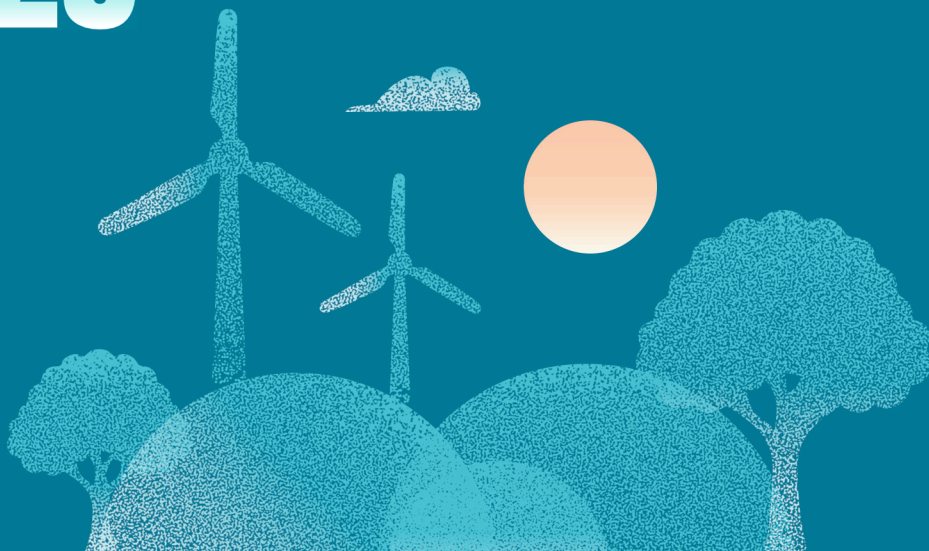


IISc and Society

2025



Foreword

Science is not static; it changes over time, reflecting shifts in the larger societies in which it is embedded

The Indian Institute of Science (IISc) has strived to keep pace with changing relations between science and society since its founding in 1909. The Institute has contributed to India's economic growth by training leaders in science and engineering. It has responded to the demands of globalisation through collaborative research and innovation. In some instances, this has resulted in the development of cost-effective innovations and inventions that have a direct impact on people and society.

Responding to the need to address societal concerns such as the availability of adequate clean water, urban development and housing, development of alternative and cheaper forms of energy, and a clean and green environment, IISc researchers have carried out trans-disciplinary research in these areas. The Institute has also incubated several startups that seek to tackle complex and challenging problems of relevance to society. In addition, as part of its outreach activities, the Institute organises public lectures, exhibitions, and an annual Open Day during which all the departments are thrown open to the general public. IISc faculty members also deliver science-based lectures at schools and colleges.

Beyond individual projects, we also seek to pursue large-scale, grand missions that address problems that scale across the country and abroad. For example, we are in the process of establishing the Tata IISc Medical School – in partnership with the Tata Group – and the Bagchi-Parthasarathy Hospital – supported generously by the Bagchi and Parthasarathy families – to catalyse unique clinical research and teaching models in India, and to bring basic science and engineering to bear on clinical science and practice. Such endeavours can create benefits for society that ripple across generations.

Although globalisation has impacted the social institution of science and transformed it radically, we need to ensure that we are committed to open disclosure of research, building channels for knowledge flow, and enabling free circulation of knowledge in the interests of society at large, wherever possible. Its commitment also lies in moving beyond mere popularisation of science to engaging with the public to enable researchers to effectively respond to people's needs and the public to effectively contribute to science.

Govindan Rangarajan
Director, IISc

December 2025

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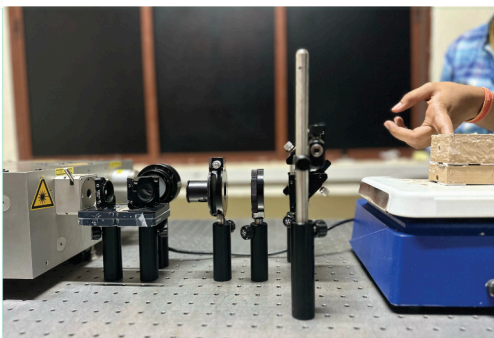
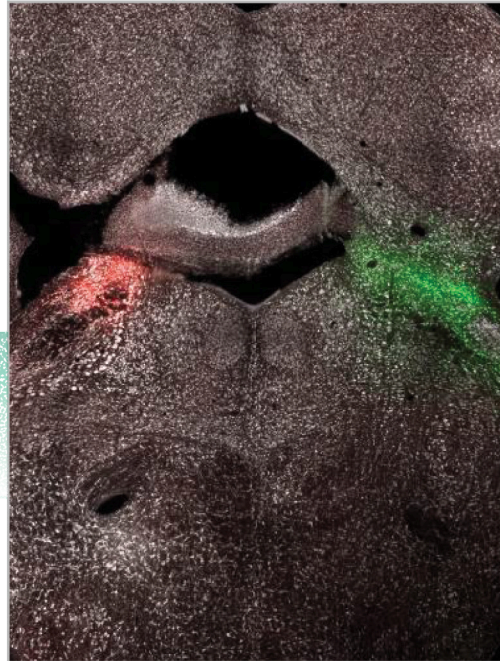
Public Outreach
& Engagement

Health & Medicine



Identifying brain regions that drive pain response

Chronic physical pain can be debilitating, but feelings of stress, fear, and hunger can sometimes suppress painful sensations. Scientists at the Center for Neuroscience have now found out how different neurons work together to control chronic pain in mice. Working with mice having chemotherapy-induced peripheral neuropathy (CIPN), the researchers discovered that both excitatory and inhibitory inputs converge onto the same set of lateral parabrachial nucleus (LPBN) neurons, which – based on the intensity of the inputs – take the call on whether to reduce licking (when the pain is less) or increase licking (when the pain is more). Such insights can help researchers devise better therapeutic strategies for chronic pain management.

