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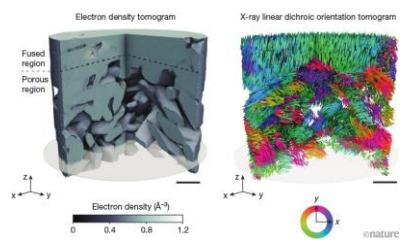
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3D IMAGING **X-ray Method Takes A 3D Fingerprint of Materials**



"A material's properties are determined by its composition and microstructure — the distribution and orientation of its building blocks. A non-destructive imaging technique has been developed that measures local variations in a property called X-ray linear dichroism to map a material's composition, microstructure and defects in 3D, with nanometre resolution across extended material volumes."

Source: [Nature](#) (11 Dec 2024)

3D PRINTING **How To Print a Car: High-Performance Multi-Material 3D Printing Techniques**



"Researchers at Tohoku University's Institute for Materials Research and New Industry Creation Hatchery Center have made a breakthrough in a multi-material 3D printing technique, demonstrating the process for creating a lightweight yet durable automobile part."

The process of metal 3D printing involves building objects by depositing metals layer by layer, using heat to bind them together. The precision of 3D printing allows for the production of unique, highly customizable shapes that often create less wasteful byproducts than traditional manufacturing methods. "Multi-material structures" which strategically combine different materials for optimal performance of a component can also be created via 3D printing. For example, steel automobile parts can be made more lightweight by combining them with aluminum. Due to these benefits, mastering such 3D printing techniques is garnering considerable attention from researchers.

However, this technique does come with some challenges."

Source: [Eurekalert!](#) (17 Dec 2024)

ARCHITECTURE **Architecture For Public Health: A Joint Approach to Sustainability and Wellness**



"The built environment significantly impacts public health, yet its potential as a tool for health promotion remains largely unrecognized. Historically, architects and urban planners have explored the connections between design and health, identifying foundational factors that improve a building's health performance. Built environment professionals possess compelling evidence on how spatial interventions can improve health outcomes, yet health practitioners often lack this perspective. Breaking down these silos is essential in the creation of spaces that promote occupant well-being."

Early efforts to highlight the interplay between built environments and health faced resistance. The idea was considered niche, with limited recognition of how design affects physical and emotional well-being. However, the narrative has evolved with the urban planning industry now acknowledging the emotional and physical impact of spaces. "The pandemic was a wake-up call that showed us how the built environment complements our health. It pushed issues like indoor air quality and trust in spaces of co-existence into the spotlight", Sara Karerat, Managing Director of Center for Active Design clarifies."

Source: [Archdaily](#) (16 Dec 2024)

AVIATION **Travelers Weigh in On Weight-Based Airfares for Eco-Friendly Skies**



"We wanted to explore how air travel could be made more sustainable, especially considering the weight we carry — both personal weight and baggage that often travels back and forth," said Markus Schuckert, professor of hospitality management. "We wondered if reducing weight overall could contribute to more eco-friendly air travel and began questioning whether passengers might accept pricing that reflects this."

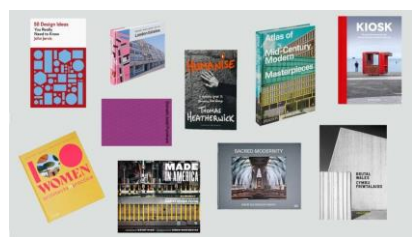
In their study, recently published in the journal of Transportation Research Part A: Policy and Practice, researchers surveyed over 1,000 U.S. air travelers to gauge their view on three potential fare policies that provided a more sustainable flying option. The heavier the aircraft, the more jet fuel it burns and the more carbon emissions are produced so they devised a tier approach — a standard policy where all passengers pay a uniform price; a threshold policy where passengers exceeding a certain weight pay additional fees; and a unit-of-body-weight policy where each passenger's airfare is based on their combined body and baggage weight.

The standard policy was the most accepted approach across all demographics, with more than half of respondents rating it as the most ethical option. Nearly 60% of participants voiced concerns about weight-based policies, citing potential fairness issues and the risk of discrimination, especially around factors like nutrition, income and accessibility which often influence body weight.

