

PHOTO: GCO



On the winning side: *MaxPlanckResearch* has won the German Design Award for 2022.

AN HONOR FOR OUR MAGAZINE

MaxPlanckResearch has been awarded one of the world's most prestigious design prizes for its design and visual appearance. The magazine received the German Design Award 2022 in the category "Excellent Communications Design – Editorial". The award was given in recognition of the magazine's redesign two years ago. Its visual concept and approach to content convinced the German Design Award jury just as much as the journal's editorial work, which focuses on translating the specialized terminology used in each branch of science into more simply formulated language that can be understood by readers with no expertise in the subject. The German Design Award is awarded by the German Design Council to honor innovative design in the fields of architecture, communication, and product design. The entries are judged by an international jury of leading experts active in all branches of design.

www.mpg.de/17883198

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AWARD-WINNING ★

DIETER OESTERHELT

The Emeritus Director of the Max Planck Institute of Biochemistry has received the Albert Lasker Basic Medical Research Award 2021 jointly with Peter Hegemann from Humboldt University and the American scientist Karl Deisseroth from Stanford University. The three scientists were honored for their discovery of light-sensitive proteins in the membrane of single-celled organisms and for their use of these proteins in optogenetics.



PHOTO: MPG/FILSER

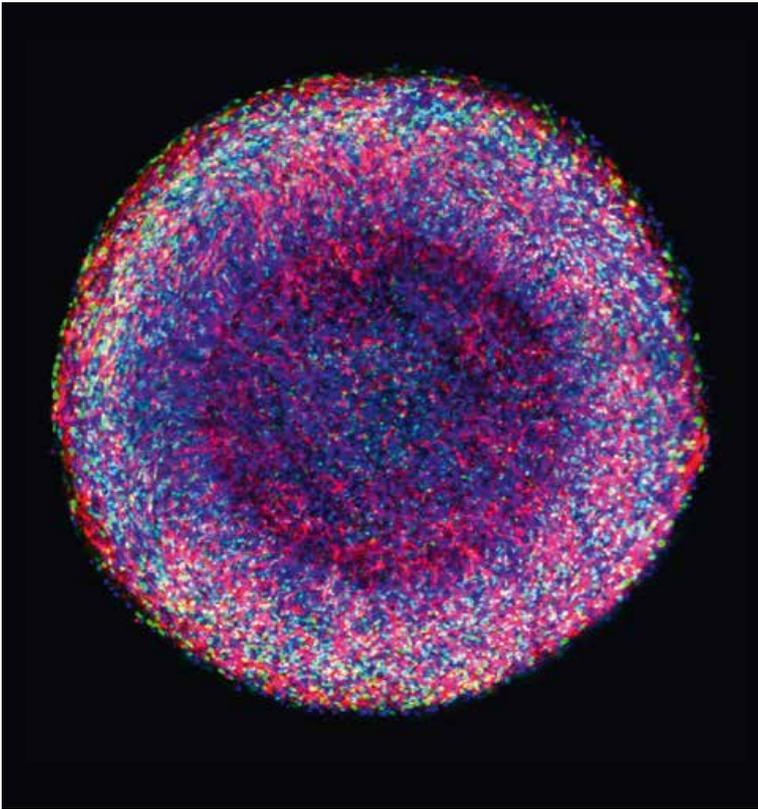
ALESSANDRA BUONANNO

This year's Balzan Prize has been awarded to Alessandra Buonanno, Director of the Max Planck Institute for Gravitational Physics, and Thibault Damour from the French Institut des Hautes Études Scientifiques. The jury paid tribute to the leading role played by the two scientists in the prediction of gravitational wave signals. Their work also provides extremely accurate confirmation of the general theory of relativity.



PHOTO: SVEN DOERING

IMAGE: MPI FOR MOLECULAR BIOMEDICINE/HENRIK RENNER, JAN BRUDER



A 25-day-old midbrain organoid (blue: cell nuclei; red: nerve cells; green: progenitor cells).

