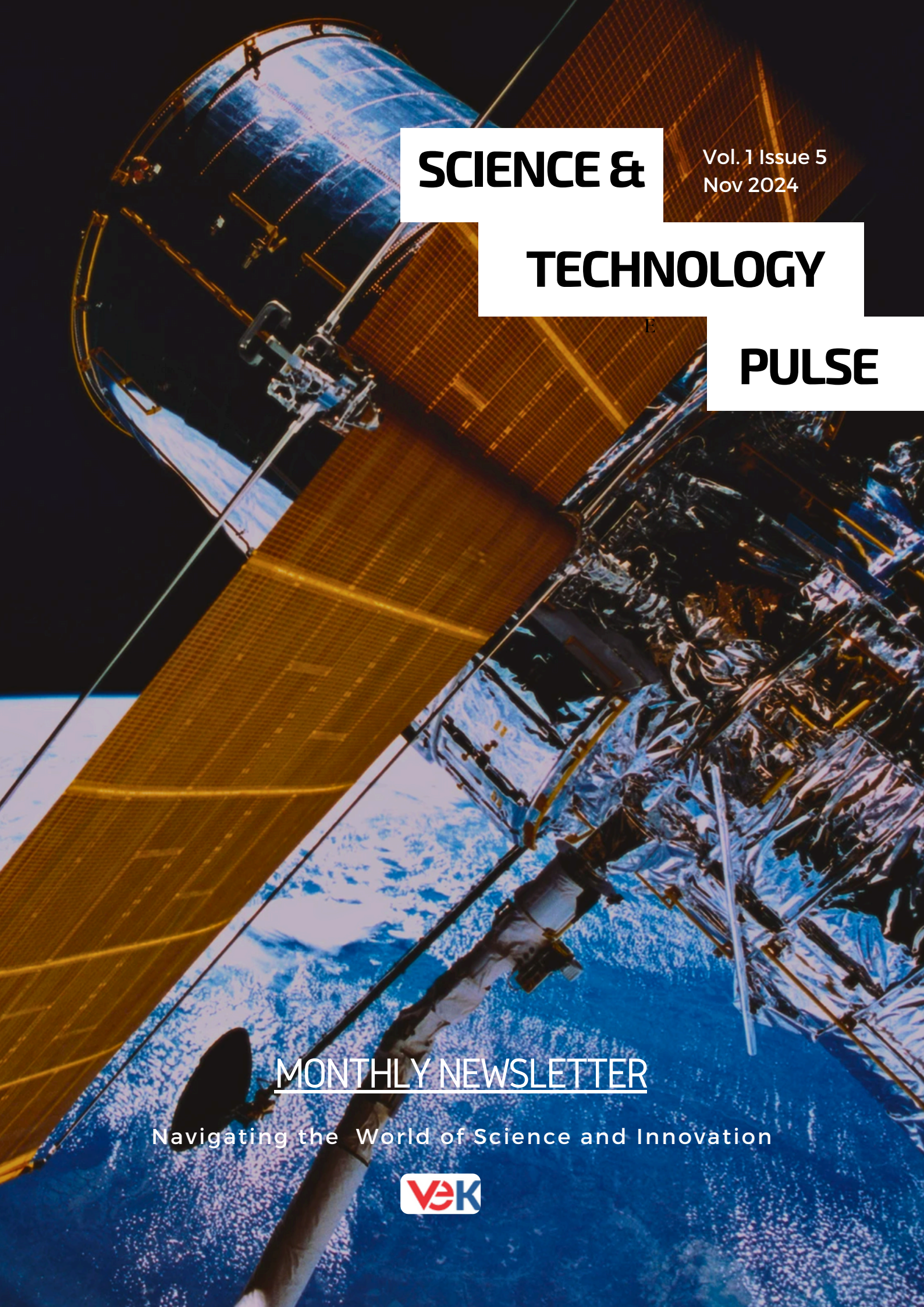

SCIENCE & TECHNOLOGY PULSE

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MONTHLY NEWSLETTER

Navigating the World of Science and Innovation

Ni-W Multilayer Coatings Revolutionize Industrial Component Durability

This innovation can significantly ***enhance the durability and energy efficiency of components in the automotive, machinery, and aerospace industries*** *by reducing wear, friction, and energy losses in gears and moving parts.*

