



Getting started: Max Planck President Martin Stratmann (front) and representatives of the other partners at the formal founding of the Munich Quantum Valley research hub, which took place at the Bavarian Academy of Sciences and Humanities.

QUANTUM NETWORK FOR BAVARIA

A quantum computer that runs circles around conventional computers, tap-proof communication methods, and fundamental elements of quantum technology are among the goals that scientists will pursue in Munich Quantum Valley. This new research hub was formally founded in January 2022 at the official signing of the founding document in the presence of Bavaria's Minister-President Markus Söder. The founding partners are both of Munich's universities, the Friedrich-Alexander University of Erlangen-Nuremberg and the Bavarian Academy of Sciences and Humanities, the German Aerospace Center,

the Fraunhofer-Gesellschaft, and the Max Planck Society. The aim of the Munich Quantum Valley research hub is to set up a Center for Quantum Computing and Quantum Technologies over the next five years. This center will provide access to the three most promising quantum computing technologies currently available, i.e. computers based on superconducting, ionic, and atomic qubits. In addition to the EUR 300 million provided by Bavaria's Hightech Agenda, the initiative has already secured more than EUR 80 million in government funding for its projects.

www.mpg.de/18184418

FIRST CENTER IN AUSTRALIA

The Max Planck Institute of Colloids and Interfaces, the Max Planck Institute for Intelligent Systems, and Queensland University of Technology have established a new joint venture: the Max Planck Queensland Center for the Materials Science of Extracellular Matrices (MPQC). The first Max Planck Center on the Australian continent has set itself the goal of researching extracellular matrices. These biological materials are considered to be the pillars of life: although they are not animate, they provide cells with support, respond to changing environmental conditions,

and store information that stimulates or inhibits cell growth. A more precise knowledge of how the composition and structure of extracellular matrices (ECM) influence their functions is relevant not only for biomedical applications and a better understanding of biological systems, but also for technical applications – for example, in robotics or architecture. The MPQC is also committed to the education and training of junior scientists. The Center will be training the future experts who are to become world leaders in the field of bioengineering.

www.mpg.de/18189505

AWARD-WINNING ★



FERENC KRAUSZ

Ferenc Krausz has been awarded this year's Wolf Prize in Physics for his pioneering contributions to ultrafast laser science and attosecond physics. The Hungarian-Austrian physicist is the Director of the Max Planck Institute of Quantum Optics and holds the Chair for Experimental Physics at the Ludwig Maximilian University of Munich. Attosecond light flashes make it possible to record the ultrafast movements of electrons in molecules and atoms. Ferenc Krausz shares the prize with his colleagues Paul Corkum from the University of Ottawa and Anne L'Huillier from the University of Lund. The Wolf Prize is one of the most prestigious awards in the field of physics.

”

ALL NATIONS MUST
COME TO THE DECISION
TO RENOUNCE FORCE
AS A FINAL RESORT OF
POLICY. IF THEY ARE
NOT PREPARED TO DO
THIS, THEY WILL CEASE
TO EXIST.

“

MAINAU DECLARATION
1955

CALL FOR PEACE

Nobel Prize laureates in various disciplines are calling for peace following the Russian invasion of Ukraine. They have signed a declaration initiated by the Max Planck Society, which is also supported by the Lindau Nobel Laureate Meetings. The declaration follows on from the Mainau Declaration of 1955, in which Nobel Prize winners attending the Lindau Nobel Laureate Meeting issued a warning against nuclear war and called for all nations to renounce force as a final resort of policy. One of the initiators of that declaration was

Otto Hahn, the first President of the Max Planck Society. The approximately 150 signatories of the current declaration are calling on governments and business leaders to use scientific discoveries and technologies responsibly and in full awareness of their long-term consequences. Russian President Vladimir Putin is urged to honor the agreements concluded under international law, withdraw his armed forces, commence negotiations, and establish peace.

