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ADITYA-L1 SPACE CRAFT ESCAPES SPHERE OF EARTH'S INFLUENCE

Relevant for: Science & Technology | Topic: Achievements of Indians in science & technology

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September 30, 2023 08:04 pm | Updated 10:59 pm IST - Bengaluru

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Aditya-L1 Mission: The fourth Earth-bound manoeuvre (EBN#4) is performed successfully. ISRO's ground stations at Mauritius, Bengaluru, SDSC-SHAR and Port Blair tracked the satellite during this operation, while a transportable terminal currently stationed in the Fiji islands for Aditya-L1 will support post-burn operations. | Photo Credit: ANI

The [Aditya-L1](#) space craft which is headed to the Lagrangian 1 (L1) point has escaped the sphere of Earth's influence. Aditya-L1 is India's first space based observatory to study the Sun."The spacecraft has travelled beyond a distance of 9.2 lakh kilometres from Earth, successfully escaping the sphere of Earth's influence. It is now navigating its path towards the Sun-Earth Lagrange Point 1 (L1)," ISRO said on Saturday.

The space agency added that this is the second time in succession that ISRO could send a spacecraft outside the sphere of influence of the Earth, the first time being the Mars Orbiter Mission. On September 19, ISRO carried out the Trans-Lagrangian1 Insertion (TL1I) manoeuvre to send it towards L1. The TL1I manoeuvre marked the beginning of Aditya-L1's 110-day journey towards the L1 point which lies between the Sun-Earth line.

L1 is about 1.5 million km from the Earth and the distance of L1 from Earth is approximately 1% of the Earth-Sun distance.

[Aditya-L1](#) was launched [on September 2](#) by the Polar Satellite Launch Vehicle (PSLV) from the Satish Dhawan Space Centre in Sriharikota.

Following the launch ISTRC carried out four earth-bound manoeuvres between September 3 and September 15.

Aditya-L1 which is dedicated to the comprehensive study of the Sun has seven payloads. Five payloads were developed by ISRO and two by Indian academic institutes in collaboration with the space agency.

Upon arrival at the L1 point in January 2024, another manoeuvre will be performed which will bind Aditya-L1 to an orbit around L1. The satellite will spend its mission life orbiting around L1 in an irregularly shaped orbit in a plane roughly perpendicular to the line joining the Earth and the Sun.

Aditya-L1 has a mission life of five years during which its payloads are expected to provide the most crucial information to understand the problem of coronal heating; coronal mass ejection; pre-flare and flare activities and their characteristics; dynamics of space weather; and propagation of particles and fields.

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USING AI FOR AUDIT TECHNIQUES

Relevant for: Science & Technology | Topic: Science and Technology- developments and their applications and effects in everyday life

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October 04, 2023 12:36 am | Updated 12:36 am IST

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The Comptroller and Auditor General of India (CAG), Girish Chandra Murmu, who is the chair for the Supreme Audit Institutions (SAIs) of the G20, warned that absolute dependence on Artificial Intelligence (AI) for auditing purposes may lead to inaccurate findings, and emphasised ethics as the cornerstone of responsible AI. The CAG conducts financial audits, compliance audits, and performance audits. The auditing challenges of AI include ensuring transparency, objectivity, fairness, and avoiding bias.

Responsible AI must be ethical and inclusive. Only ethical AI can add credibility, trust, and scalability to the CAG audit. Data sets must be complete, gathered on time, accurate, available, and relevant. If integrity of the data fields is not ensured, we will have inaccurate audit findings. The AI auditor must be extra-vigilant about the risk of inherent AI data bias if data are taken from unauthorised sources like social media, where data manipulation and fabrication are common.

In June, the European Parliament approved the EU AI Act, the first of its kind in the world. The Act ensures that generative AI tools such as ChatGPT will be placed under greater restrictions and scrutiny. Developers will have to submit their systems for review and approval before releasing them commercially. Parliament also prohibited real-time biometric surveillance from all public settings and “social scoring” systems.

Ensuring the accuracy of vast Internet data mines is a challenge. The content generated by AI systems may lead to potential copyright infringement issues, violating intellectual property rights. Addressing legal implications relating to content ownership is a formidable task. AI bias is an inherent risk originating from the human bias that is added to the data sets of machine learning. Elon Musk wants to address these concerns by developing ‘Truth GPT’, a “maximum truth-seeking AI”. His vision of a harmonious fusion of technological progress and ethical considerations poses significant challenges. A multifaceted approach may be required to mitigate bias and ensure the safety and accuracy of AI models. U.K. Prime Minister Rishi Sunak said that he wants to make the U.K. the “geographical home” of AI safety regulation. It is time for India also to take a cue from the EU and make appropriate legislation about the use of AI systems.

The CAG faces many challenges in auditing AI systems. AI regulation and data standardisation are critical. Since the data for various government entities are taken from different sources and stored in multiple divergent platforms, the AI auditor will face enormous risks and challenges. Audits cannot be based on big data from unauthorised sources. Data integration and cross-

referencing become cumbersome. The data platforms of all entities must be synchronised through the government's IT policies. According to the CAG, One Indian Audit and Accounts Department One System, a web-enabled IT application is going to support multiple languages, offline functionality, and a mobile app, enabling complete digitalisation of the audit process from April 1, 2023, with only one exception, the defence audit, because of security dimensions. The SAI G20 conference emphasised the need for a common international audit framework relating to AI.

At present, auditors can only adopt and adapt existing frameworks and regulations relating to IT. As there are limited precedents for AI use, the national audit institution needs to communicate with all the stakeholders. The existing definitions and taxonomies of AI must be examined to adopt what is legally acceptable. Since there is wide variance among AI systems and solutions, the auditor must adopt an appropriate AI design and architecture while defining the audit's objective, scope, approach, criteria, and methodology. There needs to be capacity building of auditors in varied aspects of the AI technology landscape so that they are familiar with AI frameworks, tools, and software. In the absence of explicit AI auditing guidance, auditors must focus on ethics, use authentic data sources to ensure transparency, address legal concerns, and look at deficiencies in IT controls and governance. AI audit assignments may require consultation with data scientists, data engineers, data architects, programmers, and AI specialists. AI outsourcing to third parties while using cloud computing implies the risk of third parties' having control of the infrastructure. AI domain risks such as big data, machine learning, and cybersecurity must be documented in a risk and control matrix.

Global organisations have developed many AI auditing frameworks. These include the COBIT framework for AI audit, the US Government Accountability Office framework, and the COSO ERM Framework. The U.K.'s Information Commissioner's Office has published draft guidance on the AI auditing framework. Data Protection Impact Assessments are legally required if organisations use AI systems that process personal data to avoid potential risks. The AI auditor must ensure that personal data is processed in a manner that guarantees appropriate levels of security.

With few frameworks available for auditing AI, auditors can only focus on the risks, controls and governance structures that are in place to determine whether they are operating effectively.

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SHOT IN THE ARM: ON THE MEDICINE NOBEL 2023

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October 04, 2023 12:20 am | Updated 08:20 am IST

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All nominees for the [Nobel Prize in Physiology or Medicine](#) have path-breaking achievements to their credit, but often, the final choice of the winner might have a lot to do with the timing and the context. [Katalin Karikó and Drew Weissman](#) would have thus been safe bets for their work that [enabled the development of effective mRNA vaccines](#) against COVID-19. The 2023 Nobel announcement comes as no surprise, given that the benefits of the discovery are still keeping people alive and out of hospitals. It also ticks all the boxes: the Nobel prize for Medicine must be awarded for a discovery that would confer the 'greatest benefit on mankind' which mRNA undoubtedly did. This Nobel is also significant in that it recognises the contribution of a woman of science: 13 women have now won the Nobel Prize for Medicine (out of 225 awarded); and only 62 women have won any Nobel Prize (against 894 men) so far.

The best outcomes inevitably emerge from intersectoral collaborations, and steadfast scientific research conducted against all odds. Hungarian biochemist Katalin Karikó became fascinated with mRNA when it was a mere possibility. In human cells, genetic information encoded in DNA is transferred to messenger RNA (mRNA) and this is then used as a template for protein production. Proteins are the main structural component of cells, and play a key role in growth and repair. During the 1980s, a method called in vitro transcription permitted the idea of using mRNA for vaccine and therapy to take off, but enthusiasm to work on this flagged as several hurdles emerged, including challenges in delivery and inflammatory reactions. Undeterred, Karikó kept on the course of developing methods to use mRNA for therapy, when she was an assistant professor at the University of Pennsylvania. She was then joined by immunologist Weissman, who was studying dendritic cells that have important functions in immune surveillance and activation of vaccine-induced immune responses. Over the years, by making base modifications to the mRNA they managed to ease delivery paths and get rid of the inflammatory reactions. An inchoate idea was finally teased into fruition. This was in 2005, 15 years before the COVID-19 pandemic. But the time and context arrived in 2019, when scientists taught the mRNA vaccine to instruct human cells to make the S protein found on the surface of the COVID-19 virus. This causes the body to create antibodies which will fight the virus if the individual were to contract the infection. The rest, of course, is history.

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THE TROUBLE WITH A NOBEL FOR MRNA COVID VACCINES

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October 04, 2023 12:08 am | Updated 12:08 am IST

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At the Karolinska Institute in Stockholm | Photo Credit: AFP

The 2023 Nobel Prize for Physiology or Medicine has been awarded to Katalin Karikó and Drew Weissman for developing the mRNA vaccine technology that became the foundation for history's fastest vaccine development programme during the COVID-19 pandemic. The prizes acknowledge work that has created benefits "for all mankind", but if we had to be stricter about holding scientific accomplishments up to this standard, the subset of mRNA vaccines used during the COVID-19 pandemic may not meet it. Yet, Dr. Karikó and Dr. Weissman, and others, deserved to win the prize for their scientific accomplishments. Instead, their triumph tells us something important about the world in which science happens and what "for all mankind" should really mean.

Dr. Kariko and Dr. Weissman began working together on the mRNA platform at the University of Pennsylvania in the late 1990s. The University licensed its patents to mRNA RiboTherapeutics, which sublicensed them to CellScript, which sublicensed them to Moderna and BioNTech for \$75 million each. Dr. Karikó joined BioNTech as senior vice-president in 2013, and the company enlisted Pfizer to develop its mRNA vaccine for COVID-19 in 2020.

Much of the knowledge that underpins most new drugs and vaccines is unearthed at the expense of governments and public funds. This part of drug development is more risky and protracted, when scientists identify potential biomolecular targets within the body on which a drug could act in order to manage a particular disease, followed by identifying suitable chemical candidates. The cost and time estimates of this phase are \$1billion-\$2.5 billion and several decades, respectively.

Companies subsequently commoditise and commercialise these entities, raking in millions in profits, typically at the expense of the same people whose taxes funded the fundamental research. There is something to be said for this model of drug and vaccine development, particularly for the innovation it fosters and the eventual competition that lowers prices, but we cannot deny the 'double-spend' it imposes on consumers — including governments — and the profit-seeking attitude it engenders among the companies developing and manufacturing the product.

Once Moderna and Pfizer began producing their mRNA COVID-19 vaccines, they were also mired in North American and European countries' zeal to make sure they had more than enough for themselves before allowing manufacturers to export them to the rest of the world; their use in other countries (including India) was also complicated by protracted negotiations over pricing and liability.

COVAX, the programme to ensure poorer countries did not become the victims of their subpar purchasing power and had sufficient stocks of mRNA vaccines, fell far short of its targets. India, Russia, and China exported billions of doses of their vaccines, but their efforts were also beset by concerns that manufacturing capacity had been overestimated — in India's case — and over quality in Russia's and China's. There were reports of several countries in Africa having to throw away lakhs of vaccine doses because they had been exported too close to their expiry dates. The World Health Organization did urge these countries to use the expired doses, but such a task presumed an existing base of community engagement and risk communication, which was absent in many of these countries.

A counterexample to the path that Dr. Karikó followed is Corbevax: researchers at the Baylor College of Medicine, Houston, and the Texas Children's Hospital Centre for Vaccine Development developed this protein sub-unit vaccine and licensed it to India's Biological E for manufacturing. They did not patent it. In February 2022, Texas politician Lizzie Fletcher wrote a letter nominating the vaccine's developers for a Nobel Prize for Peace "for their work to develop and distribute a low-cost COVID-19 vaccine to people of the world without patent limitation". Kenya's Ambassador to the United Nations Martin Kimani commended the developers for "providing sorely needed ethical and scientific leadership".

We cannot blame our scientists for trying to profit from their work; the mRNA vaccine story during the COVID-19 pandemic simply placed an extraordinary premium on altruism on their part — a result of administrators' botched decisions. The technology could have benefited everyone during the pandemic, but it did not. So, history should remember what actually happened during the pandemic and what the 2023 Medicine Nobel claims happened differently.

mukunth.v@thehindu.co.i

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2023 NOBEL PRIZE IN PHYSICS: SEEING ELECTRONS THROUGH BRIEF PULSES OF LIGHT

Relevant for: null | Topic: Important Prizes and Related Facts

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October 03, 2023 09:19 pm | Updated 09:55 pm IST

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(L-R) Pierre Agostini posing in his apartment in Paris; Ferenc Krausz speaking during a presentation at the Max-Planck-Institute of Quantum Optics in Munich; and Anne L'Huillier talking to journalists at Lund University, Sweden. The trio has been awarded the 2023 physics Nobel Prize. | Photo Credit: AP

The 2023 [Nobel Prize for Physics](#) was shared by three scientists—Pierre Agostini, Ferenc Krausz and Anne L'Huillier—for their “experimental methods that generate attosecond pulses for the study of electron dynamics in matter.”

The laureates have been awarded the Prize for experiments that have allowed scientists to produce ultra-short pulses of light, with which they can finally ‘see’ directly into the super-fast world of electrons.

“Attosecond physics gives us the opportunity to understand mechanisms that are governed by electrons,” Eva Olsson, chair of the Nobel Committee for Physics, said in a statement.

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Electrons are the negatively charged particles of an atom. They zoom around the denser nucleus. Before being able to study them directly, scientists understood their properties through averages.

It's like taking a picture of a race car. The longer the aperture of the camera is open, the blurrier the picture gets. But if the exposure time is small, only a small amount of light reaches the camera's sensors, yielding a sharper image. The shorter the exposure time, the sharper the image.

Similarly, the rapid movement of electrons would seem to blur together in the eyes of a camera that couldn't lower its exposure time to the order of attoseconds.

The movement of an atom in a molecule can be studied with the very shortest pulses produced by a laser. These movements and changes in the atoms occur on the order of femtoseconds—a millionth of a billionth of a second. But electrons are lighter and interact faster, in the attosecond realm. An attosecond is a billionth of a billionth of a second.

All light consists of waves of electric and magnetic energy. Each wave has a sinusoidal shape—starting from a point, going up to a peak, dipping into a trough, and finally getting back to the same level as the starting point.

By the 1980s, physicists had found ways to produce light pulses whose duration was a few femtoseconds. The technology used to produce these pulses couldn't be refined any further, so physicists believed the femtosecond to be the hard lower limit. Yet 'seeing' electrons required an even shorter flash of light.

In 1987, Anne L'Huillier and her colleagues at a French laboratory [passed an infrared laser beam through a noble gas](#). The beam's interactions with atoms in the gas produced overtones: waves of light whose wavelength was an integer fraction of the beam. For example, if the beam had a wavelength of 100, the overtones would have wavelengths of 10, 25, 50, etc.

The team also noticed that many of the overtones were just as intense as the beam. Through the 1990s, she and her colleagues continued to explore this phenomenon, in the process laying an important theoretical foundation.

Physicists found that the overtones emitted were in the form of ultraviolet light. As multiple overtones were created in the gas, they began to interact with each other. When the peak of one overtone merges with the peak of another, they produce an overtone of greater intensity, through constructive interference. But when the peak of an overtone merges with the trough of another, they cancel each other out, in destructive interference.

