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Nonlinear electron transport in quantum wires DANHONG HUANG, USAF Research Lab, Space Vehicles Directorate, GODFREY GUMBS, Hunter College, CUNY — When impurity and phonon scattering coexist, the Boltzmann equation has been solved exactly for nonlinear electron transport in a quantum wire. The scattering effects on mobilities of electrons as functions of temperature and dc field were demonstrated. For the non-differential mobility of electrons, it is switched from a linearly increasing function of temperature to a parabolic-like temperature dependence as the quantum wire is changed from an impurity-dominated system to a phonon-dominated one. A maximum has also been obtained in the dc-field dependence of the differential mobility of electrons. The low-field mobility is dominated by the impurity scattering, whereas the high-field mobility is limited by the phonon scattering. As a quantum wire is dominated by elastic scattering, the peak of the momentum-space distribution function becomes sharpened and both tails of the equilibrium electron distribution centered at the Fermi edges are raised by the dc field after a redistribution of the electrons is fulfilled in a symmetric way. If a quantum wire is dominated by inelastic scattering, on the other hand, the peak of the momentum-space distribution function is unchanged while both shoulders centered at the Fermi edges shift leftward correspondingly with increasing dc field through an asymmetric redistribution of the electrons.

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