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Extended Reality

Advances in extended reality have already changed the way we work, play and live and it's just getting started.

Extended reality, or XR, is an umbrella category that covers a spectrum of newer, immersive technologies, including virtual reality, augmented reality and mixed reality.

From gaming to virtual production to product design, XR has enabled people to create, collaborate and explore in computer-generated environments like never before.

Extended Reality(XR)

Virtual, augmented and mixed reality are all elements of XR technology.

Virtual reality(VR) puts users inside a virtual environment. VR users typically wear a headset that transports them into a virtual world one moment they're standing in a physical room, and the next they're immersed in a simulated environment.

The latest VR technologies push these boundaries, making these environments look and behave more like the real world. They're also adding support for additional senses, including touch, sound and smell.

With VR, gamers can become fully immersed in a video game, designers and customers can review building projects to finalize details prior to construction, and retailers can test virtual displays before committing to a physical one.



Augmented reality(AR) is when a rendered image is overlaid onto the real world. The mobile game *Pokémon GO* famously brought AR to the mainstream by showing computer-rendered monsters standing on lawns and sidewalks as players roam their neighborhoods.

AR graphics are visible through cell phones, tablets and other devices, bringing a new kind of interactive experience to users. Navigating directions, for example, can be improved with AR. Rather than following a 2D map, a windshield can superimpose directions over one's view of the road, with simulated arrows directing the driver exactly where to turn.

Mixed reality(MR) is a seamless integration of the real world and rendered graphics, which creates an environment in which users can directly interact with the digital and physical worlds together.

With MR, real and virtual objects blend, and are presented together within a single display. Users can experience MR environments through a headset, phone or tablet, and can interact with digital objects by moving them around or placing them in the physical world.

There are two types of MR:

- Mixing virtual objects into the real world — for instance, where a user sees the real world through cameras in a VR headset with virtual objects seamlessly mixed into the view.
- Mixing real-world objects into virtual worlds — for example, a camera view of a VR participant mixed into the virtual world, like watching a VR gamer playing in a virtual world.



The History of XR

To understand how far XR has come, consider its origins in VR.

VR began in the federal sector, where it was used to train people in flight simulators. The energy and automotive design industries were also early adopters. These simulation and visualization VR use cases required large supercomputers. It also needed dedicated spaces, including power walls, which are

ultra-high-resolution displays which are empty rooms that have the VR environment projected on each surface, from the walls to the ceiling.

For decades, VR remained unaffordable for most users, and the small VR ecosystem was mainly composed of large institutions and academic researchers.

But early in the previous decade, several key component technologies reached a tipping point, which precipitated the launch of the HTC Vive and Oculus Rift head-mounted displays (HMDs), along with the SteamVR runtime.

Individuals could now purchase personal HMDs to experience great immersive content. And they could drive those HMDs and experiences from an individual PC or workstation with a powerful GPU.

Suddenly, VR was accessible to millions of individuals, and a large ecosystem quickly sprung up, filled with innovation and enthusiasm.

In recent years, a new wave of VR innovation started with the launch of all-in-one (AIO) headsets. Previously, fully immersive VR experiences required a physical connection to a powerful PC. The HMD couldn't operate as a self-contained device, as it had no operating system and no ability to compute the image.

But with AIO headsets, users gained access to a dedicated device with a simple setup that could deliver fully tracked VR anywhere, anytime. Coupled with the innovation of VR streaming technology, users could now experience powerful VR environments, even while on the go.

Latest Trends in XR

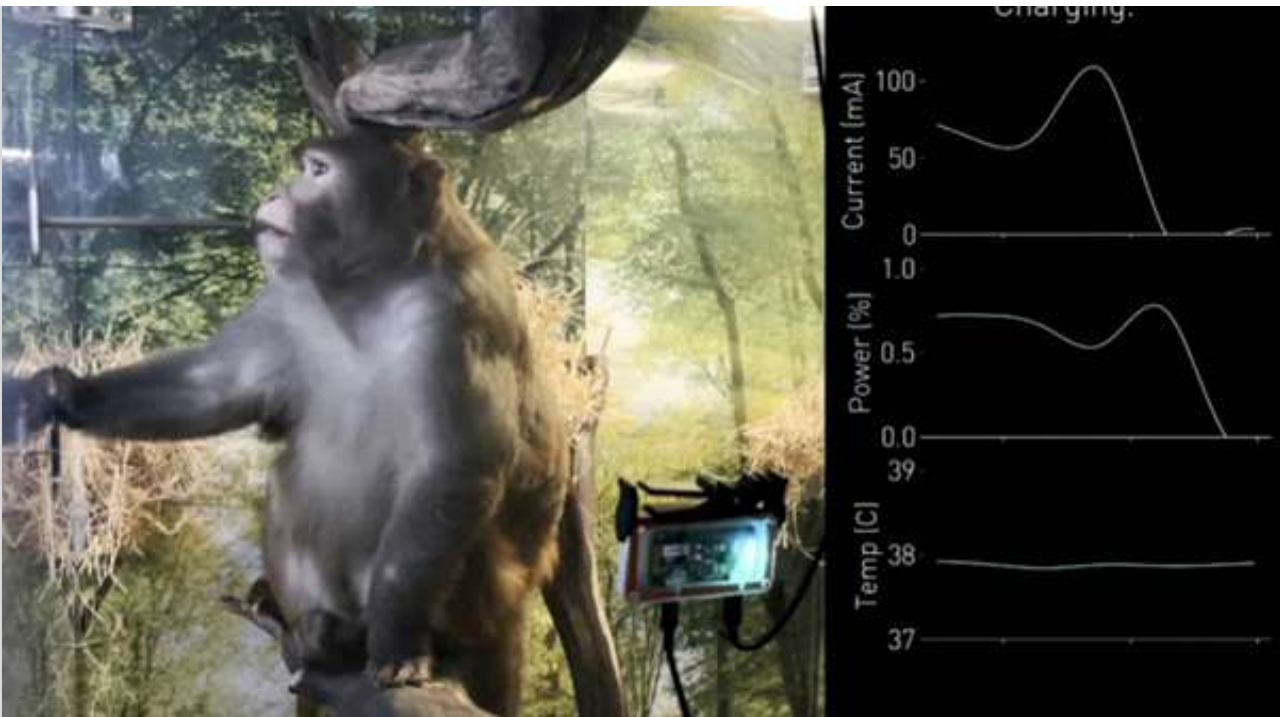
High-quality XR is becoming increasingly accessible. Consumers worldwide are purchasing AIOs to experience XR, from immersive gaming to remote learning to virtual training. Large enterprises are adding XR into their workflows and design processes. XR drastically improves design implementation with the inclusion of a digital twin.