By fine-tuning the setup used to produce the overtones, scientists realised that it should be possible to create intense pulses of light each a few attoseconds long (due to constructive interference), with destructive interference ensuring that they didn't last for longer.

In 2001, Pierre Agostini and his research group in France successfully [produced and investigated](#) a series of 250-attosecond light pulses, or a pulse train. By combining the pulse train with the original beam, the group was able to conduct some rapid experiments.

At the same time, Ferenc Krausz and his team in Austria [developed a technique](#) to separate an individual 650-attosecond pulse from a pulse train. Using that, the researchers were able to measure the energy of some electrons released by some krypton atoms.

Attosecond pulses allow scientists to capture 'images' of activities that happen in incredibly short time spans. As a result, scientists can use such pulses to explore short-lived atomic and molecular processes implicated in fields like materials science, electronics, and catalysis.

For medical diagnostics, attosecond pulses can be used to check for the presence of certain molecules based on their fleeting signatures. These pulses could also be used to develop faster electronic devices, and better telecommunications, imaging, and spectroscopy.

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LET THERE BE LIGHT: THE HINDU EDITORIAL ON THE 2023 PHYSICS NOBEL

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October 05, 2023 12:10 am | Updated 12:38 am IST

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According to the laws of quantum mechanics, the observable properties of electrons in matter — like a fruit or a rock — change in a few hundred attoseconds. One attosecond is 10^{-18} seconds. To study these extremely rapid changes, special tools are needed, and Anne L’Huillier, Pierre Agostini, and Ferenc Krausz have [received the 2023 physics Nobel Prize](#) for building these tools. From the late 1980s, Dr. L’Huillier led several studies that found that an infrared beam shone on a volume of a noble gas produced multiple overtones: waves whose wavelength was an integer-fraction of the ‘original’ light wave. Her team also observed a peculiar relationship between the original wave’s frequency and the intensity of the overtones, and explained it using the existing laws of quantum mechanics — a milestone. If the overtone waves’ peaks lined up, they would combine to produce a more intense peak (constructive interference); when one wave’s peak coincided with another’s trough, they would cancel themselves out (destructive interference). Physicists realised that this reinforcing effect could be timed such that the gas emitted intense peaks with a pulse duration of a few attoseconds, with destructive interference achieving the cut-off. Dr. Agostini and company demonstrated this in 2001 by producing light with a pulse duration of 250 attoseconds. In the same year, Dr. Krausz and company isolated a single pulse, 650 attoseconds in duration, and used it to measure the kinetic energy of electrons kicked out from krypton atoms by a bunch of photons. Attosecond physics had finally arrived.

The medicine Nobel Prize this year celebrated the invention of mRNA vaccines and their effect on the COVID-19 pandemic. The utility for people here was straightforward, whereas that for attosecond physics is not. However, the absence of evidence is not evidence of absence. The specific dynamics of electrons matter in settings with potentially immediate value, including biochemistry, diagnostics, superconductivity, and manufacturing techniques. Thanks to the laureates’ work, scientists have a way to illuminate hitherto unknown possibilities with discoveries of phenomena that live and die in attoseconds. Then again, humans rarely have all the information required to judge whether a particular discovery or invention could be of value later. The 2016 chemistry laureates were feted for building motors with individual molecules — a feat with no known applications at the time, but to achieve it, they devised techniques that improved other areas of chemistry. To paraphrase one of these laureates, J. Fraser Stoddard, there is important value in making something that was hard to do before easier to do today, and “we still have the excitement of finding out what [its applications] might be”.

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[award and prize / Sweden / physics](#)

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2023 CHEMISTRY NOBEL PRIZE: WHAT ARE QUANTUM DOTS AND WHAT IS THE RESEARCH THAT WON THE PRIZE?

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October 04, 2023 09:31 pm | Updated 10:01 pm IST

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Winners of the 2023 Nobel Prize in Chemistry on the screen: scientists Mounji Bawendi, Louis Brus and Alexei Ekimov, for discovery and synthesis of quantum dots. | Photo Credit: AP

The story so far: The [2023 Nobel Prize in chemistry](#) was awarded to Mounji G. Bawendi, Louis E. Brus and Alexei I. Ekimov on Wednesday for the discovery and synthesis of quantum dots. These nanoparticles have wide-ranging applications across fields like electronics, advanced surgery, and quantum computing.

The prize itself was embroiled in some controversy earlier when the names of winners were reportedly leaked to a Swedish newspaper. But Johan Åqvist, the chair of the deciding committee, said the decision hadn't been final at the time. "There was a press release sent out for still unknown reasons. We deeply regret that this happened. The important thing is that it did not affect the recipients in any way," he was quoted as saying by *The Guardian*.

Quantum dots are particles that are a few nanometres wide. They exhibit unique optical properties due to their small physical size. Their structure and atomic composition are the same as bulk materials, but the properties of the latter don't depend on their size.

In fact, the properties of quantum dots can be changed by changing their size.

At the scale of nanometres, materials and particles are capable of new, size-dependent properties because quantum physical forces start to dominate. At the macroscopic scale, on the other hand, like in our day to day lives, gravity and the rules of classical physics dominate.

By the 1970s, physicists knew that the optical properties of glass could be changed by adding a small amount of another element, like gold, silver, cadmium, sulphur, or selenium. They also knew how or why some of these changes could occur, but quantum dots as such hadn't been synthesised yet.

In the early 1980s, Dr. Ekimov succeeded in creating size-dependent quantum effects in coloured glass. From 1979, he studied the properties of glasses that were tinted with copper chloride, heated to a high temperature, and then cooled. He found that different ways of

preparing this glass led to it absorbing light differently. This happened because the copper chloride formed tiny crystals, and that crystals of different sizes—depending on the preparation process—interacted with light differently.

In 1983, Dr. Brus and his colleagues went a step ahead and prepared similar crystals in a liquid solution, rather than in a glass. This allowed the researchers to better manipulate and study the crystals. These crystals also interacted with light differently depending on small variations in their size.

Finally, in 1993, Dr. Bawendi and his coworkers developed a technique to make these peculiar crystals—i.e. the quantum dots—of well-defined sizes and with high optical quality. This process began by injecting some substance (of which the dot would be made) into a hot solvent and then heating the solution. Nanocrystals automatically began to take shape, and larger particles formed when the solution was heated for longer. The solvent also ensured that the crystals had a smooth outer surface.

This method was quite easy, which meant many scientists could use it to make quantum dots that they required and study them.

Today, one of the simplest applications of quantum dots is to light computer monitors and television screens. Blue LEDs behind the screen excite these dots, causing them to emit light of different colours. Combining these colours gives rise to even more colours as well as brightness.

Nanoscale-sized quantum dots are also used to map biological tissues by biochemists.

Quantum dots are also used in photovoltaic cells to improve the absorption and efficiency in converting solar light into electricity.

Certain cancer treatments use quantum dots for targeted drug delivery and other therapeutic measures. This has wider applications in the field of nanomedicine too.

Quantum dots can be used as security markers on currency and documents as an anti-counterfeit measure. Broadly, they can be used as fluorescent markers to tag and track objects.

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INSPIRING COLOURS: THE HINDU EDITORIAL ON THE 2023 CHEMISTRY NOBEL

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October 06, 2023 12:28 am | Updated 12:28 am IST

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Travelling in a bus can be an enjoyable experience if you have your own seat, the vehicle is not crowded, and there is a nice breeze. But if the bus is packed with people, you can get irritable. Something similar happens to atoms: if they are contained in a vessel at a low density, they behave in a certain way, but if they are packed densely together, with little moving space, something new happens. The [2023 Nobel Prize in Chemistry](#) has been awarded to three people who found out what happens. Technically, they have been selected for [discovering and refining quantum dots](#) — small crystals a few nanometres wide. Each quantum dot has only a few thousand atoms (whereas a single droplet of water can have a sextillion). And because the atoms are packed so closely together in the dot, their electrons are very close to each other. In this setting, the laws of quantum mechanics describe the behaviour of quantum dots — so much so that an entire dot can mimic the behaviour of an atom. The dots have another famous property. If you shine some light on a quantum dot, it will absorb and re-emit that light at a different frequency (or colour) depending on its size. Smaller dots emit light of higher frequency (bluer) and vice versa. So, a quantum dot made of some material would respond in one way whereas a quantum dot made of the same material but smaller would respond differently. For these reasons, quantum dots have found many applications in transistors, lasers, medical imaging, and quantum computing. In 1981, Alexei Ekimov, then working in the Soviet Union, first synthesised quantum dots 'frozen' inside glass. Two years later, Louis Brus synthesised quantum dots in a solution in the U.S., and worked out their quantum-physical properties. Finally, Moungi Bawendi, whose work on quantum dots began as a student under Dr. Brus, found a way to make quantum dots of high quality in an easy and reliable way in 1993. For their contributions, they have shared the Nobel Prize.

Some of the most fascinating scientific discoveries, for all their technical sophistication, are actually innocuous in their appeal. Quantum dots are one such. Understanding why they behave the way they do requires specialised knowledge of quantum mechanics, but quantum mechanics do not dictate their behaviour. Dr. Ekimov himself was inspired by the colours in stained glass. While quantum dots light up LED screens and the location of a tumour that needs to be removed, it is important not to lose sight of the colours — the reds, the greens, and the blues — and whatever more they might inspire.

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NOW A MORE EFFICACIOUS, INEXPENSIVE MALARIA VACCINE

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[A malaria vaccine — R21/MatrixM — developed by the University of Oxford](#), manufactured by the Pune-based Serum Institute of India and tested in a phase-3 trial at five sites in four countries — Mali, Burkina Faso, Kenya, and Tanzania — in Africa was recommended (but yet to be prequalified) by the WHO on October 2.

Three countries — Nigeria, Ghana, and Burkina Faso — have already approved the use of the vaccine to immunise children aged less than 36 months. According to the WHO, in 2021, there were 247 million malaria cases worldwide and 6,19,000 deaths. About 25 million children are born each year in countries with moderate to high malaria transmission.

The phase-3 trial was conducted in 4,800 children who were randomly assigned to receive either the malaria vaccine or a control (approved rabies vaccine) and neither the participants nor the people conducting the trial knew who got the vaccine and who did not. The five sites in the four countries where the trial was conducted have different malaria transmission intensities and seasonality. The participants received three vaccine doses four weeks apart, and a booster shot at the end of 12 months after the last dose. The primary vaccination was carried out prior to the malaria season in countries where malaria is seasonal or at any time of year in countries where malaria occurs throughout the year.

As per the [results of the phase-3 trial](#) that have been posted in a preprint server (preprints are yet to be peer-reviewed), the vaccine efficacy at the end of one year in children aged 5-36 months was 75% where malaria is seasonal and 68% where malaria is perennial. In children aged 5-17 months, who are more likely to die due to severe malaria, the vaccine efficacy was higher — 79% where malaria is seasonal and 75% where malaria is perennial. In children aged 18-36 months, vaccine efficacy was 73% where malaria is seasonal and 63% where malaria is perennial. “The vaccine efficacy was well maintained to 18 months with a single booster dose given 12 months after the primary series,” authors of the preprint write.

“Our findings are consistent with data from a recently completed phase IIb trial at the Nanoro seasonal site, where vaccine efficacy was 76% and 77% over one and two years of follow-up using a four dose (primary plus booster) vaccine regime in 5-17-month-old infants,” they note.

The higher vaccine efficacy in younger children (5-17 months) compared with older children (18-

36 months) might be a “sign that the vaccine is less effective in people who have already been exposed to malaria” Matthew Laurens, a malaria vaccine expert at the University of Maryland School of Medicine [told Science](#). And if that turns out to be true, then the vaccine might have “lower efficacy in areas with very high malaria incidence, where young infants are exposed at an early age”.

“There was some waning of efficacy over the first year of follow-up at both seasonal and perennial transmission sites, but a booster dose restored efficacy at the seasonal sites with a vaccine efficacy over 18 months of 74%,” says an Oxford University [release](#).

The vaccine efficacy of R21/MatrixM is much higher than the first malaria vaccine — RTS,S/AS01 that has been recommended by the WHO in 2021 — which had a vaccine efficacy of 56% at the end of one year in children aged 5-17 months. According to the preprint, even after four booster shots of the RTS,S/AS01 vaccine, the efficacy was only 58% over five years.

The results indicate that the vaccine was more efficacious in places where malaria was seasonal than when it was perennial. The authors think that this may partly be due to timing of malaria episodes in countries with seasonal or perennial malaria. The study found that in sites where malaria was seasonal, 82% of malaria episodes in the first year were recorded in the first six months of follow-up, while only 26% of malaria episodes over the first year were recorded in the first six months at the sites where malaria is perennial. The vaccine efficacy is highest 14 days after the third dose and begins to slowly wane. Since the vaccination is carried out just before the beginning of the malaria season, the protection offered is higher when the disease is seasonal than when malaria occurs throughout the year.

The authors claim that besides substantially reducing the number of clinical malaria cases, at 12 and 18 months, there was “significantly reduced” parasite load in children who received the vaccine (R21/Matrix-M). This suggests that the vaccine may help reduce malaria transmission, especially when combined with other strategies such as mosquito nets.

According to the WHO, the cost of the R21/Matrix-M manufactured by Serum Institute will be between \$2 and \$4 per dose. Serum Institute will produce “over 100 million doses a year”.

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IMPROVING THE COMPATIBILITY OF PIG ORGANS FOR TRANSPLANTATION INTO HUMANS

Relevant for: Science & Technology | Topic: Science and Technology- developments and their applications and effects in everyday life

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October 07, 2023 09:20 pm | Updated October 08, 2023 12:13 pm IST

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The design and successful transplantation of kidney grafts from genetically modified pigs into non-human primates has been described in a recent study published in *Nature*. Modifying the pig genomes to remove antigen-coding genes, add human genes and eliminate pig viruses, resulted in the long-term survival of the monkey recipients, up to around two years. This preclinical work may move the field a step closer to clinical testing of genetically modified pig kidneys for human transplantation.

The transplantation of animal organs into humans (xenotransplantation) may offer a solution to the worldwide organ shortage. Pigs are promising donor animals but several obstacles first require overcoming before they can be considered clinically viable, notably organ rejection and risk of zoonosis (transmission of animal viruses to humans). Previous work has identified three glycan antigens expressed in pigs that are recognised by human antibodies and attacked, leading to rejection of the organ. The porcine endogenous retrovirus has also been identified as a risk for transmission into humans.

Wenning Qin from Cambridge, Massachusetts, U.S. and other build on this previous research by introducing alterations into the genome of a donor pig and achieve successful transplantation of kidney grafts from a genetically engineered pig into a cynomolgus monkey model (a non-human primate with several human-like traits). The researchers introduced 69 genomic edits into the porcine donor (a Yucatan miniature pig), knocking out three glycan antigens thought to induce rejection, overexpressing seven human transgenes (to reduce hostility of primate immune system) and inactivating all copies of the porcine retrovirus gene. These kidney grafts survived substantially longer than grafts with only the glycan antigen knockouts (176 days versus 24 days), suggesting that the expression of these human transgenes offers some protection against rejection. Combined with immunosuppressive treatment, the transplant provided long-term primate survival of up to 758 days. These results demonstrate the promise of pig organs in future human transplantations and bring the technique a step closer to clinical testing, the authors conclude.

“When transplanted into cynomolgus monkeys, the kidneys with three glycan antigen knockouts alone experienced poor graft survival, whereas those with glycan antigen knockouts and human transgene expression demonstrated significantly longer survival time, suggesting the benefit of human transgene expression in vivo. These results show that preclinical studies of renal

xenotransplantation could be successfully conducted in nonhuman primates and bring us closer to clinical trials of genetically engineered porcine renal grafts” they write.