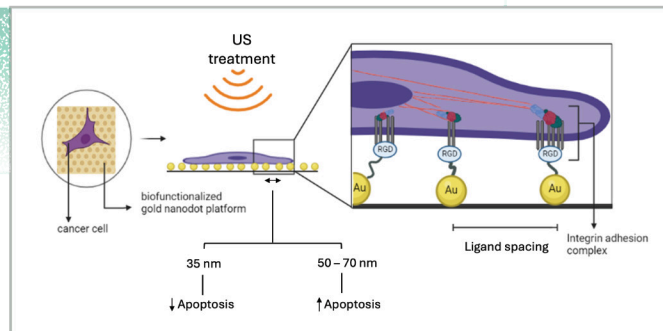


Detecting glucose through painless photoacoustics

People who have diabetes struggle with repeated use of needles to check blood glucose levels. A new technique developed by researchers at the Department of Instrumentation and Applied Physics offers an alternative. When a laser beam is shone on biological tissue, the tissue components absorb the light, and the tissue heats slightly (less than 1°C). This causes the tissue to expand and contract, creating vibrations which can be picked up as ultrasonic sound waves by sensitive detectors. Different materials and molecules – like glucose – inside the tissue absorb different amounts of the incident light at different wavelengths, creating individual “fingerprints” in the emitted sound waves. Importantly, this procedure does not damage the tissue sample being studied.

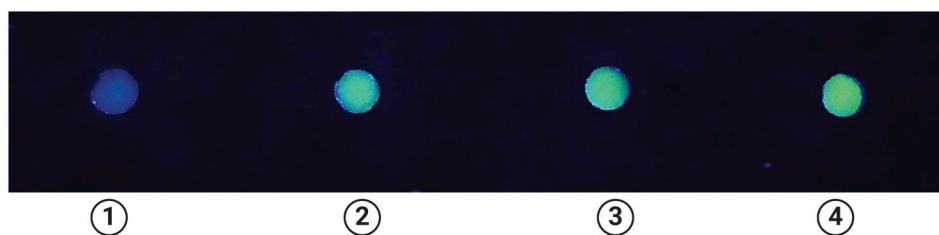
Tweaking cancer cell response to ultrasound treatment

Cancer cells bind to the extracellular matrix (ECM) using surface receptors called integrins. Researchers from the Department of Bioengineering show that tweaking this binding can boost ultrasound treatment. In tumours, excessive ECM secretion narrows the binding site spacing to under 35 nm, reducing treatment effectiveness. The team showed that a spacing of 50–70 nm causes cancer cell membranes to stretch due to forces exerted by a filament protein called myosin. More extracellular calcium is then pumped into the cytoplasm, which damages mitochondria and promotes cell death in cancer cells when exposed to low-frequency ultrasound. The team also found that combining this with a low dose of Cilengitide – a drug that blocks integrin binding – can trick cells into sensing wider spacing.



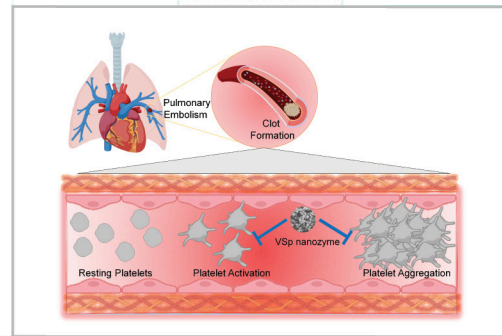
Simple sensor for liver cancer

Researchers at the Department of Organic Chemistry have developed a unique luminescent probe using terbium, a rare earth metal, to detect β -glucuronidase, an enzyme linked to liver cancer as well as colon, breast, and renal cancers, and infections of the urinary tract and AIDS. The team found that terbium ions couched in a gel matrix derived from bile salts can emit green fluorescence. When β -glucuronidase pre-treated with modified 2,3-DHN is added, the disc exhibits a much stronger green glow under UV light. Unlike conventional high-end fluorescence detection systems, these sensors can be analysed using a UV lamp and ImageJ, a freely accessible software, making this technique ideal for resource-limited settings.



Novel nanozyme prevents excess clotting

Researchers at the Department of Inorganic and Physical Chemistry have developed an artificial metal-based nanozyme that can potentially be used to clamp down on abnormal blood clotting caused by conditions like pulmonary thromboembolism (PTE). The team found that spherical-shaped vanadium pentoxide (V_2O_5) nanozymes were the most efficient. These materials mimic a natural antioxidant enzyme called glutathione peroxidase to reduce oxidative stress. The team injected the nanozyme in a mouse model of PTE and found that it significantly reduced thrombosis and increased the animals' survival rates. The team now plans to explore the efficacy of the nanozyme in preventing ischemic stroke, which is also caused by clogging of blood vessels.



Startups

Agamiseq Technologies Private Limited is a startup focused on developing advanced automated biotechnology systems with founders and directors from the Centre for Nano Science and Engineering, IISc. Their solutions are designed to enable early-onset disease diagnosis, driving transformative advancements in healthcare and precision medicine to transform the global healthcare landscape, and fostering a healthier, more equitable future for all.

