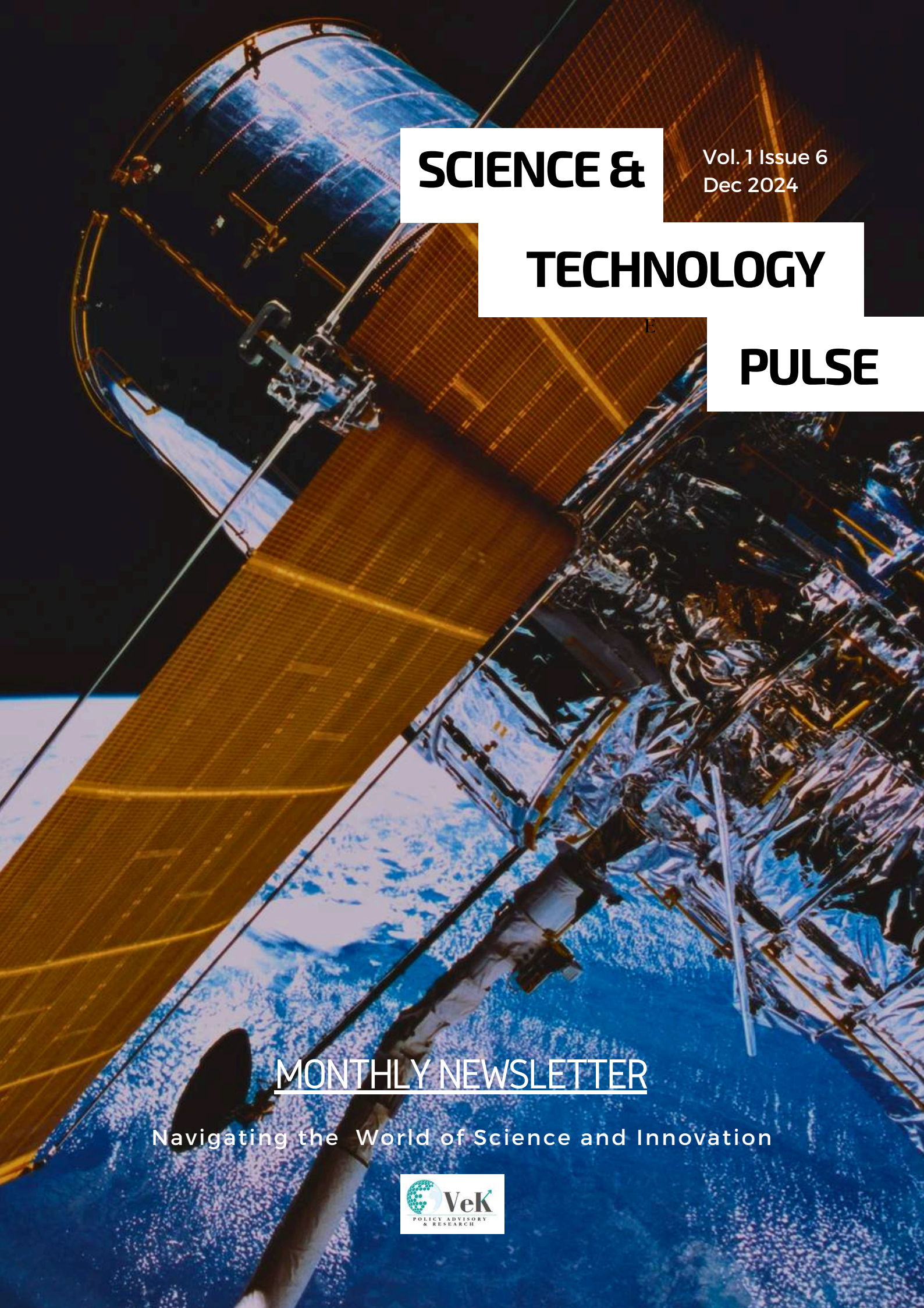

SCIENCE & TECHNOLOGY PULSE

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MONTHLY NEWSLETTER

Navigating the World of Science and Innovation

VeK
POLICY ADVISORY & RESEARCH

Predicting Crack Formation in Drying Clay Could Revolutionize Material Design and Applications

This research can benefit industries such as aerospace for crack-resistant coatings, healthcare for diagnostic tools and capsule coatings, and manufacturing for high-quality paints and protective layers. It also has applications in forensic science, construction, and cultural heritage restoration.

