Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Reynolds number effects on the coherent dynamics of the turbulent horseshoe vortex FOTIS SOTIROPOULOS, JOONGCHEOL PAIK, CRISTIAN ESCAURIAZA, University of Minnesota — The streamwise adverse pressure gradient set up by a wall-mounted obstacle causes the approaching boundary layer to separate and form horseshoe vortices (HSV) in the leading edge region. Reynolds number (Re) is one of most dominant factors on the locations of the boundary layer separation line and the stagnation point, the instability of the primary HSV causing the bursting into other vortices, the number of vortices and their interplays in the junction region, and the unsteady bimodal behavior of the HSV. We carried out detached eddy simulations of flows past a circular cylinder normally wall-mounted on a flat bed at Res ranging from 2.0 x 10^4 to 1.0 x 10^5 and analyzed the effect of Re on the large scale unsteady behavior of the turbulent HSV system. The computed results confirmed Dargahi's flow visualizations and mean flow measurements of the junction flow at Res of 2.0 x 10^4 and 3.9 x 10^4 (Exp. Fluids, Vol. 8. p. 1, 1989) which consists of a complex system of multiple vortices shedding, merging and interacting quasi-periodically in the junction region. Numerical solutions further confirmed distinct bimodal velocity histogram of the turbulent HSV system produced by its natural instability at high Re.

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Date submitted: 04 Aug 2006 Electronic form version 1.4