

ABSTRACT:

The equilibrium Fermi–Dirac distribution is revealed to transform to an asymmetric distribution in a very high electric field where the energy gained (or lost) in a mean free path is of paramount importance. The equilibrium stochastic velocity vectors randomly oriented in and opposite to the quasifree direction of a nanowire are shown to streamline in the presence of an extremely high electric field. The complete velocity-field characteristics are acquired. The ultimate directed drift velocity in a towering field is shown to be limited to the appropriately averaged Fermi velocity in the strongly degenerate limit where only half of the quantum states are accessible to electrons. This unidirectional velocity does not sensitively depend on the low-field Ohmic mobility. The emission of a quantum in the form of a phonon or photon lowers the saturation velocity from its ultimate unidirectional limit.