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UNRAVELLING THE LINKS BETWEEN CONSANGUINITY AND GENETIC DISEASES

Relevant for: Science & Technology | Topic: Biotechnology, Genetics & Health related developments

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October 08, 2023 03:30 pm | Updated 03:30 pm IST

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In the rich tapestry of human ancestry and history, there is one genomic thread that weaves a particularly complex narrative. It connects our lineage through the many generations across our existence on the earth, and also defines our genetic vulnerabilities. This thread is none other than consanguinity: the practice of marrying close relatives, an age-old tradition that is still practised widely in several human societies worldwide.

According to one estimate, approximately 15-20% of the world's population practises inbreeding, especially in Asia and West Africa.

Consanguinity has both shaped our cultural landscapes and left an indelible mark on our genetic destiny. It is a social as well as genetic construct. In the social context, it means marriage between individuals related by blood; in the genetic context, it means marriage between genetically related individuals, otherwise called inbreeding.

Using modern genomic tools, scientists can quantify the relatedness between two individuals as a percentage of the genetic material shared between them (identity by state) or by the genetic material in stretches of a chromosome that are identical to each other and are inherited from parents (identity by descent).

There is evidence to suggest that ancient human civilisations, like those of the Egyptians and Incas, among others, could have practised inbreeding or consanguinity. In particular, a body of historical and genetic evidence suggests that King Tutankhamun of Egypt was born to parents who were blood relatives.

We are still understanding the genetic and population effects of these practices. So it isn't surprising that many key insights that are biomedically relevant – including discovery of new genes and genetic correlates – have been unearthed by looking through the lens of consanguinity. Many genetic concepts [were found](#) by studying the intricate tapestry of royal marriages in Europe and the diseases the individuals have. But since the democratisation of genetics and genomics, scientists have been able to study the general population in the same way, on a larger scale.

Scientists have extensively studied the level of inbreeding in various populations around the world. Some of the most well-studied populations in this regard include the Ashkenazi Jews and the Amish. With more than 4,000 endogamous groups – i.e. people marrying within the same caste/tribe or group – India has been a fertile ground for consanguinity.

Researchers at the CSIR-Centre for Cellular and Molecular Biology, in Hyderabad, have also identified several endogamous populations in India with [very high levels](#) of genetic relatedness, and have identified many populations in India with a very high level of inbreeding – some more so than the Ashkenazi Jews.

Studies have found that a significant fraction of the global population practises consanguinity and that that has increased the mortality and the rate of recessive genetic diseases in these peoples.

While consanguinity is undesirable among humans, scientists widely wield the principle of mating between related offspring to breed plants and animals. With such efforts in experimental settings, they have been able to eliminate deleterious genetic alleles in populations. (Alleles are different versions of the same gene.)

Taking cues from these efforts, it is possible to anticipate evolutionary ‘bottleneck’ events in the past that could have resulted, similarly, in the removal of deleterious alleles from humans.

There is some evidence suggesting that ancient populations in which bottlenecks restricted mating choices would have resulted in consanguinity. In turn, such evolutionary or natural bottleneck events and consanguinity could have provided a chance to eliminate deleterious alleles while outbreeding would have created opportunities for heterozygotes (individuals with two alleles for a gene) with advantageous traits.

This said, precisely how such inbreeding and bottlenecks have contributed to human traits and diseases remains an open question.

We inherit one copy of each chromosome from our parents. When the gametes – i.e. the reproductive cells – form, the chromosomes recombine. That is, genetic information, as blocks of genomic regions in the chromosomes, are exchanged.

In an event when the parents are related to each other, there is a chance that there will be identical blocks of genetic information in both chromosomes. These blocks are called ‘runs of homozygosity’, and the subsequent exchange is said to be autozygous.

The percentage of autozygosity in an individual’s genome thus creates a unique way to understand the genetic history of the population: in terms of sexual unions between related individuals over many generations. Other measures have also been developed to measure the stretches of chromosomes that are identical to each other. This is in part due to the genome-scale data now available to scientists, with which they can estimate the kinship between any two individuals.

Many modern consanguineous societies, like the Amish population in the U.S., have been studied for recessive diseases. In fact, scientists have extensively [used autozygosity](#) as an approach to identify new genetic diseases in populations where consanguineous marriage practices is the norm.

The results of these studies have helped us uncover previously unknown genetic diseases as well as estimate different populations’ genetic predisposition to common diseases.

At the same time, we are still to uncover the relationship of consanguinity with common yet complex diseases like type-2 diabetes, obesity, and hypertension. They will have to be investigated in greater detail.

One [recent study](#), published on September 26 this year in the journal *Cell*, suggested that consanguinity could increase the risk and the rate of diseases like type-2 diabetes.

In the coming years, advances in genomics research indicate that we can expect innovative solutions to mitigate the risks associated with consanguinity on genetic diseases. This in turn could usher in a future where personalised medicine, genetic diagnostics, and genetic counselling can play a pivotal role in improving the health outcomes of affected individuals and their families.

The authors are senior consultants at the Vishwanath Cancer Care Foundation.

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HOW WAS MRNA RESEARCH USED TO FIGHT COVID?

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October 08, 2023 04:20 am | Updated 08:53 am IST

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mRNA contains four different bases, abbreviated A, U, G, and C. The 2023 Physiology or Medicine Nobel Laureates discovered that base-modified mRNA can be used to block activation of inflammatory reactions (secretion of signaling molecules) and increase protein production when mRNA is delivered to cells. Photo: nobelprize.org

The story so far: On October 2, Nobel Prize week began with the [2023 Prize in Physiology or Medicine](#) being awarded to Katalin Karikó and Drew Weissman. They were awarded the prize for their “discoveries concerning nucleoside base modifications that enabled the development of effective [mRNA vaccines](#) against COVID-19”.

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mRNA, which stands for messenger RNA, is a form of nucleic acid which carries genetic information. Like other vaccines, the mRNA vaccine also attempts to activate the immune system to produce antibodies that help counter an infection from a live virus. However, while most vaccines use weakened or dead bacteria or viruses to evoke a response from the immune system, mRNA vaccines only introduce a piece of the genetic material that corresponds to a viral protein. This is usually a protein found on the membrane of the virus called spike protein. Therefore, the mRNA vaccine does not expose individuals to the virus itself.

Editorial | [Shot in the arm: On the Medicine Nobel 2023](#)

According to an article by Thomas Schlake et al, in *RNA Biology*, RNA as a therapeutic was first promoted in 1989 after the development of a broadly applicable in vitro transfection technique. A couple of years later, mRNA was advocated as a vaccine platform. He says, “mRNA offers strong safety advantages. As the minimal genetic construct, it harbours only the elements directly required for expression of the encoded protein.” A common approach by vaccine makers during the pandemic was to introduce a portion of the spike protein, the key part of the coronavirus, as part of a vaccine. Some makers wrapped the gene that codes for the spike protein into an inactivated virus that affects chimpanzees, called the chimpanzee adenovirus. The aim is to have the body use its own machinery to make spike proteins from the given genetic code. The immune system, when it registers the spike protein, will create antibodies against it.

A piece of DNA must be converted into RNA for a cell to be able to manufacture the spike

protein. While an mRNA vaccine might look like a more direct approach to getting the cell to produce the necessary proteins, mRNA is very fragile and will be shredded apart at room temperature or by the body's enzymes when injected. To preserve its integrity, the mRNA needs to be wrapped in a layer of oily lipids, or fat cells. One way to think of this is that an mRNA-lipid unit most closely mimics how a virus presents itself to the body, except that it cannot replicate like one. DNA is much more stable and can be more flexibly integrated into a vaccine-vector. In terms of performance, both are expected to be as effective.

A challenge with mRNA vaccines is that they need to be frozen from -90 degree Celsius to -50 degree Celsius. They can be stored for up to two weeks in commercial freezers and need to be thawed at 2 degrees Celsius to 8 degrees Celsius at which they can remain for a month. But a major advantage of mRNA and DNA vaccines is that because they only need the genetic code, it is possible to update vaccines to emerging variants and use them for a variety of diseases.

Viral vector vaccines, like Covishield, carry DNA wrapped in another virus, but mRNA are only a sheet of instructions to make spike proteins wrapped in a lipid (or a fat molecule) to keep it stable. In the case of COVID-19, mRNA vaccines developed by Moderna, Pfizer and Pune-based Gennova Biopharmaceuticals, these instructions alone are capable of producing the spike protein, which the immune system then uses to prepare a defence.

After the Nobel Prize was announced, Dr. Soumya Swaminathan, formerly chief scientist of the WHO, posted on X, formerly Twitter, that painstaking research over decades and a belief that mRNA technology would have human applications one day have earned the Nobel Prize for Dr. Karikó and Dr. Weissman. "We will see more mRNA products in the near future," she said. In its release, the Nobel Assembly pointed out that enthusiasm for developing mRNA technology for clinical purposes was initially limited because of hurdles. "Ideas of using mRNA technologies for vaccine and therapeutic purposes took off, but roadblocks lay ahead. In vitro transcribed mRNA was considered unstable and challenging to deliver, requiring the development of sophisticated carrier lipid systems to encapsulate the mRNA. Moreover, in vitro-produced mRNA gave rise to inflammatory reactions."

Dr. Karikó's struggles are of special note among this year's winners. "Ten years ago...I was kicked out, from Penn [Pennsylvania University] and forced to retire," she told Adam Smith during her interview with nobelprize.org after the winners were announced. Dr. Karikó spent a large part of her career on the periphery of academic circles, always in the pursuit of grants to fund her research. Dr. Karikó spent most of the 1990s writing grant applications to fund her mRNA research. She believed that mRNA was key to treating diseases that needed the right kind of protein to fix the problem.

Together with Dr. Weissman, she published a paper in 2005 that highlighted breakthrough research in the field. In 2015, they figured how to deliver mRNA into mice using a fatty coating called "lipid nanoparticles" that protected the mRNA from degradation. Both her innovations were key to the development of COVID-19 vaccines developed by Pfizer and its German partner BioNTech.

(With inputs from agencies)

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RUSSIA REPORTS COOLANT LEAK IN BACKUP LINE AT SPACE STATION AND SAYS CREW NOT IN DANGER

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October 10, 2023 09:53 am | Updated 09:54 am IST - MOSCOW

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A Russian science lab at the International Space Station [File] | Photo Credit: NASA/AP

Coolant leaked from a backup line at the International Space Station, Russian officials said Monday, adding that there was no risk to the crew or the outpost.

Russian space agency Roscosmos said that coolant leaked from an external backup radiator for Russia's new science lab. The lab's main thermal control system was working normally, the agency emphasised.

"The crew and the station aren't in any danger," Roscosmos said.

NASA confirmed that there is no threat to the station's crew of seven and that operations are continuing as usual.

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Roscosmos said engineers were investigating the cause of the leak. The incident follows [recent coolant leaks from Russian spacecraft parked at the station](#). Those leaks were blamed on tiny meteoroids.

The lab — named Nauku, which means science — arrived at the space station in July 2021.

Last December, coolant leaked from a Soyuz crew capsule docked to the station, and another similar leak from a Progress supply ship was discovered in February. A Russian investigation concluded that those leaks likely resulted from hits by tiny meteoroids, not manufacturing flaws.

The Soyuz leak resulted in an extended stay for NASA astronaut Frank Rubio and his two Russian crewmates, Sergey Prokopyev and Dmitri Petelin, who spent 371 days in orbit instead of six months. A replacement capsule was sent to the station for their ride home.

The space station, which has served as a symbol of post-Cold War international cooperation, is now one of the last remaining areas of cooperation between Russia and the West amid the tensions over Moscow's military action in Ukraine. NASA and its partners hope to continue operating the orbiting outpost until 2030.

Current residents are: NASA's astronauts Jasmin Moghbeli and Loral O'Hara, the European Space Agency's Andreas Mogensen, Russian cosmonauts Konstantin Borisov, Oleg Kononenko and Nikolai Chub and Japanese astronaut Satoshi Furukawa.

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WHAT IS MULTIMODAL ARTIFICIAL INTELLIGENCE AND WHY IS IT IMPORTANT?

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October 10, 2023 08:30 am | Updated 08:30 am IST

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For anyone curious about what the next frontier of AI models would look like, all the signs are pointing towards multimodal systems, where users can engage with AI in several ways. People absorb ideas and form context by drawing meaning from images, sounds, videos and text around them. A chatbot, even though it can write competent poetry and pass the U.S. bar, hardly matches up to this fullness of cognition. If AI systems are to be as close a likeness of the human mind as possible, the natural course would have to be multimodal.

As another good old tech race shapes up, leading AI companies are already playing catchup. On September 25, ChatGPT-maker OpenAI announced that it had enabled its GPT-3.5 and GPT-4 models to study images and analyse them in words, while its mobile apps will have speech synthesis so that people can have full-fledged conversations with the chatbot. The Microsoft-backed company had promised multimodality in March, during the release of GPT-4 and kept the addition on the backburner. However, the company has rushed the release after a report by *The Information* revealed that Google's new yet-to-be-released multimodal large language model called Gemini, was already being tested in a bunch of companies.

The report also stated that Google had an easy advantage over competitors in the multimodal world because of its readily available bank of images and videos via its search engine and YouTube. But OpenAI is moving fast to make inroads. The company is actively hiring multimodal experts with pay packages up to a hefty \$3,70,000 per year. It is also reportedly working on a new project called Gobi which is expected to be a multimodal AI system from scratch, unlike the GPT models.

Multimodality itself isn't a novel thing. The past couple of years have seen a stream of multimodal AI systems being released. Like OpenAI's text-to-image model, DALL.E, upon which ChatGPT's vision capabilities are based, is a multimodal AI model that was released in 2021. DALL.E is built on another multimodal text-to-image model called CLIP that OpenAI released the same year.

DALL.E is in fact the model which kickstarted the generative AI boom, and is underpinned with the same concept that runs other popular AI image generators like Stable Diffusion and Midjourney — linking together text and images in the training stage. The system looks for

patterns in visual data that can connect with data of the image descriptions. This enables these systems to generate images according to the text prompts that users enter.

For multimodal audio systems, the training works in the same way. GPT's voice processing capabilities are based on its own open-source speech-to-text translation model, called Whisper, which was released in September last year. Whisper can recognise speech in audio and translate it into simple language text.

Some of the earlier multimodal systems combined computer vision and natural language processing models or audio and text together to perform some of the simpler but rather important functions like automatic image caption generation etc. And even if these multimodal systems weren't an all-powerful model like GPT-4 gunning for the ultimate dream of artificial general intelligence (AGI), they carried enough value to address very real-world problems.

In 2020, Meta was working on a multimodal system to automatically detect hateful memes on Facebook. Meanwhile, Google researchers published a paper in 2021 about a multimodal system they had built to predict the next lines of dialogue in a video.

But there are other more complex systems still in the works. In May this year, Meta announced a new open-source AI multimodal system called ImageBind that had many modes — text, visual data, audio, temperature and movement readings. In the blog post, Meta had speculated that future multimodal models could add other sensory data to them, like “touch, speech, smell, and brain fMRI signals.”

The idea behind this is to have future AI systems cross-reference this data in similar ways that current AI systems do for text inputs. For instance, a virtual reality device in the future might be able to generate not just the visuals and the sounds of an environment but also other physical elements. A simulation of a beach could have not just the waves crashing on the shore, but also the wind blowing and the temperature there.

If that sounds too futuristic, there are other uses that can be found closer to the world we live in now, like in autonomous driving and robotics.

Other industries like medicine are “inherently multimodal,” according to a post by Google Research. Processing CT scans, or identifying rare genetic variations all need AI systems that can analyse complex datasets of images, and then respond in plain words. Google Research's Health AI section has been working at this for some time now, having released papers around what the ideal method is to integrate multimodal AI systems in this field.

AI models that perform speech translation are another obvious segment for multimodality. Google Translate uses multiple models as do others like Meta's SeamlessM4T model, which was released last month. The model can perform text-to-speech, speech-to-text, speech-to-speech and text-to-text translations for around 100 languages, the company said.