And one of today's biggest trends is streaming XR experiences through 5G from the cloud. This removes the need to be tethered to workstations or limit experiences to a single space.

AR is also becoming more common. After *Pokémon GO* became a household name, AR emerged in several additional consumer-focused areas. Many social media platforms added filters that users could overlay on their faces. Organizations in retail incorporated AR to showcase photorealistic rendered 3D products, enabling customers to place these products in a room and visualize it in any space.

Plus, enterprises in various industries like architecture, manufacturing, healthcare and more are using the technology to vastly improve workflows and create unique, interactive experiences. For example, architects and design teams are integrating AR for construction project monitoring, so they can see onsite progress and compare it to digital designs.

And though it's still fairly new, MR is developing in the XR space. Trends are shown through the emergence of many new headsets built for MR, including the Varjo XR-3. With MR headsets, professionals in engineering, design, simulation and research can develop and interact with their 3D models in real life.



Elon Musk claims Neuralink is about 'six months' away from first human trial

At a 'show and tell' event in the month of November, Elon Musk said that his brain-computer interface company, Neuralink, could implant one of its devices in someone's head within the next six months — meaning it's not happening this year. He also claimed that he would get the device implanted in his own head at some point in the future.

During the presentation, Musk said that the company had submitted most of the paperwork needed for a human clinical trial to the Food and Drug Administration, which regulates medical devices in the United States. Previously, Musk had said that he had hoped for human trials to begin in 2020, and then 2022. Now, that is slipped to at least 2023.

Neuralink's goal is to create a device that can be implanted in the brain, and use it to control a computer with brain activity. Back in 2019, Musk revealed that the company was testing its device in monkeys. In 2020, it trotted out pigs with the implants. And last year, Neuralink released a video showing a monkey playing Pong with its brain. This year, the monkeys are back. In a video demonstration, one of them helped “type” the phrase 'welcome to show and tell' using their implant by focusing on highlighted words and letters. Another video showed how the monkeys were trained to charge the devices by sitting under a wireless charger.

Later in the presentation, Neuralink researchers also showed off a pig on a treadmill, which they said was helping them study how to address mobility issues in people in the future.

The Neuralink devices themselves are small, with multiple flexible “threads” that can be inserted into the brain. “It's like replacing a piece of your skull with a smartwatch, for lack of a better analogy,” Musk said.

In about 15 minutes, 64 of these “threads” can be implanted into the brain using a robotic system, said DJ Seo, the vice president of Implant and co-founder of Neuralink, during the presentation — while using a mannequin to show how the process might work.

The reason for the robot surgeons comes down to just how tiny those threads are. “Imagine taking a hair from your head and sticking it into jello covered by saran wrap, doing that to a precise depth and precision, and doing that 64 times in a reasonable amount of time,” said Christine Odabashian, the leader of Neuralink's hardware insertion team.

The company's demos in 2019 and 2020 were designed as recruitment events, and this one is no different; the company admitted recruiting was its primary goal of the evening. Neuralink is currently looking to fill many kinds of jobs as it moves from “prototype to product”, Musk said at tonight's show and tell.

The event was mostly a technical presentation of the device, showcasing how the system was built, challenges the team has faced, how the tech has improved so far, and what developments are coming next. Researchers at the company said they were developing treatments that could either help improve or restore vision, or restore movement in people with paralysis. On the tech side, the company has ambitions to make sure that the device itself can be upgraded easily.

“I'm pretty sure you would not want an iPhone 1 in your head if an iPhone 14 was available,” Musk said.



