Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

High Reynolds number Rayleigh-Taylor turbulence DANIEL LIVESCU, RAY RISTORCELLI, ROBERT GORE, SUMNER DEAN, Los Alamos National Laboratory — The turbulence generated in the variable density Rayleigh-Taylor mixing layer is studied using the fully resolved 3072^3 simulation of Cabot and Cook, Nature Phys. 2006. A comprehensive study of the budgets for the kinetic energy, mass flux, and density specific volume covariance equations is undertaken. It is found that only the large scale quantities, but not the small scale quantities, reach self-similarity. Hypotheses for the variable density turbulent transport necessary to close the second moment equations are studied. The integral length scale does not follow the $\tilde{k}^{3/2}/\epsilon$ scaling. This is due to the non-equilibrium nature of the flow and the fact that ϵ, a small scale quantity, does not have the self-similar scaling. As a consequence, the popular eddy viscosity expression $\tilde{k}^2/\epsilon$ does not model the turbulent transport in any of the moment equations. An integral length scale, based on the layer width, does scale the turbulent transport using a gradient transport hypothesis; that integral scale is a global quantity and does not lead to pointwise local closure. Despite the fact that the intermediate scales are nearly isotropic, the small scales have a persistent anisotropy; this is due to a cancellation between the viscous and nonlinear effects, so that the anisotropic buoyancy production remains important at the smallest scales. Various asymmetries in the mixing layer, not seen in the Boussinesq case, are also identified and explained.

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Date submitted: 30 Jul 2008 Electronic form version 1.4