Researchers from ARCI, India, have introduced a sustainable pulsed electrodeposition technique for Ni-W alloy coatings, designed with a multilayered architecture to improve wear resistance and mechanical performance. These coatings consist of alternating layers: nanocrystalline layers with high tungsten content (low thermal diffusivity) and microcrystalline layers with lower tungsten content (high thermal diffusivity). This structure manages heat dissipation effectively during friction, reducing residual stress by 80-90% compared to monolithic Ni-W and hard chrome (HCr) coatings. Additionally, these coatings show superior durability, achieving a wear rate half that of monolithic Ni-W coatings and one-third that of HCr coatings. The innovative method uses a single electrolyte, simplifying industrial scalability. A thin WO3 tribofilm formed during sliding further minimizes friction and wear, enhancing the overall service life of moving parts.

For more details :
https://www.sciencedirect.com/science/article/abs/pii/S0301679X22007162?via%3Dihub

In this newsletter you can expect updates from:

- Emerging Technologies
- Government Initiatives
- Food and Agriculture
- Environmental Science
- Health and Medicine
- Space Exploration

Indian Researchers Develop Tunable Piezoelectric Nanomaterials

*This advancement is particularly transformative for **the healthcare, energy, and electronics sectors,** enabling efficient and adaptable materials for sensors, wearable devices, and energy-harvesting solutions.*

Indian researchers from CeNS and JNCASR have developed peptide-based nanostructures with tunable piezoelectric properties by controlling the self-assembly pathways of peptides through parameters like temperature and solvents. These materials generate electric charges under mechanical stress, making them ideal for applications in energy harvesting, sensors, flexible electronics, and biomedical devices. The study also revealed rare chiroptical switching during peptide denaturation, which influences nanostructure formation. Supported by ANRF, this innovation paves the way for customizable smart materials for diverse technological applications.

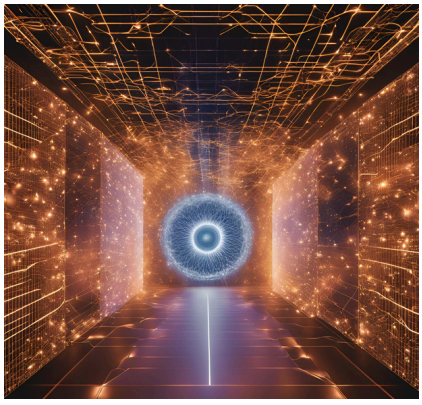
For more details:
https://pubs.rsc.org/en/content/articlelanding/2024/sc/d4sc05016a

Pioneering Glassy Memory: Indium Selenide Enables Energy-Saving Data Storage

*This innovation is transformative for **the electronics and memory storage** industries, enabling energy-efficient and compact memory solutions for smartphones, laptops, and advanced computing systems*

Researchers from IISc Bangalore, Penn Engineering, MIT, and Harvard have discovered that indium selenide, a 2D ferroelectric material, can self-transform into a glassy phase through ultralow-power electrical shocks, eliminating the need for the high-energy melt-quench process. This mechanism, published in Nature, reduces power consumption in phase-change memory (PCM) devices by a billion times. By inducing structural collapse through nanoscale defects and domain interactions, This method promises revolutionary advancements in data storage technologies, particularly for low-energy devices like cell phones and computers.

For more details:
https://www.nature.com/articles/s41586-024-08156-8



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.

