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Three-Dimensional DSMC Simulations of the Rayleigh-Taylor Instability in Gases T.P. KOEHLER, M.A. GALLIS, J.R. TORCZYNSKI, S.J. PLIMPTON, Sandia National Laboratories — The Direct Simulation Monte Carlo (DSMC) method of molecular gas dynamics is applied to simulate the Rayleigh-Taylor instability (RTI) in atmospheric-pressure monatomic gases (e.g., argon and helium). The computational domain is a 1-mm by 1-mm by 4-mm cuboid uniformly divided into 62.5 billion cubical cells. A total of 1 trillion computational molecules are used, and time steps of 0.1 ns are used. Simulations are performed to quantify the growth of perturbations on an initially flat interface as a function of the Atwood number. The DSMC results reproduce many features of the RTI and are in reasonable agreement with theoretical and empirical models. Consistent with previous work, the DSMC simulations indicate that the growth of the RTI follows a universal behavior. The numbers of bubble-spike pairs that eventually appear agree with theoretical values based on the most unstable wavelength and are independent of the statistical representation of the gas. Sandia National Laboratories is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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