PETRI DISHES REPLACE ANIMAL EXPERIMENTS

In order to elucidate the functioning of the brain and develop drugs against neurological disorders such as Alzheimer's disease, Parkinson's disease or depression, researchers have to study the brains of laboratory animals. They could in fact study nerve cells grown the traditional way in two-dimensional cultures, which thrive in a nutrient solution and form a lawn of interconnected nerve cells. However, these flat expanses of cultured cells only roughly approximate to the actual conditions in the human brain. Brain organoids from Muenster are quite different. They are grown from special neural progenitor cells that spontaneously form pieces of tissue and can create networks in all three spatial directions. They were developed by Jan Bruder and

Henrik Renner at the Max Planck Institute for Molecular Biomedicine in Muenster. The two scientists have also designed an automated production process that allows them to generate and analyze large numbers of organoids using standardized processes. Researchers can use these miniature tissues to carry out basic research into the mechanisms of neurological diseases. The organoids can also be used to test potential new drug substances. If the substances are found to be ineffective or toxic, this eliminates the need for further testing on animals. The German Federal Ministry of Food and Agriculture awarded the Animal Welfare Research Prize for 2021 to the two inventors in recognition of their work.

www.mpg.de/17946077

NEW ADMINISTRATIVE HEAD

Simone Schwanitz is to become the new Secretary General of the Max Planck Society. She was previously in charge of the "Department of Research, Technology Transfer, Digitization and the European Union" at Baden-Wuerttemberg's Ministry of Science, Research and the Arts. In this position, she was also a member of Boards of Trustees of several Max Planck Institutes. The 53-year-old political science graduate has acquired knowledge and practical experience in personnel, budget, construction and legal matters through her many years of work in Ministry operations. "This will help her not only when managing the Administrative Headquarters but also when interacting with the Institutes, governing bodies and other committees, the Ministries, and the Joint Science Conference of the federal administration and the federal states," emphasizes Max Planck President Martin Stratmann. Simone Schwanitz will take office on February 1, 2022. Her predecessor Ruediger Willems will step down in March 2022.

www.mpg.de/18416593

Lego with a memory:
a toy robot learns to
navigate a maze with the
help of an organic
neuromorphic circuit.

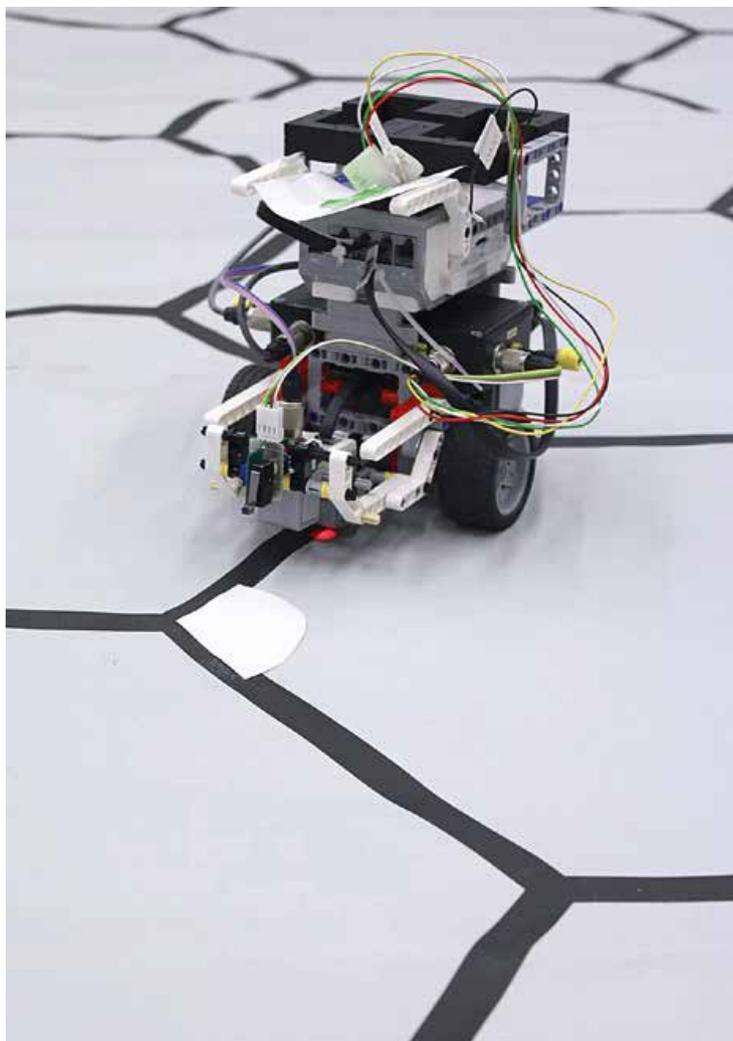
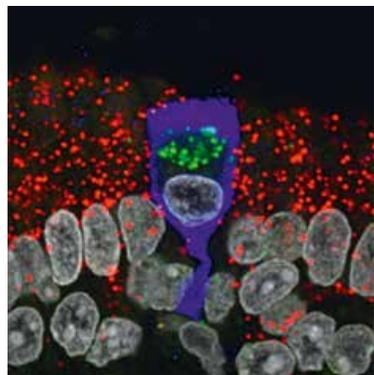


