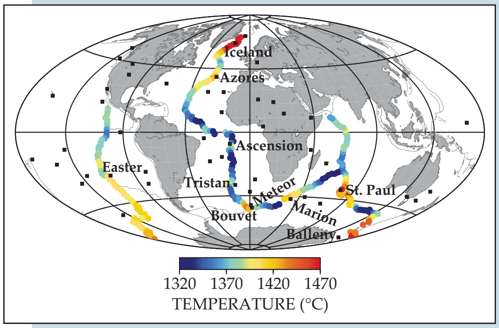
splits laser light in a silicon waveguide (red) into two parallel arms. Because the arms join together in a loop, the counter-propagating waves interfere to form a standing wave whose antinodes serve as the optical traps in the part of the wave-guide exposed to a fluid pool (blue). To independently manipulate the positions of the traps—shown suspending polystyrene beads and an array of six DNA molecules stretched between them—the researchers placed microheaters (orange) close to the waveguides. Local heating changes the optical path length and thus imparts a phase shift to the waves and moves the antinodes. Because all the optical elements producing the traps are tiny and on chip, the new platform is naturally resistant to thermal drift, environmental noise, and vibrations. (M. Soltani et al., *Nat. Nanotech.*, in press.) —RMW

Three thermometers for Earth's upper mantle. The density and viscosity of Earth's mantle govern its convection and therefore plate tectonics, and the density and viscosity are each functions of temperature and composition. At the mid-ocean ridges—an interconnected global network of volcanoes—new ocean crust is formed from the solidification of molten rock derived from the mantle. Thus, mid-ocean ridges hold important clues about the inaccessible mantle, in particular about its local temperature and composition. So Earth scientists Colleen Dalton (Brown University), Charles Langmuir (Harvard), and Allison Gale (University of Wisconsin–River Falls) set out to examine the link. The data they used include velocities of seismic shear waves 300 km beneath the ocean floor, taken from 242 different vantage points along six different ridges; how far those ridge tops lay beneath the ocean's surface; and the chemical composition of recently erupted ocean crust. Although each of those three data sets has its limitations, the authors found correlations among them that require a common cause. Further scrutiny showed that mantle temperature was by far the main driver of global variations in ridge height, seismic speed, and crustal chemistry, with mantle composition causing scatter about the thermal trend. Turning their analysis around, the trio then used ridge height, seismic speed, and chemistry to map the mantle's temperature beneath the ridges, as shown in the figure. The black squares represent known mantle hot spots, some of which are labeled. (C. A. Dalton, C. H. Langmuir, A. Gale, *Science* **344**, 80, 2014.) —SGB



Computers that are normally off. Most computer components need a constant power supply. That's because the core processor that reads, writes, and changes information typically works with electrical charge, stored and manipulated with vast arrays of transistors and other electrical components. Turn off the power and you need to start all over again, except for "nonvolatile" memory that is not directly accessible by the processor. But if components based on magnetic spin could be devised to work closer to the core—say as the main random-access memory or even as on-chip cache memory—then a computer could presumably be "normally off" between operations, even between keystrokes. That approach could lead to mobile personal computers using solar cells or hand-cranked dynamos. Needed are switching speeds as fast as 10 ns, low-power switchability, and densities up to 1 Gbit per chip. Conventional magnetic storage—a hard drive—is not up to that task because of the relatively large and power-hungry electromagnetic coils. Enter spin-transfer torque (STT) technologies, in which an electrical current is spin polarized as it traverses a ferromagnetic tunneling junction, either inducing or detecting the spin orientation on one side of the tunnel barrier. When the current is turned off, the spins remain. Many groups are now exploring STT technologies for nonvolatile computer components. At last November's 58th Conference on Magnetism and Magnetic Materials, Koji Ando of the National Institute of Advanced Industrial Science and Technology in Tsukuba, Japan, gave a concise summary of the field from his group's perspective; that summary is now available in print. (K. Ando et al., *J. Appl. Phys.* **115**, 172607, 2014.) —SGB

Our spatial sense of pitch. Across languages and cultures, humans associate high pitches with elevated spatial positions—in the placement of notes on a musical staff, for example, and even in the language: "Low" and "high," for instance, are used to describe pitch. Cesare Parise, Katharina Knorre, and Marc Ernst at Bielefeld University in Germany now show that our spatial sense of pitch combines two independent contributions. Our head and outer ears act as frequency- and position-dependent filters that strongly affect our ability to localize sound (see the article by Bill Hartmann in PHYSICS TODAY, November 1999, page 24). Analyzing such filters, known as head-related transfer functions, the researchers found that the filters transmit more high-frequency energy for sounds arriving from higher elevations. More than that, tens of thousands of samples the researchers made of environmental sounds—indoors and outdoors, urban and rural—revealed that higher-frequency sounds reaching our ears tend to originate from elevated sources, due perhaps to their inherent distribution (bird songs are at higher frequencies than footsteps) or to frequency-dependent ground adsorption. To tease apart the environmental and physiological effects the researchers sat volunteers in a chair that could tilt sideways, positioned them at different angles, and played sounds through one of several loudspeakers. The participants' ability to localize white noise was largely independent of body tilt. But the perceived sources for narrow-band sounds between 1.4 kHz and 8 kHz were systematically elevated in both the participant's tilted frame of reference and the laboratory frame. The head- and lab-centered biases were distinctly different, yet correlated: The filtering properties of the ear accentuate, perhaps by evolutionary design, the frequency–elevation mapping already present in natural auditory scenes. (C. V. Parise, K. Knorre, M. O. Ernst, *Proc. Natl. Acad. Sci. USA* **111**, 6104, 2014.) —RJF