanism of Turbulent Boundary Layer Drag Reduction Under AC-DBD Plasma Actuation SAMARESH MIDYA, ALAN DUONG, THOMAS CORKE, FLINT THOMAS, University of Notre Dame — The results of a series of experiments are reported which use near-wall active flow control designed to intervene in the process of streamwise vortex (SWV) generation, which is primarily responsible for turbulence production in wall-bounded flows. The flow control method utilizes an array of flush mounted AC-DBD plasma actuators in a ZPG TBL over the range of Re_τ =550-1750. The control flow consists of a series of near-wall, span-wise oriented unidirectional wall jets with velocity comparable to the friction velocity and has been shown to produce significant reductions (around 20%) in drag. The control flow is fully characterized using PIV. The span-wise wall jets inhibit the formation of near-wall SWVs & thus reduce the turbulence production. This manifests itself in the reduction of near wall turbulent Reynolds stress producing events. The focus of the reported experiments is to further clarify the mechanism of drag reduction. X-wire measurements utilizing the quadrant splitting technique are performed downstream of the actuator. These are used to characterize & contrast both the duration of & time interval between quadrant 2 & 4 events in the actuated & non-actuated flows. The quadrant contributions to the Reynolds stress are compared for natural & actuated cases. Effort has been made to correlate the observed drag reduction & the change in Reynolds stress profile. The turbulence statistics have also been compared to similar statistics obtained from a ZPG TBL under pulsed-DC plasma actuation where even higher drag reduction was achieved.

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