PHOTO: MPI FOR POLYMER RESEARCH

IMAGE: MAX PLANCK RESEARCH UNIT FOR NEUROGENETICS/MONA KHAN



A lone infected supporting cell is surrounded by non-infected cells in the olfactory mucosa of a COVID-19 patient who died four days after the infection was diagnosed. The infected cell has the characteristic shape of a wine glass.

10 CORONAVIRUS IN THE NOSE

COVID-19 can cause a temporary or even long-term loss of smell. This suggests that SARS-CoV-2 may infect the sensory cells in the olfactory mucosa and even travel along the olfactory nerve into the brain. However, researchers at the Max Planck Research Unit for Neurogenetics in Frankfurt have not found any traces of the virus in the sensory cells of deceased COVID-19 patients. Neither do the nerve cells in the brain's olfactory bulb appear to have been infected. This means there is as yet no evidence that SARS-CoV-2 can infect nerve cells. Instead, the virus mainly targets the supporting cells in the olfactory mucosa. The loss of smell presumably occurs when these supporting cells are infected, since they then become unable to supply the olfactory cells with sufficient nutrients. The supporting cells are located on the surface of the nasal mucosa, where the immune system is unable to afford them adequate protection. This means that even vaccinated or recovered patients can lose their sense of smell after being infected with SARS-CoV-2.

www.mpg.de/17907472

ROBOT WITH ARTIFICIAL SYNAPSES

Circuits that function like nerve cells could open up even more new computer technology applications. They could utilize energy with roughly the same efficiency as natural neurons, directly convert sensory information such as image data from a camera into control signals for a motor, and ultimately even facilitate communication between nerve cells and microelectronic components. An international team led by researchers from the Max Planck Institute for Polymer Research has now succeeded in advancing one step further in the development of neuromorphic electronics. The researchers have developed a neuromorphic circuit containing a transistor which processes information with the help of ions – just like nerve cells do – in-

stead of the electrons used by traditional microelectronic components. This circuit can permanently memorize what it has learned, since it contains a synthetic synapse which changes during the learning process in the manner of a biological synapse. The team built the neuromorphic circuit into a robot, which then learned to find its way through a maze with the help of markings. In addition to camera data, the robot used the mechanical signals it received when it mistakenly collided with the walls of the maze. As the team expected, the robot interpreted the markings more reliably after every failed attempt because the corresponding signals sent through the artificial synapse became stronger.

www.mpg.de/18023757

FEELINGS COME FROM THE HEART

People who do not feel enough fear are more likely to engage in risky behavior. However, people who are too fearful or are even susceptible to panic attacks face problems in their everyday lives. So how can fear be kept in check? The results of a study performed on mice by researchers at the Max Planck Institute of Neurobiology in Martinsried, near Munich, show that the brain uses bodily reactions to control feelings of fear, for example by slowing the heartbeat. The researchers focused on the insular cortex, a region of the brain that – also in humans – reacts to stimuli that could signal danger, such as unexpected noises. This region also receives signals from the heart via the vagus nerve. The results suggest that the insular cortex keeps fear levels within a certain median range. If it is activated, the most fearful mice lose some of their fear. In contrast, activating the cortex makes braver animals more cautious. However, the insular cortex can only perform this function with feedback from the body, since the insular cortex is not activated if there is no communication between the heart and the brain. Intensely fearful animals remain fearful, carefree ones remain carefree. This means that physical reactions are more than just the result of feelings; instead, the brain uses them to control the body in a kind of feedback loop.

www.mpg.de/17860303

TELL ME WHAT YOU PLAY...

