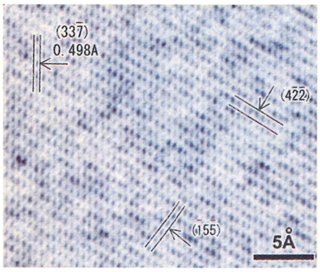
A MILLION-VOLT FIELD-EMISSION transmission electron microscope (FE-TEM) has been built by a team led by Akira Tonomura at Hitachi's Advanced Research Laboratory in collaboration with the Japan Science and Technology Corp. In an FE-TEM, electrons are drawn out of a cathode and accelerated by a high voltage. The one million volts produced a beam of electrons that was four times brighter than the best previous FE-TEM (300 kV) and 1000 times brighter than conventional thermionic-emission TEMs. The device is a marvel of engineering. The 1 MV must be stable to within half a volt, and the electron source must be held steady to within 0.5 nm. As shown here, the new device can image rows of atoms only half an angstrom apart (thus rivaling scanning tunneling microscopes) and can even take pictures fast enough—60 per second—to make movies of fine gold particles changing their shapes. In addition, due to their higher energies, the electrons can penetrate deeper into a sample than was previously possible, and thus provide three-dimensional information. Hitachi's Takeshi Kawasaki says that the microscope will be useful for observing certain dynamic properties of condensed matter systems—for example, the movement of vortices in high-temperature superconductors. (T. Kawasaki *et al.*, *Appl. Phys. Lett.* **76**, 1342, 2000.) —PFS



THE FAR SIDE OF THE SUN can be monitored for activity, in principle, with two new techniques. Both methods use instruments aboard the SOHO satellite, a joint mission of the European Space Agency and NASA. One method, dubbed helioseismic holography, uses the distortion introduced into sound waves—forever rumbling through the body of the Sun—when they reflect from magnetically active regions around sunspots. The wave fields are observed by SOHO on the near side of the Sun, but some of the distortions can be traced back to sources on the far side. The other method makes use of hydrogen's Lyman-alpha emission, which is stronger from active regions than from elsewhere on the Sun. SOHO routinely makes all-sky maps of interplanetary hydrogen's Ly_α. With careful processing, those maps can show where an active region's "beacon" of Ly_α excites more than the usual amount of complementary emission from interplanetary space, and researchers can watch as the beacon moves across the sky with the Sun's rotation. Both groups of researchers are part of a large effort to predict "space weather"; they see their efforts as leading to an extra week or two of advance warning, for astronauts and satellite operators, of large Earth-bound disturbances coming from the Sun. (C. Lindsey, D. C. Braun, *Science* **287**, 1799, 2000. J.-L. Bertaux *et al.*, *Geophys. Res. Lett.* **27**, 1331, 2000.) —PFS

HARD X RAYS STORED in a crystal resonator. Cavities for optical wavelengths of light are commonplace, but not so for x rays, particularly the high-energy (hard) ones. Now, however, physicists have built and demonstrated such a cavity at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France. The "mirrors" were a pair of vertical thin slabs, each 70% reflective, cut from a single crystal of silicon (ensuring the perfect alignment of rows of atoms in both walls) and placed 150 mm apart. The researchers, led by ESRF's Klaus-Dieter Liss, sent 10^{-10} s pulses of 15.8 keV x rays into the resonator, and saw as many as 14 back-and-forth reflections between the crystals due to multiple Bragg scattering. The new resonator can serve as a narrow-band filter, because the x rays that leak through the crystals on each pass have an ever-narrowing range of energies. Other x-ray optics applications are expected. (K.-D. Liss *et al.*, *Nature* **404**, 371, 2000.) —PFS

QUANTUM KEY DISTRIBUTION using entangled photons has been demonstrated by three independent research groups. For any coded message to be useful, a key must be available for decoding it. Classically, however, it is always possible for an eavesdropper to both intercept the key and avoid being detected. Using quantum entanglement, though, a completely secure key can be generated and distributed. Any eavesdropper's attempt to intercept the quantum key will alter the contents in a detectable way, enabling the users to discard the compromised parts of the data. To generate the key, a nonlinear crystal splits a single photon into a pair of entangled photons. The sender (Alice) and the receiver (Bob) each get one of the photons. Alice and Bob each have a detector for measuring their photon's properties, such as polarization or time of arrival. With the right combination of detector settings on each end, Alice and Bob will get the exact same value of the property. After receiving a string of entangled photons, Alice and Bob discuss which detector settings they used, rather than the actual readings they obtained, and they discard readings made with incorrect settings. At that point, Alice and Bob have their secure key. The three groups of researchers—based at the University of Vienna, Los Alamos National Laboratory, and the University of Geneva—all succeeded in distributing their keys while avoiding interception. In these experiments, the three groups used relatively slow key generation rates, but improvements are anticipated. (T. Jennewein *et al.*, *Phys. Rev. Lett.* **84**, 4729, 2000. D. S. Naik *et al.*, *Phys. Rev. Lett.* **84**, 4733, 2000. W. Tittel *et al.*, *Phys. Rev. Lett.* **84**, 4737, 2000.) —BPS ■