Coherent dynamics and mesoscopic capacitance oscillations in quantum coherent capacitors

Jianhong He*[1] and Jie Gao[2,1]

[1]College of Physical Science and Technology, Sichuan University – China
[2]National Institute of Measurement and Testing Technology – China

Abstract

The dynamic transport properties of quantum coherent conductors are governed by a frequency dependent admittance [1], showing significant discrepancies with their dc properties [2]. We experimentally study capacitance oscillations in a quantum coherent capacitor, consisting of a gated double-dot coupled to an electron reservoir by a quantum point contact. By applying a gate voltage to the quantum point contact, the state of the system is changed from the weak coupling to completely transparent channel. For low transmissions, we observe a periodic modulation in the amplitude of capacitance oscillations without application of a magnetic field. The period of the amplitude modulation gives expression to the cyclic depopulation of each of the energy strips in the double-dot system. Furthermore, we find that the Coulomb blockade oscillations in capacitance persist for a single fully transmitting channel, which is in excellent agreement with the previous theoretical predication [3]. This oscillation behavior can therefore be considered as one of the remarkable manifestations of phase coherence [4] in dynamic transport, strongly depending on magnetic field and temperature.

M. B´uttiker, H. Thomas, and A. Prêtre, Phys. Lett. A 180, 364 (1993).

J. Gabelli, G. Fève, J.-M. Berroir, B. Plaçais, A. Cavanna, B. Etienne, Y. Jin, and D. C. Glattli, Science 313, 499 (2006).

M. B´uttiker and S. E. Nigg, Nanotechnology 18, 044029 (2007).

S. Amasha, I. G. Rau, M. Grobis, R. M. Potok, H. Shtrikman, and D. Goldhaber-Gordon, Phys.
Rev. Lett. 107, 216804 (2011).

*Speaker