Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Near-wall turbulent fluctuation in the absence of the wide outer motions YONGYUN HWANG, DAMTP, University of Cambridge — Numerical experiments which filter out turbulent motions wider than $\lambda_z^+ \simeq 100$ are carried out up to $Re_\tau = 660$ in a turbulent channel. The mean-velocity profile shows very good agreement with that of full simulation below $y^+ \simeq 40$. The turbulent fluctuations mainly consist of two parts: the long streamwise velocity fluctuation confined to the near-wall region with $\lambda_x^+ \simeq 600 \sim 800$, and the short fluctuation of all the velocity components with $\lambda_x^+ \simeq 200 \sim 300$ inducing turbulence even above $y^+ \simeq 100$. In the absence of the wide outer motions, the former remains almost unchanged with the Reynolds number, resulting in an almost constant value of the near-wall maximum streamwise velocity fluctuation at all the Reynolds numbers considered. On the other hand, the latter strongly interacts with the non-realistic mean shear in the outer region and induces non-negligible amounts of the fluctuation near the channel center even at $Re_\tau = 660$. The removal of the wider structures also reveals significant amounts of drag reduction particularly at large Reynolds numbers, implying that the filtered wide outer structures are involved in generating turbulent skin friction.

Yongyun Hwang
DAMTP, University of Cambridge

Date submitted: 20 Jul 2012 Electronic form version 1.4