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ISRO TO CONDUCT FIRST TEST FLIGHT OF GAGANYAAN MISSION ON OCTOBER 21

Relevant for: Science & Technology | Topic: Science and Technology- developments and their applications and effects in everyday life

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October 10, 2023 09:09 pm | Updated 09:09 pm IST - NEW DELHI:

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The preparations for the Flight Test Vehicle Abort Mission-1 (TV-D1) is underway as ISRO is about to commence unmanned flight tests for the Gaganyaan Mission, in Sriharikota. | Photo Credit: ANI

The Indian Space Research Organisation (ISRO) will execute the first of multiple test flights ahead of the Gaganyaan mission — India's first manned mission to space — on October 21, Jitendra Singh, Minister of State for Space, Science and Technology, said on Tuesday.

The test will be conducted at the Satish Dhawan Space Centre in Sriharikota and is intended to test the 'crew module' or the part of vehicle where the Indian astronauts will be housed.

The test involves launching the module to outer space and bringing it back to earth and recovering it after touchdown in the Bay of Bengal. The Navy personnel have already started mock operations to recover the module, said Mr. Singh. Along with the crew module, there will also be a 'crew escape' system. If the spacecraft while ascending into space faces a problem, this escape system is expected to separate and bring the crew safely back to sea from where they will be picked by the Navy personnel.

In the first of this tests called, Test Vehicle Abort Mission (TV-D1), the module will be identical to the one deployed to space, except that it will be 'unpressurised.'

The TV-D1 test vehicle is a single-stage liquid-fuelled rocket developed for this abort mission. "The payloads consist of the Crew Module [CM] and Crew Escape Systems [CES] and will simulate the abort condition during the ascent trajectory corresponding to a Mach number of 1.2 [1 mach is 330 metres per second, or the speed of sound] expected in the Gaganyaan mission. CES with CM will be separated from the Test Vehicle at an altitude of about 17 km. Subsequently, the abort sequence will be executed autonomously commencing with the separation of CES and deployment of the series of parachutes, finally culminating in the safe touchdown of CM in the sea, about 10 km from the coast of Sriharikota," the ISRO said in a statement.

The success of this test will set the stage for the first unmanned "Gaganyaan" mission and ultimately manned mission to outer space in low earth orbit, said Mr. Singh. "Before the ultimate

manned “Gaganyaan” mission, there will be a test flight next year, which will carry “Vyommitra”, the female robot astronaut,” he added.

The Gaganyaan mission is expected to be executed in the second half of next year.

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CHINA PROPOSES BLACKLIST OF TRAINING DATA FOR GENERATIVE AI MODELS

Relevant for: Science & Technology | Topic: Science and Technology- developments and their applications and effects in everyday life

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October 13, 2023 10:11 am | Updated 10:11 am IST

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Generative AI learns how to take actions from past data, and creates new content like text or images based on that training. | Photo Credit: REUTERS

China has published proposed security requirements for firms offering services powered by generative artificial intelligence, including a blacklist of sources that cannot be used to train AI models.

Generative AI, popularised by the success of OpenAI's ChatGPT chatbot, learns how to take actions from past data, and creates new content like text or images based on that training.

The requirements were published on Wednesday by the National Information Security Standardization Committee, which includes officials from the Cyberspace Administration of China (CAC), the Ministry of Industry and Information Technology, and the police.

The committee proposes conducting a security assessment of each body of content used to train public-facing generative AI models, with those containing "more than 5% of illegal and harmful information" to be blacklisted.

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Such information includes "advocating terrorism" or violence, as well as "overthrowing the socialist system", "damaging the country's image", and "undermining national unity and social stability".

The draft rules also state that information censored on the Chinese internet should not be used to train models.

Its publication comes just over a month after regulators allowed several Chinese tech firms, including search engine giant Baidu, to launch their generative AI-driven chatbots to the public.

The CAC has since April said it wanted firms to submit security assessments to authorities before launching generative AI-driven services to the public.

In July, the cyberspace regulator published measures governing such services that analysts said were far less onerous than measures outlined in an April draft.

The draft security requirements published on Wednesday require organisations training these AI models to seek the consent of individuals whose personal information, including biometric data, is used for training purposes.

They also lay out detailed guidelines on how to avoid intellectual property violations. Countries globally are grappling with setting guardrails for the technology. China sees AI as an area in which it wants to rival the U.S, and has set its sights on becoming a world leader in the field by 2030.

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SKYGAZERS WATCH 'RING OF FIRE' ECLIPSE OVER WESTERN HEMISPHERE

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October 15, 2023 02:04 am | Updated 02:04 am IST - Albuquerque, United States

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The "Ring of Fire" effect caused during the annular solar eclipse is seen from Penonome, Panama, on October 14, 2023. | Photo Credit: AFP

Skygazers across the Americas turned their faces upwards Saturday for a rare celestial event: an annular solar eclipse.

A crowd of people wearing protective eyewear gathered in Albuquerque, New Mexico, one of many across the western United States watching as the Moon passed between the Sun and Earth at its furthest point from our planet.

Since it is so distant, it did not cover the Sun completely, creating a "ring of fire" effect that brought cheers from the crowd in Albuquerque.

Wow [@NASAMoon](https://twitter.com/NASAMoon) – after all this time, you finally put a ring on it! pic.twitter.com/TqQZZBICSJ

"It's majestic. We're in awe," said one viewer in Albuquerque, Shannon Cozad.

In the course of just a few hours the most striking "path of the annularity" was crossing a handful of major cities, including Eugene, Oregon and San Antonio, Texas, with partial eclipse phases lasting an hour or two before and after.

"It's kind of like a black hole," said Mubaraq Sokunbi, an excited eight-year-old who was at a hot air balloon festival in Albuquerque with his family. "The moon covers the sun and then there's a ring around it."

At any given location, the eclipse will be visible from between 30 seconds and five minutes -- but people were urged to take safety precautions and use solar viewing glasses, and never regular sunglasses, to preserve their vision.

"Do NOT look at the Sun through a camera lens, telescope, binoculars, or any other optical device while wearing eclipse glasses or using a handheld solar viewer -- the concentrated solar rays will burn through the filter and cause serious eye injury," NASA said.

The eclipse was crossing into Mexico and Central America, then into South America through

Colombia and northern Brazil before ending at sunset in the Atlantic Ocean.

The event also serves as a dress rehearsal before a total eclipse set for April 2024.

Both eclipses are going to be “absolutely breathtaking for science,” said Madhulika Guhathakurta, a heliophysics program scientist.

Solar eclipses have a noticeable effect on the upper atmosphere, such as the ionosphere, which is full of charged particles and responsible for reflecting and refracting radio waves.

“Although the atmospheric effects of solar eclipses have been studied for over 50 years, many unanswered questions remain,” said Ms. Guhathakurta.

To study these effects, NASA was launching three rockets on Saturday from the White Sands Missile Range in New Mexico to gather data on the electric and magnetic fields, electron density and temperature.

A total eclipse took place in 2017 in the United States. After next April's total eclipse, there will not be another until 2044, while the next annular eclipse will be in 2046.

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ISRO TO HOLD MORE TEST GAGANYAAN VEHICLE MISSIONS AFTER MAIDEN TEST FLIGHT ON OCTOBER 21: SOMANATH

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October 15, 2023 12:13 am | Updated 12:48 am IST - Madurai

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S. Somanath, Chairman, Indian Space Research Organisation (ISRO). | Photo Credit: K. Murali Kumar K

ISRO will conduct three more test vehicle missions under the [ambitious Gaganyaan programme](#) after the maiden TV-D1 test flight, which is scheduled on October 21, the space agency's chairman S. Somanath said on October 14.

The Gaganyaan project envisages a demonstration of the human spaceflight capability by [launching a human crew](#) to an orbit of 400 km and bringing them safely back to earth by landing in Indian sea waters.

The test vehicle development flight (TV-D1) will be conducted at the Satish Dhawan Space Centre in Sriharikota in Andhra Pradesh to test the crew module that is scheduled to house Indian astronauts during the human spaceflight late next year.

"The first test vehicle flight (of the Gaganyaan mission) will be conducted on October 21. After that we have planned for three more test missions, D2, D3, D4. We will hold thorough tests during the test flight sequence," Mr. Somanath, who is also the secretary, Department of Space, told reporters in Madurai. He was here to participate in a couple of events in Rameswaram.

Also read | [ISRO to conduct first test flight of Gaganyaan mission on October 21](#)

TV-D1 involves launching the crew module to outer space, bringing it back to earth and recovering it after touchdown in the Bay of Bengal.

Recently, the Union Science and Technology Minister Jitendra Singh said the Bengaluru-headquartered space agency would carry out the first of several test flights ahead of the Gaganyaan maiden mission on October 21 at Sriharikota.

To a query about the Aditya-L1 programme, the maiden solar mission undertaken by ISRO, Mr. Somanath expressed hope that the spacecraft will reach the Lagrange point (L1) in the middle of January 2024.

“We will insert it in the L1 point and undertake various scientific experiments from that point,” he said.

Last week, ISRO scientists performed a trajectory correction manoeuvre on the Aditya L1 spacecraft. The spacecraft was launched by a PSLV-C57 rocket on September 2.

On the setting up of another launch pad in Kulasekarapattinam in Tuticorin district, he said ISRO would be able to avail several benefits from that launch pad as it would be useful for launching smaller rockets and to serve private players.

“...right now bigger rockets like PSLV need to take a turn towards the southward direction above Sri Lanka since the launch pad is in the east (in Sriharikota). Whereas in Kulasekarapattinam, we don't need to make rockets to make that turn as they will be already facing southward,” he said.

“Smaller Satellite Launch Vehicles and private players will be able to use that launch pad (in Kulasekarapattinam). Right now, the land is in the acquisition stage. It will take two years for completion,” Mr. Somanath said.

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COASTAL SECURITY EXERCISE – EAST COAST

Relevant for: Science & Technology | Topic: Defence related developments

A two-day comprehensive Coastal Security Exercise Sagar Kavach 02/23 involving all maritime security agencies was conducted by the Indian Navy in Andhra Pradesh, Tamil Nadu and the UT of Puducherry from 11-12 Oct 2023. The exercise was executed under the aegis of the Flag Officer Commanding-in-Chief Eastern Naval Command, FOCINC (East) who also exercises the authority of Commander-in-Chief, Coastal Defence (East). About 2500 personnel from the Indian Navy, Coast Guard, State and U/T Administration, Marine Police, Fisheries, Customs, Intelligence Agencies, Light Houses, Ports Forest etc were engaged in the exercise.

The exercise aimed to assess the efficacy and robustness of the coastal security mechanism while dealing with asymmetric threat emanating from the sea. Indian Naval Ships along with assets of the Coast Guard and other coastal security agencies were deployed to augment surveillance in the area. Enhanced security measures were instituted and extensive aerial surveillance undertaken by Dornier aircraft and helicopters operating from Visakhapatnam, Chennai and Ramnathapuram. The exercise was closely monitored at Joint Operations Centre (East) at Visakhapatnam which is the nodal hub for all coastal security operations and exercises in the area of operations.

The exercise witnessed close coordination and synergy among all coastal security stakeholders. Lessons learnt from the exercise would be incorporated to strengthen the coastal security architecture.





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CONFRONTING THE LONG-TERM RISKS OF ARTIFICIAL INTELLIGENCE

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October 17, 2023 12:08 am | Updated 09:14 am IST

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'The challenge lies in aligning AI with universally accepted human values' | Photo Credit: Getty Images/iStockphoto

Risk is a dynamic and ever-evolving concept, susceptible to shifts in societal values, technological advancements, and scientific discoveries. For instance, before the digital age, sharing one's personal details openly was relatively risk-free. Yet, in the age of cyberattacks and data breaches, the same act is fraught with dangers. A vivid cinematic example of evolving perceptions of Artificial Intelligence (AI) risk is the film, *Ex Machina*.

In the story, an AI named Ava, initially viewed as a marvel of synthetic intelligence, reveals her potential to outwit and manipulate her human creators, culminating in unforeseen hazards. Such a tale exemplifies how our understanding of AI risk can drastically change as the technology's capabilities become clearer. This underscores the importance of identifying the short- and long-term risks. The immediate risks might be more tangible, such as ensuring that an AI system does not malfunction in its day-to-day tasks. Long-term risks might grapple with broader existential questions about AI's role in society and its implications for humanity. Addressing both types of risks requires a multifaceted approach, weighing current challenges against potential future ramifications.

The risks that present themselves over the long term are worth looking at.

Yuval Noah Harari has expressed concerns about the amalgamation of AI and biotechnology, highlighting the potential to fundamentally alter human existence by manipulating human emotions, thoughts, and desires. In a recent statement by the Center for AI Safety, more than 350 AI professionals have voiced their concerns over the potential risks posed by AI technology.

One should be a bit worried about the intermediate and existential risks of more evolved AI systems of the future — for instance, if essential infrastructure such as water and electricity increasingly rely on AI. Any malfunction or manipulation of such AI systems could disrupt these pivotal services, potentially hampering societal functions and public well-being.

Similarly, although seemingly improbable, a 'runaway AI' could cause more harm — such as the manipulation of crucial systems such as water distribution or the alteration of chemical balances in water supplies, which may cause catastrophic repercussions even if such probabilities appear

distant. AI sceptics fear these potential existential risks, viewing it as more than just a tool — as a possible catalyst for dire outcomes, possibly leading to extinction.

The evolution to human-level AI that is capable of outperforming human cognitive tasks will mark a pivotal shift in these risks. Such AIs might undergo rapid self-improvement, culminating in a super-intelligence that far outpaces human intellect. The potential of this super-intelligence acting on misaligned, corrupted or malicious goals presents dire scenarios.

The challenge lies in aligning AI with universally accepted human values. The rapid pace of AI advancement, spurred by market pressures, often eclipses safety considerations, raising concerns about unchecked AI development.

The world does not have a unified approach. The lack of a unified global approach to AI regulation can be detrimental to the foundational objective of AI governance — to ensure the long-term safety and ethical deployment of AI technologies. The AI Index from Stanford University reveals that legislative bodies in 127 countries passed 37 laws that included the words “artificial intelligence”.

One of the most celebrated regulations out of these is the European Union’s AI Act. It adopts a ‘risk-based’ approach, tying the severity of risk to the area of AI deployment. This makes sense when considering AI applications in critical infrastructures, which demand heightened scrutiny. However, tying risk solely to the deployment area is an oversimplified strategy. It might overlook certain risks that are not directly tied to the deployment area. Therefore, while the area-specific approach is valuable, a more holistic view of AI risks is necessary to ensure comprehensive and effective regulation and oversight.

However, there is a conspicuous absence of collaboration and cohesive action at the international level, and so long-term risks associated with AI cannot be mitigated. If a country such as China does not enact regulations on AI while others do, it would likely gain a competitive edge in terms of AI advancements and deployments. This unregulated progress can lead to the development of AI systems that may be misaligned with global ethical standards, creating a risk of unforeseen and potentially irreversible consequences. This could result in destabilisation and conflict, undermining international peace and security.

Thus, nations engaging in rigorous AI safety protocols may be at a disadvantage, encouraging a race to the bottom where safety and ethical considerations are neglected in favour of rapid development and deployment. This uneven playing field can inadvertently encourage other nations to loosen their regulatory frameworks to maintain competitiveness, thereby further compromising global AI safety.

Furthermore, the confluence of technology with warfare amplifies long-term risks. Addressing the perils of military AI is crucial. The international community has formed treaties such as the Treaty on the Non-Proliferation of Nuclear Weapons to manage such potent technologies, demonstrating that establishing global norms for AI in warfare is a pressing but attainable goal. Treaties such as the Chemical Weapons Convention are further examples of international accord in restricting hazardous technologies. Nations must delineate where AI deployment is unacceptable and enforce clear norms for its role in warfare. In this ever-evolving landscape of AI risks, the world must remember that our choices today will shape the world we inherit tomorrow.