Researchers have developed a method to predict the exact time when cracks first appear in drying clay. By studying how elasticity, fracture energy, and drying-induced stresses interact, they created a model that identifies when and where cracks will emerge. Cracks were observed to start at the edges and progress inward as the material aged.

This research extends beyond clay to other colloidal layers like blood and paint, offering practical applications in diverse fields. For instance, it could enhance forensic analysis, aid in diagnosing conditions like anemia through drying blood droplets, and improve paint and coating quality for industrial use. In aerospace, the study could help design crack-resistant coatings for spacecraft operating in extreme heat environments. By tweaking material properties like elasticity and pH levels, manufacturers can delay crack onset and extend product durability, revolutionizing coatings, medicines, and even geophysical applications.

In this newsletter you can expect updates from:

Can Twisted Ferecrystals Turn Waste Heat into Useful Electricity?

This innovation could revolutionize industries like steel, chemical manufacturing, and energy by improving efficiency and sustainability. It also holds promise for advancing thermoelectric technology, reducing energy waste, and contributing to greener industrial practices.

Scientists at JNCASR Bengaluru have created a special material that can convert waste heat into electricity more efficiently than ever before. Using twisted layers of ferecrystals inside a SnSe base, they developed a design that blocks heat waves and achieved a high thermoelectric performance score of 2.3. This material can capture heat from industrial processes, vehicle exhaust, and thermal plants and turn it into electricity.

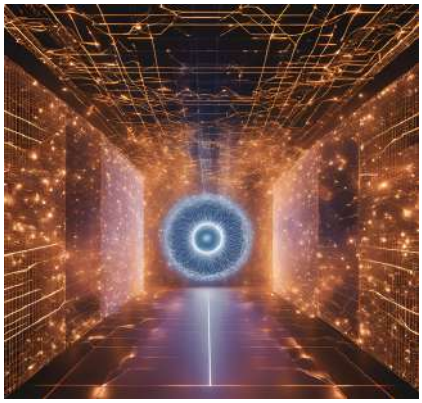
The technology not only offers a sustainable energy solution but also paves the way for reducing carbon footprints in energy-intensive sectors. With scalable potential, it could become a cornerstone of renewable energy strategies for a greener future.

Can a High-Sensitivity Antenna Redefine Telecommunications and Space Research?

Beyond cosmology, it could revolutionize industries like telecommunications and sensor technology, leveraging its high sensitivity and frequency precision for advanced applications.

Scientists at the Raman Research Institute (RRI), Bengaluru, have developed a custom-designed fantail antenna capable of detecting faint Cosmological Recombination Radiation (CRR) signals between 2.5 and 4 GHz. These signals, billions of times fainter than the Cosmic Microwave Background, hold vital clues about the Universe's thermal and ionization history. Weighing just 150 grams, the compact, portable antenna achieves exceptional sensitivity, enabling precise sky measurements and the study of unexplained radiation at 3.3 GHz linked to exotic physics like dark matter annihilation.

Easily manufacturable using PCB printing techniques, this antenna offers scalable potential for array deployments in radio-quiet zones.



India Accelerates Quantum Revolution with Eight Startups Leading Innovation

*This initiative is crucial for sectors like **cybersecurity, healthcare, energy, and telecommunications**, offering ultra-secure communication, efficient energy systems, and advanced diagnostic tools for global competitiveness.*