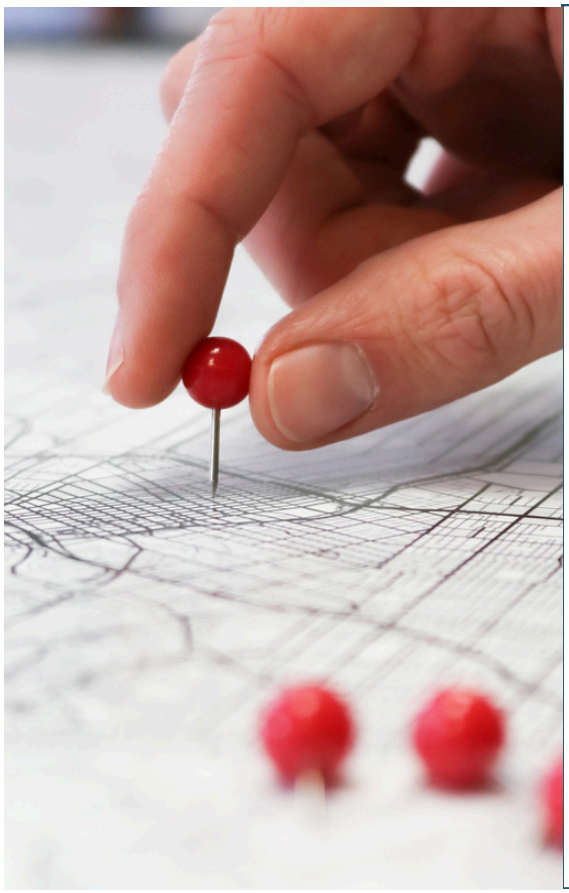
For more details:
https://dst.gov.in/dr-jitendra-singh-announces-selection-eight-pioneering-startups-support-under-national-quantum

Collaborative Efforts to Strengthen India's Geospatial Ecosystem

Geospatial technologies offer transformative potential for ***industries such as agriculture, transportation, and infrastructure, enabling data-driven solutions to improve efficiency, precision, and sustainability.***

Policymakers, experts, and industry leaders convened at the National Workshop on Strengthening the Geospatial Ecosystem in New Delhi, emphasizing collaborative efforts to implement the National Geospatial Policy 2022. Organized by the Survey of India under DST, the event showcased initiatives like Operation Dronagiri, leveraging geospatial technologies for agriculture, infrastructure, and livelihoods. Discussions focused on reducing duplication, enhancing collaboration, establishing a modernized National Geodetic Reference Frame, and advancing skill development. These measures aim to position India as a global leader in geospatial innovation and sustainable development.

For more details ;
https://dst.gov.in/national-workshop-deliberated-strengthening-indias-geospatial-ecosystem



Operation Dronagiri: Transforming India's Geospatial Future

This initiative opens ***opportunities for startups and industries in logistics, infrastructure, and environmental monitoring****, enabling scalable solutions for nationwide applications.*

The Department of Science and Technology (DST) launched Operation Dronagiri, a pilot initiative under the National Geospatial Policy 2022, aimed at showcasing the integration of geospatial data and technology to improve agriculture, livelihoods, logistics, and transport. Piloted in five states, it is supported by the Integrated Geospatial Data Sharing Interface (GDI), enabling data-driven solutions for urban planning, disaster management, and environmental monitoring. A Grand Challenge will foster geospatial startups to develop innovative solutions, with implementation overseen by IIT Tirupati and accelerators at top institutions.

For more details:
https://dst.gov.in/operation-dronagiri-launched-along-gdi-marking-milestone-national-geospatial-policy

Transforming Indian Research with PAIR program

*The program benefits **industries like technology, pharmaceuticals, and engineering by nurturing innovation ecosystems**, supporting skilled workforce development, and driving cutting-edge research collaborations.*

The Anusandhan National Research Foundation (ANRF) launched the Partnerships for Accelerated Innovation and Research (PAIR) program to enhance research excellence in Indian universities. This mentorship-driven initiative pairs top-tier institutions (hubs) with emerging universities (spokes) to foster innovation, improve research infrastructure, and bridge institutional gaps. In its first phase, hubs include top NIRF-ranked institutions, while spokes are central and state universities, select NITs, and IIITs. Each network involves multi-departmental teams across institutions, promoting regional diversity and impactful research aligned with the National Education Policy 2020.

