A new limit on the permanent electric dipole moment (EDM) of mercury atoms has been set. Many atoms behave like tiny dipole magnets, with their own north and south poles separated by some small distance. In contrast, no permanent EDM has ever been measured for atoms. Such a moment would imply that the centroids of the opposite charges within the neutral atom were slightly offset. Physicists at the University of Washington used an ultraviolet laser to monitor the Zeeman precession frequency of ^{199}Hg atoms in parallel electric and magnetic fields, and looked for differences between simultaneous measurements made in two cells having oppositely directed electric fields. The new upper limit on any permanent charge separation in Hg is 2×10^{-28} e cm, an improvement by a factor of four. To appreciate this limit, consider that if the Hg atom were the size of Earth, then the centers of its positive and negative charge distributions would be offset by less than 0.001 Å. Because a permanent EDM requires that time-reversal symmetry be violated, the result places new constraints on *CP* violation in particle physics beyond the Standard Model. (M. V. Romalis et al., *Phys. Rev. Lett.* **86**, 2505, 2001.) —PFS

Watching turbulence with a particle-physics detector. There are two distinct ways to observe fluid flow: In the Eulerian approach, one watches the fluid flow past a specific point in space, whereas in the Lagrangian approach, one follows a specific fluid element as it is carried along. The Lagrangian view is much favored by theorists who model such phenomena as fluid mixing or the dispersal of contaminants, but laboratory data of the Eulerian type have been much easier to obtain. Now, a group at Cornell University led by Eberhard Bodenschatz and Jim Alexander has brokered an experimental marriage between fluid dynamics and particle physics. The physicists modified silicon-strip detectors from Cornell's electron–positron collider to make them work as optical-imaging elements able to track minute tracer particles being buffeted about in all three dimensions within a turbulent fluid. With that setup, the researchers could track the particles' positions with 0.7-μm accuracy, at up to 70 000 frames per second. The Lagrangian data showed that a particle's acceleration was highly intermittent: It could vary from 0 to 12 000 m/s^2 and back to 0 in a fraction of a millisecond and within a few hundred microns. The group found that highly turbulent fluids, with Reynolds numbers up to 63 000, agreed well with predictions based on the scaling theory put forth in 1941 by Andrei Nikolayevich Kolmogorov. The experimental technique can be used to test recent theoretical predictions related to the geometry of turbulence. (A. La Port et al., *Nature* **409**, 1017, 2001.) —SGB

Refrigerator on a chip. Microelectronic and optoelectronic integrated circuits (ICs) develop hot spots that shorten the devices' lifetimes. To solve this problem, a collaboration led by John Bowers of the University of California, Santa Barbara, and Ali Shakouri of the University of California, Santa Cruz, is developing tiny thermoelectric (TE) refrigerators that sit right on top of the chips. Conventional TE coolers are already used widely to cool semiconductor lasers and other circuitry, but they are manufactured separately from the ICs. The new superlattice microcoolers are grown directly on silicon surfaces, giving them more intimate thermal contact with the semiconductors and simplifying overall fabrication. Earlier versions of the microcoolers made of Si and germanium required buffer layers to ease the strain of matching their lattice structures to the underlying Si substrate. By adding carbon to the lattice, the researchers found they could do without the buffer layers, and thus improve thermal contact and simplify fabrication even further. The 7°C cooling achieved so far is modest, but theoretical calculations show that a single-stage microcooler should attain the tens of degrees of cooling needed for commercial applications. (Xiaofeng Fan et al., *Appl. Phys. Lett.* **78**, 1580, 2001.) —JRR

A hybrid glass for high-density, holographic data storage has been developed. Holographic-storage techniques, which record data using interfering beams of light, can potentially sequester information at tens to hundreds of times the density of digital versatile disks (DVDs). Unfortunately, holographic recording media generally fail to meet the practical requirements—stability, cost, and processing simplicity—that would make them competitive with conventional technologies. Now, Pavel Cheben of Optenia Inc in Canada and María Luisa Calvo of Complutense University of Madrid believe they have developed a practical holographic medium that meets the most critical requirements for commercial data storage. Using a sol-gel process at room temperature, the researchers suspended thermally sensitive photoactive compounds in a porous silica glass to form a hybrid organic–inorganic glass. The resulting medium is rigid, stable, and can be cast in virtually any thickness, allowing the production of slablike structures. On moderate exposure to a pattern of green light, the glass undergoes chemical reactions that alter its index of refraction in only those regions that are bright. Once recorded, data are permanently inscribed in the new material, but future developments may lead to rewritable media as well as other applications, including optical interconnects, neural networks, and image-processing devices. (P. Cheben, M. L. Calvo, *Appl. Phys. Lett.* **78**, 1490, 2001.) —JRR ■