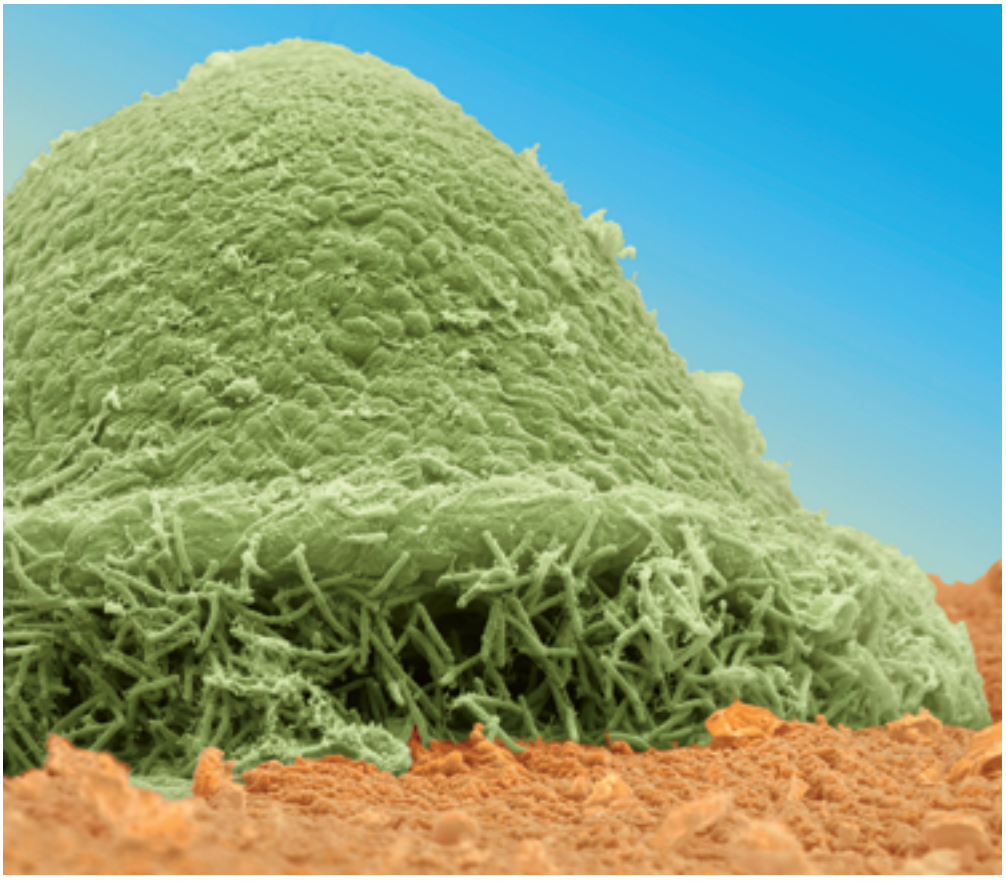
RESEARCH in Brief



In times of food shortage, *Myxococcus xanthus* forms fruiting bodies in which some of the bacteria survive as spores. The cheats among the bacteria cannot give the signal to form fruiting bodies, but are much more effective at forming spores.

PHOTO: MPI FOR DEVELOPMENTAL BIOLOGY – JÜRGEN BERGER AND SUPRIYA KADAM

DEVELOPMENTAL BIOLOGY

Resocialized Bacteria

Even bacteria are capable of being resocialized, as researchers in Gregory Velicer's group at the Max Planck Institute for Developmental Biology in Tübingen have discovered. The bacterium *Myxococcus xanthus* has a highly social lifestyle, but some strains that are not as adept at socializing cheat by taking advantage of their conspecifics' social behavior. Such cheaters might destroy the social groups upon which they depend, but in one case, cheaters have been found to re-evolve the capacity for social cooperation. (NATURE, May 18, 2006 and PNAS, May 23, 2006)

Myxococcus xanthus is a predatory social bacterium that lives in the soil, where it swarms in groups using thread-like pili on the cell surface. *M. xanthus* searches for other microorganisms in herds and breaks down their cell walls with enzymes before consuming them. When food supplies run short, they assemble into fruiting bodies comprising approximately 100,000 cells, a minority of which differentiate into robust, stress-resistant spores. When the need arises to assemble into a fruiting body, the bacteria achieve this by exchanging several biochemical signals. Cheater strains make use of signals produced by socially

Swarms learn: *Myxococcus xanthus* bacteria win back the social ability to move around in groups (top center, as well as at the 3- and 8-o'clock positions). The populations at the 3- and 8-o'clock positions derive from lines that cannot do this (5- and 10-o'clock positions).

