RESEARCH HIGHLIGHTS

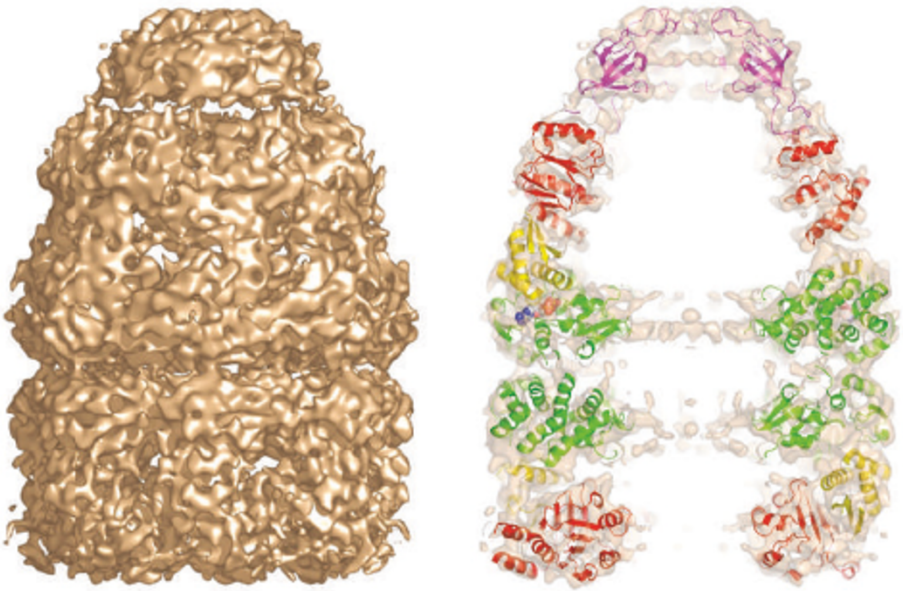
Size matters

Cell 125, 903–914 (2006)

The molecular cage that provides a safe haven for folding proteins in *Escherichia coli* has more design features than was previously thought.

Manajit Hayer-Hartl and F. Ulrich Hartl of the Max Planck Institute of Biochemistry in Martinsried, Germany, and their colleagues tweaked various properties of the molecular cage — the chaperonin protein GroEL — and studied the effects on its role as a folding helper.

It was once thought that proteins held within the GroEL complex (pictured) were simply protected from interactions with other molecules, but proteins inside its cavity fold more quickly than they do in the open. The researchers show that both the size of the protein's caging cavity and its surface charge are important in optimizing folding speed.



RANSON ET AL. NATURE STRUCT. MOL. BIOL. 13, 147–152 (2006)

CANCER BIOLOGY

Werner gene silenced

Proc. Natl Acad. Sci. USA 103, 8822–8827 (2006)

The gene to blame for higher cancer prevalence in patients with Werner syndrome, an inherited disorder associated with premature ageing, also plays a role in cancers in patients that don't have the syndrome, according to new research.

Manel Esteller at the Spanish National Cancer Centre in Madrid and his colleagues looked at more than 600 human tumours of 12 different types. They found that the *WRN* gene, which is inactivated by mutations in patients with Werner syndrome, is silenced in tumours by the addition of methyl groups at its activation site.

WRN is involved in DNA repair, so its inactivation may enable tumours to acquire mutations that help them to survive, but it also makes them more susceptible to DNA-damaging chemotherapeutic drugs, such as irinotecan.

ASTRONOMY

Beyond expectations

Astron. Astrophys. doi:10.1051/0004-6361:20065476 (2006)

A piece of missing physics may explain why the sizes of planets found orbiting stars other than the Sun don't conform to the predictions of standard planetary evolution models, argue Tristan Guillot of the Cote D'Azur Observatory in France and his colleagues.

So far, the radii of ten massive planets have been measured by watching them 'transit' in front of their parent stars. Two of the 'hot Jupiters' were much larger than expected. The researchers say that a model which includes an additional energy source inside the planets to slow their contraction can explain the results. They also say that the model's predictions for the abundance of heavy elements in the planets supports the idea that this quantity is correlated with the metallicity of the host stars.

ANIMAL BEHAVIOUR

March of the locusts

Science 312, 1402–1406 (2006)

"The locusts have no king, yet they advance in ranks," the Bible tells us. Indeed they do, and with terrible effect: marching bands of wingless, juvenile desert locusts (*Schistocerca gregaria*, pictured) can extend for kilometres, and are the precursors to swarms that devastate crops. Understanding band formation is therefore critical to pest control.

G. A. MILLER

Jerome Buhl and his co-workers at the University of Oxford, UK, have found that it occurs abruptly, in a kind of phase transition, once the locust density exceeds a critical threshold. Their lab observations reveal one transition from random to coordinated movement of individuals, then a second to unidirectional group motion. The behaviour is predicted by a simple model in which each locust tends to align itself with its neighbours.

SPACE SCIENCE

Space rock rendezvous

Science 312, 1330–1353 (2006)

Data collected by Japan's Hayabusa probe during its visit to the asteroid Itokawa are presented in seven new papers.

Among the main findings reported by the international team of scientists is evidence that the asteroid is made of rubble. Hayabusa observed that Itokawa's gravity is much weaker than that of other similarly sized asteroids and revealed its surface to be extremely rocky. This suggests that Itokawa was formed by the reagglomeration of pieces of a bigger asteroid that had been broken up in a collision.

