

# Earth-like Planet near Proxima Centauri

Astronomers discover a celestial body in the habitable zone around our nearest fixed star

Located just over four light-years away, Proxima Centauri is the nearest star outside our solar system. Astronomers, including a team at the Max Planck Institute for Astronomy,

have discovered a planet that orbits Proxima Centauri once every 11.2 days at a distance of 7 million kilometers – within a region that may just offer the right conditions for the emergence of life. The mass of the celestial body, called Proxima Centauri b, is estimated to be around 1.3 times that of Earth. The star has long commanded the attention of scientists because of continuous violent eruptions on its surface and resulting fluctuations in its brightness. The astronomers examined Proxima Centauri on 54 nights using HARPS, an instrument attached to the ESO 3.6-meter telescope in La Silla. The planet gave itself away because it exerts a gravitational force on the star it orbits, producing characteristic line shifts in the star's spectrum. ([www.mpg.de/10696319](http://www.mpg.de/10696319))



Brave new world: An artist's impression shows the Earth-like planet orbiting the star Proxima Centauri, which is 4.24 light-years away.

## Mass Panic in a Computer

Study simulates human behavior during building evacuations

When people flee a building to escape a terrorist attack or a fire, the result is often mass panic. Until now, it was nearly impossible to examine exactly what happens. In collaboration with an international team, scientists at the Max Planck Institute for Human Development have now developed a virtual scenario for this purpose. In the study, 36 participants navigated avatars through virtual rooms. The researchers were able to show that participants' behavior in the virtual environment was largely consistent with real-world behaviors. As in a real emergency, 95 percent of the participants moved to the right to avoid colliding with each other. The researchers investigated behavior in an emergency situation by simulating

the evacuation of a complex building. They induced stress in the participants by exerting time and financial pressure, as well as creating an environment with poor lighting, red flashing lights and fires at blocked exits. Their analysis

showed that crowding, jostling and herd behavior escalated rapidly in response to stress. The researchers hope that their simulations will prove useful for future testing and optimization of evacuation plans. ([www.mpg.de/10732302](http://www.mpg.de/10732302))



Drama in Duisburg: On July 24, 2010, thousands of Love Parade visitors thronged in front of the tunnel where a mass panic broke out.

# How Words Sound Is No Coincidence

Certain sounds are preferred or avoided even in unrelated languages

One of the tenets of linguistics apparently no longer holds. Up to now, linguists assumed that the association between how words sound and what they mean is largely arbitrary. Cases such as the use of the letter “m” in the word for “mother” in many languages were previously considered rare exceptions to this rule. An international research team involving researchers from the Max Planck Institutes for Mathematics in the Sciences and the Science of Human History, as well as from Leipzig University, carried out a comprehensive analysis that lays this assumption to rest. For the study, the researchers used data from more than two-thirds of the

6,000-plus languages spoken throughout the world – and found that many meanings are associated particularly often or particularly rarely with specific sounds, even in unrelated languages. This is particularly true of the names of body parts. For example, the letters o, u, p, k and q frequently occur in words for “knee”. The researchers are at a loss to explain why such coherencies exist. Linguists have now lost a tool that used to serve to establish relatedness, namely the occurrence of similar sound-meaning relationships. ([www.mpg.de/10731041](http://www.mpg.de/10731041))

People all across the world prefer certain sounds for many concepts and avoid others.



## The Call of the Dung

Vinegar fly excrement contains sex pheromones and invites other conspecifics to join the feast

*Drosophila melanogaster* has a good nose. For example, the fragrance of ripe fruit guides the vinegar fly to food and potential mates. The female not only eats the fruit, but also mates and lays her eggs there. Another important source of scents for the flies had been overlooked until now: their excrement. A team at the Max Planck Institute for Chemical Ecology in Jena discovered that the excrement of vinegar flies also contains pheromones that affect the behavior of other flies of the same species. The pheromones of males and females differ, allowing the insects to determine from afar whether there are potential partners at the site. The insects also benefit if many flies of the same species join the feast. The fly larvae that hatch out of the fruit appear to be able to assimilate the food more easily if it has been predigested by microorganisms contained in the excrement of fellow flies. Excrement is thus an important communication tool for vinegar

flies – and possibly also other species, such as the spotted-wing drosophila, *Drosophila suzukii*. If this difficult-to-control pest in orchards and vineyards is also attracted by its own feces, its excrement could conceivably be used to lure it into traps. ([www.mpg.de/10733681](http://www.mpg.de/10733681))



Many vinegar flies have already feasted on this blueberry. The magnification shows small spots where the flies have left their excrement. The smell of feces makes the fruit even more attractive to the insects.

