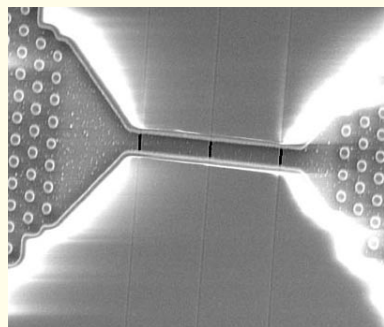


PHYSICS UPDATE

► **SILICON CAGE CLUSTERS.** Silicon is a vital material for the vast semiconductor industry and is one of the most studied elements in all of science. Unlike pure carbon, which can form C_{60} buckyballs, pure Si cannot form stable, closed cages. Nevertheless, researchers at the Joint Research Center for Atom Technology in Japan have managed to create just such configurations of Si atoms, but with lone transition metal atoms trapped inside. In fact, the experimentalists found that a metal ion served as a reaction site, nucleating a cluster of Si atoms until it was completely covered. The number of Si atoms that formed the cage cluster depended on the chemical identity of the metal atom. For example, hafnium was stably surrounded by 14 Si atoms, tantalum by 13, tungsten by 12, rhenium by 11, and iridium by 9. The remarkable stability of these compounds could allow them to be used as tunable building blocks for new nanostructures. The scientists note in particular that the cage clusters efficiently isolate their guest metal atoms from the surrounding environment, a characteristic that could make them useful in a quantum computer, where a cluster could store a single bit of information in the spin state of the enclosed metal atom. (H. Hiura et al., *Phys. Rev. Lett.* **86**, 1733, 2001.) —JRR

► **A NEAR-FIELD SCANNER** for moving molecules has been built and demonstrated by a multinational research team. The scanner offers a potentially fast way to make high-resolution images of molecules such as DNA. Traditional scanning-probe microscopes can produce molecular-resolution images, but at the cost of slow scanning speeds. The new device, shown here, is stationary; molecules travel past an array of posts intended to stretch them, then proceed through a microscopic fluid channel (5 microns wide by 1 micron deep) across a trio of 100-nm-wide slits illuminated with near-field laser light. The laser causes the molecules to fluoresce, and that fluorescence yields a far-field image. To ensure high-quality images, the



microscope accepts data only from those molecules that cross the three slits at roughly equal time intervals. The researchers obtained 200-nm-resolution imaging data in just 100 milliseconds for a DNA molecule with 200 000 base pairs (corresponding to about 74 microns in stretched form). Resolution improvements are possible by narrowing the slits or making the covering plate thinner. Future ver-

sions of the device will have narrower and shallower fluid channels for better stretching of the molecules. Such a device could potentially obtain high-resolution maps of the binding sites of repressor/promoter proteins critical for the expression of genes, part of an emerging field called epigenetics. (J. O. Tegenfeldt et al., *Phys. Rev. Lett.* **86**, 1378, 2001.) —BPS

► **OPTICAL BILLIARD TABLES FOR ATOMS.** A quickly moving spot of laser light can appear to draw a continuous circle on a screen. Similarly, a rapidly scanned, tightly focused laser will generate a closed two-dimensional boundary—actually an optical dipole potential boundary that repels closely approaching atoms like the cushions of a billiard table. Ultracold atoms can be confined in the third dimension with an orthogonal standing wave, making the system planar. Research groups at the University of Texas at Austin and at the Weizmann Institute of Science in Israel have now independently created and studied such systems. Two differences from regular billiards are that the atoms penetrate some distance into the walls before rebounding, and the walls are easily moved or redrawn in real time. The groups probed atomic trajectories indirectly by creating a little hole in the optical billiard and measuring the atoms' escape rate for various billiard geometries, and found excellent agreement with classical chaos theory. In future studies, both teams plan to use optical billiards to test such things as quantum chaos and the effects of noise on the trajectories of atoms. (V. Milner et al., *Phys. Rev. Lett.* **86**, 1514, 2001. N. Friedman et al., *Phys. Rev. Lett.* **86**, 1518, 2001.) —BPS

► **THE HUMAN GENOME** is now available in two draft forms, one by an academic consortium coordinated by the National Institutes of Health and the US Department of Energy, and the other by Celera Genomics of Rockville, Maryland. Physicists have been involved with the genome project from before its beginning (see the obituary for George Irving Bell on page 85) and on through the heady days leading to its completion. Indeed, physicists developed many of the tools, instruments, and data-analysis methods that were vital to the biologists' success. But drafting the genome is just the beginning. Understanding human complexity will require much more than simply spelling out the genome. In fact, many researchers with their roots in physics are already deeply involved with studying gene expression, the resulting protein structures, and the physical and chemical interactions that make us who we are. (Special issues of *Nature*, 15 February 2001; and *Science*, 16 February 2001.) —SGB ■