Physics Update

Dipolar sonoluminescence (SL) flashes. SL is a process in which a gas bubble, trapped in a liquid and exposed to a sound field, expands and contracts, emitting picosecond pulses of light. The mechanism by which the bubble concentrates sound energy and converts it into light is largely unknown. (See PHYSICS TODAY, September 1994, page 22.) An experiment at the University of California, Los Angeles, by Seth Putterman and his colleagues has now shown that the pattern of SL light emission has an angular dependence—a dipole shape—at least some of the time. This observation implies that the bubble's collapse is not spherically symmetric. Furthermore, when the dipole pattern exists, its orientation drifts on a time scale of about 400 bubble cycles. Meanwhile, in an erratum, Putterman says that his group's earlier results on isotope effects (PHYSICS TODAY, December 1995, page 9) could be due to impurities at the parts-per-million level. "We are humbled," he says, "by the complexity and sensitivity of this phenomenon." (K. Weninger, S. J. Putterman, B. P. Barber, *Phys. Rev. E* **54**, R2205, 1996; R. A. Hiller, S. J. Putterman, *Phys. Rev. Lett.* **77**, 2345, 1996.) —PFS

Particle-like excitations in a bed of sand can form into "molecules" and even "crystals." As part of a large effort to understand pattern formation in nature, University of Texas physicists Paul Umbanhower and Harry Swinney vertically shake a container, evacuated to 13 pascals, with a layer of tiny bronze balls at the bottom. At a certain frequency, *f*, the energy put into the system manifests itself as small isolated structures in the bronze "sand"; each of these "oscillons" changes from a peak to a crater and back again with a frequency of *f*/2. These oscillons remain stable for 10^6 or more shakes, and can slowly drift across the sand bed. And like electrical charges, when it comes to oscillons, opposites attract. When two oscillons of opposite phase—one is a peak when the other is a crater—are close enough, they migrate until they are adjacent, in a dipole state. Binding of additional oscillons leads to trimers, chains and even extended lattices. Similarly, nearby same-phase oscillons weakly repel each other. Because energy dissipation by the beads is crucial to the experiment, the researchers feel that such localized structures may exist in dissipative systems other than granular materials. For more on granular media, see PHYSICS TODAY, October 1995, page 17, and April 1996, page 32. (P. B. Umbanhowar, F. Melo, H. L. Swinney, *Nature* **382**, 793, 1996; accompanying pictures for this and the next Update can be viewed on the Web at http://www.aip.org/physnews/graphics/) —PFS

A three-dimensional, full-color, solid-state display has been created by a team of California scientists at Stanford University, the IBM Almaden Research Center, and the SDL Corp in San Jose. The image was displayed in a three-layered, sugar-cube–sized piece of heavy metal fluoride glass. Elizabeth Downing and her colleagues doped each of the three layers with different rare earth lanthanides, which fluoresced in different colors (praseodymium for red, erbium for green and thulium for blue) when illuminated by intersecting infrared laser beams of the appropriate frequency combinations. By illuminating individual volume pixels (voxels) in the transparent cube at a refresh rate of 30–60 Hz (to avoid flicker), the researchers could create a persistent, three-dimensional, full-color image, able to be viewed from any angle without any special viewing equipment. For now, the small size of the cube and the enormous amount of information contained in a three-dimensional image preclude its application in fields such as medical imaging and computer-assisted design; so far only wire-frame figures or simple shapes can be rendered. (E. Downing *et al.*, *Science* **273**, 1185, 1996.) —PFS

The quest for stable antihydrogen continues. Although last year's shotgun wedding at CERN of positrons and antiprotons created the first antihydrogen atoms made in a lab, experimenters had no chance to study their creation in detail. (See PHYSICS TODAY, March 1996, page 17.) Leisurely examinations could shed light on whether antimatter obeys the same fundamental symmetry relations and exhibits the same gravitational interactions as matter. Antiprotons and positrons have been cooled and trapped separately, but traps designed for both positively and negatively charged particles are usually leaky. As a prelude to making anti-H atoms, Harvard University physicists Gerald Gabrielse and David Hall tried to combine beams of protons and electrons into ordinary H atoms (which they call "anti-antihydrogen"). Recently, they succeeded in trapping both electrons and protons in a single device consisting of a Penning trap (which uses a combination of electric and magnetic fields) for negative particles nested inside another Penning trap for positive particles. The electrons, which outnumber the protons by a factor of several thousand to one, help to cool the protons to a common temperature of 4 K. At this temperature the likelihood that two positrons and an antiproton will form an anti-H plus an energetic positron is estimated to be eight orders of magnitude higher than at room temperature (300 K). However, detecting any neutral H atoms that may have formed is quite difficult, because, unlike anti-H, neutral H atoms do not annihilate spectacularly with ordinary matter when allowed to escape from the trap. Next, Gabrielse will try his trap on positrons obtained from radioactive decays and antiprotons from CERN's Low Energy Antiproton Ring, which will permanently shut down at the end of the year. (D. S. Hall, G. Gabrielse, *Phys. Rev. Lett.* **77**, 1962, 1996.) —PFS

© 1996 American Institute of Physics, S-0031-9228-9611-310-7