Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Low-variance direct Monte Carlo simulation of the Boltzmann transport equation in the relaxation-time approximation[1] GREGG RADTKE, NICOLAS HADJICONSTANTINOU, MIT — The relaxation-time approximation, known as the BGK model within the rarefied gas dynamics community, has recently found widespread application in various fields in connection to microscale and nanoscale science and technology. In this talk, we present an efficient particle method for simulating the Boltzmann transport equation in the relaxation-time approximation for application to problems where characteristic length scales are of the order of or smaller than the carrier (molecule, photon, phonon) mean free path. Our formulation's main advantage over existing particle methods–such as direct simulation Monte Carlo (DSMC)–is significantly reduced statistical uncertainty in low- signal (small deviation from equilibrium) problems, achieved by simulating only the deviation from equilibrium. Algorithms based on simulating the deviation from a global (absolute) and local equilibrium will be discussed and contrasted.

[1]This work was supported by the Singapore-MIT Alliance

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Date submitted: 03 Aug 2008 Electronic form version 1.4