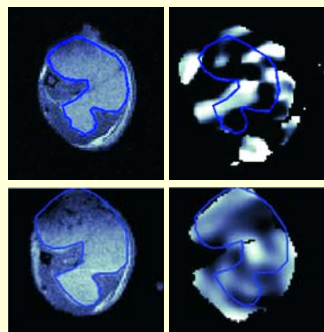


Electron paramagnetic resonance imaging (EPRI) can determine the oxygen content of tumors and other biological tissue. Low levels of oxygen make a cancerous tumor more resistant to radiation and chemotherapy; higher doses could be administered to such areas—provided those areas could be found. With the goal of mapping biological oxygen in three dimensions, researchers at the University of Chicago are developing a new technique that lets them magnetically manipulate un-



paired electrons in certain oxygen-containing molecules. With an appropriate contrast agent present, each little volume element of a sample produces an absorption line whose width gives the oxygen content at that location. The team has thus been able to quantify and image, with millimeter spatial

resolution, the oxygen distribution in small animals. By superimposing those images on anatomically superior MRI images, regions rich or poor in oxygen can be located, as reported by Charles Pelizzari at the July meeting in Seattle of the American Association of Physicists in Medicine. For example, in these 7-mm panels showing a mouse tumor, the upper images were obtained just prior to a treatment and the lower ones four days later; the left images were made with MRI (with the tumor outlined); the right ones, showing a noticeable change in oxygen content (bright areas), were made with EPRI. Pelizzari thinks that images like these may have potential for biologically based planning and assessment of radiation therapy. (C. Haney et al., AAPM Meeting talk WE-D-I-609-8.) —PFS

Vibration can do the work of gravity during gas-liquid phase transitions. Fluids in space behave very differently from their Earthbound counterparts. For example, the phase separation of gas and liquid is dramatically slowed in microgravity conditions, in which capillary flows dominate and the buoyancy of gas bubbles plays no role. Scientists in France, led by Daniel Beysens, a researcher at the French Atomic Energy Commission, studied a 20-mm³ sample of molecular hydrogen near its critical point of 33 K. To simulate weightlessness, they levitated the sample in a strong magnetic field gradient. (See PHYSICS TODAY, September 1998, page 36, to learn about this technique.) The researchers found that subjecting the sample to high-speed, low-amplitude vibrations could restore the effects of gravity. The vibrations introduced velocity differences between gas and

liquid domains—which have different densities—and thereby allowed shear flow and pressure differences across domains to greatly accelerate the phase transitions. (D. Beysens et al., *Phys. Rev. Lett.* **95**, 034502, 2005.) —PFS

Neutrino geophysics. Neutrinos have no charge and very little mass, and interact but rarely. Underground neutrino detectors can nevertheless record these ghostly particles (or their antiparticles) originating from the Sun, from cosmic rays, and from nuclear reactors. Now, the Kamioka liquid scintillator antineutrino detector (KamLAND) in Japan has registered the presence of candidate antineutrinos coming from radioactive decays of uranium-238 and thorium-232 inside Earth. A statistical analysis of data gathered over 749 days revealed between 4.5 and 54.2 such particles at the 90% confidence level. Geoscientists accept that Earth's tectonic plates are kept in motion by a reservoir of energy deriving from two principal sources: residual energy from Earth's formation and additional energy from subsequent radioactive decays. The rudimentary inventory of geoneutrinos observed so far is consistent with the theory. (T. Araki et al., *Nature* **436**, 499, 2005.) —PFS

Two-dimensional atomic crystals. A chemical compound's properties can depend strongly on its arrangement. Even something as simple as crystalline carbon takes on different characteristics if it is zero-dimensional (as for a buckyball), 1D (a nanotube), or 3D (graphite or diamond). Largely absent, however, have been experimental samples of 2D crystals. Unsuccessful attempts have been made to chemically remove such arrangements from layered materials, which have strong in-plane bonds but weak coupling between adjacent planes. A group at the University of Manchester (UK) has now found a simple, low-tech route to success: The researchers scrape the fresh surface of a layered crystal against another solid surface. Surprisingly, among the many flakes left on the substrate are always some macroscopic flakes that are just one atomic layer thick. As an added surprise, the monolayer flakes are stable and retain a high crystalline quality under ambient conditions. The 2D crystals were identified among the detritus using optical microscopy followed by atomic force microscopy. Thus far, the technique has succeeded on five different materials: graphite, BSCCO, BN, NbSe₂, and MoS₂. The researchers, led by Andre Geim, also made electrical conductivity measurements on their samples. For example, the carrier concentration in a layer of NbSe₂ in a 3D crystal is 100 times higher than in an isolated plane of the same material. (K. S. Novoselov et al., *Proc. Natl. Acad. Sci. USA* **102**, 10451, 2005.) —SGB ■