PHOTO: MPI FOR DEVELOPMENTAL BIOLOGY

competent bacteria, despite being unable to produce them themselves. By 'defecting' from cooperation in this way, a much larger proportion of cheater bacteria transform themselves into spores compared to the cooperators. If a population of cooperating and cheating bacteria live through sequential bouts of starvation, the cheats will gradually win the upper hand – until too few cooperating bacteria remain in the mixed groups to produce enough signal molecules for fruiting body formation. In some cases, the entire population can die off when cheats become too common, exemplifying what evolutionary biologists call "evolutionary suicide."

But it doesn't have to come to this, as Velicer and his group discovered when they mixed a population of cooperating bacteria with a cheating strain. Over a number of cycles of food shortage and abundance, the cheats rapidly won the upper hand over the cooperating bacteria. Eventually, the cheating strain nearly caused the entire population to become extinct due to lack of cooperation during starvation. However, in a further cycle, the scientists suddenly found spores again. A new strain derived from the previous cheating *Myxococcus* had apparently changed in such a way that the bacteria were able to cooperate again.

The scientists then screened the genetic material of the newly evolved cooperators for changes that triggered this resocialization, using a relatively new method to detect the base sequence in the DNA. Biotechnologists call this process 'sequencing-by-synthesis,' in which they copy the DNA and complete a strand, base by base. Immediately after a new base has attached itself to the strand, it can be identified using a florescent marker. Decoding the gene sequence in this way is much easier than with conventional sequencing techniques in which an enzyme puts together fragments of the genome in all possible lengths and a sequencer then analyzes the differences between the fragments.

In order to check the results of their first sequencing analysis, the biologists also looked for mutations in the genetic material of *M. xanthus* using the conventional sequencing method – and found no more genetic changes than with sequencing-by-synthesis. Thus, the researchers showed that the new, simpler method was sufficiently reliable to track down all genetic changes that had accumulated over generations in an evolved lineage. This means that, in the future, it will be much easier to follow the evolution of organisms at the level of their genetic material. This is true even for organisms like *M. xanthus*, whose genetic information is stored on a relatively large genome – and even if the difference between the two strains of bacteria lies in only a single mutation. In fact, it was precisely one mutation that transformed the cheating bacterium back into a cooperating one.

Inspired by ancient Greek mythology, the Max Planck scientists called this new strain *Phoenix* and went on to show that *Phoenix* not only re-evolved the ability to make spores, but actually makes spores more efficiently than the original cooperator against which the cheater competed. The mutation causes *Phoenix* to produce greater amounts of an acetyltransferase enzyme than its ancestors – an increase that is likely to be one reason why *Phoenix* is so efficient at development. However, the precise mechanism of how the mutation restores social cooperation has yet to be determined. In any case, this single mutation not only makes *Phoenix* efficient at spore production, it also prevents it from being cheated on by its own cheating ancestor. Thanks to its superior sporulation and resistance to cheating, *Phoenix* rapidly dominated mixed populations.

Biologists call the cheating behavior of some *Myxococcus* strains obligate: like parasites or symbiotic organisms, they rely on other organisms – in this case, cooperative members of their own species. Until now, it was not known whether organisms could escape from such a dependent lifestyle – and if they could, just how long it might take for an obligate life form to evolve back into an independent one. According to the Max Planck researchers, *Myxococcus* can realize this opportunity over just tens of generations

Through the intermediate stage of obligate cheating behavior, the *Phoenix* lineage took a large evolutionary step forward by becoming more successful than the cooperating strain that the cheaters had first invaded. The scientists' work is providing a new glimpse into the many directions in which social systems can evolve. ●

@ **Further information from:**
GREGORY J. VELICER
Max Planck Institute for Developmental Biology, Tübingen
Tel.: +49 7071 601-1462
Fax: +49 7071 601-305
e-mail: gregory.velicer@tuebingen.mpg.de

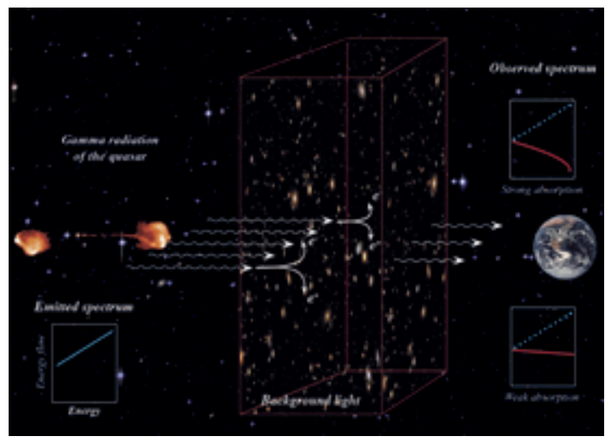
ASTROPHYSICS

A Faint Glow from Space

A cosmic background glow pervades outer space. This is thought to be the remains of all the light that was ever radiated by stars, galaxies and other sources. Astrophysicists have now discovered that this glow is substantially fainter than previously supposed. As "probes," the researchers used two very distant quasars whose gamma spectra were recorded by the H.E.S.S. telescopes in Namibia. The spectra were only slightly reddened, indicating that the background light was not strong enough to significantly dim out the quasars. (NATURE, April 20, 2006)