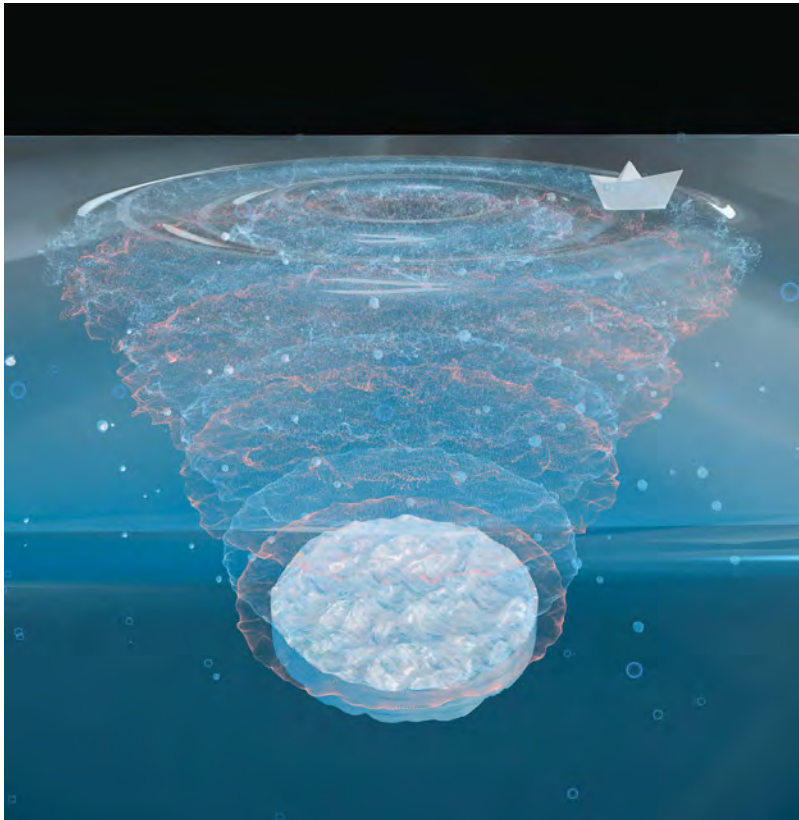
## Resistance Comes at a Price

Almost half our genes can be the starting point for diseases. Some 11,000 genes occur in the human genome in variants that can cause disease. Scientists from the Max Planck Institute for Evolutionary Biology in Plön have studied why such high-risk genes persist in the human genome instead of being eliminated by selection. Their analyses suggest that continuous adaptation to new pathogens in the course of evolution has increased the diversity of our immune genes, but that this comes at a price. According to the researchers, such diversity also extends to neighboring DNA segments, where it results in the persistence of harmful gene variants. Genetic diseases can thus be traced back to contact with pathogens that humans encountered in the course of evolution. ([www.mpg.de/10713899](http://www.mpg.de/10713899))



# Holograms with Sound

A new way of shaping waves in 3D could find applications in technology and medicine



It will soon be possible to easily make sound three-dimensional. Researchers from the Max Planck Institute for Intelligent Systems and the University of Stuttgart have found an easy way to produce an acoustic hologram. It works in much the same way as its optical counterpart, which uses the phase shift of light waves to produce a three-dimensional image. The acoustic hologram created by the Max Planck researchers is a plastic relief through which sound waves travel faster than through the surrounding area. Because of the varying thickness of the material, the profile of the acoustic pressure changes as it passes through the plastic relief. With the help of this finely modulated acoustic pressure, particles ranging in size from several micrometers to several millimeters can be shifted to form larger structures. The technique could also be used to improve ultrasound diagnostics in medicine and materials testing. ([www.mpg.de/10741300](http://www.mpg.de/10741300))

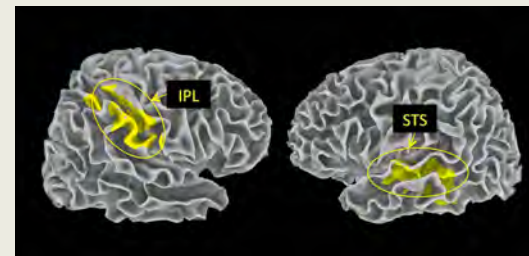
Ultrasound-driven surfer: On the surface of water, a hologram can be used to produce a standing wave on which a paper boat rides in circles.

