half vortices have intrinsic degeneracies that can be tapped for quantum computation by moving the half vortices around each other. And because the degeneracy resides in a collective state, coherence is more robust.

For the scheme to work, the energy required to pull apart a half vortex pair must be small. To overcome the troublesome spin–orbit coupling, Das Sarma, Nayak, and Tewari propose an electromagnetic analog of Salomaa and Volovik's thin film idea: Apply a magnetic field to reorient the spins and suppress the coupling.

Five years ago Maeno, Rice, and Sigrist reviewed research on strontium ruthenate for PHYSICS TODAY. The title they picked, "The Intriguing Superconductivity of Strontium Ruthenate," now seems even more apt.

Charles Day

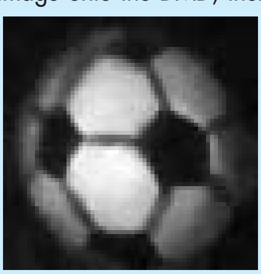
References

1. K. D. Nelson, Z. Q. Mao, Y. Maeno, Y. Liu, *Science* **306**, 1151 (2004).
2. J. Xia et al., *Phys. Rev. Lett.* **97**, 167002 (2006).
3. F. Kidwingira et al., *Science* (in press).
4. T. M. Rice, M. Sigrist, *J. Phys.: Condens. Matter* **7**, L643 (1995); G. Baskaran, *Physica B* **224**, 490 (1996).
5. G. M. Luke et al., *Nature* **394**, 558 (1998).
6. Y. M. Yakovenko, http://arxiv.org/abs/cond-mat/0608148.
7. G. E. Volovik, L. P. Gorkov, *Sov. Phys. JETP* **61**, 843 (1985).
8. P. G. Björnsson et al., *Phys. Rev. B* **72**, 012504 (2005).
9. D. A. Wollman et al., *Phys. Rev. Lett.* **74**, 797 (1995).
10. M. M. Salomaa, G. E. Volovik, *Phys. Rev. Lett.* **55**, 1184 (1985).
11. S. Das Sarma, C. Nayak, S. Tewari, *Phys. Rev. B* **73**, 220502(R) (2006).

physics update

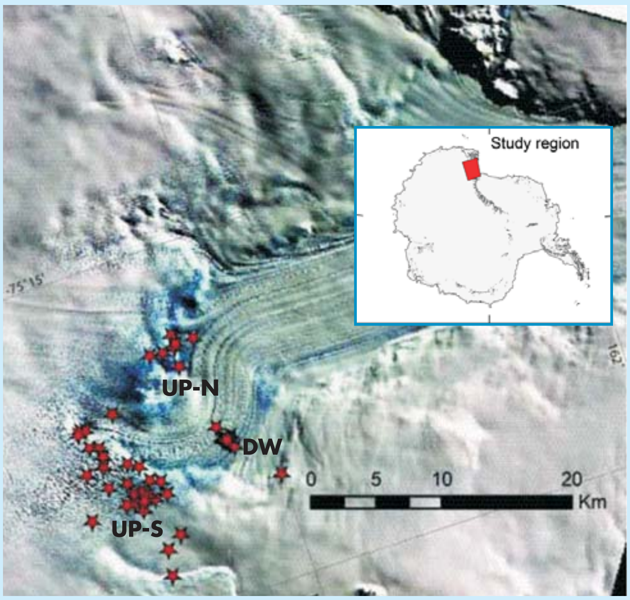
Supplementary material related to these items can be found at www.physicstoday.org.

A single-pixel camera has been developed by researchers at Rice University. The device is part of an emerging shift from digital signal processing, in which analog signals are converted into their digital counterparts for processing, to computational signal processing, in which analog signals are fed in some suitable form directly into nonlinear processing algorithms. Instead of data-gathering pixels, the Rice camera uses a digital micromirror device—an array of micromirrors that can each adopt one of two orientations. A lens focuses an image onto the DMD; then the image is reflected by a randomly chosen subset of the mirrors through another lens and focused onto a single photodiode. The photodiode generates a voltage that serves as a coefficient for the particular DMD configuration. The image is sampled repeatedly with different DMD configurations, and the collection of measured voltages is processed to reconstruct the image. Typically, many fewer measurements are needed than the number of mirrors in the array, which leads to savings in data storage and processing. For example, the image of a soccer ball shown here was taken with a 4096-mirror (64 × 64) camera and 1600 measurements. The tradeoff in the new scheme is between data compression and acquisition time rather than between resolution and number of sensors. Because the camera uses only one sensor (a photodiode in the prototype), the researchers say that "compressive sensing" can be adapted for imaging at wavelengths inaccessible to digital photography. The Rice results were reported at the Frontiers in Optics 2006 meeting of the Optical Society of America held in October in Rochester, New York. (See paper FWN3 among the Wednesday abstracts at http://www.osa.org/meetings/annual/program/default.aspx .) —PFS



