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Radiation Effects in Mesoscopic Electron Transport

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Motivated by the recent observation of radiation induced 'zero resistance states' of two-dimensional electron gas in magnetic fields, we examine the role of radiation in electron transport in mesoscopic conductors. We demonstrate that the direct electric current through a conductor can be significantly affected by oscillating electric field. Through a simple model of oscillating barrier, we show how the 'Fano resonance', 'photon blockade', and 'photon assisted tunneling' appear in the frequency domain. We investigate also the non-equilibrium electron distribution function resulting from electron scattering off the time-dependent barriers. Thereby we could examine the frequency dependence and nonlinear properties of Joule heat released by the conducting electrons. We also study the role of quantum coherence in transport through oscillating barriers. We show how various degree of decoherence affects the transport properties of quantum dynamical states. Finally, we discuss how the radiation may affect the magneto-resistance concerning the radiation induced 'zero resistance states'.

keywords : mesoscopic electron transport, non-equilibrium transport, zero resistance state