Aditya Sinha is Officer on Special Duty, Research, Economic Advisory Council to the Prime Minister. Tweets@adityasinha004. The views expressed are personal

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SEEING THE MAGIC OF ARTIFICIAL INTELLIGENCE APPLICATIONS IN OPHTHALMOLOGY

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October 19, 2023 10:23 pm | Updated 10:23 pm IST

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AI is being adopted for a number of applications in ophthalmology like automated screenings. | Photo Credit: PTI

We all know, by now, that Artificial Intelligence (AI) is a branch of computer science that focuses on creating computer systems and software that can perform tasks like problem-solving, learning, reasoning, understanding natural language, and perceiving the environment. The aim of AI is to develop systems that can mimic and replicate various aspects of human intelligence or cognitive functions, and thereby automate and enhance processes, make predictions, assist in decision-making, and improve the efficiency and capabilities of systems and devices.

If AI is touching everything in modern life, then it cannot possibly leave out medicine, can it?

There are certain aspects of artificial intelligence that make it particularly useful in medicine. For instance, AI can analyse data from sensors and predict when equipment or machinery will require maintenance, reducing downtime. This, as you can imagine, will be massively useful in hospitals and clinics, particularly in procedures and diagnostics, where we constantly use some form of machinery to treat patients. Additionally, AI can be used, with machine learning, to analyse and interpret images and videos, making it useful in reading and coming up with interpretations of scans and other diagnostics, based on the data we have fed it already. Already, robotics has been employed in precision surgery, with good outcomes, and faster recovery periods. AI is being used in commerce to tailor recommendations on social media, and it is to be seen whether this application might assist in patient care too.

But the basic question that we must ask in medicine is: can a computer perform better than a human brain? Then the answer is Yes, particularly in the field of ophthalmology.

AI has made significant advancements in the field of ophthalmology, offering a range of potential applications that can improve patient care and enhance the efficiency of eye disease diagnosis and treatment. In fact, we are among the early adopters of AI for health care, and some of the key uses are:

Retinal disease diagnosis: AI algorithms can analyse retinal images, such as fundus photographs and optical coherence tomography (OCT) scans, to detect and classify various

retinal diseases, including diabetic retinopathy, age-related macular degeneration (AMD), and glaucoma. These AI systems can help identify diseases at an early stage, allowing for timely treatment and reducing the risk of vision loss.

Automated screening: AI-powered screening programmes can assist in the early identification of eye diseases by analysing large datasets of retinal images. This can be particularly useful in regions with limited access to ophthalmologists, and in mobile medical camps.

Glaucoma diagnosis and management: AI can aid in monitoring glaucoma progression by analysing visual field tests and OCT scans. It helps ophthalmologists in making more informed decisions about the treatment and management of glaucoma patients.

Customised treatment plans: AI can recommend personalised treatment plans for patients with conditions like AMD. By analysing patient data and clinical information, AI can assist in tailoring treatment strategies to maximise effectiveness. Already, AI is also being used regularly by ophthalmologists in surgical assistance. During eye surgeries, AI can provide real-time guidance to surgeons by tracking eye movements, enhancing precision, and reducing the risk of complications. AI is also used to diagnose and stage Retinopathy of Prematurity (ROP), a blinding disease affecting premature & low birth weight babies and in telemedicine.

Besides these regular areas, AI is also being used to discover new drugs for ophthalmic conditions by analysing vast datasets to identify potential therapeutic targets and compounds and in predicting whether individuals may develop eye diseases, based on their health records, lifestyle factors, and genetic data. This can help in early intervention and preventive care. Besides this, there is the rather well-known deployment of AI in managing and analysing electronic health records and keeping them secure. More recently, AI is being used in ophthalmic research to model disease pathways, thus speeding up the development of new treatments and technologies.

There is a great deal of work that we have to do though, before AI can be let loose. In ophthalmology, as perhaps any other crucial field, deployment of AI involves a systematic procedure that includes data acquisition, preprocessing, model development, validation, and deployment. Since what we input into the software in order to generate output, it is important to make sure that this data is accurate. So, the first step is to gather a large and diverse dataset of relevant ophthalmic images and patient records. These datasets may include fundus photographs, OCT scans, visual field tests, and other types of eye-related data. The data is appropriately de-identified and anonymised to maintain patient privacy.

After that, we need to 'clean up' the data to remove artifacts, low-quality images, and other irrelevant information. It is standardised and normalised to ensure consistency in terms of format, resolution, and colour. It is then annotated, and labelled with relevant information (e.g., disease diagnosis, severity levels, patient demographics). The data must be divided into three subsets: training, validation, and testing data. A common split is 70% for training, 15% for validation, and 15% for testing. The training dataset is used to teach the AI model, the validation dataset is used to fine-tune the model and optimise hyperparameters, and the testing dataset is used to evaluate the model's performance.

We also need to extract relevant features from the images or data. For ophthalmic images, this could involve detecting blood vessels, optic discs, or lesions. Feature extraction is particularly important for traditional machine-learning approaches. Post that, it is time to focus on model development. Convolutional Neural Networks (CNNs) are commonly used for image-based ophthalmic applications. The model has to be taught to recognise patterns and make predictions based on the provided data. It is fine-tuned using the validation dataset and parameters are

adjusted as needed until it reaches an acceptable level of performance.

Then we must assess the model's performance using the testing dataset. Common evaluation metrics include accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve. Only when the AI model demonstrates sufficient accuracy and reliability, can it be integrated into clinical practice. After deployment, it is important to continue to monitor the AI system's performance, especially in real-world clinical settings.

As far as approvals go, it is also important to ensure that the AI system we have developed complies with regulatory requirements and obtains the necessary approvals required to operate in the region. (e.g., FDA approval in the U.S.). We would also advise constant collaboration with other ophthalmologists to ensure that the AI is on track, and in tune with the developments.

An innovation that has come to really benefit people with vision impairments is the smart vision glasses. These glasses incorporate a combination of hardware, software, and artificial intelligence (AI) to provide a range of features aimed at improving the visual experience for those with vision challenges. Smart glasses are equipped with cameras and sensors to capture the user's surroundings. Advanced image recognition algorithms and AI are employed to identify and describe objects, text, people, and more within the wearer's field of vision. This information is then conveyed to the user, often through audio feedback. Smart glasses can also convert printed text into audible speech, allowing users to "read" signs, documents, labels, and other text-based content. This helps individuals navigate and understand their environment. The glasses can offer real-time directions, guiding users through indoor and outdoor spaces using GPS and mapping data.

While we have enumerated the multiple benefits of using AI systems, it will be half the job done if we do not acknowledge some pain points. For instance, AI systems heavily depend on high-quality, diverse, and unbiased datasets. If the training data is flawed, biased, or unrepresentative, it can lead to inaccurate or biased AI predictions. Naturally, once technology goes digital, regulatory and ethical challenges related to issues of data privacy, informed consent, and patient trust crop up. AI models need rigorous validation in real life clinical setting, and unless updated regularly with emerging data sets, can become outdated. Also, determining responsibility in case of errors made by AI in healthcare can be legally complex. The costs of implementing AI in health care are prohibitively high, not something every institution can afford.

But this is the ultimate bottom line: Even if clinicians employ AI as a valuable tool for ophthalmology, aiding in early disease detection, diagnosis, and treatment, ultimately leading to improved eye health and quality of life for patients, AI should merely complement, not replace, human clinicians. Ophthalmologists must be able to interpret AI-generated recommendations and maintain clinical judgment.

(Dr. Mohan Rajan is Chairman & Medical Director, Rajan Eye Care. drmohanrajan@gmail.com)

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GAGANYAAN MISSION

Relevant for: Science & Technology | Topic: Indigenization of technology and developing new technology

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October 20, 2023 09:44 pm | Updated October 21, 2023 01:08 am IST - Bengaluru

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Gaganyaan's Flight Test Vehicle Abort Mission-1 will lift off from the first launch pad of the Satish Dhawan Space Centre in Sriharikota. Photo: X/@ISRO via ANI

The Indian Space Research Organisation (ISRO) on October 21 will [conduct the Gaganyaan's](#) first Flight Test Vehicle Abort Mission-1 (TV-D1), which will demonstrate the performance of the Crew Escape System.

The TV-D1 will lift off at 8 a.m. on October 21 from the first launch pad of the Satish Dhawan Space Centre in Sriharikota.

According to ISRO, the test vehicle developed for this abort mission is a single-stage liquid rocket. The payloads consist of the Crew Module (CM) and Crew Escape Systems (CES) with their fast-acting solid motors, along with CM fairing (CMF) and Interface Adapters.

The CM is where the astronauts are contained in a pressurised earth-like atmospheric condition during the [Gaganyaan mission](#). For the TV-D1, the CM is an unpressurised version.

"This flight will simulate the abort condition during the ascent trajectory corresponding to a Mach number of 1.2 encountered in the Gaganyaan mission. CES with CM will be separated from the Test Vehicle at an altitude of about 17km. Subsequently, the abort sequence will be executed autonomously commencing with the separation of CES and deployment of the series of parachutes, finally culminating in the safe touchdown of CM in the sea, about 10 km from the coast of Sriharikota," ISRO said.

The entire duration of the flight from lift off to CES and CM separation to deployment of parachutes and touch down of the crew module in the sea about 10 km from the coast of Sriharikota will be completed in about eight and half minutes.

ISRO said that the Indian Navy will lead the recovery of the TV-D1 CM after touchdown. Recovery ships positioned at a safe range in sea waters will approach the CM and a team of divers will attach a buoy, hoist the CM using a ship crane and bring it to the shore.

The objectives of this mission are flight demonstration and evaluation of test vehicle sub-systems, evaluation of CES including various separation systems and CM characteristics and deceleration systems demonstration at higher altitude and its recovery.

Simply put, the objective of the mission is to check the safety of the CES for its capabilities to take the CM to safety in case of an emergency that will require ISRO to abort the mission.

The Gaganyaan mission aims to demonstrate the capability to launch human beings (three crew members) to low earth orbit and bring them back safely to earth by landing them in either the Bay of Bengal or the Arabian Sea.

Prior to the first crewed flight, three test vehicles (TV) flights have been planned: TV-1, TV-2 and TV-3.

Saturday will be the first flight, and the beginning of next year, one more unnamed flight will carry the humanoid VyomMitra. Subsequently, manned flight is expected to take place in 2025.

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SCIENTISTS SURPRISED BY SOURCE OF LARGEST QUAKE DETECTED ON MARS

Relevant for: Science & Technology | Topic: Science and Technology- developments and their applications and effects in everyday life

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October 20, 2023 05:36 pm | Updated 05:36 pm IST

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The planet Mars is shown in this NASA Hubble Space Telescope view taken May 12, 2016. | Photo Credit: Reuters

On May 4, 2022, NASA's InSight lander detected the largest quake yet recorded on Mars, one with a 4.7 magnitude - fairly modest by Earth standards but strong for our [planetary neighbour](#).

Given Mars lacks the geological process called plate tectonics that generates earthquakes on our planet, scientists suspected a meteorite impact had caused this marsquake. But a search for an impact crater came up empty, leading scientists to conclude that this quake was caused by tectonic activity - rumbling in the planet's interior - and giving them a deeper understanding about what makes Mars shake, rattle and roll.

"We concluded that the largest marsquake seen by InSight was tectonic, not an impact. This is important as it shows the faults on Mars can host hefty marsquakes," said planetary scientist Ben Fernando of the University of Oxford in England, lead author of the research published this week in the journal *Geophysical Research Letters*. "We really thought that this event might be an impact."

"This represents a significant step forward in our understanding of Martian seismic activity and takes us one step closer to better unraveling the planet's tectonic processes," added Imperial College London planetary scientist and study co-author Constantinos Charalambous, co-chair of InSight's Geology Working Group.

[Also Read | Meet the scientist \(sort of\) spending a year on Mars](#)

NASA retired InSight in 2022 after four years of operations. In all, InSight's seismometer instrument detected 1,319 marsquakes.

Earth's crust - its outermost layer - is divided into immense plates that continually shift, triggering quakes. The Martian crust is a single solid plate. But that does not mean all is quiet on the Martian front.

"There are still faults that are active on Mars. The planet is still slowly shrinking and cooling, and

there is still motion within the crust even though there are no active plate tectonic processes going on anymore. These faults can trigger quakes," Fernando said.

The researchers determined that the 4.7 magnitude quake was centered in the Al-Qahira Vallis region in the Martian southern hemisphere, roughly 1,200 miles (2,000 km) southeast of InSight's location just north of the equator. They think it originated perhaps a few dozen miles (km) below the surface.

"Most of the marsquakes we've detected thus far have been associated with a region called Cerberus Fossae, located eastward of InSight. Conversely, the origin of this one left us puzzled, as no discernible surface features indicated ongoing tectonic processes as a likely cause, particularly ones that would cause such a powerful quake," Charalambous added.

The energy it released surpassed the cumulative energy from all the other marsquakes InSight recorded. The researchers initially noted similarities in its seismic signature to two meteorite impacts detected by InSight that gouged craters roughly 500 feet (150 meters) wide.

[Also Read | With drained battery and no fuel, Mangalyaan bids adieu](#)

They enlisted the various space agencies with spacecraft monitoring the Martian surface - the European, U.S., Chinese, Indian and United Arab Emirates agencies - to check for evidence of an impact on the day of the quake. No luck.

"The absence of a crater in our image search for this large marsquake represents a significant milestone in interpreting seismic signals on Mars," Charalambous said.

With future human missions to Mars in mind, a greater understanding of Martian seismic activity is pertinent.

"On Earth, a quake of this size would probably break windows, shake things off shelves, etc., but would not bring the house down," Fernando said.

Charalambous said the location of the majority of the marsquakes detected by InSight remained uncertain, with a poor understanding of the mechanisms that triggered them.

"Each seismic event detected by InSight is a valuable piece of the puzzle, but this particular event plays a crucial role in unveiling the Red Planet's geological history, shedding light on its interior and evolution," Charalambous said.

"Furthermore, it provides essential insights into the distribution of seismic activity on Mars, which is a vital consideration for planning future human missions to the planet."

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THE ASCENT BEGINS: THE HINDU EDITORIAL ON THE PROGRESS OF INDIA'S HUMAN SPACEFLIGHT MISSION

Relevant for: Science & Technology | Topic: Achievements of Indians in science & technology

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October 23, 2023 12:10 am | Updated 01:51 am IST

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At 10 a.m. on October 21, the Indian Space Research Organisation (ISRO) commenced the first uncrewed developmental flight of its 'Gaganyaan' human spaceflight mission from Sriharikota, designated TV-D1. The launch vehicle, a single-stage rocket, carried a crew module fit with a crew-escape system (CES) to an altitude of 12 km. There, the CES detached itself with the crew module from the rocket and climbed up to 17 km. In response to a command, the CES separated from the crew module, leaving the module to reorient itself before dropping over the Bay of Bengal. Its descent was slowed first by drogue parachutes and then by the main parachutes. Finally, the [module splashed into the Bay](#) a short distance from Sriharikota, where the Indian Navy hauled it out. The CES also splashed down farther down range. The flight tested the CES's ability to protect the crew in case the rocket malfunctioned, and collected data via sensors to inform future tests. The test's value will be based on this data. According to ISRO chairman S. Somanath, [ISRO has many tests planned](#) to develop confidence that the organisation can safely launch humans to orbit. Even the parachutes used for TV-D1 underwent 16 tests. Such fastidiousness is non-negotiable. TV-D1 was supposed to have been conducted at 8 a.m., when unfavourable weather pushed it to 8.45 a.m. Then, however, the automatic launch sequence held back the launch with a few seconds on the clock. Mr. Somanath subsequently announced that TV-D1 would be postponed. But ISRO personnel were able to quickly identify and resolve the problem, and the launch was rescheduled for 10 a.m.