The background light is truly a universal phenomenon, uniformly permeating intergalactic space. All types of objects, whether stars, galaxies or quasars, contribute to this fog of radiation. This extragalactic background light (EBL) is thought to be the "leftovers" from all the light ever emitted in space, spanning all epochs from the birth of the first stars and galaxies to the present day. Scientists have long tried to measure this emission. Its direct measurement from the even glow of the night sky proved very difficult and inexact because the Earth's atmosphere, the solar system and the Milky Way all outshine the weak glow.

The observation of quasars – cosmic powerhouses that harbor a massive black hole in their centers – offer a solution to this. These gravity traps devour the surrounding gas and spit part of it back out as plasma. In the process, they accelerate it almost to the speed of light. The focused beam of protons, electrons and electromagnetic radiation often expands to 100 times the intensity of its mother galaxy. If the quasar's "jet" points toward the Earth, the radiation detected is much stronger. Astronomers call this a blazar.



The effects of the extragalactic background light (EBL) on the gamma radiation of a distant quasar: At higher densities, the EBL photons collide frequently with the gamma-ray particles – the absorption is strong and the spectrum clearly changes (above right). At a lower EBL, photon density absorption is weaker and the spectrum changes little (below right).

PHOTO: H.E.S.S. COLLABORATION

Both objects observed by the H.E.S.S. researchers belong to this group. But how can gamma rays from these blazars be used as probes for the cosmic background light? On their long journey to the Earth, the highly energetic gamma-ray particles collide with background light photons and are thus attenuated. This causes the initial gamma spectrum of the blazar to redden – somewhat like the reddening of the setting Sun as it nears the horizon due to the Earth's atmosphere dispersing more of the blue portion of sunlight than the red. And the thicker the atmosphere, the redder the Sun will appear. The reddening thus depends on the thickness of the medium (in this case the layers of air). In this way, it should be possible to determine the intensity of the background light.

"The main problem is that the energy distribution in the gamma spectrum of quasars can take on many different forms. Until now, we just couldn't say whether an observed spectrum looked red because it had truly undergone a strong reddening in intergalactic space, or whether it was that way from the start," explains Luigi Costamante from the Max Planck Institute for Nuclear Physics in Heidelberg.

The gamma spectra of the two quasars H 2356-309 and 1ES 1101-232 have now solved this problem. The objects are more distant than any observed sources to date and could only be investigated thanks to the superior sensitivity of the H.E.S.S. telescope array. The result: the intensity of the background light is not strong enough to redden the light from the quasars – the spectra are too blue and contain too much gamma radiation at the high-energy end of the measurable range.

The maximum intensity of the diffuse light that has been derived from the H.E.S.S. data is, in fact, very near the lower limit resulting from the sum of the light of each individual galaxy visible to optical telescopes. This answers one of the questions that have been puzzling scientists for some years: is the diffuse light primarily the result of radiation from the first stars in the universe? The H.E.S.S. result would seem to preclude such a possibility: it indicates that the background glow is from ordinary galaxies. ●

@ **Further information from:**
DR. FELIX AHARONIAN
Max Planck Institute for Nuclear Physics, Heidelberg
Tel.: +49 6221 516-485
Fax: +49 6221 516-324
e-mail: Felix.Aharonian@mpi-hd.mpg.de

COAL RESEARCH

Coiled Stones

Chemistry often seems to be governed by chance. But this isn't necessarily the case, as experiments by scientists at the Max Planck Institute of Coal Research in Mülheim an der Ruhr and the International Max Planck Research School "SurMat" have now proven. They were able to grow silica particles from a solution onto a surface in such a targeted way that a regular pattern of tiny cones was formed, creating a hierarchical structure previously seen only in nature. (ADVANCED MATERIALS, vol. 18, issue 8, April 2006)

Bones are light and stable because they are built optimally – whether on the smallest or the largest scale. Their smallest elements bind together to form fibrils, which collectively fold to make lamellae. These, in turn, organize themselves into girders that form a scaffold whose network has also inspired structural engineers. Materials scientists call these structures "hierarchical." The silica particles produced by the Max Planck researchers also display a type of hierarchical structure.

