Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Direct numerical simulation of flat-plate turbulent boundary layer up to $Re_\theta = 2000$ XIAOHUA WU, Royal Military College of Canada, PARVIZ MOIN, CTR, Stanford University — Recent flow visualization and statistical results from DNS of flat plate turbulent boundary layer are presented. We have extended the DNS of Wu & Moin (JFM, **630**, 2009) to twice the streamwise length with much increased Reynolds number. The calculations were carried out using a grid of 8192×500×256 along the streamwise, wall-normal and spanwise directions, respectively. The computational domain in the spanwise direction was increased by 50% over the earlier calculations of Wu & Moin. Well-controlled boundary layer bypass transition to turbulence is promoted by the passage of isotropic turbulent flow patches in the free-stream. As in Wu & Moin, in the transitional region, the instantaneous flow fields are vividly populated by hairpin vortices with distinct regularity. Many of these transitional hairpin vortices reach the local boundary layer edge. Throughout the turbulent region, forests of hairpin vortices are found to persist. As Reynolds number increases with downstream distance, the hairpin vortices exhibit more chaotic characteristics in the form of twisting and merging with more pronounced irregularity compared to their transitional counterparts. At higher Reynolds numbers hairpin forests are generally limited to about 70 percent of the local boundary layer thickness. Mean and second-order turbulence statistics and the corresponding spatial and time scales will also be presented.

Xiaohua Wu
Royal Military College of Canada

Date submitted: 06 Aug 2009 Electronic form version 1.4