These checks and balances are expensive, but are in place to prevent greater costs later. Plans for the programme were first readied in 2009 at an estimated 12,400 crore. The Union Cabinet granted its approval in December 2018 at 9,023 crore assuming first flight by 2022. But the COVID-19 pandemic and other commitments have caused delays such that the earliest the first crewed flight can happen is currently 2025. Last week, Prime Minister Narendra Modi called on ISRO to launch humans to the moon by 2040. Even with the requisite financial support, this would be a very tight deadline, but as with fastidiousness, contemporary geopolitics has also rendered returning to the moon non-negotiable. Fortunately, with 'Gaganyaan', ISRO has indicated how a balance can be struck: plan ahead, boost local manufacturing, test exhaustively, launch when ready. The deadline may be missed, but the mission can be undertaken with confidence while also improving local capabilities.

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TWO FORERUNNERS THAT SET THE STAGE FOR ISRO'S GAGANYAAN TEST

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October 22, 2023 09:26 pm | Updated 09:26 pm IST

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The crew module onboard an Indian Navy vessel at the end of the TV-D1 test. | Photo Credit: ISRO/Twitter

There were two important forerunners to the success of the Test Vehicle Abort Mission (TV-D1) flight that the [Indian Space Research Organisation \(ISRO\)](https://www.isro.gov.in/) conducted on October 21. During the test, an uncrewed crew module was brought back safely to the earth after launching it on a small rocket and simulating an emergency abort command. The test and its forerunners are ISRO's first major steps towards launching humans to orbit as part of its 'Gaganyaan' mission.

The TV-D1 test was carried out smoothly, especially given that ISRO had to overcome a glitch five seconds before lift-off at 8.45 am, when the ground computer, called the Automatic Launch Sequence, halted the lift-off. ISRO Chairman S. Somanath said it issued a "hold" when it detected a non-conformity "for allowing the engine to continue thrusting to further go. This happened due to a monitoring anomaly in the system." He added: "We could identify [the anomaly] very, very fast and correct it ... It took us some time to refill the gases...", after which the launch was rescheduled for 10 am.

The first forerunner to the TV-D1 mission was ISRO's Space Capsule Recovery Experiment (SRE-1). An orbiting satellite called SRE was brought back to the earth on January 22, 2007, after a Polar Satellite Launch Vehicle (PSLV) had placed it in orbit on January 10. In a series of manoeuvres, the shuttlecock-shaped SRE came down from an altitude of 635 km to splash down into the Bay of Bengal, 140 km from Sriharikota, where the Coast Guard recovered it. India thus successfully brought back an orbiting satellite in its first attempt.

The descent manoeuvres included sophisticated braking systems, deceleration techniques, and the deployment of parachutes. Overall, the SRE-1 mission showcased ISRO's mastery of re-entry technology. B.N. Suresh, former Director of the Vikram Sarabhai Space Centre, Thumba, said, "The satellite looked as fresh as it was when we gave it for integration with the PSLV for the launch", after it survived its fiery reentry.

SRE-1 was India's first big step towards sending an Indian astronaut into space and bringing them back safely. Former ISRO Chairman G. Madhavan Nair had said, "This is a humble step towards sending an Indian into space." B.R. Guruprasad, a former ISRO official and a science writer, had said then, "Nothing symbolises the ascent of India in science and technology as the

return of SRE-1.”

The second forerunner to the TV-D1 mission happened on December 18, 2014, when the Launch Vehicle Mark 3 (LVM-3) placed the 3.75-tonne uncrewed crew module in a sub-orbital altitude of 126 km, and left it to descend. The module knifed through the earth’s atmosphere and also survived re-entry. Its parachutes deployed and soon it was bobbing in the Bay of Bengal, about 700 km from Port Blair. This test, called Crew Module Atmospheric Re-entry Experiment (CARE), marked India’s second step towards sending its astronauts into space and getting them back.

Dr. Guruprasad pointed out that while the SRE weighed about 555 kg, the uncrewed crew module in CARE weighed nearly seven-times as much. In TV-D1, the module weighed 200 kg more, a full four tonnes.

TV-D1 also had three other highlights. According to Dr. Guruprasad, they were a standalone liquid booster rocket launching for the first time from Indian soil; the successful performance of the Crew Escape System that pulled the crew module away from the launch vehicle; and the crew module reorienting itself before landing in the Bay.

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HOW BAT GENOMES PROVIDE INSIGHTS INTO IMMUNITY AND CANCER

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October 22, 2023 03:30 pm | Updated 10:21 pm IST

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Close-up of two fruit bats hanging upside down in a tree in Australia. | Photo Credit: Getty Images/iStockphoto

Bats are [extraordinary organisms](#) in many ways. They are the only mammals on the earth that can maintain sustained flight. They also have relatively long life-spans and are relatively more protected from a variety of diseases, including cancer. They also have a unique ability in echolocation, whereby they use sound to navigate and locate objects, freeing them from being constrained by the availability of light like humans are.

By population, bats make up 20% of all mammals. There are more than 1,400 species of bats today around the world; more than 60 are endangered and 170-odd are classified as vulnerable. The bumblebee bat weighs only 2 grams whereas the flying foxes, which have a wingspan of 1.5 metres, weigh up to 1.6 kg.

In all bats play crucial roles in maintaining the ecological balance, and are essential for pollination, insect control, etc.

However, bats have grabbed the headlines of late for the wrong reasons. Their notoriety stems from the fact that many deadly viruses use bats as a reservoir host, including coronaviruses, Nipah, Ebola, Marburg virus, and Hendra virus, among others. The COVID-19 pandemic also cast a bright spotlight on the habits of bats.

Bats do host a wide variety of pathogens, including ones deadly to other mammals, but they themselves don't get infected. Scientists have been curious about the source of this protection.

Scientists' first object of study is the bat genome. Over the years, researchers have unearthed significant insights by sequencing the genomes of many bat species. Bats are also unique because they have a relatively small genome, around 2 billion bases.

One watershed moment came in 2013. In a paper published in the journal [Science](#), scientists compared the genomes of a fruit-eating and an insect-eating species and found that genes involved in metabolism and immune response had been positively selected. That is, these bats had evolved by improving these two biological domains.

In the following decade, scientists sequenced a large number of bat genomes. The ambitious Bat1K global genome consortium – to sequence all the 1,400 or so species' genomes – is also currently underway.

A number of studies have also shed insights into the peculiar biological features of bats. For example, by analysing bat genomes, scientists have found the natural selection of a [protein called prestin](#), which is involved in echolocation (dolphins have the same protein).

Of course, immunity-related genes have been one of the more well-studied gene classes in bats. The fraction of these genes is also unique in bats: some 2.7-3.5% of the bat genome versus roughly 7% of the human genome. Emerging evidence also suggests that a set of immune-related genes have been undergoing positive selection in bats, adapting them to control the spread of viruses while mitigating the antiviral inflammatory response. As a result, the bats are shielded from the [effects of the clinical response](#) of their bodies to these viruses.

The heightened pro-inflammatory activity is what makes these viruses deadly in humans.

One of the first Bat1K genome consortium papers described six high-quality bat species genomes in the journal [Nature](#). It suggested that echolocation, loss of pro-inflammatory genes, and expansion of antiviral genes are ancestral traits of bats. This suggests that bats have molecular mechanisms that allow them to host a range of deadly viruses but evade clinical disease.

It is not surprising, therefore, that genome sequencing – but especially metagenomic sequencing, adept at providing an unbiased view of the diversity of viruses – has been the mainstay of investigations of the viruses that bats carry, also known as the *bat virome*. Aside from knowing that bats can harbour all types of viruses, we have also found that bats can harbour multiple viruses at the same time, i.e. in a state of co-infection, without themselves falling ill.

Long-read sequencing technologies are those that can 'read' thousands to tens of thousands of bases of a genome at a time. With their advent, it has become possible today for scientists to quickly assemble the nearly complete whole-genomes of organisms. Another benefit to them is that they no longer had to use more complex, time-consuming, and expensive molecular technologies in the pursuit of building complete genomes.

A recent report by researchers from the Cold Spring Harbor Laboratory, New York, used a long-read technology to sequence two bat genomes as well as compared the genomes of 15 species that were already available. Their results were published in the recent edition of the journal [Genome Biology and Evolution](#).

The researchers reported that subsets of genes involved in mounting an immune response – which encode proteins called interferons (IFN) – had contracted significantly. This in turn changed the relative proportions of two subsets, interferon-alpha (IFN-) and interferon-omega (IFN-), relative to each other. The researchers attributed bats' immune properties to these changes. By shedding the genes for IFN-, bats can dampen the pro-inflammatory response against a number of viruses, thus protecting themselves from clinical disease.

The researchers also reported that a number of genes involved in suppressing tumours and in repairing DNA contained signs of positive selection. According to them, this could contribute to the bats' longer life span and a significantly lower risk of developing cancer.

With rapid deforestation, ecological degradation, and more and more unfavourable human-

animal interactions, we should expect significantly enhanced outbreaks of zoonotic diseases in future. The Nipah outbreaks in Kerala over the last few years is a good example, as are outbreaks of Marburg disease and the Ebola virus in some African countries. In this milieu, genome-sequencing – especially its more advanced avatars – could help us cope without violating the balances of nature.

The authors are senior consultants at Vishwanath Cancer Care Foundation. All opinions expressed here are personal.

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NVIDIA TO MAKE ARM-BASED PC CHIPS IN MAJOR NEW CHALLENGE TO INTEL

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October 24, 2023 10:27 am | Updated 10:27 am IST

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The AI chip giant's new pursuit is part of Microsoft's effort to help chip companies build Arm-based processors for Windows PCs [File] | Photo Credit: REUTERS

Nvidia [dominates the market for artificial intelligence computing chips](#). Now it is coming after Intel's long-time stronghold of personal computers.

Nvidia has quietly begun designing central processing units (CPUs) that would run Microsoft's Windows operating system and use technology from Arm Holdings, two people familiar with the matter told Reuters.

The AI chip giant's new pursuit is part of Microsoft's effort to help chip companies build Arm-based processors for Windows PCs. Microsoft's plans take aim at Apple, which has nearly doubled its market share in the three years since releasing its own Arm-based chips in-house for its Mac computers, according to preliminary third-quarter data from research firm IDC.

Advanced Micro Devices also plans to make chips for PCs with Arm technology, according to two people familiar with the matter.

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Nvidia and AMD could sell PC chips as soon as 2025, one of the people familiar with the matter said. Nvidia and AMD would join Qualcomm, which has been making Arm-based chips for laptops since 2016. At an event on Tuesday that will be attended by Microsoft executives, including vice president of Windows and Devices Pavan Davuluri, Qualcomm plans to reveal more details about a flagship chip that a team of ex-Apple engineers designed, according to a person familiar with the matter.

Nvidia shares closed up 3.84%, and Intel shares ended down 3.06% after the Reuters report on Nvidia's plans. Arm's shares were up 4.89% at close.

Nvidia spokesperson Ken Brown, AMD spokesperson Brandi Marina, Arm spokesperson Kristen Ray and Microsoft spokesperson Pete Wootton all declined to comment.

Nvidia, AMD and Qualcomm's efforts could shake up a PC industry that Intel long dominated, but which is under increasing pressure from Apple. Apple's custom chips have given Mac computers better battery life and speedy performance that rivals chips that use more energy. Executives at Microsoft have observed how efficient Apple's Arm-based chips are, including with AI processing, and desire to attain similar performance, one of the sources said.

In 2016, Microsoft tapped Qualcomm to spearhead the effort for moving the Windows operating system to Arm's underlying processor architecture, which has long powered smartphones and their small batteries. Microsoft granted Qualcomm an exclusivity arrangement to develop Windows-compatible chips until 2024, according to two sources familiar with the matter.

Microsoft has encouraged others to enter the market once that exclusivity deal expires, the two sources told Reuters.

"Microsoft learned from the 90s that they don't want to be dependent on Intel again, they don't want to be dependent on a single vendor," said Jay Goldberg, chief executive of D2D Advisory, a finance and strategy consulting firm. "If Arm really took off in PC (chips), they were never going to let Qualcomm be the sole supplier."

Microsoft has been encouraging the involved chipmakers to build advanced AI features into the CPUs they are designing. The company envisions AI-enhanced software such as its Copilot to become an increasingly important part of using Windows. To make that a reality, forthcoming chips from Nvidia, AMD and others will need to devote the on-chip resources to do so.

There is no guarantee of success if Microsoft and the chip firms proceed with the plans. Software developers have spent decades and billions of dollars writing code for Windows that runs on what is known as the x86 computing architecture, which is used by both Intel and AMD. Computer code built for x86 chips will not automatically run on Arm-based designs, and the transition could pose challenges.

Intel has also been packing AI features into its chips and recently showed a laptop running features similar to ChatGPT directly on the device.

Intel spokesperson Will Moss did not immediately respond to a request for comment. AMD's entry into the Arm-based PC market was earlier reported by chip-focused publication SemiAccurate.

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SPACEX SIGNS DEAL TO LAUNCH KEY EUROPEAN SATELLITES: REPORT

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October 24, 2023 09:15 am | Updated 09:15 am IST

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A SpaceX Falcon 9 rocket taking off [File] | Photo Credit: AP

SpaceX has signed a deal to launch up to four of Europe's flagship navigation and secure communications satellites into orbit, The Wall Street Journal reported on Monday.

The European Commission, the European Union's executive arm, along with EU member states, must still give final approval for the deal, the report added, citing officials.

SpaceX and the European Space Agency recently signed an agreement for two launches next year, each carrying two Galileo satellites, Javier Benedicto, the agency's director of navigation, told the Journal.

The agreement calls for the satellites to be launched on [SpaceX's Falcon 9 rocket from the U.S.](#), he added.

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SpaceX, and the European Commission did not immediately respond to a request for comment.

European space officials said last month they face crucial timing decisions in the coming weeks on the return to flight of Europe's flagship space launchers, following a series of delays.

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ISRO CHIEF SOMNATH SAYS SPACE AGENCY PREFERS WOMAN FIGHTER TEST PILOTS FOR ITS CREWED MISSION, POSSIBLE IN FUTURE

Relevant for: Science & Technology | Topic: Indigenization of technology and developing new technology

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October 22, 2023 03:48 pm | Updated October 23, 2023 09:35 pm IST - Thiruvananthapuram

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ISRO prefers woman fighter test pilots or female scientists for its Gaganyaan mission, the space agency chief S. Somanath said. File | Photo Credit: K. Murali Kumar

ISRO prefers woman fighter test pilots or female scientists for its much-awaited human space flight [programme Gaganyaan](#) mission and it is possible to send them in the future, the space agency chief S. Somanath said on Sunday.

He also said ISRO would send a female humanoid - a robot that resembles a human - in its unmanned Gaganyaan spacecraft next year. The ambitious mission aims to send humans into space on a Low Earth Orbit of 400 km for three days and bring them safely back to the Earth.

"No doubt about it...but we have to find out such possible (women) candidates in the future," Somanath told *PTI* over phone in response to a query.

Also read: [Gaganyaan: The mission to send Indians to space is on track](#)

His statement came a day after the ISRO successfully launched its TV-D1 test vehicle ahead of the human space flight mission Gaganyaan.

He said the manned mission is expected by 2025 and that it will be a short duration mission.

"Right now, the initial candidates are to be from Air Force fighter test pilots...they are a bit different category. Right now, we are not having women fighter test pilots. So, once they come, that is one route," the Chairman said.

The second option was when there would be more scientific activity, he said.

"Then, scientists will come as astronauts. So, at that time, I believe that more possibilities for women are there. Currently, possibilities are lesser because there are no women fighter test pilots," Mr. Somanath explained.

To a question, he said the ISRO's target is to put a fully operational space station by 2035.

ISRO had successfully launched TV-D1 test vehicle ahead of the human space flight mission Gaganyaan on Saturday.

