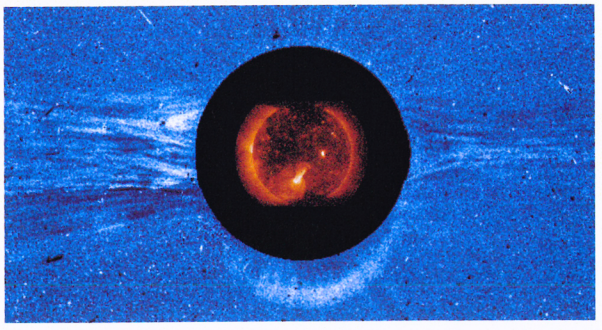
PHYSICS UPDATE

ACOUSTIC SURGERY uses sound to perform such tasks as destroying tumors and stopping internal bleeding. Last June, at the joint meeting in Seattle of the International Congress on Acoustics and the Acoustical Society of America, Gail ter Haar of the Royal Marsden Hospital in Sutton, England, described a clinical trial in which focused ultrasound destroyed parts of liver, kidney and prostate tumors in 23 patients. Just as sunlight sent through a magnifying glass can burn a leaf placed where the light converges, sound broadcast through a specially shaped transducer can converge inside the body to create a precisely targeted region of intense heat that can destroy tissue. The spot is so small that the boundary between destroyed and completely unharmed tissue is only six cells—a precision that is finer than any knife can achieve. Ter Haar said the next phase is to attempt complete destruction of tumors in the liver and prostate. At the same meeting, Roy Martin of the University of Washington discussed the use of ultrasound to stop internal bleeding in the liver. Just as a grill sears a steak, the focused sound waves heat the bleeding area to create chemical and physical changes that cauterize it. Otherwise, liver surgery (including the removal of tumors) is often hampered by bleeding that is difficult to stop with conventional cauterizing methods, Martin said. —BPS

A NEW FORM OF SOLID CARBON, based on carbon-36 molecules, has been predicted and then created by separate groups at Lawrence Berkeley National Laboratory. The theorists, led by Marvin Cohen and Steven Louie (who are also at the University of California, Berkeley), showed that a highly symmetric crystal of covalently bonded C_{36} molecules should form. (Solid C_{60} is held together by weak van der Waals forces.) They also suggest that, because the C_{36} fullerene has higher curvature than its larger cousin, the C_{60} buckeyball, its solid form will also have a stronger electron–phonon coupling and thus a higher superconducting transition temperature—perhaps as high as for ceramic superconductors. Alex Zettl and his colleagues synthesized the new bucky-lite and extracted it—as liquids, powders and films—from the general stew of fullerenes created in an electrical arc flashing between two graphite electrodes. The material had the expected symmetry and covalent bonds. (M. Côté *et al.*, *Phys. Rev. Lett.* **81**, 697, 1998. C. Piskoti *et al.*, *Nature* **393**, 771, 1998.) —PFS

A SUN–EARTH CONNECTION EVENT, in which a gust of plasma particles (a coronal mass ejection, or CME) detaches from the Sun and travels all the way to our planet, where it can cause electromagnetic disturbances and auroras, has been monitored from beginning to end for the first time. A global network of ground-based and satellite detectors, collectively known as the International Solar–Terrestrial Physics program, watched the drama play out on 6–11 January 1997. In this composite image, the CME—coming directly at us—appears in the SOHO satellite's coronagraph as a halo around the southern limb of the Sun, and the superimposed Sun's surface (as seen in x rays by the Yohkoh satellite) shows the bright active region responsible for the CME. (More than 20 articles in *Geophys. Res. Lett.* **25** (14), 15 July 1998.) —PFS



NEW IMPLICATIONS OF EXTRA DIMENSIONS have been explored by three physicists at CERN. Grand unified theories (GUTs) are the framework wherein three of nature's forces—strong, weak and hypercharge (the last being a better way of describing the electromagnetic force at energies above several hundred GeV)—come together as facets of one underlying force. It is generally assumed that these theories fully come into play only at the very high energies (10^{16} GeV) that prevailed in the very early (and hot) universe. The new proposal, however, makes the case that the unification energy can be considerably lower if extra spacetime dimensions exist. For example, a new dimension rolled up into a radius of 10^{-19} m would lower the GUT scale to the TeV range. That's because as an elementary particle (such as a photon) is accelerated, its energy increases and its Compton wavelength decreases accordingly. Eventually, the particle would, in a sense, shrink enough to fall into the new dimension, whereupon its wavefunction would behave like a particle-in-a-box. This would produce a series of higher-frequency "echoes" of the original particle, which would have the effect of lowering the GUT scale. By studying these "Kaluza–Klein excitations," researchers would be able to determine the size of the extra dimensions and the properties of GUT (and string) theories at energies far lower than was previously thought possible. Coincidentally, the CERN trio and Gordon Kane were unaware of each others' efforts when Kane's fictional "Physics Tomorrow" essay on detecting extra dimensions appeared in PHYSICS TODAY (see May, page 13, and this issue, page 11). (K. R. Dienes, E. Dudas, T. Gherghetta, http://xxx.lanl.gov/abs/hep-ph/9803466 and hep-ph/9806292, 1998.) —PFS ■