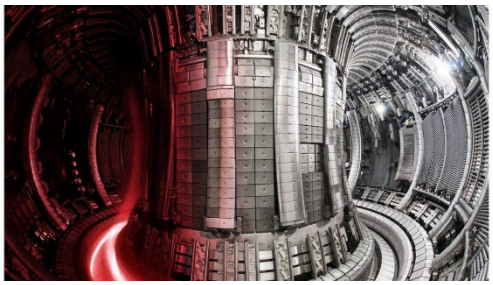
St Benedict's SCIENCE NEWS *Monthly*

Welcome to the March 2022 issue

SCIENCE NEWS *Monthly* is produced by the Science Department, St Benedict's Catholic Secondary School, Bury St Edmunds, Suffolk, UK.

OXFORDSHIRE BECOMES THE HOTTEST PLACE ON EARTH – AND IT'S NOT GLOBAL WARMING!

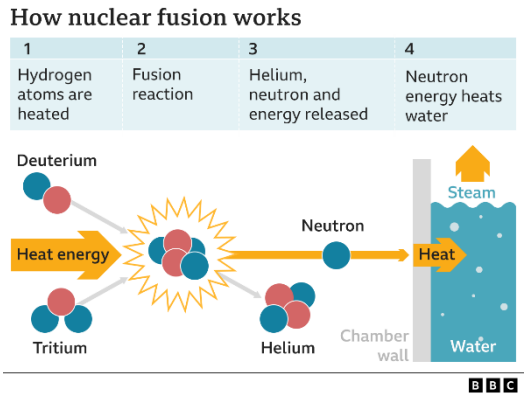
The long-standing dream of using nuclear fusion to create a safe, efficient supply of energy has come closer to reality. Scientists at the **Joint European Torus (JET)** near Oxford, UK, announced on 9 February that they had generated the highest sustained energy pulse ever created by fusing together atoms, more than doubling their own record from experiments performed in 1997 – and it required heating a mixture of hydrogen gas isotopes to over **100 million degrees Celsius!**



Fusion works on the principle that energy can be released by forcing together atomic nuclei rather than by splitting them, as in the case of the fission reactions that drive existing nuclear power stations. In the core of the Sun, huge gravitational pressures allow this to happen at temperatures of around 10 million Celsius. At the much lower pressures that are possible on Earth, temperatures to produce fusion need to be much higher - above 100 million Celsius. No materials exist that can withstand direct contact with such heat. So, to achieve fusion in a lab, scientists have devised a solution in which a super-heated gas, or plasma, is held inside a doughnut-shaped magnetic field – this chamber is the Torus.

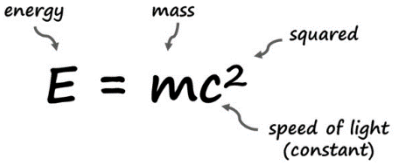
The Joint European Torus (JET), sited at Culham in Oxfordshire, has been pioneering this fusion approach for nearly 40 years. *"These experiments we've just completed had to work,"* said JET CEO Prof Ian Chapman. *"If they hadn't then we'd have real concerns about the future. This was high stakes and the fact that we achieved what we did was down to the brilliance of people and their trust in the scientific endeavour."*

The experiments produced **59 megajoules of energy over five seconds (11 megawatts of power)**. This is more than double what was achieved in similar tests back in 1997. It's not a massive energy output - only enough to boil about 60 kettles' worth of water. But the significance is that it validates design choices that have been made for an even bigger fusion reactor now being constructed in France. Operating the power plants of the future based on fusion would produce no greenhouse gases and only very small amounts of short-lived radioactive waste.



Recreating processes that take place in stars, it uses a mixture of two isotopes of hydrogen gas: deuterium and tritium. Their atomic nuclei contain 1 proton+1 neutron and 1 proton+2 neutrons, respectively. When they are heated to over 100 million degrees Celsius they form a plasma, a 4th state of matter, in which the atomic nuclei fuse together to form the next heaviest element, helium. During this fusion, a neutron is released along with a huge amount of energy. This energy can then be converted to electricity by conventional means, heating water to drive steam turbines, as in any existing power station.

The energy produced is as a result of the loss of a tiny amount of mass when the deuterium and tritium fuse. This tiny amount of mass is converted into a colossal amount of energy, a phenomenon that was recognised over a hundred years ago by Albert Einstein in his famous equation.....