[www.mpg.de/
peace-declaration-nobel-prize-laureates](http://www.mpg.de/peace-declaration-nobel-prize-laureates)

CANCER DRUG TO ENTER CLINICAL TRIALS

The U.S. Food and Drug Administration (FDA) has given the green light for clinical trials of a novel cancer drug. Up to seventy patients with advanced solid tumors are to receive an active substance known as Q901 as part of a phase 1/2 study taking place in the U.S. The initial goal will be to determine the dosage more precisely. Data from pre-clinical studies have shown that Q901, which targets cyclin-dependent kinase 7 (CDK7), can specifically target and kill cancer cells with aberrant cell division cycles or transcriptional regulation. The underlying research was performed as part of a joint project involving the University of Muenster, the Max Planck Institute of Immunobiology and Epigenetics in Freiburg, and the Lead Discovery Center established by the Max Planck Society. The South Korean biotech company Qurient licensed the results from the technology transfer organization Max-Planck-Innovation, optimized the program still further, and completed the studies required for the investigational new drug (IND) application. If the clinical trials are successful, the drug could be used to treat various malignancies including ovarian, breast, prostate, colorectal, lung, and pancreatic cancer.

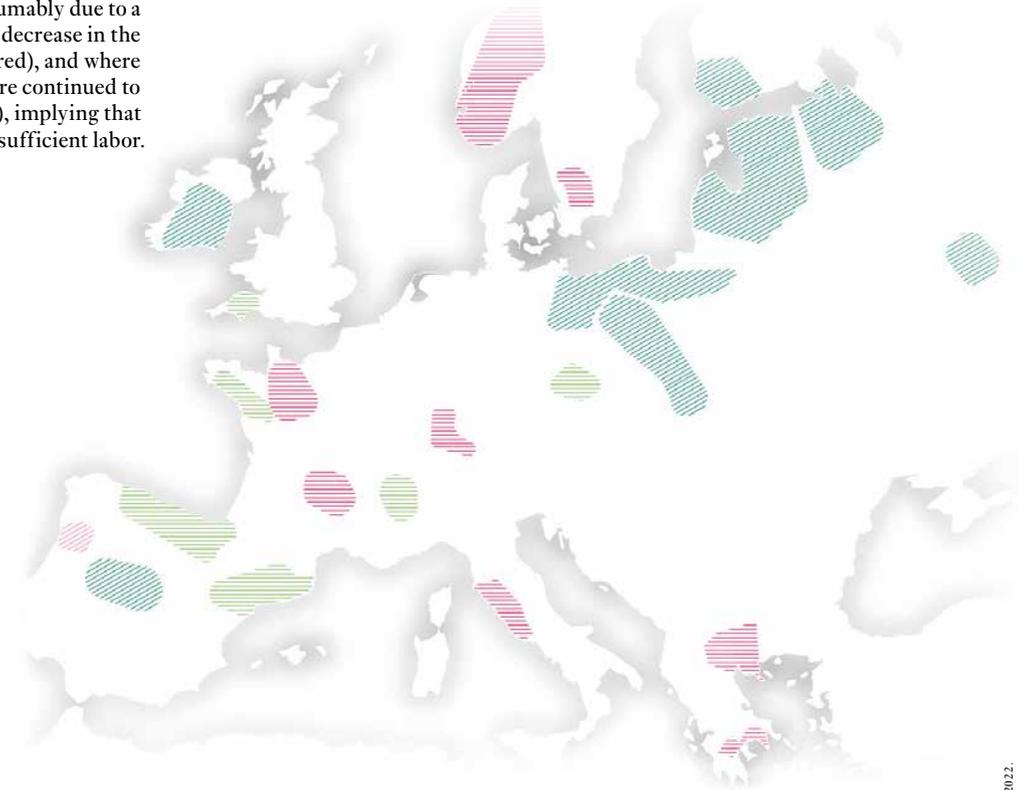
www.mpg.de/18270598 (in German)

Regional discrepancies in the effects of the plague: samples of cereal pollen from wetlands and sediments show where cereal cultivation declined, presumably due to a significant decrease in the population (red), and where agriculture continued to prosper (green), implying that there was sufficient labor.

