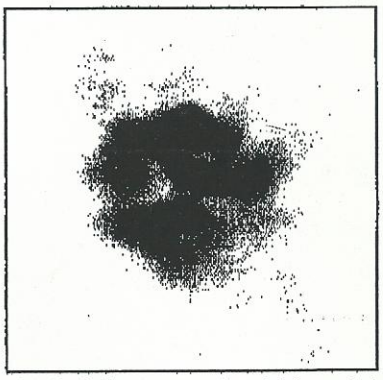
PHYSICS UPDATE

ATMOSPHERIC GAMMA-RAY BURSTS have been observed on the ground. Physicists from the University of Bologna in Italy, operating scintillation detectors atop the Gran Sasso mountains, observed two kinds of gamma-ray events during thunderstorms. One type showed a slow increase of radiation, with photon energies up to 3 MeV, and lasted for an hour or more before slowly decreasing again. The researchers attribute those photons to radioactive aerosol particles descending in rainfall. Superimposed on these gradual data were impulsive bursts of higher-energy photons (up to 10 MeV) that lasted mere minutes, a phenomenon previously observed at energies up to only a few hundred keV. These more powerful gamma rays are most likely bremsstrahlung radiation emitted by high-energy electrons colliding with atoms in the atmosphere. The scientists postulate that the acceleration mechanism is the so-called runaway electron effect—in which strong electric fields during the storms impart tremendous energies to electrons that initially exceed a certain energy threshold. A similar acceleration process could operate during other upper atmospheric and cosmic phenomena, including solar flares. (M. Brunetti *et al.*, *Geophys. Res. Lett.* **27**, 1599, 2000.) —PFS

LASER COOLING BY COHERENT SCATTERING in an optical cavity has been proposed. By making use of atomic scattering, rather than absorption, Stanford's Vladan Vuletić and Steven Chu say their new method can cool a variety of particles because it is largely independent of a particle's specific internal energy level structure. In a cavity, some frequencies of light can propagate but not others. The Stanford physicists' analysis showed that if they detune the incident laser light based on what the cavity will accept, rather than on what an atom can absorb, they will encourage scattering events in which the particles lose energy. They believe the technique will be demonstrated within the next year, and could be useful for cooling molecules, dense samples of interacting atoms, or collections of mixed isotopes. (V. Vuletić, S. Chu, *Phys. Rev. Lett.* **84**, 3787, 2000.) —PFS

FEMTONEWTON FORCE SPECTROSCOPY has been used on DNA molecules. Caltech physicists Jens-Christian Meiners and Stephen Quake attached a bead to each end of a DNA molecule, then held the beads in separate optical tweezers—focused laser beams that trap the beads with radiation pressure. By analyzing the cross-correlations of the beads' jiggling motions, the researchers were able to extract force information about the molecule that connected them, with 6 fN resolution and on millisecond time scales. Further, they did it in a wet, warm environment typical of biology, not in a chilled vacuum. One of their findings, contrary to expectation, was that the molecule's relaxation time actually decreased as its extension increased. (J.-C. Meiners, S. R. Quake, *Phys. Rev. Lett.* **84**, 5014, 2000.) —PFS

MICROLASERS in a semiconductor powder. Most current microlasers—including vertical-cavity surface-emitting, microdisk, and photonic bandgap defect-mode lasers—are fabricated in expensive, state-of-the-art facilities. But now, Hui Cao and her colleagues at Northwestern University have created microlasers in a glass beaker, using zinc oxide powder, a simple disordered medium. About 20 000 of the 50 nm ZnO crystallites were induced to coalesce into a 1–2 μm sized cluster. Light fed into the cluster was strongly scattered, and some of it became trapped in highly localized spots (via interference effects) and enhanced, as shown by the bright areas (at 380 nm) in the accompanying image. The light amplification occurred through an active, coherent feedback of the interference effects. (H. Cao *et al.*, *Appl. Phys. Lett.* **76**, 2997, 2000; *Phys. Rev. Lett.* **84**, 5584, 2000.) —PFS



FREELY ROTATING MAGNETIC PARTICLES in a new nanocomposite material. Normally, the constituents of a composite solid, such as cement or fiberglass, are locked in place. But now, in a new twist, a research team led by Ron Ziolo and Javier Tejada at the University of Barcelona Xerox Lab in Spain has developed a composite material consisting of 5–10 nm magnetic iron-oxide particles that are free to move within tiny cavities inside a polymer matrix. When a magnetic field is turned on, the particles—not just their magnetic moments—make use of the elbowroom to align with the field. Just how the tiny cavities form during the material's annealing process is unknown. In retrospect, says Ziolo, it was fortunate that the iron oxide was magnetic; otherwise it would have been impossible to detect such mechanically free nanoparticles buried deep in the material. The little compass needles remain in the composite over a temperature range of 4.2–200 K, above which the solid melts. A room-temperature version of the material is being investigated as an electrical transformer core. The developers envision many other applications, such as in sensor and switching technologies, electronic circuitry, and heat transfer management. With nonmagnetic, mechanically free particles, a composite material might have new acoustical, thermal, optical, or mechanical, as well as electromagnetic properties. (J. Tejada *et al.*, *J. Appl. Phys.* **87**, 8008, 2000.) —SGB ■