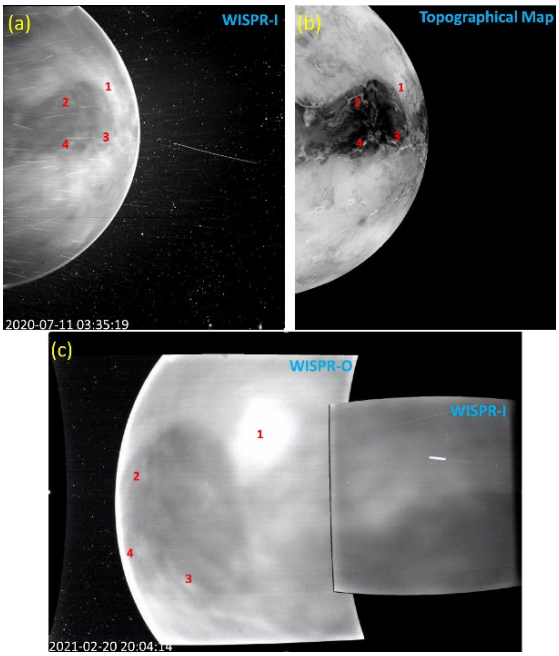


https://www.bbc.co.uk/news/science-environment-60312633
https://www.nature.com/articles/d41586-022-00391-1

PLANETARY SCIENCE - first visible-light images of Venus' surface captured from space

By serendipity, scientists have photographed Venus' surface from space for the first time – the images were taken by cameras on-board NASA's Parker Solar Probe. Although the probes main mission is to fly by the Sun, it must periodically also flyby Venus in order to regulate its orbit. Those assists from Venus helped the spacecraft make headlines last year, when it became the first probe to actually fly through the Sun's atmosphere.

Though the planet's rocky body is concealed beneath a thick veil of clouds, telescopes aboard NASA's Parker Solar Probe managed to capture the first visible-light images of the surface taken from space, researchers reported in the journal *Geophysical Research Letters*. *"We've never actually seen the surface through the clouds at these wavelengths before,"* said Lori Glaze, Director of NASA's Planetary Science Division.



It was during two Venus flybys in July 2020 and February 2021 that the probe's WISPR telescopes captured the new images. While WISPR found Venus' dayside too bright to image, it was able to discern large-scale surface features, such as the vast highland region called Aphrodite Terra, through the clouds on the nightside.

Clouds tend to scatter and absorb light. But some wavelengths of light get through, depending on the clouds' chemical makeup. Though scientists knew such spectral windows exist in Venus' thick clouds of sulphuric acid, the researchers didn't expect light visible to human eyes would break through so intensely. And while WISPR was designed to study the sun's atmosphere, its construction also happens to allow it to detect this unanticipated window of light in Venus' clouds.

The photographs show a planet so hot that it glows, much like red-hot iron. The pattern of bright and dark that you see is basically a temperature map — brighter regions are hotter and darker regions are cooler. This pattern correlates well with topographic maps previously produced from radar and infrared surveys. Highlands appear dark and lowlands appear bright

The images come as NASA prepares to launch two missions to Venus. The new photographs may help in the interpretation of the observations taken in the future from these new missions.

https://www.sciencenews.org/article/venus-surface-photo-parker-solar-probe-space-nasa

PHYSICS & MATHS - tiny magnetic swirls used to generate true random numbers

You might think that it must be easy to generate numbers at random, but the fact is that it is incredibly difficult.
Random number generators are typically software, *pseudo* random number generators. Their outputs are not truly random numbers. Instead they rely on algorithms to mimic the selection of a value to approximate true randomness. The outputted values from a pseudo random number are adequate for use in most applications but they should not always be relied on for secure cryptographic implementations. For such uses, a cryptographically secure random number generator is called for.

A hardware random number generator (HRNG) or true random number generator (TRNG) — is cryptographically secure and takes into account physical attributes such as atmospheric or thermal conditions. However, even numbers generated in this way are not necessarily random in the strictest sense. Now a group of Brown University physicists has developed a technique that can potentially generate millions of truly random digits per second by harnessing the behaviour of **SKYRMIONS** - tiny magnetic anomalies that arise in certain materials