Microphone-equipped toilet will detect diseases and give you advice

There are many diseases that could potentially be detected through human waste. One such infection includes cholera. Cholera is a bacterial disease that causes diarrhea and affects millions of people each year. It results in approximately 150,000 deaths worldwide, each year.

Cholera is spread through contaminated food and water. Large epidemics that spread the bacterium are related to fecal contamination of water or food. It can sometimes be spread through undercooked shellfish and other seafood-related infections, as well.

Cholera is caused by the vibrio cholerae bacteria

Cholera is a diarrheal illness caused by an infection in the intestine with *Vibrio cholerae* bacteria. Although the infection is often mild, it can sometimes be life-threatening. According to the Center for Disease Control and Prevention (CDC), about one in 10 people with cholera will experience severe symptoms, including thirst, restlessness, and diarrhea.

Signs of dehydration while a patient has diarrhea could also be a warning that someone has cholera. The signs include rapid heart rate and low blood pressure. People with cholera can experience extreme dehydration, which can lead to kidney failure and death.

In order for patients to be treated for cholera, they must know that they have the disease first. However, it can be a sensitive and difficult task to monitor bowel diseases, such as cholera. Maia Gatlin, a research engineer at the Georgia Institute of Technology, created a way to use artificial intelligence to detect diarrhea. She calls her presentation *The Feces Thesis: Using Machine Learning to Detect Diarrhea*.

A noninvasive microphone sensor can detect disease in bowels

Gatlin presented her thesis and the sensor tool on Dec. 5, 2022 at the annual Meeting of the Acoustical Society of America, explaining her findings on how machine learning can be used to detect diseases in the bowel. She uses a noninvasive microphone sensor to identify bowel diseases, without necessarily collecting identifiable information, meaning the AI can determine the infection without having to be examined in a medical facility to collect additional data.

The method involves using the microphone and machine learning to detect diarrhea. Gatlin and her research team tested the sensor technique on audio files from online resources. Each single audio sample of an excretion, or bowel movement, was converted into a spectrogram, which captures sound in an image. A spectrogram is a visual way of representing the sound of a signal over time, representing a visual of sound.

The different types of excretion create different features in the audio and the spectrogram. The diarrheal tone produced more of a random sounding audio to the researchers. The spectrogram images were then used as input and were put into a machine learning algorithm. The algorithm's performance was then tested against data with and without background noises to make sure it was gaining the information to interpret the sounds using the sensor, regardless of the environment.

The sensor can be used in places with persistent cholera outbreaks

Gatlin wants to use the AI sensor in locations where bowel infections such as cholera are prevalent. "The hope is that this sensor, which is small in footprint and non-invasive in approach, could be deployed to areas where cholera outbreaks are a persistent risk," said Gatlin.

"The sensor could also be used in disaster zones (where water contamination leads to spread of waterborne pathogens), or even in nursing/hospice care facilities to automatically monitor bowel movements of patients." Gatlin can also see the future usage of the sensory as being utilized in homes for individuals to test their own wellbeing through their bowel movements. She stated that "perhaps someday, our algorithm can be used with existing in-home smart devices to monitor one's own bowel movements and health!"

Researchers have developed a device that can mimic aspects of a heart attack with hopes of using the device to test and develop novel heart medications. The research team, from the University of Southern California Alfred E. Mann Department of Biomedical Engineering in the U.S., created the tool, which they call a “heart attack on a chip.”

Understanding a heart attack through simulation

The device can simulate key components of a heart attack, also called a myocardial infarction, in a practical, structured system. Researchers hope it will one day serve as a place to test for new heart drugs.

“This enables us to more clearly understand how the heart is changing after a heart attack. From there, we and others can develop and test drugs that will be most effective for limiting the further degradation of heart tissue that can occur after a heart attack,” said Megan McCain, an associate professor of biomedical engineering and stem cell biology and regenerative medicine. She also developed the device with postdoctoral researcher Megan Rexius-Hall.

Heart disease is the leading cause of death in U.S.

Heart disease is the leading cause of death in America. This disease caused nearly 700,000 deaths in the U.S. in 2020. The most common type of heart disease is coronary artery disease, which can lead to a heart attack. About 18.2 million American adults have coronary artery disease. A heart attack occurs when fat, cholesterol or other deposits reduce the flow of blood and oxygen to the heart.

If a patient survives a heart attack, there's a chance that the individual can still be fatigued, sick, and possibly die from future heart failure. The reasoning behind this is because heart cells don't regenerate like other muscle cells. Scarring can also develop, which weakens the heart muscles.

Researchers don't completely understand the process of how heart cells in the healthy and injured part of the heart transmit messages to each other, and how they change after a heart attack. McCain and Rexius-Hall are hopeful that their device will help to uncover some of the mysteries of what happens after a heart attack. “Fundamentally, we want to have a model that can lead to a better understanding of heart attack injury,” said Rexius-Hall.

The microfluidic device

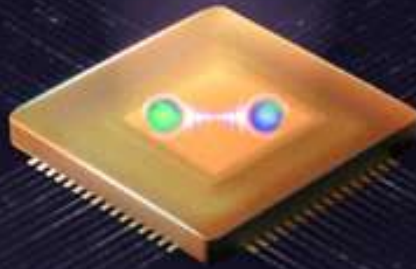
The heart attack on a chip, as it is called, is a square microfluidic device a little larger than a quarter. A microfluidic device is a small-scale, clear tool that processes fluid through it. At the base, it is 22-millimeter-by-22-millimeter and made from a rubber-like polymer called PDMS. It has two channels on opposite sides through which gases flow.