LIGHT NEUTRINO

The most common elementary particle in the universe is also far and away the lightest. The Karlsruhe Tritium Neutrino Experiment (KATRIN) at Karlsruhe Institute of Technology has now revealed that neutrinos have a mass of less than 0.8 electron volt, i.e. approximately 10^{-33} grams (10^{-33} means one zero in front of the decimal point, 32 zeros after it, and then a one). KATRIN uses the beta decay of tritium, an unstable hydrogen isotope, to determine the mass of the neutrino from the energy distribution of electrons released during the decay process. This requires immense technical effort: the 70-meter-long experimental facility houses the world's most intense tritium source and a giant spectrometer that can measure the energies of decay electrons with unprecedented precision. KATRIN's measurements, which also involved a team from the Max Planck Institute for Physics, have thus achieved a precision of less than one electron volt for the very first time. The upper limit for the mass of a neutrino is therefore less than 1 electron volt (1 eV). This means that the neutrino has no more than one millionth of the mass of an electron, which itself is not exactly heavy. The precision of KATRIN is to be increased still further in order to determine how heavy neutrinos really are. Because these elementary particles are so common, the knowledge of a neutrino's actual mass could help improve models depicting the development of the universe, e.g. the formation of galaxies.

www.mpg.de/18230856



- Significant increase
- Significant decrease
- Insignificant increase
- Insignificant decrease

LESS DEADLY THAN ORIGINALLY THOUGHT

Also known as the Black Death, the plague that ravaged Europe between 1347 and 1352 is one of the most infamous pandemics in history. Historians estimate that the plague took the lives of almost half the European population. A study has now demonstrated that the plague's high mortality rate was less extensive than assumed. An international team led by researchers from the Max Planck Institute for the Science of Human History analyzed pollen from 261 sites in 19 European countries to find out which plants grew there in which quantities, thus providing clues as to whether agricultural activities continued or ceased in the respective regions. The results indicate that agri-

cultural activity declined particularly sharply in Scandinavia, France, southwestern Germany, Greece, and central Italy, a finding which correlates with the information available from medieval sources. In contrast, central and eastern Europe and parts of western Europe – including Ireland and the Iberian Peninsula – show signs of continuity and lasting growth. One reason for these surprising results may be that many of the written sources originated in cities, where people lived in particularly close proximity and hygiene was poor. However, at that time, more than three quarters of Europe's population lived in rural areas, where the plague was not as widespread.

www.mpg.de/18236353

PHOTO: MPI FOR BIOLOGY, TUEBINGEN



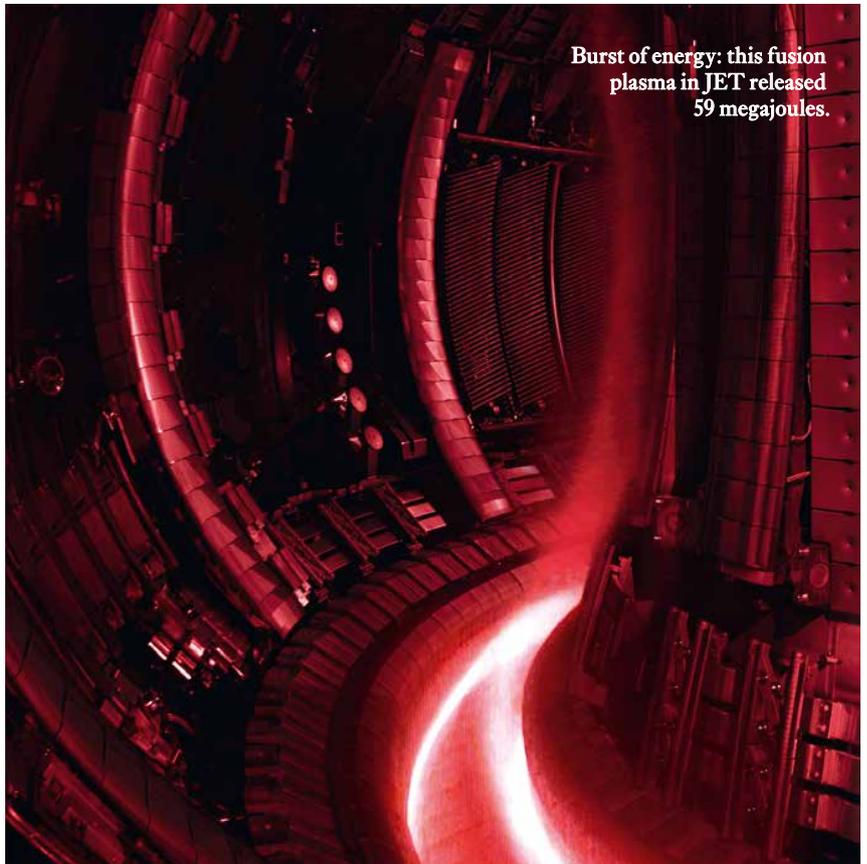
Important model organism: thale cress, *Arabidopsis thaliana*.