After overcoming initial hiccups including delays, the space agency successfully launched the test vehicle with payloads related to the country's ambitious Gaganyaan programme.

Scientists simulated an abort situation for the Crew Escape System to carry the Crew Module of the test vehicle out as they made a splash into the Bay of Bengal with planned precision.

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AI-GENERATED CHILD SEXUAL ABUSE IMAGES COULD FLOOD THE INTERNET; UK WATCHDOG CALLS FOR ACTION

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October 25, 2023 09:01 am | Updated 09:01 am IST - NEW YORK

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The U.K.-based Internet Watch Foundation urges governments and technology providers to act quickly [File] | Photo Credit: REUTERS

The already-alarming proliferation of child sexual abuse images on the internet could become much worse if something is not done to put [controls on artificial intelligence tools that generate deepfake photos](#), a watchdog agency warned on Tuesday.

In a written report, the U.K.-based Internet Watch Foundation urges governments and technology providers to act quickly before a flood of AI-generated images of child sexual abuse overwhelms law enforcement investigators and vastly expands the pool of potential victims.

“We’re not talking about the harm it might do,” said Dan Sexton, the watchdog group’s chief technology officer. “This is happening right now and it needs to be addressed right now.”

In a first-of-its-kind case in South Korea, a man was sentenced in September to 2.5 years in prison for using artificial intelligence to create 360 virtual child abuse images, according to the Busan District Court in the country’s southeast.

(For top technology news of the day, [subscribe](#) to our tech newsletter Today’s Cache)

In some cases, kids are using these tools on each other. At a school in southwestern Spain, police have been investigating teens’ alleged use of a phone app to make their fully dressed schoolmates appear nude in photos.

The report exposes a dark side of the race to build generative AI systems that enable users to describe in words what they want to produce — from emails to novel artwork or videos — and have the system spit it out.

If it isn’t stopped, the flood of deepfake child sexual abuse images could bog investigators down trying to rescue children who turn out to be virtual characters. Perpetrators could also use the images to groom and coerce new victims.

Sexton said IWF analysts discovered faces of famous children online as well as a “massive demand for the creation of more images of children who’ve already been abused, possibly years ago.”

“They’re taking existing real content and using that to create new content of these victims,” he said. “That is just incredibly shocking.”

Sexton said his charity organisation, which is focused on combating online child sexual abuse, first began fielding reports about abusive AI-generated imagery earlier this year. That led to an investigation into forums on the so-called dark web, a part of the internet hosted within an encrypted network and accessible only through tools that provide anonymity.

What IWF analysts found were abusers sharing tips and marvelling about how easy it was to turn their home computers into factories for generating sexually explicit images of children of all ages. Some are also trading and attempting to profit off such images that appear increasingly lifelike.

“What we’re starting to see is this explosion of content,” Sexton said.

While the IWF’s report is meant to flag a growing problem more than offer prescriptions, it urges governments to strengthen laws to make it easier to combat AI-generated abuse. It particularly targets the European Union, where there’s a debate over surveillance measures that could automatically scan messaging apps for suspected images of child sexual abuse even if the images are not previously known to law enforcement.

A big focus of the group’s work is to prevent previous sex abuse victims from being abused again through the redistribution of their photos.

The report says technology providers could do more to make it harder for the products they’ve built to be used in this way, though it’s complicated by the fact that some of the tools are hard to put back in the bottle.

A crop of new AI image-generators was introduced last year and wowed the public with their ability to conjure up whimsical or photorealistic images on command. But most of them are not favoured by producers of child sex abuse material because they contain mechanisms to block it.

Technology providers that have closed AI models, with full control over how they’re trained and used — for instance, OpenAI’s image-generator DALL-E — appear to have been more successful at blocking misuse, Sexton said.

By contrast, a tool favored by producers of child sex abuse imagery is the open-source Stable Diffusion, developed by London-based startup Stability AI. When Stable Diffusion burst onto the scene in the summer of 2022, a subset of users quickly learned how to use it to generate nudity and pornography. While most of that material depicted adults, it was often non-consensual, such as when it was used to create celebrity-inspired nude pictures.

Stability later rolled out new filters that block unsafe and inappropriate content, and a license to use Stability’s software also comes with a ban on illegal uses.

In a statement released Tuesday, the company said it “strictly prohibits any misuse for illegal or immoral purposes” across its platforms. “We strongly support law enforcement efforts against those who misuse our products for illegal or nefarious purposes,” the statement reads.

Users can still access unfiltered older versions of Stable Diffusion, however, which are “overwhelmingly the software of choice ... for people creating explicit content involving children,” said David Thiel, chief technologist of the Stanford Internet Observatory, another watchdog group studying the problem.

“You can’t regulate what people are doing on their computers, in their bedrooms. It’s not possible,” Sexton added. “So how do you get to the point where they can’t use openly available software to create harmful content like this?”

Most AI-generated child sexual abuse images would be considered illegal under existing laws in the U.S., U.K. and elsewhere, but it remains to be seen whether law enforcement has the tools to combat them.

The IWF’s report is timed ahead of a global AI safety gathering next week hosted by the British government that will include high-profile attendees such as U.S. Vice President Kamala Harris and tech leaders.

“While this report paints a bleak picture, I am optimistic,” IWF CEO Susie Hargreaves said in a prepared written statement. She said it is important to communicate the realities of the problem to “a wide audience because we need to have discussions about the darker side of this amazing technology.”

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U.S. STATES SUE META FOR HARMING YOUNG PEOPLE'S MENTAL HEALTH, COLLECTING DATA ON CHILDREN

Relevant for: Science & Technology | Topic: Science and Technology- developments and their applications and effects in everyday life

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October 24, 2023 09:58 pm | Updated 09:58 pm IST

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The Meta logo is seen at the Vivatech show in Paris on June 14, 2023. | Photo Credit: AP

A group of 33 States including California and New York are suing Meta Platforms Inc. for harming young people's mental health and contributing the youth mental health crisis by knowingly designing features on Instagram and Facebook that addict children to its platforms.

The lawsuit filed in federal court in California also claims that Meta routinely collects data on children under 13 without their parents' consent, in violation of federal law.

"Kids and teenagers are suffering from record levels of poor mental health and social media companies like Meta are to blame," said New York Attorney General Letitia James. "Meta has profited from children's pain by intentionally designing its platforms with manipulative features that make children addicted to their platforms while lowering their self-esteem."

The broad-ranging suit is the result of an investigation led by a bipartisan coalition of attorneys general from California, Florida, Kentucky, Massachusetts, Nebraska, New Jersey, Tennessee, and Vermont. It follows damning newspaper reports, first [by The Wall Street Journal in 2021](#), based on the Meta's own research that found that the company knew about the harms Instagram can cause teenagers — especially teen girls — when it comes to mental health and body image issues. One internal study cited 13.5% of teen girls saying Instagram makes thoughts of suicide worse and 17% of teen girls saying it makes eating disorders worse.

Following the first reports, a consortium of news organisations, including The Associated Press, published their own findings based on leaked documents from whistleblower Frances Haugen, who has testified before Congress and a British parliamentary committee about what she found.

The use of social media among teens is nearly universal in the U.S. and many other parts of the world. Up to 95% of youth ages 13 to 17 in the U.S. report using a social media platform, with more than a third saying they use social media "almost constantly", according to the Pew Research Center.

To comply with federal regulation, social media companies ban kids under 13 from signing up to

their platforms — but children have been shown to easily get around the bans, both with and without their parents' consent, and many younger kids have social media accounts.

Other measures social platforms have taken to address concerns about children's mental health are also easily circumvented. For instance, TikTok recently introduced a default 60-minute time limit for users under 18. But once the limit is reached, minors can simply enter a passcode to keep watching.

In May, U.S. Surgeon General Vivek Murthy called on tech companies, parents and caregivers to take "immediate action to protect kids now" from the harms of social media.

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SCIENTISTS TRACE POWERFUL RADIO SIGNAL TO MOST DISTANT GALAXY YET

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October 24, 2023 04:01 pm | Updated 04:01 pm IST

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This artist's impression, not to scale, illustrates the path of a fast radio burst from the distant galaxy where it originated all the way to Earth, in one of the Milky Way galaxy's spiral arms, in this handout picture obtained on October 20, 2023. | Photo Credit: Reuters

Every day and night, hundreds of thousands of intense, brief flashes of radiation suddenly flicker on and then off all across the sky. These "fast radio bursts" are invisible to the naked eye, but to a radio telescope many almost outshine everything else in the sky for a few thousandths of a second.

Since the [first such burst](#) was spotted in 2006, we have found that nearly all of them [come from distant galaxies](#). Most bursts pass unnoticed, occurring outside the field of view of radio telescopes, and never occur again.

In new research published in [Science](#), we have found the most distant fast radio burst ever detected: an 8-billion-year-old pulse that has been travelling for more than half the lifetime of the universe.

Astronomers are fascinated by fast radio bursts for two reasons.

The first is that [their cause is unknown](#). The bursts are a trillion times more energetic than the things that look most like them: rotating neutron stars called pulsars, in our own galaxy.

The second reason is that the bursts provide a new tool to study [other aspects of the cosmos](#).

Fast radio bursts let us study the "cosmic web" of matter floating in the space between galaxies. This matter is very hot, diffuse gas and almost invisible, but it subtly slows down fast radio bursts as they pass through it. (This is ordinary matter, the same kind that makes up stars, planets and humans, not the invisible "dark matter" that also lurks throughout the universe.)

The degree to which bursts slow down correlates with the distance they have travelled.

In 2020, analysis of fast radio bursts revealed that the cosmic web actually contains [more than half of the normal matter in the universe](#) – which astronomers had previously thought was "missing".

More distant and extreme fast radio bursts promise to reveal further secrets about the universe, so astronomers are on the hunt. I lead a team [doing just that](#), using the [Australian SKA Pathfinder \(ASKAP\)](#) radio telescope.

On June 6 2022, our team detected and pinpointed a very bright burst with a high degree of slowing (known officially as “FRB 20220610A”). Our initial calculations suggested it might be the most distant ever found.

However, there was a possibility that the burst was closer than we thought – or that it might come from a distant galaxy too faint to be seen with an optical telescope.

We turned to one of the world’s most powerful optical observatories to search for the host galaxy: the [Very Large Telescope](#) (VLT) in Chile. The observatory’s four telescopes are equipped with cutting-edge cameras and spectrographs that can identify faint host galaxies and study their properties in detail.

At the position pinpointed by ASKAP as the source of the burst, initial images revealed faint smudges of light that looked like a distant galaxy. Analysing the spectrum of light from the galaxy showed it was strongly “redshifted”, meaning the emission from the burst has doubled in wavelength as it stretched out on its journey through the expanding universe.

The redshift had a value just over 1, which shows the burst was emitted more than 8 billion years ago, when the universe was less than half its present age. This confirmed that FRB 20220610A had broken the record for the most distant fast radio burst.

Like Olympic athletes, astronomers (including me) enjoy breaking records. Beyond personal satisfaction, however, this detection can also be used to explore the two fundamental questions about fast radio bursts.

First, the burst has the most energy of any that has been securely pinpointed to a location. It is more energy than our Sun puts out in 30 years, and approaches what we believe are fundamental physical limits.

The upper limit on the amount of energy any one fast radio burst can carry may be determined by quantum mechanical effects. At a certain point, the burst’s surge of radio photons may meet resistance from [a sea of “virtual” electrons and positrons](#) which British physicist Paul Dirac predicted in 1930.

Our discovery also demonstrates the potential for fast radio bursts to study the composition of the distant universe. As we look back in time, we see the structure of galaxies changes a great deal. Bursts in distant galaxies may allow us to study the detailed structure of their hosts.

We now know that energetic bursts exist in the distant universe. As new and upgraded telescopes join the hunt for fast radio bursts, we are likely to see many more tracked down to their host galaxies.

We are currently building a new fast radio burst search system for ASKAP which will make it five times more sensitive, enabling us to push the frontier of our research further out into the universe.

And in the future, ultra-sensitive radio telescopes such as the [Square Kilometre Array](#) (SKA) will be able to detect bursts at ever greater distances. These detections will be used to map the structure of the universe and resolve the tale of a modern astronomical mystery.

[Ryan Shannon](#), Associate Professor, Swinburne University of Technology, [Swinburne University of Technology](#)

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GOVERNMENT TO ORGANISE HACKATHON ON 5G TECHNOLOGY FOR LAW ENFORCEMENT, DISCUSS 360-DEGREE SURVEILLANCE AND PREDICTIVE POLICING

Relevant for: Science & Technology | Topic: Science and Technology- developments and their applications and effects in everyday life

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October 26, 2023 02:49 am | Updated 02:49 am IST - NEW DELHI

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Bureau of Police Research and Development (BPR&D) Director General Balaji Srivastava and Telecom Centre of Excellence Chairman Ajay Kumar Sahu during a media briefing on the Curtain Raiser event regarding the launch of the VIMARSH 5G Hackathon organised by the Bureau of Police Research and Development under MHA, in New Delhi on Wednesday. | Photo Credit: ANI

The government is organising a Hackathon to develop applications and tools that would help law enforcement agencies leverage the 5G technology for better policing. The Hackathon would be exploring “360-degree surveillance” and “predictive policing” – among other topics.

Rajesh Kumar, CEO of the Indian Cybercrime Coordination Centre (I4C) said that 5G enables faster data transfer and it will help police make better decisions at a scene of crime as information can be relayed to the headquarters at a higher speed.

When asked about financial frauds such as loan apps emanating from countries like China, Mr. Kumar said, “We are seeing many financial frauds being perpetrated from outside the country. The Ministry of Home Affairs (MHA) is working with banks, Financial Intelligence Units, Department of Telecommunications to combat this. Every day new technology is emerging. We are in touch with government and non-government entities to prevent such malicious acts.”

Also Read | [Jio can deploy 5G cell every 10 seconds, deployed 85% 5G network in India: Akash Ambani](#)

Rajshekhar N. from the Bureau of Police Research and Development (BPR&D) said that there is a proposal that all government websites be audited every six months in the wake of threats such as hacking from foreign agencies.

There are nine problem statements that have been shortlisted for the event which will be open to startups, academia and MSMEs among others.

One of the problem statements listed on the website vimarsh.tcoe.in is to find solutions and develop apps to get real time location of mobile users with internal authentication process.

It states, “authentication feature to enable ground officers to access permission from seniors for data accessibility, biometric and face recognition. The app gathers information such as time, date, speed and direction of the target,” adding that the mobile phone user’s real-time location helps in controlling planned crime, tracing a victim and crowd control.

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The Hackathon will involve three stages of ideas screening – Stages I and II shall be done in virtual mode whereas Stage III will be held at nodal centres in physical mode where the 5G testbeds/Private Networks/Labs would be available. The winners for each problem statement with an award money of 1.5 lakh will be announced during the valedictory session in February 2024. Applicants can register between November 1-December 9.

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THE LEGALITY OF USING WHITE PHOSPHORUS

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October 26, 2023 12:23 am | Updated 12:23 am IST

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A file photo of a Palestinian being treated for burns at the Nasser Hospital in Khan Younis in the southern Gaza Strip. Human Rights Watch issued a report in 2009 that Israel fired white phosphorous shells indiscriminately over densely populated Gaza. The group has alleged recently that Israel has once again used white phosphorous in the latest conflict. | Photo Credit: AP

Human Rights Watch recently [accused Israel of using white phosphorus munitions](#) in Gaza, and said that such weapons put civilians at risk of serious and long-term injury. In the 2008-2009 Gaza War too, there were allegations that the Israel Defense Forces (IDF) [struck the Gaza Strip with sub-munitions containing white phosphorus](#). The Israeli government, which initially denied this, later acknowledged that it did use white phosphorus in 2009, but only in uninhabitable areas, for the purpose of signalling and marking.