Those who were more in favor of weight-based policies tended to be younger with those ages 18-35 accepting weight-based pricing almost 20 percentage points more than travelers who were 66 and older. Additionally, travelers with higher incomes or frequent flyer status were 25% more likely to support weight-based policies than those in lower income brackets or who didn't travel as much."

Source: [UNH](#) (11 Dec 2024)

DESIGN **The Top 10 Architecture and Design Books Of 2024**



"For those still looking for Christmas gifts, we round up this year's top architecture and design books as part of our review of 2024."

Kiosk by David Navarro and Martyna Sobiecka

Simply named Kiosk, this book features photos of more than 150 modernist, modular kiosks that brighten streets across central and eastern Europe.

Authors David Navarro and Martyna Sobiecka aimed to draw attention to the surviving, unusual structures that were constructed in factories in the Eastern Bloc from the 1970s to the 1990s.

100 Women: Architects in Practice by Harriet Harriss, Naomi House, Monika Parinder and Tom Ravenscroft

Written by academics Harriet Harriss, Naomi House, Monika Parinder and Dezeen editor Tom Ravenscroft, 100 Women: Architects in Practice showcases the work of architects from 78 different countries.

The book contains interviews with some of the world's best-known architects including Liz Diller, Tatiana Bilbao, Mariam Issoufou Kamara and Lina Ghotmeh, along with numerous women who have not yet received extensive global attention..."

ENERGY **Breakthrough Brings Body-Heat Powered Wearable Devices Closer to Reality**



"A QUT-led research team has developed an ultra-thin, flexible film that could power next-generation wearable devices using body heat, eliminating the need for batteries."

This technology could also be used to cool electronic chips, helping smartphones and computers run more efficiently.

Professor Zhi-Gang Chen, whose team's new research was published in the prestigious journal Science, said the breakthrough tackled a major challenge in creating flexible thermoelectric devices that converted body heat into power.

This approach offers the potential of a sustainable energy source for wearable electronics, as well as an efficient cooling method for chips."

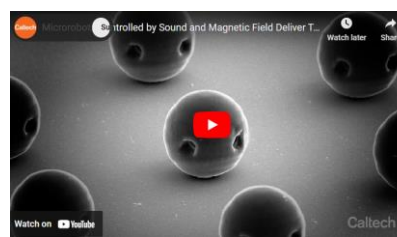
"Flexible thermoelectric devices can be worn comfortably on the skin where they effectively turn the temperature difference between the human body and surrounding air into electricity," Professor Chen said.

"They could also be applied in a tight space, such as inside a computer or mobile phone, to help cool chips and improve performance."

"Other potential applications range from personal thermal management — where body heat could power a wearable heating, ventilating and air conditioning system."

"However, challenges like limited flexibility, complex manufacturing, high costs and

MED TECH **Minuscule Robots for Targeted Drug Delivery**



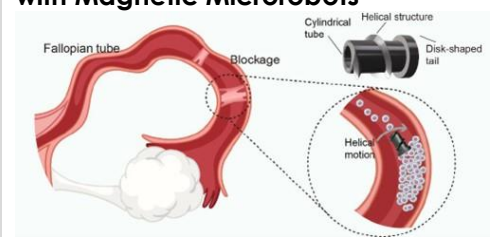
"In the future, delivering therapeutic drugs exactly where they are needed within the body could be the task of miniature robots. Not little metal humanoid or even biomimicking robots; think instead of tiny bubble-like spheres."

Such robots would have a long and challenging list of requirements. For example, they would need to survive in bodily fluids, such as stomach acids, and be controllable, so they could be directed precisely to targeted sites. They also must release their medical cargo only when they reach their target, and then be absorbable by the body without causing harm.

Now, microrobots that tick all those boxes have been developed by a Caltech-led team. Using the bots, the team successfully delivered therapeutics that decreased the size of bladder tumors in mice. A paper describing the work appears in the journal Science Robotics.

