LIGHT AMPLIFICATION IN SILICON. Ubiquitous in integrated circuitry, bulk silicon is notoriously reluctant to emit light. The road to ever-faster circuits, however, leads to optoelectronics—the use of optical rather than electronic components such as switches. Silicon can emit some light, but only from nanoscale structures in which quantum effects come into play. Most semiconductor lasers are instead made from so-called III–V materials, like gallium arsenide or indium phosphide. Now, physicists in Italy (at INFM and the universities of Trento and Catania have demonstrated optical gain in silicon nanocrystals. They embedded a dense array of 3-nm silicon quantum dots—at a concentration exceeding 10^{19} cm^{-3}—in a silicon oxide matrix. The material exhibited both stimulated emission of light and an optical gain comparable to that from III–V semiconductors. The researchers attribute the gain to radiative surface states at the abundant nanocrystal–oxide interfaces. The next step for the scientists is to try to make the light coherent, an essential property for optoelectronic applications. (L. Pavesi et al., *Nature* **408**, 440, 2000.)

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NEW UPPER LIMIT ON GRAVITY-WAVE EVENTS. The International Gravitational Event Collaboration (IGEC) involves a network of five cryogenic resonant-cylinder gravity-wave detectors: two in Italy and one each in Switzerland, the US, and Australia. The search for passing gravity waves is a delicate art; in the resonant-cylinder approach, it means measuring strain displacements far smaller than the size of an atomic nucleus on the end faces of 3-meter-long, 2000-kg metal cylinders. The IGEC team has now reported that in its first operational period, covering 1997 and 1998, no gravity waves were detected. From this they calculated an annual upper limit of four events with a mean Fourier component exceeding 10^{-20} Hz^{-1} arriving at Earth. The IGEC typically used thresholds that correspond to the conversion of 0.04–0.11 solar masses to gravity waves in an astrophysical source—such as a coalescing binary system of neutron stars or black holes—at the Galactic center. The collaboration also demonstrated that a network of many detectors operating simultaneously can achieve a negligible false alarm rate. (Z. A. Allen et al., *Phys. Rev. Lett.* **85**, 5046, 2000.)

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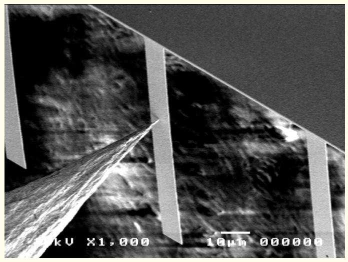
TUNABLE MICROMECHANICAL OSCILLATOR. The movement of tiny cantilevers is important in many kinds of devices, including scanning probe microscopes, magnetometers, filters for telecommunications, and mass sensors. Applications are somewhat limited, however, because cantilevers oscillate at or near a single characteristic resonant frequency. Now, though, a group of researchers at Cornell University has built a cantilever that is tunable from 9.6 kHz all the way to 37 kHz. They used a scanning tunneling microscope probe, excited by a piezoelectric motor, to set a thin cantilever vibrating. In the figure, the probe comes in from the left and down at a 45° angle. The probe also played a second role: By moving along the length of the cantilever (which was clamped at one end), it changed the resonant frequency of the cantilever, much as one can adjust the frequency of a violin string by fingering it at various places. The Cornell scientists believe that their concept of combining a local drive force with a constraint will find many applications in microelectromechanical systems. They are currently working to extend this oscillator into the MHz region. (M. Zalalutdinov et al., *Appl. Phys. Lett.* **77**, 3287, 2000.)



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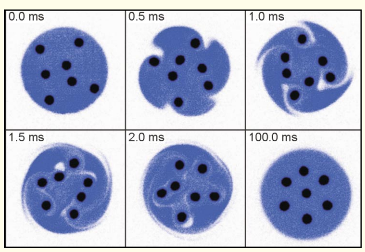
VORTEX WITHIN A VORTEX. Examples of two-dimensional fluid flows abound—for example in the ocean, atmosphere, and astrophysical settings—and vortex phenomena in such flows are many and varied. Recent numerical studies by Dezhe Jin and Dan Dubin (both at the University of California, San Diego) identified a new phenomenon not yet recognized in nature, that occurs when a small, intense, pointlike vortex is within a larger, disklike vortex (imagine a tornado within a hurricane), both spinning in the same direction. Now, Dan Durkin and Joel Fajans (both at the University of California, Berkeley) have studied the dynamics of such a system experimentally. They used a strongly magnetized electron column; under the right conditions, such a column behaves two-dimensionally, evolving by the $\mathbf{E} \times \mathbf{B}$ force, and is fully equivalent to a 2D fluid vortex. Among their findings was that the point vortex can induce a surface wave on the outer edge of the disk vortex. Eventually the wave "breaks," closing in on itself and capturing some "empty" space, which then behaves like a region of negative vorticity, spinning in the opposite direction. They also found that if multiple point vortices were initially arranged symmetrically within the disk vortex, that arrangement remained stable. In addition, if the initial distribution was random, it quickly crystallized into a stable symmetric pattern, as shown above. (D. Durkin, J. Fajans, *Phys. Rev. Lett.* **85**, 4052, 2000.)



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