अप्रैल
Apr
2025

खंड/Vol. : 50 अंक/Issue : 61

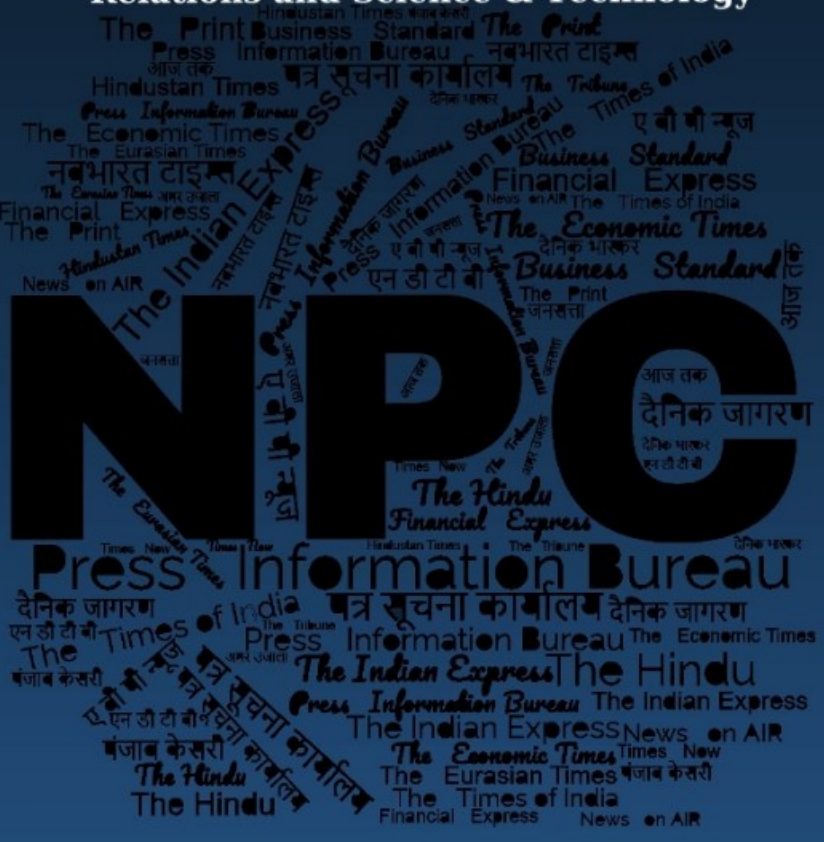
29/03-01 /04/2025

समाचार पत्रों से चयनित अंश

Newspapers Clippings

डीआरडीओ समुदाय को डीआरडीओ प्रौद्योगिकियों, रक्षा प्रौद्योगिकियों, रक्षा नीतियों, अंतर्राष्ट्रीय संबंधों और विज्ञान एवं प्रौद्योगिकी की नूतन जानकारी से अवगत कराने हेतु दैनिक सेवा

A Daily service to keep DRDO Fraternity abreast with DRDO Technologies, Defence Technologies, Defence Policies, International Relations and Science & Technology



रक्षा विज्ञान पुस्तकालय
Defence Science Library
रक्षा वैज्ञानिक सूचना एवं प्रलेखन केंद्र
Defence Scientific Information & Documentation Centre
मेटकॉफ हाउस, दिल्ली - 110 054
Metcalfe House, Delhi - 110 054

CONTENTS

DRDO News

Army inducts in-house developed First Person View drones

Source: The Hindu, Dt. 29 Mar 2025,
URL: https://www.thehindu.com/news/national/army-inducts-in-house-developed-first-person-view-drones/article69387082.ece

sIn a first-of-its-kind initiative, the Indian Army has begun inducting a First Person View (FPV) drone equipped with an anti-tank payload. This drone was developed, tested, and validated internally in collaboration with the **Terminal Ballistics Research Laboratory (TBRL), Chandigarh**. Officials confirmed that an initial batch of five FPV drones, each costing ₹ 1.4 lakh, has been inducted, with a subsequent procurement of 95 more planned.

FPV drones gained prominence during the war in Ukraine, where they demonstrated their capacity to alter battlefield dynamics by effectively neutralising substantial and costly military assets such as tanks.

The FPV drone was developed by Major Cephas Chetan in conjunction with a team from TBRL, led by Dr. Raghvendra, under an initiative launched in August 2024.

An official stated that this project represents a significant milestone in tactical drone warfare, marking the successful in-house development, testing, and validation of an FPV drone armed with an impact-based, kamikaze-role anti-tank munition – a first for the Indian Army.

Officials further added that the FPV drone was entirely assembled at the Rising Star Drone Battle School, which, as of March 2025, had fabricated over 100 drones within the formation.

*

Defence ministry defends DRDO amid escalating costs

Source: Deccan Chronicles, Dt. 31 Mar 2025,
URL: https://www.deccanchronicle.com/nation/defence-ministry-defends-drdo-amid-escalating-costs-1870071

Amid ongoing concerns about delays and cost overruns in crucial defence projects, the ministry of defence has defended the Defence Research and Development Organisation (DRDO), citing the inherent complexities and uncertainties in research and development.

"Given the complexities and uncertainties involved in developing state-of-the-art defence technologies, accurately estimating the exact time and cost for completion of projects is a continuous process," the ministry informed Parliament last week.

The ministry's clarification follows a December 2022 Comptroller and Auditor General (CAG) report highlighting significant delays and cost escalations in high-priority military projects handled by DRDO. The CAG had noted that several projects were prematurely declared successful despite not achieving all their intended objectives.

Responding to these findings, the ministry emphasised that DRDO identifies research areas based on strategic documents such as the Long-Term Technology Perspective Plan (LTTPP), Long-Term Integrated Perspective Plan (LTIPP), DRDO Five-Year Plan, vision documents, and technology roadmaps.

Further, the ministry explained that DRDO primarily focuses on designing and developing critical, advanced, and complex systems typically avoided by private industry due to associated high risks and costs. Projects classified as Mission Mode Projects are initiated only after approval by the Defence Acquisition Council (DAC), Defence Procurement Board (DPB), or Services Procurement Board (SPB).

The CAG report pointed out significant delays in 119 of the 178 mission mode projects reviewed. It noted time overruns ranging from 16 per cent to as much as 500 per cent, with extensions repeatedly sought. Additionally, the audit revealed that among 86 projects declared successful between January 2010 and December 2019, at least 20, costing Rs 1,074 crore, failed to achieve one or more key objectives yet were still marked complete.

Highlighting further inefficiencies, the report stated DRDO initiated 15 new projects, costing Rs 516 crore, specifically to address objectives left unachieved by previously "successful" projects. The CAG called attention to the premature closure of projects and urged more rigorous monitoring and realistic planning by the DRDO.

*

DRDO का एक और कमाल**,** हाई एंड्योरेंस ऑटोनॉमस अंडरवाटर व्हीकल का सफल परीक्षण**!**

Source: TV9 Bharatvarsh, Dt. 31 Mar 2025,
URL: https://www.tv9hindi.com/india/drdo-auv-india-underwater-defense-strengthens-naval-surveillance-3206261.html

भारतीय सेनाएं हर रोज पहले के मुकाबले मजबूत हो रही हैं. इसके लिए कई तरह के काम कर रही हैं. कई परीक्षण किए जा रहे हैं. जिनकी मदद से दुश्मनों का मुकाबला किया जाए और उन्हें किसी घटना को अंजाम देने से पहले ही खत्म कर दिया जाए. DRDO ने अब पानी के अंदर चलने वाले AUV का सफल परीक्षण किया है.

रक्षा अनुसंधान और विकास संगठन (DRDO) ने पानी में हाई एंड्योरेंस ऑटोनॉमस अंडरवाटर व्हीकल (AUV) का सफल परीक्षण किया है. इस AUV का उद्देश्य समुद्री निगरानी और रक्षा में मदद करना है.

इस परीक्षण के दौरान, AUV को पानी की सतह और गहराई में चलाया गया. कई बार किए गए परीक्षणों में यह पाया गया कि AUV बिना किसी रुकावट के सही ढंग से काम कर रहा है. इसके सोनार और संचार प्रणाली ने भी बेहतरीन प्रदर्शन किया है.

यह नया पानी के अंदर चलने वाला वाहन (AUV) भारतीय नौसेना और तटीय सुरक्षा के लिए एक बड़ी उपलब्धि है. इससे समुद्र में दुश्मन की गतिविधियों पर नजर रखना, खोज और बचाव अभियान चलाना और समुद्री सर्वेक्षण करना आसान होगा. इस नए वाहन की मदद से दुश्मनों के बारे में पता लगाना और भी आसान हो जाएगा.

क्या है इस वाहन में खास**?**

ऑटोनॉमस अंडरवाटर व्हीकल यानी AUV पानी के अंदर चलने वाला वाहन है. ये बिना किसी ड्राइवर के चल सकता है. इसे इस तरीके से डिजाइन किया गया है कि यह खुद ही अपनी गहराई और दिशा तय कर सकता है. इसका इस्तेमाल मुख्य रूप से समुद्री निगरानी के लिए किया जाता है. यह नया वाहन नौसेना की जरूरतों को ध्यान में रखते हुए डिजाइन किया गया है.

मल्टीपल रन के दौरान इसका ट्रायल सफल रहा है. दुनिया के कुछ गिने चुने देशों के पास ही इस तरह के टेक्नालाजी मौजूद है. जिनमें अब भारत भी शामिल है. यह पानी के अंदर रहते हुए नौसेना के बेस स्टेशन से संपर्क बनाए रखता है और बेहद चुपचाप तरीके चलता है, जिसकी भनक भी किसी को नहीं लग सकती है.

