Session 27V

Direct Observation of Vortices in High-Tc superconductors **27V1**

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Vortices inside high-Tc superconductors became dynamically observable using the newly developed 1-MV field-emission electron microscope that has the brightest electron beam with the narrowest monochromaticity ever reported. We have obtained new results on the unconventional behavior of vortices in high-Tc superconductors. One example of the results is to distinguish vortex lines trapped by tilted columns and those penetrating the films perpendicularly to the film plane as different images: elongated and circular ones, respectively. We determined the experimental conditions under which individual vortex lines were trapped along tilted columnar defects in Bi-2212 thin films. When the sample temperature decreased below 14 K, we found to our surprise that the trapped vortices became perpendicular to the film plane as if the defects disappeared at lower temperatures.

The quantronium : a solid-state quantum bit circuit **27V2**

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We have designed and operated a superconducting electrical circuit called the quantronium, whose two lowest energy quantum states implement a quantum bit. This device, based on the Cooper pair box, combines single Cooper pair charging effects and Josephson tunneling. It is designed in order to preserve quantum coherence while allowing for qubit manipulation and readout. We demonstrate the preparation of an arbitrary qubit state using radiofrequency pulses, and we show that readout approaching single-shot resolution can be performed. The coherence time during which a coherent superposition of qubit states is preserved corresponds to about 8000 periods of the qubit transition. We discuss the implementation of quantum gates based on coupled quantronium circuits.