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Accuracy of higher-order lattice Boltzmann methods for micro-scale flows with finite Knudsen numbers[1] SEUNG HYUN KIM, HEINZ PITSCH, Stanford University, IAIN BOYD, University of Michigan — The accuracy of the lattice Boltzmann (LB) method for micro-scale flows with finite Knudsen numbers is investigated. We employ up to eleventh-order Gauss-Hermite quadrature and a diffuse-scattering boundary condition for fluid-wall interactions. Detailed comparisons with the Direct Simulation Monte Carlo (DSMC) method and the linearized Boltzmann equation are made for planar Couette and Poiseuille flows. With a consistent definition of the Knudsen number, the slip coefficients of the LB equation with the standard D2Q9 scheme are found to be slightly larger than those of the Boltzmann equation with the same boundary condition, which makes the standard LB method remain quantitatively accurate only for small Knudsen numbers. While all higher-order LB methods considered here perform better than the standard LB method, accuracy of the LB hierarchy does not monotonically increase with the order of the Gauss-Hermite quadrature.

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