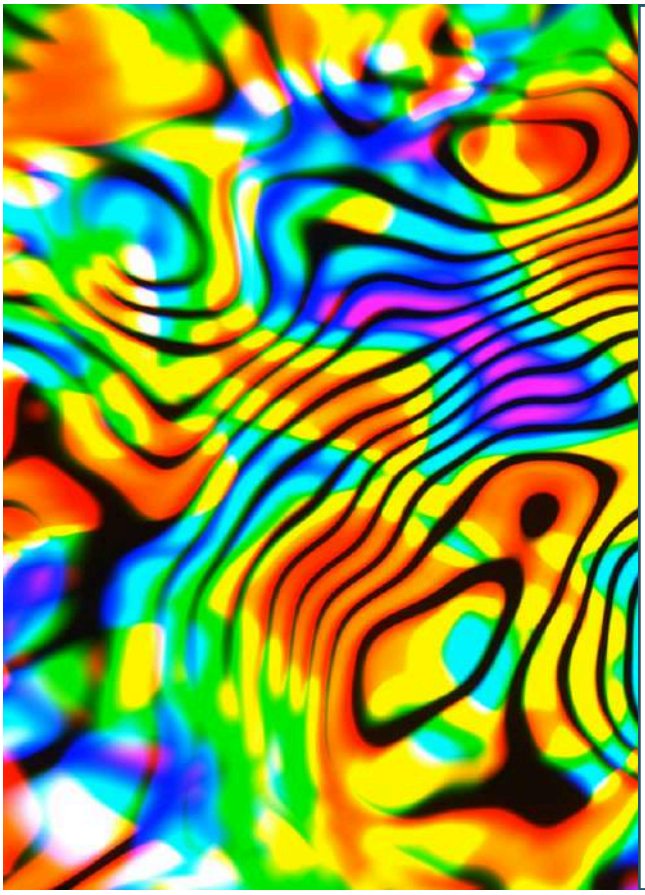
India has selected eight startups under the National Quantum Mission (NQM) and NM-ICPS to spearhead advancements in quantum technology. These startups are developing solutions like quantum-safe networks (QNu Labs), superconducting quantum computers (QPiAI), and optical atomic clocks (QuPrayog), addressing applications in cybersecurity, healthcare, and energy efficiency. Supported by DST's guidelines, their innovations aim to revolutionize industries and strengthen national security.

Union Minister Dr. Jitendra Singh emphasized quantum technology's role in energy systems, secure communication, and sustainability, showcasing India's commitment to global leadership in quantum science.

Can Flexible Plasmonics with Scandium Nitride Redefine Wearable Tech and NIR Devices?

ScN's durability and adaptability make it a game-changer for industries such as telecommunications, healthcare, and wearable technology. This innovation paves the way for scalable, high-performance NIR devices, enabling breakthroughs in flexible sensors, optoelectronic devices, and medical imaging tools.

Researchers at JNCASR, Bengaluru, have developed a flexible near-infrared (NIR) plasmonic material using scandium nitride (ScN), a cost-effective alternative to traditional materials like gold and silver. NIR devices operate in the near-infrared spectrum (wavelengths just beyond visible light, 780 nm to 2500 nm) and are crucial in applications like medical imaging, optical communications, and environmental monitoring. By pairing ScN with van der Waals substrates, the team created high-quality, bendable layers that efficiently interact with NIR light for advanced functionality.



Can Hexagonal Boron Nitride Nanosheets redefine Infrared Regulation?

Industry applications could include thermal camouflage, radiative heat barriers, and advanced thermal management systems in construction, textiles, and defense sectors.

Scientists at CeNS, Bengaluru, have developed an innovative method to control infrared (IR) radiation using 2D nanosheets of hexagonal boron nitride (h-BN) embedded in polymer network liquid crystals. This breakthrough enables effective IR regulation, reducing excess heat and discomfort caused by solar radiation, and offering potential energy savings in cooling systems.

The technology, supported by numerical simulations and thermal imaging tests, boasts high mechanical strength and versatility.

PAIR Program: Bridging Research Gaps in Indian Institutions.

The Anusandhan National Research Foundation (ANRF) launched the Partnerships for Accelerated Innovation and Research (PAIR) Program at Bharat Mandapam, New Delhi, aiming to strengthen India's research ecosystem. Rooted in the vision of NEP 2020, the program pairs top-tier institutions with others to mentor and enhance research capabilities, focusing on regional diversity and institutional growth.
With a hub-and-spoke model, established institutions will guide emerging ones, improving infrastructure, resources, and research standards.

This initiative is set to foster innovation, bridge institutional gaps, and elevate R&D across the country, benefiting both academia and industries. Industries can tap into the enhanced research output for innovation, technology development, and skilled manpower, driving national progress in science and technology.

Can Blending Heritage and Technology Propel India Toward Global Leadership?

Dr. Jitendra Singh, Union Minister of Science and Technology, emphasized the fusion of India's traditional knowledge with modern science as a unique strength during the five-year celebration of the Science and Heritage Research Initiative (SHRI). Key projects like non-invasive heritage preservation techniques, Ajanta Caves' VR experience, and innovations like the Kosh Shree Sanskrit dictionary and HerbaHeal herbal products were unveiled, showcasing the potential of heritage-inspired innovation.