Mynvax, a clinical stage vaccine biotechnology company with a co-founder from the Molecular Biophysics Unit, IISc, was founded with the singular vision of developing novel, improved, recombinant, thermostable vaccines to protect against respiratory viral infections.

MIMYK is a deep-tech spin-off from IISc, building intelligent and immersive solutions for medical procedures. These systems are powered by AR/VR, Robotics, and Visual Computing technologies. The technologies being developed at MIMYK have the potential to change medical procedures by improving access, outcome, safety, and efficiency.

PathShodh Healthcare Private Limited is focused on making healthcare diagnoses affordable and accessible. Founded on research from the Centre for Nano Science and Engineering at IISc, the company's products leverage bio-sensing technology to improve chronic disease management. Their unique handheld device can measure multiple biomarkers specifically targeting diabetes, kidney disease, anemia, malnutrition, and liver-related ailments.

Environment & Sustainability



Anthropogenic changes threaten Eastern Himalayan birds

Researchers at the Centre for Ecological Sciences studied how changes in forest microclimates after selective logging influence the survival of wild bird populations in the Eaglenest Wildlife Sanctuary, Arunachal Pradesh, over 10 years (2011-2021). The team found that logged forests are consistently hotter and drier during the day and colder at night – in comparison to primary forests – exposing birds to stressful fluctuations due to loss of the forest canopy. The study highlights the significance of understanding why certain species of birds are declining after logging, and how microclimatic niches in disturbed habitats influence population dynamics.



The GRAMA project: Empowering farmers

Agriculture in India is greatly influenced by nature; stochastic climate conditions and global warming make farming both challenging and volatile. Small and marginal farmers often face a vicious cycle of low growth, low income, and high debt. In response, the GRAMA project led by researchers at the Department of Computer Science and Automation seeks to leverage artificial intelligence and game theory-based techniques for improving the efficiency of agricultural planning and operations. The GRAMA project stands for **G**ame Theory, **R**andom Processes, **A**rtificial Intelligence, and **M**achine Learning for **A**griculture.

1. Crops
Crop Planning System

4. Prepare
Price Prediction for Agriculture

2. Acre
Agri Crop Recommendation

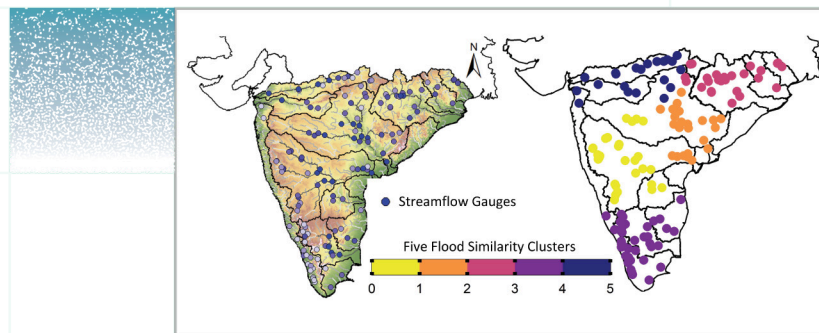
5. Prosper
Protocols for Optimal Selling of Produce for Enhanced Revenue

3. Promise
Procurement Mechanisms for Inputs and Services

6. Agri-Vaahan
AIML Pipeline for Agriculture

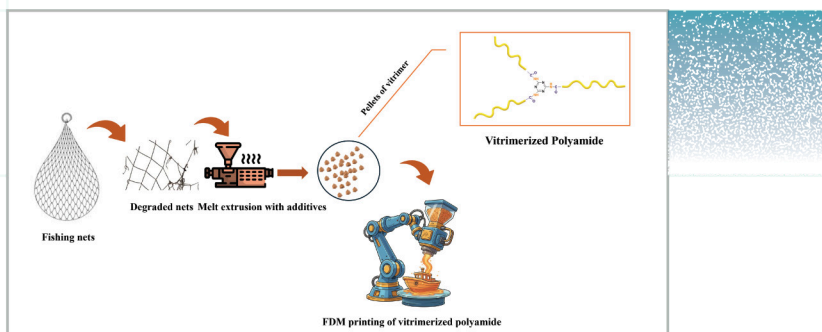
Predicting floods by studying river basins

India is the second-most flood prone country in the world. About half of the casualties due to natural disasters are purely due to flooding. But what if we could predict when or where it could happen? Researchers at Department of Civil Engineering are currently on a mission to revitalise the mapping of India's river floods. By analysing long-term data from 137 river gauging stations, they found that floods often occur simultaneously across multiple river basins, challenging traditional basin-by-basin flood assessments. Their work uses regional statistical modelling to better capture large-scale flood behaviour influenced by climate variability and extreme rainfall. This research addresses critical data gaps, considers the role of reservoirs, and provides insights that can improve flood forecasting, infrastructure planning, and disaster management, ultimately reducing vulnerability to floods.



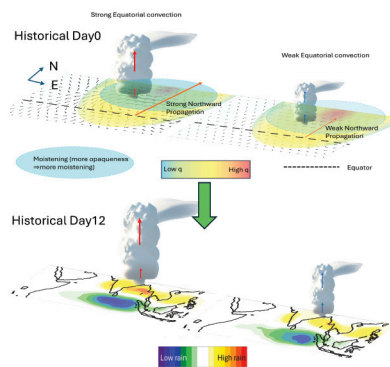
Better methods to recycle plastic waste

A new study from the Department of Materials Engineering describes a rapid method to recycle commonly used plastic. Researchers used a novel chemical process to recycle waste sourced from fishing nets and automotive parts made of a type of polymer called PA-66 (Polyamide 66, commonly called Nylon 66), which is challenging to reprocess. The process involves introducing a chemical cross-linker named melamine into the melted waste containing PA-66 in the presence of a catalyst. The recycled PA-66 made using their process was tested to 3D print objects, including a chair and a speedboat. Improved recycling processes for polymers like PA-66 can give used plastic a new lease of life, while also incentivising waste collection. The faculty member leading the project is also the co-founder of a startup called VOiLA3D that uses such recycled materials to design products for households and civil infrastructure.



