

Receptive to Music

Pregnant women respond to music with particularly strong changes in blood pressure

Music can be soothing or stirring, it can inspire us to dance or make us feel sad. It also triggers powerful physiological reactions in pregnant women. Scientists at the Max Planck Institute for Human Cognitive and Brain Sciences have discovered that music causes significant changes in blood pressure during pregnancy – despite being rated as similarly pleasant or unpleasant by pregnant women and their non-pregnant counterparts. The researchers' experiments showed that dissonant music played forwards caused blood pressure to drop significantly, while dissonant music played backwards resulted in higher blood pressure after ten seconds and a lower reading after thirty seconds. Unpleasant music thus doesn't generally increase blood pressure like other stress factors. The body's response is just as dynamic as the music itself. Music appears to have a special status among the sensory percep-

tions, as women's responses to most sensory perceptions are weaker during pregnancy. It is thus possible that the em-

bryo may already be conditioned to music in the womb.

(PSYCHOPHYSIOLOGY, May 19, 2014)



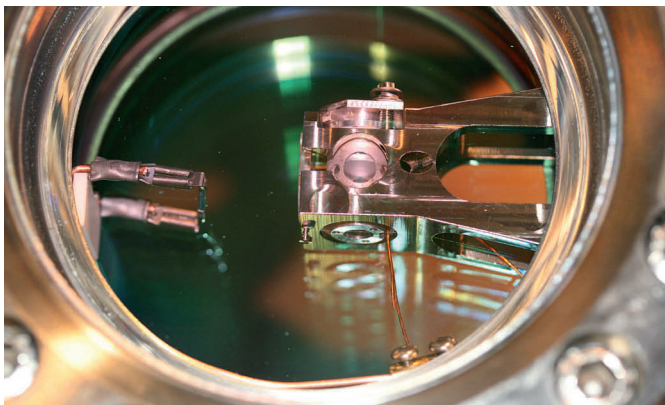
Music is moving: During pregnancy, the female body's response to music is much stronger.

Computing with a Quantum Trick

With a special gate, Max Planck physicists have developed an essential logic element for quantum computers

You can count on quantum information in the future. Physicists from the Max Planck Institute of Quantum Optics in Garching have developed an innovative quantum gate, an essential component of a quantum computer. Such a comput-

er may be able to perform certain tasks far faster in the future than a standard computer. As a key element of their quantum gate, the Max Planck physicists use an atom trapped between two mirrors of a resonator. This allows them to switch the state of the photon by reflecting it off the resonator depending on the state of the atom. Moreover, this gate operation can entangle the atom with the photon. When quantum particles are entangled, their properties become interdependent. Entanglement opens up an array of new concepts in information processing. The quantum gate now presented by the Garching-based physicists makes it possible to design quantum networks in which information is transferred in the form of photons between several quantum processors that compute with atoms. (NATURE, April 10, 2014)



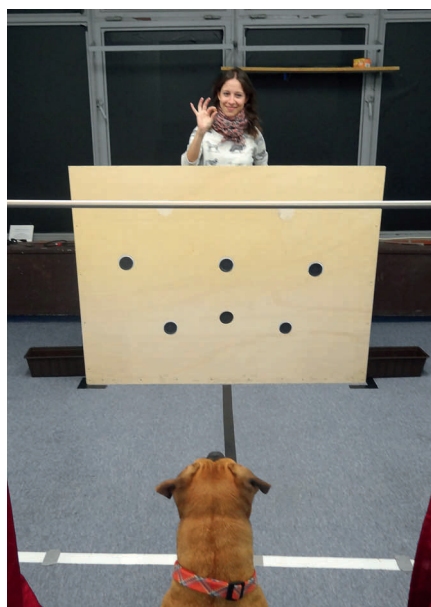
Capturing atoms and photons: Two glass mirrors in the shape of truncated cones are assembled in the stainless steel clasp. One can be seen in this image to the right of center. The Max Planck researchers capture individual atoms between the mirrors. The laser pulses stream into the vacuum chamber through the glass window.

