Session 26bD

Bloch Oscillating Transistor - a New Quantum Amplifier **26bD1**

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Bloch Oscillating Transistor (BOT) is a novel mesoscopic three terminal device that provides high input impedance ($\gg h/e^2$), large current gain (about 10), and large bandwidth (100 MHz). The operating principle of a BOT utilizes the fact that Zener tunneling up to a higher band will lead to blockade of Cooper-pair tunneling (Bloch oscillation) in a suitably biased Josephson junction. Bloch oscillation is resumed only after the junction has relaxed to the lowest band by quasiparticle tunneling. Thus, by a small quasiparticle control current one is able to control a much larger supercurrent component. We will discuss the basic theory and our first experimental results, indicating that the principle works in practice.

Shot noise in diffusive SNS and SIN junctions **26bD2**

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We studied shot noise in metallic SNS and doped silicon based SIN junctions. In SNS structures, the shot noise is very much enhanced due to incoherent Multiple Andreev Reflections (MAR) which are truncated, at low voltage, by inelastic electron-electron interaction. These experimental results show good agreement with recent semiclassical theory[1]. In SIN junctions, the zero voltage conductance is increased by coherent MAR (reflectionless tunneling) and we found that the shot noise is double ($S_I = 4eI$) below the Thouless energy and equals the full shot noise ($S_I = 2eI$) above. We also present conductance measurements which show the transition from zero bias to finite bias anomaly in double-barrier metallic SININ junctions[2].

[1] C. Hoffmann et al., submitted to Euro. Phys. Jour. B and E.V. Bezuglyi et al., PRB 63(2001)100501
[2] D. Quirion et al., PRB 65(2002)100508

26bD3 Tunnel Spectroscopy of a small Al particle

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Previously, we (Y.P. and J.S.T.) succeeded in fabricating a lithographically made Al single-electron transistor that showed gate modulation at room temperature (*Yu. A. Pashkin, Y. Nakamura, J. S. Tsai, Appl. Phys. Lett. 76 (2000) 2256*). In this report, we present experimental results of the current-voltage characteristics at very low temperatures. We find a stepwise structure near the threshold voltage, which is attributed to the discrete energy levels in the island. The distribution of level spacing has a tendency that supports the level repulsion effect.

26bD4 Tunneling Measurement of a Single Quantum Spin

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Measurement of the tunneling current via a molecule or an atom with a localized spin provides information on the orientation of that spin. Such measurement constitutes an example of indirect-consecutive quantum measurement. We show that a strong tunneling current due to the shot noise suppresses the spin dynamics, such as the spin precession in an external magnetic field, and the relaxation due to the environment (quantum Zeno effect). A weak tunneling current preserves the spin precession but the oscillatory component of the current is much weaker than the noise. We propose an experimental setup to observe Zeno effect in a tunneling system and describe how the tunneling current may be used to read a qubit represented by a single quantum spin 1/2.

26bD5 Manipulation of local nuclear spin polarization in quantum Hall systems

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We demonstrate a new possibility of locally manipulating nuclear spin polarization in integer quantum Hall (IQH) devices. Nuclear spins in a limited area along IQH edge channels (ECs) are dynamically polarized by selectively populating spin-resolved ECs through the hyperfine interaction. Local radio-frequency (RF) magnetic field generated by transmitting RF current through the micro metallic wire fabricated just above the ECs selectively depolarizes nuclear spins in the region below the wire with nuclear magnetic resonance (NMR). The resulting change of the local nuclear spin polarization is detected by a change of Hall resistance. Two equivalent wires fabricated in series along an edge yield NMR signals with different amplitudes, proving the $local$ manipulation of nuclear spins.

Magnetic-field-induced the quantum Hall effect - Hall insulator transition and hopping conductivity in InAs/GaAs quantum dot layers

26bD6

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We have investigated the temperature dependence of resistance in the temperature range T = 0.07-300 K and in magnetic field up to 35 T in InAs/GaAs quantum dot layers. In samples with relatively high carrier concentration the quantum Hall effect - Hall insulator transition was observed in high magnetic fields. Two-dimensional Mott variable range hopping conductivity has been observed at low temperatures in samples with low carrier concentration. The length of localization correlates very well with the quantum dot cluster size obtained by Atomic Force Microscope.