*

Defence News

Defence Strategic: National/International

MoD inks two contracts worth Rs 62,700 crore with HAL for supply of 156 LCH, Prachand to the Armed Forces

Out of 156 LCHs, 66 LCHs will be supplied to the Indian Air Force and 90 to the Indian Army

MOD also signs a contract with Metrea Management for Wet Leasing of one Flight Refuelling Aircraft; To provide Air to Air refuelling training to pilots of Indian Air Force and Indian Navy

Source: Press Information Bureau, Dt. 28 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2116411

Ministry of Defence on March 28, 2025, signed two contracts with Hindustan Aeronautics Limited (HAL) for supply of 156 Light Combat Helicopters (LCH), Prachand, along with training and other associated equipment worth Rs. 62,700 crore, excluding taxes. The first contract is for supply of 66 LCHs to the Indian Air Force (IAF) and second is for supply of 90 LCHs to the Indian Army.

The supply of these Helicopters shall commence from the third year and will be spread over the next five years. The contracts will enhance the combat capability of Armed Forces at high altitudes. LCH is India's first indigenously designed and developed combat helicopter having a capability of operating at an altitude of over 5000 meters. This helicopter has a large number of components designed & manufactured in India and it is planned to achieve an overall indigenous content of over 65% during the execution of this procurement. This will involve over 250 domestic companies mostly MSMEs and will generate over 8,500 direct & indirect jobs.

Ministry of Defence also signed a contract with Metrea Management for Wet Leasing of one Flight Refuelling Aircraft (FRA) for providing Air to Air refuelling training to pilots of IAF and Indian Navy. Metrea will provide FRA (KC135 Aircraft) within six months which will be the first FRA to be wet leased by IAF.

With signing of these three contracts, the total number of contracts signed by Ministry of Defence during 2024-25 reaches to 193 with overall contract value exceeding Rs 2,09,050 crore, which is the highest ever and nearly double the previous highest figure. Out of these, the contracts to domestic industry are 177 (92%) with contract value Rs 1,68,922 Crore (81%).

*

CDS Gen Anil Chauhan inaugurates 'Techkriti 2025', Asia's largest intercollegiate technical and entrepreneurial festival at IIT Kanpur

Source: Press Information Bureau, Dt. 28 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2116045

Chief of Defence Staff (CDS) General Anil Chauhan, inaugurated Techkriti 2025, Asia's largest intercollegiate technical and entrepreneurial festival, at IIT Kanpur. In a Fireside Chat, the CDS gave insights on the need for advancement and modernisation in the Indian Armed Forces and shared his perspectives on preparing for emerging challenges of Future Wars, specifically in the Cyber, Artificial Intelligence, Quantum and Cognitive domains.

In his address, Gen Anil Chauhan emphasized the importance of embracing technological advancements, strategic thinking and adaptability to meet future security challenges. He inspired

the young audience comprising scholars, students and NCC Cadets by highlighting the values of Discipline & Resilience, Courage & and Sacrifice. His encouraging words at Techkriti 2025 motivated students to pursue careers in defence and technology.

The inaugural ceremony was attended by distinguished guests, including Air Marshal Ashutosh Dixit, AOC-in-C, Central Air Command and Prof. Manindra Agrawal, Director IIT Kanpur. This year's theme, "Panta Rhei" (Everything Flows), highlights the continuous evolution of technology and innovation. Techkriti 2025 promises to be a remarkable celebration of technology, entrepreneurship and collaboration, pushing the boundaries of discovery and innovation.

A special segment, 'Rakshakriti', a dedicated Defence Expo to showcase the cutting-edge defence technology, was a key feature of Techkriti 2025. Driving further synergy between armed forces, academia and defence industry, Gen Anil Chauhan interacted with budding technologists. The event provided a sound platform to connect researchers with industry leaders, enabling the development of advanced technologies like autonomous drones, strengthening national security and reducing import dependence.

*

Indian And Russian Navies Set For The 14th Edition Of Maritime Bilateral Exercise – INDRA 2025

Source: Press Information Bureau, Dt. 28 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2116181

The 14th edition of the Indian - Russia bilateral naval exercise INDRA, a cornerstone of the enduring maritime partnership between India and Russia, is set to take place off Chennai from 28 Mar to 02 Apr 25.

Since its inception in 2003, Exercise INDRA epitomises the long-term strategic relationship between the two Navies.

The exercise has evolved into a symbol of maritime cooperation, showcasing the two nations' commitment to enhancing naval interoperability and operational synergy. The exercise is being conducted in two phases - Harbour phase from 28 to 30 Mar 25 at Chennai, and Sea phase from 31 Mar to 02 Apr 25 in Bay of Bengal.

The exercise will see participation of Russian Federation Naval Ships Pechanga, Rezkiy and Aldar Tsydenzhapov along with Indian Naval Ships Rana, Kuthar and Maritime patrol aircraft P8l.

The Harbour Phase will include Opening ceremony, Subject Matter Expert Exchanges (SMEEs), reciprocal visits, sports fixtures, and pre-sail briefings between personnel from both navies. The Sea Phase will witness advanced naval drills, including tactical manoeuvres, live weapon firings, anti-air operations, underway replenishment, helicopter cross-deck landings and exchange of sea-riders.

These exercises and interactions are intended at enhancing maritime cooperation, strengthening bridges of friendship, exchanging best operational practices and to bolster diplomatic ties between the two nations.

*

‘Operation Brahma’ – Medical Assistance To Myanmar Earthquake Victims By Indian Army

Source: Press Information Bureau, Dt. 29 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2116635

In a swift response to the devastating earthquake that struck Myanmar on 28th March 2025, the Indian Army, under ‘Operation Brahma’, is deploying a specialised medical task force to provide urgent humanitarian assistance.

A 118-member team from the elite Shatrujeet Brigade Medical Responders, led by Lieutenant Colonel Jagneet Gill, is set takeoff to Myanmar shortly along with essential medical equipment and supplies. The Airborne Angels Task Force is trained and equipped to deliver advanced medical and surgical care in disaster-affected zones.

As part of the operation, the Indian Army will establish a 60-bed Medical Treatment Centre to provide immediate care to those injured in the calamity. The facility will be capable of handling trauma cases, emergency surgeries, and essential medical services to support the local healthcare system, which has been severely strained by the disaster.

This humanitarian assistance underlines India's commitment to its 'Neighbourhood First' policy and the timeless Indian ethos of 'Vasudhaiva Kutumbakam' – the world is one family. The Indian Army continues to stand shoulder to shoulder with friendly nations in times of crisis, reflecting India's resolve to be a first responder in the region.

The deployment has been coordinated closely with the Ministry of External Affairs and in partnership with authorities in Myanmar.

*

Indian Air Force To Participate In Multi-Nation Air Exercise INIOCHOS-25

Source: Press Information Bureau, Dt. 30 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2116710

The Indian Air Force (IAF) will be participating in Exercise INIOCHOS-25, a prestigious multi-national air exercise hosted by the Hellenic Air Force. The exercise will take place at Andravida Air Base, Greece, from 31 March 2025 to 11 April 2025. The IAF contingent will include Su-30 MKI fighters along with combat enabler IL-78 & C-17 aircraft.

INIOCHOS is a biennial multinational air exercise hosted by the Hellenic Air Force. It serves as a platform for air forces to hone their skills, exchange tactical knowledge, and strengthen military ties. The exercise will integrate multiple air and surface assets from fifteen countries under realistic combat scenarios, designed to simulate modern-day air warfare challenges

The IAF looks forward to participating in Exercise INIOCHOS 25, a platform to enhance international cooperation, synergy and interoperability among participating Air Forces. This exercise will provide an opportunity to train in planning and executing Combined Air operations, refine tactics in complex air warfare scenarios, and gain insights into operational best practices. With all operations conducted from Andravida, IAF's participation will not only strengthen its operational capabilities but also contribute to mutual learning and enhanced coordination among participating countries.

IAF's participation in INIOCHOS-25 reflects its commitment to global defence cooperation and operational excellence. The exercise will further reinforce India's strategic partnerships-and bolster its capabilities in joint operations with friendly nations

*

Ex Tiger Triumph - 25

Source: Press Information Bureau, Dt. 31 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2117042

The Fourth edition of Exercise Tiger Triumph, the bilateral Tri-Service India-US Humanitarian Assistance and Disaster Relief (HADR) Exercise, is scheduled on the Eastern Seaboard from 01 to 13 Apr 25. The exercise is aimed at developing interoperability for conducting HADR operations and for the formulation of Standard Operating Procedures (SOPs) to establish a Combined Coordination Center (CCC) that would enable rapid and smooth coordination between Indian and US Joint Task Forces (JTF) during exercises and crisis / contingencies.

The Indian side would be represented by Indian Naval Ships Jalashwa, Gharial, Mumbai and Shakti with integral helicopters and landing crafts embarked, Long Range Maritime Patrol Aircraft P8I, Army Troops from 91 Inf Brigade and 12 Mech Infantry Battalion, Air Force C-130 Aircraft and MI-17 Helicopters, along with the Rapid Action Medical Team (RAMT). The US side would be represented by US Navy Ships Comstock and Ralph Johnson with troops of the US Marine Division embarked.

The Harbour Phase is scheduled at Visakhapatnam from 01 to 07 Apr 25 during which an Opening Ceremony with a joint Flag Parade and Media Interaction will be held onboard INS Jalashwa on 01 Apr 25. Participants from both sides would also engage in Training Visits, Subject Matter Expert Exchanges, Sports Events and Social interactions. On completion of the Harbour Phase, the ships with troops embarked, would sail for a Sea Phase and undertake Maritime, Amphibious and HADR operations off Kakinada.

During the exercise, a joint command and control center, would be established by Indian Army and US Marines at the Kakinada Naval Enclave. The IAF RAMT and the US Navy medical team would also establish a joint medical camp for providing medical aid. The exercise would culminate with a closing ceremony on board US Navy Ship Comstock on 13 Apr 25 at Visakhapatnam.