“Fetch!”

Dogs can follow human voice commands to find hidden food

Researchers at the Max Planck Institute for Evolutionary Anthropology in Leipzig have now scientifically proven what dog owners have probably always suspected: dogs can locate hidden food by using human voice direction. To this end, the researchers gave dogs and puppies the opportunity to choose between two identical boxes, only one of which contained food. Therefore, dogs don't rely just on pointing gestures or the direction of gaze, but also on their ears to find hidden food. Other animals are unable to do this: wolves, the closest relatives of dogs, and chimpanzees are unable to make much sense of such visual or acoustic cues. When domesticating the wolf, humans may have subconsciously selected the animal that paid the closest attention to them. This aware-

ness of human signals may have thus become part of dogs' genetic make-up. (PROCEEDINGS OF THE ROYAL SOCIETY B, May 7, 2014)



In the behavioral experiment, the dogs know that there is something to eat in one of the boxes – but not which one. They follow only the human voice to find the food.

Outgrowing Emotional Egocentricity

Egocentricity plays a major role in many conflicts. Children are also often unable to differentiate between their own point of view and that of others. A team from the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig has now demonstrated that they project not only their ideas and desires, but also their emotions onto others. Such behavior isn't necessarily the result of poor upbringing, but may instead have an organic explanation. According to the researchers, the supramarginal gyrus region in the right part of the brain must be sufficiently well developed in children for them to overcome their egocentric behavior. This area of the brain is closely connected with other parts that are responsible for the ability to empathize with others. The supramarginal gyrus' primary function appears to be overcoming one's own perspective. Only when it begins to develop as they get older can children surmount egocentric thinking. (SOCIAL COGNITIVE AND AFFECTIVE NEUROSCIENCE, May 21, 2014)

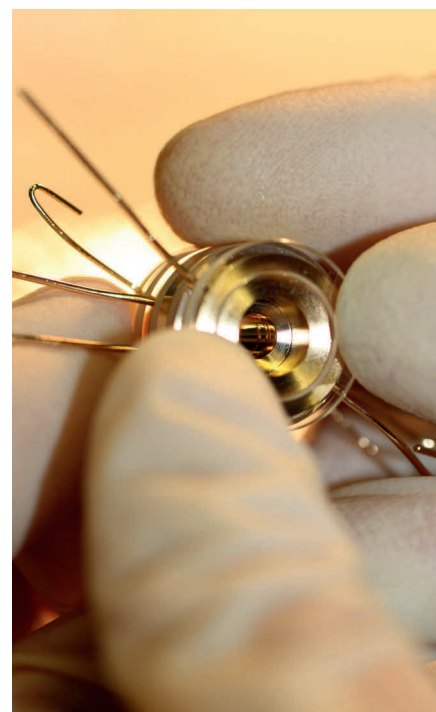
At the Heart of the Antimatter Mystery

An extremely accurate measurement of the proton's magnetic moment may help explain the surplus of matter in the universe

Why something is something and not nothing isn't just a philosophical question, but also a physical one. Fractions of a second after the Big Bang, matter and antimatter formed in almost equal amounts – only to largely annihilate each other again. The fact that a small surplus of matter survived is explained by a previously unknown difference between matter and antimatter. A German and Japanese team, in which researchers from the Max Planck Institute for Nuclear Physics headed by Klaus Blaum were strongly represented, has now taken steps to identify this asymmetry. The scientists measured

the proton's magnetic moment with a precision never achieved before. A similarly accurate measurement of the antiproton, which the team is now planning, may reveal a difference between matter and antimatter. The physicists hope to use the data to formulate a theory of matter and antimatter that also explains the surplus of matter. (NATURE, May 29, 2014)

A single proton is stored in the gold-plated Penning trap consisting of ring-shaped electrodes. The proton's magnetic moment can be determined from its oscillations in the trap.