Above the base there's a thin layer of the PDMS polymer, which is porous to allow oxygen through. On the top layer, there is a micro layer of protein. The researchers created the device in a similar format mimicking the structure of the human heart. It is patterned in a way “so that the heart cells align and form the same architecture that we have in our hearts,” McCain stated. The final part of the tool includes rodent heart cells that are grown on top of the protein.

For the researchers to imitate a heart attack, gas with and without oxygen was released through each channel of the microfluidic device. This creates a similar likeness to a heart attack by “exposing our heart on a chip to an oxygen gradient, similar to what really happens in a heart attack,” McCain said.



Physicists create a holographic wormhole using a quantum computer



Physicists have purportedly created the first-ever wormhole, a kind of tunnel theorized in 1935 by Albert Einstein and Nathan Rosen that leads from one place to another by passing into an extra dimension of space.

The wormhole emerged like a hologram out of quantum bits of information, or “qubits,” stored in tiny superconducting circuits. By manipulating the qubits, the physicists then sent information through the wormhole, they reported today in the journal *Nature*.

The team, led by Maria Spiropulu of the California Institute of Technology, implemented the novel “wormhole teleportation protocol” using Google’s quantum computer, a device called Sycamore housed at Google Quantum AI in Santa Barbara, California. With this first-of-its-kind “quantum gravity experiment on a chip,” as Spiropulu described it, she and her team beat a competing group of physicists who aim to do wormhole teleportation with IBM and Quantinuum’s quantum computers.

When Spiropulu saw the key signature indicating that qubits were passing through the wormhole, she said, “I was shaken.”

The experiment can be seen as evidence for the holographic principle, a sweeping hypothesis about how the two pillars of fundamental physics, quantum mechanics and general relativity, fit together. Physicists have strived since the 1930s to reconcile these disjointed theories — one, a rulebook for atoms and subatomic particles, the other, Einstein’s description of how matter and energy warp the space-time fabric, generating gravity. The holographic principle, ascendant since the 1990s, posits a mathematical equivalence or “duality” between the two frameworks. It says the bendy space-time continuum described by general relativity is really a quantum system of particles in disguise. Space-time and gravity emerge from quantum effects much as a 3D hologram projects out of a 2D pattern.

Indeed, the new experiment confirms that quantum effects, of the type that we can control in a quantum computer, can give rise to a phenomenon that we expect to see in relativity — a wormhole. The evolving system of qubits in the Sycamore chip “has this really cool alternative description,” said John Preskill, a theoretical physicist at Caltech who was not involved in the experiment. “You can think of the system in a very different language as being gravitational.”

To be clear, unlike an ordinary hologram, the wormhole isn’t something we can see. While it can be considered “a filament of real space-time,” according to co-author Daniel Jafferis of Harvard University, lead developer of the wormhole teleportation protocol, it’s not part of the same reality that we and the Sycamore computer inhabit. The holographic principle says that the two realities — the one with the wormhole and the one with the qubits — are alternate versions of the same physics, but how to conceptualize this kind of duality remains mysterious.

Opinions will differ about the fundamental implications of the result. Crucially, the holographic wormhole in the experiment consists of a different kind of space-time than the space-time of our own universe. It’s debatable whether the experiment furthers the hypothesis that the space-time we inhabit is also holographic, patterned by quantum bits.

“I think it is true that gravity in our universe is emergent from some quantum [bits] in the same way that this little baby one-dimensional wormhole is emergent” from the Sycamore chip, Jafferis said. “Of course, we don’t know that for sure. We are trying to understand it.”

Asymmetry detected in the distribution of Galaxies

Physicists believe they have detected a striking asymmetry in the arrangements of galaxies in the sky. If confirmed, the finding would point to features of the unknown fundamental laws that operated during the Big Bang.

“If this result is real, someone's going to get a Nobel Prize,” said Marc Kamionkowski, a physicist at Johns Hopkins University who was not involved in the analysis.

As if playing a cosmic game of Connect the Dots, the researchers drew lines between sets of four galaxies, constructing four-cornered shapes called tetrahedra. When they had built every possible tetrahedron from a catalog of 1 million galaxies, they found that tetrahedra oriented one way outnumber their mirror images.

A hint of the imbalance between tetrahedra and their mirror images was first reported by Oliver Philcox, an astrophysicist at Columbia University in New York, in a paper published in *Physical Review D* in September. In an independent analysis conducted simultaneously that's now undergoing peer review, Jiamin Hou and Zachary Slepian of the University of Florida and Robert Cahn of Lawrence Berkeley National Laboratory detected the asymmetry with a level of statistical certainty that physicists usually consider definitive.

But with such a blockbuster finding — and one that's still under review — experts say caution is warranted.

“There's no obvious reason that they've made a mistake,” said Shaun Hotchkiss, a cosmologist at the University of Auckland. “That doesn't mean that there isn't a mistake.”

