

Site-specific phonons. In many substances, slight differences in the vibrations of just a few constituent atoms can have important effects on macroscopic material properties. For example, the vibrational motion of impurities can determine whether a material is useful as a conductor or semiconductor. Now, a group of researchers in Japan has developed a method to determine the phonon density of states for different sites in a material, even when the difference involves only dissimilar states or environments of otherwise identical atoms. The physicists used a refinement of nuclear resonant inelastic scattering to measure not only phonon energy spectra but also the hyperfine interactions between nuclei and the surrounding electronic states. As a demonstration at Japan's SPring-8 synchrotron source, the group studied iron atoms in magnetite; two-thirds of those atoms are surrounded by six oxygen atoms and the remaining iron atoms are surrounded by four oxygens. Oscillations in the gamma radiation signal clearly showed the ratio of iron atoms in the two different atomic environments. The researchers say that the new method has many potential applications, for example to study the differences in the dynamical properties of atoms in complex condensed matter systems and in large biological molecules. (M. Seto et al., *Phys. Rev. Lett.* **91**, 185505, 2003.) —JRR

Do microfluid pumps enhance hearing in mammals? The cochlea is the part of the mammalian inner ear that converts pressure waves of various frequencies into nerve impulses. Fluid-filled ducts, separated by a sensory epithelium called the organ of Corti, run the length of the spiral-shaped cochlea. The organ's outer hair cells generate membrane voltage changes in response to sound and change their length in response to changes in membrane voltage. At the November meeting of the Acoustical Society of America in Austin, Texas, researchers presented visual evidence of contracting outer hair cells pushing fluid back and forth in a tiny channel—the tunnel of Corti—running lengthwise through the sensory organ. David Mountain (Boston University) and Domenica Karavitaki (Harvard Medical School) used stroboscopic illumination that flashed up to 10 000 times a second to create slow-motion movies of hair and nerve cell motions. Less than 1/1000 the length of the cell, the tiny motions were synchronized in a manner suggesting a pump action that can provide an electromechanical feedback loop. Such a loop supports the researchers' theory that the pumped fluid within the organ amplifies the motion of the membrane on which the organ of Corti sits, and thus increases hearing sensitivity. (Movies available at <http://www.physicstoday.org>.) —BPS

The farthest man-made thing, the Voyager 1 spacecraft, has detected a change in its local environment. At a distance of 85 times the Earth–Sun separation, Voyager first detected a greatly enhanced density of energetic particles that lasted more than six months, from mid-2002 into 2003, then dropped to normal levels. Two research groups have interpreted the data differently. One group believes that Voyager has finally passed through our solar system's termination shock, the region of space where the outward-going supersonic wind of solar particles brakes to subsonic speeds in its confrontation with the interstellar medium. That group says the shock then overtook the spacecraft again at 87 times the Sun–Earth separation. The shock front is generally expected to be a good particle accelerator, and the observed upswing in fast particles is suggestive. The other group, however, argues that the observed increase was an expected precursor—the accelerated particles streaming back from the shock toward the approaching spacecraft. This group cites the relatively unimpressive presence of so-called anomalous cosmic rays that are accelerated at the shock and the absence of the compression expected in the magnetic field if the wind carrying it had slowed down. Voyager 1 and its twin, Voyager 2 (not quite as far from Earth) were launched in 1977. (S. M. Krimigis et al., *Nature* **426**, 45, 2003; F. B. McDonald et al., *Nature* **426**, 48, 2003.) —PFS

A large liquid wall in a fusion energy device can improve plasma performance. At last October's American Physical Society division of plasma physics meeting in Albuquerque, New Mexico, Princeton Plasma Physics Laboratory researchers described how they tested this idea on a spherical torus, a rotund version of the well-known tokamak. The torus uses magnetic fields to confine hot plasma, and a portion of the outermost closed magnetic surface rests against a special high-temperature assembly called a limiter. At the bottom of their plasma vessel, the researchers placed a 2000-cm² stainless steel tray to act as a limiter. This limiter was an order of magnitude larger than in previous experiments, both at PPPL and elsewhere. The physicists then fired up the machine with the tray variously empty, containing solid lithium, and filled with liquid lithium. The liquid lithium performed best: It increased the efficiency of generating current within the plasma, did an excellent job of absorbing impurities, and minimized the "recycling" of ions that cool the plasma. Also, because the liquid surface both flows and can be continually replenished, it is not subject to the same degradation and damage that occur when neutrons bombard a solid metal wall. (APS meeting paper no. R11.004; preprint available from R. Majeski, rmajeski@pppl.gov.) —BPS ■

