Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

A Three- or Four-Equation Reynolds-Averaged Navier-Stokes Model of Large Reynolds Number Rayleigh-Taylor Turbulence and Mixing[1] OLEG SCHILLING, Lawrence Livermore National Laboratory, GREGORY BURTON, Stanford University — Using data from a 3072^3 direct numerical simulation of Rayleigh–Taylor flow [*Nature Physics* **2**, 562 (2006)], it is shown *a priori* that gradient-diffusion and scale-similarity closures provide a closed three- or four- equation Reynolds-averaged Navier–Stokes model that correlates well with the data. In particular, using order of magnitude estimates of the exact transport equations and their closures, it is shown that the turbulent production and destruction terms in the turbulent kinetic energy dissipation rate and density variance dissipation rate equations scale as the square root of the turbulent Reynolds number, resulting in scale-similarity model coefficients that asymptote. A simplified algebraic Reynolds stress tensor model, similar to that used in turbulent convection and other buoyancy-driven turbulent flows, is shown to provide a good model for the anisotropic Reynolds stress tensor. Exploration of other algebraic Reynolds stress modeling approaches for incorporating the early-time nonequilibrium production-to-dissipation mechanisms is also discussed.

[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.

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Date submitted: 11 Aug 2009 Electronic form version 1.4