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Semiclassical lattice hydrodynamics of rarefied channel flows. (English) Zbl 1428.76161

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Summary: The two-dimensional channel flows of gas of arbitrary statistics in the slip and transition regimes as characterized by the Knudsen number are studied using a newly developed semiclassical lattice Boltzmann method. The method is directly derived by projecting the Uehling-Uhlenbeck Boltzmann-BGK equations onto the tensor Hermite polynomials using moment expansion method. The intrinsic discrete nodes of the Gauss-Hermite quadrature provide the natural lattice velocities for the semiclassical lattice Boltzmann method. The mass flow rates and the velocity profiles are calculated for the three particle statistics over wide range of Knudsen numbers and the Knudsen minimum can be captured. The results indicate distinct characteristics of the effects of quantum statistics.

MSC:

76M28 Particle methods and lattice-gas methods
76P05 Rarefied gas flows, Boltzmann equation in fluid mechanics

Keywords:

lattice Boltzmann; semiclassical; channel flows

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