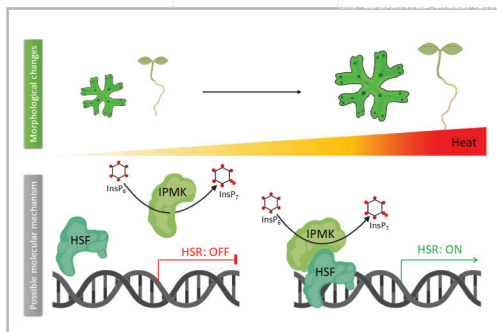
Cloud band strength influences Indian monsoon

A recent study from Centre for Atmospheric and Oceanic Sciences has shown that contrary to previous understanding, the strength of a cloud band plays a key role in its movement and the density of rains that the Indian subcontinent receives during wet spells of the monsoon. This contrasts with theories which had suggested that regardless of the strength of disturbance at the equator, the cloud band propagates northward. The IISc team found that the robust northward propagation of the Boreal Summer Intraseasonal Oscillation (BSISO) occurs only when the equatorial cloud band is strong. This strong cloud band increases moisture in the atmosphere over the subcontinent via stronger winds and triggers northward propagation.



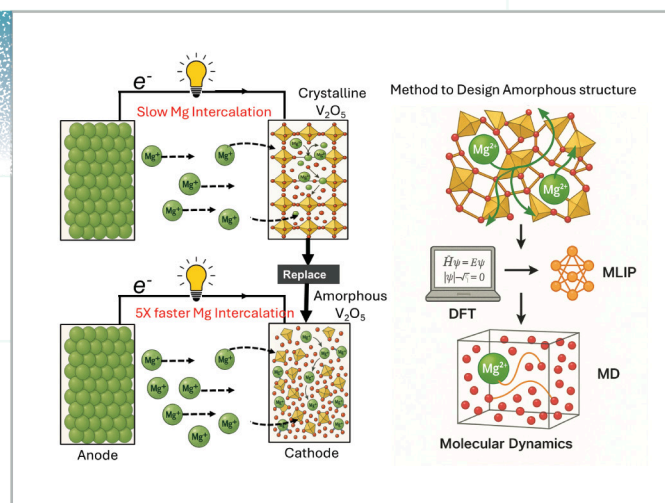
How plants fight against extreme heat

A study by researchers at the Department of Biochemistry, IISc, in collaboration with the University of Freiburg, Germany, uncovered how plants use a conserved internal signalling molecule, 4/6-InsP₇, to survive extreme heat. Found across land plants from ancient liverworts to modern species like *Arabidopsis thaliana*, this molecule helps regulate heat stress responses by interacting with heat shock factors that activate protective genes when temperatures rise. Plants lacking the enzymes that produce 4/6-InsP₇ show reduced heat tolerance, highlighting its key role. Understanding this natural heat-stress mechanism can guide the development of crops with improved resilience to rising global temperatures, aiding sustainable agriculture in a warming world.



Building better batteries

Lithium-ion batteries power most electronics, but they have limited energy density – they can store only a certain amount of energy per mass or volume of the battery. Researchers at the Department of Materials Engineering have studied how to boost the movement of ions in magnesium batteries, which can have a higher energy density. In a new study, using a machine learning model, they show that using amorphous materials as positive electrodes to build these batteries can significantly increase their rate of energy transfer. The work offers a new path toward energy-dense, faster-charging batteries, though experimental validation is still needed.

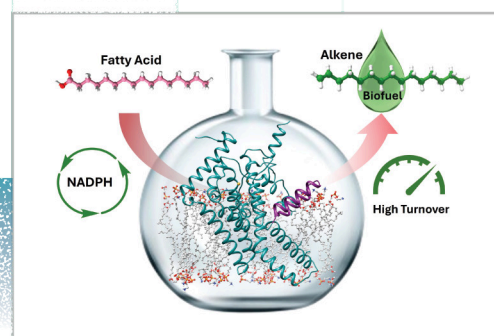


Impacts of livestock grazing in the Himalayas

Domestic grazers are increasingly replacing wild herbivores in ecosystems around the world, leading to insidious changes in soil characteristics and vegetation patterns. A long-term study by the Centre for Ecological Sciences in Spiti Valley shows that this replacement can drastically influence the numbers of ground-dwelling arthropods like spiders, as well as that of ticks and mites that can spread vector-borne diseases. Areas grazed by livestock had greatly reduced spider populations, and larger numbers of grasshoppers and disease carriers like ticks and mites. The researchers suggest that steps need to be taken towards "rewilding" native herbivores and improved surveillance of vector-borne disease risks. The findings also underscore the need for effective conservation policies.

Biocatalytic platform for green hydrocarbon production

Researchers at the Department of Inorganic and Physical Chemistry have developed an environment-friendly, highly efficient cell-free enzyme system that converts fatty acids into 1-alkenes – versatile hydrocarbons that can serve as “drop-in” biofuels, polymer feedstocks, or pharmaceutical precursors. The team integrated a bacterial metallozyme called UndB into a self-sustaining cell-free system that mimics the biological reaction environment without relying on living cells. The team’s biocatalytic platform provides an alternative to synthesis from petrochemicals.