The putative imbalance violates a symmetry called “parity,” an equivalence of left and right. If the observation withstands scrutiny, physicists think it must reflect an unknown, parity-violating ingredient in the primordial process that sowed the seeds of all the structure that developed in our universe.

“It's an incredible result — really impressive,” Kamionkowski said. “Do I believe it? I'm going to wait to really celebrate.”

Left-Handed Universe

Parity was once a cherished symmetry of physics. But then, in 1957, the Chinese American physicist Chien-Shiung Wu's nuclear decay experiments revealed that our universe indeed has a slight handedness to it: Subatomic particles involved in the weak nuclear force, which causes nuclear decay, are always magnetically oriented in the opposite direction from the one they move in, so that they spiral like the threads of a left-handed screw. The mirror-image particles — the ones like right-handed screws — do not feel the weak force.

Wu's revelation was shocking. “We are all rather shaken by the death of our well-beloved friend, parity,” the physicist John Blatt wrote in a letter to Wolfgang Pauli.

The left-handedness of the weak force has subtle effects that could not have influenced the cosmos on galactic scales. But ever since Wu's discovery, physicists have sought other ways in which the universe differs from its mirror image.

If, for instance, some primordial parity violation was in effect when the universe was in its infancy, it might have imprinted a twist onto the structure of the cosmos.

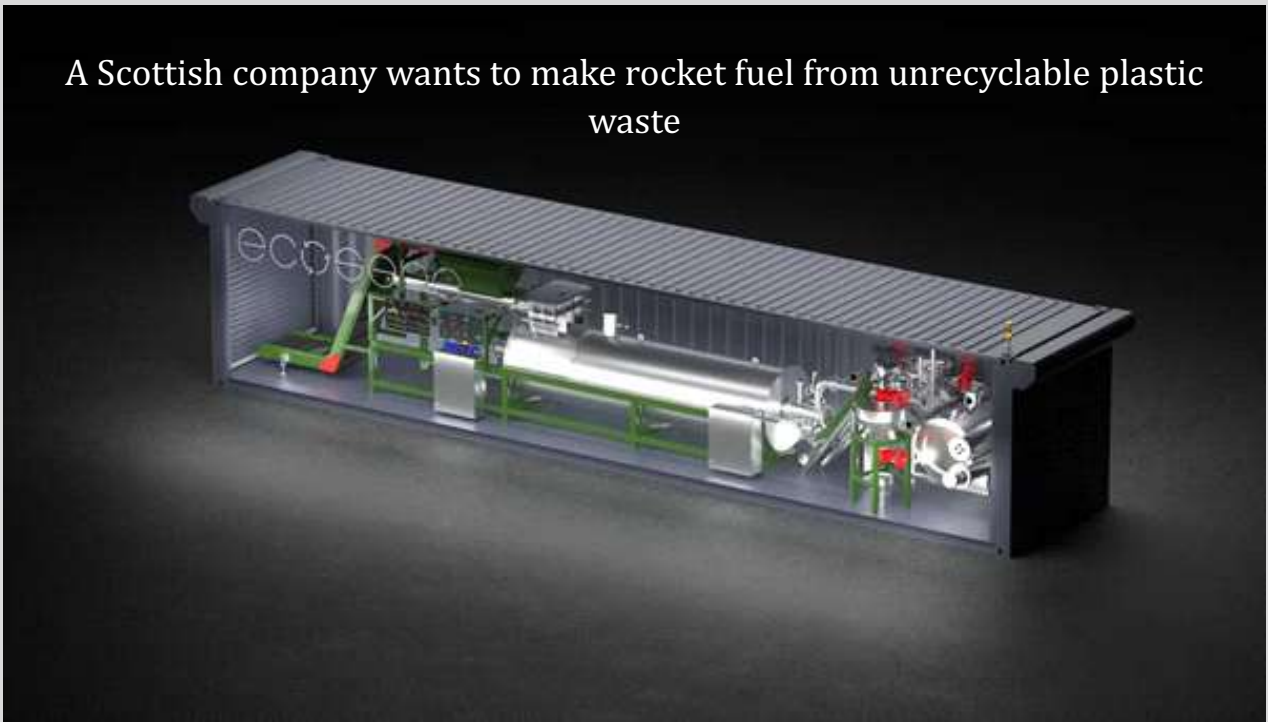
At or near the time of the universe's birth, a field known as the inflaton is thought to have permeated space. A roiling, boiling medium where inflaton particles continuously bubbled up and disappeared, the inflaton field was also repulsive; for the brief time it may have existed, it would have caused our universe to rapidly expand to 100 trillion trillion times its original size. All those quantum fluctuations of particles in the inflaton field were flung outward and frozen into the cosmos, becoming variations in the density of matter. The denser pockets continued to gravitationally coalesce to produce the galaxies and large-scale structure we see today.

In 1999, researchers including Kamionkowski considered what would happen if more than one field was present before this explosion. The inflaton field could have interacted with another field that could produce right-handed and left-handed particles. If the inflaton treated right-handed particles differently than the left-handed ones, then it could have preferentially created particles of one handedness over the other. This so-called Chern-Simons coupling would have imbued the early quantum fluctuations with a preferred handedness, which would have evolved into an imbalance of left-handed and right-handed tetrahedral arrangements of galaxies.