The scientists mixed a silicon compound in the reaction solution with an amine that sports a long fatty acid tail. The amine molecules then assemble to form micelles, which build long threads upon which the silica subsequently accumulates. If the scientists dip an untreated support in the solution (for example, a slightly contaminated glass plate) the particles form random deposits: sometimes as cones, sometimes as double cones and sometimes as fibers.

To change this, the Mülheim scientists place "bait" on the surface for specific particle shapes: using a silicone stamp, they apply square-shaped patches of a methylated – and therefore water-repellent – substance to the glass, which itself is water-attracting. The edges of the water-repellent patches are 3 micrometers (thousandths of a millimeter) long and act as seeds for growth: if the chemists immerse the treated glass plate in the reaction solution, a small cone composed of long coiled threads builds up on each square within around 3 days. It is still unclear why the silica particles prefer to accumulate on the water-repelling patches. "Perhaps the organic micelles adsorb and coil together there, and then direct the silica assembly," says Frank Marlow, who heads the research.

By luring the silica particles onto the surface of the printed glass, the scientists can control the type of hierarchical structure the silicate particles finally form: the first particles have almost no alternative but to lay themselves onto the support in an ordered shape – in a coiled manner like in a planar spiral. The cone grows as the planar spirals stack up on top of each other.

What determines the direction of the growing cones is a "global singularity" – the midpoint of the silica spirals. "The standard explanation is that a defect, such as a hole in the crystalline structure, impedes growth," Marlow explains. "I'm convinced, however, that in our case, the hole itself determines what kind of structure will end up developing. That's why I coined the term 'global singularity'." The scientists then steer this self-organization of the particles with the square-shaped patches to attain the desired superstructure.

This effectively combines a bottom-up with a top-down technique. Materials scientists use the term "bottom-up" when particles organize themselves into larger structures. In top-down formations, the advantages and drawbacks are exactly the opposite: chip manufacturers use top-down procedures on silicon chips covered with a photoresist layer on which a structural plan is drawn, which they then etch out of the semiconductor. The resolution of this process, however, is limited, which also limits how small such structures can be made. Frank Marlow and his research team can control events at a nanometer scale, making extremely fine structures possible. Their efforts may help to reduce the size of electrical and optical components. ●

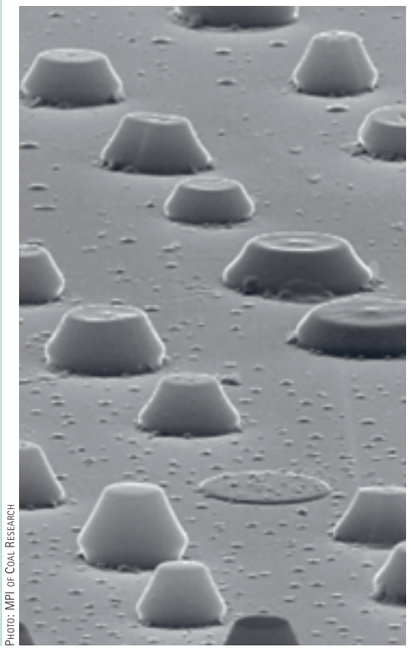


PHOTO: MPI OF COAL RESEARCH

Silica cones grow like pixels on a pre-treated substrate. The silica builds a spiral-shaped mesostructure in each cone.

@ Further information from:
DR. FRANK MARLOW
Max Planck Institute of Coal Research, Mülheim an der Ruhr and International Max Planck Research School "SurMat", Düsseldorf
Tel.: +49 208 306-2407
Fax: +49 208 306-2995
e-mail: marlow@mpi-muelheim.mpg.de

TAX LAW

A Business Tax Reform for Germany

The German Federal Government has plans to introduce a new framework for business taxation. In order to build the reform on reliable scientific foundations, the government asked renowned lawyers and economists to systematically examine the options for this venture. An expert report was submitted to Federal Ministers Peer Steinbrück and Michael Glos at the beginning of April. Wolfgang Schön, Director at the Max Planck Institute for Intellectual Property, Competition and Tax Law in Munich, played a lead role in preparing the report. The Federal Government intends to incorporate the detailed proposals into the corporate taxation reforms it has planned for 2008.

PHOTO: BMWI

Setting their sights on corporate tax reform: Max Planck Director Wolfgang Schön, Bert Rürup, Chairman of the German Council of Economic Experts, Federal Ministers Michael Glos and Peer Steinbrück, and Wolfgang Wiegard, Member of the Council of Experts (from left).

The taxation policies pursued by modern industrial states are increasingly exposed to conflict: on the one hand, in the face of international competition for investment, there is a need to remain attractive in terms of taxation; but on the other hand, there is an equally compelling need to satisfy the financial demands inherent in a modern welfare system. Dual income tax – first implemented successfully in the early 1990s in the Scandinavian countries and Finland – offers a possible way out of this dilemma by redefining the traditional view of the burden of taxation in the face of changing circumstances.

