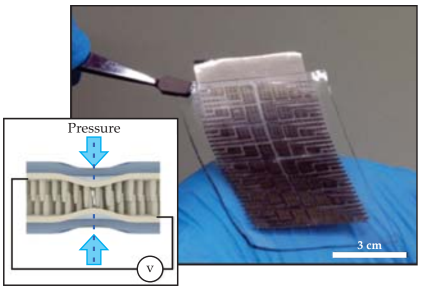
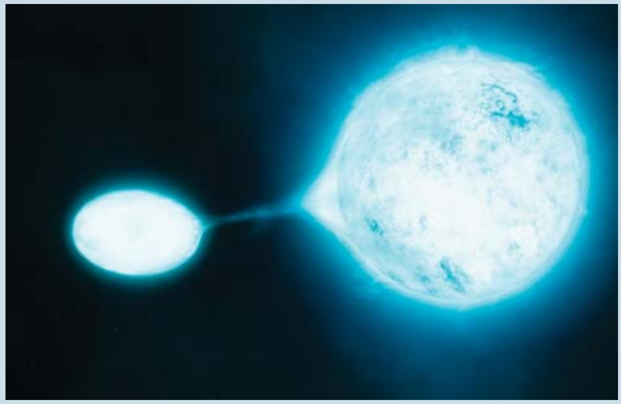
physics update

These items, with supplementary material, first appeared at http://www.physicstoday.org.

Platinum hairs add finishing touch to artificial skin. As a mechanical sensor, human skin is uniquely versatile: It can detect not just the magnitude of a contact force but the particulars of how the force is applied. Thus, we know whether we're being poked or pinched, tapped or tugged. Now, researchers led by Kahp-Yang Suh (Seoul National University, South Korea) have engineered an electronic skin that can similarly discriminate between various kinds of touch. The skin consists of two thin polymer sheets, each lined with hair-like, platinum-coated nanofibers. When the sheets are sandwiched together, as illustrated at left, the nanofibers—each about a micron long and a tenth of a micron wide—interlock to form Pt–Pt contacts that close an electronic circuit. The total contact area, and therefore the resistance, changes when the sheet is subjected to mechanical stress. Pressure, shear, and torsion each produce distinct electronic signatures, so even when all three are applied at once, the detected stress can be resolved into its component parts. In laboratory tests, the artificial skin, pictured at right, proved sensitive enough to track the movement of crawling ladybugs and detect the impact of a falling water droplet. The researchers envision the thin, flexible sensors being used as prosthetic devices or medical monitors; worn like a bandage on the wrist, the device can easily measure a human pulse. (C. Pang et al., *Nat. Mat.*, in press.) —AGS



Most very bright stars have companions. With masses at least 15 times that of the Sun, type-O stars are the heaviest and brightest of all. And because they live only a few million years, they're quite rare. Having analyzed the O-star populations of six nearby star clusters, a team led by Hugues Sana (Amsterdam University) has concluded that over 70% of O stars—far more than had been thought—have binary companions close enough to exchange matter with them. Interaction with companions, large or small, would therefore seem to dominate the evolution of the massive stars, and it should now be taken into account when interpreting observations of distant star-forming galaxies. A smaller companion might become a "vampire star" (see the artist's impression), sucking away the O star's hydrogen envelope, or it might itself be swallowed up. The team estimates the probabilities of different O-star fates by deducing the distribution of binary-pair orbital parameters from periodic Doppler shifts in spectra taken mostly with the Very Large Telescope array in Chile. For significant binary interaction and reasonable detection probability, a companion's orbital period should be less than about four years. O stars end their lives in core-collapse supernovae that seed the host galaxy with heavy elements. The team's estimate of the fraction of O stars that lose their hydrogen envelopes to vampires resolves an old puzzle; it's in good



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agreement with the observed frequency of core-collapse supernovae that exhibit no hydrogen lines. (H. Sana et al., *Science* **337**, 444, 2012.) —BMS

Toward a compact microbeam radiotherapy system. The intense, narrow x-ray beams produced by synchrotrons are ideal for zapping tumors: With diameters of just 10–100 µm, the beams deliver a dose pattern with exquisite precision. What's more, for some unknown reason, the beams' high intensity is both more effective at killing tumors and less damaging to healthy tissue than are the lower-intensity beams used in conventional radiotherapy. But synchrotrons are large, expensive, and sparsely distributed. To circumvent those disadvantages, Sha Chang and Otto Zhou of the University of North Carolina in Chapel Hill are developing a compact, convenient method for bringing what's known as microbeam radiotherapy into the clinic. Their approach entails producing x rays by slamming high-energy electrons into a tungsten anode, just as in dental cameras and other medical x-ray devices. But instead of boiling off the electrons from a metal cathode, they use the field effect to extract the electrons from a cathode made from carbon nanotubes. Thanks to the nanotubes' tiny diameters, the resulting x-ray beams, while not as powerful as those from synchrotrons, are almost as narrow. To assess whether the technology is practical, Chang and her colleague Eric Schreiber simulated a device capable of treating lab mice. The virtual device consists of a circular array of 12 or more units that direct their beams inward toward the circle's center. As they report in a new paper, the device can indeed deliver a tumor-killing dose to tightly defined volumes within a phantom mouse. The researchers are now testing their first prototype. (E. C. Schreiber, S. X. Chang, *Med. Phys.* **39**, 4669, 2012.) —CD

Optical vortex pulses. In addition to having spin angular momentum, light beams can also have orbital angular momentum (see the article by Miles Padgett, Johannes Courtial, and Les Allen in PHYSICS TODAY, May 2004, page 35). Often called vortex beams, they have a helical wavefront and a doughnut-shaped profile with vanishing intensity along the beam axis, and they are being increasingly used in applications such as rotating particles in optical tweezers. Though most investigations with optical vortex beams have focused on continuous-wave (CW) operation, pulsed vortex beams could open up several additional applications in materials processing or nonlinear frequency conversion. Now Haohai Yu (Shandong University) and colleagues have demonstrated