Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

A low-variance deviational simulation Monte Carlo for the Boltzmann equation[1] NICOLAS HADJICONSTANTINOU, THOMAS HOMOLLE, MIT — We present an efficient particle method for solving the Boltzmann equation. The key ingredients of this work are the variance reduction ideas presented in [L. L. Baker and N. G. Hadjiconstantinou, Physics of Fluids, vol. 17, art. no 051703, 2005] and a new collision-integral formulation which allows the method to retain the algorithmic structure of direct simulation Monte Carlo (DSMC) and thus enjoy the numerous advantages associated with particle methods, such as a physically intuitive formulation, computational efficiency due to importance sampling, low memory usage (no discretization in velocity space), and the ability to naturally and accurately capture discontinuities in the distribution function. The variance reduction, achieved by simulating only the deviation from equilibrium, results in a significant computational efficiency advantage for low signal flows (e.g. low flow speed) compared to traditional particle methods such as DSMC. In particular, the resulting method can capture arbitrarily small deviations from equilibrium at a computational cost that is independent of the magnitude of this deviation. The method is validated by comparing its predictions with DSMC solutions for spatially homogeneous and inhomogeneous problems.

[1]This work was supported, in part, by Sandia National Laboratory

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Date submitted: 20 Jul 2007 Electronic form version 1.4