Abstract Submitted
for the DPP06 Meeting of
The American Physical Society

MHD Turbulence, div B = 0 and Lattice Boltzmann Simulations[1]

NATE PHILLIPS, BRIAN KEATING, GEORGE VAHALA, William & Mary, LINDA VAHALA, Old Dominion University — The question of div B = 0 in MHD simulations is a crucial issue. Here we consider lattice Boltzmann simulations for MHD (LB-MHD). One introduces a scalar distribution function for the velocity field and a vector distribution function for the magnetic field. This asymmetry is due to the different symmetries in the tensors arising in the time evolution of these fields. The simple algorithm of streaming and local collisional relaxation is ideally parallelized and vectorized – leading to the best sustained performance/PE of any code run on the *Earth Simulator*. By reformulating the BGK collision term, a simple implicit algorithm can be immediately transformed into an explicit algorithm that permits simulations at quite low viscosity and resistivity. However the div B is not an imposed constraint. Currently we are examining a new formulations of LB-MHD that impose the div B constraint – either through an entropic like formulation or by introducing forcing terms into the momentum equations and permitting simpler forms of relaxation distributions.

[1]work supported by DoE.

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Date submitted: 23 Jul 2006 Electronic form version 1.4