*

India junks NYT claim of HAL transferring sensitive tech to Russia

Source: The Times of India, Dt. 01 Apr 2025,
URL: https://timesofindia.indiatimes.com/india/india-junks-nyt-claim-of-hal-transferring-sensitive-tech-to-russia/articleshow/119827473.cms

The Indian govt has described as factually incorrect and misleading a New York Times report claiming that an Indian firm - state-owned Hindustan Aeronautics Limited - facilitated transfer of

sensitive British equipment and technology from a Reform UK party donor to Russian arms agency Rosoboronexport.

According to the report, the Indian company received equipment from HR Smith group, which donated £1,00,000 (just under $1,30,000) to Reform UK last year, and, within days, sent parts to Russia with the same identifying product codes.

Govt sources, speaking on condition of anonymity, said the report was factually incorrect and misleading, and has tried to frame issues and distort facts to suit a political narrative.

"The Indian entity mentioned in the report has scrupulously followed all its international obligations on strategic trade controls and end-user commitments. India's robust legal and regulatory framework on strategic trade continues to guide overseas commercial ventures by its companies," said an official.

"We expect reputed media outlets to undertake basic due diligence while publishing such reports, which obviously was overlooked in the instant case," added the official.

The report said that the components have civilian and military uses and have been flagged by the British and American authorities as critical to Russia's war effort in Ukraine. "Officials have urged exporters to carry out detailed checks to ensure that their clients are not redirecting restricted equipment to Moscow," it said.

*

India boosting covert warfare capabilities of special forces

Source: The Times of India, Dt. 31 Mar 2025,
URL: https://timesofindia.indiatimes.com/india/india-boosting-covert-warfare-capabilities-of-special-forces/articleshow/119775174.cms

From midget submarines, loiter munitions and nano drones to specialised weaponry, surveillance and communication equipment, India is progressively strengthening the capabilities of its Special Forces to undertake covert warfare deep behind enemy lines as well as counter-terrorism operations.

The upgrade in the gruelling combat training, which will include “augmented reality/virtual reality mission planners and simulators” in the near future, as well as “specialised equipping” of the Special Forces in the Army, IAF and Navy is part of an ongoing process, sources told TOI.

There are now 10 Para-Special Forces and five Para (Airborne) battalions (each has around 620 soldiers) in the Army, 27 `flights’ of around 1,600 Garud commandos in IAF and over 1,400 marine commandos (Marcos) in Navy.

A major shortcoming, however, is the lack of a full-fledged Special Operations Command, which would bring the disparate Special Forces together under a unified command and control structure for planning and executing strategic operations instead of merely tactical ones.

Nevertheless, the creation of a truncated Armed Forces Special Operations Division (AFSOD) has somewhat addressed the issue of “jointness and synergy” among the Para-SF, Garuds and Marcos.

The induction of advanced software-defined radios, including manpack versions, and satellite-communication systems, for instance, have ensured “uninterrupted and seamless” long-range communications for joint operations among the three forces, the sources said.

The Special Forces already have a wide array of specialized weapons, ranging from Finnish Sako long-range sniper rifles, American M4A1 carbines and Israeli TAR-21 Tavor assault rifles to Swedish Carl Gustaf lightweight rocket launchers, Russian VSS suppressed sniper rifles and Italian Beretta pistols with silencers.

“The induction of loiter munition systems has boosted the precision-targeting capabilities of Para-SF units. Similarly, remotely-piloted aerial vehicles, nano drones, surveillance copters and lightweight drones with FLIR (forward-looking infra-red) payloads have been inducted for advanced short and medium-range surveillance up to 10-km,” a source said.

With stealth being paramount for insertion behind enemy lines, advanced indigenous `combat free-fall parachute systems’ and other such equipment have been inducted, while procurement of new `integrated combat diving kits’ is also underway. “Guided aerial delivery systems are now available to ensure commandos can operate independently behind enemy lines for longer durations,” another source said.

Given their maritime role, the Marcos in turn have midget submarines or sea chariots, underwater scooters, remotely-operated underwater vehicles for explosive disposal, open-circuit diving equipment and air-droppable rubberized inflatable boats, among other such things.

The selection and training for the Para-SF, Marcos and Garuds, which have a rejection rate as high as 70-80%, also remains a major focus area. The training, in which the volunteers are stretched to their physical and mental limits, includes operations for surgical strikes, hit-and-run missions, strategic and tactical surveillance of vital enemy targets, intelligence-gathering, laser-designated bombings and other such clandestine tasks.

The Army’s first vertical wind tunnel to enhance ‘combat freefall’ skills of its Special Forces and others is fully operational at the Special Forces Training School at Bakloh in Himachal Pradesh. “Simulators are now increasingly being used. The plan is to also induct AI-based systems soon to make the training more realistic and economical,” a source said.

*

India, SL to ink first defence pact during PM’s visit next week

Source: The Tribune, Dt. 29 Mar 2025,
URL: https://www.tribuneindia.com/news/india/india-sl-to-ink-first-defence-pact-during-pms-visit-next-week/

India and Sri Lanka are all set to sign their maiden defence cooperation agreement during Prime Minister Narendra Modi's visit to the island nation next week.

The move comes amid China's relentless attempts to increase its military influence over Colombo. Last year, Sri Lanka had, on India’s request, refused permission to a Chinese survey vessel--a spy ship--to dock at a port.

The two sides are also likely to firm up bilateral agreements, including on restructuring Sri Lanka's debt. PM Modi and Sri Lankan President Anura Kumara Dissanayake are scheduled to meet in Colombo on April 5.

The PM will kick off his two-nation tour on April 3 by visiting Thailand for the BIMSTEC summit. Foreign Secretary Vikram Misri said at a media briefing that an MoU on defence cooperation was expected to be signed in Sri Lanka.

The MoU is set to signal a major change in India-Sri Lanka ties, leaving behind the chapter relating to India pulling out the Indian Peace Keeping Force from the island nation 35 years ago. “Sri Lanka is an integral part of our 'Neighbourhood First' policy and the relationship, based on mutual trust and goodwill, has stood the test of time," Misri said.

Modi’s trip to Sri Lanka comes over three months after Dissanayake visited India, a trip when he conveyed to the PM that his nation would not allow its territory to be used against New Delhi's security interests. Misri said the PM’s visit also came in the context of a recovering Sri Lankan economy.

In Colombo, Modi and Dissanayake will dedicate several projects that are being built in that country with India's assistance.

The two leaders would also witness the virtual ground-breaking of the Sampur solar energy project, which would be a milestone in the bilateral partnership, said Misri.

On April 6, Modi and Dissanayake will travel together to the historic city of Anuradhapura where they will pay their respects at the Mahabodhi temple.

*

HAL registers revenue of ₹30,400 crore during FY 2024-25

Source: The Hindu, Dt. 31 Mar 2025,
URL: https://www.thehindu.com/news/national/karnataka/hal-registers-revenue-of-30400-crore-during-fy-2024-25/article69396789.ece

The Hindustan Aeronautics Ltd. (HAL) recorded a revenue of ₹30,400 crore (provisional and unaudited) for the financial year ending March 31, 2025, as against the revenue of ₹30,381 crore during the previous year.

“This achievement was despite the shortfall in deliveries of Light Combat Aircraft (LCA) and Advanced Light Helicopter (ALH). The deliveries of LCA were affected owing to the non-availability of engines. The ALH delivery schedule too got hit owing to an accident in January 2025 and subsequent grounding of the fleet. However, the deliveries of other products and services were accelerated, which helped us to maintain the top line,” said D.K. Sunil, CMD, HAL.

“With the company’s order book significantly improving in the last 12 months, the company used the year to add capacities as additional lines for LCA and HTT-40 were put-up besides augmenting the aero engine capacity at Koraput,” HAL said.

The order book stood at ₹1,84,000 crore as against the opening order book position of ₹94,129 crore and after adjusting current year liquidation.

During the year 2024-25, HAL received new manufacturing contracts of ₹1,02,000 crore and ROH contracts of ₹17,500 crore. Recently, the company signed a contract with MoD for supply of 156 LCH Prachand worth ₹62,777 crore. This is the single biggest procurement by MoD from HAL till date. It added that the other highlights of 2024-25 were: HAL becoming the first Defence PSU to achieve the prestigious 'Maharatna' status, contracts signed for supply of additional 12 Su-30 MKI aircraft, Mid Life Upgrade (MLU) of 40 Do-228 aircraft, supply of 240 AL31FP engines of Su-30 MKI aircraft and avionics upgrade of one IL-78 aircraft.

"With the supply chain issues stabilising, new orders in hand and enhancement of capacities, the company is gearing up for more robust physical and financial performance in the FY 2025-26," HAL said.

*

Army inducts indigenous surveillance systems, boosts defence capabilities with precision software

Source: The Economic Times, Dt. 28 Mar 2025,
URL: https://economictimes.indiatimes.com/news/defence/army-inducts-indigenous-surveillance-systems-boosts-defence-capabilities-with-precision-software/articleshow/119663835.cms

The Indian Army has signed key agreements to bolster its defence capabilities through indigenous innovation. These include a MoU with ADRIN for precision targeting software 'LAKSHYA-PT' and a contract with Zen Technologies for an Integrated Air Defence Combat Simulator. Additionally, the first tranche of systems under the indigenous Battlefield Surveillance System 'Project Sanjay' has been inducted into field formations, according to an ADG PI - Indian Army post.

Taking on X, Indian Army wrote, "Towards inclusion of Niche Technology in Precision Targeting, a MoU was signed between Indian Army & Advanced Data Processing & Research Institute (ADRIN), Hyderabad for design & development of precision targeting software 'Location Awareness & Knowledge Based Solution for High Resolution 3D Layer Archive for Precision Targeting' (LAKSHYA-PT). LAKSHYA-PT is an indigenously Designed & Developed Software which will facilitate target acquisition with a sub-decametre accuracy."