IMPORTANT GENES MUTATE LESS OFTEN

Changes to DNA, known as mutations, occur regardless of their consequences for the organism – for many decades, this was a basic hypothesis in evolutionary biology. A team from the Max Planck Institute for Biology in Tuebingen has now refuted this dogma. Their study shows that non-genetic segments in thale cress (*Arabidopsis thaliana*) DNA mutate twice as often as genetic segments. On the other hand, less important genes mutate almost 50 percent more often than those that are essential for the plant's survival. This asymmetrical distribution is the result of chemical changes within the DNA and its associated proteins. These modifications regulate the cell's natural repair mechanisms in such a way that any damage to particularly crucial segments of the DNA is repaired more frequently than damage to the rest of the genome. This finding explains why it is quite difficult to alter certain plant genes. The researchers assume that all organisms, not just thale cress, can preserve key areas of their genome from mutation.

www.mpg.de/18132001

PHOTO: EUROFUSION CONSORTIUM



Burst of energy: this fusion plasma in JET released 59 megajoules.

JET FUSION PLANT SETS A NEW WORLD ENERGY RECORD

The highest output ever achieved by a fusion plant: the Joint European Torus (JET for short) in Culham, near Oxford, UK, has succeeded in releasing 59 megajoules from a stable plasma, a very hot ionized gas, in just five seconds – equivalent to an average output of 11 megawatts. As with stars, nuclear fusion could generate practically inexhaustible supplies of climate-friendly energy in the future by fusing hydrogen isotopes. However, the JET facility is too small to produce more energy than is required to heat the plasma used. The fusion experiment was set up by an interna-

tional team consisting of several hundred scientists, who included researchers from the Max Planck Institute for Plasma Physics. The experiment is seen as preparation for firing up the international fusion plant ITER, since JET used the same mixture of the heavy hydrogen isotopes deuterium and tritium that will burn in ITER. ITER, which is currently under construction in Cadarache, in southern France, is expected to be the first fusion device able to generate more energy than is required to heat its fuel.

www.mpg.de/18250857

11

VISION-BASED SENSE OF TOUCH FOR ROBOTS

Robots may be able to function with greater sensitivity in the future. A team at the Max Planck Institute for Intelligent Systems in Stuttgart has developed a sensor that can register even gentle physical contact using vision-based technology and artificial intelligence. Named Insight, this sensor is similar to a thumb with a flexible “skin” that is four millimeters thick; inside, it is equipped with a ring of colored light-emitting diodes and a camera. The diodes generate a pattern of colored light inside the sensor that changes in response to touch and is recorded by the camera. Using machine-based learning techniques, the researchers trained the sensor to identify which forces are acting on it from which direction, based on the changes in color pattern. Unlike previous haptic sensors, Insight can detect touch over a wider range and also senses forces acting parallel to its surface. It is also more robust and easier to manufacture. It could therefore help robots handle objects more carefully and interact with humans without putting them at risk.

www.mpg.de/0120221en

Sensitive thumb: the sensor Insight detects how firmly it is being touched and from which direction, using color patterns that are generated by light-emitting diodes and recorded by a camera in its interior.



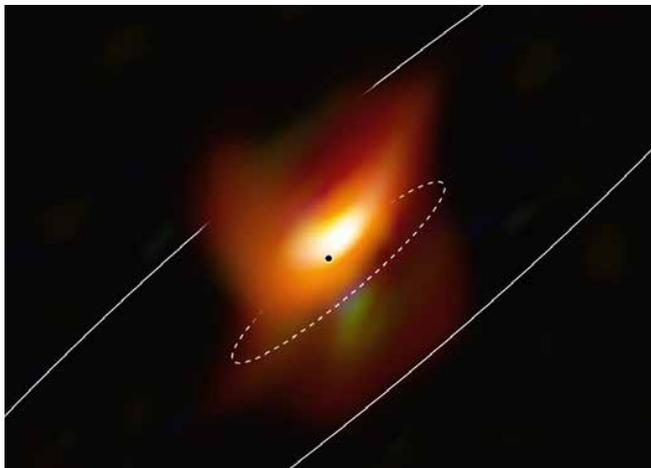
IMAGE: SUN, H., KUCHENBECKER, K. J. & MARTIUS, G. A SOFT, THUMB-SIZED VISION-BASED SENSOR WITH ACCURATE ALL-ROUND FORCE PERCEPTION. NAT MAGH INTELL 4, 135–145 (2022)