Their research, published in *Nature Communications*, reveals previously unexplored dynamics of single skyrmions. Discovered around a half-decade ago, skyrmions have sparked interest in physics as a path toward next-generation computing devices that take advantage of the magnetic properties of particles – a field known as spintronics. *"There has been a lot of research into the global dynamics of skyrmions, using their movements as a basis for performing computations,"* said Gang Xiao, chair of the Department of Physics at Brown and senior author of the research. *"But in this work, we show that purely random fluctuations in the size of skyrmions can be useful as well. In this case, we show that we can use those fluctuations to generate random numbers, potentially as many as 10 million digits per second."*

https://www.sciencedaily.com/releases/2022/02/220207124827.htm

PALAEONTOLOGY - The 'weirdest wonder' of evolution had an even weirder cousin

From 541 million to 485 million years ago, Earth's seas bloomed with biodiversity for the first time. This era, sometimes called the **Cambrian explosion**, was when the relatives of all major animal groups alive today first appeared in the water. The Cambrian explosion also gave rise to the world's first truly fearsome apex predators. Those carnivorous killers are known as the radiodonts — a reference to the circular-saw-shaped mouths on the undersides of their heads. We study them today by their fossilised remains in ancient rock strata.

One of these was an apparently unique and fearsome creature known as *Opabinia regalis*. With five eyes, a backward-facing mouth, and a long, claw-tipped trunk where its nose should be, *Opabinia regalis* is one of the strangest-looking celebrities of the Cambrian period. In fact, this ancient sea-dweller is so unique that scientists have never discovered another in the fossil record that appears to fit into its alien-faced family – until now.

Meet ***Utaurora comosa*** (artist impression on the right) — a small, spiky-tailed marine animal that lived a few million years after *Opabinia.* First described in 2008, *U. comosa* was originally classified as a relative of the fearsome *Anomalocaris*, a claw-faced apex predator that terrorised the Cambrian seas. But a new study suggests that *U. comosa* may have been much more than just another ancient predator. In a paper published in the journal *Proceedings of the Royal Society B*, researchers re-examined the only known *U. comosa* fossil, comparing it with more than 50 living and extinct animal specimens. The team concluded that *U. comosa* is almost certainly a relative of *Opabinia,* making *U. comosa* only the second member of Opabinia's family ever discovered and the first one found in 100 years*. "The weirdest wonder of the Cambrian no longer stands alone,"* the researchers wrote in their paper.

In a broader sense, the existence of another opabiniid shows that this wasn't just a family of weirdos but that both creatures were *"part of a bigger picture"* of Cambrian evolution. With their backward-facing mouths and furrowed bodies that appear almost segmented, *Opabinia* and *U. comosa* seem to be clear predecessors of modern arthropods, many of which possess these same traits.

https://www.livescience.com/cambrian-period-opabinia-extinct-relative

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MORE PALAEONTOLOGY - Fossil of largest Jurassic pterosaur found on Skye

Last month's *News* carried a piece about a huge, marine Jurassic creature, an Ichthyosaur, being uncovered in Rutland. Now it has been announced that a flying reptile has been found on the Isle of Skye – a fossil, of course, not a live one!

PhD student Amelia Penny spotted its sharp-toothed jaw in a layer of ancient limestone on Skye's coast back in 2017. That initial discovery has now been followed up with detailed examination of the fossil skeleton. Researchers from the Hunterian Museum, in Glasgow, and the Staffin Museum, on Skye, had to extract the rock slab entombing the fossil - a painstaking and noisy process racing the incoming tide - and bring it to the University of Edinburgh. But it was well worth the effort.

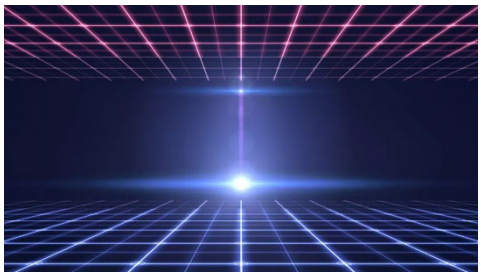
Those studies, published in the journal *Current Biology*, show the flying lizard had a 2.5m (8ft) wingspan. It has now been given the Gaelic name Dearc sgiathanach (pronounced Jark Ski-an-Ach), which means "winged reptile", and is estimated to be 170 million years old. The remarkable condition and completeness of this specimen - particularly the detail preserved in its skull - has already allowed scientists from the universities of Edinburgh and St Andrews and National Museums Scotland, where the fossil will be displayed and studied further, to conclude Dearc had good eyesight.

Prof Steve Brusatte, of the University of Edinburgh, who was leading the Isle of Skye field trip, called it *"a superlative Scottish fossil. The preservation is amazing, far beyond any pterosaur ever found in Scotland and probably the best British skeleton found since the days of [fossil hunter] Mary Anning in the early 1800s,"* he said. And its size *"tells us that pterosaurs got larger much earlier than we thought, long before the Cretaceous period when they were competing with birds, and that's hugely significant"*.