They further wrote, "The Indian Army continues to spearhead the #AtmanirbharBharat initiative by signing a contract with M/s Zen Technologies Private Limited for Integrated Air Defence Combat Simulator, designed and developed through the 'Make' route."

"'Project Sanjay' - the indigenous Battlefield Surveillance System (BSS) was flagged off by Hon'ble Raksha Mantri Shri Rajnath Singh, on 24 Jan this year. The first tranche of the systems has been delivered today for induction into the Field Formations; balance systems will be inducted progressively by October this year," the post added on X.

On the other hand, Hindustan Aeronautics Limited (HAL) is augmenting the strength of armed forces and is opening new dimensions of manufacturing, research and development by collaborating with the private sector, as Defence Minister Rajnath Singh announced earlier in March.

"India has firmly moved forward towards self-reliance in the defence sector. It shows not only our commitment to self-reliance but also our commitment to public-private partnership and collaboration," he said.

*

Indian Army signs procurement deal with Ashok Leyland defence systems for heavy recovery vehicles

Source: The Economic Times, Dt. 28 Mar 2025,
URL: https://economictimes.indiatimes.com/news/defence/indian-army-signs-procurement-deal-with-ashok-leyland-defence-systems-for-heavy-recovery-vehicles/articleshow/119666574.cms

In a bid to enhance the combat force regeneration capability of the Indian Army, the Ministry of Defence has signed a contract worth Rs 168.09 Crore with M/s Ashok Leyland Defence Systems Ltd for 54 Heavy Recovery Vehicles (HRV), an official statement from the Ministry of Defence said.

The newly procured HRVs will play a crucial role in the recovery of disabled, stranded and damaged military vehicles across challenging terrains, including high-altitude and desert environments. These vehicles are designed with advanced lifting and winching mechanisms and high endurance to meet the demanding operational requirements of the Indian Army.

Indigenously designed and developed, this specialised vehicle will contribute towards 'Atmanirbhar Bharat' initiative of Government of India by prioritizing indigenous designs and manufacturing, thereby reducing dependency on foreign defence imports.

The integration of these advanced HRVs is expected to significantly improve recovery operations, ensuring higher mission success rates and operational readiness, the release added.

*

Force Motors bags order for 2,978 vehicles from defence forces

Source: The Economic Times, Dt. 29 Mar 2025,
URL: https://economictimes.indiatimes.com/news/defence/force-motors-bags-order-for-2978-vehicles-from-defence-forces/articleshow/119705088.cms

Force Motors on Saturday said it has received an order for 2,978 vehicles from the Indian defence forces. The vehicles are tailored to meet the diverse operational requirements of both the Indian Army and the Indian Air Force, showcasing the company's capability to deliver mission-ready

vehicles designed to perform in demanding defence environments, the Pune-based automaker said in a statement.

Force Motors has been catering to the defence sector for many years through its Gurkha LSV (Light Strike Vehicle), a vehicle renowned for its durability, off-road prowess, and adaptability.

"Our vehicles are designed with focus on quality, reliability, ruggedness, and performance, aligning perfectly with the operational needs of our defence personnel," Force Motors MD Prasan Firodia said. The order is a testament to the trust and confidence Indian defence forces place in Force Motors, he added.

*

Defence ministry inks ₹2,500 cr deals for light vehicles and anti-tank weapons

Source: The Economic Times, Dt. 28 Mar 2025,
URL: https://economictimes.indiatimes.com/news/defence/defence-ministry-inks-2500-cr-deals-for-light-vehicles-and-anti-tank-weapons/articleshow/119611013.cms

The defence ministry has inked contracts worth ₹2,500 crore to procure new anti-tank weapons and light specialist vehicles for the Army, with all systems to be manufactured indigenously.

Officials said that state-owned Armoured Vehicle Nigam Ltd has been given a contract to produce a tracked version of the indigenously developed Nag Missile System. The anti-tank weapons will cost ₹1,801 crore and have been developed by DRDO, with officials saying they would enhance the operational readiness of the Army. "NAMIS is one of the most sophisticated anti-tank weapon systems against enemy armour with fire-and-forget anti-tank missile and sighting system for enhanced firepower and lethality," they said.

The other order inked is for procurement of light specialist vehicles that have a payload of 800 kg and are designed to navigate tough terrain. This has been signed with Mahindra & Mahindra and Force Motors.

*

PM Modi visits Solar Defence facilties in Nagpur, launches loitering munition test range, MALE drone runway

Source: ANI News, Dt. 30 Mar 2025,
URL: https://www.aninews.in/news/national/general-news/pm-modi-visits-solar-defence-facilties-in-nagpur-launches-loitering-munition-test-range-male-drone-runway20250330182223/

Seeking to further promote Aatmanirbharta in defence, PM Narendra Modi on Sunday visited the Solar Defence and Aerospace Ltd complex.

During the visit, the PM was briefed by the Solar Industries chairman Satyanarayan Nuwal on the various weapon test facilities and product range of the company.

In the Technical Area, the Prime Minister inaugurated the Loiter Munition Test Range. Spread over 1080 acres, this test range has a dedicated Command and Control Centre, UAV Take off Area, endurance and communication range and many other facilities.

The PM also visited the product gallery wherein Solar Defence showcased its products like Pinaka Rocket System, air-bombs, mines, grenade, military explosives, Anti tank Guided Missile (ATGM), Nagastra 1 & 2 Loiter Munitions, and many more.

The PM also inaugurated the newly constructed air strip which is a 1.27 km runway facility built for development & testing of MALE/HALE Class Unmanned Aerial Systems (UAS).Solar Defence said it has taken a big initiative for developing a MALE UAV and a suo-moto proposal has already been submitted to IAF which is under consideration.

The Prime Minister also witnessed the display of the state of art indigenously developed systems viz. Loiter Munition (Nagastra 3), Bhargavastra (Micro-Missile based Counter Drone System) and Bhaumastra (Mine Detection & Disposal System).

Keeping in view the futuristic requirements of this emerging technology, Solar Defence said it has taken the initiative to develop Nagastra series of Loiter Munitions of ranges from 15 km to more than 100 km and explosive payload carrying capability from 1 kg to 10 kg.

Nagastra 3 is a Vehicle Launched Loiter Munition System of endurance 3 hours and range of 100 km. It can carry 8.5 kg warhead. It is being developed under Make 2 project from Arty of Indian Army.

The Bhargavastra is an indigenously designed and developed Counter Drone System meant for quick interception of drones for an assured hard kill using tiny, guided missiles with swarm

engagement capability. This solution offers mobile protection against drone attacks with near simultaneous engagement of multiple drones.

With a long range of detection (upto 6 km) and a long range of neutralization (upto 2.5 km), it ensures the safety of vulnerable assets/battlefield formations.

SDAL has taken an initiative to address the global menace of landmine detection and disposal. As per some estimates, there are more than 11 million buried mines worldwide that remain uncleared and are causing casualties or maiming of both soldiers and civilians in peacetime. Bhaumastra, a drone-based system under development by SDAL, would be the first of its kind in any developed nation to provide a drone-based solution to this global problem.

*

US boosts Indo-Pacific presence amid rising tensions with China

Source: The Economic Times, Dt. 28 Mar 2025,
URL: https://economictimes.indiatimes.com/news/defence/us-boosts-indo-pacific-presence-amid-rising-tensions-with-china/articleshow/119653778.cms

The US military is "posturing forward" in the Indo-Pacific area, including the Philippines, to reinforce deterrence amid rising regional tensions due to Beijing's assertiveness in the South China Sea (SCS), stated the Pentagon chief on Wednesday, as reported by Inquirer.net.

US Secretary of Defence Pete Hegseth made a stop in Hawaii to converse with officials from the Indo-Pacific Command before heading to the Philippines and Japan later this week, according to Inquirer.Net.

Hegseth described his trip to Asia as "a reflection of America's commitment to the Indo-Pacific and the Trump administration's emphasis on ensuring we are doing all we can to deter conflict with the communist Chinese."

"We do not seek conflict at all, but we will remain firm in deterrence and will deploy troops forward; that is the reason we are visiting Guam, our allies in Japan, and the Philippines," he mentioned. "We are posturing forward, engaging and communicating with commanders who can comprehend the AOR (area of responsibility), speaking with friends and allies," he continued, as reported by Inquirer.Net.

Hegseth is scheduled to arrive in the Philippines on Friday for discussions with President Marcos and Defense Secretary Gilberto Teodoro Jr.

"Reestablishing deterrence is part of what President Trump has instructed me, driven me to do... Reinstituting deterrence is a significant part of our purpose here," he stated, as noted by Inquirer.Net.

Inquirer.Net highlighted that, according to him, his visit to Asia would "showcase the pivot that President Trump is making towards the Indo-Pacific, ensuring we are adequately focusing and prioritizing our efforts."

Over the weekend that Manila and Washington would explore methods to enhance current partnerships during Hegseth's visit.

Earlier, Philippine authorities revealed the capture of six Chinese nationals and one Filipino, who were suspected of spying on US and Philippine navy ships near the entrance of the strategically important Subic Bay, as reported by Radio Free Asia.

*

America's Golden Dome to Think for Itself, AI to Handle Next-Gen Missile Defense

Source: Republic World, Dt. 31 Mar 2025,
URL: https://www.republicworld.com/defence/global-defence-news/americas-golden-dome-to-think-for-itself-ai-to-handle-next-gen-missile-defense

The U.S. Army is moving fast toward a fully autonomous missile defence system, looking to slash the number of personnel required to operate what could be America's most advanced homeland shield yet—Golden Dome. With artificial intelligence at the core, the Army is shaping a future where missiles, radars, and interceptors make real-time decisions with minimal human intervention.