An Odor Lexicon

A hunter-gatherer group in Thailand has multiple words for smells



Smells play a significant role in everyday life for the Maniq. Linguist Ewelina Wnuk spent several years among this ethnic group and produced an odor lexicon of these hunter-gatherers in the Thai rainforest.

“A sweet, flowery and oriental composition of scents with jasmine and May rose absolute” – this is how a well-known cosmetics manufacturer describes one of its most successful women’s perfumes. It may sound sophisticated, but it relies on metaphors and similes because Western cultures lack abstract concepts to describe the wide range of aromas in our environment, such as those used for taste or things we see. According to linguists from the Max Planck Institute for Psycholinguistics in Nijmegen, Netherlands, some languages have a specific vocabulary for odors. The Maniq, a group of hunter-gatherers in southern Thailand, can describe smells using at least 15 different abstract expressions. In contrast to languages such as German or English, these expressions aren’t derived from one specific object. Instead, there are terms that represent a smell that can originate from various sources. Maniq has a word for the smell of an old shelter, which is also the same as the one used for the odor of mushrooms, or the skin of a dead animal. Human language is thus perfectly capable of expressing the variety of smells in our environment. This probably reflects how important the sense of smell was for survival over the course of human history, something that is greatly underestimated today. (COGNITION, Vol. 131, April 2014)

Fear of the Cuckoo Mafia

Out of fear of retaliation, birds accept and raise brood parasites’ young

The mafia rarely has to extort protection money by means of violence, as the fear of the consequences alone is enough to make restaurant owners pay up. Similar mafia-like behavior can also be observed among parasitic birds, like the brown-headed cowbird (*Molothrus ater*) found in North America. They lay their eggs in other birds’ nests. If the host birds throw the cuckoo’s egg out, the brood parasites take their revenge by destroying the entire nest. Consequently, the hosts accept a certain degree of parasitism as long as they can raise their own offspring alongside the cuckoo chicks. Only previously seen in field observations, scientists at the Max Planck Institute for Evolutionary Biol-

ogy in Plön have now modeled this behavior mathematically to confirm it as an effective behavioral strategy of the host birds. The proportion of birds that accept the cuckoo’s eggs in their nests

and of parasites that respond with violence toward insubordinate behavior by the hosts fluctuate periodically – and contrastingly.

(SCIENTIFIC REPORTS, March 4, 2014)



The brown-headed cowbird of North America can place several dozen eggs in other birds’ nests to be hatched by stepparents.

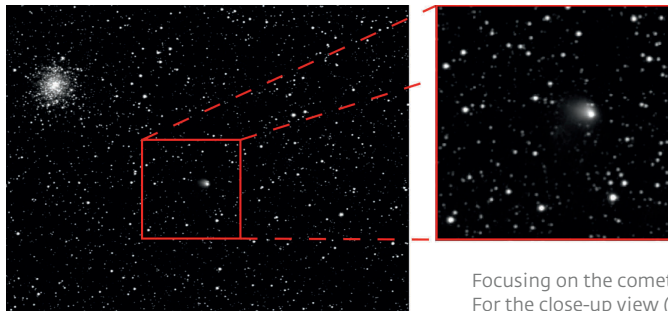


Rosetta's Target Comet Awakes

The camera on board the ESA's space probe observes 67P/Churyumov-Gerasimenko

The 67P/Churyumov-Gerasimenko comet, the target of the ESA's *Rosetta* mission, has begun to develop a dust coma. This can be seen in a series of images taken by OSIRIS – the

spacecraft's scientific imaging system – between March 27 and May 4. In the images taken at the end of April, the dust that the comet is already emitting into outer space is clearly visible as an evolving coma and reaches approximately 1,300 kilometers into space. At the time the images were taken, 67P/Churyumov-Gerasimenko was still more than 600 million kilometers from the Sun. From the changes in brightness that the comet displays periodically over the course of several hours, the OSIRIS team was also able to determine its rotational period. At 12.4 hours, it is around 20 minutes shorter than previously thought. The scientists presented their findings at a meeting held at the Max Planck Institute for Solar System Research.



