Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Compressibility effects in planar wakes JEAN-PIERRE HICKEY, Royal Military College of Canada, FAZLE HUSSAIN, University of Houston, XIAOHUA WU, Royal Military College of Canada — Far-field, temporally evolving planar wakes are studied by DNS to evaluate the effect of compressibility on the flow. A high-order predictor-corrector code was developed and fully validated against canonical compressible test cases. In this study, wake simulations are performed at constant Reynolds number for three different Mach numbers: $Ma = 0.2$, 0.8 and 1.2. The domain is doubly periodic with a non-reflecting boundary in the cross-flow and is initialized by a randomly perturbed laminar profile. The compressibility of the flow modifies the observed structures which show greater three-dimensionality. A self-similar period develops in which the square of the wake half-width increase linearly with time and the Reynolds stress statistics at various times collapse using proper scaling parameters. The growth-rate increases with increasing compressibility of the flow: an observation which is substantiated by experimental results but is in stark contrast with the high-speed mixing-layer. As the growth-rate is related to the mixing ability of the flow, the impact of compressibility is of fundamental importance. Therefore, we seek an explanation of the modified growth-rate by investigating the turbulent kinetic energy equation. From the analysis, it can be conjectured that the pressure-strain term might play a role in the modified growth-rate.

Jean-Pierre Hickey
Royal Military College of Canada

Date submitted: 06 Aug 2010 Electronic form version 1.4