Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Pure spin current pump in a quantum channel with both Rashba and Dresselhaus effects CHIA-HUI LIN, RCAS, Acdemia Sinica, CHI-SHUNG TANG, National United University, Taiwan, YIA-CHUNG CHANG, RCAS, Academia Sinica, Taiwan — We demonstrate a spin pump to generate pure spin current of tunable intensity and polarization in the absence of charge current. The system under consideration is a two-dimensional electron gas (2DEG) that is present at the interface of a heterostructure due to modulation doping and has intrinsic static Rashba and Dresselhaus spin-orbit interactions. The pumping functionality is achieved by means of an ac gate voltage that modulates the Rashba constant dynamically in a local region of a quantum channel in which both the static Rashba and Dresselhaus spin-orbit interactions are taken into account. The spin-resolved Floquet scattering matrix formalism is applied to our system. Based on the Floquet theorem, this formalism provides an exact and nonperturbative solution to the time-periodic Schrodinger equation in the mesoscopic system. Because the time-dependent spin-orbit interaction couples two spin polarizations and all sidebands together, analytic expression for the sideband dispersion is not feasible. Thus, we determine the sideband dispersion relation numerically by solving the Schrodinger equation in a nearly complete basis with the spatial inhomogeneity handled by matching boundary conditions region by region. The Floquet scattering matrix gives a coherent solution that goes beyond the adiabatic regime.

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Date submitted: 23 Nov 2008 Electronic form version 1.4