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**Holographic Microscopy Reveals Buffer Layer Structures Generating Wall Stress Extremes in a Turbulent Boundary Layer**[1] JIAN SHENG, University of minnesota, EDWIN MALKIEL, JOSEPH KATZ, Johns Hopkins University — 3-D velocity distributions and wall stresses are measured concurrently in the inner part of a turbulent boundary layer in a smooth square channel using digital holographic microscopy. With over 750 realizations analyzed, mean velocity and Reynolds stress profiles agree well with published data. Conditional sampling based on local shear stress maxima and minima reveals two types of dominant buffer layer structures. The first develops as spanwise vorticity lifts abruptly from the wall, creating initially a vertical arch, which is then stretched and forms a pair of inclined, counter rotating vortices with ejection-like flow between them. A wall-stress minimum occurs under the point of initial detachment, while stress maxima develop 35 wall units downstream, due to vortex-induced entrainment during early stages of vortex rollup. This structure exists in 16.4% of the samples. The second structure is a slightly inclined, single, predominantly streamwise vortex. It appears in 20% of the instantaneous realizations and generates an elongated, strong stress maximum on one side, and a weak minimum on the other.

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