For more details:
https://www.anrfonline.in/ANRF/PAIR?HomePage=New

Advancing Agriculture with Eco-Friendly Nanopesticides

*This innovation is highly beneficial for **the agrochemical and organic farming sectors,** enabling cost-effective, sustainable pest control solutions that meet the increasing demand for eco-conscious agricultural practices.*

Researchers have developed a nanopesticide system that improves pesticide efficiency and reduces environmental impact. Encapsulating active ingredients in microscopic carriers, these nanopesticides adhere more effectively to plant surfaces by optimizing their surface chemistry. Using a mix of Ethyl Lauroyl Arginate (ELA) and neem seed extract, the system ensures up to 90% reduction in pesticide waste and enhances crop protection for fruits, vegetables, and cereals. This approach addresses gaps in current methods, where over 80% of pesticides miss their target, leading to pollution and economic losses. The eco-friendly solution also minimizes harm to non-target organisms and human health.

For more details:
https://www.sciencedaily.com/releases/2024/12/241206162002.htm

Biodegradable Microbeads for Beauty and Food Industries

*This innovation aids the **beauty and food industries** by offering eco-friendly alternatives to microplastics and enabling nutrient fortification in challenging environments.*

MIT researchers have developed biodegradable polymers to replace harmful plastic microbeads used in beauty products and to encapsulate nutrients for food fortification. These polymers, derived from poly(beta-amino esters), degrade into sugars and amino acids and withstand extreme conditions like boiling water and high humidity. Demonstrated applications include bouillon cubes fortified with vitamins and effective cleansers outperforming traditional microbeads.

Backed by funding from the Gates Foundation and NSF, the innovation could address global microplastic pollution while enhancing food and beauty product sustainability.

For more details:
https://news.mit.edu/2024/new-biodegradable-material-could-replace-certain-microplastics-1206

Enzyme-Driven Biofuel: Efficient Alternative to Diesel from Food Waste

*This innovation offers a **sustainable alternative for the logistics and aviation industries,** providing biofuels that match diesel's efficiency while reducing reliance on fossil fuels. It also supports pharmaceutical manufacturing by improving eco-friendly chemical production processes.*

Researchers from King's College London and the Brazilian Biorenewables National Laboratory have developed a groundbreaking method to produce biofuels from leftover cooking oil, achieving efficiency 1,000 times higher than current methods. By modifying the P450 enzyme and using UV light in liquid salt, they created a fuel matching diesel's energy standards while requiring fewer raw materials and no harmful catalysts like platinum. This sustainable approach cuts costs, greenhouse gas emissions by up to 94%, and extends potential use to aviation fuels and pharmaceuticals production.

For more details:
https://www.kcl.ac.uk/news/from-chip-shop-to-pit-stop-scientists-make-cooking-oil-biofuel-as-efficient-as-diesel

A Game-Changer in Asthma and COPD Treatment: Benralizumab Injection

*This development **offers pharmaceutical and biotech industries** an opportunity to repurpose existing biologics for broader respiratory conditions, potentially reducing healthcare costs and advancing personalized medicine in respiratory care.*

A study published in The Lancet Respiratory Medicine shows that benralizumab, a monoclonal antibody used for severe asthma, significantly reduces the need for further treatment in asthma and COPD attacks by 30%. The injection targets eosinophils, reducing inflammation more effectively than traditional steroid tablets, which often have severe side effects. The ABRA trial revealed improved symptoms, fewer hospitalizations, and better quality of life for patients. This research could transform treatment for over a billion people globally and addresses a 50-year stagnation in therapy options.