The report submitted in Berlin is intended to contribute to the realignment of German income tax law and to make Germany – in tax terms – a more attractive place to do business. The proposals it contains are also expected to maintain a largely even playing field as regards corporate financing and legal forms. Experts anticipate that, as a result, both German and foreign investors will show an increased willingness to invest in Germany, and that economic growth and wages will both benefit in the medium term.

Under these proposals, income from internationally mobile production factors such as physical and, especially, financial capital would be fundamentally subject to a low and, as far as possible, proportionally structured tax rate with the intention of guaranteeing efficient tax collection. Conversely, there are no economic or financial reasons to reduce tax on income from immobile factors, and especially not on income from employment and social transfers.

The foremost considerations under this model are the concrete economic effects of entrepreneurial activity. Tax assessments would no longer be dependent on whether income derives from trade or industry or the management of assets, or whether it is earned by persons who are employed or those who are self-employed. Under a growth-oriented (tax) policy, the deciding factor is whether and to what extent income earned in the marketplace is attributable to investment.

For reasons relating to the politics of location, the total tax burden on that portion of corporate earnings designated as investment income should not exceed 25 percent. Aided by extensive model calculations, the experts have demonstrated that a dual income tax would substantially increase Germany's attractiveness as a target for both domestic and foreign investment. In an international comparison of selected industrialized nations, Germany would advance from the lower end of the table to join the leading mid-ranked players. In terms of one-man businesses and partnerships, it would, in fact, lead the field in Western Europe. This is also easily justifiable in terms of location issues, given that SMEs in Germany frequently find themselves competing with foreign enterprises.

The introduction of dual income tax would thus largely achieve the aims of corporate tax reform. The model would also lead to greater decision-making neutrality, as well as offering a flexible array of instruments oriented toward financial interests. The report presented to the German government – in whose preparation the German Council of Economic Experts and the Center for European Economic Research in Mannheim were also involved, in addition to the Max Planck institute – represents an important step toward the necessary reform of corporate tax law. ●

@ Further information from:
PROF. DR. WOLFGANG SCHÖN
Max Planck Institute for Intellectual Property, Competition and Tax Law, Munich
Tel: +49 89 24246-5400
Fax: +49 89 24246-524
e-mail: Wolfgang.Schoen@ip.mpg.de

CANCER RESEARCH

Molecular Bouncers

When cellular protection mechanisms fail, certain genes can trigger the growth of tumors and cancer. Bcl-3 is one of these oncogenes and can cause, among other things, leukemia. Researchers at the Max Planck Institute of Biochemistry in Martinsried and the Ludwig Maximilians University of Munich have found a new mechanism that regulates this important oncogene: a protein called Cyld holds Bcl-3 in check, protecting mice from tumor growth. (CELL, May 19, 2006)

PHOTO: MPI OF BIOCHEMISTRY

A tumor suppressor becomes active: The microscope images show three skin cells where the Cyld protein (green) accumulates around the cell nucleus (blue) and prevents the oncogene Bcl-3 from entering. The red structure shows the F-actin cytoskeleton of the cell.

Cell growth, division and differentiation are some of the best-regulated processes in the body, since even a single cell boycotting this control can lead to a tumor. Oncogenes are a bit like ticking time bombs, since they possess the potential to trigger cancer. In healthy cells, so-called tumor suppressor genes control their activity.

Until now, however, the cellular opponent of the Bcl-3 oncogene was unknown. What was known was that, as part of a transcription factor, the protein must enter the cell nucleus in order to function. Transcription factors initiate and support the transcription of genes, the protein-encoding DNA regions; the process serves to transfer genetic information for protein synthesis.

In gene transcription, Bcl-3 cooperates with other extremely important transcription factors. However, two representatives of this family (p50 and p52) must first be activated themselves to be able to drive the transcription of specific disease-relevant genes. An important mechanism here is the binding to Bcl-3. In a first step, the Munich team headed by Max Planck Director Reinhard Fässler showed how Bcl-3 finds its way into the cell nucleus – namely with a molecular ticket.

Ubiquitin is a molecule that can be attached several times along the sequence of a protein. One particular pattern of binding marks the protein as trash that must be disposed of. In a different arrangement, the ubiquitin groups serve as docking sites for additional protein interactions. The latest results now show that this is also the case for Bcl-3, whose polyubiquitin chain recruits new binding partners that support the import of Bcl-3 into the nucleus. Only, however, if it has not previously crossed paths with a protein called Cyld. Cyld was first found in patients suffering from cylindromatosis, a disease that causes tumors to grow on the face, neck and scalp.