Although Pterosaurs and their close relations, Pterodactyls, are often thought of as "flying dinosaurs", they are merely related. In fact, they may be more closely related to our modern-day birds.

https://www.bbc.co.uk/news/science-environment-60407928

WEIRD SCIENCE - Do we live in a computer simulation?



Is everything we know and experience, up to and including reality itself, a simulation created by some unseen and unknowable entity? This idea, known as the **simulation hypothesis**, was first posed by University of Oxford professor Nick Bostrom in 2003. But does the simulation hypothesis offer a compelling argument, or is it just interesting food for thought? Let's find out.....

The simulation hypothesis is the latest in a long tradition of philosophical thinking that questions the ultimate nature of the reality we experience. Through the ages, philosophers have wondered if our reality is the construct of a malicious demon, or if we live inside of someone else's dream, or if it really is the product of a supreme deity. It's the ultimate form of scepticism and is useful to remind ourselves that there are limits to the empirical study of nature.

As philosophical arguments go, the simulation hypothesis is a good one. But the hypothesis ends with a trilemma — three statements, one of which must be true (if you accept all the assumptions in the argument), but we can't tell which one:

1. Our descendants (or other intelligent beings in the universe) will never be able to develop the technological ability to faithfully simulate the cosmos.

2. Our descendants (or other intelligent beings in the universe) will develop the technology but choose not to simulate the cosmos.

3. The vast majority of all conscious entities, including you, are living in a simulation.

Within these arguments is the notion that eventually we shall advance our technology to the point where we could build a computer so large and powerful that it could actually run a program that simulates the entire Universe. If this is our destiny, then maybe another civilisation in another “parallel” Universe has beaten us to it and that our own Universe is just their simulation.

Here’s another mind-boggling proposition: fitting in with the simulation hypothesis is a theory that our Universe is made up of “bits” of information which are held in sub-atomic particles, neutrons and protons. Therefore, from a computing point of view, how many “bits” of information would be needed to simulate the Universe? One estimate is $6x10^{80}$, that’s 600 million trillion trillion trillion trillion trillion trillion!

https://www.livescience.com/universe-simulation-hypothesis-problems

EVERYDAY SCIENCE - Why do water droplets stay on plastic items after they’ve gone in the dishwasher?

Once upon a time dishwashers were seen as something of an expensive luxury, almost a sign of decadence. Now, however, they are relatively commonplace and affordable. But they still provide some puzzles: for example, have you ever wondered why glass items come out sparkling and perfectly dry, while plastic items still look wet?

Dishwashers work by spraying jets of water and detergent at up to 68°C – much hotter than you would use for washing up by hand. At the end of the washing cycle, the hot, clean crockery dries itself just by evaporation. But although everything inside the dishwasher starts off at the same temperature, plastic items cool down much quicker. This is because they have lower **‘thermal mass’**.

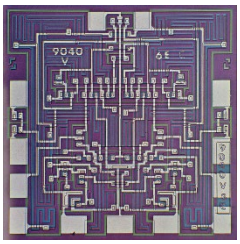
The plastic of a food storage container is thinner than a cup or plate, and plastic is a lower density material, so for a given temperature, its molecules hold less heat energy. As the water evaporates from the surface, it quickly cools the plastic down and this slows the rate of evaporation. Heavy plates and pans hold their heat much longer and are still quite warm even after all the water has been evaporated away. China, glass and metal are also much **better heat conductors than plastic**. This means that all the heat in the vertical sides of an upturned bowl or cup can flow quickly to supply heat to the horizontal surfaces, to evaporate any water that has puddled. The heat in a plastic container spreads more slowly so small water droplets remain on the surfaces.

The differences in **thermal conductivity** between ceramics, glass and plastics also provides an answer to a similar conundrum: after everything has cooled down in the dishwasher, why do the plastic items still feel warmer than the ceramic ones? Objects feel warm or cold because of the rate and direction at which heat flows between them and our fingers. That, in turn, depends on the thermal conductivity of the material they’re made of. Plastic’s thermal conductivity is around 10 times lower than ceramic’s. This relatively sluggish transfer of heat is what makes plastic feel ‘warmer’ than ceramic, even if they’re at the same temperature!

https://www.sciencefocus.com/science/why-water-droplets-stay-on-plastic-items/

COMPUTING - Memory weavers and Navajo women made the Apollo missions possible

Project Apollo, the American mission to land "a man on the Moon", is rightly regarded as a supreme achievement. But notice the emphasis of landing a "man" on the Moon. In fact, when you see replays of the Apollo missions, including the activities within the Launch and Mission Control Centres, you could be forgiven for thinking that the only women who played a part were the astronauts' wives and girlfriends. History is now addressing this.....