From creating herbal remedies and antioxidant-rich teas to advanced handloom technologies, these efforts not only preserve cultural heritage but also open avenues for startups and industries in healthcare, tourism, and traditional crafts.

By aligning ancient wisdom with cutting-edge technology, India is paving the way for sustainable development and global recognition.

Are Nanoplastics from Single-Use Bottles Fueling Antibiotic Resistance?

In the industry, this research could lead to innovative materials science approaches to designing safer plastics and solutions for mitigating nanoplastic contamination, particularly in food packaging and medical equipment.

A new study by the Institute of Nano Science and Technology (INST), Mohali, reveals that nanoplastics from single-use plastic bottles may accelerate the spread of antibiotic resistance (AR). Researchers demonstrated that these polyethylene terephthalate bottle-derived nanoplastics (PBNPs) facilitate gene transfer between bacteria, turning beneficial gut bacteria like Lactobacillus acidophilus into potential reservoirs for AR genes.

The findings highlight two novel pathways through which PBNPs promote AR gene transfer, posing a threat to the human gut microbiome and overall health. This study underscores the urgent need for stricter safety guidelines and effective plastic waste management to safeguard public health.

Is Foldscope the New Tool Revolutionizing Farming in Chhattisgarh?

This low-cost innovation is finding industry applications in plant disease management, biopesticide testing, and livestock breeding, promising to uplift rural communities and enhance productivity.

Farmers across 20 districts in Chhattisgarh are embracing Foldscope, an affordable portable microscope, to revolutionize pest and disease detection, soil quality assessment, and water analysis. Implemented by ICAR-National Institute of Biotic Stress Management and supported by DST's SYST program, the initiative empowers farmers with frugal science to make informed decisions for sustainable agriculture.

Foldscope Microscopy has identified 16 fungal diseases, tested biopesticides, and even assessed cattle semen quality for artificial insemination. Workshops and hands-on training have equipped rural youth, students, and extension officers to expand the initiative's reach, creating a transformative impact on agricultural livelihoods.

Can Janus Monolayers Shape the Future of Smarter, Energy-Efficient Devices?

This discovery could significantly impact industries like flexible electronics, quantum computing, and energy-efficient devices. With their ability to streamline device design and reduce components, Janus monolayers pave the way for smaller, smarter, and more sustainable technologies, enhancing daily life and promoting greener innovation.

Scientists at INST Mohali have identified Janus Sb_2XSX' monolayers as promising materials for next-generation electronic devices. These two-dimensional materials, with their unique asymmetric structure, are not only highly stable but also exhibit remarkable properties like piezoelectricity and spin-splitting effects. These features make them ideal for spintronics, a field of electronics that uses electron spin for faster and more energy-efficient data storage and processing.

The Janus structure also enables these materials to perform multiple functions, such as sensing, data processing, and energy harvesting, all in one compact platform.

Can 2D Materials Unlock Cleaner Energy and a Greener Environment?

Industries can leverage this research to innovate in renewable energy, water treatment, and pollution control technologies.

A new study by INST Mohali reveals how 2D materials, combined with smart engineering, can revolutionize photocatalysis for sustainable energy and environmental solutions. By tweaking the properties of metal-telluro-halide materials and applying magnetic fields, scientists demonstrated efficient ways to generate free charge carriers, overcoming challenges in traditional photocatalysis.