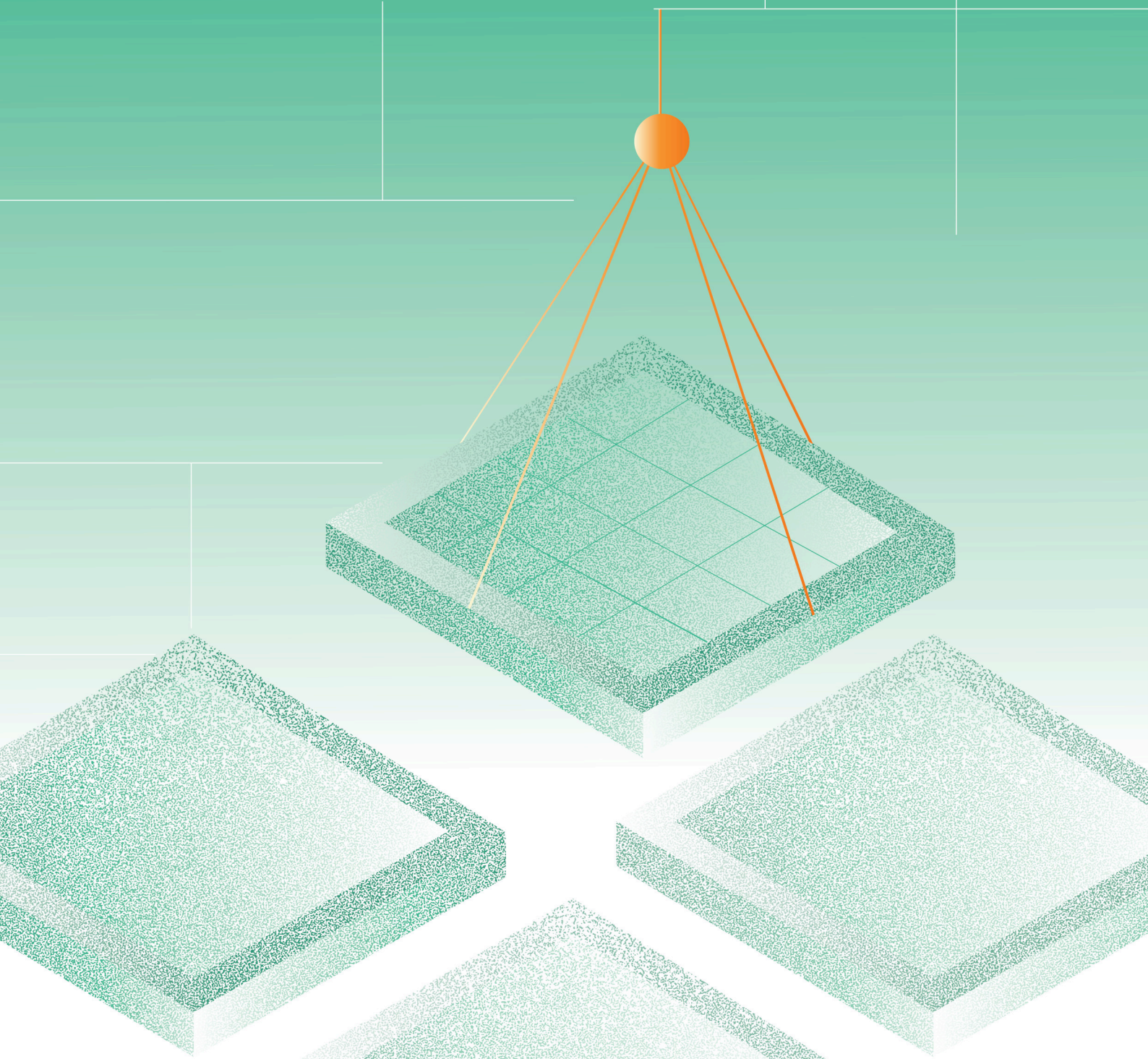
Startups

ABX3PV Private Limited, founded by a team at the Centre for Nano Science and Engineering, specialises in the development of next-generation perovskite solar cell modules. With a focus on early commercialisation and an environment-friendly approach, the company emphasises eco-conscious manufacturing practices and contributes to the development of a cleaner and more sustainable future. Its products will be ultra-lightweight and more efficient for powering high-altitude drones, satellites, indoor PV for IoT devices, electric vehicles, and agrivoltaics.

NOVACRET, co-founded by faculty members at the Department of Civil Engineering, has formulated a clinker-free concrete technology called 'NOVACRET' which reduces carbon footprint, conserves water from curing, and attains target strength within three days.

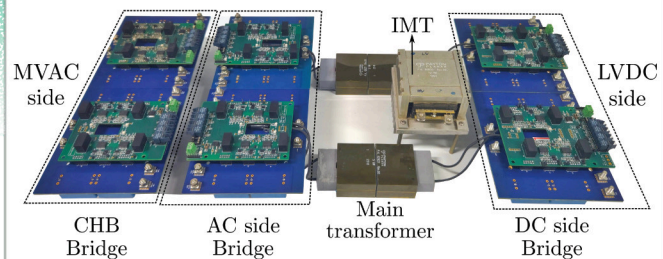
Sickle Innovations is a farming solutions company founded by IISc alumni with a core focus on improving conventional farming practices through design intervention. They closely work with farming communities to identify problems and challenges facing the agricultural sector and offer innovative solutions.

