

PHYSICS UPDATE

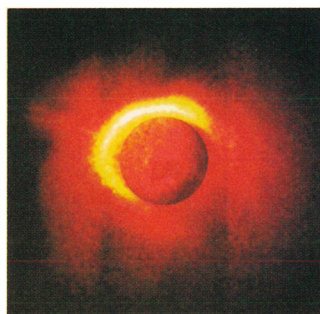
► **ULTRASOUND-ACTIVATED BUBBLES** can break up clots and deliver drugs and genes. Because they reflect sound so well, μm -sized bubbles—called contrast agents—have traditionally been used to enhance ultrasound images. Now, at the recent meeting in Atlanta of the Acoustical Society of America, Evan Unger (University of Arizona and ImaRx Therapeutics, both in Tucson) presented several possible medical uses for such contrast agents injected into the bloodstream. In one application, Unger reported that he and his coworkers used ultrasound to burst microbubbles near a blood clot in a rabbit's artery, thereby sweeping away the clot in small pieces. Unger and his colleagues have also attached various ligands, drugs, and genes to the microbubbles in several ways, for several uses. For example, bubbles coated with a specific antibody can attach to a tumor or other targeted tissue. Once attached, the bubbles can be made to pop—gently to release an encapsulated drug, or violently to deliver a lethal dose of energy to the tissue. The researchers have also introduced gene-containing microbubbles into an animal, and have seen the gene expressed. Such a procedure could be safer than traditional gene therapy, in which the gene is delivered via a modified virus—with potentially serious allergic reactions. In addition, genes exposed to ultrasound seem to express themselves at an enhanced rate, but the mechanism for the enhancement is unknown. Although promising, these applications require further testing and development. —BPS

► **TINY LEAKS CAUGHT WITH SOUND.** A new “photoacoustic” technique, described at the recent meeting of the Acoustical Society of America in Atlanta, can remotely detect pinprick leaks (as small as $10^{-6} \text{ cm}^3 \text{ s}^{-1}$) in sealed containers, and pinpoint them to within a millimeter, in mere seconds. Serdar Yonak and David Dowling of the University of Michigan, Ann Arbor, use sulfur hexafluoride, an inert, nontoxic tracer gas, to fill the part being tested. A carbon dioxide laser then scans the part up to 7500 times per second. When the laser beam passes through a cloud of leaking gas, the rapidly heated gas expands and generates a sound pulse. To find the exact location of the leak, the researchers use a sonar signal processing technique called matched field processing. An array of sensitive microphones 0.4 m away records the sound, and computer processing essentially reconstructs the trajectory of the sound waves backward in time until they reconverge at the location of the leak. —BPS

► **LIQUID MOLECULAR DEUTERIUM** has been transformed into a metallic fluid. Physicists at Lawrence Livermore National Laboratory used the powerful Nova laser to push a plunger that, in turn, sent a shock wave through a sample of cryogenic liquid D_2 , an insulator. Using another beam

from a separate probe laser, the researchers simultaneously monitored the velocity of the shock (as a diagnostic of the pressure) and the sample's reflectivity (as a diagnostic of metallic behavior). They found that the reflectivity began to increase at around 20 GPa, at which pressure the D_2 begins to dissociate and form the metallic fluid. Above 50 GPa, the reflectivity was saturated, and the change from an insulating to a conducting state was complete. The change was continuous rather than abrupt, indicating that the metallization was not a first-order phase transition. At 50 GPa, the temperature of the metallic deuterium was about 8000 K, near the conditions expected in Jupiter's interior. (P. M. Celliers *et al.*, *Phys. Rev. Lett.* **84**, 5564, 2000.) —PFS

► **FIRST IMAGES ARRIVE** from the IMAGE (Imager for Magnetopause-to-Aurora Global Exploration) satellite. Launched this past March, IMAGE is studying the global properties of Earth's magnetosphere, that tenuous plasma reaching from the top of the atmosphere out into space, controlled jointly by Earth's magnetic field and the solar wind. To do so, the satellite has an array of neutral atom, ultraviolet, and radio plasma imagers. The ability to



view Earth and its environs through what might be considered plasma-colored glasses is important for understanding and monitoring “space weather,” the general name for disturbances in our planet's vicinity caused by fields and particles streaming from the

Sun. The two images seen here were among the first data, released on 31 May at the American Geophysical Union meeting in Washington, DC, by James Burch (Southwest Research Institute) and his colleagues. Above is the first global view of Earth's plasmasphere, looking away from the Sun at extreme UV light scattered from ionized helium. The helium plasma clearly extends to about three times the size of our planet, and the irregularity in the upper left indicates magnetic storm activity. The other image shows Earth's aurora, in far UV wavelengths. The aurora is caused by electrons and ions smashing into the neutral atmosphere, traveling along magnetic field lines toward Earth's poles. The green shows the electron aurora, red is where the proton aurora dominates, and both auroras are comparable in the yellow regions. —PFS ■