Humans all over the world play games, but not all the games they play are the same. Previous studies suggested that people in hierarchical societies often play competitive games, while the games most commonly played in egalitarian societies tend to be more cooperative. However, these correlations have so far only been investigated in a small number of cultures. Researchers from the Max Planck Institute for Evolutionary Anthropology in Leipzig have now joined forces with colleagues in Jena, Gera and Australia to analyze historical data about this topic. The key

question was whether the games typically played in a society allow conclusions to be drawn about how cooperative it is. The results showed that societies that frequently became embroiled in conflict with other societies played cooperative games more frequently than competitive ones. On the other hand, cultures in which there were frequent conflicts within the community were more likely to play competitive games. No reliable associations were found between the type of game and the hierarchical structures within the societies.

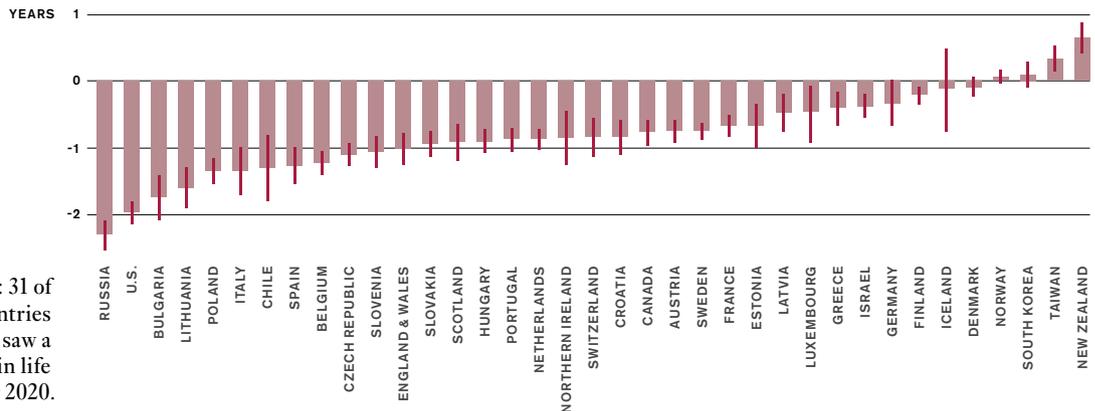
www.mpg.de/17889012

COVID-19 REDUCES LIFE EXPECTANCY

Over the last few decades, most western industrialized nations have grown used to seeing the average life expectancy of their populations consistently increase by a few weeks every year. The COVID-19 pandemic has now halted this development. This conclusion is the outcome of a study by the Max Planck Institute for Demographic Research and the Universities of Oxford and Cambridge. The team used complete sets of reliable data to calculate life expectancy in 37 middle and high-income countries. In 31 of the

countries investigated, life expectancy decreased among both men and women. Russia was most strongly affected, with men's life expectancy declining by 2.33 years and women's by 2.14 years. In second place was the U.S., where men's average life expectancy fell by 2.27 years and women's by 1.61 years. Life expectancy indicates how long people would live on average if their circumstances during the year being investigated were to remain constant for the rest of their lives.

www.mpg.de/17634809



Negative balance: 31 of the 37 countries investigated saw a decrease in life expectancy during 2020.

HOW WELL MASKS PROTECT US

Even three meters' distance is not enough. If an unvaccinated person who is not wearing a mask stands within the so-called moist breath zone of a person infected with COVID-19, the risk of them becoming infected with the COVID-19 virus increases rapidly within just a few minutes. However, masks provide highly effective protection against virus transmission. When both people are wearing well-fitting medical face masks, the risk of becoming infected within twenty minutes falls to no more than ten percent. With properly fitting FFP2 or KN95 masks, the risk actually falls to less than 0.1 percent, and even poorly fitting FFP2 masks limit the risk to no more than 4 percent. These upper limits for the risk of infection were calculated in an extensive study conducted by a team from the Max Planck Institute for Dynamics and Self-Organization in Goettingen. The team investigated how well various masks protect the wearer from infection by the delta variant of COVID-19 when worn in different ways. They calculated the risk of infection extremely conservatively and are therefore certain that masks provide even better protection in real-life conditions. They also believe that masks reduce the risk of transmitting the omicron variant even more effectively than they do the delta variant, even though only a half to one-third of the virion load is required for a person to become infected with omicron. The researchers resolved this apparent contradiction by looking at the respective viral load and the size of the resulting particles found in the upper and lower airways: in the lower airways, the omicron viral load is significantly lower than that of delta. In the upper airways, the viral loads of both variants are comparably high. However, large, virus-laden particles are produced in this area – especially when talking, singing and shouting – and masks, including medical masks, can filter them particularly effectively from the wearer's breath. www.mpg.de/17916867

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Masks that do not fit tightly at the edges allow air to enter and exit, especially at the nostrils but also at the cheeks. However, even poorly-fitting masks significantly reduce the risk of infection.

