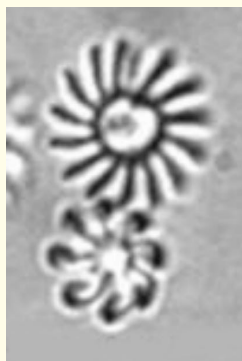


PHYSICS UPDATE

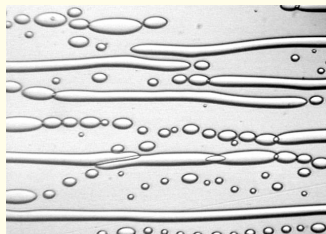
► **OPTICAL MICROROTORS.** Using lasers, two researchers at the Hungarian Academy of Sciences have built and operated structures that work much like windmills. First, Pál Ormos and Péter Galajda



used two-photon polymerization (see *PHYSICS TODAY*, May 1999, page 9) to chemically carve rotors out of a resin-based material. Then, holding a free-floating rotor in optical tweezers, they used radiation pressure instead of wind to turn it at a speed dependent on the photon flux. They also manufactured other shapes for their devices, including helices and propellers. In the demon-

stration of light-powered micromachinery shown here, an optical rotor turned an interlinked cog-wheel, each about $5\text{ }\mu\text{m}$ in diameter. In addition to providing torque to miniature devices, the rotors could be used to measure fluid properties on micron scales. Alternatively, it may be possible to study the mechanical properties of certain molecules, such as proteins or DNA, by fixing one end to a surface, attaching a rotor to the other end, and using light to apply a twisting force. (P. Galajda, P. Ormos, *Appl. Phys. Lett.* **78**, 249, 2001.) —JRR

► **STRINGS IN SHEARED POLYMER BLENDS.** Many advanced polymers are composed of two or more components—like rubber and nylon—that do not mix but are forced into intimate contact, often by a shearing process. By varying the components, researchers can alter the properties of the resultant material. For example, polystyrene is very brittle, but when rubbery particles are incorporated, it can withstand large impacts. Ordinarily, such a blend has droplets of one polymer dispersed within a matrix of the other, and the final product (such as a car bumper) is much larger than the micron size of



an individual droplet. In a new experiment at NIST in Gaithersburg, Maryland, Kalman Migler looked at sheared blending in a system whose size is just tens of microns

across. He found that, as the shear rate decreases, the droplets first grow, then line up like a pearl necklace, and finally coalesce, as shown here, into very stable strings or ribbons that can be 10 cm long. According to Migler, potential microscale applications of string components could include conductive plastic wires, ultrathin composite materials, and tissue engineering. (K. Migler, *Phys. Rev. Lett.* **86**, 1023, 2001.) —BPS

► **SUBLUMINAL ČERENKOV RADIATION.** In vacuum, nothing travels faster than light. In transparent substances like water, however, it is possible for high-energy charged particles to exceed the speed of a light beam in that substance. When this happens, the particle will radiate a cone of light called Čerenkov radiation. A team of researchers (University of Michigan and Max Planck Institute for Condensed Matter Research in Stuttgart) has now taken a closer look at the theory, and found that conical Čerenkov emission also occurs at subluminal speeds. The researchers verified the finding experimentally using subpicosecond laser pulses to generate—through a nonlinear optical process—relativistic dipoles that emitted infrared Čerenkov radiation in a zinc selenide crystal. (T. E. Stevens et al., *Science* **291**, 627, 2001.) —PFS

► **A SQUID MULTIPLEXER** has been demonstrated that can service an array of low-temperature sensors. A SQUID (superconducting quantum interference device) can detect very small currents or magnetic fields by monitoring tunneling Cooper pairs of electrons. Physicists at the University of California, Berkeley, inductively coupled eight low-temperature sensors, using eight different AC frequencies, to a single superconducting current loop. The researchers then coupled a single readout SQUID to the loop to examine the output of any or all of the sensors. The number of sensors that can be multiplexed in this way is limited mainly by the slew rate of the SQUID. The device might be used in biomagnetic imaging or astronomical instrumentation. (J. Yoon et al., *Appl. Phys. Lett.* **78**, 371, 2001.) —PFS

► **DOUBLE IONIZATION ELECTRON SPECTRA** have now been measured for helium. Atoms exposed to a focused, strong laser field have a tendency to simultaneously lose two or more electrons more often than expected (see *PHYSICS TODAY*, March 2000, page 9). Such nonsequential double ionization (NSDI) has been seen in several noble gases. Due to its simplicity, however, only He is accessible to a full theoretical treatment. Unfortunately, the experimental measurement of correlated NSDI in He has been plagued with difficulties, due to its high ionization energy and the overwhelming preponderance of single-ionization events. Now, using an electron-ion coincidence technique at Brookhaven National Laboratory, a team of researchers has succeeded in measuring the energies of the correlated electron pairs from He. In addition, the scientists performed a model calculation that, together with their spectra, supports the “rescattering” explanation wherein one electron is freed by the laser field, then accelerated back by the same oscillating electric field to knock out the other electron as well. (R. Lafon et al., *Phys. Rev. Lett.*, in press.) —SGB ■