Many things had to be developed in order to make Project Apollo a success. Some would be improvements to existing technologies, but one in particular would be a completely new invention: the **INTEGRATED CIRCUIT,** which allowed the development of the **MICROCHIP**. The invention of the integrated circuit stands historically as one of the most important innovations of mankind. Almost all modern products use chip technology.

The pioneers known for inventing microchip technology are **Jack Kilby** and **Robert Noyce**. In 1959, Kilby of Texas Instruments received a U.S. patent for miniaturized electronic circuits and Noyce of Fairchild Semiconductor Corporation received a patent for a silicon-based integrated circuit. Thus their new, ground-breaking technology came at just the right time for the development of spacecraft electronic and computing systems throughout the 1960s. But someone had to manufacture the chips...and that's where women became crucial.

Beyond Neil Armstrong, Buzz Aldrin and a handful of other names that we remember were hundreds of thousands of men and women who contributed to Apollo over a decade. Among them: the Navajo women who assembled state-of-the-art integrated circuits for the Apollo Guidance Computer and the women employees of Raytheon who wove the computer's core memory. Fairchild, one of the founding companies of the new technology, opened a plant in Shiprock, N.M., within the Navajo reservation, in 1965. The Fairchild factory operated until 1975 and employed more than 1,000 individuals at its peak, most of them Navajo women manufacturing integrated circuits. It was challenging work, but the native women proved themselves to be experts. Electrical components had to be placed on tiny chips made of a semiconductor such as silicon and connected by wires in precise locations, creating complex and varying patterns of lines and geometric shapes. The Navajo women's work *"was performed using a microscope and required painstaking attention to detail, excellent eyesight, high standards of quality and intense focus,"* writes digital media scholar Lisa Nakamura. Fairchild directly compared the assembly of integrated circuits with what the company portrayed as the traditional, feminine, Indigenous craft of rug-weaving.

Far from the Shiprock desert, outside of Boston, women employees at Raytheon assembled the Apollo Guidance Computer's core memory with a process that in this case directly mimicked weaving. Again, the moon missions demanded a stable and compact way of storing Apollo's computing instructions. Core memory used metal wires threaded through tiny doughnut-shaped ferrite rings, or "cores," to represent 1s and 0s. All of this core memory was woven by hand, with women sitting on opposite sides of a panel passing a wire-threaded needle back and forth to create a particular pattern. (In some cases, a woman worked alone, passing the needle through the panel to herself.)

That such crucial technology relied on the skilled, technical, embodied expertise and labour of thousands of women, including women of colour, was ignored and is only now being recognised. They were indubitably women of science, and their untold stories call us to reconsider who does science, and what counts as scientific expertise.

https://www.sciencenews.org/article/core-memory-weavers-navajo-apollo-raytheon-computer-nasa

WORD(S) OF THE MONTH:

EUKARYOTE (noun, *"Yoo-CARE-ee-ote"*)

Eukaryotes are living things whose cells contain a nucleus. For example, we Humans are eukaryotes. The nucleus is a pouch that stores the cell's DNA. Eukaryotic cells also hold other pouches that do specific jobs inside the cells. These pouches are called organelles. Some, for instance, generate energy to keep cells running. Others remove unwanted waste. This is similar to the way organs in your body do different jobs to keep you healthy.

But not every living thing is a eukaryote. Some are prokaryotes. These are living things whose cells do not package their DNA inside a nucleus. The genetic material just floats around the cell. Prokaryotic cells don't have organelle pouches, either. They are simple cells. And all prokaryotes are single-celled creatures. Bacteria and archaea are examples. Eukaryotes are thought to have emerged about 2 billion years ago. They may have arisen from simpler cells that gobbled up their neighbours. Some of the cells that got eaten were not digested. Instead, they started doing the work of organelles inside the bigger cells. Mitochondria, for instance, may have once been snarfed-up cells. Now, those organelles generate energy for eukaryotic cells.

EARTH - Let's learn about tornadoes

The storms of February that ran over the UK – Eunice and Franklin – reminded us of how violent nature can be when it comes to weather and atmospheric conditions. However, our February storms were "mild" compared to a phenomenon that, fortunately, is quite rare for us at home: **TORNADOES**. But what is a tornado?