## Good and Evil in the Brain

Two areas are involved in networks that interpret situations positively or negatively

When someone offends you while smiling, should your brain interpret it as a genuine smile or as an offense? Such ambiguous situations are difficult for our brain to interpret. The same sentence can take on different meanings depending on the tone of voice. Researchers at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig have identified how the brain interprets such scenarios. They found that two networks in the brain determine how we interpret situations. The one is active when we perceive a scene as positive, and

the other when we have negative impressions. Two areas within these networks respond to the change between perceptions. The superior temporal sulcus in the temporal lobe is responsible for interpreting positive events, and the inferior parietal lobule (IPL) for negative events. The two regions appear to inform each other which of them is active or inactive. In this way, it is believed, they determine whether positive or negative impressions dominate in an ambiguous situation, and relay that information to other areas of the brain. ([www.mpg.de/10680717](http://www.mpg.de/10680717))



A matter of interpretation: The inferior parietal lobule (IPL) in the parietal lobe evaluates negative situations, while the superior temporal sulcus (STS) in the temporal lobe interprets positive events. Both areas are part of two neural networks that help the brain to evaluate its environment.

# The Great Tit Fares Better in the Countryside

The birds have fewer and smaller offspring in cities



Great tits are evidently fans of country life: Although urban great tits begin to breed earlier, their broods are smaller and the fledglings weigh less than their counterparts in the countryside. According to researchers from the Max Planck Institute for Ornithology in Seewiesen, temperature, humidity, light and noise are not the reasons why rural birds have it easier – despite the fact that different values were measured between the city and the countryside for all four environmental factors. The study highlights just how difficult it is to precisely measure the impact of urbanization on natural ecosystems. ([www.mpg.de/10708754](http://www.mpg.de/10708754))

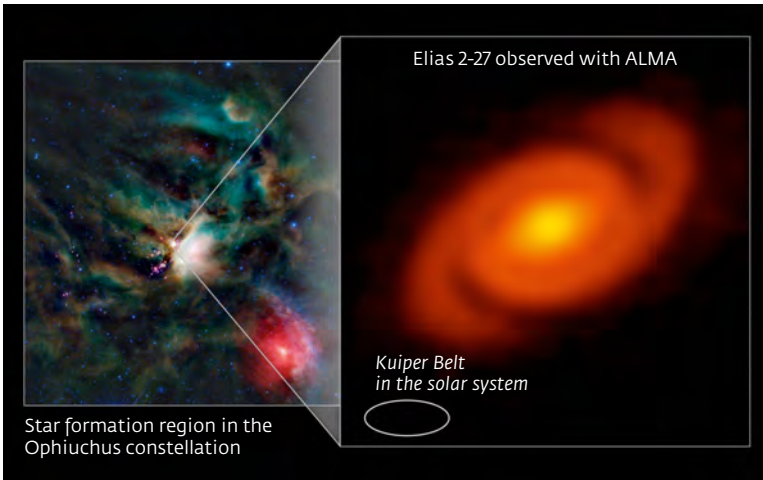
In focus: For the study, individuals with an interest in nature sponsored a nest box and used a webcam to observe its residents. The camera images were transmitted directly to the sponsors' mobile devices.