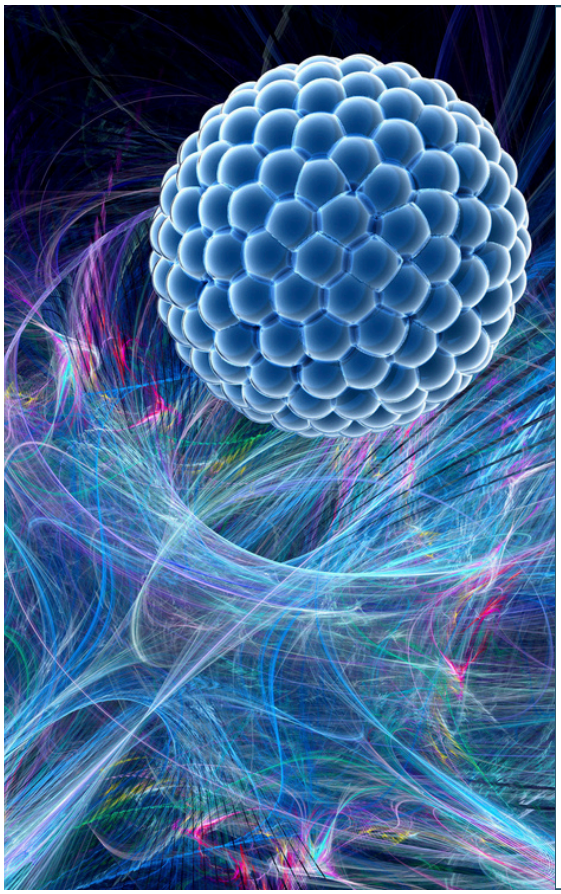
For more details:
https://www.news-medical.net/news/20241127/New-injection-treatment-could-be-a-game-changer-for-people-with-asthma-and-COPD.aspx

HIV Detection with GQ-RCP Platform: A Game-Changer in Diagnostics

*The **healthcare and diagnostic sectors** can leverage this technology for more reliable pathogen detection, enhancing outcomes in infectious disease management and public health monitoring.*

Researchers at JNCASR have developed the GQ Topology-Targeted Reliable Conformational Polymorphism (GQ-RCP) platform, a novel diagnostic technology for precise detection of HIV by targeting its unique G-Quadruplex (GQ) DNA structure. Utilizing a fluorescent probe (TGS64), the method significantly reduces false positives and enhances reliability. Originally designed for SARS-CoV-2, this versatile platform demonstrates modularity for various DNA/RNA pathogens. Published in Analytical Chemistry, the study highlights its ability to improve diagnostic accuracy by distinguishing specific nucleic acid sequences.

