Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Half-loop and full-loop shedding in the wake of wall-mounted square cylinders due to boundary layer-wake interaction JASON BOURGEOIS, ZAHRA HOSSEINI, ROBERT MARTINUZZI, University of Calgary — The vortical flow in the finite wall-mounted obstacle wakes can be important in heat transfer devices, turbomachinery components, and flame stabilizer devices, and is of fundamental importance since it displays fully three-dimensional states of Kármán vortex streets that are found in 2D bluff body wakes. The turbulent state of the wake of a finite square cylinder (height-to-width ratio h/w=8) has been found to be sensitive to the conditions of the approach boundary layer. The energetic quasi-periodic vortical structure topology is found to change between two topological states. Boundary layer thicknesses δ/d=0.7 and 1.6 yield half-loop and full-loop structures, respectively. This modification of the structure topology has significant consequences for modifying the mixing, momentum transfer, turbulence production, and Reynolds stresses in the wake. Using synchronized particle image velocimetry (PIV) and surface pressure measurements for these two boundary layers, the coherent structures in the wake of the cylinder are reconstructed and analyzed. Vortical connector strands which tie together subsequently shed structures lead to high incoherent Reynolds stresses, streamwise vorticity, vortex stretching, and turbulence production in their neighbourhood, but do not appear in the lower regions of the wake for the half-loop topology.

Jason Bourgeois
University of Calgary

Date submitted: 04 Aug 2011 Electronic form version 1.4