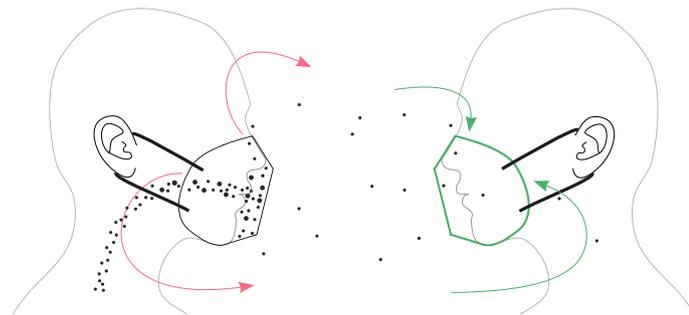


PHOTO: JAMES ST. CLAIR

New Caledonian crow with a hooked tool.

CROWS VALUE TOOLS

The care with which we humans handle our property often depends on its value. The sticks that some crows use to forage for food do not have a price tag, but the birds still know their value. This was the inference drawn from a study of New Caledonian crows conducted by researchers from the University of St. Andrews and the Max Planck Institute of Animal Behavior in Konstanz. The birds use a rare species of plant to painstakingly craft hooked tools that allow them to extract their prey ten times faster than the non-hooked tools that are easier to make. The German-British team has now found that crows take more care to safeguard these valuable tools when they are not in use than they do the more basic tools. Once they have extracted their prey from cracks and crevices using a stick, they have to put their tool down in order to eat. They then hold it securely under their feet or place it temporarily in a nearby hole. They do this in an attempt to avoid accidentally dropping the stick and to prevent it from being stolen by other crows. www.mpg.de/18061418

WEAK GULF STREAM REDUCES MONSOON RAINFALL

If the ice sheet covering Greenland were to thaw, this could have dire consequences for tropical water supplies. It would cause large quantities of fresh water to flow into the North Atlantic, thus slowing the Atlantic Meridional Overturning Circulation (AMOC) to which the Gulf Stream belongs. The monsoon rainfall so vital to East Asia and India would then probably decrease. This conclusion was drawn by an international team led by researchers from the Max Planck Institute for Chemistry, who performed a study that shows how the weakening of the Gulf Stream has affected monsoon rainfall in the

past. For this purpose, the team analyzed the chemical signature in stalagmite deposits taken from a stalagmite cave in southern China to obtain information about the amount and duration of precipitation during the monsoon season. The researchers combined these data with results obtained by other groups, which state that the AMOC weakened at the end of the penultimate glacial period due to the increased volume of meltwater flowing into the North Atlantic. Hence, the team was able to prove that monsoon rainfall decreased dramatically during this period.

