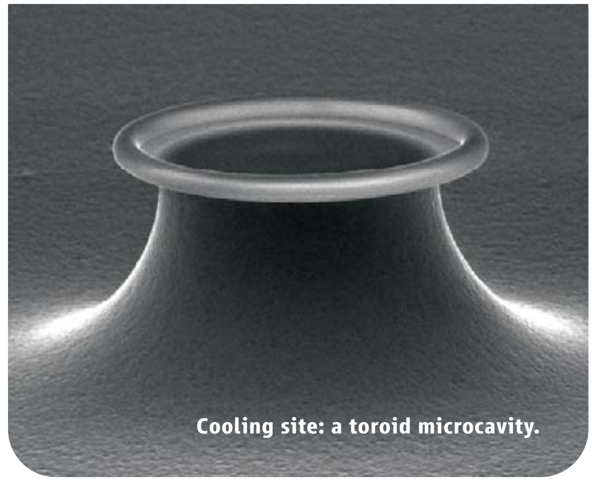


Cooling site: a toroid microcavity.

APPLIED PHYSICS

Cooling Rays of Light

Just as the vibrational frequency of a mechanical oscillator shifts in response to changes in its environment (e.g., changes in the pressure, temperature, or viscosity of the medium in which it sits), so it may be expected that the radiation pressure exerted by light on an object can also affect the vibrational modes of mechanical resonators. This phenomenon opens the possibility of either amplifying (heating) or damping (cooling) the motion of the resonator with light. Whereas laser cooling is now routine for microscopic objects such as atoms, translating the technique to larger objects presents more of a challenge, because the dynamical back-action between the photons and the resonator requires that photon lifetimes be long enough to interact with the mechanical modes of the resonator. Effectively, the photons must be confined in the cavity on a time scale comparable to the mechanical oscillation period of the resonator. Four recent studies, by Schliesser *et al.*, Gigan *et al.*, Arcizet *et al.*, and Kleckner and Bouwmeester, successfully access this regime for dynamical back-action and demonstrate efficient optical cooling of a mechanical oscillator mode to cryogenic temperatures. The ability to cool macroscopic objects with light not only has practical applications, as for mirror stabilization in large-scale interferometers, but also offers a means of probing quantum effects in mechanical systems. — ISO

Phys. Rev. Lett. **97**, 243905 (2006); *Nature* **444**, 67; 71; 75 (2006).

ASTROCHEMISTRY

Capturing Ferroelectric Ice

At low temperature and pressure, water crystallizes in two distinct morphologies, termed ice I and ice XI. Ice I exhibits the form of a hexagonal lattice of oxygen atoms, with attached protons distributed randomly around them. In ice XI, the protons become ordered and the resulting solid is ferroelectric. The inherent stability of ice XI is of particular interest because of its possible formation in space. However, researchers have accessed it only by doping of water samples with potassium hydroxide, and the influence of the dopant on long-range ordering was not well resolved.

Fukazawa *et al.* have succeeded in making large quantities of Ice XI in the laboratory by doping D_2O (deuterated to raise the neutron scattering efficiency) with very small amounts of KOD, and then carefully maintaining the samples in a 60 to 70 K temperature range over tens of hours. Neutron diffraction experiments confirmed an extended ordered structure. The existence of ice XI in cold space environments is therefore likely; the electronic properties of the bulk ice may affect the formation mechanism of icy planets. — JB

Astrophys. J. **652**, L57 (2006).

GENETICS

Pining for Understanding

The genes underlying complex (and industrially important) traits in pine have long been sought, but the paucity of genetic resources has made this an arduous search. González-Martínez *et al.* use a population genomic approach to examine the associations between phenotypic traits and single-nucleotide polymorphisms (SNPs) in known genes to identify specific allelic variants underlying solid wood production and wood biochemistry in loblolly pine. In spite of the large genome size in conifers, the high heterozygosity and rapid breakdown of linkage disequilibrium allowed them to identify 20 genes underlying complex polymorphic traits. Although the effects demonstrated for each SNP were relatively low, on the order of 5% (similar to that observed in previously identified quantitative trait loci), combining markers associated with the same trait accounted for 20% of the phenotypic variation and 40% of the additive genetic variance.

Besides its potential commercial use in tree breeding, this approach can also be applied to investigations of the evolution and ecological genetics of loblolly pine. — LMZ

Genetics 10.1534/genetics.106.061127 (2006).