In the summary of the report of the United Nations Headquarters Board of Inquiry into certain incidents in the [Gaza Strip](#) between December 27, 2008 and January 19, 2009, the then UN Secretary General said that the IDF had targeted certain UN facilities and asserted that “any precautions that were taken by the IDF were clearly inadequate in view of the firing of high-explosive shells into the compound [of a UNRWA Field Office].”

Further, the UN Fact Finding Mission on the Gaza Conflict, also called the [Goldstone Report \(2009\)](#), condemned the IDF’s use of white phosphorus in civilian areas. Due to the mounting outrage both at international and domestic levels in the case of *Yoav Hass and others v. Chief of Staff* (2013), the Israel military agreed to abandon the use of white phosphorus except in situations which they communicated to the Justices at the Israel High Court of Justice. The Court recommended the consideration of alternatives. The outrage over the use of the toxic substance led to calls for investigations into whether its use constituted a violation of international humanitarian law.

[White phosphorus](#) has a wide range of applications. It is useful in military operations. But it also poses environmental dangers. White phosphorus can be employed to create dense smoke screens in the context of combat, hindering visibility and providing cover for military manoeuvres. Additionally, it can be used in incendiary devices such as grenades and artillery shells, which can result in persistent and intense fires, effective against people, equipment, and structures. However, the ethical concerns surrounding its use in populated areas are significant due to its potential to cause severe burns and suffering. The Convention on Certain

Conventional Weapons (CCW) imposes restrictions on the use of incendiary weapons, including white phosphorus, with the aim of safeguarding civilians.

In addition, white phosphorus use is subject to the rules and principles of international humanitarian law, which aims to minimise harm to both civilians and combatants in armed conflicts. This includes the principles of distinction, which require differentiation between combatants and civilians, and proportionality, ensuring that military actions do not cause excessive harm to civilians compared to the military advantage sought. International humanitarian law also prohibits indiscriminate attacks that may disproportionately harm civilians and civilian objects.

[Protocol III under the CCW](#) specifically deals with incendiary weapons. Article 1 of this protocol defines an “incendiary weapon” as a weapon or munition primarily designed to set fire to objects or to cause burn injury to persons through the action of flame, heat, or combination thereof, produced by a chemical reaction of a substance delivered on the target. Article 1(b)(i) includes an exemption in this classification for munitions that may cause unintended incendiary effects, such as illuminants, tracers, smoke, or signalling systems. White phosphorus munitions are primarily intended to produce illuminating and smokescreen effects, with the incendiary aspects being secondary or unintentional. Consequently, incendiary munitions clearly fall within the exceptions outlined in Protocol III’s definition of an “incendiary weapon.”

The [Chemical Weapons Convention \(CWC\)](#) is a treaty that establishes a comprehensive ban on the use of chemical weapons. White phosphorus, although a chemical agent and toxic, is not covered by the CWC. When employed as an incendiary weapon and not for chemical warfare, white phosphorus falls under the regulations of Protocol III of the CCW. However, Protocol III does not effectively regulate multi-purpose munitions such as those containing white phosphorus, which can cause harm in the same way as the incendiary weapons it defines. Strengthening Protocol III would be a progressive step in terms of legal and procedural process. In this context, it is important to consider the Advisory Opinion on the Legality of the Threat or Use of Nuclear Weapons (International Court of Justice Report 226, 1996) and Additional Protocol I of the Geneva Conventions, which assess the effects of specific types of weapons to determine their legality.

The legal consequences of employing white phosphorus in warfare emphasise the utmost importance of upholding international law, treaties, and protocols to reduce harm to both civilians and the environment. Breaches of these legal principles can lead to global condemnation, investigations, and potential prosecution for war crimes. Strengthening Protocol III would create a binding agreement for states that prevents them from engaging in uses that exploit legal loopholes. Removing ambiguity in Protocol III would also facilitate enforcement because with clearer rules, violations will become more easily identifiable.

Nabeela Siddiqui is Assistant Professor of Law, Vinayaka Mission’s Law School, Chennai

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ISRO TO HOLD MORE TESTS FOR GAGANYAAN IN COMING MONTHS

Relevant for: Science & Technology | Topic: Achievements of Indians in science & technology

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October 25, 2023 09:55 pm | Updated 09:55 pm IST - THIRUVANANTHAPURAM

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ISRO successfully launched the Gaganyaan's Flight Test Vehicle Abort Mission-1 (TV-D1) from Satish Dhawan Space Centre in Sriharikota. | Photo Credit: ANI

After the [successful Test Vehicle-D1 \(TV-D1\) mission](#) on October 21, the Indian Space Research Organisation (ISRO) has lined up more test missions in the months ahead for the Gaganyaan programme.

Upcoming tests include the TV-D2 mission, the G-X unmanned orbital demonstration flight, an Integrated Air-Drop Test (IADT) and a Pad Abort Test, S. Unnikrishnan Nair, Director, Vikram Sarabhai Space Centre (VSSC), told *The Hindu*.

A crew module with service module will be used in the G-X mission. This unmanned mission, to be launched aboard a human-rated LVM3, will have 'Vyommitra' - the 'female' robot astronaut designed and developed by the ISRO Inertial Systems Unit (IISU) - on board. In this mission, ISRO will put to test control systems, a "reduced version" of the life support system for the crew, thermal protection systems and the parachute systems.

Editorial | [The ascent begins: On the progress of India's human spaceflight mission](#)

Meanwhile, the Test Vehicle (TV) development programme will continue parallelly. TV-D2 will be the second of four tests planned for demonstrating in-flight abort capability under different initial conditions with respect to the launch vehicle. Unlike TV-D1, TV-D2 will also have onboard a control system for re-orienting the attitude of the crew module once it separates.

The test vehicle will be the same, expendable version based on the L40 strap-on of the multi-purpose vehicle Geosynchronous Satellite Launch Vehicle (GSLV) used in TV-D1 mission. TV-D1 demonstrated the in-flight abort of the Crew Escape System (CES) at 1.2 Mach speed, which was followed by the separation of the crew module and its recovery from the sea.

At the same time, ISRO is also examining whether the TV-D1 crew module, recovered from the sea after a parachute-assisted splash-down, can be reused for future tests. The space agency is looking into this possibility, Dr. Unnikrishnan Nair said. The lead unit of ISRO for launch vehicles, VSSC was responsible for the structural design and manufacture of the unpressurised crew module used for the test.

As the module had come into contact with salt water, only a detailed inspection can tell whether it can be reused and in what capacity. “We are working out a plan to reuse it. We need to open and clean it and see what can be done. Efforts will be taken to divert it for the appropriate test programme under Gaganyaan,” he said.

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IMC 2023: INDIA HAS TO PLAY LEAD ROLE IN 6G, PM MODI SAYS

Relevant for: Science & Technology | Topic: Achievements of Indians in science & technology

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October 27, 2023 11:16 pm | Updated 11:16 pm IST

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Prime Minister Narendra Modi addressing IMC 2023 | Photo Credit: Haider Ali Khan

Prime Minister Narendra Modi on Friday inaugurated the [7th edition of India Mobile Congress \(IMC\) 2023](#) saying India has to play the lead role in 6G. "We have 4 lakh 5G base stations covering 97% cities and 80% population," PM Modi said.

PM also informed that India has grown 3x in median mobile speed and now ranks 43rd in broadband speed index.

"We developed 4G without corruption and internet has helped in improving ease of living. It has brought social and economic growth," PM said.

Access to resources, capital and technology is the priority of government, he said.

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Narendra Modi emphasised that technology should reach everyone without any barrier. He also talked about direct benefit transfer (DBT) giving rights to people.

He said that 2 lakh Gram Panchayats are now connected with broadband and 75 lakh students are getting the benefits of new age technologies with Atal Tinkering Labs.

Prime Minister also dedicated 100 5G labs to the country to help students understand the potential of new age technologies. "These 5G labs will help students dream and achieve," he said.

"Our startup ecosystem has achieved a lot. We've a century of unicorns now and the 3rd largest startup ecosystem in the world."

On smartphone ecosystem, PM Modi said that India is now an exporter of mobile phones and is the 2nd largest mobile manufacturer with Rs 2 lakh crore of export achieved.

"Google has announced to make Pixel 8 in India. Samsung's Fold 5 and Apple iPhone 15 are already made here," he added.

He further added, semiconductor manufacturing is already in full swing and it is going to fuel local and global demands.

PM said that India should also be the thought leader as well. “UPI is our identity in thought leadership,” he added.

Ashwini Vaishnaw, Minister for IT, Government of India, said that mobile phones are now being exported to 70 countries.

“International Telecommunication Union (ITU) has already accepted India’s 6G vision and there’s going to be a standardisation meeting next year in India,” he said.

Now it takes 7 days in tower installation, Mr. Vaishnaw further added.

Akash Ambani, Chairman of Reliance Jio, said that Jio Bharat phone is to end digital exclusion. He also said that Jio now has 85% 5G coverage across India with a network of 10 lakh 5G cells.

Sunil Bharti Mittal, Chairperson of Bharti Enterprises, said, “India’s Digital Public Infrastructure (DPI) can enhance world’s economy.” He further mentioned that satellite communication is here to serve India, and it will start from next month onward. Mr. Mittal reiterated the complete 5G rollout by end of 2024.

Kumar Mangalam Birla, Chairman of Aditya Birla Group talked of further investment in 5G rollout.

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WHAT IS PHOTOCOPYING AND HOW DOES IT WORK?

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October 29, 2023 10:30 am | Updated 12:20 pm IST

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Workers busy making copies at a photocopy shop in Chennai., February 25, 2012.
Representative photo. | Photo Credit: S.S. Kumar/The Hindu

“... for the first time in world history, mechanical reproduction emancipates the work of art from its parasitical dependence on ritual. To an ever greater degree the work of art reproduced becomes the work of art designed for reproducibility.”Walter Benjamin

The German philosopher [Walter Benjamin](#) wrote these words in his landmark [1935 essay](#) *The Work of Art in the Age of Mechanical Reproduction*. While Benjamin’s thesis centred on the character of art in a capitalist society and the effects of mass reproduction – and reproducibility – on it, it’s tempting to see parallels to the effect that photocopying had on the production and availability of textual material in the modern era.

Broadly, photocopying is a set of techniques with which to duplicate some content using, among other things, light. However, the contemporary colloquial use of the word ‘photocopying’ refers almost exclusively to xerography.

Both the word ‘xerography’ and the name ‘Xerox’ come from the Greek root-word ‘xero’, meaning ‘dry’. This is because xerography is a type of photocopying method whose process doesn’t involve messy liquid chemicals. Xerographic machines are in ubiquitous use around the world today to quickly and cheaply reproduce printed material.

Xerography has a few basic elements.

The first is the photoconductive surface – a surface coated with a photoconductive material. Such a material, when exposed to light, allows electrons to flow through it (i.e. conducts electricity) but blocks them when it’s dark.

This surface is negatively charged by placing a thin negatively charged wire with a high voltage next to it.

Then, the sheet of paper to be copied is illuminated with a bright light. The darker parts of the paper – where something is printed, i.e. – don’t reflect the light whereas the unmarked parts do.

This reflected light is carried by lenses and mirrors to fall on the photoconductive surface. In the

parts of the surface where light falls, the photoconducting material will become conductive and allow the electrons near its surface to dissipate downwards (into a grounding). So the parts that remain negatively charged at the end of this step will correspond to parts of the paper-to-be-copied (TBC) where something was printed.

Next, a powdery substance called toner is applied to the surface. The toner is positively charged, so it will settle where negative charge persists on the surface. The surface then transfers the pattern of toner on it to a sheet of paper. The paper has a stronger negative charge that causes the toner to jump.

Finally, the toner is heated so that it melts and fuses with the paper. This is the paper that rolls out of the photocopying machine, the whole process having been completed in a few seconds.

In practice, a rotating drum is used instead of a flat surface, and the paper TBC is illuminated by a flashing or stroboscopic light or a moving scanner.

There have been many innovations since the idea of a dry photocopying technique first took shape in the 1930s to improve the xerographic process, including the way the toner is supplied, the unit cost of materials, the development of colour-copying, the use of lasers, and the overall user experience.

Inspired by the work of the Hungarian engineer Paul Selenyi, an American attorney named Chester F. Carlson came up with a rudimentary version of xerography by 1938. Seven years later, he sold his idea to a non-profit organisation called the Battelle Memorial Institute in Ohio, where researchers refined the technique.

A year later, in 1946, the small New York-based Haloid Photographic Company purchased a licence from Battelle to build a machine based on the technique. The company trademarked the name for this machine as the “Xerox machine” in 1948 and availed the first model for sale in 1949.

(Haloid’s managers were responsible for coining the word ‘xerography’, replacing Carlson’s ‘electrophotography’.)

Haloid itself changed its name to Haloid Xerox in 1958 and to Xerox Corporation in 1961. Two particular models accelerated the adoption of this technology worldwide: the Xerox 914 in 1959, which was marketed as being very simple to use, and the Xerox 813 in 1963, as being able to fit on a table.

The Xerox logo outside the company’s Stamford, Connecticut, corporate headquarters as seen on July 25, 2007. In 2008, Xerox unveiled a new logo intended to scuttle its old image as a photocopier manufacturer and highlight its software, colour printers and other technologically updated products. | Photo Credit: Douglas Healey/AP

About a decade later, Xerox also introduced the laser-based photocopier. Instead of using a lamp to reflect light off the document to be copied to the drum, the data to be copied – or printed – was encoded as a bitmap that was fed to a laser, which then inscribed the requisite shapes onto the drum.

By the second half of the 20th century, Xerox wasn’t the sole maker of photocopier machines, even if it was the dominant supplier. Companies like Kodak made and released devices based on patents they owned. Xerox remained ahead because its patents ensured that its competitors’ products had to use specially prepared paper (on which to print) rather than plain paper.

IBM was able to overcome this when one of its researchers developed a process based on an organic photoconducting material in the late 1960s, among other changes.

Three examples illustrate xerography's wide-ranging impact.

(i) Counterfeiting: In 2002, people discovered that Xerox machines refused to copy banknotes that included a particular marking – of five small rings positioned like stars in the Orion constellation. Similar markings have since been found on the banknotes of at least 35 national banks. A [2005 statement](#) from the Reserve Bank of India, accompanying the release of new Rs 50 notes, called it the “Omron anti-photocopying feature”, suggesting that a Japanese corporation named Omron was responsible for designing the rings to prevent counterfeiters from duplicating or printing currency notes using xerographic machines.

(ii) Copyright and surveillance: In 2012, a raft of academic publishers, including Oxford University Press, filed a suit alleging copyright infringement against a photocopy shop and the University of Delhi. The suit claimed that teachers at the university had picked pages from books published by the publishers to be copied and bound together at the shop, and sold to university students at Rs 0.50 per page. The matter famously [concluded in the university's favour](#), highlighting the rights that attend to and the benefits that accrue from being able to make numerous copies of educational material at a low cost.

A view of Rameshwari Photocopy Service, the shop implicated in the DU photocopy case. | Photo Credit: Jaideep Deo Bhanj/The Hindu

Similarly, Katherine Eichhorn, an associate professor at The New School University, New York, wrote in a [2016 book](#): “the spread of copy machines made copying an increasingly independent practice ... As a result, these machines enabled the reproduction of texts that would never have passed the censors,” such as “militant manifestos, ... DIY guides on how to build your own bombs or grow your own marijuana.”

(iii) Art: Walter Benjamin contended that by taking away the ritual of producing art, mechanical reproduction had rerouted art's value in politics instead. But transformative technologies like xerography never have simple consequences. As Dr. Eichhorn wrote in the same book, a “vibrant arts scene” that emerged in 1970s' New York created “a generation of innovative artists, writers, and musicians” who benefited as much from low rent in some areas as xerography, allowing “musicians without agents” to print “homemade posters advertising upcoming gigs”, artists “to move their art out of the gallery and museum and into the street”, and writers to “self-publish zines, broadsides, and even books.”

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