

Lighting's Latest Leitmotif

Conventional incandescent and fluorescent light sources are being replaced at a growing rate by illumination technologies such as light-emitting diodes. **Schubert and Kim** (p. 1274; see the Policy Forum by **Mills**) review the principles and applications of solid-state lighting. Not only can solid-state devices provide greater energy efficiency, but the nature of emission can be custom tailored—for example, indoor lighting could be programmed to change in its color spectrum just as the Sun's does during the day.

An Icy Realm

Amalthea is one of Jupiter's small inner moons whose orbit is within that of Io. The Galileo spacecraft passed close enough to Amalthea to obtain an estimate of its mass from radio Doppler data. Using estimates of its size from both *Voyager* and Galileo observations, **Anderson et al.** (p. 1291) calculate that its density is less than 1000 kilograms per cubic meter, which suggests that it is composed of mostly porous ice. These results are consistent with Amalthea having formed elsewhere and later captured by Jupiter.

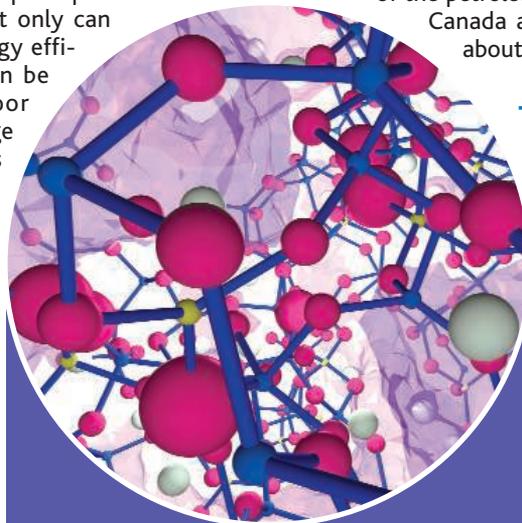
Asymmetrical Supernovae

When a star exhausts its nuclear fuel, gravitational forces cause the remaining stellar material to collapse, triggering a supernova explosion. Some of these events have been linked to very bright gamma ray bursts, an unusual and still not understood high-energy astrophysical phenomenon. Gamma ray bursts, however, require strongly asymmetric jet-like explosions, whereas supernovae have been thought to be mostly spherical explosions. **Mazzali et al.** (p. 1284) report recent supernova observations with the Subaru and Keck telescopes in which spectral lines of stellar material show an unusual double-peak structure indicative of an aspherical explosion. The results suggest that gamma ray bursts may be produced in supernovae, but they can remain unseen on Earth if they point in the wrong direction.

Direct Oil Dating

Petroleum deposits typically form when oil generated from source rocks collects beneath or in some geologic trap, such as under relatively impermeable rocks. Migration usually occurs long after the source rocks are deposited, and establishing the timing of migration and identifying the source rocks are critical for further exploration. Most isotopic dating systems, however,

date the history of the rock rather than the oil. **Selby and Creaser** (p. 1293; see the Perspective by **Schaefer**) now show that oil contains enough rhenium and osmium, inherited from organic-rich source rocks, to provide important direct ages on the history of the petroleum. Data for the great oil sand deposits of Canada all plot along a single isochron dating to about 112 million years ago.



Boson Peaks and Glass Formation

The origin of a characteristic feature in the vibrational spectra of glasses, a broadband of low-frequency modes (between 20 to 50 wavenumbers or 4 to 12 millielectron volts) called the Boson peak, has been a matter of debate; many explanations invoke collective modes reminiscent of phonon modes in crystals. **Greaves et al.** (p. 1299) have used high-resolution inelastic neutron scattering to follow the decay of low-frequency features in zeolite Y as they amorphize this open framework material to varying degrees. They identified vibrations that destabilize the crystalline state, and they can attribute the Boson peak to the coupling of oscillations between rings within the structures that have a range of sizes.

Timing Light Emission

One goal of photonic band gap engineering is to control the spontaneous decay rate of optical excitations. In practice, however, fabrication of high-quality samples with a fully three-dimensional (3D) bandgap is highly challenging. It was suggested that the strict requirements of a 3D bandgap could be relaxed by combining a 2D bandgap and a high-dielectric material. **Fujita et al.** (p. 1296) have prepared a series of such samples and show that spontaneous emission of an embedded emitter can indeed be inhibited. Simultaneously, the energy stored in the system can be redistributed and emitted from a specifically designed defect in the crystal structure.

