PHYSICS UPDATE

WAVEPACKET TECHNOLOGY for isotope separation has been demonstrated. Femtosecond laser pulses have a truncated spatial extent; according to classical wave mechanics, they are a phased superposition of waves having different wavelengths. When an atom or molecule absorbs such a pulse, the resultant quantum state is also a phased superposition of different states—a wavepacket. Wavepackets can behave like classical particles for short times; at longer times, quantum effects set in, complete with possible periodic recurrences of classical behavior. Using such "quantum revivals," physicists at the Weizmann Institute of Science in Israel and the Steacie Institute for Molecular Sciences of the National Research Council of Canada have created wavepacket states for $^{79}Br_2$ and $^{81}Br_2$ that are essentially identical. The long-time evolution of these wavepackets, however, produces revivals at slightly different times for the two isotopes. When a second laser pulse is applied at just the right moment, one isotope can be ionized and extracted, leaving the other isotope behind. The researchers believe not only that wavepacket techniques can be used to control chemical reactions, but also that these techniques can be applied in other fields. For example, interference of wavepackets in semiconductor materials could lead to terahertz switches, a thousand times quicker than the fastest existing switches. (I. Sh. Averbukh *et al.*, *Phys. Rev Lett.* **77**, 3518, 1996.) —BPS

HELIUM DROPLETS ACT AS NANOSCALE cryostats. The study of tiny clusters of metal atoms, poised between the atomic and bulk worlds, is complicated by environmental factors. Most of a cluster's atoms are at or near the cluster's surface, so when placed on a solid substrate, a cluster takes on some of the properties of the support medium. Clusters in a beam are not contaminated by a surface, but they have a relatively high temperature. Scientists at the Max Planck Institute for Fluid Dynamics in Göttingen, Germany, have gotten around these problems by embedding clusters (of silver, indium or europium atoms) in droplets of liquid helium. The clusters, with as many as 19 atoms, are stable and at a precisely defined temperature of 0.37 K, making possible high-resolution spectroscopy and perhaps the study of superconductivity in such structures. (A. Bartelt *et al.*, *Phys. Rev. Lett.* **77**, 3525, 1996.) —PFS

STELLAR MOTIONS AT THE HEART of the Milky Way provide new evidence for the existence there of a supermassive black hole. Deducing a star's radial velocity, its speed along our line of sight, is relatively easy; just measure the Doppler shift in the star's spectrum. By contrast, measuring a star's proper motion, its movement across our line of sight, is difficult, especially for stars as far away as the Galactic center—25 000 light years distant. And yet those proper motions are just what astronomers need to formulate a full traffic report in the vicinity of Sagittarius A*, the radio source around which the entire Milky Way rotates. Over the last five years, Reinhard Genzel and Andreas Eckart of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, have used the European Southern Observatory's New Technology Telescope in Chile to track 39 stars near Sgr A*. The proper motions they find are as big as the radial velocities for those stars. The implied velocities range up to 2000 km/s (at 0.03 light years from Sgr A*) and fall off with distance in a Keplerian fashion, suggesting the presence of a 2.5 million solar mass dark object packed within a 0.1–light-year volume at our Galaxy's nucleus. "Anisotropic motions can't be fooling us about the mass," says Genzel. (A. Eckart, R. Genzel, *Nature* **383**, 415, 1996.) —PFS

A MODEL FOR THE DYNAMICS OF A FLOCK of birds, a school of fish or a cloud of mosquitoes has been developed. Ezequiel Albano of the National University of La Plata, Argentina, assumed that each individual of such a group is self-propelled, and that some communication (visual, verbal, chemical and so on) exists between individuals. He then used simple local rules for an individual's motion (as an average of its neighbors' motions with some noise added) and for the population dynamics (with stringent birth constraints and death from either overcrowding or isolation) to describe the global collective behavior of living things. He found a "rich and complex critical behavior," with many similarities to actual biological groups. (E. V. Albano, *Phys. Rev. Lett.* **77**, 2129, 1996.) —SGB

SIGNAL TRANSMISSION through a mammalian nerve-cell network can be enhanced with the help of electrical noise, a new experiment has shown. The phenomenon of stochastic resonance (SR) employs an optimal amount of noise to enhance the transmission or detection of an otherwise undetectably weak periodic signal. In the experiment, researchers applied a weak electric field (containing both signal and noise) to a slice of rat hippocampus, a brain region essential for memory and other tasks. All neurons in the network were exposed to the field, but the signal alone was unable to trigger any activity. At an optimal noise intensity, however, ensemble activity was seen and a maximum in the signal-to-noise ratio was reached—a hallmark of SR. This experiment offers the intriguing possibility that spatial SR may be used to aid in transmitting, detecting and processing signals in neuronal networks. (See the article on SR in PHYSICS TODAY, March 1996, page 39.) (B. J. Gluckman *et al.*, *Phys. Rev. Lett.* **77**, 4098, 1996.) —BPS ■