www.mpg.de/17885842

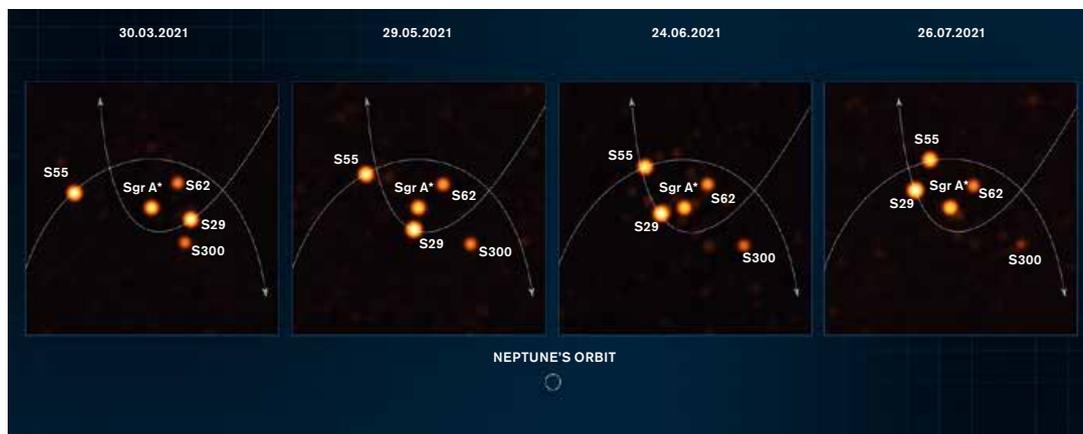
PHOTO: JASPER WASSENBURG, MAX PLANCK INSTITUTE FOR CHEMISTRY

Stony witnesses: the chemical signature in the bands that accumulate as a stalagmite grows (the photo shows a stalactite from Morocco) provides precise information about historical climate change.



40 mm

IMAGE: ESO/GRAVITY COLLABORATION



Stars circling the black hole: photographed between March and July 2021, these images show stars orbiting very close to the giant monster lurking at the heart of the Milky Way.

ZOOMING INTO THE GALACTIC CENTER

The heart of our Milky Way holds a surprise or two – not least because it is the home of a giant black hole. A team led by the Max Planck Institute for Extraterrestrial Physics has now taken a look deep inside this galactic center. Under the direction of Reinhard Genzel, the researchers concentrated on measuring the orbits of stars close to the gravity trap. These

included the record-breaking star S29, which at the end of May 2021 approached the black hole at the breathtaking speed of 8,740 kilometers per second and passed it at a distance of 13 billion kilometers – just 90 times the distance between the Sun and the Earth. No other star has yet been observed passing that close or traveling that fast around the black hole. The

group also found that these and other stars exactly followed the orbits predicted by the general theory of relativity for objects moving around a black hole with a mass 4.3 million times that of the Sun. With an accuracy of about 0.25 percent, this is the most precise estimate of the black hole's mass to date.

www.mpg.de/18035817

PARROTS PRACTICE SELF-CONTROL

At the beginning of the 1970s, researchers performed a so-called “marshmallow experiment” to find out how long children can wait for a reward if it grows larger over time. A number of animal species, including chimpanzees, capuchin monkeys, dogs, squid, and crows, also have this ability to control their impulses. A research team from the Max Planck Institute for Ornitho-

logy in Seewiesen has now compared the self-control of four different parrot species at the Loro Parque – Animal Embassy in Spain. The scientists tested how long the parrots resisted immediately eating a sunflower seed when the alternative was to wait somewhat longer for a walnut. On average, African grey parrots were able to wait longer for their favorite food than macaws.

The best performance was achieved by a grey parrot called Sensei, who managed to wait more than twice as long as the most patient macaw. One explanation of these differences could be that bird species that have to invest more time in searching for food or that live in more complex social settings learn to exhibit more self-control.

www.mpg.de/17804523

COMMON ROOTS

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The family of Transeurasian languages includes members as diverse as Japanese, Korean, Tungusic, Mongolian and Turkish. However, their origins and dispersion have long been a mystery. An interdisciplinary study with Martine Robbeets, Research Group Leader at the Max Planck Institute for the Science of Human History, as the lead author has now found genetic, archaeological and linguistic evidence that the spread of this family of languages correlated with the spread of agriculture. The data indicate that the origins of the Transeurasian languages go back to the early days of millet farming along the western Liao River in northeastern China. Proso millet (*Panicum miliaceum*) was already being cultivated in that region nine thousand years ago. From there, the family of languages initially spread to neighboring regions. In the late Neolithic, Bronze and Iron ages, the millet farmers gradually mixed with populations on the Yellow River, in Western Eurasia and in Japan. They also brought along their knowledge of pasture farming and cultivating rice and other food crops.

