Lattice Boltzmann simulations of flowing matter across scales: classical, quantum and relativistic

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Abstract

Over the last near three decades, the Lattice Boltzmann (LB) method has gained increasing interest as an efficient computational scheme for the numerical simulation of complex flows across a broad range of scales, from fully-developed turbulence in real-life geometries, to multiphase and microflows, all the way down to biopolymer translocation in nanopores. Lately, the method has also shown promising potential for the simulation of quantum-relativistic flows, such as quark-gluon plasmas, electron transport in graphene and relativistic magnetohydrodynamics. After a brief introduction to the main ideas behind the LB method, we shall illustrate a few selected applications, along with future prospects for future multiscale applications, including recent coupling to electronic structure simulations.