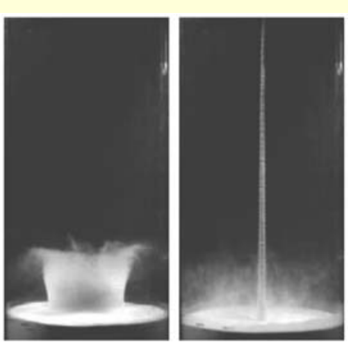
Supplementary material related to these items can be found at www.physicstoday.org.

Pairs and loners in a polarized Fermi gas. In recent years, low-temperature fermion gases have demonstrated some remarkable properties. For example, under certain circumstances a trapped sample can be magnetically tuned through a so-called Feshbach resonance (see PHYSICS TODAY, August 2004, page 12). On one side of the resonance, the spin-up and spin-down fermions pair strongly into molecules and form a superfluid Bose–Einstein condensate (BEC); on the other side, they pair weakly into a superconducting-type superfluid. Two independent groups—one at Rice University, the other at MIT—have now explored what happens when the spin-up and spin-down populations of lithium-6 atoms are unequal. Both groups found signatures in which leftover fermions are expelled into a halo surrounding the superfluid core. The MIT group found that when the polarization exceeded a critical value, the superfluid state collapsed under the pressure of the unpaired fermions. The Rice group observed that the phase separation occurred only above a critical polarization; for the resonantly interacting gas at small polarization, they saw evidence that unpaired fermions can coexist with the superfluid. If confirmed, that coexistence would constitute a new form of fermionic superfluidity. The work may have relevance to magnetized superconductors or to quark matter at the cores of neutron stars. (G. B. Partridge et al., *Science*, in press; M. W. Zwierlein et al., *Science*, in press. Both articles were posted to *Science Express* on 22 December 2005.) —SGB

Fast x-ray pictures of sand jets. Granular materials, which have both solid-like and liquid-like characteristics, can exhibit unexpected behavior even in the simplest experiments. When, for example, researchers at the University of Chicago dropped a heavy sphere into a bed of loose fine sand, the results surprised them. They used high-speed video to view the splashdown (left image) and resulting jets (right), and discovered that in a vacuum, the jet was much shorter and thinner than in ambient conditions (shown here). Furthermore, as the gas pressure was reduced toward a vacuum, a two-stage structure emerged with a more pin-like jet perched atop a thicker one. The physicists then combined the video with high-speed x-ray radiographs taken at the Advanced Photon Source at Argonne National Laboratory to view the interior of the sand bed as the jet formed. The x rays revealed that simple gravity-driven collapse of the void produced by the descending ball could explain the fine jet but not the large one. Further examination showed that as the void pinched off near the top and sand filled it in from the sides, enclosed gas was pressurized and drove the large jet up and out. (J. R. Royer et al., *Nat. Phys.* **1**, 164, 2005.) —PFS



An integral look at supernovae and stars. As a tracer of continuing nucleosynthesis in our galaxy, aluminum-26, with its half-life of less than a million years, is particularly useful. The gamma rays it emits during decay cruise largely unabated through the Milky Way to detectors at Earth. An international team led by Roland Diehl (Max Planck Institute for Extraterrestrial Physics, Garching, Germany) has used 1.5 years of data from the European Space Agency's *INTEGRAL* satellite to map ^{26}Al in the inner galaxy at high spectral resolution. The astronomers found that the radioactive tracer was redshifted on one side of the galactic center and blueshifted on the other, which demonstrates that the ^{26}Al occurs in star-forming regions throughout the rotating galactic plane. That finding allowed the team to estimate a total of about three solar masses of ^{26}Al in the entire galaxy, from which they determined current-epoch star-formation and supernova rates. Their conclusions? Our Milky Way produces about seven new stars every year and two spectacular supernovae from massive-star collapses each century. (R. Diehl et al., *Nature* **439**, 45, 2006.) —SGB

A quantum search with ions. Among the much-touted abilities of quantum computers is a dramatic speedup in searching an unsorted database for a particular entry by using what is known as Grover's algorithm (see PHYSICS TODAY, October 1997, page 19). That algorithm has already been realized with photons, nuclei, and Rydberg atoms. In those cases, however, the needed resources grow exponentially with the number of qubits, according to Christopher Monroe (University of Michigan), whose group has now implemented Grover's algorithm with cadmium ions. The physicists trapped two ions as qubits (storing four states) and used a variety of fields and optical and microwave sources to control the ions' positions, states, entanglement, and measurement. With a single query, any initially marked state was successfully identified and recovered 60% of the time, whereas the classical result could be no better than 50%. The Michigan group has also trapped a single ion within an integrated gallium arsenide semiconductor chip, and sees no impediment to scaling the system up to large numbers of qubits. (K.-A. Brickman et al., *Phys. Rev. A* **72**, 050306, 2005; D. Stick et al., *Nat. Phys.* **2**, 36, 2006.) —BPS