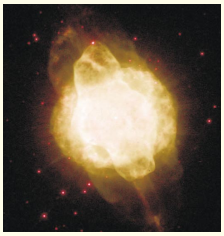
Physics Update

A very long-lived atomic state has been measured in an astrophysical nebula. Most excited atomic states last much less than a second. The lifetimes of longer-lived states are difficult to measure because collisions between atoms cause deexcitations before the atoms can decay radiatively. With a vacuum far better than any on Earth, outer space is the laboratory of choice for such atomic measurements. That's why Tomas Brage of Lund University (Lund, Sweden), Philip Judge of the High Altitude Observatory (Boulder, Colorado), and Charles Proffitt of Computer Sciences Corp (Baltimore, Maryland) turned their gaze on the planetary nebula NGC3918 (shown here). Amid that wreckage of a dying star, there is enough energy to excite atoms but a low enough density (a few thousand atoms per cubic centimeter) that collisions are not a problem. Using the Hubble Space Telescope, the scientists looked at the emissions from triply ionized nitrogen atoms and found a lifetime of 2500 seconds for one particular hyperfine-induced transition in which a nuclear spin flip induces an electronic transition. The measurement provides important confirmation of earlier calculations, and thus lends support to theoretical studies of both atoms and large-scale, low-density astrophysical sources. (T. Brage, P. G. Judge, C. R. Proffitt, *Phys. Rev. Lett.* **89**, 281101, 2002.) —PFS



Acoustic microscopy in medicine. At last December's First Pan American/Iberian Meeting on Acoustics in Cancún, Mexico, researchers presented results on this burgeoning technique, which could provide new kinds of medically useful information on biological tissue. To achieve microscopic resolution, acoustic frequencies of 1 GHz or higher are needed; the more familiar medical ultrasound imaging is typically done at 30 MHz or less. Unlike optical microscopy, which uses stains to examine the chemical nature of biological specimens and usually requires tissue removal, acoustic microscopy examines the mechanical nature of tissue and can even be performed inside the living body. The mechanical properties of many materials, including biological tissue, have a wider range of values than the optical properties, so the technique could come in handy for quickly assessing tissue pathologies without the need for biopsy. At the meeting, researchers described how acoustic microscopy is already advancing cardiology, specifically in the area of intravascular ultrasound (IVUS), in which a small ultrasound camera is threaded into the body to detect artery blockage. Using a scanning acoustic microscope to gather basic data on artery plaque, Yoshifumi Saijo of Japan's Tohoku University and his colleagues are helping clinicians better interpret IVUS images. Meanwhile, at the Erasmus Medical Center in the Netherlands, Ton van der Steen and his colleagues have developed a clinical technique called IVUS elasticity imaging, which can detect vulnerable artery plaques, a hard-to-catch condition that kills up to 250 000 people every year in the US alone. —BPS

The activity of a single ion-channel protein has been detected with a new method. Ion channels act like pores with doors that allow ions to flow in and out of cells. That ionic current is how cells exchange information in various neural, cardiovascular, intestinal, and reproductive processes. The standard patch-clamp method for studying ion channels uses the tip of an electrolyte-filled micropipette that is connected to an amplifier. Now, scientists from the University of Munich, Germany, have replaced the pipette with micron-sized holes drilled into a glass chip. They use gentle suction to position and seal an individual cell onto a hole so that an ion-channel protein in the cell's membrane protrudes out the bottom. The researchers believe that this flat architecture will facilitate an automated bio-nanotechnological approach to ion-channel research. They add that the planar geometry also enables the combination of scanning-probe techniques or high-resolution fluorescence microscopy with simultaneous electrical recording. (N. Fertig et al., *Appl. Phys. Lett.* **81**, 4865, 2002.) —PFS

Carbon nanotube resonance frequencies can be tuned by a factor of 10 in a field-emission microscope (FEM). A group of physicists at the University of Lyon, France, grew several multiwall nanotubes (MWNT) on a nickel support tip, then placed the tip in an FEM. With a static voltage applied between the nanotubes and a counter electrode, electrons sprayed out of the MWNTs onto a detection screen. Each MWNT has natural resonant frequencies at which it oscillates with large amplitudes. The vibration is excited by applying an additional sinusoidal voltage of the correct frequency to one of the electrodes. By varying the applied voltage and watching the screen, the researchers not only measured the natural resonances for several MWNTs—permitting a measure of the MWNT stiffness—but also found that the voltage effectively "pulls" on the nanotube, tuning it much like increasing the tension on a guitar string. According to group member Stephen Purcell, carefully excited and tuned MWNTs may act as a core element for future nanometric oscillator circuits, nanobalances, or nanoforce sensors. For more on carbon nanotubes, see articles in PHYSICS TODAY by Thomas Ebbesen (June 1996, page 26) and by Cees Dekker (May 1999, page 22). (S. T. Purcell et al., *Phys. Rev. Lett.* **89**, 276103, 2002.) —PFS