Focusing on the comet: On April 30, the comet's coma extended around 1,300 kilometers into space. For the close-up view (small image), a long sequence of images was taken and stacked.

Desire for Reward

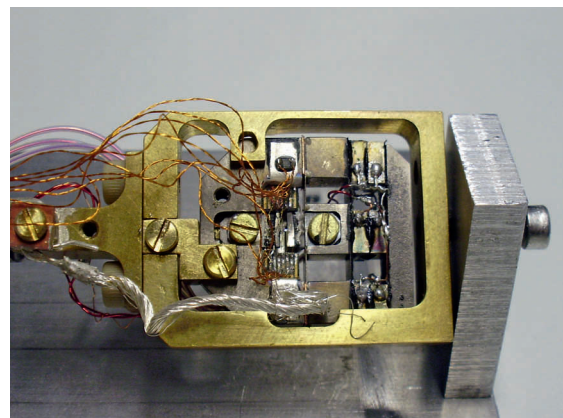
Pornography is a social taboo. Few will admit to its use, yet porn sites are among the most frequently visited on the Internet. However, the intensive consumption of pornography doesn't leave traces solely on the Internet, but also in the brain. According to a study by researchers at the Max Planck Institute for Human Development, the more pornography men consume, the smaller their striata become. This area of the brain makes up part of the reward system that is responsible for producing feelings of pleasure. The activity of the nerve cells in the striatum and their communication with other parts of the brain were much lower when viewing sexually stimulating images when men watch pornography frequently and regularly. Men with high pornography consumption require even stronger stimuli to reach the same reward level. It is unclear whether frequent pornography use leads to these changes in the brain or whether, alternatively, it could be a precondition that determines the level of pornography consumption.

(JAMA PSYCHIATRY, published online ahead of print, June 2, 2014)

Resistance under Pressure

An unconventional superconductor conducts electricity at higher temperatures loss-free when compressed or stretched

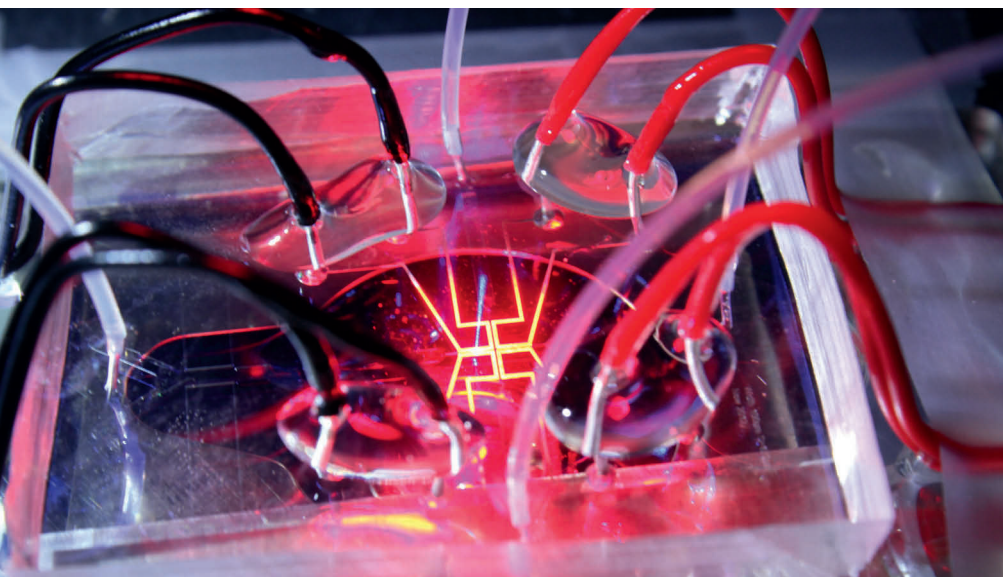
Some superconductors remain a mystery to physicists. Why they conduct electric current at very low temperatures without resistance can't be explained with the established theory of superconductivity. If physicists could solve the puzzle of these unconventional superconductors, they would come closer to the manufacture of artificial materials that conduct electricity loss-free at room temperature, thus helping to save energy. Andrew Mackenzie and his team at the Max Planck Institute for Chemical Physics of Solids have established that strontium-ruthenate becomes a superconductor at much higher temperatures than usual when it is compressed or stretched. For their experiments, the researchers developed a measuring cell that enabled a sample to be stretched and compressed in a precisely controlled way at low temperatures. (SCIENCE, April 18, 2014)



