Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Tomographic PIV Study of Hairpin Vortices[1] DANIEL SABATINO, TOBIAS ROSSMANN, Lafayette College — Tomographic PIV is used in a free surface water channel to quantify the flow behavior of hairpin vortices that are artificially generated in a laminar boundary layer. Direct injection from a 32:1 aspect ratio slot at low blowing ratios ($0.1 < BR < 0.2$) is used to generate an isolated hairpin vortex in a thick laminar boundary layer ($485 < Re_{\delta^*} < 600$). Due to the large dynamic range of length and velocity scales (the resulting vortices have advection velocities 5X greater than their tangential velocities), a tailored optical arrangement and specialized post processing techniques are required to fully capture the small-scale behavior and long-time development of the flow field. Hairpin generation and evolution are presented using the λ_2 criterion derived from the instantaneous, three-dimensional velocity field. The insight provided by the tomographic data is also compared to the conclusions drawn from 2D PIV and passive scalar visualizations. Finally, the three-dimensional behavior of the measured velocity field is correlated with that of a simultaneously imaged, passive scalar dye that marks the boundary of the injected fluid, allowing the examination of the entrainment behavior of the hairpin.

[1]Supported by the National Science Foundation under Grant CBET-1040236

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Date submitted: 01 Aug 2014 Electronic form version 1.4