CLIMATE SCIENCE

Thin White Lines

The 100,000 or so ships that make up the global commercial and military fleet collectively travel billions of vessel-miles every year, producing a large fraction of the pollution contributed by fossil fuel burning in the transportation sector. In addition to the direct radiative effects of their emissions, caused by the light-scattering properties of the particles themselves, aerosols from the exhaust plumes can produce thin lines of very low clouds in the marine boundary layer, an example of the aerosol indirect effect. It has been shown that the local effects of these clouds can be large, up to 100 W/m^2 (for comparison, the average solar flux at the top of the atmosphere is about 340 W/m^2), but how large an influence they exert on the global albedo has been an unresolved concern. Schreier *et al.* analyzed a full year of satellite data derived from ENVISAT AATSR (Environmental Satellite Advanced Along-Track Scanning Radiometer) in order to estimate the size of the radiative forcing caused by ship tracks. They found that, contrary to fears arising from previous global model estimates, the global annual mean radiative forcing from ship tracks was small, 0.4 to 0.6 mW/m^2, and negligible compared to estimates of total net anthropogenic radiative forcing, 0.6 to 2.4 W/m^2. Thus, it seems that ship tracks are too inconsequential to affect the rate of anthropogenic global warming. — HJS

Geophys. Res. Lett. **34**, L17814 (2007).

MOLECULAR BIOLOGY

Regulation Revealed Under Stress

In most eukaryotic genes, the protein-coding sequences are interrupted by noncoding introns. These introns are removed from the pre-mRNA transcript by RNA splicing, a process that provides an additional and sometimes critical layer of gene regulation. Unlike more complex organisms, few genes in the yeast *Saccharomyces cerevisiae* contain introns. In those that do, the splice site sequences often conform to a strict consensus, making it unlikely that the use of alternative splice sites figures in the differential expression of genes. Intriguingly, though, ribosomal protein genes (RPGs)—components of the mRNA translation machinery—are the largest class of intron-containing genes.

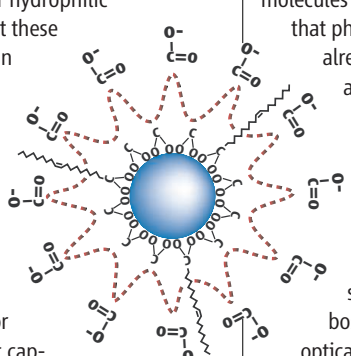
Pleiss *et al.* show that amino acid starvation, which induces a general repression of translation, also results in a rapid and specific reduction in the splicing efficiency of nearly all intron-containing RPG transcripts. This is not merely an effect of stressful circumstances, because exposure to high levels of ethanol does not have an effect on RPG splicing; rather the splicing of distinct sets of transcripts is either down- or up-regulated. The yet-to-be-discovered regulatory mechanisms, which other evidence suggests could be mediated by core, rather than accessory, spliceosomal components, probably explain the evolutionary retention of introns in these groups of yeast genes and, given the conservation of the RNA splicing machinery, similar mechanisms may pervade pre-mRNA splicing in higher eukaryotes. — GR

Mol. Cell **27**, 10.1016/j.molcel.2007.07.018 (2007).

CHEMISTRY

A Hot Dip Before Swimming

Most solution routes for nanoparticle synthesis proceed in nonpolar solvents and achieve size selectivity in part by capping the surfaces with hydrophobic groups. However, after this preparation, many applications require dispersing the nanoparticles in aqueous solvents. Ligand exchange reactions can be used to introduce capping agents that bear hydrophilic groups on their ends, but these reactions, which often run near room temperature, tend to be incomplete, and can lead to aggregation if ligand desorption dominates and exposes the underlying surfaces. Zhang *et al.* have developed a robust method for exchanging hydrophobic capping groups with short-chain polyelectrolytes such as poly(acrylic acid). The reactions run in polar solvent such as diethylene glycol with a high boiling point (in this case, ~245°C). The multivalent polyelectrolytes help displace the hydrophobic ligands while minimizing surface exposure. The properties of several nanoparticles—magnetism for iron oxides, photocatalysis for titanium dioxide, and photoluminescence for cadmium selenide—were maintained or even improved after such processing. — PDS



Nano Lett. **7**, 10.1021/nl071928t (2007).

