Abstract Submitted
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Quantum lattice Boltzmann scheme for the Dirac equation with second-order accuracy[1] PAUL DELLAR, DENIS LAPITSKI, University of Oxford — We present a second-order accurate quantum lattice Boltzmann formulation for the Dirac equation with a scalar potential. Following earlier work of Succi and co-workers, the scheme is derived by integrating the Majorana form of the Dirac equation along light-cone characteristics using the trapezoidal rule. However, our scheme differs by consistently using the same characteristic for the streaming and algebraic terms, improving the accuracy from first to second order. This improvement comes at the price of implicitness, but the implicit coupled equations are rendered fully explicit by a unitary change of variables analogous to that used in the derivation of lattice Boltzmann hydrodynamics. We thus obtain a unitary, second-order accurate, and readily parallelisable numerical scheme. Some computations of the time-dependent Klein paradox for the tunnelling of wave-packets through a strong potential barrier will be presented in relation to recent experimental studies of the Klein paradox in graphene.

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