Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

DSMC Simulations of Transiently Decaying Shear Flow J.R. TORCZYNSKI, M.A. GALLIS, D.J. RADER, Sandia National Laboratories — The accuracy of the Direct Simulation Monte Carlo (DSMC) method is investigated for simulating the transient decay of a shear flow between two parallel specular walls. In the continuum limit, the exact solution is determined numerically from the Navier-Stokes equations, and an approximate closed-form solution is determined for linear isothermal flow (i.e., small shear stress). DSMC simulations are performed using hard-sphere argon from free-molecular to continuum conditions. Initially, the tangential velocity component varies spatially according to one half-cycle of a cosine wave. The velocity amplitude is low enough to ensure that the flow remains linear and isothermal. Simulations are performed with various cell sizes and time steps while using an extremely large number of molecules (10 million). For each continuum case, the effective viscosity is determined by matching the closed-form solution for the velocity profile to the simulation results. The Chapman-Enskog value of the viscosity is obtained to within 0.3% in the resolved limit, and the departures at finite spatial and temporal resolution are in reasonable agreement with Green-Kubo theory. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

J.R. Torczynski
Sandia National Laboratories

Date submitted: 13 Jun 2006 Electronic form version 1.4