Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

**Perturbation theory and numerical modelling of weakly and moderately nonlinear incompressible Richtmyer-Meshkov instability** M. HERRMANN, Arizona State University, A.L. VELIKOVICH[1], Plasma Physics Division, Naval Research Laboratory, S.I. ABARZHI, Carnegie Mellon University — A study of incompressible two-dimensional Richtmyer–Meshkov instability by means of high-order Eulerian perturbation theory and numerical simulations is reported. Nonlinear corrections to Richtmyer's impulsive formula for the bubble and spike growth rates have been calculated analytically for arbitrary Atwood number and an explicit formula has been obtained for it in the Boussinesq limit. Conditions for early-time acceleration and deceleration of the bubble and the spike have been derived. In our simulations we have solved 2D unsteady Navier–Stokes equations for immiscible incompressible fluids using the finite volume fractional step flow solver NGA developed by Desjardins et al., J. Comput. Phys. **227**, 7125 (2008), coupled to the level set based interface solver LIT, Herrmann, J. Comput. Phys. **227**, 2674 (2008). The impact of small amounts of viscosity and surface tension on the RMI flow dynamics is studied numerically. Simulation results are compared to the theory to demonstrate successful code verification and highlight the influence of the theory's ideal inviscid flow assumption. Theoretical time histories of the interface curvature at the bubble and spike tip and the profiles of vertical and horizontal velocities have been favorably compared to simulation results, which converge to the theoretical predictions as the Reynolds and Weber numbers are increased.

[1]Work supported by the US DOE/NNSA.

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Date submitted: 11 Jul 2014 Electronic form version 1.4