Physics
AT QUEENS COLLEGE

Colloquium Notice

Richard Liboff

University of Central Florida

High-field properties of a semiconductor

A general introduction to elements of semiconductor physics is presented, including discussions of E-k diagrams as well as the four fundamental electron-phonon interactions. The quantum-generalized Boltzmann equation is reviewed and applied to high-field transport in a semiconductor. From this analysis a new kinetic equation for the electron distribution function is derived which includes terms corresponding to the four electron-phonon interactions. In the quasi-classical limit, it is found that the acoustic strain interaction dominates, which gives rise to a reduced kinetic equation. In the steady-state limit this equation yields a second-order nonlinear differential equation for the perturbation distribution. The exact solution of the related nonlinear equation represents a significant new result. The distribution function is a generalized Fermi-Dirac distribution which contains the electric field explicitly and is found to reduce to correct forms in various limits.** The analysis is then extended to Silicon, where `equivalent' intervalley scattering comes into play. Drift velocity obtained from the approximate solution of resulting equations is found to agree with observed values for electric fields up to 105 V/cm. A criterion is described discerning between linear and nonlinear electric field effects. * This research includes results from four publications:
1. Phys. Rev. B34, 7063 (1986)
2. J. Appl. Phys. 62, 177 (1987)
3. J. Appl. Phys. 63, 5363 (1988)
4. Phys. Rev. B40, 5624 (1989)
** This `SL Distibution,' appears in the 4th edition of B. Ridley's book, Quantum processs; in semiconductor.

Monday
November 14, 2005
Starts at 12:15 PM
Coffee at 12:00 PM
Physics Conference Room, SB B326