Tornadoes are violently rotating columns of air that can carve a path of destruction a mile wide and are some of the world's most fearsome weather events. These violently spinning columns of air can fling aside cars and flatten houses. The biggest ones can carve a path of destruction 1.6 kilometres (1 mile) wide. And they can tear across more than 160 kilometres (100 miles) before winding down. Some last mere minutes. Others roar on for more than an hour.

Tornadoes tend to emerge from thunderstorms called *supercells*. In these storms, chaotic winds can churn air into a horizontally rotating tube. A strong upward surge of air can then tilt that tube to spin vertically. Under the right conditions, that eddy of air can give rise to a tornado. It's generally thought that tornadoes snake down from the clouds to touch the ground. But some tornadoes may in fact form from the ground up.

Storms whip up tornadoes around the world. But the United States sees more of these events than any other country, averaging more than 1,000 tornadoes each year. Many of these whirlwinds tear through a swath of the Great Plains nicknamed *"Tornado Alley."* States in this region include Nebraska, Kansas and Oklahoma. All 50 states, though, have had tornadoes touch ground at some point. Canada and Bangladesh also suffer.

People always ask about wind speeds in a tornado, but it is impossible to know the exact strongest wind speed as weather instruments are inevitably destroyed as the tornado increases ferocity. Doppler radars can give some remotely sensed wind speeds although these are not always accurate. Despite this, on 3 May 1999, a tornado in Oklahoma was measured to reach 302 mph, the highest winds ever found on the Earth's surface.

According to the Met Office (UK), around 30 tornadoes a year are reported in the UK, but these are typically small and short-lived; however, they can cause significant structural damage if they pass over built-up areas.

https://www.sciencenewsforstudents.org/article/lets-learn-about-tornadoes

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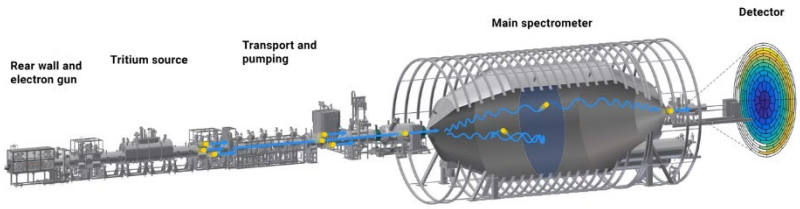
PARTICLE PHYSICS - Neutrinos are lighter than 0.8 electronvolts – hooray!

Neutrinos are arguably the most fascinating elementary particle in our universe. In cosmology they play an important role in the formation of large-scale structures, while in particle physics their tiny but non-zero mass sets them apart, pointing to new physics phenomena beyond our current theories. Without a measurement of the mass scale of neutrinos our understanding of the universe will remain incomplete.

New research, published in the journal *Nature Physics*, has broken an important 'barrier' The international KArlsruhe TRItium Neutrino Experiment (Katrin), located at Karlsruhe Institute of Technology (KIT), has broken an important "barrier" in neutrino physics which is relevant for both particle physics and cosmology. Based on new data a new upper limit of 0.8 electronvolt (eV) for the mass of the neutrino has been obtained. This first push into the sub-eV mass scale of neutrinos by a model-independent laboratory method allows Katrin to constrain the mass of these lightweights of the universe with unprecedented precision.



70m long KATRIN experiment with its main components: tritium source, main spectrometer and detector.

The international KATRIN experiment at Karlsruhe Institute of Technology (KIT) with partners from six countries has taken up as the world´s most sensitive scale for neutrinos. It makes use of the beta decay of tritium, an unstable hydrogen isotope, to determine the mass of the neutrino via the energy distribution of electrons released in the decay process. This necessitates a major technological effort: the 70 meter long experiment houses the world´s most intense tritium source as well as a giant spectrometer to measure the energy of decay electrons with unprecedented precision.

What is a neutrino? *It's one of the so-called fundamental particles, which means it isn't made of any smaller pieces, at least that we know of. Neutrinos are members of the same group as the most famous fundamental particle, the electron. But while electrons have a negative charge, neutrinos have no charge at all. Neutrinos are also incredibly small and light. They have some mass, but not much. They are the lightest of all the subatomic particles that have mass. They're also extremely common—in fact, they're the most abundant massive particle in the universe.*

https://www.sciencedaily.com/releases/2022/02/220214111754.htm

NATURAL WORLD - Two thirds of life in the seabed is unknown to science

With so much emphasis placed on finding life elsewhere in our Solar System, especially on Mars, one might be forgiven for thinking that we have accounted for all life here on planet Earth. After all, more than a million species, plants and animals, have been described. But there has always been a nagging suspicion among biologists that we are nowhere near the true number. A recent paper published in the journal *Science Advances* appears to prove the point, at least when it comes to the deep ocean.