Engineering Solutions



Novel fast-charging solution for electric vehicles

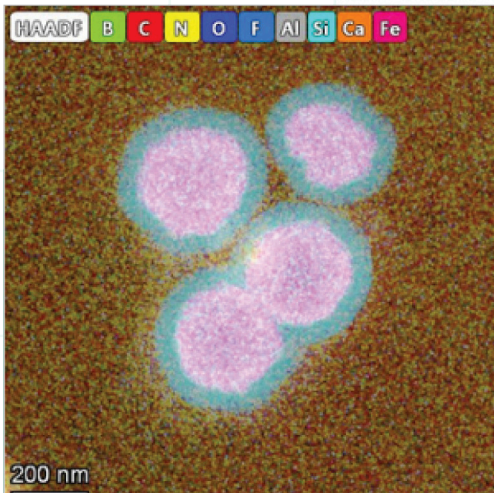
Researchers at the Department of Electrical Engineering, in collaboration with Delta Electronics India, have developed a novel cascaded H-bridge (CHB)-based multiport DC converter which eliminates the need for large and expensive line frequency transformers (LFTs). Such converters can help address the growing power demands of fast charging EV stations, crucial for scaling up India's EV infrastructure. At a megawatt scale, this leads to energy savings, significant reductions in cost, and a smaller material footprint, which makes the charging stations environmentally friendlier. It can also potentially support essential facilities like hospitals during a power outage. This project is part of a national effort to implement fast EV-charging technology across India within the next five years.



Magnetically guided nanobots relieve tooth sensitivity

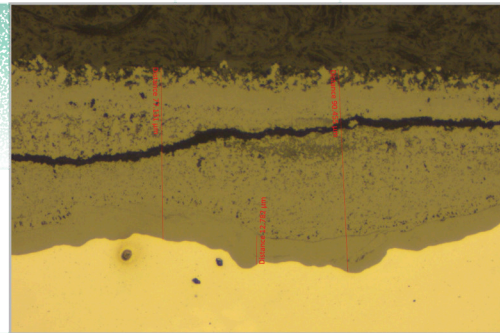
Dental hypersensitivity affects nearly one in four people worldwide. Most current solutions, such as desensitising toothpastes, offer only surface-level relief and need to be reapplied regularly.

Researchers from the Centre for Nano Science and Engineering, in collaboration with deep-tech startup Theranautilus, have now engineered CalBots – magnetic nanobots that can penetrate deep into dentinal tubules (tiny tunnels in teeth that lead to nerve endings) and form durable seals for worn enamel, offering lasting relief from sensitivity in just one application. The CalBots are composed entirely of materials classified as 'Generally Recognised as Safe' (GRAS), ensuring high biocompatibility. Toxicity tests on mice showed no adverse effects. By creating a regenerative, active nanomaterial, this is a step towards the possibility of "tiny mechanical surgeons."



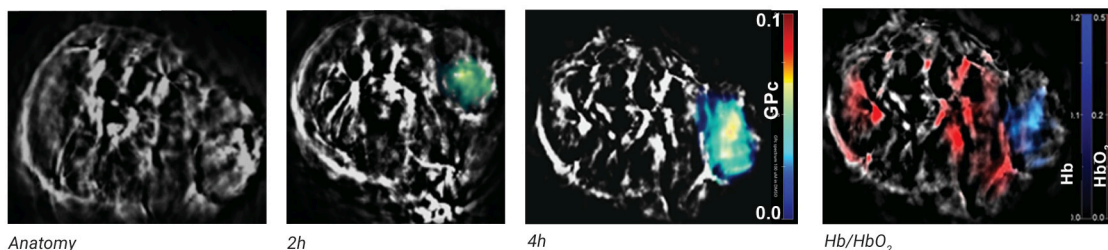
AI imaging to assess equipment corrosion

Researchers from the Department of Computational and Data Sciences, IISc and the Qatar Science and Technology Research Center (QSTRC) developed a new automated method to assess corrosion in industrial equipment using advanced machine learning and image analysis. The novel machine learning algorithm can analyse microscope images of corroded metal surfaces to estimate corrosion severity, without requiring human input. When microscopy images of metal surfaces are fed to the algorithm, it can quantify and infer key features that indicate the level of corrosion. Such a technique is promising for industrial maintenance and operations, and enables quantitative, data-driven corrosion assessment across facilities and sectors. Integrating it with digital monitoring systems can further contribute towards industrial digitalisation, offering meaningful benefits in safety, operational efficiency, and materials science research.



Novel photoacoustic contrast agent to visualise tumours

Tumour cells have higher metabolic activity and consume more glucose compared to healthy tissue. Positron Emission Tomography (PET) – the current gold standard diagnostic technique – can detect this difference but is expensive and poses the risk of radiation accumulation in case of repeated scans. To solve this, researchers from the Department of Bioengineering have developed a biocompatible small molecule that serves as a minimally invasive contrast agent for Photoacoustic (PA) Tomography, enabling safer and more sensitive detection of superficial tumours. Unlike the PA in a clinical setting, which relies on natural chromophores in the human body, this external molecule – not typically found in human cells – provides better sensitivity and contrast, which makes it easier to differentiate the target region from normal tissues.



