Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

DNS of the flow around a wall-mounted square cylinder under various inflow conditions RICARDO VINUESA, PHILIPP SCHLATTER, JOHAN MALM, DAN S. HENNINGSON, KTH Mechanics, CATHERINE MAVRIPLIS, University of Ottawa — The flow around a wall-mounted square cylinder is investigated by means of DNS. The effect of inflow conditions is assessed by considering two different cases with matching $Re_\theta \simeq 1000$ at the obstacle: the first case is a fully-turbulent zero pressure gradient boundary layer, and the second one is a laminar boundary layer with prescribed Blasius inflow profile. An auxiliary simulation carried out with the pseudo-spectral code SIMSON is used to obtain time-dependent inflow conditions which are then fed into the main simulation where the actual flow around the cylinder is computed. This main simulation is performed, for both laminar and turbulent inflows, with the spectral element code Nek5000. Transition to turbulence is observed in the laminar case, induced by the recirculation bubble produced at the obstacle. In both cases we find the same Strouhal number $St = 0.1$, in good agreement with available experimental measurements, although the two wakes exhibit structural differences associated with turbulent wall-normal transport and spanwise fluctuations. In the turbulent case the streamwise fluctuations modulate the horseshoe vortex formed around the cylinder. Additional insight on the differences between both wakes is achieved by means of a POD study of the flow.

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Date submitted: 29 Jul 2014 Electronic form version 1.4