Golden Dome, a pet project of former President Donald Trump, is now being modelled on the Guam Defense System, which is expected to go operational by 2027. Taking cues from that program, the Army is now working to make air and missile defence smarter, faster, and more independent, Maj. Gen. Frank Lozano, the service's Program Executive Officer for Missiles and Space, revealed in an interview at Redstone Arsenal. Speaking on the sidelines of the Association of the U.S. Army's Global Force Symposium, Lozano made it clear: "We need AI and autonomous systems to take over the heavy lifting."

From Soldiers to AI: The Shift in Missile Defense

Currently, every launcher, radar, and fire control unit in the U.S. missile defence network requires teams of trained operators. A typical launcher needs at least two or three soldiers to man it, conduct routine checks, and be ready to fire when needed. Golden Dome is about changing that.

"The plan is to move toward containerized missile systems—think of it as a box of rockets instead of a traditional launcher," Lozano explained. These could be placed above or even below ground, needing less frequent upkeep. Instead of human soldiers stationed around the clock, AI will remotely monitor the systems, with troops checking in only every few weeks. This is where the Army's Integrated Battle Command System (IBCS) comes in. IBCS, already being deployed in Guam, is an AI-enabled command centre that links radars, missiles, and interceptors into one real-time network. Golden Dome, will be supercharged with new AI-driven fire control, reducing human decision-making to just a final authorization step before a missile launch.

The "Super Bowl" of Missile Defense is Coming

The Army's Integrated Fires Test Campaign (IFTC), originally meant to test the Guam missile defence network, is now being retooled to focus on AI and autonomy for Golden Dome. The 2026

IFTC event, dubbed the “Super Bowl” of missile defence, will be the proving ground for these next-gen autonomous systems.

A U.S Army Soldier lifts the hydraulic launching system on the new Long-Range Hypersonic Weapon (LRHW) during Operation Thunderbolt Strike at Cape Canaveral Space Force Station, Florida, March 3, 2023. Beyond 2027, the Army wants to be ready. “If we’re called upon to support Golden Dome initiatives, we need AI, remote operations, and autonomous-based formations ready to deploy,” Lozano stated.

The roadmap includes:

- Mapping human decision points in missile defence operations.
- Developing AI algorithms to handle tracking, targeting, and interception.
- Setting up fail-safes, where AI hands decisions back to humans when necessary.

AI won’t be given full control over missile launches, but for tracking, identifying, and prioritizing threats, it will operate independently.

Industry Giants and Startups Join the AI War Effort

This kind of shift needs more than just traditional military contractors—so the Army is opening doors to AI startups and tech firms. At the Global Force Symposium, Lozano met with French defence giant Safran, which already supplies navigation and timing systems for U.S. missile defence programs like Patriot and Precision Strike Missiles. Now, Safran is being brought in to see how AI can replace manual human checks in missile defence operations.

Another key player? Anduril, the high-tech defence startup that recently acquired Numerica, the company behind the Army’s IBCS fire control software. Anduril is now exploring ways to inject AI-driven decision-making into air and missile defence command-and-control systems.

Anduril’s entry signals a new era of defence collaboration, where Silicon Valley-style AI startups play a bigger role in modernizing America’s warfighting capabilities. The Army is also talking to venture capital-backed AI firms and small tech startups, a departure from its usual reliance on massive defence contractors like Lockheed Martin and Raytheon. For the next six to nine months, the Army will define what it needs from the industry before opening up contract opportunities for AI-driven missile defence systems.

Golden Dome: The Future of U.S. Homeland Security?

Golden Dome isn’t just about upgrading America’s missile shield—it’s about redefining how war is fought and defended. With China, Russia, and North Korea investing heavily in next-gen missiles, the U.S. is betting big on AI-driven defence to keep up. By bringing in AI-powered fire control, autonomous launch systems, and real-time decision-making algorithms, Golden Dome could become the most advanced homeland missile defence network in history. If it works, it could change the way the U.S. defends its skies—and reshape the future of military AI warfare.

*

U.S.-China Aerial Warfare: How 5G Could Redefine The Future Of Battles Between The Dragon & The Eagle

Source: The EuraAsian Times, Dt. 30 Mar 2025,
URL: https://www.eurasiantimes.com/5g-race-between-the-dragon-and-the-eagle/

In March 2025, at the Mobile World Congress (MWC) in Barcelona, Nokia revealed that the US defense and aerospace manufacturer Lockheed Martin has deployed Nokia's 5G solutions into its Hybrid Base Station (HBS).

According to its website, Lockheed's HBS is a unified network solution that provides communications, Edge processing, and advanced network capabilities for interoperable, resilient, and secure connectivity and data flow across all domains. Nokia added that its military-grade 5G technology makes it possible to "integrate commercial 5G connections with military communications systems to provide decisive information for national defense," highlighting the importance of interoperability.

Earlier this year, China claimed to have introduced what it describes as the world's first mobile 5G base station for military purposes. According to a South China Morning Post report, it was developed in partnership with China Mobile Communications Group and the Chinese People's Liberation Army (PLA). The reports highlighted that the 5G mobile base station delivers high-speed, low-latency, and secure data services, supporting up to 10,000 users within a 3km radius.

The system maintains a consistent total throughput of 10 gigabits per second with latency under 15 milliseconds. The report also stated that this new 5G base station paves the way for the extensive deployment of intelligent war machines. China is currently constructing what it claims to be the world's most significant unmanned military force, featuring advanced yet cost-effective drones, robotic dogs, and other autonomous combat platforms that could eventually outnumber human soldiers.

Effective communication is essential in military aviation, where split-second decisions can determine a mission's success or a personnel's safety. The advent of fifth-generation wireless technology (5G) and advanced communication networks promises to revolutionize this field. With unparalleled speed, low latency, and extensive connectivity, 5G has transformative potential for real-time data sharing among aircraft, command centers, and other platforms.

It enhances real-time communications in military aviation, strengthens network-centric warfare for a more integrated air force, and introduces security risks that must be addressed to protect operations. By examining these factors, we can recognize the significant implications of advanced communication technologies for modern military aviation.

Understanding 5G Technology

5G, the fifth generation of wireless communication technology, is characterized by its high speed, low latency, and capacity to connect many devices simultaneously. These attributes make it a game-changer for military aviation, where timely and reliable communication is critical. Unlike its predecessors, 5G operates on higher frequency bands, such as millimeter waves, providing wider bandwidths for faster data transmission. It also employs techniques like beam forming, directing

signals to specific devices rather than broadcasting omnidirectionally, to optimize signal strength and reduce interference.

Military Aviation: Possibilities

In military aviation, real-time data sharing involves the seamless exchange of information between aircraft, command centers, unmanned aerial vehicles (UAVs), and other platforms. 5 G's speed often exceeds 1 Gbps. Its latency, reduced to as low as 1 millisecond, enables near-instantaneous communication, a stark improvement over 4G's 20-30 millisecond latency.

Types of Data: Real-time data is crucial in military and defense applications, enhancing situational awareness and operational efficiency. Sensor data from radar, infrared, and other detection systems provides critical intelligence on enemy positions and movements. For instance, a fighter jet detecting a hostile target can instantly transmit its coordinates to allied forces, improving response time. Video feeds, including HD or 4K footage from UAVs or onboard cameras, offer live intelligence, with 5G ensuring seamless transmission to command centers. Telemetry data tracks aircraft speed, altitude, fuel levels, and system health, enabling proactive maintenance and reducing downtime.

Communication data, including voice and text transmissions, ensures seamless coordination between pilots, ground crews, and commanders, facilitating synchronized operations. These data types support real-time decision-making, enhancing battlefield effectiveness, reducing risks, and optimizing mission success rates. Integrating AI and advanced networks further strengthens these capabilities, making modern military operations more responsive and precise.

Enhancing Data Sharing Across Platforms: In combat scenarios, aircraft must exchange vast amounts of data, radar signatures, sensor readings, high-definition video feeds, and tactical updates with command centers and allied units. Consider a multi-aircraft operation targeting enemy defenses: each fighter jet must instantly share its position, target data, and threat assessments.

For instance, a reconnaissance plane detecting an enemy convoy could stream live video to a command center, relaying precise coordinates to strike aircraft within moments. This speed enhances decision-making, enabling commanders to adapt strategies dynamically. Moreover, 5G's low latency is a game-changer for time-sensitive applications. Even a half-second delay could be fatal during air-to-air engagements, where pilots rely on real-time radar and missile lock data. By slashing latency to 1 ms, 5G ensures data arrives when needed, improving coordination and precision.

Integration with Unmanned Systems: Unmanned aerial vehicles (UAVs) and drones are increasingly vital to military operations, reconnaissance, strikes, and electronic warfare. These systems depend on robust communication links to receive commands and transmit data. 5G's high capacity and responsiveness enhance this connectivity. For example, a drone swarm conducting surveillance over hostile territory could send high-resolution imagery back to a command center while receiving real-time updated flight instructions. This capability supports more autonomous and complex UAV missions, such as coordinated attacks or perimeter defense, by maintaining a constant, reliable link.

Additionally, 5G's massive device connectivity allows numerous sensors and platforms to be integrated. A single operation might involve dozens of drones, manned aircraft, and ground stations, all sharing data through a unified network. This scalability ensures the communication infrastructure can keep pace as unmanned systems proliferate, fostering a more versatile and responsive air force.

Network-Centric Joint Warfare: Network-centric warfare (NCW) redefines military operations by linking all elements, aircraft, ground forces, naval units, and command centers into a cohesive information-sharing network. The goal is to achieve a decisive advantage through enhanced situational awareness, coordination, and speed.