PHYSICS

Stimulated Symmetry

Whereas the underlying parameters of condensed matter systems may be fixed, thereby limiting the phase space in which to vary the material properties, the ability to tune and manipulate atoms or molecules trapped in an optical lattice opens up that phase space. With success demonstrated already in systems with isotropic symmetry, as in the case of the superfluid–to–Mott-insulator transition of bosons on a square lattice, interest is now in describing systems with an anisotropic symmetry in the order parameter. Hemmerich and Morais Smith describe a scenario for imprinting a $d_{x^2-y^2}$ wave symmetry onto an array of polarizable bosons confined to a two-dimensional (2D) optical lattice. They show theoretically that exciting the atoms by stimulated Raman scattering can result in the formation of a checkerboard-like pattern of staggered flux states on adjacent plaquettes of the 2D lattice, resulting in a *d*-wave

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Published by AAAS

momentum distribution. The proposed scenario offers the prospect of engineering optical lattices for the modeling of complex interacting phenomena from the likes of high-temperature superconductivity to magnetic frustration. — ISO

Phys. Rev. Lett. **99**, 113002 (2007).

BIOCHEMISTRY

Acquiring a Trace Element

Iron, as the central element in heme cofactors or as part of metal clusters, endows enzymes with the capacity to carry out a much wider range of redox reactions (such as those in respiration and photosynthesis) than is supported by the functional groups of the genetically encoded amino acids. Hence, the acquisition of iron is a highly competitive endeavor, and as ocean supplementation experiments have shown, iron can be a limiting nutrient for the growth of plankton. Nevertheless, marine organisms face a special challenge because iron in an aqueous and aerobic environment of neutral pH is present mostly in insoluble forms. The bacterial solution has been the manufacture and secretion of siderophores, small molecules that chelate Fe(III). Following on their previous identification of a borate-siderophore interaction, Harris *et al.* provide a fuller characterization of the equilibria in the reaction of $B(OH)_3$ and vibrioferrin, a siderophore of *Marinobacter* spp. The tetrahedral coordination of B(III) by the pair of α-hydroxycarboxylate moieties in vibrioferrin is highly pH-dependent, and accounting for the protons contributed by the hydroxyls as well as one donated by solvent allowed the authors to assemble the formal binding constants for the multiple borate-vibrioferrin complexes. Extending this analysis to the other two types of siderophores—the catecholates and the hydroxamates—revealed that the former are also competent to bind boron whereas the latter are not. Whether any of these capabilities are in fact used by the siderophore producers is as yet unclear, though low-pH environments may be one place to look. — GJC

J. Am. Chem. Soc. **129**, 10.1021/ja073788v (2007).

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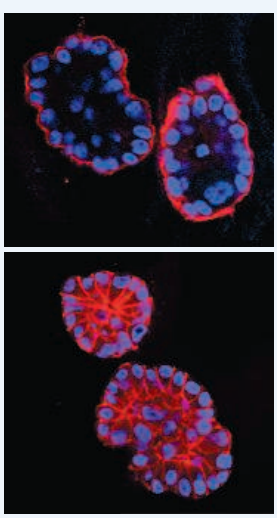
<< Preventing Transformation

The oncogene c-*Myc*, which encodes a transcription factor, is well known for its ability to transform cells. However, not all cells are equally sensitive to c-Myc–induced transformation. Partanen *et al*. compared the responses of organized epithelial acini and of disorganized or immature acini formed from mammary epithelial cells to the transforming ability of a form of c-Myc ($MycER^{tm}$) activated by cell exposure to tamoxifen. When epithelial cells were plated in Matrigel (a three-dimensional cell culture environment prepared from an extract of extracellular matrix) and $MycER^{tm}$ was activated right away, the cells formed misshapen acini and some cells could be seen in the luminal space. On the other hand, cells grown in the absence of activated c-Myc formed symmetrical acini with an empty lumen, and the acini were smaller. If tamoxifen was added after the cells had already formed organized acinar structures, then c-Myc lost its oncogenic activity: The morphology and size of the acini were unchanged, and cell proliferation was not induced. Cells in which the kinase LKB1 (implicated in the establishment of cellular polarity) was silenced formed disorganized acini with disrupted cell polarity when cultured in Matrigel. However, these LKB1-deficient cells did become quiescent. Activation of c-Myc in the LKB1-deficient cells stimulated reentry into the cell cycle, thus confirming the potency of epithelial organization as a brake for oncogenic transformation. The authors also addressed the apoptotic activity of c-Myc, which sensitized cells of fully organized acini to TRAIL (a death-inducing agent that activates apoptosis) and revealed that both TRAIL and Myc were required to promote apoptosis. However, in LKB1-deficient cells with disorganized acini or immature acini, the activation of $MycER^{tm}$ or TRAIL caused apoptosis, and these two agents had an additive effect on cell death. Thus, disorganized epithelia are more sensitive to both the cell-proliferative and apoptotic effects of c-Myc. — NRG



c-Myc expression does not alter basal polarity (upper) or cell-cell junctions (lower) in organized acinar cultures.

CREDIT: PARTANEN *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **104**, 14694 (2007)

Proc. Natl. Acad. Sci. U.S.A. **104**, 14694 (2007).