PHYSICS UPDATE

VERTICAL CAVITY SURFACE EMITTING LASERS are now able to work efficiently at visible and infrared wavelengths. VCSELs emit light vertically from the plane of the laser's active medium, rather than horizontally from one of its edges. Arrays of such lasers could be used in displays, short-distance communication between microchips and possibly in long-distance transmissions over fibers. A few months ago Motorola began selling commercial devices that use VCSELs, and a Minnesota company, APA Optics, has made a VCSEL that operates in the ultraviolet. A group at Sandia National Labs recently produced VCSELs that emit in the visible (red) range with nearly the same efficiency of previously successful near-infrared devices; this entailed overcoming several obstacles, including a mismatch between neighboring semiconductor layers. A Santa Barbara group has produced a VCSEL that emits at 1.52 microns, an important wavelength for transmission in fibers. This device has set a record for the lowest threshold current density for a laser operating at room temperature, but it does not yet operate in a continuous-wave mode, which is desirable for commercial use. (K. D. Choquette, *et al.*, *Optics Lett.* **19**, 969, 1994. D. I. Babić, *et al.*, *Appl. Phys. Lett.* **66**, 1030, 1995.)

DURING A FULL MOON, Earth's average global temperature is 0.02 K warmer than during a new moon. Two researchers at Arizona State University were able to correlate daily measurements of global temperature for the period 1979–94 with the 29.53-day lunar cycle. They assert that the result underscores both the accuracy of daily global temperature readings and the need to consider the lunar phase in studies of short-term temperature variability on Earth. (R. C. Balling Jr, R. S. Cerveny, *Science* **267**, 1481, 1995.)

CPT CONSERVATION AND THE SINGLE ANTIPROTON. Gerald Gabrielse of Harvard and his colleagues can adjust the voltages of their tabletop antiproton trap at CERN to remove antiprotons until only one remains. Measuring a single antiproton greatly improves precision in measurements of its charge-to-mass ratio. The rate at which the circulating antiproton completes an orbit around the trap, known as the cyclotron frequency, is the product of the magnetic field strength and the particle's charge-to-mass ratio. When these measurements were compared to measurements of a single *proton* in the trap, they confirmed that the cyclotron frequencies of antiprotons and protons are identical to one part in a billion—a factor-of-40 improvement over the CERN group's previous measurements involving many trapped particles and 45 000 times more precise than earlier measurements with hot antiprotons. These measurements stringently test the CPT theory, which holds that the outcome of any particle experiment is identical to a time-reversed mirror image of the experiment in which all of the particles are replaced by their antiparticles. Although precision tests of the CPT theorem have already been performed for leptons and pions, this is its first high-precision test for baryonic matter. (G. Gabrielse *et al.*, to appear in *Phys. Rev. Lett.*)

HIGHER CURRENT DENSITIES can now be achieved in high-temperature superconductors. Arunava Gupta and his colleagues at IBM in Yorktown Heights, New York, have measured current densities as high as 10^5 amp/cm^2 in mercury cuprate (Hg-Ba-Ca-Cu-O) films at a temperature of 110 K. This is ten times the density achieved with thallium- or bismuth-based superconducting films at that temperature. Measurements were made with a magnetic field perpendicular to the film sample. When the field lines are oriented in the plane of the film, 10^7–10^8 amp/cm^2 can be sustained without the film losing its superconducting property. In Gupta's samples, the high current densities can be achieved with high parallel magnetic field strengths, but perpendicular fields must be kept low so as not to disrupt the superconducting state. The mercury-based compound is potentially valuable in such applications as microwave transmitters and filters, and in the fabrication of superconducting quantum interference devices (SQUIDs), which are highly sensitive magnetometers. (L. Krusin-Elbaum, C. C. Tsuei, A. Gupta, *Nature* **373**, 679, 1995.)

THE FASTEST TECTONIC MOTION in the world has been measured near the Samoan islands, where the Pacific plate is subducted at the Tonga trench. According to a multinational consortium of scientists, the Australian and Pacific plates are in general convergence in this region of the Earth's crust, with a small platelet, the Tonga ridge, splitting off of the Australian plate like a windshield wiper. The convergence at the leading tip of the Tonga ridge is 24 cm/year as measured by ground stations using signals from the Global Positioning System of satellites. The group believes that the high seismic activity in the region is related to the rapid subduction rate. (M. Bevis *et al.*, *Nature* **374**, 249, 1995.)

PHILLIP F. SCHEWE
AIP Senior Science Writer