Pressure chamber for high-precision experiments: In order to stretch and compress a sample, it is held tightly between the two right screws in the center of the image. Three Piezo crystals, fitted with soldered electric contacts, are positioned in a row to the right. The center Piezo crystal exerts pressure on the sample when voltage is applied and it is stretched. The outside Piezo crystals push a bracket connected to the far end of the sample to the left, causing a pulling effect.

Music under the Microscope

Droplets on a microfluidic chip can be controlled so precisely that they become a musical instrument



Water droplets are musical. Researchers at the Max Planck Institute for Dynamics and Self-Organization in Göttingen converted the frequencies of droplets flowing through thin channels into musical notes by controlling AC voltage very precisely. In this way, they played Beethoven's *Ode to Joy*. This is more than a mere gimmick: the fact that the droplets can be controlled so precisely means they are also of interest in medical diagnostics. Laboratories on microfluidic chips, for example, are currently being developed that would make it possible to examine minute samples of fluid, such as blood and DNA, in an extremely small space. The new procedure represents a major step forward in achieving this goal.

(SCIENTIFIC REPORTS, April 30, 2014)

Researchers at the Max Planck Institute in Göttingen can precisely control the frequency at which the water droplets flow through the channels of a microfluidic chip using AC voltage. The four transparent tubes transport oil and water into the fine channels of the chip. The yellow lines shown are electrodes, while the red and black cables transport the electric current.

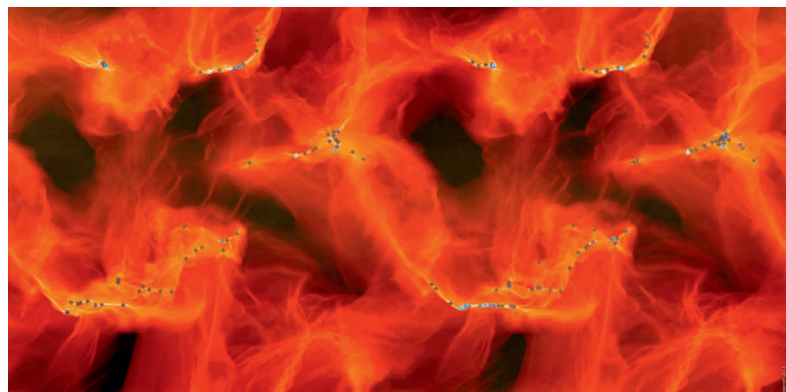
A Recipe for Star Formation

New model enables reconstruction of the spatial structure of molecule clouds

Astronomers have found a new way to predict the rate at which cosmic molecular clouds will form new stars. They developed a technique that facilitates the modeling of the spatial structure of individual gas clouds. The required data comes from an astronomical version of the X-ray procedure: the light of distant stars shining through a cloud before reaching the Earth is dimmed by the dust in the cloud. The reconstruction of the cloud structure uses the dimming measurements for tens of thousands of stars. If the scientists know the spatial structure, then they can also calculate the densities of the various sections within the cloud. It became evident that new stars formed only in regions above a particular density. The re-

searchers from the Max Planck Institute for Astronomy estimate the critical value at around 5,000 hydrogen molecules per cubic centimeter. (SCIENCE, April 11, 2014)

Birth in the computer: This image shows star formation in a turbulent gas cloud. The astronomers used these and similar simulations to test their method for reconstructing the three-dimensional structure of such gas clouds.