As for what the additional field might be, one possibility is the gravitational field. In this scenario, a parity-violating Chern-Simons interaction would occur between inflaton particles and gravitons — the quantum units of gravity — which would have popped up in the gravitational field during inflation. Such an interaction would have created a handedness in the density variations of the early universe and, consequently, in today's large-scale structure.



A Scottish company wants to make rocket fuel from unrecyclable plastic waste



Edinburgh-based Skyrora is a company aiming for many firsts. It wants to be the first company to accomplish an orbital launch from U.K. soil but is likely to end up being known as the first company that converts unrecyclable waste plastic into rocket fuel.

With the recent completion of the Artemis I mission, humanity is well on its way to setting up a settlement on the Moon and now has Mars in its sights. As our goals become more ambitious, we also need larger rockets that can take us to faraway destinations. However, rocket launches require tons of fuel and produce larger amounts of carbon emissions.

Skyrora's approach to the problem allows for rocket launches to be carried out unabated since they are largely clearing up the problem of plastic waste every time. The technology being developed by the company converts waste plastic into high-performance rocket fuel, called Ecosene, since it is similar in composition to premium kerosene.

Converting plastic waste to rocket fuel

Skyrora relies on a well-known technique called pyrolysis that uses heat to degrade a substance in the absence of oxygen and convert it into liquid oil. The Ecosene technology carries out pyrolysis at low temperatures, and the resultant fuel produced can be used to fuel rockets or even a regular vehicle.

According to Supercluster's report, each ton of plastic waste can be degraded into anywhere between 170-198 gallons (650-750 liters) of fuel, depending on the quality of plastic used.

Interestingly, the technology being used by the company allows for the use of even low-grade plastics in the process, something predecessors who attempted this failed at. Therefore, plastics such as polystyrenes and polyesters, as well as metalized packaging from snacks and chip packets, can be used in this process.

More importantly, the fuel produced this way is significantly cheaper and is likely to cost a fifth of the \$13 a gallon that space companies are paying for rocket fuel today.

The road ahead

According to the estimates of the Organization for Economic Co-operation and Development (OECD), 400 million tons of plastic waste is generated every year, and only nine percent ends up being recycled. The rest either ends up in landfills or is incinerated.

According to Skyrora, when a ton of plastic is incinerated, it releases about 900 kilowatts of energy. However, when the same amount of waste is converted into Ecosene, it can release up to 10 times more energy. While these claims still need to be independently verified, tests indicate that burning Ecosene produces lesser sulfur emissions than kerosene, *Supercluster* said in its report.

In addition to setting up a rocket engine manufacturing facility in the U.K., Skyrora is also looking at making available fully scalable and modular plants that can be brought to the site of plastic waste and deployed to convert them into fuel which could also be used to power regular vehicles.



A world-first project that uses 'self-healing' concrete to repair sewage pipes

Sewer pipe corrosion, or crown corrosion, occurs when sewage pipe material comes into contact with sulphuric acid. The aging pipe material corrodes, and the pipes crack. Over the past few years, engineers have developed sewer bots to inspect sewage pipes and go to places unsafe for humans.

But that also means the robots would have to go to places where existing wireless communications cannot reach them. Hurdles are aplenty.

Professor Yan Zhuge, an engineering expert at the University of South Australia, is trialing a novel solution. It involves no humans or bots but self-healing concrete.

The world-first project, if successful, could be a significant help. It could prevent 17,000 kilometers of sewer pipes in Australia from cracking in the future without any intervention by humans, helping to save \$1.4 billion in annual maintenance costs, as per a release.

"We are confident this novel self-healing concrete based on advance composite technology will address issues of sewer pipe corrosion and sludge disposal in one hit," Zhuge said in a statement.

The microcapsules will release healing agents when pH value changes

Every year, hundreds of millions of dollars are required to treat sewage pipes buckling under internal pressure, temperature fluctuations, and corrosive acid. Self-healing concrete, in the form of microcapsules filled with water treatment sludge, could change everything.

"Sludge waste shows promise to mitigate microbial corrosion in concrete sewer pipes because it works as a healing agent to resist acid corrosion and heal the cracks," Zhuge said.

According to the release, researchers will develop microcapsules with a pH-sensitive shell and a healing agent core with alum sludge, a by-product of wastewater treatment plants, and calcium hydroxide powder. This combination will be resistant to microbially induced corrosion.

The alum sludge will be embedded inside the concrete at the final step of mixing to protect it from breakage. And when the pH value changes, the microcapsules will release the healing agents.

Self-healing concrete is the solution

"This technology will not only extend the lifetime of concrete structures, saving the Australian economy more than \$1 billion, but it will promote a circular economy as well by reusing sludge that would normally end up in landfill," Zhuge said.

"Mainland Australia alone has about 400 drinking water treatment plants, with a single site annually generating up to 2,000 tonnes of treated water sludge. Most of that is disposed of in a landfill, costing more than \$6 million each year, as well as causing severe environmental issues," Zhuge continued.

