

PHYSICS UPDATE

▶ **LIGHT SLOWED AND STORED IN A SOLID.** The group velocity of light—the speed at which the wave pulse propagates—can be considerably lowered, even to zero, in a medium having an index of refraction that changes dramatically with wavelength. The energy and information in the original light pulse can be stored, without any heating, in the form of coherent spin excitations in the atoms of the medium. Last year, two different experiments stopped and stored light in a vapor sample (see PHYSICS TODAY, March 2001, page 17). Now the feat has been carried out in a 3-mm-thick crystal—yttrium silicate doped with atoms of the rare earth praseodymium—already in common use for high-density optical data storage. The experiment was carried out at MIT and at the Air Force Research Laboratory in Hanscom, Massachusetts. The researchers foresee many applications in areas such as quantum computing, ultrasensitive magnetometry, and acousto-optics. (A. V. Turukhin et al., *Phys. Rev. Lett.* **88**, 023602, 2001.) —PFS

▶ **INDIRECT IMAGING OF ELECTRON SPINS** has been shown to be feasible. Spintronic devices seek to exploit both the charge and the spin of mobile electrons, but determining precisely where spin flips occur is exceedingly difficult because of short electron transit times. Spin carriers can, however, get trapped by defects and dynamically transfer their spin polarization to nearby nuclei. Now, researchers working at the US Army Research Laboratory in Adelphi, Maryland, have used magnetic resonance force microscopy (MRFM; see PHYSICS TODAY, May 1997, page 9) to image three different spin-polarized nuclei in a single 3- μm -thick sample of gallium arsenide. The researchers first induced nonuniform spin polarization in a narrowly confined region of the sample. Then, while varying an applied magnetic field, they observed the spin contrast of gallium-69, gallium-71, and arsenic-75, revealed by 2-pm deflections of their cantilever at the appropriate resonance field strengths. Prior to this work, MRFM had detected a total of four nuclear spins: hydrogen, fluorine-19, sodium-23, and cobalt-59. The physicists say that their observations open up the possibility of three-dimensional imaging of spin-polarized electron currents in operating spintronic devices. (K. R. Thurber et al., *Appl. Phys. Lett.* **80**, in press.) —RJF

▶ **DID ENVIRONMENTAL “NOISE” TRIGGER** a climatic roller coaster during the last Ice Age? Under certain conditions, noise can paradoxically increase a weak signal’s detectability and influence. This phenomenon, called stochastic resonance (SR), has been observed in settings as diverse as chaotic lasers and human reflex systems (see PHYSICS TODAY, March 1996, page 39). Andrey Ganopolski and Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research in Germany

have shown that SR may have played a role in triggering 20 or so abrupt and dramatic warming events—called Dansgaard-Oeschger (DO) events—during the last Ice Age, which lasted from about 120 000 to 10 000 years before the present. Each DO event started with a roughly 10-year warming of about 10°C over the North Atlantic, and each lasted for up to a few centuries before cooling again. Curiously, the DO events typically were 1500 years apart, but sometimes skipped a beat and occurred after 3000 or 4500 years. The researchers used a global climate model with added environmental “white noise” in the form of random changes in the amount of precipitation and melted ice and snow entering the Nordic seas. Through the SR mechanism, that random influx of fresh water could amplify a weak underlying 1500-year signal of unknown (but perhaps solar) origin. The scientists found that North Atlantic ocean currents, on crossing a salinity threshold, could have flipped between two different states, one in which warm Gulf Stream waters reached only to midlatitudes and another in which warm waters penetrated much farther north. The SR-based model reproduces key features of the DO events and North Atlantic ocean circulation during the last Ice Age. If confirmed, this mechanism may help to explain why the Ice Age climate was so much less stable than that of the past 10 000 years, in which human civilization has thrived. (A. Ganopolski, S. Rahmstorf, *Phys. Rev. Lett.* **88**, 038501, 2002.) —BPS

▶ **A LIQUID-GAS PHASE TRANSITION FOR NUCLEI.** In school, most physicists learned the liquid-drop model of the nucleus. In recent years, several groups have addressed the next question: Is there also an equilibrium nuclear “vapor” such that changing a parameter akin to pressure or temperature can send the nucleus back and forth between the two states of matter? Now, two groups have analyzed data from the Indiana silicon sphere (ISiS) experiment at Brookhaven National Laboratory, in which pions and protons were slammed into gold nuclei to induce so-called nuclear multifragmentation. A group from Michigan State University found strong circumstantial evidence for a liquid-gas phase transition, while a group from Lawrence Berkeley National Laboratory was able to fully map out a liquid-vapor coexistence line, with a critical point, in the nuclear phase diagram. That a finite system like a nucleus, with only about 200 particles, not only shows a robust phase transition but also has discoverable quantities like vapor pressure, evaporation enthalpy, and surface energy is “very exciting,” according to Luciano Moretto, the leader of the Berkeley group. (T. Lefort, L. Beaulieu et al. [IU], *Phys. Rev. C* **64**, 064603-4, 2001; M. K. Berkenbusch et al. [MSU], *Phys. Rev. Lett.* **88**, 022701, 2002; J. B. Elliott et al. [LBNL], *Phys. Rev. Lett.* **88**, 042701, 2002.) —PFS ■