In aviation, NCW transforms isolated aircraft into nodes within a broader system, amplifying their effectiveness through collective intelligence. With 5G, NCW reaches new heights. Its high-speed, low-latency network enables seamless data exchange across platforms, creating a more integrated air force.

Imagine a scenario where a reconnaissance drone identifies a mobile missile launcher. Within seconds, 5G transmits this intelligence to a nearby fighter jet, which adjusts its flight path while informing ground-based air defenses and a command center. The jet engages the target, and the updated status is shared network-wide, allowing other units to reposition accordingly. This rapid, synchronized response exemplifies how 5G enhances operational tempo and effectiveness.

Enhancing Situational Awareness: Modern combat aircraft, including fifth—and sixth-generation fighters, rely heavily on seamless communication with command centers, reconnaissance drones, and other allied aircraft. The ability to transmit and receive data in real-time enhances situational awareness, allowing pilots to react swiftly to evolving threats.

Optimising Command and Control: Military command centers depend on real-time data feeds to make strategic decisions. 5G networks enable instantaneous transmission of mission-critical information, including radar feeds, target tracking, and intelligence updates. This increased speed and reliability minimize decision-making delays, ensuring that commanders can deploy assets more efficiently and respond dynamically to threats.

AI and Big Data Integration: Advanced communication networks empower artificial intelligence (AI) systems to analyze vast battlefield data in real-time. AI-driven analytics can provide predictive insights on enemy movements, optimize flight paths, and suggest strategic maneuvers to pilots. Fusing AI with 5G networks creates a more innovative, adaptive military force capable of making split-second decisions based on real-time intelligence. This integration allows for the efficient processing of large volumes of data, enabling the military to make informed decisions and respond effectively to changing situations.

Security Risks

Integrating 5G into military aviation offers enhanced communication, real-time data sharing, and improved battlefield awareness. However, it also introduces significant security risks that could compromise mission success. As military systems increasingly rely on wireless, software-driven networks, the attack surface expands, creating new vulnerabilities.

One primary concern is jamming and interference, whereby adversaries employ electronic warfare techniques to disrupt 5G signals, which could sever critical communication links. Cyber attacks pose another serious threat; hackers might manipulate data transmissions, injecting false coordinates into navigation systems, potentially leading to disastrous consequences such as mission failure or friendly fire.

Espionage is also a pressing issue, as adversaries could intercept sensitive transmissions, including radar data and flight plans, thereby exposing strategic operations. Furthermore, vulnerabilities in the supply chain emerge due to reliance on commercial 5G infrastructure. Many private firms involved in 5G deployment may inadvertently introduce security loopholes, whether intentionally or not, granting hostile entities backdoor access. The sheer speed of 5G exacerbates these risks, allowing adversaries to launch large-scale cyber attacks more swiftly than traditional defense mechanisms can react.

Additionally, the heavy dependence on virtualization and software-defined networking introduces software-based vulnerabilities, which, if left unpatched, could be exploited by sophisticated attackers. EW adds another layer of complexity. Adversaries might target 5G's millimeter-wave frequencies, which, while offering high bandwidth, are susceptible to interference in contested environments. A successful jamming operation could isolate aircraft from command, crippling NCW's effectiveness.

Threats to Military Aviation: These risks have dire implications for aviation. A compromised 5G network could disrupt UAV control, causing drones to crash or attack unintended targets. Interrupted communications might allow enemies to anticipate and counter maneuvers during a coordinated strike. Moreover, reliance on commercial networks shared in 5G deployments raises concerns about espionage, especially if foreign entities dominate the supply chain. Debates over certain manufacturers' involvement in 5G infrastructure highlight fears of embedded vulnerabilities accessible to rival nations.

Mitigation Strategies

Robust defense mechanisms must be established to address the security risks associated with 5G in military aviation. Encryption is vital, ensuring that intercepted communications remain indecipherable to adversaries. End—to—end encryption safeguards sensitive data, such as radar feeds and flight plans, from exploitation. Authentication protocols further bolster security by requiring multi-factor authentication to verify user and device identities, thereby preventing unauthorized access. Intrusion detection systems play a crucial role by continuously monitoring network traffic for anomalies, enabling rapid responses to cyber threats before they cause harm.

Furthermore, redundancy is essential—backup communication channels, such as satellite links, provide fail-safes during 5G network disruptions due to jamming or cyberattacks. Developing dedicated, military-specific 5G networks, distinct from commercial infrastructure, further enhances security by minimizing exposure to supply chain risks and potential backdoors.

Regular security audits and penetration testing help identify vulnerabilities before adversaries can exploit them. Collaborating with the private sector can also strengthen the security of commercial components used in military applications.

Lastly, training personnel to recognize cyber threats and respond effectively ensures that human factors do not become vulnerabilities in cybersecurity. By adopting a comprehensive, multi-layered defense strategy, the military can mitigate 5 G-related risks while harnessing its advantages.

Conclusion

The 5G race between China and the United States is more than just a contest for technological supremacy; it is a battle that could redefine the future of aerial warfare. As both nations invest heavily in next-generation networks, integrating 5G into military aviation will enable faster data transmission, enhanced artificial intelligence, and real-time battlefield awareness.

This technology has the potential to revolutionize drone warfare, enable seamless coordination between manned and unmanned systems, and improve electronic warfare capabilities. However, the competition is not solely about innovation but security and strategic dominance. The United States remains wary of China's 5G infrastructure, citing risks of espionage and cyber vulnerabilities, while China continues to push its indigenous advancements to reduce dependence on Western technology.

The outcome of this race will shape military strategies and influence global alliances, trade policies, and the future of digital warfare. As the dragon and the eagle vie for control, nations aligning with either power must carefully navigate the geopolitical implications of their technological choices. Ultimately, the side that harnesses 5G most effectively for aerial combat may gain a decisive edge in future conflicts, setting the stage for a new era of warfare.

*

Science & Technology News

Union Minister Dr. Jitendra Singh announces the creation of Regional BIRAC Centers across India, in collaboration with States, to accelerate StartUps and biomanufacturing, and thus harness the biotech potential in different parts of the country

Source: Press Information Bureau, Dt. 28 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2116170

At a high-level meeting of the Department of Biotechnology, Union Minister Dr. Jitendra Singh announced the creation of Regional BIRAC (Biotechnology Industry Research Assistance Council) Centers across India, in collaboration with States, to accelerate StartUps and biomanufacturing, and thus harness the biotech potential in different parts of the country.

Dr. Jitendra Singh, Minister of State (Independent Charge) Science & Technology; MoS PMO, Personnel, Public Grievances, Pensions, Atomic Energy and Space emphasized the need for

comprehensive mapping of states based on their biotech potential and directed the department to collaborate with them in establishing Bio E3 (Economy, Environment and Employment) Cells highlighting that Assam is the first state to establish a dedicated BIO E3 cell. These specialized cells will provide necessary support for fostering innovation, entrepreneurship, and scaling up biotech ventures.

Recognizing the critical role of StartUps in advancing biomanufacturing, Dr. Jitendra Singh called for enhanced handholding and incubator support to encourage new-age biotech entrepreneurs. He highlighted the importance of Foreign Direct Investment (FDI) in biomanufacturing and bio foundries, ensuring global investment to drive India's biotech revolution.

Dr. Jitendra Singh stressed that the Tripartite arrangement—a synergy between Research Infrastructure, Startups, and Industrial R&D—is the way forward for India’s biotech sector. He directed the department to prioritize setting up Core R&D Facilities equipped with state-of-the-art biomanufacturing capabilities to facilitate pilot validation, upscaling, and commercialization of promising biotech innovations.

Recalling the Centre-State Partnership Summit held in Delhi, Dr. Jitendra Singh reiterated the Government's commitment to fostering a biotech revolution across states through collaboration, knowledge-sharing, and technical assistance. He noted that several states have expressed interest in setting up Biotechnology Parks, further strengthening India's bio-economy.

The Science & Technology Minister underscored the significance of regenerative technologies, directing the department to prioritize their promotion within India’s biomanufacturing landscape. He urged officials to partner with industry leaders to replicate the success of India's Space Sector in biotech.

Dr. Jitendra Singh instructed the Department of Biotechnology to establish early industry linkages and work towards a 4P Model (Public-Private-People Partnership) for accelerating biotech growth. He also welcomed proposals to create BIRAC Centers at a global level to attract cutting-edge biomanufacturing technologies and investments.

Dr. Jitendra Singh expressed pride in India’s global standing in biotech research, noting that India ranks 3rd in biotech publications worldwide, with nearly two-thirds of research papers emanating from the Department of Biotechnology. He said “This reflects India’s growing influence and leadership in the international biotech arena.”

With these strategic directives, Dr. Jitendra Singh reinforced the Government’s vision to position India as a global leader in biotechnology, ensuring that biomanufacturing, research, and innovation drive the country’s economic and scientific growth to achieve Prime Minister’s vision of Viksit Bharat @2047.

Dr. Rajesh S. Gokhale, Secretary, DBT, DG-BRIC & Chairman, BIRAC, along with Managing Director, BIRAC, Shri Jitendra Kumar, and other senior officials and scientists of the department, were present at the review meeting.

*

ISRO achieves breakthrough in Semicryogenic engine development for LVM3

Source: The Hindu, Dt. 29 Mar 2025,
URL: https://www.thehindu.com/sci-tech/isro-achieves-breakthrough-in-semicryogenic-engine-development-for-lvm3/article69389411.ece

ISRO has announced significant progress in the design and development of a Semicryogenic engine or Liquid Oxygen/Kerosene engine with a high thrust of 2,000 kN (kilonewton) that will power the Semicryogenic booster stage of the Launch Vehicle Mark-3 (LVM3).

The first major breakthrough in the semicryogenic engine development programme was achieved on March 28, when the first successful hot test of Engine Power Head Test Article (PHTA), was carried out at ISRO Propulsion Complex, Mahendragiri, Tamil Nadu, said the organisation.