"Improving the concrete mixture design is the preferred method for controlling microbially induced corrosion. Using self-healing concrete that can seal cracks by itself without any human intervention is the solution," she added.



NASA's heatshield promises advanced space exploration and help to fight forest fires

As the global space industry gears up for human space exploration of Mars and beyond, it will need technologies that make atmospheric entries innumerable safer.

That's where NASA's Low-Earth Orbit Flight Test of an Inflatable Decelerator (LOFTID) heatshield technology comes in. This year, the US space agency successfully tested the novel heatshield technology in orbit for the first time.

It essentially acts as a massive inflatable brake system for spacecraft, making spaceflight much safer. It could help humans safely land on Mars and also explore the further reaches of our solar system.

Not only that, the technology also has a very practical application here on Earth as it can be used to fight forest fires.

This is number 14 in Interesting Engineering's series, showcasing the best inventions of 2022. Check back to discover more about groundbreaking AI, unique solar panels, new 3D printing methods, and much more.

NASA's successful orbital heatshield test

LOFTID was launched aboard a United Launch Alliance Atlas V rocket on Nov.10. It was deployed into orbit from an altitude of approximately 78 miles (125 km) and it performed a splashdown in the ocean near Hawaii roughly two hours after launch.

The test flight was carried out to analyze the potential of a technology that could one day allow space missions to carry a compact, pliable heatshield in a payload compartment that can be unfolded before the mission enters its destination planet's atmosphere.

This technology could prove vital due to the dangers of entering a planet's atmosphere that has different conditions to Earth. Mars' atmosphere, for example, is much thinner than Earth's and the descent of NASA's Perseverance rover into its atmosphere was famously described as "seven minutes of terror".

LOFTID technology could help firefighters on Earth

NASA's six-meter-diameter (20 feet) LOFTID aeroshell acts as a massive brake system, creating much more atmospheric drag than traditional, much smaller aeroshells. NASA explains on its website that the technology was built to withstand atmosphere re-entry temperatures in excess of 2900°F (1600°C).

The space agency adds that the heatshield has "three layers: an exterior ceramic fiber cloth layer to maintain integrity of the surface, a middle layer of insulators to inhibit heat transmission, and an interior layer that prevents hot gas from reaching the inflatable structure. The flexible thermal protection system is also foldable, packable, deployable, and tailorable."

LOFTID is one of many examples of technologies built for space that could also have incredibly important practical applications on Earth. The heat shielding material developed for LOFTID, in fact, has already been used to build a prototype heat shelter to help tackle forest fires. NASA has worked with the U.S. Forest Service's Missoula Technology and Development Center (MTDC) to develop more effective fire shelters to save lives, meaning their heat-resistant material could save human beings in space and on Earth.



Virtual reality can work for those with one functional eye - Here's how

- Virtual reality (VR) may soon be the way we use the internet.
- There are misconceptions about who can and cannot use the technology.
- Trying out headsets and apps is a great way to know if the technology suits your needs.

If you or someone you know only has one functional eye, and this has been keeping you away from exploring the world of virtual reality, then here's a little surprise for you. VR experiences are not majorly affected if you do not use both of your eyes.

We know this because users with two functional eyes have experimented with using VR with one eye and have found little that is different in their experience. There are many VR enthusiasts who vouch for this, and you can rest assured that you or a dear one can enjoy the experience too.

Before we get into how it happens, let's go to the source of the problem. Why do we think that users with one functional eye cannot enjoy the full VR experience?

The 3D movie experience

The idea that users with one functional eye will miss out on VR comes from our previous experience with another virtual reality format, the 3D movie. Even those with two perfectly functional eyes do not enjoy a 3D movie experience if the 3D glasses are not put on properly.

While watching a 3D movie, we have probably all tried to remove our glasses to experience the movie in its actual format and then put the glasses back on almost immediately. This is because the 3D movie projection relies upon our binocular vision to deliver the experience.

There are different types of 3D movie technologies. One type uses a fusion camera system which is designed to capture two sets of images at once. Another system uses a rig with two separate cameras for all shots. The old-style 3D movies that used red and blue glasses tinted one set of images red and the other blue. The glasses then filtered the images so that each eye see only one image. The brain processes the images as two perspectives of the same object, creating the illusion of a 3D image.

Many modern 3D movies, however, use polarization. In this case, a filter in front of the projector changes the polarization of each image to match the filter on either the right or left lens of the glasses. Again, the brain processes the images as two perspectives of the same thing - giving a 3D view.

In both cases, for individuals who cannot use one eye, the intended projection does not happen, and the experience is soured.

However, in virtual reality, using modern-day headsets, this problem does not occur.

How does VR work in headsets?

Modern-day VR headsets, such as the Meta Quest Pro, use two different displays to project three-dimensional computer-generated images to deliver a highly immersive environment that our brain perceives as real.

Unlike 3D movies that rely only on binocular vision to create the intended effect, VR headsets use a wide range of technologies, ranging from spatial audio to eyeball tracking, to create the virtual world around us. Since even one functional eye can receive and transmit these images to the brain for perception, the VR experience with one eye is not as affected as it would be with a 3D movie.