www.shh.mpg.de/2071364

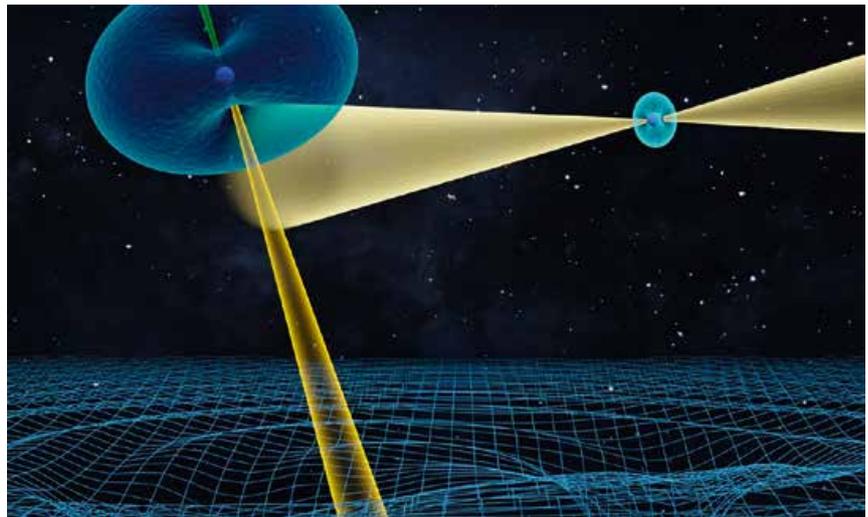


IMAGE: MICHAEL KRAMER / MPIFR

Cosmic test: the image is an artistic representation of the double pulsar system PSR J0737-3039 A/B, in which two active pulsars orbit each other in just 147 minutes. The orbital motion of these extremely high-density neutron stars causes a series of relativistic effects that have been precisely measured over a period of sixteen years.