Photos and graphic: Ph. Sprach (top), NASA/JPL-Caltech/WISE team (bottom left), B. Saxton (NRAO/AUI/NSF), ALMA (ESO/NAO/NRAO), L. Pérez (MPIOR) (bottom right)

# Spirals Assist in the Birth of Planets

Astronomers discover density waves in a protoplanetary disk around a star

A team of scientists headed by Laura Pérez from the Max Planck Institute for Radio Astronomy has discovered a striking spiral arm structure in the disk of gas and dust around the young star Elias 2-27, which is located around 450 light-years from Earth. They obtained the image with the world's biggest radio telescope, the ALMA in the Chilean Andes, which consists of 66 antennas. The spirals are either a result of the presence of young planets, or they create the conditions under which new planets form in the first place. The structure is made up of matter near the midplane of the disk, the region in which new planets can arise. The spirals can produce instabilities, leading to sub-regions with much higher density, and thus to the formation of planets. Previously, astronomers knew of density waves only from much larger objects: they normally occur in spiral galaxies. ([www.mpg.de/10777685](http://www.mpg.de/10777685))



Where stars are born: The photo on the left is an infrared image of the Rho-Ophiuchi region, around 450 light-years away. The image on the right shows thermal dust emissions from the protoplanetary disk surrounding the young star Elias 2-27.

# Warmer Mediterranean Turns the Sahel Green

Anthropogenic climate change helps fan the West African monsoon by carrying moisture from the Mediterranean



Climate change can have mixed consequences: it would appear that the warming of the Mediterranean region, which has brought greater heat and drought to the region over the past 20 years or so, has led to increased rainfall in the Sahel region. Researchers from the Max Planck Institute for Meteorology in Hamburg report that more moisture from the eastern Mediterranean is reaching the southern edge of the Sahara at the start of the West African monsoon in June due to higher sea temperatures in the Mediterranean. Moreover, according to the ongoing study, the future precipitation trend in the Sahel region will depend crucially on warming trends in the Mediterranean, particularly as compared with the tropical oceans. ([www.mpg.de/10645369](http://www.mpg.de/10645369))

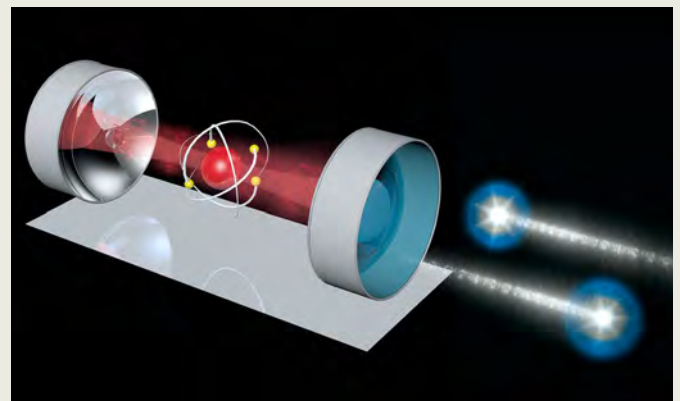
In the past 20 years, the Sahel has become greener as a result of the West African monsoon bringing more rain to the sub-Saharan region.

## Quantum Logic with Light

A photon can switch another photon with the aid of a single atom between two mirrors

The Jedi in the Star Wars saga wage an impossible battle – not because of the superiority of the enemy empire, but because of the constraints of physical laws. Light-sabers don't clash and clang like metal blades: light beams simply don't notice each other. For a light beam to interact with another light beam, a relatively large optical component is required as a mediator, as well as a very intense light source. Researchers from the Max Planck Institute of Quantum Optics have now managed to bring two individual photons into contact with each other. They achieved this by allowing the two photons to interact with a single atom that they held suspended between two mirrors with the aid of a laser. In the process, the direction of oscillation of one photon changed depending on the direction of oscillation of the other. The researchers' experiments therefore not only solved the Jedi's prob-

lem, but also produced a photon switch that is suitable for use as a processor in future photon-based quantum computers. Single photons are particularly suitable for the job because they can be used to transmit quantum information over long distances. ([www.mpg.de/10644678](http://www.mpg.de/10644678))