Highlighting that the Friday's (March 28, 2025) test demonstrated the smooth ignition and boost strap mode operation of the engine for a test duration of 2.5 seconds, the space agency said the objective of the test was to validate the integrated performance of the critical subsystems such as the pre-burner, turbo pumps, start system and control components by carrying out a hot-firing for a short-duration.

"The test proceeded as predicted and all the engine parameters were as expected. With this breakthrough, ISRO is further planning a series of tests on the PHTA to further validate and finetune the performance before the realisation of the fully integrated engine," reads ISRO's statement.

Noting that the Liquid Propulsion Systems Centre (LPSC) is developing the Semi cryogenic propulsion Engine and Stage, ISRO said the stage (SC120) powered by the 2,000kN semi-cryogenic engine (SE2000) will replace the present core liquid stage (L110) of LVM3 for payload enhancement and power the booster stages of future launch vehicles.

Non toxic and non hazardous propellants (Liquid Oxygen and Kerosene) are employed in Semi cryogenic propulsion and will deliver higher performance compared to existing L110 stage.

Induction of the Semi cryogenic propulsion system along with an uprated cryogenic stage in the LVM3 vehicle enhances its payload capability from 4 tonne to 5 tonne in Geosynchronous Transfer Orbit (GTO), said the space agancy.According to ISRO, major subsystems of the SE-2000 engine include thrust chamber, pre-burner, turbo pump system, control components and start up system.

The statement on the agency's web page states that, "The complex engine hardware uses special materials to withstand the high temperature and oxidiser rich combustion. The hardware along with the space grade kerosene are realised in partnership with Indian industry. The development of this engine in these high thrust levels is highly challenging and this technology is available with only very few nations."

ISRO conducts flight acceptance hot test of Cryogenic Engine for LVM3-M6 MissionThe realisation of a test facility to qualify the engine and stage is equally complex and challenging, ISRO said.

The complex Semicryogenic Integrated Engine Test facility (SIET) was established at its Propulsion Research Complex (IPRC), Mahendragiri for testing the engine and stage and was dedicated to the nation by Prime Minister Narendra Modi on February 27 last year.

Prior to the conduct of integrated engine level hot tests, it is planned to carry out performance evaluation tests of the intermediate configuration, designated as Power Head Test Article (PHTA), which comprises all the engine systems except the thrust chamber, informed the statement.

The hot test that was carried out on Friday (March 28, 2025), is the first of a series of tests planned to validate the design of the propellant feed system, including the low-pressure and high-pressure turbo-pumps, the pre-burner, start system and control components.

ISRO, NSIL explore opportunities to manufacture LVM-3"All subsystems for the test were realised and had undergone rigorous qualification tests prior to integration to Power Head Test Article," the space agency said.

The ignition sequence for PHTA was derived from a series of hot tests in single element level, ISRO said. In order to ensure the smooth ignition process during the PHTA test, another test article, Pre-burner Ignition Test Article (PITA), was realised, which consists of the pre-burner along with its feed systems, start-systems, and related control components.

"A series of tests were successfully completed using the PITA, and the optimum start sequence for the power head test article was derived," said the agency.

*

क्वांटम कंप्यूटर्स पर बड़ी खोज, प्रकाश को फ्रीज करने में मिली कामयाबी के क्या हैं मायने

Source: NavBharat Times, Dt. 29 Mar 2025,
URL: https://navbharattimes.indiatimes.com/india/miraculous-success-this-discovery-will-change-quantum-computers/amp_articleshow/119706370.cms

प्रकाश को किसी ठोस चीज जैसी शक्ल में ला देने की खबर ने दुनिया में सनसनी मचा रखी है। लेकिन इस बारे में कोई लंबी उड़ान भरने से पहले कुछ गलतफहमियां दूर कर लेना जरूरी है। पहली यह कि जैसे तापमान गिराने और दबाव बढ़ाने से गैसें द्रव में और द्रव ठोस में बदल जाते हैं, उस पूरे खेल से इस खबर का कुछ लेना–देना नहीं है। ताप और दाब के प्रभाव में अपनी अवस्था बदल लेना प्रकाश के स्वभाव में नहीं है। ऐसा होता तो अत्यंत ठंडे अंतरिक्ष में इसे सृष्टि की सबसे तेज गति न हासिल होती। कुछ अलग तरह की खबरें हम प्रकाश की गति घटाने या उसे रोक ही लेने की भी सुनते आ रहे हैं। 2013 में एक खास क्रिस्टल में संयोजित प्रैसियोडिमियम तत्व के आयनों में फंसाकर प्रकाश को पहली बार मिनट भर के लिए रोक लिया गया था। अभी की खबर ऐसे प्रयोगों से भी हट कर है।

सॉलिड और सुपर सॉलिड : इटली के दो प्रतिष्ठित संस्थानों CNR नैनोटेक और यूनिवर्सिटी ऑफ पावियो के शोधकर्ताओं की टीम का यह काम पूरी तरह क्वांटम मेकेनिक्स के दायरे में आता है। इसके तहत प्रकाश की जो अवस्था उन्होंने प्राप्त की है, वह 'सॉलिड' न होकर 'सुपर–सॉलिड' है। ठोस (सॉलिड) पदार्थ की वह अवस्था है,

जहां उसका एक स्पष्ट आकार होता है और बहने का गुण बिल्कुल नहीं होता। लेकिन सुपरसॉलिड अवस्था में पदार्थ का एक आकार होता है, साथ में बिना किसी घर्षण या रुकावट के वह बह भी निकलता है। इस तरह की एक चीज पहले सिर्फ परिकल्पना में हुआ करती थी और अभी बनाई जा चुकी है– बोस–आइंस्टाइन कंडेंसेट। भारतीय भौतिकविद सत्येंद्र नाथ बोस और अल्बर्ट आइंस्टाइन ने परम शून्य तापमान (माइनस 273.15 डिग्री सेंटीग्रेड) पर पदार्थों के लिए इस अवस्था की परिकल्पना की थी, जिसे बाद में बहुत सूक्ष्म मात्रा में बना भी लिया गया। यही सुपरसॉलिड अवस्था इटली में प्रकाश को दी गई है।

पदार्थ की पांचवीं अवस्था : परिभाषा में जाएं तो सुपरसॉलिड स्टेट पदार्थ की पांचवीं अवस्था है और हमारे लिए यह कोई जानी–पहचानी चीज नहीं है। अपने इर्द–गिर्द मौजूद इसकी तीन अवस्थाओं ठोस, द्रव और गैस के बारे में हम बचपन से सुनते आ रहे हैं। चौथी अवस्था 'प्लाज्मा' की खोज हाई–एनर्जी फिजिक्स की देन है। गैसों को बहुत ऊंचे तापमान पर ले जाने पर उनमें परमाणु के स्तर पर टूट–फूट हो जाती है। उनके कुछ इलेक्ट्रॉन अपनी कक्षा से बाहर निकल आते हैं और एक आवेशित पदार्थ प्राप्त होता है, जिसमें पॉजिटिव चार्ज वाले आयन और नेगेटिव चार्ज वाले इलेक्ट्रॉन, दोनों साथ–साथ मौजूद होते हैं। अभी की 'सुपर सॉलिड' अवस्था प्लाज्मा के दूसरे छोर, यानी परम शून्य तापमान पर प्राप्त होती है।

कुचालक और सुचालक दोनों : वैज्ञानिकों ने इसके लिए एक खास सेमीकंडक्टर का इस्तेमाल किया है। सेमीकंडक्टर यानी वह चीज, जो विद्युतधारा के लिए सुचालक और कुचालक, दोनों का ही व्यवहार करती हो। जब चाहें करंट इससे होकर गुजर जाए, और जब चाहें, सूखी लकड़ी की तरह यह करंट को रोक भी ले। इसका मुख्य उपयोग अभी कंप्यूटरों के दिमाग की कोशिका की तरह होता है। सर्किट जुड़ जाए तो डैश, टूट जाए तो डॉट। डैश–डॉट में बनने वाले पैटर्न्स से ही कंप्यूटरों की भाषा बनती है। लेकिन वहां सेमीकंडक्टर के तौर पर सिलिकॉन आजमाया जाता है, जबकि इटली के वैज्ञानिकों ने अपने प्रयोग के लिए गैलियम आर्सेनाइड नाम का सेमीकंडक्टर लिया, इसका एक नफीस ढांचा तैयार किया और बाकी काम के लिए लेजर इस्तेमाल किए।

युग बदलने वाली खोज : यह खोज तकनीकी के क्षेत्र में युग बदलने वाली हो सकती है। लिहाजा, पर्याप्त सफाई के साथ उसे समझना और समझाना फिलहाल इस क्षेत्र में अध्ययन–अध्यापन करने वालों के भी बूते की बात नहीं है। लेकिन संक्षेप में कहा जाए तो सेमीकंडक्टर्स में विद्युत धारा प्रवाहित करने पर इसमें 'एक्साइटॉन' नाम के छद्म–कण दर्ज किए जाने लगते हैं– पॉजिटिव चार्ज वाले होल (छेद) और नेगेटिव चार्ज वाले इलेक्ट्रॉन के जोड़े। लेजर के जरिये गैलियम आर्सेनाइड के 'रिज स्ट्रक्चर' पर छोड़े गए प्रकाश–कण (फोटॉन) इन एक्साइटॉन्स के साथ मिलकर एक और तरह के छद्म–कण 'पोलैरिटॉन' का निर्माण करते हैं, जो प्रकाश को द्रव्य के साथ बांध देने जैसा है। जैसे–जैसे ढांचे में पोलैरिटॉन्स की संख्या बढ़ती जाती है, उनका प्रेक्षण सुपरसॉलिड जैसे नतीजे देने लगता है।

