Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Time Resolved Tomographic PIV Measurements of Rough-Wall Turbulent Channel Flow[1] RINALDO MIORINI, CAO ZHANG, JOSEPH KATZ, Johns Hopkins University — Time resolved tomographic PIV is used to study flow structures in the outer region of a rough-wall turbulent boundary layer, focusing on imprints of the roughness on the outer layer. Measurements are performed in a transparent channel installed in the JHU optically index matched facility. The roughness consists of pyramids with height, k=0.46 mm, and wavelength, λ =3.2 mm, satisfying h/k=55 (h=25.4 mm is the channel half-height), k^+ =64 and Re=40000. The TPIV setup consists of four high-speed cameras operating at 3 kHz, which view the sample volume through acrylic prisms. The flow field is illuminated by an Nd:YLF laser. Following enhancement, calibration, and reconstruction, 64^3 voxels interrogation volumes with 0.75 overlap provide 3D velocity fields with spacing of 0.588^3 mm^3. Formation and transport of near-wall 3D U-shaped vortex structures, with base in front of the pyramids, and quasi-streamwise legs extending between pyramid crest lines are evident from the data. Extended streamwise regions of high wall-normal vorticity appear "latched" to the roughness elements close to the wall, but are transported downstream at higher elevations. Also evident are traveling streamwise low velocity streaks, which cover many roughness elements.

[1]Sponsored by NSF CBET and ONR.

Rinaldo Miorini
Johns Hopkins University

Date submitted: 02 Aug 2013 Electronic form version 1.4