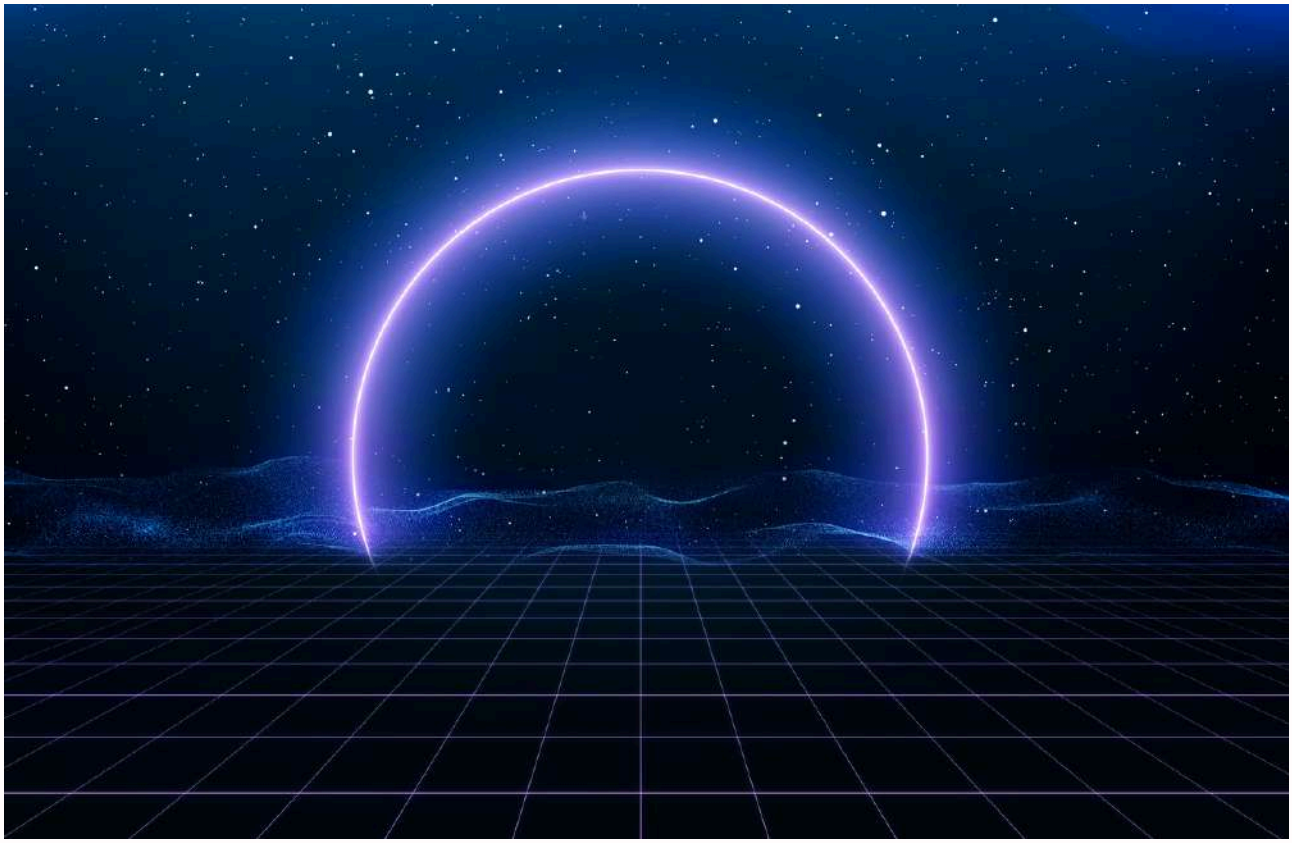
Using advanced supercomputing, they showed that a specific material combination (GaTeCl/InTeBr) can split water to produce hydrogen and solar fuels like methanol, offering clean energy alternatives. These materials also help break down pollutants, paving the way for cleaner air and water.

Can Tripura's Fermented Bamboo Shoots Unlock New Solutions for Weight Management?

This research can benefit the health and wellness industry for developing natural anti-obesity supplements and functional foods.

Researchers at the Institute of Advanced Study in Science and Technology (IASST) have found that Melye-amiley, a traditional fermented bamboo shoot from Tripura, has promising anti-obesity effects. The extract reduces fat storage and boosts energy usage by activating fat-burning genes and enhancing mitochondrial activity through a natural cellular process. These effects improve weight management and metabolic health by increasing fatty acid breakdown.

This discovery highlights the potential of fermented bamboo shoot extracts in creating natural weight management products, offering industries in health, wellness, and functional foods a new, sustainable ingredient for combating obesity.



How UVIT Discoveries in Andromeda Could Drive Innovation in Space Tech and Imaging Systems?

This research showcases the potential of UV telescopes like UVIT in astrophysical studies and could inspire future space missions in UV and X-ray spectroscopy, benefiting industries involved in space technology, data analytics, and advanced imaging systems.

Astronomers from the Indian Institute of Astrophysics (IIA), Bengaluru, have detected far ultraviolet emissions from 42 novae in the Andromeda galaxy, catching 4 of them during their explosive outbursts. Using data from AstroSat's Ultraviolet Imaging Telescope (UVIT), the team studied these binary star systems where white dwarfs accumulate matter from their companions, eventually leading to dramatic nova eruptions. These findings help trace the life cycle of novae and provide insights into galactic chemical enrichment and thermonuclear processes.

Thank you for reading!

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