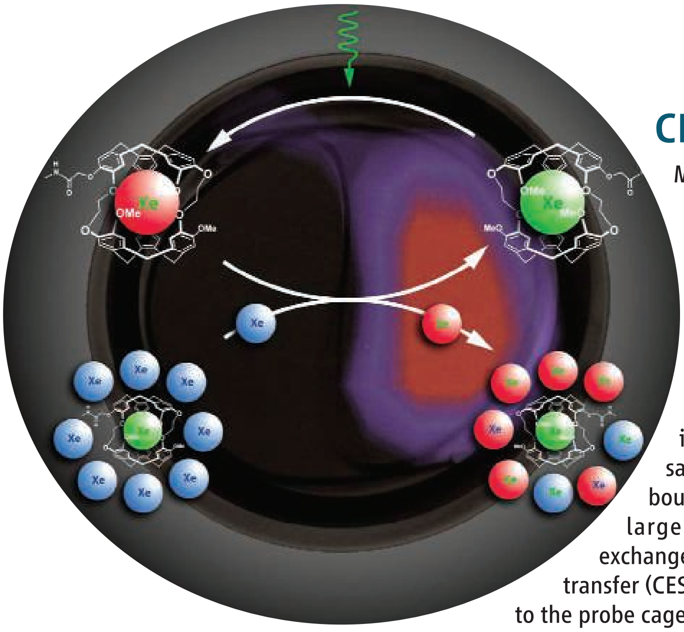
EDITED BY STELLA HURTLEY AND PHIL SZUROMI



CEST with Zest

Magnetic resonance imaging of biological systems generally detects local concentration gradients of highly abundant compounds, such as water. Various molecular probes can be used to target more specific regions or substrates for imaging, but often at the expense of greatly reduced sensitivity. **Schröder *et al.*** (p. 446; see the Perspective by **Driehuys**) combine two techniques to achieve a large measure of both specificity and sensitivity. They prepare a molecular cage framework that can encapsulate hyperpolarized xenon (Xe) in close proximity to a selectively bound target. To compensate for the relatively low probe concentration, they detect the bound Xe through its modulation of the signal arising from the large pool of unbound Xe as the bound and unbound atoms exchange positions—a method termed chemical exchange saturation transfer (CEST). The authors demonstrate the method by appending biotin to the probe cage and selectively imaging an in vitro avidin sample.

Entangled Quantum Error–Correction

Quantum error–correction codes were introduced just over a decade ago to tackle the problem of decoherence, which at the time was thought to be an insurmountable obstacle to the development of quantum information processing. The present quantum error–correction codes are effective but somewhat limited in application and tend to be slow. **Brun *et al.*** (p. 436, published online 28 September; see the Perspective by **Gottesman**) present a theory of entanglement-assisted quantum error correction, a technique that generalizes and simplifies the existing theory of stabilizer codes and opens the possibility of whole new classes of highly efficient codes to protect quantum information from decoherence. The existing classes of quantum error–correcting codes can now be seen to be special cases of a much larger class, the entanglement-assisted error-correcting codes.

In a Big Spin

One way in which the particles that become cosmic rays can obtain their high energy is through acceleration by shock waves, such as those produced by supernovas, including nearby ones within our own Galaxy. However, the paths that cosmic rays take are then scrambled by interstellar magnetic fields, which obscures their origin. **Amenomori *et al.*** (p. 439; see the Perspective by **Duldig**) have mapped the distribution of cosmic rays on the sky using 16 years of data from the Tibet Air Shower Array. They see clear anisotropies, including a component associated with the Cygnus spiral arm of the Milky Way. Although present at energies up to tens of teraelectron volts (TeV), the anisotropic spots disappear at an energy near 300 TeV. This result suggests that the spots arise through the galactic rather than heliospheric magnetic field, and corotate with the gas and stars in the Milky Way.

Single-Cycle Attosecond Pulses

The availability of single-cycle isolated attosecond pulses provides the possibility of probing ultrafast electron dynamics in atoms and molecules where the strong-field processes are driven by the electric field of the attosecond pulses, rather than by the brute-force response to their high intensity. **Sansone *et al.*** (p. 443) have now generated isolated, single-cycle 130-attosecond pulses with energies in the extreme ultraviolet (~ 36 electron volts). Phase-stabilized, 5-femtosecond infrared driving pulses with modulated-polarization state were fired into an argon-filled gas cell to generate these higher harmonics.