The Munich-based researchers succeeded in completely reconstructing the Cyld interaction with Bcl-3, starting with recruiting Cyld to the perinuclear membrane until the ubiquination of Bcl-3 and the reversal of this process by Cyld. The scientists have also shown in detail that loss of Cyld allows accumulation of Bcl-3 in the cell nucleus and, together with p50 and p52, triggers accelerated cell growth.

Moreover, in humans, there is also evidence that a defect in the Cyld gene has more adverse consequences than growth of the mostly benign tumors in cylindromatosis. The researchers found little or no Cyld in the cells of other skin tumors. Furthermore, it is also known that the situation is similar in some cases of liver, kidney and cervical cancers. "Cyld is expressed in all the cells of the body," says Reinhard Fässler. "I believe that this deubiquitinase acts as a tumor suppressor in all tumors where the oncogene Bcl-3 plays a role." ●

@ Further information from:
PROF. DR. REINHARD FÄSSLER
Max Planck Institute of Biochemistry, Martinsried
Tel.: +49 89 8578-2424
Fax: +49 89 8578-2203
e-mail: faessler@biochem.mpg.de

QUANTUM PHYSICS

Twin State Coupling in the Laboratory

Entangled photons behave like a deeply intimate but somewhat muddled couple: at first, neither partner knows who went shopping where. So, of course, one of them goes to the baker and the other visits the butcher – without having arranged things beforehand. This is known as pure-state entanglement in physics, and is most often seen with photon pairs. Scientists at the Federal University of Rio de Janeiro and the Max Planck Institute for the Physics of Complex Systems have, for the first time, directly measured whether such photon pairs are fully or only partially coupled. (NATURE, April 20, 2006)

Entangled particles, whether photons or atoms, are the smallest units needed for quantum computers, quantum cryptography and quantum teleportation. At the moment, however, they are challenging the experimental artistry of physicists – and the very way most people view the world. Pure-state entanglement means that, at the instant the photon couple is generated in special crystals, hardly any properties have been determined for the two partners. Where they are is just as uncertain as where they are going, and their polarization – the direction in which their light waves vibrate – is also completely unknown.

Only when, for instance, one of the photons is forced to disclose its polarization in a suitable filter is it constrained to one axis of vibration. Should this axis be vertical, its partner has no choice but to vibrate horizontally. In the process, the photons can even be hanging out in completely different corners of the universe. What defies all common sense is that they exchange absolutely no information as to which of the two takes on which polarization.

PHOTO: FOCUS-SPL

A nonlinear crystal creates two photons from one: The light particles in both of the blue laser signals form entangled pairs, each of the two flying off in a different direction. Regardless of how far the partners are from each other, however, their physical characteristics remain coupled to each other.

Not all photons, however, attain this pure degree of entanglement. The second photon often retains the freedom to more or less determine its own polarization. "We can measure just how entangled the photons are by using concurrence," explains theoretical physicist Andreas Buchleitner at the Max Planck Institute for the Physics of Complex Systems. In quantum physics, the term "concurrence" is used to describe how much information one particle carries with reference to another. "We have shown that concurrence can be expressed as an expected value of an observable property," says Buchleitner.

In simplified terms, the scientists have shown how photon entanglement can be determined with a single experiment. To date, satisfactory results could be achieved only in experiments in which two photons were either completely entangled or not at all. In the first case, it is then clear that, for instance, if one photon is horizontally polarized, the other must be vertically polarized. In the second case, the second photon can oscillate freely in any direction, independently of what the first one is doing.

In all other cases – which are much more common – one measurement is insufficient. Entangled and non-entangled photons are mixed up together. This mixing is so complex that physicists need to determine all of the measurable characteristics of a photon pair to characterize its state, and thus its degree of entanglement. Previously, researchers gained such information by determining, for instance, the vertical to horizontal proportion in a particular polarization. They also had to determine how the wave peaks of the vibrations are displaced against one another. Thus, a huge number of elaborate measurements were needed, challenging even the capabilities of laboratories with the most powerful of instruments.