BLACK HOLE IN A RING OF DUST

12

A gigantic black hole is lurking behind a cosmic dust cloud at the heart of the Messier 77 galaxy (NGC 1068). A team has now exposed this super-massive gravity trap using the Very Large Telescope at the European Southern Observatory (ESO). The researchers, who include scientists from the Max Planck Institutes for Astronomy and Radio Astronomy, detected a thick ring of cosmic dust and gas that shrouded a black hole at its center. This massive monster is fed by material that spirals towards it, following the irresistible force of gravity. Enormous amounts of energy are released in the process, literally outshining the light emitted by all the stars in the galaxy. It appears that black holes are found in all active galactic nuclei, although they shine with varying degrees of brightness. According to a 30-year-old theory, their brightness depends on the angle from which we observe the black hole and its thick dust ring from the Earth – in other words, how much the ring obscures or even completely conceals the black hole from our view. The latest observations show this dust very clearly and thus support this theory.

www.mpg.de/18287037



Dust at the center: the image shows the inner region of the active galaxy Messier 77. The black dot shows the most probable position of the black hole, while the inner ellipse (dotted line) shows the extent of the thick inner dust ring, and the outer ellipse indicates the extent of the large dust disk.

IMAGE: ESO/JAFFE, GÁMEZ-ROSAS ET AL.

Rich ecosystem: communities consisting of dozens of sponges with diameters ranging from one centimeter to half a meter cover the peaks of the submarine mountain range in the Arctic Ocean.

PHOTO: PSI01 AWI OFOS SYSTEM



WEIGHTY DATA LEAKS

Whistleblowers not only help uncover immoral or criminal acts, they can also deter offenders. Niels Johansen from the University of Copenhagen and Tim Stolper, a former research associate at the Max Planck Institute for Tax Law and Public Finance, have found clear evidence of this. Their study showed that following the public disclosure of the first data leak at the LGT Bank in Liechtenstein, Swiss banks that engaged in cross-border tax evasion, suffered sharp declines in their share prices. Banks that helped conceal money from the financial authorities saw their profit expectations drop significantly as a result of the data leak from the LGT Bank. Since the Liechtenstein tax affair was the first data leak to become public knowledge, the researchers presume that tax evaders and their accomplices had hitherto paid insufficient attention to the risks associated with data leaks. The initial realization of the existence of such a risk had a correspondingly chilling effect on the supply and demand for tax-haven transactions, thus reducing the banks' expected profits and thereby their share prices.

www.mpg.de/18313408

DEEP SEA SPONGE GARDENS

Hardly any food reaches the deeper layers of the Arctic Ocean, because parts of it are constantly covered by ice that lets little light through to support the growth of algae. Nonetheless, these areas are teeming with life. Scientists from Bremen, Bremerhaven and Kiel have discovered a densely populated ecosystem with countless sponges growing on the extinct volcanic peaks of a submarine mountain range at the North Pole. But how can these sponges get the nutrients they need in such a nutrient-poor environment? After all, the algae in the upper layers of water that die and sink into the deep account for less than one percent of the carbon that the sponges

need to consume. Using tissue samples, researchers from the Max Planck Institute for Marine Microbiology discovered that the sponges live in symbiosis with microorganisms that enable them to make use of old organic matter. Thousands of years ago, substances seeped from the Earth's crust and supplied a rich ecosystem inhabited by numerous creatures. The remnants of these now-extinct inhabitants – which include worm tubes composed of proteins and chitin, fossilized remains from deep-sea vents and seeps, and other trapped organic detritus – now form the basis of these sponge gardens.

www.mpg.de/18207355

RADIO FLASHES AT AN UNUSUAL LOCATION

They are among the great mysteries of the universe: bursts of radiation that last about a thousandth of a second and only appear in radio telescopes. A team including researchers from the Max Planck Institute for Radio Astronomy using its 100-meter antenna in Effelsberg has now found one of these fast radio bursts (FRB) closer to the Earth than ever before, in the spiral galaxy Messier 81 some 12 million light years

away. Moreover, the source appears to be located in a globular cluster in this galaxy – the last place where one would expect to find an FRB, since these clusters only contain old stars. In theory, however, the flashes could be coming from magnetars. These neutron stars – which are about 20 kilometers in size, rotate rapidly, and have extremely strong magnetic fields – are said to be the relatively young remnants of exploded suns.

