Center for Quantum Science and Engineering (CQSE)

Weekly Seminar
Dec. 24, 2010 (Friday)

TIME	Dec. 24, 14:30 ~ 15:30
TITLE	Time-dependent Transport through Quantum Devices
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PLACE	Rm716, CCMS & New Physics Building, NTU

Abstract

Quantum devices are emerging where the functionality is based on split-gated devices, quantum dots, or quantum wires. The semiclassical models used to describe the conventional semiconductor devices are not satisfactory or not applicable for such nanostructures. Therefore, a fully quantum mechanical treatment is needed.

We report on modeling of time-dependent quantum transport in mesoscale conductors that is sandwiched between semi-infinite leads. The transport properties involving intricate coupling between the subbands and sidebands are tunable by adjusting the time-dependent fields, the applied magnetic fields, and the coupling between the system and the leads. For strong coupled systems acted upon by periodic time-dependent fields, we employ a time-dependent mode-matching method [1] or a time-dependent Lippmann-Schwinger approach [2] to explore dynamic quantum transport properties.

For weak coupled systems with a time-dependent switching-on coupling potential, generalized master equation formalism is employed to calculate the time-dependent charge current and the spatial distribution of charge density [3]. After switched-on a dc bias, the charge current first shows some transient oscillations and then converges to s steady-state value. These time-dependent mesoscopic systems could serve as an elementary device for sensitive spectroscopy tool for electrons and quantum information processing.

References:

[1]. C.S. Tang et al., Phys. Rev. B **53**, 4838 (1996); **60**, 1830 (1999); **67**, 205324 (2003).

[2]. C.S. Tang and V. Gudmundsson, Phys. Rev. B **74**, 195323 (2006); K. Torfason, C.S. Tang, and V. Gudmundsson, Phys. Rev. B **80**, 195322 (2009).

[3]. N.R. Abdullah, C.S. Tang, and V. Gudmundsson, Phys. Rev. B **82**, 195325 (2010)