Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

What happens to wall-bounded flows when the mean velocity profile is artificially prescribed?[1] JAVIER JIMENEZ, U. Politécnica Madrid and CTR Stanford, FLORIAN TUERKE, UPM and Technische U. Berlin — Direct numerical simulations of turbulent channels with artificially prescribed mean velocity profiles, both natural and purposely unnatural, are used to study the dynamics of the energy-containing turbulent fluctuations. It is found that turbulence develops correctly in natural profiles, but that even slightly incorrect mean velocity gradients modify the intensities and Reynolds stresses substantially. The extra energy created by a locally stronger imposed shear resides in structures with essentially correct dimensionless ratios, but which are out of energy equilibrium. In profiles with sharp shear jumps in the logarithmic layer, the relaxation rates away from the discontinuity are different for the kinetic energy, the tangential Reynolds stress, and the dissipation, but they are all consistent with the turbulent advection of eddies with relaxation times of the order of the local eddy turnover. Correspondingly, the energy imbalance is compensated by turbulent diffusion. Interestingly, only eddies above a certain size are created by the discontinuity. The smallest ones do not immediately attach to the wall, but those about twice as large do.

[1]Funded by CICYT and ERC.

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Date submitted: 10 Aug 2011 Electronic form version 1.4