Hayabusa was meant to return fragments of the asteroid's surface to Earth, but there are doubts about whether the probe managed to collect any material during its landing in November 2005, and engine problems may thwart its journey home.

B. BARKSDALE/AGSTOCK/SPL

BIOTECHNOLOGY

From curse to cure

Proc. Natl Acad. Sci. USA 103, 8804–8809 (2006)

Scientists are edging closer to transforming tobacco (pictured right) from a cancer-causing to a cancer-curing plant.

Hilary Koprowski of Thomas Jefferson University in Philadelphia, Pennsylvania, and his colleagues infected tobacco plants with DNA that codes for antibodies against a tumour-signalling molecule. The molecule, a sugar marker known as Lewis Y antigen, is expressed by breast, colorectal and other cancers. As in previous studies, the plant-produced antibodies attacked tumour cells in culture and cut tumour progression in mice.

In this work, the researchers boosted their yield by fusing a genetic tag called KDEL to the code for the antibody. They also showed that the antibodies bound to the human Fc receptor — a key mediator of successful immunotherapy.

PHYSICS

Feel the force

Phys. Rev. Lett. 96, 200402 (2006)

According to quantum theory, a vacuum is far from empty: it seethes with photons that pop into and out of existence. An object moving through these photons should feel a slight drag — one type of the 'Casimir effect' — that Woo-Joong Kim and colleagues at Dartmouth College in Hanover, New Hampshire, think should be possible to measure.

In their proposed experiment, one end of a reflective cavity is vibrated in the gigahertz range, sending vacuum photons — which cannot be detected directly — towards a cloud of sodium atoms held in the container. The collision would knock the atoms into a lower energy level, making them emit a second burst of photons that would signal the existence of a dynamic Casimir effect.

CELL BIOLOGY

Sharing the inheritance

Proc. Natl Acad. Sci. USA 103, 8209–8214 (2006)

Genetic material must be shared out before a cell divides, but what happens to proteins? Biologists from the University of Oxford, UK, propose that a mechanism related to the one that partitions DNA divvies up and positions proteins, too.

In the bacterium *Rhodobacter sphaeroides*, a cluster of proteins making up a chemotaxis signalling pathway (which helps to direct movement towards chemicals) is localized in the cytoplasm at the cell's mid-point. Judith Armitage and her co-workers show that this cluster duplicates before cell division, with the two clusters positioning themselves at the future centres of the daughter cells.

The team shows that cluster division and positioning depend on the protein PpfA, which is homologous to ParA, a protein involved in DNA partitioning.

QUANTUM PHYSICS

Phased and confused

Phys. Rev. A 73, 051601(R) (2006)

The supersolid — an elusive quantum state of matter — could be probed by looking at the noisy motion of atoms held in optical lattices, say researchers in the United States.

Optical lattices use lasers to arrange a gas of ultracold atoms into a periodic array, mimicking the structure of atoms in crystalline materials. It has been predicted that these trapped atoms could settle into a supersolid state — in which they flow, like a superfluid, without resistance. So far, the only evidence for supersolidity comes from difficult experiments on solid helium.

Vito Scarola of the University of Maryland in College Park and his colleagues show that the noise correlation function for atoms in an optical lattice could be instrumental in revealing the signature of supersolid order.

PHYSIOLOGY

Pee for protection

Nature Med. doi:10.1038/nm1407 (2006)

An antimicrobial compound produced by the body that protects our skin from bacterial attack also disinfects the urinary tract, a new study shows. This provides an additional line of defence in a system otherwise kept clean by its regular flush-throughs.

Annelie Brauner of the Karolinska University Hospital in Stockholm, Sweden, and her colleagues detected the antimicrobial peptide cathelicidin in human urine and showed that it is produced by the epithelial cells that line the urinary tract. They also showed that strains of *Escherichia coli* that had caused more invasive infections were more resistant to the cathelicidin LL-37.

JOURNAL CLUB

Srikanth Sastry
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A statistical physicist finds a way into a tangled web of matter.

Taking a bold step can leave you in a mess. But here I discuss an instance where it seems to have been successful.

I'm interested in the states that materials can end up in, other than their equilibrium states. Equilibrium phase diagrams of simple substances present a tidy enough picture, with well understood fluid and crystalline phases. But when nature chooses to cheat equilibrium thermodynamics, it can weave a tangled web.

The fascinating body of recent work on how rigidity arises in colloidal solutions — small particles suspended in a fluid — presents one such tangle. Diverse mechanisms have been proposed to explain the process, known as structural arrest, but a fully satisfactory picture is yet to emerge.

Researchers at Harvard University in Cambridge, Massachusetts, tackled this problem by measuring the structure and dynamics of a colloidal solution during phase separation. They analysed the results using 'mode coupling theory', which uses the static structure of a material to predict its dynamics (S. Manley *et al. Phys. Rev. Lett.* 95, 238302; 2005). This was a bold move, as phase separation in a colloid induces its structure to evolve continually. Nevertheless, it seems to have worked.

They find that structural arrest results from a 'glass transition' in the particle-rich regions of the colloid, meaning the particles' dynamics simply become too sluggish, because of their high density, for them to continue to phase separate. Computer simulations back up this view (G. Foffi *et al. J. Chem. Phys.* 122, 224903; 2005).

A few years ago, I analysed the thermodynamic stability boundaries of glasses, but it was not obvious how to probe them experimentally. Manley and colleagues' work shows an elegant way do so.