Cloudy Future

Rising concentrations of atmospheric CO_2 will have two main impacts, those of global warming and acidification of the oceans. It is unclear whether anthropogenic CO_2 emissions can be reduced quickly enough to avoid potentially damaging consequences, and one alternative is that we "geo-engineer" climate in order to mitigate some of the damaging effects of atmospheric CO_2 buildup. **Wigley** (p. 452, published online 14 September; see the news story by **Kerr**) explores one option—injecting sulfate aerosol precursors into the stratosphere, which would increase the number of aerosol particles that can function as cloud condensation nuclei and increase cloud coverage, as is the case after large volcanic eruptions like that of Mount Pinatubo in 1991. The net effect would be to reflect more sunlight back into space, but this approach would have no positive influence on ocean acidification.

Winds, Water, and Wetlands

Wetlands along the coast of the Gulf of Mexico help protect inland areas from storm-driven ocean surges, and the effects of their erosion became painfully clear after Hurricanes Katrina and Rita made landfall in 2005. Coastal wetlands have been thought to gain and maintain mass through the sediment deposits that occur when rivers overflow during flooding events. **Turner *et al.*** (p. 449, published online 21 September) show that the deposition of sediments by hurricanes is actually

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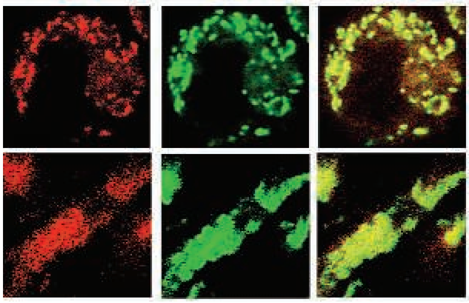
the dominant process. This finding should have considerable impact on the implementation of wetland restoration projects in the region.

Viral Host Exploitation

Human immunodeficiency virus type–1 (HIV-1) is a retrovirus and uses reverse transcription to generate DNA, which enters the nucleus to integrate with the host DNA. The latter process is catalyzed by a virally–encoded integrase enzyme, and this latent reservoir represents a major obstacle to the treatment of HIV disease. The transcriptional coactivator LEDGF/p75 (p75) binds the HIV-1 integrase protein and protects it from degradation by the cell's proteasomal machinery. **Llano *et al.*** (p. 461, published online 7 September) now show that p75 plays a crucial role in viral integration by acting as tether between the integrase and chromatin. For the case of baculovirus replication, **Goley *et al.*** (p. 464) now find this process requires the redistribution of the actin cytoskeleton into the nucleus of infected cells. *Autographa californica* induces nuclear actin assembly by recruiting the host actin-nucleating Arp2/3 complex into the nucleus and activating it with p78/83, a Wiskott-Aldrich syndrome (WASP)–like viral protein. This unanticipated role for the assembly of actin in the nucleus may play a role in the action of other pathogens.

Protein Degradation and Growth Regulation

Controlled protein degradation is a fundamentally important cellular regulatory mechanism. **Dorrello *et al.*** (p. 467; see the Perspective by **Sonenberg and Pause**) searched for binding partners of the ubiquitin ligase $SCF^{\beta TRCP}$ and detected programmed cell death protein 4 (PDCD4). The growth factor–stimulated protein kinase, S6K1, phosphorylated PDCD4 and promoted its ubiquitination by $SCF^{\beta TRCP}$ and consequent degradation. The degradation of PDCD4 relieved its inhibitory effect of on a translation initiation factor and enhanced protein synthesis. Thus, regulated destruction of PDCD4 appears to regulate cell proliferation and cell size.



Fixing Faulty Mitochondria

Mitochondrial dysfunction plays a key role in the etiology of many complex human diseases as well as aging. Disease-causing mitochondrial transfer RNA (tRNA) mutations are targets for the development of potential therapeutic strategies. **Mahata *et al.*** (p. 471) now find that the efficient tRNA import apparatus found in protozoan parasite *Leishmania* can be used to induce the import of a complementing cytosolic tRNA into human mitochondria and can rescue mitochondrial function in mutant cells.

Genetic Contribution to Memory

Human memory is a polygenic trait. **Papassotiropoulos *et al.*** (p. 475) analyzed a genome-wide panel of more than 500,000 genetic polymorphisms for association with performance on memory tests in a group of Swiss subjects. An association was found in a polymorphism within a neuronal protein called KIBRA, which has been implicated in synaptic function. The association was also present in a group from the United States and a second group from Switzerland. KIBRA is expressed in areas of the brain that control memory, and brain activity during memory retrieval is correlated with the KIBRA allele.

Living Deep in the Sunless Sea

A sulfate-reducing bacterium has been isolated from a seam of water that was found by drilling in a gold mine at a depth of 2.8 kilometers. The microbes appear to have survived for tens of millions of years on geological hydrogen and sulfate sources without any nutrients derived from photosynthesis. **Lin *et al.*** (p. 479) report on the chemical composition of the groundwater, its apparent microbiological composition, the geological and biological processes involved, and the rates at which such subsurface communities are sustained.

CREDIT: MAHATA ET AL.

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