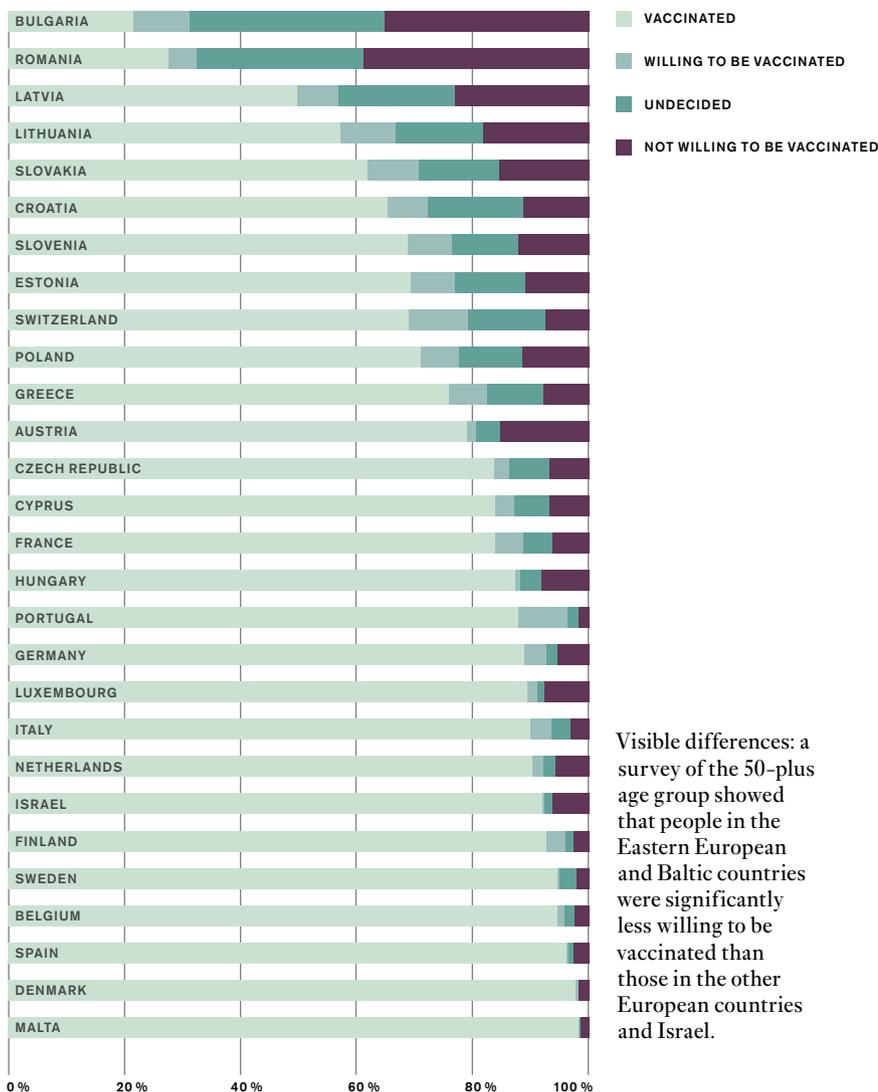
EINSTEIN IS PROVEN RIGHT ONCE AGAIN

More than a hundred years after Albert Einstein published his theory of gravity, scientists all over the world are still trying to find possible flaws in his general theory of relativity. The observation of any deviation from the predictions of this theory would open a new window onto the science of physics and expand our current theoretical understanding of the universe. A team of researchers from ten countries has spent sixteen years attempting to prove or disprove Einstein’s general theory of relativity using some of the toughest tests yet developed. For

this, the group led by Michael Kramer from the Max Planck Institute for Radio Astronomy investigated a unique pair of stars with extreme properties; known as pulsars, they form a binary star system in which each orbits the other. Measurements were taken using seven radio telescopes located all over the world. These revealed new relativistic effects that had been expected but were now being observed for the first time. And the observations matched Einstein’s theoretical predictions by more than 99.99 percent.

www.mpg.de/18014666

IN BRIEF



GRAPHIC: GGO ACCORDING TO SHARE-ERIC

Visible differences: a survey of the 50-plus age group showed that people in the Eastern European and Baltic countries were significantly less willing to be vaccinated than those in the other European countries and Israel.

WHO ARE THE UNVACCINATED?

A team of researchers from the Max Planck Institute for Social Law and Social Policy has performed a study to find out which demographic, socio-economic and health factors play a role in making the decision for or against the COVID-19 vaccine. For this, they used the Survey on Health, Aging and Retirement in Europe, which regularly collects data from the 50+ age group in 27 European countries and Israel. One significant finding was that vaccine hesitancy and refusal to be vaccinated were much more pronounced in Eastern Europe than in other regions. Moreover, people in lower income brackets were vaccinated less often. Another influential factor was the level of education: 15 to 16 per-

cent of the people who had achieved a low or intermediate level of education were undecided or refused to be vaccinated, but only around 9 percent of the people who were more highly educated responded the same way. People aged between 50 and 65 were more likely to refuse the vaccine than older respondents; this finding was consistent in almost all countries. Gender was also a factor in most countries: women were more likely to be hesitant than men. There was also a correlation between the respondents' willingness to be vaccinated and their physical health, or whether they knew people who had fallen seriously ill with COVID-19.

www.mpg.de/17673849

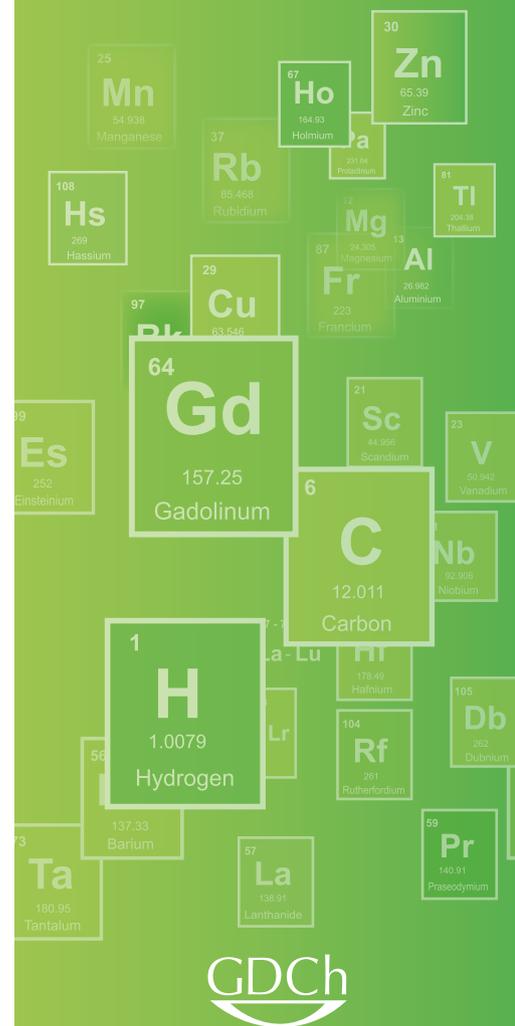
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