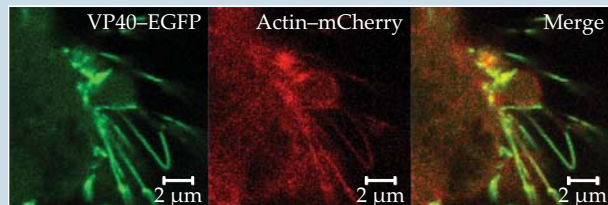


lines are so densely packed that they are known as “the Ly- α forest.” With the beacon of a single quasar, absorption-line redshifts in the Ly- α forest can reveal the distribution of neutral hydrogen along the line of sight. As part of the Sloan Digital Sky Survey III, the Baryon Oscillation Spectroscopic Survey (BOSS) team has now acquired spectra for more than 48 000 quasars with redshifts of $z \geq 2.0$, corresponding to a time more than 10.3 billion years ago, or less than 3.4 billion years after the Big Bang. (For reference, $z = 0.0$ refers to the current epoch, and even $z \geq 0.1$ was long considered “high redshift.”) Redshift correlations along different lines of sight then uncover hydrogen’s large-scale three-dimensional structure. In the resulting correlation function, the team found a pronounced peak due to “baryon acoustic oscillations” (see the article on BAOs in *PHYSICS TODAY*, April 2008, page 44) that constrained the expansion rate at that early time. With further analysis, the BOSS team (63 members from 27 institutions in 9 countries) confirmed that the cosmic expansion switched over at about $z = 0.8$ (roughly 7 billion years ago), from slowing down in the matter-dominated era to speeding up in the dark-energy-dominated era. (N. G. Busca et al., <http://arxiv.org/abs/1211.2616>.) —SGB

Tracking Ebola virus within host cells. Once a viral genome penetrates a cell’s membrane, the host cell is doomed to replicate the alien genome and make the proteins that constitute the virus’s coat, or capsid. The capsid proteins self-assemble; the replicated genomes are packed inside; and the newly created viruses burst out of the cell. To reproduce, viruses commandeer the host’s molecular facto-



ries. But, as a team led by Robert Stahelin of the Indiana University School of Medicine and the University of Notre Dame, Indiana, has discovered, the deadly Ebola virus exploits another, quite different molecule inside cells, actin. Actin polymerizes into filaments that form a cell’s internal scaffolding. Its presence in Ebola capsids had been detected before, but its role was unclear. To resolve the mystery, Stahelin and his colleagues created mutant cells whose actin molecules were labeled with mCherry, a red fluorescent protein. They also created mutant Ebola protein that, when expressed, labeled a capsid protein called VP40 with EGFP, a green fluorescent protein. By using confocal microscopy and single-particle tracking, Stahelin’s team found that the actin filaments not only attracted VP40 (see figure), but also directed the proteins’ movement through the cell. What’s more, by dosing the cells with a toxin that inhibits actin polymerization, the team discovered that actin filaments promote capsid assembly. Given that actin is found in all cells that have nuclei, it’s perhaps not surprising that a virus evolved to exploit the ubiquitous molecule. But now that it’s been revealed, Ebola’s actin dependence could lead to a treatment for the disease, which typically kills 90% of its victims. (E. Adu-Gyamfi et al., *Biophys. J.* **103**, L41, 2012.) —CD

Ferroelectric refrigeration. Just as a ferromagnet has a spontaneous magnetic moment that can be controlled by an applied magnetic field, a ferroelectric has a spontaneous electric polarization that can be controlled by an applied electric field. And in what’s known as the electrocaloric effect, applying or removing the electric field induces a reversible temperature change in a ferroelectric. If, as part of a thermal cycle, the electric field is adiabatically raised to heat the material and lowered to cool the material, a ferroelectric can function as a heat pump for heating or cooling. Such materials thus hold promise for compact, small-scale, solid-state refrigeration. Though early work achieved temperature changes of only a few kelvin, researchers in 2006 were able to cool a 350-nm-thick ferroelectric film by 12 K. Recent experiments by Yang Bai (University of Science and Technology Beijing) and colleagues have shown that for barium titanate, the cooling effect extends to temperatures above the ferroelectric transition and increases as the field increases. At the Carnegie Institution of Washington, staff scientist Ronald Cohen and summer intern Maimon Rose have now further explored the behavior. Through first-principles atomic-scale molecular dynamics simulations on lithium niobate, the pair confirmed that cooling indeed occurs both below and above the ferroelectric transition and found that it peaks at temperatures that, for a given applied field, maximize the material’s dielectric susceptibility, which relates the polarization and the field strength. Generalizing to other ferroelectrics, the two concluded that the operating temperature for refrigeration and other energy-scavenging applications should be well above the transition temperature. Moreover, a large electrocaloric effect should be observable in any insulator with a large, temperature-dependent dielectric susceptibility. (M. C. Rose, R. E. Cohen, *Phys. Rev. Lett.* **109**, 187604, 2012.) —RJF

Primed plasmas deliver better ion beams. Accelerated ion beams are finding a broad range of applications, including cancer therapy, isotope generation, and art forensics (see *PHYSICS TODAY*, January 2012, page 58). One convenient way to generate such beams is to laser ionize a gas so as to initiate a plasma shockwave. Charge-density gradients at the shock front produce an electric field that reflects ions at twice the wave’s propagation speed. (See the article by Chandrashekhhar Joshi and Thomas Katsouleas, *PHYSICS TODAY*, June 2003, page 47.) Shockwave acceleration, as it’s known, can produce impressively energetic ion beams, but their use has been limited due to their large energy spreads. A year ago, Joshi (UCLA), Luis Silva (Instituto Superior Técnico, Lisbon, Portugal), and coworkers reported a curious experimental result: When they initiated a shockwave with a train of short laser pulses instead of a single long one, they produced a beam that was very nearly monoenergetic. In a new paper, they’ve explained how it works: The first couple of pulses in the train serve to prepare the plasma with a smoothly decaying charge-density profile having a peak value near the propagation threshold. When a subsequent pulse instigates the shockwave, the smoothly decaying profile ensures that the shock front travels at a steady speed and imparts a uniform velocity to reflected ions. Simulations suggest the strategy could deliver high-quality proton beams of up to 200 MeV. (D. Haberberger et al., *Nat. Phys.* **8**, 95, 2012; F. Fiuza et al., *Phys. Rev. Lett.* **109**, 215001, 2012.) —AGS ■