Anatomy

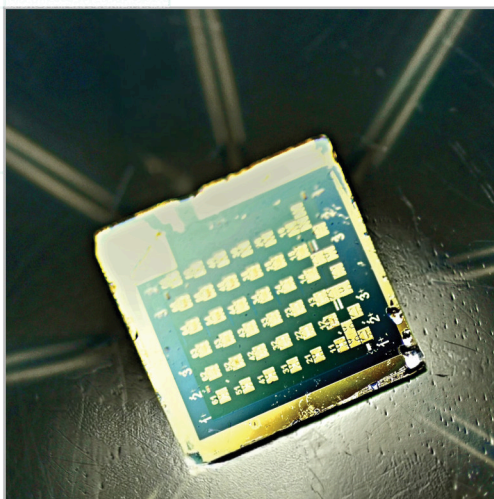
2h

4h

Hb/HbO₂

Using bacteria to fix cracked space bricks

Researchers at the Department of Mechanical Engineering have developed a bacteria-based technique to repair bricks that can be used to build lunar habitats. By filling defects in bricks with a slurry made from *S. pasteurii*, guar gum, and lunar soil simulant, the bacterium produced calcium carbonate and biopolymers, which together with the residual brick structure, restores the brick's strength. This process can stave off the need to replace damaged bricks with new ones, extending the lifespan of built structures. The team is currently working on a proposal to dispatch a sample of *S. pasteurii* into space as part of ISRO's Gaganyaan mission, to test their growth and behaviour under microgravity.

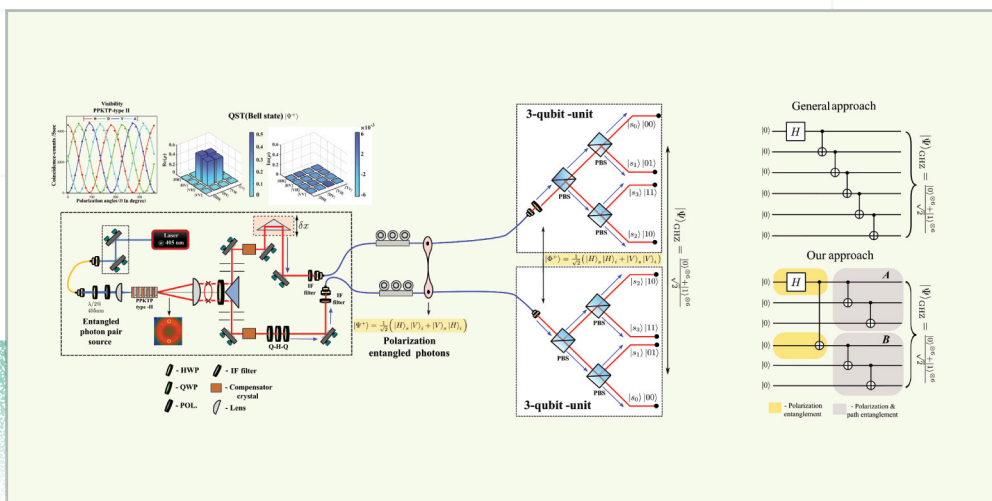


Indigenous high-power microwave transistors

For the first time in India, researchers at the Centre for Nano Science and Engineering have developed a fully indigenous gallium nitride (GaN)-on-silicon microwave transistor. Both the material stack (wafer) and the transistors were fully designed, fabricated, and tested at IISc. Most GaN microwave transistors are import-restricted because of their strategic importance in radars, jammers, electronic warfare and telecom infrastructure, making this indigenous development highly significant. Additionally, as most GaN microwave transistors are built on the relatively expensive silicon carbide (SiC) platform, transitioning to a more affordable GaN-on-silicon platform offers potential for large-scale, cost-effective manufacturing. The IISc team demonstrated transistors that deliver 8 W of power at 10 GHz – performance that is of considerable strategic interest.

Quantum computers using a packet of light

A classical computer stores information as bits in two states: ON (1) and OFF (0), while quantum computers use qubits. Like the former, quantum computers use their own set of operations similar to the classical AND, OR and NOT logic gates, called quantum gates. Researchers at the Department of Electronic Systems Engineering and Department of Instrumentation and Applied Physics have now designed universal quantum gates by manipulating single photons to function as a set of three qubits. Photonic qubits are naturally resistant to noise and can function efficiently at room temperatures, making them ideal for quantum computing. By experimentally showing how single photons can encode multiple qubits and implement multi-qubit gates deterministically, the study presents a leap forward towards creating quantum computers that can one day be used widely, just like classical computers.



Dataset and vision models for Indian urban traffic

The AI for Integrated Mobility (AIM@IISc) initiative, anchored at the Centre for Infrastructure, Sustainable Transportation and Urban Planning (CiSTUP), publicly released a large-scale traffic image dataset called UVH-26, and a suite of fine-tuned object detection models designed for Indian urban traffic scenarios. UVH-26 comprises 26,646 high-resolution traffic images from Bengaluru's Safe City project, annotated with 1.8 million bounding boxes across 14 India-specific vehicle classes, including two-wheelers, auto-rickshaws, light commercial vehicles, and buses. Such a large-scale and accessible dataset can accelerate the research and development of evidence-based, intelligent transportation planning in India.

Startups

AlgoBotix, a venture founded by a faculty member from the Department of Aerospace Engineering and IISc alumni, is a pioneering deep-tech venture offering solutions to UAV platform manufacturers, service providers, defense establishments, and various governmental organisations. They are committed to revolutionising industries via autonomous systems and delivering robust application-specific solutions that advance drone technology.

Mithra Increst Private Limited (MIPL), co-founded by a retired faculty member of the Department of Aerospace Engineering, is exploring concepts of industrial relevance that are economically viable and adopting innovative strategies. It extends work carried out at IISc in the areas of Waste-To-Energy (WTE) and Biomass based Renewable Energy (RE).

