Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Coherent structures and associated sub-grid scale energy transfer in a rough-wall turbulent channel flow[1] JIARONG HONG, JOSEPH KATZ, CHARLES MENEVEAU, Johns Hopkins University, MICHAEL SCHULTZ, United States Naval Academy — Our earlier study has revealed spectral bumps and enhanced dissipation of turbulent kinetic energy (TKE) by roughness scale eddies in the outer parts of a rough wall channel flows at Re_τ=3520-5360. Here, conditional averaging of PIV data, based on high subgrid-scale (SGS) energy flux, shows an inclined large structure with negative spanwise vorticity in streamwise-wall-normal (xy) planes, and two pairs of counter-rotating vortices in streamwise-spanwise (xz) planes, both near the wall and in the outer-layer. In instantaneous snapshots, this structure consists of periodic bundles of roughness-scale eddies spaced by a roughness wavelength, resulting from lifting and re-orientation of near-wall, quasi-streamwise vortices. Near the wall, the peak of SGS energy flux occur at the intersection of the quasi-streamwise eddies, while in the outer-layer, elevated flux occurs within the large structure owing to interaction among eddies in a bundle. At the conditioning point, the SGS kinetic energy peaks, but the resolved TKE has a minimum. The location of the resolved TKE maximum varies with elevation due to the increasing impact of ejections with distance from the wall.

[1]Sponsored by ONR.

Jiarong Hong
Johns Hopkins University

Date submitted: 12 Aug 2011 Electronic form version 1.4