Florian Mintert, who completed his Ph.D. at the Max Planck Institute for the Physics of Complex Systems, Marek Kus from the Polish Academy of Sciences in Warsaw and Andreas Buchleitner have pieced together an elegant method that requires only one measurement on two copies of a state. "Not only that, our colleagues in Rio have been able to hone this down to a single photon pair," explains Buchleitner. This means that the physicists were able to characterize one copy by the momentum of the photons and the other by its polarization. ●

@ Further information from:
DR. ANDREAS BUCHLEITNER
Max Planck Institute for the Physics of Complex Systems, Dresden
Tel.: +49 351 871-2211
Fax: +49 351 871-2299
e-mail: abu@mpipks-dresden.mpg.de

BIOCHEMISTRY

A Compound That Stops Cell Death

After a stroke, every minute counts. And if help doesn't come quickly, the brain can be damaged permanently. Scientists from the Max Planck Research Unit for Enzymology of Protein Folding, in collaboration with KeyNeurotek, Magdeburg, have now synthesized a compound that at least partially averts this damage to nerve cells – or repairs the damage if it isn't able to prevent it. The compound resembles a drug that doctors use to suppress the immune system following transplantation surgery or to treat autoimmune diseases, and that also protects nerve cells. (JOURNAL OF BIOLOGICAL CHEMISTRY, May 26, 2006)

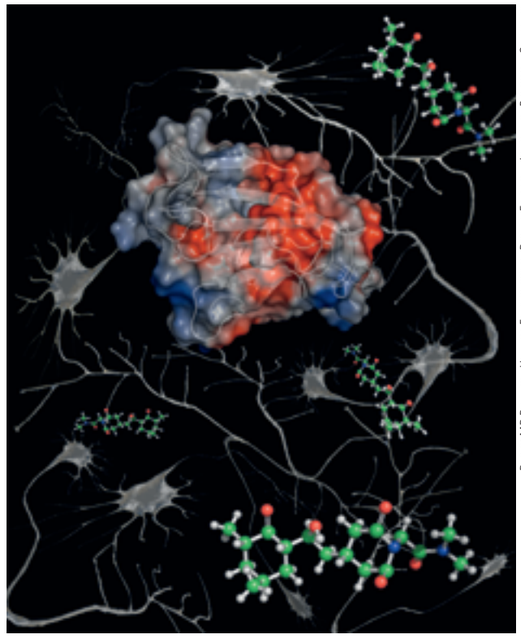


PHOTO: MP RESEARCH UNIT FOR ENZYMOLOGY OF PROTEIN FOLDING – JOURNAL OF BIOLOGICAL CHEMISTRY

An enzyme is blocked: In the center is a three-dimensional image of FK506-binding protein FKBP38. Its surface shows negatively charged (red), positively charged (blue) and hydrophobic (gray) regions. The neuro-protective substance DM-CHX is shown as a ball-and-stick model. In the background, microscopic images of nerve cells illustrate which ones are protected by the blocking reaction.

A stroke cuts off the blood supply to parts of the brain when a blood clot blocks the vessel that supplies the nerve cells with oxygen. Doctors must try to dissolve the clot as fast as possible, since the longer the nerve cells are deprived of oxygen, the more neurons die, plummeting into programmed cell death. Until now, there has been no means of protecting nerve cells from death, or replacing dead nerve cells. But that just may be changing: a Max Planck research group headed by Gunter Fischer has now discovered a cellular target and an inhibitory substance that controls lasting damage in rats with stroke symptoms, and even partially reverses it. The biochemists call the compound DM-CHX. It blocks an enzyme from a family of enzymes known as FKBP (short for FK506-binding protein), whose family members help proteins fold up. DM-CHX very selectively switches off the family member FKBP38. "When FKBP38 is very active, it triggers programmed cell death in nerve cells," says Fischer. "Blocking FKBP38 gives the cells a better chance of surviving." In addition, blocking FKBP38 helps the nerve cells grow faster, so that they can repair any damage already incurred. The Max Planck researchers have not only observed the action of CHX at the cellular level: rats paralyzed by a stroke were also able to crawl better after treatment with the new substance than untreated animals.

In contrast, enzymes of the FKBP family other than FKBP38 can neither prevent nerve cell suicide nor lead to repair of damaged neurons. At least that is what Fischer and his colleagues have concluded from their experiments. Consequently, DM-CHX or improved derivatives have a good chance of becoming an active agent in a drug – or at least a much better chance than a whole range of other known compounds that similarly block FKBP enzymes, but that bind much less specifically to FKBP38.

Some of these substances also affect completely different sites in metabolism – like the compound FK506, which first led the biochemists to DM-CHX. It, too, protects nerve cells from cell death. In medical treatment, however, it has an entirely different task. Doctors treat transplantation patients with drugs containing FK506 so that their bodies don't reject the new organ. Also patients with autoimmune diseases take this drug to prevent their immune systems from turning against their own bodies.

