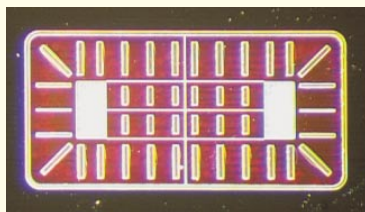


PHYSICS UPDATE

▶ **A TINY MICROPHONE DIAPHRAGM** based on fly ears has been built. Ronald Miles (SUNY Binghamton) and his colleagues based their diaphragm on *Ormia ochracea*, a small parasitic fly that uses sound to track down its cricket host even in complete darkness. The fly can detect changes as small

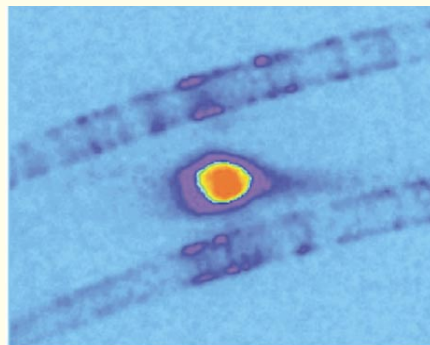


as two degrees in a sound's direction. Such directional sensitivity—as good as humans'—is unexpected, since the fly's ears are just a few hundred microns apart. Mammals' ears, in contrast, are well separated from one another, so that differences in sound signals at the ears provide localization cues (see PHYSICS TODAY, November 1999, page 24). The fly's hearing organs are a pair of mechanically coupled membranes: Sound waves incident on one membrane can deflect the other. With this coupling, the fly can obtain both the average pressure of an incoming sound and its pressure gradient, which together provide localization information. The Binghamton researchers' 2-mm² prototype microphone diaphragm, shown above, closely reproduced the fly ears' characteristics. This unconventional approach to localizing sound may lead to new applications, such as a compact hearing aid that responds only to sound in front of the wearer. The work was presented at last December's Acoustical Society of America meeting in Ft. Lauderdale, Florida, as paper number 2aEA1.

—BPS

▶ **A QUANTUM COMPUTER HAS NOW FACTORED** the number 15. A program for a quantum computer uses quantum bits, called qubits, and the property of superposition to look at all possible combinations of "0" and "1" simultaneously. Researchers from IBM's Almaden Research Center and Stanford University needed seven qubits for this first experimental demonstration of Shor's algorithm—a quantum-computer method that can factor large numbers much more quickly than can be done on traditional binary computers. The group designed a "computer molecule" that incorporated five fluorine-19 atoms and two carbon-13 atoms to provide seven nuclear-spin qubits that could be manipulated by a sequence of spin-selective radio-frequency pulses. The pulses were applied to a liquid containing those molecules at room temperature and the first three qubits were then "read" with nuclear magnetic resonance spectroscopy, yielding the factors three and five. Although the implementation cannot easily be scaled up, it nevertheless provides a demonstration of real-life quantum computing together with a predictive model of decoherence for the system. (L. M. K. Vandersypen et al., *Nature* **414**, 883, 2001.) —BPS

▶ **A STORAGE RING FOR NEUTRAL ATOMS.** Generally, a storage ring not only stores charged particles but also defines their energy and trajectory; particles with the wrong energy simply fly away from their magnetically guided route. Neutral atoms don't have a net charge for magnets to act on, but they can have a net magnetic dipole moment. If the atom moves slowly enough, its dipole is sufficient for magnetic guidance, and several such neutral atom guides have already been built. Physicists at Georgia Tech have now built a ring only 2 cm across, consisting of two concentric current-carrying wires, separated by 840 μm . They also built a wire "funnel" to transfer neutral rubidium atoms from a magneto-optic trap to the ring, where the atoms moved at only 85 cm/s, corresponding to kinetic energies of about 100 neV. The researchers thus dubbed their



device the "Nevatron." The image shows an atom cloud after having completed two full circuits between the two ring wires. So far, swarms of 1 million atoms have

made as many as 10 circuits around the ring. The physicists are extending the work to include ring-based atom interferometry and cold-beam generation. (J. A. Sauer, M. D. Barrett, M. S. Chapman, *Phys. Rev. Lett.* **87**, 270401, 2001.) —PFS

▶ **A DENDRIMER DYE LASER** has been demonstrated. A conventional dye laser uses fluorescing dye molecules as the active medium. When excited with an external laser, the molecules emit a range of wavelengths that are then tuned by the dye-laser cavity. In most dye lasers, the dye concentration cannot go above a millimole/liter without quenching the fluorescence. Now, scientists at the Communications Research Laboratory in Japan and PRESTO Japan Science and Technology Corp have achieved lasing with a dye concentration of 9 mmol/l by encapsulating the dye molecules at the heart of hyperstructured, tree-shaped polymers called dendrimers. As the dye concentration increased within the new dendritic high-gain medium, the laser output also increased while the lasing threshold decreased. Furthermore, the resultant spectral linewidth was only 0.1 nm. The researchers are now working to incorporate their dendrimers into solid-state waveguides, optical fibers, and photonic crystals. (S. Yokoyama, A. Otomo, S. Mashiko, *Appl. Phys. Lett.* **80**, 7, 2002.) —PFS ■