In both 3D movies and VR headsets, binocular vision can help us perceive depth. However, that's not the only way to perceive depth. For example, when driving in a car, it appears as though nearby features move rapidly and far away features move slowly. This is the perception of depth using parallax — the observed displacement of an object caused by the change in the observer's point of view

Our own knowledge of the world also helps us perceive depth. For instance, a dog inside a car may appear bigger than a building outside the window. Since we know that dogs are not bigger than buildings, we also know that the dog is closer while the building is further away.

The VR experience does not rely on one technology alone, and users can expect a realistic experience while using the headset. However, because the technology was designed and developed for users with two functional eyes, there are some things that users with only one eye, or sight in only one eye, will miss out on.

What will you lose when you use VR with one eye?

Different apps or games are designed differently to deliver the most immersive experience, but some use two displays to deliver 3D. In some cases, the user interface (UI) elements may be locked onto the head movement. This would mean that even if you turn your head, you will never be able to see the images displayed on the other screen. However, in apps where the UI elements are not locked this way, a simple turn of the head should be sufficient to know what's happening on the other display.

While this might sound a bit difficult for most, users with one functional eye would not find the VR world any different from their real world. The compensation required to experience VR will not be very different from those used to experience the real world. Users might have to turn their heads to see things on the blind side just like they do in the real world. However, since the field of view of VR headsets is still small, the compensation needed in the VR world will also be lesser.

There could also be small issues with the perception of the image quality since the single display image can only sharpen images to a certain extent, but it should not ruin the VR experience. Instead, there are a few things one can do to improve the experience instead.

What can be done to improve the experience?

To ensure that you don't feel short-changed by the VR experience, make sure you try out the technology before you spend your money on it. Instead of shopping for the headsets online, walk into a store and use the demo headsets there to get a feel of what using the device will be like for you.

This might not be the easiest way out and take some additional time, but it will be totally worth it since you will know exactly what to expect when your device arrives. It is likely that the store has a few experiences loaded onto the headsets for you to try, and you can even request them to download apps or games that you look forward to using on the device during your visit.

Alternatively, you can head over to a friend who has a VR headset and give it a shot there before making your buying decision. Certain games and apps require a wide field of vision and might not work out for you. However, the rest should work equally well with a narrowed field and let you explore the virtual world with ease.

An important point to note is that most VR app stores have in place refund policies for apps and games used for less than two hours. This means that even for new purchases in the future if your experience is sub-optimal, you can simply return your purchase and look for something that is more suited to your needs.

If your requirement is really unique and specific, you could even get in touch with the developers, who might be happy to make little tweaks available in their upcoming updates to improve user experience. Do remember the VR industry is still in its infancy, and developers are keen to meet users' needs. Many might be more than happy to accommodate special needs if that opens up a new market for them.

This aircraft fuel-saving technology is based on the skin of sharks



Last week, the European Union Aviation Safety Agency (EASA) granted Lufthansa Technik permission to modify two Boeing 777 variants with the fuel-saving AeroSHARK riblet films, a sustainability-focused innovation developed jointly by Lufthansa Technik and chemicals company BASF, according to a press release by the aircraft maintenance firm.

The new technology will now be installed on Lufthansa Cargo and Swiss International Air Lines (SWISS) aircraft.

"Thanks to its special surface structure of microscopic ribs – so-called riblets – AeroSHARK reduces the frictional resistance of the aircraft skin. As a result, the fuel consumption and CO₂ emissions are reduced by around one percent," noted the statement.

"For each Boeing 777-300ER operated by SWISS, this means annual savings of around 400 tons of kerosene and more than 1,200 tons of carbon dioxide. The slightly shorter Boeing 777F saves around 370 tons of fuel and 1,170 tons of CO₂ each year."

First flights with the new tech already on the way

The first AeroSHARK-equipped Boeing 777-300ER of the Swiss airline had already begun daily operations in October. The first flights of this plane, conducted on September 8 and 9 2022 with the EASA, were undertaken to collect detailed proof that the AeroSHARK modification had no negative impact on the operational safety and handling of the Boeing 777.

The initial flights were followed by several weeks of evaluation of the collected data and other documents, such as measured values from flow simulations. The new decree issued by EASA will now allow Lufthansa Technik to apply the riblet films to any given Boeing 777-300ER and 777F aircraft.

"The approval of AeroSHARK for the Boeing 777 variants is an important step in the distribution of this new technology for more sustainability in air transport," said Soeren Stark, Chief Executive Officer of Lufthansa Technik.

"With our partner BASF, we can now support our customers in making entire subfleets more climate-friendly. Moreover, we intend to realize the use of the new technology for further aircraft types. We are the only MRO company in the world to offer such solutions to reduce fuel consumption and CO₂ emissions for commercial aircraft. We are naturally very proud of this."

"Realizing such a project is only possible through cooperation in partnership and great trust in each other's expertise. Together, we have succeeded in developing a tailor-made solution that combines economic action and sustainability in equal measure," further explained Dr. Uta Holzenkamp, head of BASF's Coatings division.

"With the Novaflex Sharkskin functional film, we are helping our customers to achieve their individual sustainability goals and in this way make aviation measurably more environmentally friendly."