AGNIT Semiconductors Private Limited is a Gallium Nitride (GaN) semiconductor company based in India, co-founded by a team of professors and alumni of the Centre for Nano Science and Engineering. The company designs and manufactures GaN materials (wafers) and electronic components primarily for radio frequency applications. AGNIT's GaN components offer compelling performance-price-footprint advantages for the defense and telecommunication industries.

Public Engagement & Outreach



Training rural teachers

In 2009, IISc started a unique programme at its Challakere campus to train rural science and mathematics teachers. Built on the idea of teaching scientific concepts through experiments, this residential programme has trained more than 11,000 teachers from schools and colleges across the country. Following the Prime Minister's visit to IISc in 2015, the training centre was declared a Centre of Excellence under the Pandit Madan Mohan Malviya National Mission on Teachers and Teaching.



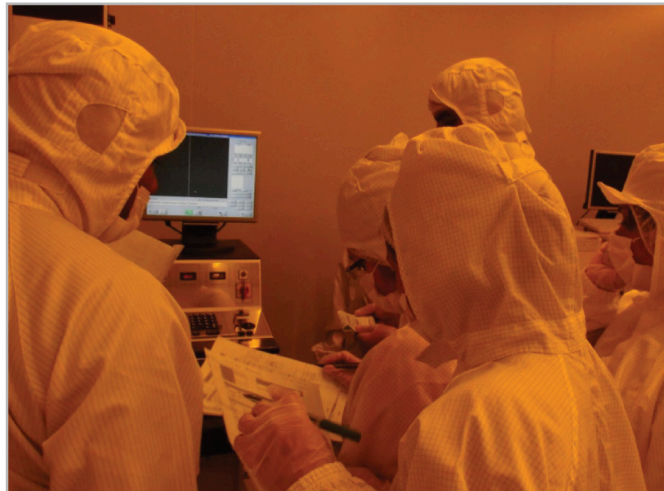
Training local community and engineers

The Skill Development Centre (SDC) at the IISc's Challakere campus was inaugurated in 2020. It is an outcome of a unique collaboration between Hindustan Aeronautics Limited (HAL) and IISc that imparts high-end skills in manufacturing, including aerospace, mechanical, electrical, and electronic sectors at multiple levels. The goal of the SDC is to create a large pool of trained personnel to address vital skill development gaps in our country, crucial for economic growth and self-sufficiency.



National capacity building in nanoelectronics

Launched in 2008, the Indian Nanoelectronics Users' Programme (INUP) is a unique initiative aimed at accelerating research and development in nanoelectronics in India. It not only aims to train researchers in using advanced equipment and facilities but also helps them kick-start new research projects and collaborations. The three-tier programme has trained more than 4,200 researchers from 450 institutions across India. It has also been offered to researchers in India's neighbouring countries such as Sri Lanka, Bangladesh, Myanmar, Maldives, Vietnam and Kazakhstan, through the Ministry of External Affairs.



Showcasing science and technology for the general public

An extremely popular annual event, Open Day is organised by IISc to welcome students and the general public into its campus to catch a glimpse of the various research activities and facilities. Attendees have the opportunity to visit the departments and centres, tour state-of-the-art labs, and interact with faculty members and students. Open Day features popular lectures, experimental demos, poster presentations, quiz contests, scientific competitions, and exhibitions. A special “Kids Zone” with demos and experiments is a popular attraction for young school children.



Raising awareness about climate change

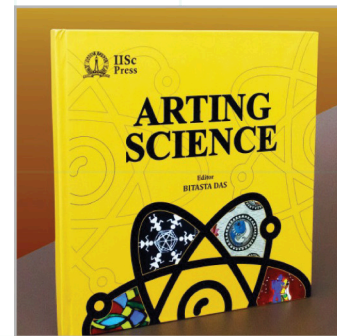
An annual Climate and Environment Science Quiz is organised at IISc for science and engineering college students, in order to raise awareness about climate change and mitigation mechanisms. While the focus of the quiz is climate change, it also includes topics such as weather, atmosphere and oceans, and renewable energy. Hundreds of students from colleges across the city participate each year. The quiz aims to strengthen the students' knowledge and awareness of climate change issues and inspire them to pursue careers in related areas.

Taking knowledge to society

The Office of Communications, IISc, hosts various outreach programmes to facilitate dialogue with the public.

The IISc Archives preserves the history of the Institute. Set up in 2008, it houses a valuable collection of letters, photographs, memos, publications, and other valuable documents. The documents in the Archives tell several stories about modern science in India and the people behind them. Efforts are currently underway to conserve old documents as well as digitise the collection so that it can be accessed by students, researchers, historians, and the general public.

IISc has a book publishing platform called the IISc Press. Established in 2008, it brings out quality books on science and engineering at affordable prices to make them accessible for students. Besides independent publishing, IISc Press also co-publishes with some of the leading book publication houses.



Connect is the Institute's quarterly magazine that highlights its research, campus life, and rich heritage. Published both in print and online, the magazine serves as a platform to document and communicate the Institute's activities and engagements with society.

Kernel is the monthly online newsletter of IISc that provides a snapshot of recent research at the Institute, including feature stories on large-scale initiatives and facilities, and profiles of diverse labs and groups.

The podcast channel of the Office of Communications (OoC), IISc, brings research and ideas to a wider audience through engaging conversations with scientists, scholars, and innovators. It also preserves the rich culture of India through archiving of audio folkloric material.

Public talks and science plays are regularly organised, which welcome the general public to the campus. These events aim to make science accessible and relatable to wider audiences. They also serve as a platform for dialogue between researchers and the Society.





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