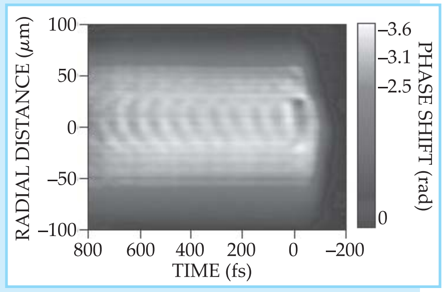
Element 118 is discovered. At the Joint Institute for Nuclear Research in Dubna, Russia, 20 physicists from JINR and 10 from Lawrence Livermore National Laboratory in the US sent a beam of calcium-48 ions into a target of californium-249 atoms to briefly create three representatives of element 118, which lies just beneath radon in the periodic table and is therefore a kind of noble gas. In separate runs with about 2×10^{19} calcium projectiles each, one atom of element 118 appeared in the year 2002 and two more in 2005; the exhaustive analysis took until now to complete. That analysis included the clear and unique decay sequence via the offloading of alpha particles: Nuclei of $^{294}118$ decay to become element $^{290}116$ (an isotope also first produced in these experiments), followed by $^{286}114$, $^{282}112$, and then the products of spontaneous fission. The average observed lifetime for element 118 was about one millisecond. As part of the continued quest for the so-called island of stability expected near $N = 184$, the Dubna–Livermore team next hopes to produce element 120 by crashing a beam of iron atoms into a plutonium target. To create still heavier nuclei, a beam of neutron-rich radioactive nuclei will be needed. (Y. T. Oganessian et al., *Phys. Rev. C* **74**, 044602, 2006.) —PFS

Glacial earthquakes in Antarctica. Little tectonic activity takes place on Earth's ice-covered, southernmost continent. That makes the area around David Glacier (shown in the figure and located on the inset map) especially interesting because a lot of low-level seismic events have been detected there over the



years. Those detections prompted Stefania Danesi and Andrea Morelli of the National Institute of Geophysics and Volcanology in Bologna, Italy, and Stephen Bannister of GNS Science in Lower Hutt, New Zealand, to deploy a portable seismographic array for three months during the austral summer of 2003–04. They recorded more than 6000 events, most of which originated within the ice layer; the remaining 121 were induced by ice–rock interactions as the outlet glacier flowed over the underlying terrain. Those 121 events—all with magnitudes from 1.1 to 2.2—had unusual but similar waveforms and occurred in three main clusters, labeled and shown with stars in the figure. Two loose clusters are situated where the glacier drops 300–400 meters. In contrast, the DW cluster has 75 events located within 2 km^2, where the glacier flows past a promontory in the basement. The researchers speculate that repeated ruptures of a single asperity at the ice–bedrock interface are responsible for the DW events. The scientists note that this is a new and complex environment for studying fracture dynamics. (S. Danesi, S. Bannister, A. Morelli, *Earth Planet. Sci. Lett.*, DOI:10.1016/j.epsl.2006.10.023, 2006.) —SGB

Snapshots of laser wakefields. Tabletop plasma devices can now produce electron beams in the GeV range. In such machines, electrons experience enormous accelerating gradients as they surf on electric fields generated in the wake of a high-power pulse of either laser light or charged particles traversing the plasma. (See the article on plasma accelerators in PHYSICS TODAY, June 2003, page 47.) The precise nature of idealized wakefields has been calculated and simulated, but actual wakefields have been difficult to see for two reasons: They are very small and they move very fast. Now, however, physicists from the University of Texas and the University of Michigan have found a way to take snapshots of wakefields in the laboratory.



In a technique called frequency-domain holography, the researchers use a pair of long, wide laser pulses. The leading "reference" pulse arrives at the gas just before the high-power laser pulse turns the gas into a plasma. Meanwhile, the trailing "object" pulse rides with the ionizing pulse and overlaps both the ionization front and the wake oscillations. The interfering reference and object pulses generate a hologram that can be reconstructed and displayed in a few seconds. The image shown here is of a strongly driven wake whose trailing wavefronts are successively more curved. The physicists say that such images will help them understand, for example, how the wave curvature relates to injection of electrons from the plasma into the waves. In addition, the images provide a means for active feedback control and optimization of a laser–plasma accelerator. (N. H. Matlis et al., *Nat. Phys.* **2**, 749, 2006.) —SGB

String-theory calculations of quark drag. When two very heavy nuclei smash together forcefully enough, theorists expect the nucleons' constituents to become unbound and form a quark–gluon plasma. An individual quark traversing the plasma would interact strongly with it and experience a friction-like retarding force. Several recent papers have presented first-principles calculations of parameters associated with such quark drag. All of them employ gauge–string duality, which takes a problem in a suitable strongly interacting gauge theory and converts it to a problem in a weakly interacting gravity theory. The most extensive of the papers is by Christopher Herzog and his colleagues. Some results of that paper have been obtained independently by Steven Gubser and by Jorge Casalderrey-Solana and Derek Teaney. A fourth paper, by Hong Liu and colleagues, focuses on the so-called jet quenching parameter and, alone among the four papers, considers light quarks. All four papers calculate quark damping in a supersymmetric theory that, unlike quantum chromodynamics, is amenable to dualization. Optimistically, one could hope that results obtained from the supersymmetric theory would capture the essence of a true QCD calculation. Encouragingly, the theoretically derived parameters roughly agree with those deduced from experiments at Brookhaven's Relativistic Heavy Ion Collider. (C. P. Herzog et al., *J. High Energy Phys.* **07**, 013, 2006; S. Gubser, http://arxiv.org/abs/hep-th/0605182; J. Casalderrey-Solana, D. Teaney, *Phys. Rev. D* **74**, 085012, 2006; H. Liu, K. Rajagopal, U. A. Wiedemann, *Phys. Rev. Lett.* **97**, 182301, 2006.) —SKB ■