DEVELOPMENT

Import Controls

The directed and controlled differentiation of cells is of critical importance for being able to use embryonic stem cells in a clinical setting. Yasuhara *et al.* have shown that a switch in a nuclear transport mechanism is involved in cell fate determination. For nuclear import, a protein with a nuclear localization signal (NLS) binds to the receptor importin-α, which in turn recruits importin-β to mediate translocation through the nuclear pore. They find that mouse embryonic stem (ES) cells express the subtype importin-α1, whereas cells that have differentiated into neurons express importin-α5. Experimental manipulation confirmed that neural differentiation can be enhanced by combining the down-regulation of importin-α1 with the overexpression of importin-α5. Hence, the switching of importin-α subtype triggers neural differentiation of ES cells. The authors propose a mechanism by which importin-α subtypes function in either the undifferentiated or differentiated state by controlling the selective import of transcription factors into the nucleus—Oct3/4 for the former and Brn2 with SOX2 in the latter—which adds yet another layer of regulation for cell fate specification, this one acting via the intracellular trafficking of transcription factors. — BAP

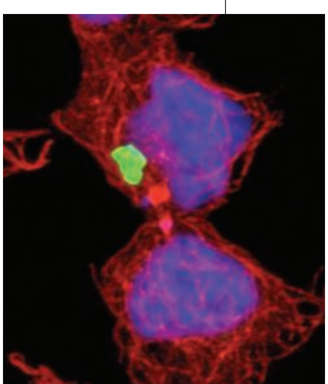
Nature Cell Biol. 10.1038/ncb1521 (2006).

CELL BIOLOGY

Sorting Out the Trash

When cells accumulate large quantities of proteins that have been damaged (for instance, via modification by reactive oxygen species) or that have not folded properly (for instance, as a result of mutations associated with neurodegenerative diseases), the degradative capacity of the intracellular quality-control system can be overwhelmed. Under these conditions, the aberrant proteins collect to form an aggresome, which is an inclusion body situated close to the microtubule-organizing center and just outside of the nucleus.

Rujano *et al*. examined the fate of cultured cells containing an aggresome, and of the aggresomes themselves, as the cells divided. Do aggresome-containing cells complete mitosis successfully? Are both daughter cells equally likely to inherit the parental garbage, or is one daughter preferentially spared? They found that aggresome-containing cells could indeed progress through mitosis productively and that the preexisting aggresome was inherited asymmetrically, yielding daughter cells relatively poor (or rich) in damaged proteins. Furthermore, a survey of cells in the epithelial crypts of the small intestine in two spinocerebellar ataxia (a neurodegenerative disorder) patients revealed a systematic allocation of the protein inclusions to the short-lived differentiated daughter cells, presumably ensuring the preservation of long-lived stem cells. — SMH



Aggregated protein (green) passes to only one daughter cell.

CREDIT: RUJANO *ET AL., PLOS BIOL.* **4**, E417 (2006)

PLoS Biol. **4**, e417 (2006).

PSYCHOLOGY

Changing Attitudes

One emerging theoretical view posits two systems of reasoning: a slow-learning system that acquires and classifies associations over long periods of time, and a fast-learning module that emphasizes higher-order conscious cognition. A stimulus—for example, the negatively valenced word "hate"—can be paired in a subliminal fashion with a person's face (for example, Bob's); this association will induce subjects to regard Bob unfavorably, as assessed by their poststimulus choice of positive or negative adjectives, yet they will be unaware of having evolved this implicit attitude. Similarly, written descriptions of Bob's praiseworthy behavior will result in subjects expressing a liking for Bob, where this evaluation reflects a studied and thoughtful appraisal—that is, the formation of an explicit attitude. Rydell *et al.* show that these mental processes can be accessed separately and appear to operate independently. Not only are subjects capable of developing apparently inconsistent negative implicit attitudes and positive explicit attitudes about the same individual, but they can actually be influenced to invert their preferences by the subsequent presentation of subliminal (positive) words and supraliminal (negative) descriptions. — GJC

Psychol. Sci. **17**, 954 (2006).

CHEMISTRY

A Tale of Two Lattices

One promising aspect of metal organic framework (MOF) solids is the ease with which chiral components can be incorporated into the structural lattice. By linking metal centers with a network of chiral bridging ligands, researchers can prepare porous crystals with the potential to serve as robust asymmetric catalysts. However, assembling an extended MOF with specific steric and electronic properties remains highly challenging.

Wu and Lin highlight this challenge in presenting two MOF structures composed largely of the same building blocks, but exhibiting strikingly different lattice geometries and consequent properties. The first MOF was crystallized from a solution of cadmium nitrate and a chiral binaphthol derivative, appended with pyridines to bridge two metal centers. The hydroxyl groups in the lattice remained free to bind Ti(IV) centers, which in turn catalyzed ethylation of aromatic aldehydes with high yields and enantioselectivities. When a second MOF was prepared from the same precursors, but with the nitrate counterions replaced by perchlorate, a very different lattice structure emerged, which failed to catalyze the reaction. The authors suggest that steric crowding near the hydroxyls in this second structure inhibited effective binding of the titanium ions. — JSY

Angew. Chem. Int. Ed. **45**, 10.1002/anie.200602099 (2006).