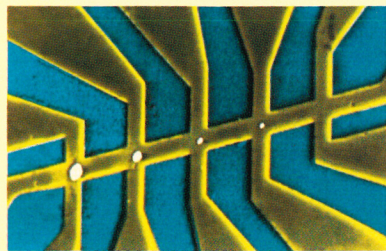


PHYSICS UPDATE

▶ **ELECTRON HOLOGRAPHY**, using low energy electron diffraction (LEED), can provide a three-dimensional, atomic-resolution image of a complex, ordered surface structure. In conventional holography, one part of a split laser beam (the object beam) is scattered from an object while another part (the reference beam) is left unscattered. The two beams meet in a piece of film where they inscribe an interference pattern that, when reconstituted, renders a three-dimensional image of the object. Now, Klaus Heinz, Uli Starke and their colleagues at the University of Erlangen-Nürnberg in Germany have done an experiment in which all of this happens on a nanoscopic level, and with electron waves instead of light waves. When a low-energy electron beam strikes a surface, any prominent atom can be thought of as a beam splitter, creating a reference electron wave—scattered directly back to the detector—and an object wave after subsequent scattering by neighboring atoms. From the measured electron diffraction pattern, a three-dimensional image of the local environment of the beam-splitting atom can be reconstructed. This information is then used iteratively, with conventional LEED, to elucidate the entire structure of a complex unit cell, as long as there is only one prominent atom. The researchers determined the structure of a (3×3) -reconstructed surface of SiC, a potentially important material for electronics applications. (K. Reuter *et al.*, *Phys. Rev. Lett.* **79**, 4818, 1997.) —PFS

▶ **QUANTUM BOXES FOR COOPER PAIRS.** Quantum dots, comparable in size to an electron's wavelength, are used to study how spatial confinement alters allowed electron energies. Recently, a European team of scientists, led by Andre Geim of The Netherlands, has built such a box for Cooper



pairs, the doublets of electrons that form in superconductors. Essentially studying the size dependence of superconductivity, the researchers monitored the magnetization of individual superconducting aluminum disks ranging in size from $0.1 \mu\text{m}$ up to $2.4 \mu\text{m}$ for a variety of temperature and field conditions. Their "ballistic Hall micromagnetometer" is shown here with disks in four of the five sensitive areas. They found both first- and second-order phase transitions between numerous superconducting states, and even "fractional" flux jumps. They can explain most of this unexpected diversity of superconducting behavior using the nonlinearized Ginzburg-Landau equations. (A. K.

Geim *et al.*, *Appl. Phys. Lett.* **71**, 2379, 1997; A. K. Geim *et al.*, *Nature* **390**, 259, 1997; P. S. Deo *et al.*, *Phys. Rev. Lett.* **79**, 4653, 1997.) —PFS

▶ **A SINGLE PRESELECTED MOLECULE OF DNA** can be attached to a silicon surface using an "optical tweezer." In their demonstration, researchers at Rockefeller University first attached DNA molecules to latex beads in water. Then, using a focused laser beam—the optical tweezer—they found and trapped a bead with only one DNA attached. Next, the silicon surface (the tip of an atomic force microscope) and the bead were brought into contact, and the heat from the laser "welded" them together in a reversible manner. The composite tweezer-AFM tool enables the DNA to be manipulated with great flexibility, retains the biological functionality of the DNA and offers the possibility of studying DNA and protein interactions. For example, beads with known DNA sequences could be grafted into a regular array on a silicon substrate. (G. V. Shivashankar, A. Libchaber, *Appl. Phys. Lett.* **71**, 3727, 1997.) —BPS

▶ **HIGH-PRESSURE SULFUR IS A SUPERCONDUCTOR.** When squeezed in a diamond anvil press, sulfur undergoes a number of changes, including a transition from insulator to conductor at about 90 GPa (about 10 000 atmospheres). Now, scientists from the Carnegie Institution of Washington and the Institute of High-Pressure Physics in Troitsk, Russia, have found an unpredicted superconducting transition at 93 GPa, with a T_c of 10.1 K. Above 162 GPa, T_c went up to 17 K, the highest yet for any elemental solid. Sulfur's unexpected behavior should provide a testing ground for theories of superconductivity. (V. V. Struzhkin *et al.*, *Nature* **390**, 382, 1997.) —PFS

▶ **PHYSICS OF POSTURE CONTROL.** Any infant, or robot designer, knows that standing on two feet is nontrivial. To understand this process better, scientists at Boston University have put subjects on a special force-sensitive platform, which records the minutiae of the individuals' swaying motions. Subjecting the digitized information to a statistical analysis, they found that the fluctuation-dissipation theorem applied. An important conclusion was that the human postural system strives to maintain an upright posture in the same way whether the subject is standing at ease or is being perturbed by a slight external push. In other words, static and dynamic posture control are the same. This finding is of great interest to those who treat patients with apparent balance problems; now, frail patients needn't be pushed, thus avoiding potential injuries. (M. Lauk *et al.*, *Phys. Rev. Lett.* in press, 1998.) —PFS ■