Searching for life in the abyss of the deep ocean is akin to searching in outer space. It is a particularly difficult environment to reach and search in, where we literally grope in the dark! Up to two thirds of the life living in the deep oceans could be unknown to science. The new study trying to understand this diversity found that 60% of DNA sequences from marine sediments could not be identified at a higher taxonomic level, demonstrating the huge gap in scientific knowledge as a new era of deep sea mining is set to begin. This is the finding of a study analysing hundreds of sediment samples from expeditions around the world's oceans, which revealed that almost two thirds of the deep sea's diversity is unknown. Some of these completely new forms of life may be associated with the biological carbon pump, which helps to regulate the planet's climate.

Dr Andrew Gooday, co-author and scientific associate at the Natural History Museum, says*, "It's been known since at least the 1960s that life is very diverse on the ocean floor, and that most species that are found in the deep sea are undescribed. What is new in this study is that a considerable proportion of this novel diversity is at a higher taxonomic level, suggesting that many unknown groups of organisms live in the deep sea. Most of these new lineages are likely to be small protozoans rather than larger organisms that most studies focus on."*

Despite covering 71% of the Earth's surface the oceans are relatively understudied when compared with the land, with just 21% of the seabed mapped at high resolution. This leaves much of the life which lives there unknown, with one study estimating that as much as 91% of the ocean's species are yet to be described. One of the main difficulties associated with discovering these species is the sheer size of the ocean. While terrestrial life is generally constrained to the planet's surface, marine species are spread vertically from the surface to a depth of 11,000 metres at the ocean's deepest point in Challenger Deep.

https://www.nhm.ac.uk/discover/news/2022/february/two-thirds-life-seabed-unknown-science.html

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WHACKY SCIENCE – ticklish rats!

Although rats are not everyone's cup of tea, to many they come across as fascinating and even endearing, hence our liking for keeping them as pets. Who could not be charmed by the character, "Ratty"*, in the classic tale *"The Wind in the Willows"*?

Rats are also used in a wide range of laboratory experiments, which provokes controversy. However, some experiments are definitely not harmful and appear to show an interesting side to rat behaviour – they love being tickled and can even suffer a severe fit of the "giggles"!

For the ticklish among us, just the approach of wiggling fingers is enough to elicit squeals, if not screams. And it turns out we're not the only ones. Now, a study in rats pinpoints the "tickle centre" of the mammalian brain, showing for the first time that stimulating neurons in that region can elicit a paroxysm of ultrasonic squeaks, the rat version of human laughter.

Scientists have puzzled over the mysteries of tickling for millennia, with Aristotle famously asking why most people can't tickle themselves. There are important neurological and psychological reasons to study tickling: One tell-tale symptom of schizophrenia, for example, is that these people can tickle themselves. Tickling is also linked to our ability to laugh, play, and feel good, notes Shimpei Ishiyama, a neuroscientist at the Humboldt University of Berlin. *"Neuroscientists are so obsessed with deficits such as depression and anxiety, it's rare to find papers about positive emotions,"* he says.

To tickle a rat effectively takes some practice, but Ishiyama is an expert. Starting with juvenile male rats, which tend to be most playful, he spends a week or two letting them get used to being tickled on the back and belly. *"It's pretty much like if you tickle kids or dogs or cats,"* he says. *"Over time, the rats learn it is fun to play with this big hand, and they start chasing it and even recognizing it as a playmate,"* he says.

*In Kenneth Grahame's famous children's book, the rat character (known as "Ratty" to his friends) is astute, charming and affable. However, he is actually not a rat at all, but a **Water Vole**.

https://www.science.org/content/article/watch-these-ticklish-rats-laugh-and-jump-joy

SPRING HAS SPRUNG – the month of "meteorological" spring and the Spring Equinox

The month of March has always been seen as a pivotal point in the year – it marks the beginning of "meteorological" spring; the Full Worm Moon; the spring (vernal) equinox; and the clocks going forward to British Summer Time. The name "March", however, has a rather dark history.....

"March" is named after the Roman god of war, Mars, as this was the time of year to resume military campaigns that had been interrupted by winter; hardly something that we would wish to celebrate today. In the early Roman calendar, March (or *Martius*) was the first month of the calendar year, as March brought the first day of spring with the vernal equinox, and it was seen as the start of new beginnings for the year. Around 700 BCE the months of January and February were added to the calendar and, around 450 BCE, the Romans decided that January would become the first month of the new year, with March becoming the third.

