Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

A conservative Dirichlet boundary treatment for the finite volume lattice Boltzmann method LEITAO CHEN, LAURA SCHAEFER, University of Pittsburgh — The finite volume lattice Boltzmann method (FVLBM) enables the model to use the exact body-fitting mesh in the flow problems that involve the complex boundaries. However, the development of proper boundary treatment for the FVLBM has been outpaced. The boundary treatments designed for the conventional lattice Boltzmann method (LBM) framework are still heavily applied to the FVLBM. The largest defect of using the old boundary treatment is that, on the Dirichlet boundaries, the macroscopic variables cannot be conserved. In another word, there exist nontrivial discrepancies between the macroscopic variables defined by the boundary conditions and those yield by the numerical solutions. The errors on the boundaries will contaminate the internal solutions and even cause instability, especially on the complex boundaries. To overcome such a shortcoming, a conservative boundary treatment for the Dirichlet hydrodynamic boundary conditions is developed for the FVLBM. Through the benchmark tests, it is shown that the macroscopic conservations on the Direchlet boundaries are up to machine accuracy and completely independent of the size of relaxation time, the type of lattice model, the level of mesh resolution, the shape of boundaries and the type of internal scheme.

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Date submitted: 01 Aug 2014 Electronic form version 1.4