Session 26aE

Application of Superconductor-Semiconductor Schottky Barrier for Electron Cooling — 26aE1

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Electronic cooling in superconductor - semiconductor (thin heavily doped silicon-on-insulator film) - superconductor structures at subKelvin has been demonstrated. Effect of carrier concentration in semiconductor on performance of the micro-cooler has been investigated. The doping level in the semiconductor considerably affects both the efficiency of the cooler (characteristic resistance of the Schottky junction) and the value of the electron-phonon coupling in the semiconductor.

Cryogenic X-ray Microcalorimeters for Materials Analysis and Astronomy — 26aE2

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Microcalorimeters and bolometers using superconducting transition-edge sensors (TES) have been demonstrated to provide high-resolution detection of photons from millimeter waves through x-ray in a wide variety of applications. In this talk, I will provide an overview of the development of x-ray microcalorimeters at NIST for use in microanalysis and x-ray astronomy. We have previously demonstrated a single-pixel TES microcalorimeter spectrometer system achieving an energy resolution of 2 eV at 1.5 keV with count rates of up to 500 cps. The performance of this system enables a wide range of research opportunities, including improved particle analysis and chemical bonding state analysis. Work is underway to develop large-format arrays of TES microcalorimeters with improved energy resolution and count rates, instrumented with multiplexed SQUID amplifiers and room temperature digital feedback electronics.

26aE3 Magnetic Calorimeters for High Resolution X-Ray Spectroscopy

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Magnetic calorimeters for x-ray detection consist of an x-ray absorber, which is strongly coupled to a paramagnetic temperature sensor located in a small magnetic field. The energy deposition of an incident particle leads to a change of the absorber temperature and thus to a change of the magnetization of the sensor, which can be measured with high resolution using a sensitive DC-SQUID magnetometer. The performance of metallic magnetic calorimeters based on the paramagnetic alloy Au:Er has improved rapidly and has now reached a level where various applications are conceivable. We discuss the principle of operation and the optimization criteria of magnetic calorimeters, the design and performance of prototype detectors for x-ray detection and the fundamental limits of the energy resolution of such detectors.

26aE4 Production of Zero Energy Radioactive Beams through Extraction across Superfluid Helium Surface

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A radioactive ^{223}Ra source was immersed in superfluid helium at 1.2 - 1.7 K. Electric fields transported recoiled ^{219}Rn ions in the form of snowballs to the liquid surface and further extracted them across the surface. The ions were focussed onto an aluminium foil and alpha particle spectra were taken with a surface barrier spectrometer. This enabled us to determine the efficiency for each process unambiguously. The pulsed second sound wave proved effective in enhancing the extraction of positive ions from the surface. Thus we offer a novel method for study of impurities in superfluid helium and propose this method for production of zero-energy nuclear beams for use at radioactive ion beam facilities.

26aE5 Frequency Noise in Hysteretic Resistive-SQUIDs

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We present measurements of hysteretic resistive SQUIDs (R-SQUIDs) as a function of the hysteresis parameter $\beta_L = 2\pi L I_c/\Phi_0$. Varying β_L *in situ* from 15 to 45, we observe quasiperiodic peaks in frequency noise which *decrease* toward the thermal limit with *increasing* temperature. We have developed a model illustrating the dynamics of the two characteristic time scales: Josephson phase oscillations and catastrophic transitions in phase. From this model, an intuitive energy picture emerges wherein low thermal energy is shown to promote trapping in false minima leading to excess frequency noise. The energy model further illustrates that confusion between degenerate branch solutions results in quasiperiodic noise peaks.
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