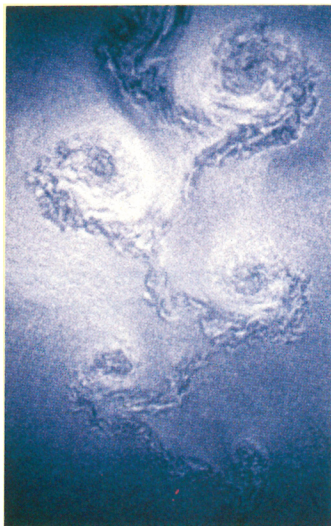


PHYSICS UPDATE

► **BOSE-EINSTEIN CONDENSATION IN HYDROGEN** has been achieved. An MIT group headed by Daniel Kleppner and Thomas Greytak cooled the trapped, spin-polarized hydrogen atoms to the BEC state with radio frequency evaporation. The RF signal singled out those atoms at the edge of the trap and flipped their spins, thereby ejecting them with no need to lower the magnetic field. The result was a colder, denser gas in the trap. When the atoms' de Broglie waves finally started to overlap, driving the condensation, the density-dependent lifetime of the gas showed a marked decrease. That was expected for hydrogen, and, together with an associated spectral feature, provided the evidence for BEC. While waiting for additional results, the group was reluctant to publicize their achievement, but word leaked out in early July. Very preliminary numbers reveal that the condensate contains more than 10^8 atoms, has a transition temperature of about $40\ \mu\text{K}$ and lasts up to 5 seconds. (By comparison—as reported in *PHYSICS TODAY*, August 1995, page 17—the first BEC had about 2000 rubidium-87 atoms, at a temperature of about $170\ \text{nK}$ and lasted more than 15 seconds.) The MIT group's work is important because every atomic property involved in BEC can be reliably calculated for hydrogen, providing a crucial link between theory and experiment. —SGB

► **TUMBLING AND FLUTTERING** of falling leaves and paper has received some experimental attention from a group at the Weizmann Institute of Science in Israel. In their experiment, the re-



searchers dropped long, flat strips of steel, plastic, and brass into a narrow, fluid-filled tank. The strips naturally orient themselves flat side down, and they were constrained to move in a two-dimensional vertical plane. What determined whether a falling strip predominantly oscillated from side to side (fluttered) or rotated end over end (tumbled) was the Froude number—the ratio of the time it takes for the strip to fall its own length to the time it takes to execute the pendulum-like side-to-side motion. Longer or lighter strips, which have a low Froude number (like a piece of typing paper), fluttered; smaller or heavier strips (like a business card) tumbled. As shown in the photo, a

fluttering strip also creates a zigzag wake by shedding fluid vortices synchronized with the fluttering oscillations. Such vortex studies may be relevant to the question of how airplanes stall, and also may help explain why certain insects can fly with great efficiency. (A. Belmonte, H. Eisenberg, E. Moses, *Phys. Rev. Lett.* **81**, 345, 1998.) —BPS

► **A COHERENT SOFT X-RAY SOURCE** has been devised by scientists at the University of Michigan. Margaret Murnane's group converted 800 nm laser light into 17–32 nm x rays by sending it through a hollow, gas-filled waveguide. Until now the task of producing x rays by the “harmonic conversion” process has been hampered by two facts. First, the nonlinear crystals that are often used to double the light frequency in the visible and ultraviolet ranges soak up x rays. Second, the gas media that are more hospitable to x rays cause the x-ray beam to fall out of phase with the laser-light beam as they co-propagate. The Michigan researchers succeeded in preserving the phase match because the hollow waveguide introduced a geometric component to the phase velocity. The researchers were thereby able to increase the x-ray yield by a factor of 100–1000 over previous devices. (A. Rundquist *et al.*, *Science* **280**, 1412, 1998.) —PFS

► **A SINGLE FAR-INFRARED (FIR) PULSE** has been imaged by two physicists at Rensselaer Polytechnic Institute in Troy, New York. Conventional photography records the visible world at wavelengths of 300–800 nm. Two-dimensional images at near-infrared wavelengths (around $1\ \mu\text{m}$) are also available. Doing spectroscopy or making pictures or movies at even longer wavelengths (up to 1 mm or, equivalently, down to terahertz frequencies) is difficult but desirable. Difficult in part because there have been no reliable, fast detectors for this region of the electromagnetic spectrum; desirable because many molecules (including some found in pollutants, diseased tissue and explosives) have rotational and vibrational transitions at FIR wavelengths. Now, Xi-Cheng Zhang and Zhiping Jiang have found a way to measure the actual waveform—the electric field as a function of time (over a 25-ps period) and one-dimensional space (over a 10 mm span)—of a single THz burst of radiation. They encode the THz signal onto an optical light pulse that has been stretched from 200 fs to 20 ps in a process called chirping. The combined signal is later decoded and imaged with a video camera, yielding a real-time image of an FIR pulse, not just a sequence of stroboscopic samplings of many pulses over a long time period. The researchers believe that their method provides the highest possible data acquisition rate, and will be valuable for studying fast phenomena such as flames. (Z. Jiang, X.-C. Zhang, *Optics Lett.* **23**, 1114, 1998.) —PFS ■