Sensitivities of Mixing Rates Due to Rayleigh-Taylor Instability.[1]

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Three-dimensional simulations of turbulent mixing by the Rayleigh-Taylor (RT) instability in the near-incompressible regime have been completed using the piecewise-parabolic-method (PPM)[2], both as converged DNS with Navier-Stokes (NS) dissipation and as "pure PPM" without NS dissipation. The observed mixing rates are lower than those seen in experiments[3], and roughly consistent with some other simulations in the literature[4]. However, switching off the Navier-Stokes dissipation, so that the dissipation is entirely numerical and due to the PPM algorithm, and reducing the spatial scale size of the initial perturbations both result in a *decrease* in the mixing rate.

Other simulations[5] yield mixing rates in agreement with the experiments cited above. These discrepancies motivate further simulation studies, which are underway and some of which will be reported, that attempt both directly to resolve this discrepancy and to more broadly explore the various sensitivities of the mixing rates to both physical and numerical aspects of the simulation models. These aspects include initial conditions (broad spectra with and without cutoffs vs. sharply peaked spectra; whether or not the spectra contain modal components that are not resolved by the numerics or are in the dissipation range associated with the dissipation), the form of the dissipation (numerical or true Navier Stokes), whether there is inter-species diffusion (in the multi-species case) or thermal or density diffusion (in the single-species case), effective Reynolds' number, boundary conditions and system aspect ratio, and compressibility.

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[2]P. Colella and P.R. Woodward, JCP **54**, 174 (1984).

[3]K.I. Read Physica D **12**, 45 (1984); G. Dimonte et al., Phys. Rev. E**54** 3740 (1996).

[4]D.L. Youngs, Laser and Particle Beams **12**, 725 (1994).

[5]J. Hecht et al., Laser and Particle Beams, **13**, 423 (1995); O. Schilling et al., this meeting.