However, it appears that there is another process that leads to the birth of a magnetar. The researchers postulate that an object of this type could also form when a white dwarf – an old, burnt-out star – accumulates so much mass from a stellar partner that it collapses under its own weight and turns into a magnetar. Large numbers of white dwarfs are believed to exist in globular clusters.

www.mpg.de/18354177

12,000,000

light years from Earth – this is the distance of the closest fast radio burst (FRB) yet observed.

SHOSHONE ROCK ART PRECISELY DATED

14 The rocks in America's Great Basin are decorated with human-like beings, fantastic animal shapes, and geometric patterns. Tracey and Meinrat O. Andreae, both researchers at the Max Planck Institute for Chemistry, have now reliably dated the petroglyphs left by the ancestors of the Shoshone people. The results indicate that the pictures are around 12,000 years old. The researchers made this discovery by using a portable x-ray fluorescence spectrometer to analyze the proportion of manganese in the natural rock varnish, most commonly known as desert varnish. This mixture of manganese and iron oxides forms in layers on rocks in desert environments. The age of the petroglyphs can be determined from the quantity of manganese deposited on them. The results of the analyses, for which no samples had to be taken, are more accurate than the dating previously obtained using other methods. According to the new measurements, the petroglyphs give insights into the conceptual world of the Shoshone people at a particularly interesting time, i.e. during the transition from the Pleistocene epoch to the Holocene.

www.mpg.de/18213975

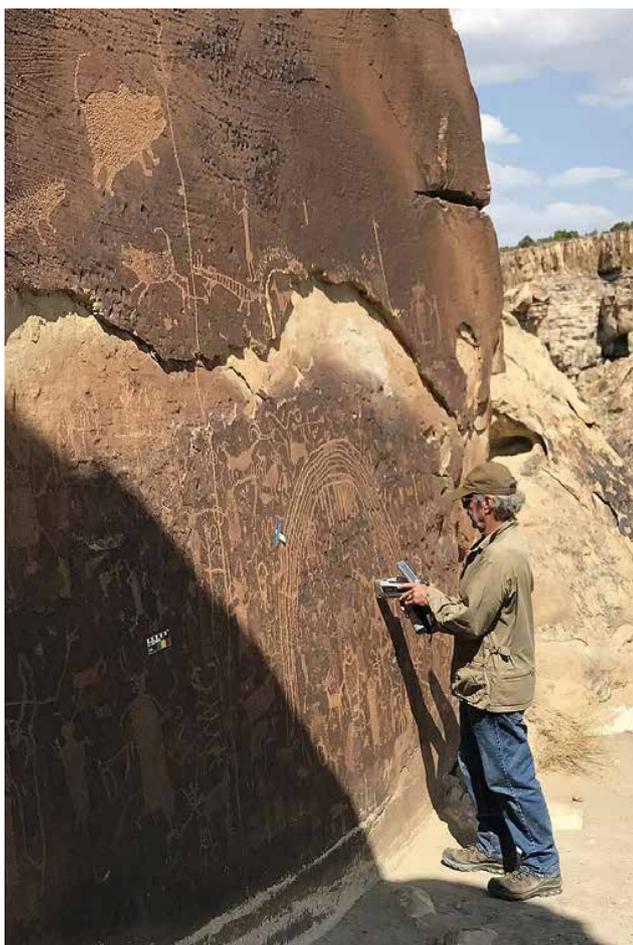


PHOTO: TRACEY ANDREA, MPI FOR CHEMISTRY

Mobile dating:
Meinrat O.
Andreae measures
the rock varnish
using a portable
x-ray fluorescence
spectrometer.