"We have designed a single platform that can address all of these problems," says Wei Gao, professor of medical engineering at Caltech, Heritage Medical Research Institute Investigator, and co-corresponding author of the new paper about the bots, which the team calls bioresorbable acoustic microrobots (BAM). "Rather than putting a drug into the body and letting it diffuse everywhere, now we can guide our microrobots directly to a tumor

MED TECH **Tiny Robots, Big Impact: Revolutionizing Infertility Treatment with Magnetic Microrobots**



"Infertility affects an estimated 186 million people worldwide, with fallopian tube obstruction contributing to 11%-67% of female infertility cases. In AIP Advances, researchers at the SIAT Magnetic Soft Microrobots Lab have developed an innovative solution using a magnetically driven robotic microscrew to treat fallopian tube blockages."

"This new technology offers a potentially less invasive alternative to the traditional surgical methods currently used to clear tubal obstructions, which often involve the use of conventional catheters and guidewires," said author Haifeng Xu.

The microrobot is made from nonmagnetic photosensitive resin, coated with a thin iron layer to give it magnetic properties. By applying an external magnetic field, the robot rotates, generating translational motion that enables it to navigate through a glass channel simulating a fallopian tube. The robot successfully clears a cell cluster obstruction placed in the channel, mimicking a typical blockage in the female reproductive system. This magnetic control provides precise navigation through the delicate and narrow structures of the fallopian tube.

The design of the microrobot is another key innovation. It has a screw-shaped body with a helical structure, a cylindrical central tube, and a disk-shaped tail. The helix-shaped

insufficient performance have hindered these devices from reaching commercial scale."

Most research in this area has focused on bismuth telluride-based thermoelectrics, valued for its high properties that convert heat into electricity which makes it ideal for low-power applications like heart rate, temperature or movement monitors.

In this study, the team introduced a cost-effective technology for making flexible thermoelectric films by using tiny crystals, or "nanobinders", that form a consistent layer of bismuth telluride sheets, boosting both efficiency and flexibility.

"We created a printable A4-sized film with record-high thermoelectric performance, exceptional flexibility, scalability and low cost, making it one of the best flexible thermoelectrics available," Professor Chen said."

Source: [Dezeen](#) (17 Dec 2024)

Source: [QUT](#) (13 Dec 2024)

site and release the drug in a controlled and efficient way," Gao says."

Source: [caltech](#) (11 Dec 2024)

structure is crucial for propulsion, while the disk-shaped tail helps stabilize the robot's motion. As the screw rotates, it generates a vortex field that helps push fragmented debris toward the tail, clearing the blockage more effectively.

In tests, the microrobot demonstrated both effectiveness and efficiency in clearing the simulated blockage, with the vortex created by the rotating screw propelling debris away from the obstruction.

Looking to the future, the research team plans to make the microrobot smaller and more advanced. They also aim to test the robot in isolated organ models and incorporate in vivo imaging systems to track the microrobot's movement and position in real time. The team also envisions expanding the robot's applications in surgery, including automatic control systems that could enhance the efficiency of blockage removal and other medical procedures.

"The ultimate goal is to provide a more effective, minimally invasive solution for patients suffering from infertility," said Xu."

Source: [AIP](#) (17 Dec 2024)

PHYSICS

Physicists 'Bootstrap' Validity of String Theory



"String theory, conceptualized more than 50 years ago as a framework to explain the formation of matter, remains elusive as a "provable" phenomenon. But a team of physicists has now taken a significant step forward in validating string theory by using an innovative mathematical method that points to its "inevitability."

In their work, reported in the journal *Physical Review Letters*, New York University and Caltech researchers posed the following question: "What is the math question to which string theory is the only answer?" This approach to understanding physics is known as the "bootstrap," which is reminiscent of the adage about "pulling yourself up by your bootstraps"—producing results without additional assistance or, in this case, input.

In the *Physical Review Letters* paper, the scientists discovered a way to bootstrap these string amplitudes—specifically, constructing them through the creation of mathematical formulas. By implementing special mathematical conditions on their formulas for scattering amplitudes—which describe how particles interact and ultimately form—the group found that the amplitudes of string theory emerged as the only consistent answer.

"This paper provides an answer to this string-theory question for the first time," says Grant Remmen, a James Arthur Postdoctoral Fellow in NYU's Center for Cosmology and Particle Physics and one of the authors of the paper. "Now that these mathematical conditions are known, it brings us a step closer to understanding if and why string theory must describe our universe."