Stalking Stacking Domains

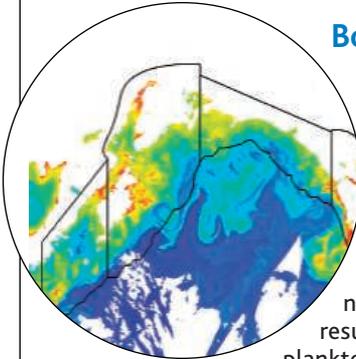
When a metal is deposited onto a substrate that has a different lattice spacing, a domain texture will form, but the mechanism for forming this texture has been much debated. **El Gabaly et al.** (p. 1303) present a real-time study of the microscopic domain structure of a heteroepitaxial thin film of copper on a ruthenium substrate. By combining bright- and dark-field low-energy electron microscopy images, they could map both the stacking and rotational domains of the film and follow their temporal evolution on the

time scale of seconds. The boundaries between stacking domains within a given rotational domain move quickly and smoothly but get stuck at the rotational boundaries. Thus, the mobility of the stacking domains depends on the orientation and boundaries of the rotational domains, where threading dislocations represent an effective barrier for the gliding atomic planes.

Plant Life in the Fast and Slow Lanes

The movements of plants vary in speed from the slow curling of a tendril to the rapid snapping of a Venus flytrap. **Skotheim and Mahadevan** (p. 1308; see the cover) have analyzed the diversity of plant movements and find certain guiding principles to the

sorts of movements that can be accommodated and at what speeds. Many of these movements depend on alterations in turgor pressure, and the analysis lends insights into the design of mechanical systems that are driven by hydraulic forces.



Bottom-Up Fish Control

Fishery harvests, in particular resident groundfish, are associated with bottom-up production of phytoplankton. **Ware and Thomson** (p. 1280, published online 21 April 2005) surveyed two distinct oceanographic regimes in the northeast Pacific: the Coastal Upwelling Domain, which extends from southern California to central British Columbia, and the Coastal Downwelling Domain, which extends from northern British Columbia to the Aleutian Islands. The results establish that the strong linkage between phytoplankton and fish also applies at much smaller spatial scales

than had been previously reported, and that for coastal British Columbia, where there are long zooplankton biomass time series, the link is clearly from phytoplankton to zooplankton to fish.

No Rest for Microglial Cells

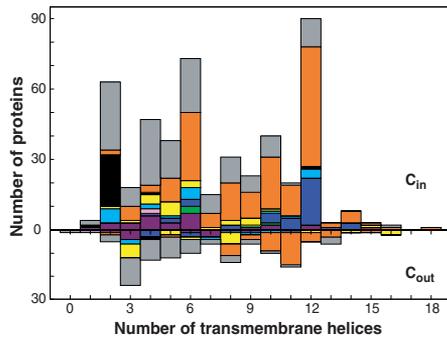
Resident microglial cells, the brain's immune surveillance cells, are thought to remain in a quiescent dormant state until they respond to damage or disease. **Nimmerjahn et al.** (p. 1314, published online 14 April 2005) filmed living fluorescent microglia in situ for up to 10 hours and found that so-called "resting" microglia in the normal brain are, in fact, not resting at all but are continuously exploring their microenvironment. Microglia responded extremely rapidly to disturbances (lesions created in the blood-brain barrier with a laser) by switching their behavior from patrolling the brain to shielding the injured site.

Violence Begets Violence

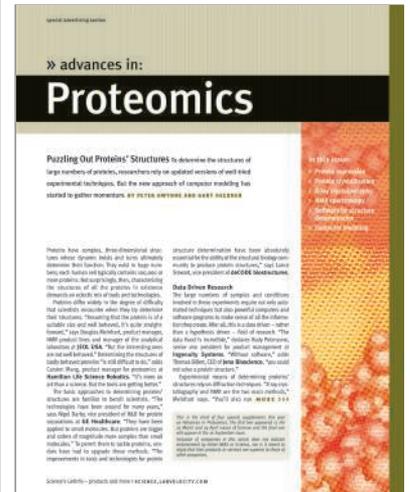
Although the association between exposure to community violence and concurrent or subsequent violent behavior has been established, it has proved harder to demonstrate causality. **Bingenheimer et al.** (p. 1323; see the news story by **Holden**) have applied a study design and analytical method that is meant to approximate a randomized experiment to more than 1500 adolescents living in Chicago neighborhoods. Although it is not possible to remove all potential confounding variables, the data suggest that exposure to violence more than doubles the likelihood that an adolescent will perpetrate a violent or aggressive act within 2 years.

Proteomic Topology

The global characterizations of protein composition, either of organisms or organelles, depends on analytical techniques optimized for soluble proteins, which comprise about 70% of the coding capacity of a genome. The remaining 30% have proven more difficult to analyze as a group. **Daley et al.** (p. 1321) have used topological markers (alkaline phosphatase for the periplasm and green fluorescent protein for the cytoplasm) to establish the inside-outside orientations of the C termini of almost all of the 700 inner membrane proteins in *Escherichia coli*. Combining these experimental determinations with prediction algorithms based on sequence yields a much improved database of how many times each of the polypeptides crosses the membrane and of where the N and C termini are located.



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