VIRAL ARTIFICE

A new approach developed by the Max Planck Institute for Medical Research, involving the production of artificial virus-like particles, is now making it easier to study SARS-CoV-2. Known as virions, these particles have a similar structure to natural viruses but contain no genetic information and are therefore unable to reproduce. The artificially created chemical environment of the virions can be used to investigate questions relating not only to SARS-CoV-2, but also to other viruses. One way in which the researchers have been using the synthetic particles is to analyze the effects of the fatty acids that are released when inflammation occurs in the body; these fatty acids are responsible for controlling the body's immune response. The team discovered that the coronavirus spike protein changes its shape when it binds with a fatty acid. On the one hand, the virus uses this spike protein to bind to the host cells' ACE2 receptors and infect them; on the other, antibodies produced by the host bind to the spike protein and mark the virus as a target for the immune system. The shape change means that the spike protein can no longer bind with the ACE2 receptor. This may be one way in which the virus inhibits the host's immune response and infects the host more efficiently. www.mpg.de/18300636

Under the microscope: human epithelial cells (green with nuclei) and synthetic SARS-CoV-2 virions (magenta).

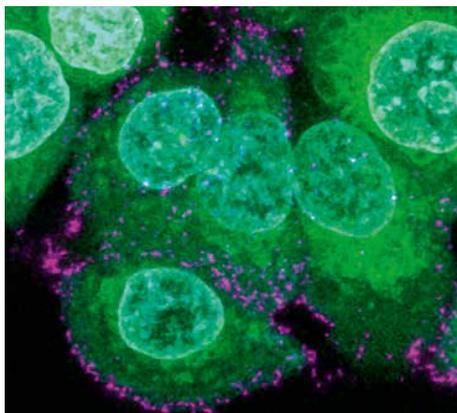


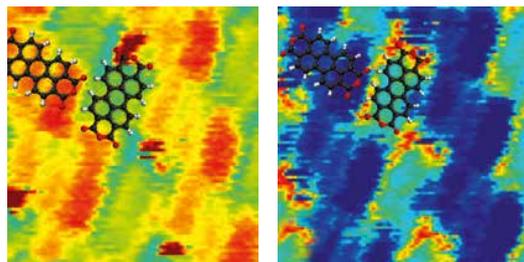
IMAGE: OSKAR STAUFER/MPI FOR MEDICAL RESEARCH

ROLL CAMERA!

It is often used as a metaphor for great – or at least tangible – progress, but in reality, a quantum leap is minute, quick as a flash, and almost impossible to record. Nevertheless, a team from the Max Planck Institute for Solid State Research has now managed to capture a quantum leap on film for the very first time. The researchers achieved this by combining scanning tunneling microscopy and attosecond laser spectroscopy. Scanning tunneling microscopy allows

high spatial resolution, while spectroscopy with attosecond pulses achieves exceptional temporal resolution. This is because these pulses last only one billionth of one billionth of a second, i.e. one billionth of a nanosecond. The team was thus able to capture the leaps between various quantum states of a molecule. A better understanding of such processes could one day help control chemical reactions with greater precision. www.mpg.de/18173993

IMAGES: MANISH GARG/MPI FOR SOLID STATE RESEARCH



In the quantum world: two images from a sequence in which researchers recorded the leap between a lower-energy (left) and a higher-energy state (right).

15

A LEGACY FROM THE NEANDERTHALS

Whether or not a person falls seriously ill with COVID-19 depends on a number of factors, including specific gene variants in their DNA. Some time ago, researchers from the Max Planck Institute for Evolutionary Anthropology discovered that the most important genetic risk factor for falling seriously ill with COVID-19 is a gene variant passed on by Neanderthals to their modern descendants when the two hominins interbred tens of thousands of years ago. Further analyses have shown that the prevalence of this variant has increased among modern humans since the end of the last ice age. Back then, it must have given its carriers an advantage in the fight for survival. The variant is located in a region on

chromosome 3 that includes several immune system receptor genes. New studies have now shown that people who carry this COVID-19 risk variant have fewer CCR5 receptors, which are used as a gateway by another pathogen: the HIV virus. In fact, it has been found that carriers of the COVID-19 risk variant are almost 30 percent less likely to contract HIV. However, since HIV did not emerge until the 20th century, the COVID-19 risk variant's protective effect against this infectious disease cannot explain why it was already so prevalent among humans ten thousand years ago. It may have been the protection it gave from another disease that caused this gene variant to become so widespread. www.mpg.de/18289931