Source: [NYU](#) (17 Dec 2024)

QUNTUM COMPUTING

More Is Better in Error-Resilient Quantum Computer: Google Quantum AI Lowers Error Rates as It Adds More Qubits to Its Chip



"Quantum computers are currently error-ridden machines, greatly limiting practical applications. In a study published today in *Nature*, researchers at Google and their colleagues reveal they have, for the first time, developed a quantum processor that can reliably fix errors faster than it generates them.

The qubits at the heart of quantum computers are very error-prone pieces of technology. Currently, quantum computers typically suffer roughly one error every thousand operations, far short of the one-in-10-billion error rates needed for the machines to run long enough for many practical applications, the new study notes.

Scientists often hope to compensate for these high error rates by spreading quantum computations across many redundant qubits. These quantum error correction strategies would help quantum computers detect and correct mistakes, so that a cluster of "physical" qubits can altogether behave as one low-error "logical" qubit, serving as the foundation of a fault-tolerant quantum computer.

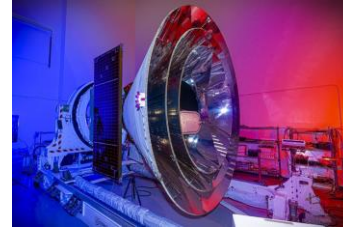
"Quantum error correction is the path towards large-scale quantum applications, including things like drug discovery, material design, improved optimization, and so on," says Kevin Satzinger, a research scientist at Google Quantum AI. "Think better pharmaceuticals or better batteries."

However, quantum error correction schemes are not foolproof. Each quantum error correction strategy is only useful if the hardware's error rates are low enough to benefit from it. This error threshold depends on the specific strategy and the nature of the errors. Above that critical threshold, adding more qubits will only increase, not decrease, the number of errors."

Source: [IEEE Spectrum](#) (9 Dec 2024)

SCIENCE

Science In 2025: The Events to Watch for In the Coming Year



"New and repurposed obesity drugs, daring space missions and climate-action policies are among the developments set to shape research in 2025.

Weight-loss wonder drugs

Following the runaway success of 'miracle' drug Wegovy (semaglutide) and other GLP-1 agonists, 2025 is likely to bring results and approvals for a new wave of treatments targeting obesity. The pharmaceutical firm Eli Lilly in Indianapolis, Indiana, will wrap up a phase III trial for its oral pill orforglipron, evaluating its long-term safety in people with type 2 diabetes. The drug is easier to produce and potentially cheaper than existing treatment.

Mind-reading machines

In 2025, China plans to test brain-computer interface (BCI) technologies that could compete with implants made by Elon Musk's firm Neuralink, based in Fremont, California. China's Ministry of Industry and Information Technology has announced plans to develop BCI devices for applications ranging from medical rehabilitation to virtual reality. One of these products is NEO, a wireless and minimally invasive BCI with eight electrodes placed over the brain's sensorimotor cortex, designed to restore hand movement in people with paralysis. Clinical trials for NEO began in 2023, and early results showed that a participant with spinal-cord injury was able to eat, drink and grasp objects after nine months of using the BCI at home. The researchers behind NEO plan to expand to larger trials in 2025..."

Source: [IEEE Spectrum](#) (17 Dec 2024)

WORKPLACE

Being Digitally Hyperconnected Causes 'Techno-Strain' For Employees



"A new study has shown that employees are experiencing mental and physical techno-strain due to being 'hyperconnected' to digital technology making it difficult for people to switch off from work.

Researchers from the University of Nottingham's Schools of Psychology and Medicine conducted detailed interviews with employees from a range of professions and found that the cognitive and affective effort associated with constant connectivity and high work pace driven by the digital workplace is detrimental to employee wellbeing. The results have been published today in *Frontiers in Organizational Psychology*.

This new paper is the final part of a research project exploring the 'dark side effects' of digital working which include stress, overload, anxiety and fear of missing out. The results highlight an overarching theme of 'digital workplace technology intensity' as a result of digital workplace job demands.

The findings in this latest paper indicate a sense of burden associated with working digitally which surfaced for most participants in perceptions of overload and feelings of being overwhelmed by the proliferation of messages, applications and meetings in the digital workplace. Fear of missing out on important information and contact with colleagues also contributed to stress and strain for digital workers, as did hassles encountered when using digital technologies."

Source: [Nottingham](#) (17 Dec 2024)

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