However, it will take some time before DM-CHX actually becomes a component of a drug. The researchers must first better investigate the action of DM-CHX over short and long time periods, and they must understand in greater detail how DM-CHX affects the growth and differentiation of cells, so that they can rule out unwanted side-effects. As far as the researchers know, the new substance acts only on nerve cells. Accordingly, it might not only protect against lasting damage after a stroke, but also relieve the consequences of other diseases that destroy nerve cells – such as Alzheimer's. ●

@ Further information from:
PROF. DR. GUNTER FISCHER
Max Planck Research Group for Enzymology of Protein Folding
Halle/Saale
Tel.: +49 345 55-22800
Fax: +49 345 55-11972
e-mail: fischer@enzyme-halle.mpg.de

Panorama

AN IMBALANCE IN MAMMALIAN EGGS is key to their fertilization and later development: At the Freiburg Max Planck Institute of Immunobiology, researchers used egg cells of mice to show that the fertilization of these cells takes place in a space created by the polar body. This polar body creates a space between the egg cell and its protective sheath – the zona pellucida – an area that apparently provides sperm preferred "berths" and thus dictates the location of fertilization. The genetic material of the ovum is also located near the polar body, below the egg membrane. Both indicate that the asymmetrical fertilization of the ovum in mice – and thus the basic orientation of the future embryo – is determined, not biochemically, but rather by the purely mechanical influence of the polar body.

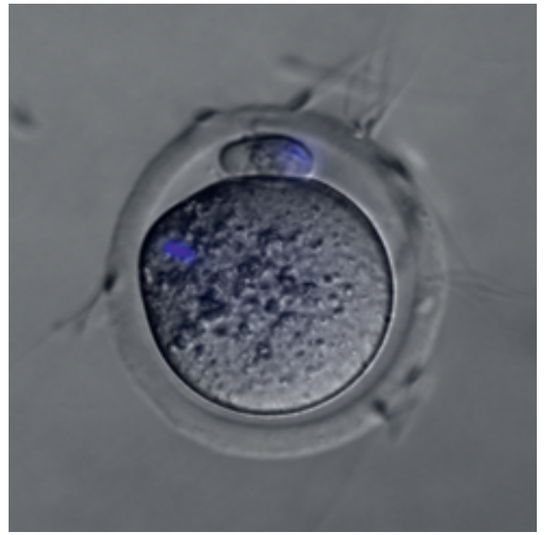


PHOTO: MPI OF IMMUNOBIOLOGY

An egg cell shortly before fertilization: The polar body creates a space between the zona pellucida and the egg cell, thus dictating the fertilization location for sperm.

PLAYING BILLIARDS WITH ELECTRONS, deliberately influencing their movements and, by doing so, steering chemical reactions: A team of Dutch and German physicists, including researchers from the Garching Max Planck Institute of Quantum Optics, has come one big step closer to this goal. To this end, the scientists used laser pulses with a duration of femtoseconds (millionths of a billionth of a second) and precisely controlled, custom-tailored wave shapes. This allowed them to steer the dissociation of deuterium molecules in such a way that, after separation, each of their binding electrons attached to a specific one of the two resulting molecule fragments.

THE HORMONE SEROTONIN acts as a fountain of health for the liver: It contributes significantly to regenerating injured or damaged liver tissue. This finding comes from researchers at the Max Planck Institute for Molecular Genetics and the Max Delbrück Center in Berlin, together with surgeons and pathologists in Zurich and Strasbourg. The scientists altered thrombocytes – blood platelets – of mice in such a way that they no longer transported serotonin; they then removed portions of the animals' liver tissue. As a result, the livers of these mice were far less capable of regeneration than those of the untreated control animals. However, when a serotonin precursor was administered, the liver tissue of the handicapped animals recovered just as quickly as in normal mice. This finding may prove beneficial in the treatment of patients with liver damage or following liver transplantation.

A GYRATING NEUTRON STAR has been spotted in the Canis Major constellation by an international team of researchers, including some from the Garching-based Max Planck Institute for Extraterrestrial Physics. In addition to the usual fluctuations caused by its rapid rotation (in the range of a few seconds), the object also exhibits long-period variability in X-ray light: the proportion of hard X-ray light in the neutron star's spectrum rose between 2000 and 2004, then the contribution of this high-energy radiation sank again. From this behavior, the scientists conclude that the neutron star's rotation axis is precessing, similar to that of a spinning gyroscope. The cause of this, in turn, could be a lateral shove that the neutron star experienced upon its birth from a supernova.

SIGNPOSTS FOR NERVE PATHWAYS: That is one function of special signal substances that promote nerve fiber growth and ensure targeted connections to, for instance, certain muscle groups. This finding comes from scientists at the Max Planck Institute of Neurobiology in Martinsried, together with their French and American colleagues.
The substances these researchers identified are produced by cells in the tissue through which the fiber-like extensions (axons) of nerve cells grow toward their target structure and thus establish themselves as command strings. The finding means a first step toward solving the question of how a nerve cell knows which muscle it is responsible for. ●

www Further information is available at www.maxplanck.de