**PHYSICS**

**Snapshot Magnetometry**

In cold-atom chips, atoms are guided above tracks of wires that supply the magnetic field to keep them aloft. In applications ranging from quantum information processing to metrology, any deviation in the magnetic field from point to point over the chip could influence the delicate state of the atoms. Terraciano et al. introduce a technique that takes a snapshot image of the magnetic field landscape. Using a cloud of cold rubidium atoms, whose energy levels are sensitive to magnetic field, they let the cloud fall toward the chip and probe the atoms’ state with a laser beam tuned to one of the magnetic transitions. The ability to take a two-dimensional snapshot image of magnetic field variations of 30 mG/cm above the atom chip over 5 mm with 250-µm resolution should prove useful in calibrating these chips for their envisioned applications. — ISO


**BIOCHEMISTRY**

**Translation Translocations**

Ribosomes translate mRNA into protein with the help of GTPases: the elongation factors (EFs). In prokaryotes, as each mRNA codon is presented in the A site of the ribosome, EF-Tu loads a complementary, amino acid–bearing tRNA into the A site. After peptide bond formation, EF-G translocates the ribosome along the mRNA strand by three nucleotides, moving the tRNA (now carrying the nascent polypeptide chain) into the neighboring P site and bringing the next codon into the A site. The GTPase EF4/LepA was recently found to promote backward translocation of the ribosome along the mRNA strand, moving the tRNA from the P site back into the A site. This function may allow the ribosome to recover from forward translocations of the wrong number of nucleotides. Connell et al. have visualized EF4 in complex with a ribosome and associated tRNAs using single-particle cryo–electron microscopy (EM). Fitting the crystal structure of EF4 into the cryo-EM reconstruction revealed that its C-terminal domain forms multiple contacts with a tRNA in the A site, suggesting that EF4 promotes back-translocation by stabilizing the A-site tRNA position over the P-site tRNA position. — NM*


**CLIMATE SCIENCE**

**1000 Years of Hurricanes**

The natural variability of hurricane activity is poorly known, not least because the historic record for hurricanes extends back only about 130 years. As a result, there has been controversy over whether hurricane activity will change—or is already changing—as a result of global warming. Sediments may hold clues to hurricane activity over longer time scales, but few studies have yielded sedimentary records of hurricane activity at annual resolution. Besonen et al. have now obtained an annually resolved lake sediment record from Lower Mystic Lake in Boston, Massachusetts, that covers the past 1000 years. The record contains anomalous features—unusually thick layers in which coarse sediments and terrestrial, organic detritus are overlain by progressively finer sediments—that are indicative of strong flooding. Comparison with the historic record shows that 10 out of 11 of these features...
BIOCHEMISTRY

Plasmid Propulsion

To be propagated stably in prokaryotes, low-copy number plasmids must be allocated actively during cell division. The R1 plasmid is maintained at four to six copies per cell by the par operon, which encodes the DNA-binding protein ParR and the actin-like ATPase ParM. ParR binds cooperatively as a dimer to 11–base pair repeats in parC; ParM undergoes ATP-dependent polymerization, but only grows into long parallel filaments that are capable of pushing replicated plasmids apart when capped by the ParR-parC complex. To understand how elongating filaments are stabilized, Salje and Lowe have used electron microscopy and biochemistry to determine the architecture of capped filaments. ParR-parC complexes have previously been shown to form a clamplike structure in which parC DNA wraps around a helical array of ParR dimers. Guided by biochemical mapping of the ParR-ParM interaction sites, they modeled the crystal structure of ParR onto the end of the double-helical ParM filament. The ParR-parC clamp wraps around the filament with the C-terminal regions of ParR bound to exposed loops of ParM. Each ParR-parC complex binds the end of a single filament, and the filament ends can be bound simultaneously. Unlike actin, ParM forms left-handed filaments, which allows ParM monomers access to the ends of protofilaments capped with right-handed ParR-parC. The authors suggest a model in which force is produced by the alternating addition of monomers to each protofilament accompanied by rocking of the ParR clamp from side to side, analogous to the model proposed for formin-assisted actin polymerization. — VV


BIOPHYSICS

Molecular Cloaking

Natural products, such as latex rubber or beta-lactam antibiotics, have given rise to entire industries, and green fluorescent protein (GFP) has fought its way onto the list. A series of variants created in several laboratories have shifted the peak excitation and emission wavelengths (for multicolor imaging), improved the photostability (for time-lapse cinematography), and enhanced the quantum yields (lowering detection thresholds). Andresen et al. describe their latest entry—which has been christened Padron in recognition of its “reversed” behavior in comparison to its parent, Dronpa—and demonstrate how to implement multilabel, single-color imaging. Dronpa and its widely used descendant rsFastLime fluoresce when excited with blue light (488 nm), which also converts them from an “on” state to an “off” or nonfluorescent state, from which they can be switched on again by irradiation with ultraviolet (UV) light (405 nm). In contrast, Padron (differing at eight amino acid residues from Dronpa) is switched off by UV and on by blue light. As the emission of both proteins is centered at roughly 520 nm, and both exhibit very low off-state fluorescence, a single detection window can be used. — GJC


BIOLOGY

From Clinic to Lab and Back

Some breast cancer patients respond to docetaxel chemotherapy, but some do not. Honma et al. have marshaled converging evidence that ribophorin II (RPN2), a mammalian oligosaccharyl transferase component, contributes to the development of resistance to docetaxel. Assessing gene expression levels in nonresponders versus responders yielded 85 genes expressed at higher levels in nonresponsive patients. Down-regulating these genes individually by applying small interfering RNAs (siRNAs) to a docetaxel-resistant breast cancer cell line winnowed the candidates to eight, with RPN2 knockdown strongly associated with the inhibition of cell growth (taxanes are antimitotic agents) and activation of apoptotic (programmed cell death) pathways; conversely, docetaxel-resistant cells displayed enhanced expression of RPN2 and also of MDR1, which encodes a multidrug efflux pump. Translating these findings into two animal models—created by implanting two docetaxel-resistant breast cancer cell lines into mice—revealed that RPN2 siRNA delivery restored sensitivity to docetaxel and inhibited tumor growth; these effects were mediated by the diminished maturation and glycosylation of MDR1 and the accumulation of docetaxel within the orthotopic tumors. Finally, in a new, albeit small, set of breast cancer patients, RPN2 expression matched responsiveness to docetaxel treatment. — GJC


RPN2 expression matched responsiveness to docetaxel treatment. — GJC

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