PHYSICS UPDATE

ATOMS HAVE BEEN GUIDED through hollow optical fibers, introducing a potentially convenient and flexible method for manipulating atoms and perhaps measuring their wavelike properties. With a hollow glass fiber filled with laser light, a University of Colorado and NIST collaboration guided rubidium atoms through cores as narrow as 10 microns. By making the laser light brightest at the center of the core, and tuning the laser just below the frequency at which the atoms absorb the maximum amount of light, the researchers ensure that the atoms are attracted to the core's axis as they travel through the fiber. The hollow fiber can twist and turn, but there is a limit to how sharply it can curve while still transmitting atoms. This technique may be useful for moving atoms from a high-density source into an ultrahigh-vacuum environment for conducting atomic physics experiments. It might be possible to make atomic-scale electronic circuits by performing "lithography in reverse": Instead of using chemicals to etch features on a silicon wafer, one would use the fiber as an "atomic fountain pen" to spray atoms onto the surface. There is also the possibility of performing "fiber-atomic interferometry." If an atom's DeBroglie wavelength is comparable to the diameter of the core, the atom will propagate like a wave. By splitting the fiber in two, the atom would split into a pair of wavelets, which could be later recombined to produce an interference pattern. (M. J. Renn *et al.*, *Phys. Rev. Lett.* **75**, 3253, 1995.) —BPS

ULTRAHIGH-ENERGY COSMIC RAYS, those with energies above 10^{19} electron volts, pose a problem for astrophysicists. The rays cannot originate too far out in the cosmos, because interactions with photons in the cosmic microwave background would cool them to lower energies. On the other hand, if they arise in the Milky Way, their Larmor radii are so large that the Galaxy cannot contain them. Now a joint US–European study of the arrival directions of 143 cosmic ray events with energies higher than 2×10^{19} eV reveals a nonuniformity; the 42 events with energies exceeding 4×10^{19} eV seem to arrive preferentially from the "sheet" in the sky—called the supergalactic plane—along which nearby galaxies cluster. This finding supports the notion that the highest energy cosmic rays originate outside our own galaxy, perhaps in relatively nearby radio galaxies with their associated jets and hot spots. (T. Stanev *et al.*, *Phys. Rev. Lett.* **75**, 3056, 1995.) —PFS

ANOTHER STEP TOWARD ANTIHYDROGEN. Theodor Hänsch (Max Planck Institute for Quantum Optics, Garching) and his colleagues in Germany have simultaneously trapped electrons and protons in the same small region of space. The hybrid apparatus consists of a Penning trap (a homogeneous static magnetic field and a static electric quadrupole field) for confining the ions and a Paul trap (which adds another electric quadrupole field, oscillating at microwave frequencies) for confining the electrons. Because of the long recombination time, the German physicists plan to stimulate ordinary hydrogen production from the electrons and protons using a carbon dioxide laser. Making antihydrogen—consisting of a positron in orbit around an antiproton—would allow the laws of physics to be tested all over again, this time with antimatter. (J. Walz *et al.*, *Phys. Rev. Lett.* **75**, 3257, 1995.) —PFS

NEW EFFECTS IN SONOLUMINESCENCE have been observed by Seth Putterman and his colleagues at UCLA. SL is a mysterious phenomenon in which acoustic energy is transduced into light energy; high-frequency sound waves act on bubbles in a liquid, usually water. A bubble, oscillating wildly, emits bright bursts of light. (See PHYSICS TODAY, September, 1994, page 22.) Many things about this phenomenon are still unknown, and now there are two more. The researchers substituted heavy water for ordinary water, which caused the peak of the SL spectrum to shift dramatically from ultraviolet toward longer wavelengths. According to the researchers, "The shift is remarkably large, especially in view of the small difference in chemical and elastic properties between H_2O and D_2O." In another study, they found that a bubble of pure xenon undergoes SL in a variety of liquids, not just in water. (R. A. Hiller, S. J. Putterman, to appear in *Phys. Rev. Lett.*; K. Weninger *et al.*, *J. Phys. Chem.* **99**, 14 195, 1995.) —PFS

BOSE–EINSTEIN CONDENSATION OF SODIUM ATOMS has been observed by Wolfgang Ketterle and coworkers at MIT. The researchers cooled the atoms in their magnetic quadrupole trap with the "hole" at the bottom of the trap plugged with a laser beam (see PHYSICS TODAY, August, page 17). Their apparatus can produce a condensate in a mere 9 seconds, as compared to the several minutes needed by groups that used different trap designs and species of atoms. The sodium condensates also contained more atoms—up to 5×10^5 atoms at densities greater than 10^{14} atoms/cm^3. The transition to a condensate, which occurred at a temperature of about 2 μK, was signaled by the change in the velocity distributions of the trapped atoms from a purely spherical distribution to a combination of an elliptical and a spherical distribution. (K. B. Davis *et al.*, to appear in *Phys. Rev. Lett.* This and other recent BEC results will be discussed further in an upcoming "Search and Discovery" story.) —GPC