Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Lattice-Boltzmann Models of Ion Thruster Cathode 3D MHD Flows JACQUES RICHARD, PRERIT SHAH, Texas A & M University — The lattice-Boltzmann method (LBM) has been applied to modeling the flow through ion thruster optics where a linearized Boltzmann equation for a lattice is coupled to Poisson's equation for the electrostatics. LBM has also been implemented in modeling three-dimensional (3D) magneto-hydrodynamics (MHD) wherein the magnetic field is represented by a separate three-component vector distribution function corresponding to a vector kinetic equation. Discretization of the 3D phase space is based on a 19-bit scheme for the fluid model and on a 7-bit scheme for the magnetic field versus finite differencing of all of Maxwell equations. Issues that affect ion thruster operation, like the flow about the cathode assembly that reduce cathode and hence engine life, are investigated with this model. Historically, the transport of mass, momentum, energy, sub-atomic particles, etc. and the complex multi-scale physics involved in ion thrusters had been modeled mostly using Bird's Direct Simulation Monte Carlo (DSMC). While DSMC has achieved great success in EP models, their connection to the Boltzmann equation for the molecular velocity distribution function suggests alternate approaches based more directly on that equation.

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Date submitted: 08 Dec 2004 Electronic form version 1.4