March features in literature – we all know the famous warning in Shakespeare's Julius Caesar: *"Beware the ides of March!"* The great American poet, Henry Wadsworth Longfellow, wrote a poem, The Poet's Calendar, about the whole year. It was published in 1882, the year of Longfellow's death.

MARCH

I Martius am! Once first, and now the third!
To lead the Year was my appointed place;
A mortal dispossessed me by a word,
And set there Janus with the double face.
Hence I make war on all the human race;
I shake the cities with my hurricanes;
I flood the rivers and their banks efface,
And drown the farms and hamlets with my rains.

JULIUS CAESAR ACT 1, SCENE 2, 15–19 (William Shakespeare)

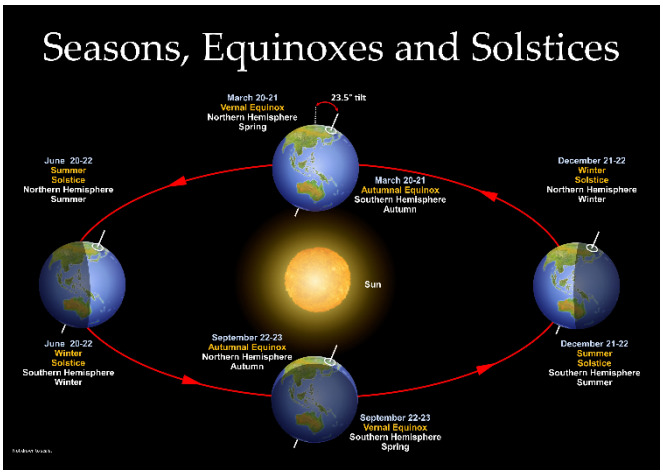
Caesar:
Who is it in the press that calls me?
I hear a tongue shriller than all the music.
Cry "Caesar!" Speak, Caesar is turn'd to hear.

Soothsayer:
Beware the ides of March.

Caesar:
What man is that?

Brutus:
A soothsayer bids you beware the ides of March.

The Roman general and statesman Julius Caesar was assassinated by conspiring senators, notably including Marcus Brutus, on March 15 (the "ides") in 44 BCE. Caesar became a dictator after causing a civil war. His rule, and murder, effectively ended the Roman republic—and changed the course of history.



The Romans, and indeed most ancient civilisations, knew that the month contained the day when the length of the day equalled the length of the night and that, thereafter, the days would grow longer. This year it will fall on Sunday 20th March. The Equinox in the Northern Hemisphere occurs twice a year around 20 March (the spring equinox) and around 22 September (the autumn equinox). They occur between the summer and winter solstices and mark the point the Sun crosses the equator's path and becomes positioned exactly above the equator between the Northern and Southern Hemisphere. During the equinox, day and night will be around the same length which is evident in the word's origin derived from the Latin *equi* (meaning 'equal') and *nox* (meaning 'night'). The reason for this is that the Earth's axis is actually tilted in relation to its orbital path around the Sun, by 23.5 degrees. This is also why we have seasons.

Today we take timekeeping and calendars for granted but in ancient times, before the invention of timepieces and clocks, people turned to the passage of the Sun and Moon to chart the year. It may be that in the UK we have one of the world's first and most famous calendar mechanisms – the monument **STONEHENGE**.

Located on the chalk downlands of southern Britain, Stonehenge has long been thought to incorporate some kind of calendar, although its specific purpose and exactly how it worked remain far from clear. Various proposals have been put forward: is it a 'May Calendar' based on 'clock-stars'; is it some sort of "Neolithic computer" for the purposes of time-reckoning and predicting eclipses; or is it a calendar of 16 months, using the solstices, equinoxes, May/Lammas and Martinmas/Candlemas as turning points in the cycle.

Timothy Darvill, an archaeology professor at Bournemouth University in the U.K., has recently published a paper in the journal *Antiquity* that proposes a new idea – Stonehenge eventually became a SOLAR CALENDAR. Stonehenge may have been used as a solar calendar, with each of the stones representing a day and sections of the circle of stones possibly corresponding to weeks. Scholars have long known that Stonehenge was built to align with the winter and summer solstices; Darvill thinks this alignment would have helped people to use the calendar correctly. People could check that they were keeping track of time correctly by seeing if the alignments occurred when they were supposed to.