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Entropic Lattice Boltzmann Algorithms for Turbulence[1] GEORGE VAHALA, William & Mary, JEFFREY YEPEZ, Air Force Research Lab., Hanscom Field, MIN SOE, Rogers State University, LINDA VAHALA, Old Dominion University, BRIAN KEATING, William & Mary, JONATHAN CARTER, NERSC, LBNL — For turbulent flows in non-trivial geometry, the scaling of CFD codes (now necessarily non-pseudo spectral) quickly saturate with the number of PEs. By projecting into a lattice kinetic phase space, the turbulent dynamics are simpler and much easier to solve since the underlying kinetic equation has only local algebraic nonlinearities in the macroscopic variables with simple linear kinetic advection. To achieve arbitrary high Reynolds number, a discrete H-theorem constraint is imposed on the collision operator resulting in an entropic lattice Boltzmann (ELB) algorithm that is unconditionally stable and scales almost perfectly with PE's on any supercomputer architecture. At this mesoscopic level, there are various kinetic lattices (ELB-27, ELB-19, ELB-15) which will recover the Navier-Stokes equation to leading order in the Chapman-Enskog asymptotics. We comment on the morphology of turbulence and its correlation to the rate of change of enstrophy as well as simulations on 1600^3 grids.

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