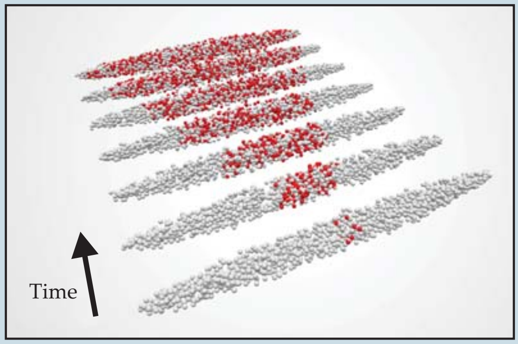
**Exiting the heliosphere.** As the Sun plows through the local interstellar medium (ISM), the wind of supersonic charged particles continually emanating from its surface envelops the solar system in hot, low-density plasma. Called the heliosphere, this plasma bubble is presumed to have a distinct aspherical boundary with the ISM's much cooler, higher-density plasma that comes within a few times $10^{10}$ kilometers of the Sun. (The orbital radius of Uranus is $5 \times 10^9$ km.) To considerable acclaim, NASA reported in September that its *Voyager 1* spacecraft, launched toward the outer planets 35 years ago, crossed that boundary "on or about" 25 August 2012, at a distance of $1.8 \times 10^{10}$ km from the Sun. The principal evidence for the spacecraft's emergence into the ISM, the first by any human artifact, is the expected abrupt 40-fold increase in plasma density, measured by the rise of the plasma's density-dependent oscillation frequency. Simultaneous with the density step, *Voyager*'s cosmic-ray detectors recorded the abrupt disappearance of energetic charged particles from sources inside the heliosphere and a concomitant rise in the flux of cosmic rays from the rest of the galaxy. There was, however, one surprise.

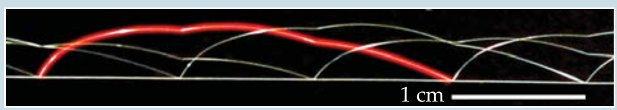
Straightforward models of the heliosphere posit that its magnetic field, generated by the Sun, is quite independent of the galactic magnetic field beyond the bubble. But *Voyager's* magnetometer found no evidence of a change in the magnetic field's direction. The paper, authored by the team that monitors the spacecraft's plasma-wave detector, speculates that "the interstellar magnetic field may be linked to the Sun's magnetic field by some mechanism . . . not completely understood." (D. A. Gurnett et al., *Science* **341**, 1489, 2013.) —BMS

**Equilibration of an isolated quantum many-body system.** Despite extensive study, many gaps remain in our understanding of the statistical mechanics of quantum many-body systems. Among them is how an isolated quantum many-body system achieves thermal equilibrium. A new report by Jörg Schmiedmayer and colleagues at the Vienna University of Technology provides insights. A cigar-shaped, effectively one-dimensional ultracold gas of rubidium atoms provided a strongly isolated test system, intrinsically rife with fluctuations, that evolved on experimentally observable time scales. To probe its relaxation dynamics, the researchers split a trapped atom cloud longitudinally into two parts, let the resulting nonequilibrium state evolve for a certain time, then used matter-wave interferometry to measure the phase differences between the two parts along the length of the system. By conducting some 150 iterations for each wait interval, the team determined how the phase correlations between the two clouds evolved over time. Although the




split clouds started off strongly correlated (symbolized by gray atoms in this plot), the short-range coherence immediately began to decay exponentially with distance—a signature of thermal correlations (indicated by mixed red and gray atoms)—but only up to a certain length, beyond which long-range coherence persisted. Notably, the position of the crossover moved: The thermal correlations propagated through the system at the speed of sound. Technically, the phases relaxed to a so-called prethermalized state. Nonetheless, the results suggest a general route through which classical properties emerge in isolated quantum many-body systems. (T. Langen et al., *Nat. Phys.* **9**, 640, 2013. Image courtesy of the Vienna University of Technology.) —RJF

**Making multifilament wires for electric solar wind sails.** High-velocity protons stream copiously from the surface of the Sun. Harnessing their momentum for interplanetary travel is the goal of a novel propulsion system known as E-sail. Invented in 2004 by Pekka Janhunen of the Finnish Meteorological Institute, E-sail consists of long electrically conducting tethers that fan out from the spacecraft like the spokes of a bicycle wheel. Each tether consists of a web of interlaced wires, whose holes allow micrometeorites to pass through and whose electric field penetrates up to 100 m into the surrounding plasma. When protons encounter the positively charged tethers, they're deflected, and that generates thrust. Although the E-sail converts momentum efficiently, propelling a modestly sized spacecraft requires the tethers to be very long. To meet that criterion without overburdening the spacecraft with inertia, the wires must be very thin. In a new paper, a team led by the University of Helsinki's Henri Seppänen reports the culmination of a




four-year project to make an entire tether of micron-scale wires automatically. The prototype tether is 1 km long, consists of nearly 100 000 loops formed by three 25-µm-thick aluminum wires bonded to a 50-µm-thick base wire, and weighs just 10 g. The figure shows a typical section, with one loop highlighted in red. Making, checking, and repairing—if necessary—so many bonds entailed customizing a manual wire bonder and incorporating a microscope, image analysis software, and computer control. A shorter, manually produced E-sail is currently being tested aboard Estonia's first-ever orbiter, the tiny *ESTCube-1*. (H. Seppänen et al., *Rev. Sci. Instrum.* **84**, 095102, 2013.) —CD ■