Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Two-Equation Turbulence Model Predictions of Transition in Buoyancy- and Shock-Driven Flows[1] BRYAN JOHNSON, OLEG SCHILLING, Lawrence Livermore National Laboratory — Two-equation Reynolds-averaged Navier–Stokes (RANS) models are generally regarded as relevant only for fully-developed turbulent flow. It is shown here that the early-time evolution of these models captures the turbulent transition for Rayleigh–Taylor instability and shock–turbulence interaction. When the fluctuation energy is much less than the mean flow energy, turbulent diffusion is negligible and the equations can be integrated analytically for a steady mean flow. For an incompressible flow, the turbulent kinetic energy grows exponentially at the physical growth rate (with appropriate model coefficients). For a shock-driven flow, the turbulent kinetic energy is amplified over the advection time across the shock, with an amplification factor equivalent to the physical amplification factor. Once turbulent diffusion becomes important, the turbulent quantities across the mixing layer are generally insensitive to the initial evolution. The primary consequence of varying model coefficients and initial conditions in the linear regime is a shift in the time at which the mixing layer begins to develop.

[1]This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

Bryan Johnson
Lawrence Livermore National Laboratory

Date submitted: 03 Aug 2010 Electronic form version 1.4