Session 21bD

Resistance Induced by Quantum Phase-Slips in Superconducting Nanowires **21bD1**

M. Tinkham, C. N. Lau, N. Markovic

Harvard University, Cambridge, MA 02138, USA

We have measured the resistive transitions of ~ 20 nanowires of superconducting amorphous MoGe with diameters ~ 10 nm and lengths from 100 nm to 1000 nm. The transition width increases with decreasing cross sectional area (i.e. increasing normal resistance per unit length) as described by the phenomenology including quantum phase slips used by Giordano to explain his earlier data and also by the rather similar results of a microscopic theory of Golubev and Zaikin. The resistance well below T_c is much greater than can be explained by thermally activated phase slips alone. We consider this to strongly support the reality of quantum phase slips, and the basic correctness of these theories. The exact role of dissipation, whether from metal in the wire, from the carbon nanotube substrate, or from the electromagnetic environment, in reducing quantum phase-slips needs further clarification.

Vortex states in mesoscopic superconductors **21bD2**

François M. Peeters, B.J. Baelus, M.V. Milošević

Departement Natuurkunde, Universiteit Antwerpen (UIA), Universiteitsplein 1, B-2610 Antwerpen

The vortex state in mesoscopic superconductors is studied using the non-linear Ginzburg-Landau equations which are solved numerically 'exact'. The demagnetization effect due to the bending of the magnetic field lines around the superconductor are fully taken into account.
The exact geometry of the superconductor has a large influence on its vortex state. For example, in a square geometry we can have the nucleation of a giant vortex, an ordered pattern of single vortices, or a combination of both. The vortex state can be brought into a metastable region owing to the presence of barriers for flux motion which leads to unexpected effects like fractional flux and even negative flux entry. A magnetic disk on top of a superconducting film creates a giant vortex underneath the magnetic disk which is surrounded by rings of anti-vortices.

21bD3 Phase Periodic Thermopower in Normal Metal/Superconductor nanostructures

A. Parsons, I. Sosnin, V.T. Petrashov

Royal Holloway University of London, Egham, Surrey, TW20 0EX, U.K.

The phase-periodic thermopower in diffusive Sb/Al nanostructures (Andreev interferometers) has been measured in the temperature range $0.3 < T < 1.5K$. Upon the increase of the dc current applied to the heater electrodes, the amplitude of the oscillations first increases then goes to zero as in earlier work by Chandrasekhar's group on Au/Al interferometer (Phys. Rev. Lett., 1998). Surprisingly, in our case the oscillations reappear at yet higher heater currents with their phase being π-shifted. The dependence of the amplitude of oscillations on temperature strongly correlates with that of $\mathrm{d}R/\mathrm{d}T$, R is the resistance of Sb wire.

21bD4 Biologically-inspired Devices for Controlling the Motion of Flux-Quanta

Franco Nori

Frontier Research System, The Institute of Physical and Chemical Research (RIKEN), Wako-shi 351-0198, Japan; Physics Department, University of Michigan, Ann Arbor, Michigan, USA

We have recently studied non-equilibrium thermal fluctuations in several types of new ratchet systems in superconductors. These produce stochastic transport of flux quanta in superconductors by alternating current (AC) rectification. Our simulated systems provide a variety of fluxon pumps, "lenses", or fluxon "rectifiers" because in them the applied electrical AC is transformed into a net DC motion of fluxons. Thermal fluctuations and the asymmetry of the pinning potential induce this "diode" effect. The latter can have important applications in devices, like SQUID magnetometers, and for "fluxon optics", including convex and concave "fluxon lenses" that focus/concentrate or disperse flux quanta.