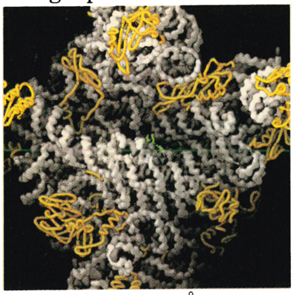
PHYSICS UPDATE

NUCLEAR–ATOMIC ENERGY RESONANCE observed— in both directions. Normally, thousands or millions of eV separate atomic and nuclear energies. But for heavy atoms, the innermost (K-shell) electrons can have binding energies comparable to some nuclear transition energies, a crucial feature in two recent experiments. A multinational experiment, conducted at the GANIL accelerator in France, took tellurium atoms with 47 or even 48 of their 52 electrons removed and smashed them into a target. In those collisions, the Te nucleus was put into an excited state and subsequently emitted a "virtual photon"—a γ ray that was immediately absorbed by a K-shell electron. Rather than kicking the electron out of the atom, however, the γ-ray energy was just right to promote it into a highly excited, bound (Rydberg) state. Such internal conversion, from one atomic bound state to another, had not been seen before. Meanwhile, a group of physicists in Japan observed the inverse process—nuclear excitation by electronic transition (NEET). That group used the Spring-8 synchrotron source to knock K-shell electrons out of gold-197 atoms. Usually an outer electron will fill the K-shell vacancy, giving up energy in the form of x rays and throwing Auger electrons from the atom during the process. The researchers, however, observed that the energy occasionally excited the nucleus instead of creating Auger electrons and x rays. Together, these experiments can help explain anomalous lifetimes of some nuclear species, and have implications reaching from the laboratory to astrophysical plasmas. (T. Carreyre *et al.*, *Phys. Rev. C* **62**, 024311, 2000. S. Kishimoto *et al.*, *Phys. Rev. Lett.* **85**, 1831, 2000.) —PFS

THE COMPLETE ATOMIC STRUCTURE of a bacterial ribosome's major subunit has been determined. Some of the food we eat gets broken down into amino acids, which are then reassembled into useful proteins in a workshop called the ribosome. Yale crystallographers, led by Thomas Steitz and Peter Moore, presented their 2.4-Å resolution map at the July meeting of the American Crystallographic Association. Their work presents the largest (by a factor of four) asymmetric molecular structure that has thus far been mapped at the atomic scale. Key to their success was a procedure by which they could reproducibly grow crystals untwinned and much thicker than was previously possible. The crystals could diffract x rays to at least 2.2-Å resolution in the synchrotron light sources at Brookhaven and Argonne. The researchers found that the ribosome contains RNA (gray, in this image) at its very core, with surrounding proteins (gold) stabilizing the structure, and they identified an adenosine base in RNA as the site (green) in the core that catalyzes the formation of the peptide bonds that string together amino acids to form proteins. (N. Ban *et al.*, *Science* **289**, 905, 2000; P. Nissen *et al.*, *Science* **289**, 920, 2000.) —BPS



NONMOLECULAR NITROGEN has been observed by scientists at the Carnegie Institution of Washington. Because of its triple bond, diatomic nitrogen is one of the most strongly bound simple molecules in nature. Atomic nitrogen has not been seen under ambient conditions, but was thought to exist at very high pressure, such as in Jupiter's core. The physicists squeezed (and monitored) N_2 in a diamond anvil cell. At pressures above 150 GPa, the sample became optically opaque, and rotational and vibrational features disappeared from the Raman and infrared spectra. The researchers interpret these results to mean that the N_2 dissociated into a nonmolecular state of nitrogen that appeared to be semiconducting. There is speculation that nitrogen might become metallic at pressures above 275 GPa, a regime the group is currently exploring. (A. F. Goncharov *et al.*, *Phys. Rev. Lett.* **85**, 1262, 2000.) —PFS

GEOLOGICALLY FOCUSED SEISMIC WAVES can explain anomalous earthquake damage. During the 1994 Northridge earthquake in California, Santa Monica experienced concentrated damage, at a level consistent with being much closer to the epicenter than its distance of 21 km. The usual explanation—local site effects such as compliant soils—could explain a doubled wave amplification, but not the sixfold increase that was observed. An alternative explanation involves deep geologic structures acting like acoustic lenses. Accurate computer modeling of such focusing must include both short-wavelength (100-m) effects and high spatial (10-m) resolution, and has been restricted to two dimensions. Also, knowledge of the underground geology is needed, but is not currently available. Now, however, a group of geophysicists, led by Paul Davis of UCLA, has turned the problem on its head. They inverted the data from 22 aftershocks (each one recorded at about 18 stations) and iteratively identified relevant underground structures from a simple 3D model of deep basin focusing. The model shows that local site effects can be enhanced by a factor of three or more. They found that the basement-to-sediment contact geometry north of Santa Monica has three seismic lenses embedded in it at depths ranging from 1.3 to 3.0 km. One of those locations is well characterized geologically, and coincides with the intersection of the Santa Monica fault with the basin basement, resulting in a concave low-velocity structure. The researchers showed that high frequencies of 5–15 Hz would have been selectively focused, consistent with the resonant frequencies of damaged buildings. Finally, they note that seismic waves entering the lenslike structures at angles other than from the epicenter would not focus as strongly. (P. M. Davis *et al.*, *Science* **289**, 1746, 2000.) —SGB