For more details ;
https://pubs.acs.org/doi/10.1021/acs.analchem.4c03374

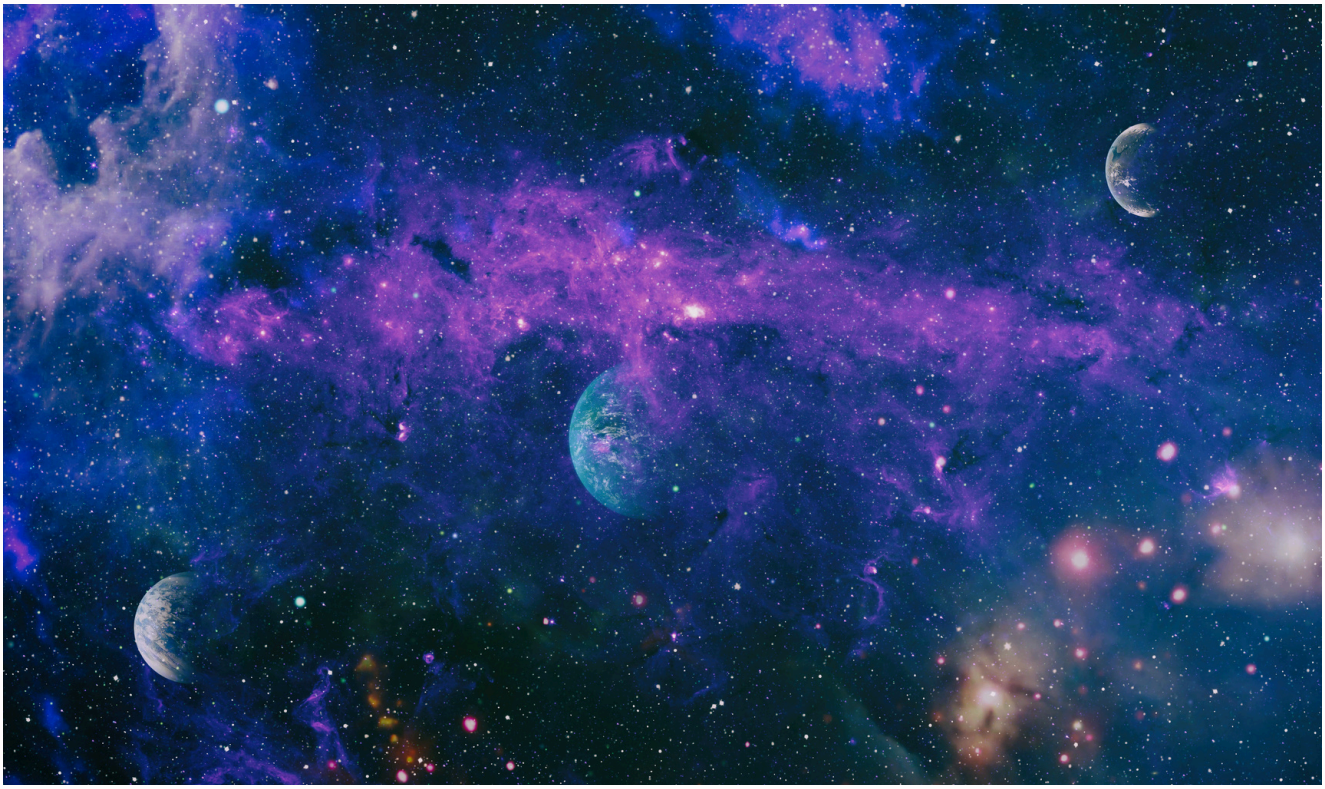


Advancing Nanozyme Applications for Durable Biomaterials in Medicine

*Nanozyme-based collagen stabilization **boosts pharmaceutical, biomedical, and tissue engineering industries** by improving collagen-based biomaterials. This advancement enhances applications like wound healing, prosthetics, and drug delivery, ensuring longer product lifespans and more efficient medical treatments.*

Researchers at CSIR-Central Leather Research Institute (CLRI) have advanced nanozyme applications by showcasing their ability to enhance biomaterials like collagen for medical use. Using manganese-based nanozymes, they developed a method to crosslink collagen, improving its resistance to degradation while preserving its structure. Additionally, a copper-based nanozyme design within a metal-organic framework addressed challenges of enzyme selectivity and specificity.

For more details:
https://pubs.rsc.org/en/content/articlepdf/2024/sc/d4sc03767g



Unlocking the Mystery of Fiery Hot Gas Around the Milky Way

This research aids the space exploration and astrophysics industries, offering data critical for refining X-ray telescopes, star-formation models, and interstellar medium studies.

Researchers from the Raman Research Institute, IIT-Palakkad, and Ohio State University revealed that supernova explosions in the Milky Way's stellar disc are key to heating and enriching surrounding gas, creating fiery regions emitting faint X-rays. Their model explains how turbulent gas, enriched with α-elements like sulfur and magnesium, either escapes or falls back into the disc. This dual process clarifies the origin of hot absorbing and emitting gas observed in X-ray signals. Findings, published in the Astrophysical Journal, promise deeper insights into stellar processes and galactic dynamics.

For more details:
https://phys.org/news/2024-11-veil-fiery-gas-revealed-disk.html

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