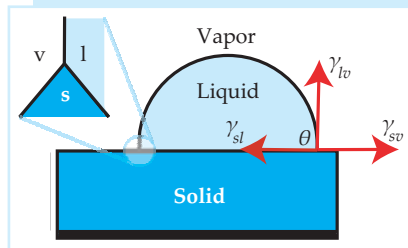


2007, page 84). However, for more than two centuries, theories yielded unrealistic singularities for stress and strain at the three-phase contact line. That's because Young's equation does not account for the vertical, out-of-plane force pulling on the solid substrate, which naturally should be balanced by the substrate's elastic response. Now,



researchers at Yale University and at consumer products manufacturer Unilever have experimentally and theoretically resolved the out-of-plane contributions. Using a confocal fluorescence microscope, the

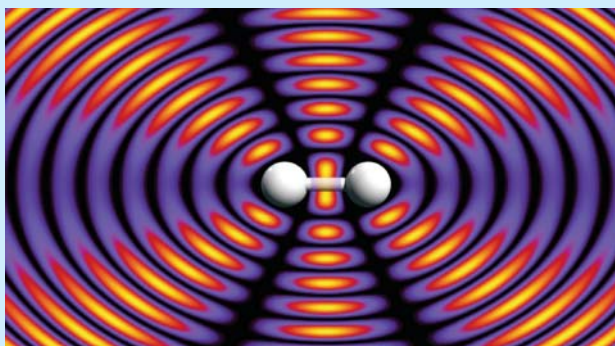
researchers, led by Yale's Eric Dufresne, laced a 20-micron-thick film of silicone gel with fluorescent beads and measured the deformation due to a water droplet. At equilibrium, a one-micron-high ridge, illustrated in the inset, formed in the gel at the contact line. When the researchers factored the gel's surface tension and thickness into a linear elastic model, they arrived at a nonsingular theoretical solution for stress that closely fit their experimental data. Their model, however, underestimates the deformations in the solid-liquid contact plane, which they believe are caused by pinning or viscous drag. (E. R. Jerison et al., *Phys. Rev. Lett.* **106**, 186103, 2011.) —JNAM

Mending polymers with light. We know all too well from daily life that materials made from polymers can be damaged: Tires get punctured, garbage bags rip, plastic eyeglass lenses get scratched. But over the past decade, several ways have been developed to heal polymers. Some methods are autonomous, drawing only on resources within the material. More commonly, though, the repair process is externally activated, typically by heat: When heated above their glass transition or melting temperature, the polymer chains can rearrange, diffuse, and reentangle. Stuart Rowan (Case Western Reserve University), Christoph Weder (University of Fribourg), and colleagues have now demonstrated a healing mechanism activated by light. The team's method exploits so-called supramolecular polymers, in which noncovalent bonds connect large repeating units. In the new work, the repeating units were elastic, hydrophobic hydrocarbon segments terminated by hydrophilic ligands. Those building blocks, termed macromonomers, were joined together into chainlike structures by metal ions, either Zn^{2+} or La^{3+} . The chains' hydrophobic and hydrophilic regions phase separated into a tough, cross-linked lamellar pattern. When UV light excited the metal-ligand bonds, most of the absorbed energy went into heating, which locally dissociated and liquefied the macromonomers. Thus freed, the macromonomers could quickly diffuse and mend defects. The researchers found that for some experimental samples, two 30-second bursts of light could completely heal cuts halfway through a thin film and restore the material to its original toughness. (M. Burnworth et al., *Nature* **472**, 334, 2011.) —RUF

New limit on putative dark-matter particle. Several lines of evidence suggest that dark matter, the mysterious substance that makes up 83% of the mass of the universe, consists of subatomic particles known generically as WIMPs (weakly interacting massive particles). On cosmic scales, the presumed influence of WIMPs is easy to spot; the particles' collective gravity controls the distribution and motion of stars in galaxies. Detecting single WIMPs is far harder. After running continuously for 100 days, the

XENON100 experiment has now yielded the most stringent limits on WIMP properties. Situated in a cavern in Italy's Apennine mountains, XENON100 consists of a bank of photomultiplier tubes that monitor 100 kg of liquid xenon. If a WIMP—or any other energetic particle—were to collide with one of the xenon atoms, the resulting scintillation would be detected. The overlying rock prevents cosmic muons from reaching the xenon, but the rock also contains radioactive elements, whose gamma-ray emission can beget scintillations. Although XENON100 incorporates ways to discriminate between the two sources of scintillations, some residual, unremovable background remains. In a paper submitted for publication, the XENON100 team report detecting three events that survived all the discrimination criteria. Given that the expected background was 1.8 events, the three events don't constitute a firm detection, but they do lower the limits on the WIMP mass and the WIMP-nucleon cross section. Supersymmetry, an extension to the standard model of particle physics, predicts the existence of WIMPs of order 100 GeV/c^2 , which is both consistent with the XENON100 results and within reach of the Large Hadron Collider. (E. Aprile et al., <http://arxiv.org/abs/1104.2549>.) —CD

Simple molecules mimic double slits. The double slit experiment, in which a coherent beam of particles diffracts through closely spaced slits to produce interference fringes, is perhaps the simplest and most famous demonstration of wave-particle duality. It has been shown to work with photons, electrons, and even the comparatively massive buckminsterfullerenes. According to a theory outlined by Howard Cohen and Ugo Fano nearly 50 years ago, interference fringes should also result from the photoionization of a diatomic molecule, provided electrons on each atom are ejected simultaneously and bestowed with enough kinetic energy that their wavelengths are similar to the



interatomic distance, as illustrated here. Unfortunately, the direct approach—fixing molecules' orientation in space, photoionizing them, and detecting fluctuations in the angular distribution of electron density—is, for the most part, impractical. Instead, an international team of scientists led by Fernando Martín (Autonomous University of Madrid) used an elaborate first-principles theory to predict the effect that interference should have on the relationship between a molecule's photoionization cross section and its vibrational energy. Working at Lawrence Berkeley National Laboratory's Advanced Light Source, they then used extreme UV light pulses to ionize hydrogen, nitrogen, and carbon monoxide gas. For H_2 , the simplest molecule of the bunch, the theory almost perfectly described the vibrationally resolved ionization spectra. For N_2 and CO , the theory was less accurate, but still in qualitative agreement with the data. The results could help to resolve ambiguities surrounding previous attempts to demonstrate the phenomenon. (S. E. Canton et al., *Proc. Natl. Acad. Sci. USA* **108**, 7302, 2011.) —AGS ■