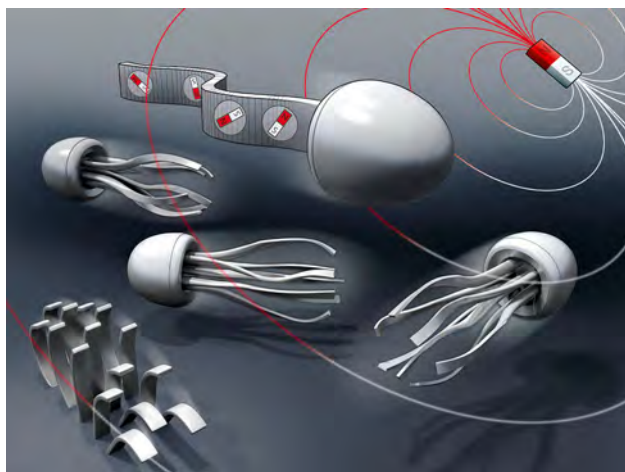
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A universal quantum gate: Max Planck physicists cause two photons (right) to interact with each other by using an atom in a resonator as a mediator. The resonator consists of two mirrors and a laser that suspends the atom between them.



# Magnetically Driven Microrobots

Rubber strips that change shape in magnetic fields could serve as motors for tiny swimming robots

Microrobots could one day mimic the locomotion of spermatozoa and paramecia and swim through the human body, delivering drugs precisely where they are needed. Researchers from the Max Planck Institute for Intelligent Systems in Stuttgart developed magnetic rubber strips for such tiny robots that copy the swimming movements of natural flagella, cilia and tentacles. To achieve this, the silicone strips have magnetic particles embedded in them. The scientists use a magnetic field to control the complex movements of the biomimetic locomotor mechanisms. The magnetic field, in turn, is controlled by a sophisticated computer program. Driving microrobots indirectly in this manner is more effective than embedding magnetic particles in them and directly drawing them through a fluid with a magnetic field. Components that can be reshaped with a magnetic field could find applications in micro process engineering, in which chemical and physical processes are carried out on an extremely small scale. ([www.mpg.de/10754617](http://www.mpg.de/10754617))



Magnetic cilia and tentacles: Using an external magnetic field and silicone strips containing magnetic particles, robots can be moved like jellyfish, bacteria or spermatozoa.

## Loophole for Tumors

Cancer cells destroy blood vessel walls in order to escape from the bloodstream and form metastases

Many cancers become a mortal danger only if they form metastases elsewhere in the body. Such secondary tumors are formed when individual cells break away from the main tumor and travel through the bloodstream to distant areas of the body. To enter surrounding tissue, they must pass through the walls of small blood vessels. Scientists from the Max Planck Institute for Heart and Lung Research in Bad Nauheim and Goethe University Frankfurt have now shown that cancer cells kill specific cells in the vascular wall. The vascular wall cells themselves give the signal for their own death: they present a receptor molecule called death receptor 6 (DR6) on their surface. Contact with a cancer cell activates the receptor and kills the vascular wall cell. In this way, the cancer cell creates a passage out of the bloodstream. The researchers were able to reduce the spread of metastases in cancerous mice by blocking DR6 with an inhibitor. However, before the DR6 blockade can be used in cancer patients, it must be determined whether the results in mice can be transferred to humans and whether such therapy produces unwanted side effects. ([www.mpg.de/10686146](http://www.mpg.de/10686146))

Graphic: Phil Loubere

## Clichés about Nations Govern our Actions

Economic theories have generally ignored the influence of clichés on international cooperation. Scientists from the Max Planck Institute for Research on Collective Goods had 1,200 people from six countries interact with each other online. They presented the subjects with the prisoner's dilemma – a game in which the participants, who can't make any arrangements with one another, must decide whether to behave selfishly or cooperatively. The dilemma lies in not knowing what the other person will do, so the partners must try to assess the behavior of the other. If a player thinks their partner will behave selfishly, then they will likewise usually choose selfish behavior. If a player judges their partner to be cooperative, then they will likely also choose to cooperate. In the game, the only thing the players knew about their opponents was their nationality. The scientists also asked the participants to assess each other – and found that they were strongly guided by prejudices. Americans, for example, expected a high level of cooperation from Japanese but less cooperation from Israelis, and acted accordingly. Israelis, in turn, judged Americans to be cooperative and opted to cooperate themselves. The Japanese, on the other hand, tended to judge other nationalities pessimistically and therefore usually acted egotistically. Thus, the players often acted on the basis of stereotypes that proved to be wrong. ([www.mpg.de/10746991](http://www.mpg.de/10746991))