Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

On the physics of the bimodal coherent dynamics of the turbulent horseshoe vortex at Re=1.16 $\times$ 10^5 JOONGCHEOL PAIK, CRISTIAN ESCAURIAZA , FOTIS SOTIROPOULOS, University of Minnesota — Due to the strong adverse pressure gradients, the boundary layer approaching a wall-mounted obstacle undergoes a three-dimensional separation with horseshoe vortices which wrap around the obstacle like necklace. Devenport and Simpson (J Fluid Mech., Vol. 210, P. 23 1990) reported the large scale unsteady bimodal nature of the horseshoe vortex system in the leading edge region of a wing at Re=1.16 $\times$ 10^5 which switches aperiodically from one mode to another at time intervals and accounts for turbulent energy production and turbulent stresses an order of magnitude higher than those from conventional shear mechanism in the upstream boundary layer. We carried out detached eddy simulations of the flow past a wing experimentally investigated by Devenport and Simpson and for the first time numerically confirmed the experimental finding of the bimodal velocity probability phenomenon in the horseshoe vortex region. Detailed quantitative comparisons with the measurements and analysis of the 3D nature of large scale coherent vortical structures in the wing-body junction flow will be present in the presentation.

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Date submitted: 05 Aug 2006 Electronic form version 1.4