

Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Wigner approach to quantum transport in graded semiconductors¹ A.A. KISELEV, G.J. IAFRATE, Dept. of Electrical and Computer Eng., North Carolina State Univ., Box 7911, Raleigh, NC 27695 — Graded electron bandstructures have long been used to beneficially influence the performance and functionality of electronic devices. In this work, we have developed a consistent fully quantum description of electron transport in terms of the Wigner distribution function, making use of the symmetric and hermitian effective-mass-like single band Hamiltonian that can be unambiguously constructed for graded systems. The generalized Wigner equation includes contributions that, in the quasiclassical limit, can be interpreted as directly corresponding to the drift and diffusion terms, but, unlike the homogeneous materials, the velocity operator is coordinate dependent and the electron is subject to the influence of the k-dependent quasidelectric fields originating from both the inhomogeneous potential profile and composition-dependent modulation of the quasiparticle inertia. The approach is useful for the analysis of a broad class of transport phenomena in graded systems, where quantum effects are important, but a full quantum treatment would be prohibitively costly.

¹This work was supported by ONR.

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Date submitted: 29 Nov 2005

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