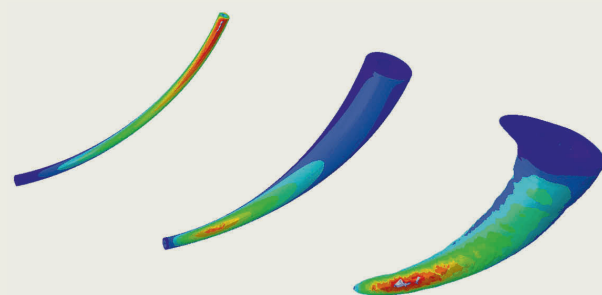
The Ringed Asteroid

The asteroid Chariklo, which circles the Sun between the orbits of Saturn and Uranus, is surrounded by two rings of ice particles. This finding was obtained by a team that included scientists from the Max Planck Institute for Solar System Research. In June 2013, seven observatories in South America focused their telescopes on the 250-kilometer-wide asteroid because it was set to conceal a star. However, the star didn't disappear abruptly for a short time: it dimmed erratically several seconds before and after the actual occultation – an indication of a ring system. It consists of two very thin structures: a gap of just nine kilometers separates the inner ring, with a width of seven kilometers, and the outer ring, with a width of three kilometers. Previously, astronomers have observed the rings of only the planets Jupiter, Saturn, Uranus and Neptune. Such rings are less likely to be found in asteroids, as their fields of gravity are weaker. (NATURE, published online ahead of print, March 26, 2014)

Small gap: A gap of just 9 kilometers separates the brighter inner ring and the significantly fainter outer one. The inner ring has a diameter of 782 kilometers.



Photos: ESO/L. Calçada/Nick Risinger (left), Nature Communications 2014/MPI of Colloids and Interfaces (right)



Testing evolution: In various model structures for a spider's venom fang, the yellow and red areas must sustain the greatest load. In a needle-shaped design (left), these areas are located at the base, meaning that the fang could possibly break there. In the case of a conically shaped fang (center), only the tip would break off. With the natural venom fang (right), the stress at the tip is greater than in the model, as the natural fang wall is somewhat thinner than in the model.

An Incisive Bite

The fangs of the large wandering spider (*Cupiennius salei*) are incisively shaped, right to the tip. The spider uses its curved fang to grasp its prey, puncture its chitinous armor and inject venom into the victim. An Austrian-German research team headed by Yael Politi at the Max Planck Institute of Colloids and Interfaces in Potsdam-Golm established that the shape and structure of the fangs have evolved extremely well to perform their lethal task as reliably as possible over the spiders' lifetime, and with the minimum amount of damage. For the first time, the researchers analyzed in detail the correlation between the structure and the mechanical properties of the cone-shaped fang and compared it with other potential configurations, such as a needle. The chitin fibers of which the poisonous fangs are essentially made up are arranged in various layers, helping the fang to withstand pressure particularly well when biting. The findings may help improve injection devices used in medicine and technology.

(NATURE COMMUNICATIONS, May 27, 2014)

Your Stress Is My Stress

Merely observing stressful situations can trigger a physical stress response

Stress is contagious. This is the conclusion of a study by scientists from the Max Planck Institute for Cognitive and Brain Sciences and the Technische Universität Dresden. During a stress test, observers watched trial subjects struggle with difficult mental arithmetic tasks and interviews. Around a quarter of the observers showed a significant

increase in the stress hormone cortisol in blood tests – a clear indication of the body's stress response. Where the test subjects and observers were partners in a relationship, the stress level actually rose by 40 percent. Even when it came to complete strangers, stress has contagion potential that was able to be transmitted via a screen between a stressed

test subject and an observer. Television programs depicting the suffering of other people can thus also transmit the stress to viewers. Furthermore, the researchers dispelled a common prejudice: men and women experience empathetic stress reactions with equal frequency.

(PSYCHONEUROENDOCRINOLOGY, April 17, 2014)