एलईडी की मिसाल : बीते एक दशक में हमने LED (लाइट एमिटिंग डायोड) के जरिये अपने इर्द–गिर्द रोशनी का समूचा खेल ही बदल जाते देखा है। जानकर आश्चर्य होता है कि अभी 2010 तक सफेद LED अपनी तकनीकी विकास की प्रक्रिया में ही था और इसके आविष्कारक इसके महत्व को लेकर पूरी तरह आश्वस्त नहीं थे। अपनी इस खोज के लिए उन्हें 2014 का नोबेल पुरस्कार मिला, लेकिन स्वीडन के जिस हॉल में वे पुरस्कृत हुए, वह LED बल्बों से ही जगमगा रहा था।

क्वांटम कंप्यूटर्स पर असर : यह प्रकरण बताता है कि महत्वपूर्ण तकनीकी खोजों के जनजीवन पर व्यापक प्रभाव डालने में अब पहले जितना वक्त नहीं लगता। यह बात प्रकाश को सुपर सॉलिड स्टेट में लाने से भी जुड़ी है। इसका सीधा असर सबसे पहले क्वांटम कंप्यूटर्स के विकास पर पड़ने की उम्मीद की जा रही है, जो अभी के दौर में

अमेरिका और चीन के बीच जारी तकनीकी शीतयुद्ध का सबसे चर्चित क्षेत्र है। लेकिन इस काम के साथ बड़े दायरे की संभावनाएं जुड़ी हैं और सूचना–संचार से लेकर जीवन के कितने ही पक्ष इससे आड़े–तिरछे प्रभावित हो सकते हैं।

*

अंतरिक्ष में सैटेलाइट्स में अब ऐसे पैदा की जाएगी बिजली, जानें क्या है कोल्ड फ्यूजन तकनीक

Source: Jagran, Dt. 30 Mar 2025,
URL: https://www.jagran.com/news/national-cold-fusion-technology-to-power-satellites-indian-startup-space-mission-23908941.html

अंतरिक्ष में सेटेलाइट्स की उम्र बढ़ाने, उन्हें निर्बाध ऊर्जा प्रदान करने, उनके भार में कमी लाने और स्वच्छ ऊर्जा स्त्रोत प्रदान करने के उद्देश्य से विज्ञानी अब कोल्ड फ्यूजन तकनीक पर काम कर रहे हैं। हैदराबाद स्थित स्टार्ट–अप 'हाइलेनर टेक्नोलाजीज' जल्द ही अंतरिक्ष में बिजली उत्पन्न करने के लिए इस तकनीक का प्रदर्शन करने की योजना बना रहा है। इसका उद्देश्य पृथ्वी की कक्षा में सेटेलाइट्स के जीवन को बढ़ाना और उनका वजन कम करना है। साथ ही अंतरिक्ष में लंबी अवधि के मिशन को सक्षम बनाने और सौर ऊर्जा या अन्य ऊर्जा स्त्रोतों पर निर्भरता कम करने का भी इसका महत्वपूर्ण उद्देश्य है।

हाइड्रोजन फ्यूजन से पैदा होती है बिजली

हाइलेनर टेक्नोलाजीज ने कम ऊर्जा वाले परमाणु रिएक्टर (एलईएनआर) का परीक्षण करने के लिए एक अन्य नवोदित फर्म टेकमी2स्पेस सेटेलाइट्स के साथ समझौता किया है। एलईएनआर बिजली उत्पन्न करने के लिए हाइड्रोजन फ्यूजन का उपयोग करता है। कोल्ड फ्यूजन की अनूठी विशेषता यह है कि यह फ्यूजन रिएक्शन के लिए खपत की गई बिजली के मुकाबले अधिक बिजली उत्पन्न करता है।

हाइलेनर टेक्नोलाजीज के संस्थापक और सीईओ सिद्धार्थ दुराइराजन ने बताया, "प्रत्येक 100 वाट की इनपुट ऊर्जा के लिए एलईएनआर 178 वाट की आउटपुट थर्मल ऊर्जा उत्पन्न करता है।"

दुराइराजन ने कहा कि परीक्षण एवं प्रक्षेपण के लिए कंपनी ने स्काईरूट और इसरो के छोटे उपग्रह प्रक्षेपण यान और ध्रुवीय उपग्रह प्रक्षेपण यान (पीएसएलवी) बुक किया है। उन्होंने कहा, "हमारा उत्पाद तैयार है। हम प्रक्षेपण मंच की प्रतीक्षा कर रहे हैं। इसलिए उनकी प्रक्षेपण तिथियों के आधार पर ही हमारे उत्पाद वहां होंगे।"

गौरतलब है कि टेकमी2स्पेस अंतरिक्ष में कंप्यूट इंफ्रास्ट्रक्चर का निर्माण कर रहा है। इसका उपयोग अंतरिक्ष में डाटा केंद्रों को संचालित करने के लिए किया जा सकता है। उन्होंने कहा, "क्यूबसैट पर ग्राफिक्स प्रोसे¨सग यूनिट (जीपीयू) बहुत अधिक गर्मी उत्पन्न करते हैं। हम उस गर्मी का दोहन करने और इसे सेटेलाइट में उपयोग करने योग्य ऊर्जा के रूप में परिवर्तित करने का प्रयास कर रहे हैं। इससे अंतरिक्ष में लंबी अवधि के मिशन और आफ–ग्रिड बिजली समाधानों के लिए नई संभावनाएं खुल सकती हैं।"

टेकमी2स्पेस के फाउंडर ने क्या कहा?

टेकमी2स्पेस के संस्थापक रौनक कुमार सामंत्रे ने कहा कि उनकी कंपनी एलईएनआर सहित कई ऊर्जा प्रौद्योगिकियों की तलाश कर रही है ताकि कंप्यूट–केंद्रित सेटेलाइट्स में गर्मी निष्कर्षण और संभावित पुन: उपयोग के लिए प्रभावी तरीकों का आकलन किया जा सके। हाइलेनर के पास अपनी कम ऊर्जा परमाणु रिएक्टर तकनीक के लिए सरकार से प्राप्त पेटेंट है। यह तकनीक अंतरिक्ष अनुप्रयोगों के लिए गर्मी पैदा करने, कई अनुप्रयोगों के लिए भाप उत्पादन, वैश्विक स्तर पर ठंडे क्षेत्रों में कमरे को गर्म करने, और घरेलू एवं औद्योगिक आवश्यकताओं के लिए प्रेरण (इंडक्शन) हीटिंग के लिए इनपुट इलेक्ट्रिसिटी में वृद्धि करती है।

दुराइराजन ने कहा कि सौर पैनल, बैटरी और अन्य उपकरणों की मदद से बिजली के उपभोग की वजह से किसी भी सेटेलाइट का भार 40–60 प्रतिशत तक बढ़ जाता है। हाइलेनर का कोल्ड फ्यूजन डिवाइस और टेकमी2स्पेस का आफ–ग्रिड बिजली समाधान अंतरिक्ष में सेटेलाइट्स को बिजली समाधान प्रदान करने तथा अंतरिक्ष में लंबी अवधि के मिशन का प्रयास कर रहा है। अंतरिक्ष में डाटा सेंटर बहुत जल्द एक वास्तविकता बन जाएंगे।

*

Laser allows long-range detection of radioactive materials

Source: The Hindu, Dt. 01 Apr 2025,
URL: https://www.thehindu.com/sci-tech/science/laser-allows-long-range-detection-of-radioactive-materials/article69396261.ece

In a new breakthrough, a team of physicists from the U.S. has successfully demonstrated a new way to detect radioactive materials using carbon-dioxide lasers — from a distance. The potential applications of this innovative technique span national defence and emergency response, where rapid, accurate detection from safe distances is paramount.

At the core of the new technique is a phenomenon called avalanche breakdown. When some material undergoes radioactive decay, the charged particles it releases travel through the air and ionise it, i.e. separate its positive and negative charges and create a state of matter called plasma.

The negative charges, or electrons, can be accelerated to collide with other atoms and release even more electrons. This is avalanche breakdown. The researchers used a carbon-dioxide laser emitting long wave infrared radiation at a wavelength of 9.2 micrometres to accelerate the electrons, and were able to detect alpha particles from a radioactive source located 10 m away. This improves the range in previous experiments by a factor of 10. (An alpha particle is a bundle of two protons and two neutrons.)

The electrons that are accelerated in the first step of avalanche breakdown are called seeds. In this experiment, each seed electron resulted in distinct balls of microplasma in the air that generated a measurable optical backscatter. Crucially, the researchers were able to amplify this backscatter as it travelled back through the laser system, substantially improving detection sensitivity.

A compelling advantage of using long-wavelength lasers is their ability to drive electron avalanches, which in turn is crucial to detect very low concentrations of seeds. The laser’s longer wavelengths also reduce the likelihood of undesirable ionisation effects that could otherwise mask the detection signal.

In the experiment, the researchers also used fluorescence imaging to further illuminate the dynamics within the plasma created by the laser-induced avalanches, allowing them to characterise in detail the seed density profiles. Then they developed a mathematical model that accurately predicted the backscatter signals based on these seed densities, validating the technique.

The advance sets the stage to potentially expand avalanche-based laser detection techniques to identify gamma-ray radiation sources at greater stand-off distances. Gamma rays, which some radioactive nuclides like caesium-137 emit, travel much farther in air than alpha particles, reducing the density of the ionisation they produce. Despite this challenge, the researchers suggested that a Cs-137 source could be detected from about 100 m away provided the laser focusing optics are scaled up appropriately. This would greatly surpass current detection capabilities.

But extending the detection range further also introduces notable difficulties. Using longer focal lengths to reach distances of around 1 km or more would require even larger optics and higher laser energies due to diminishing signal strengths. At such extended distances, the laser backscatter method — the primary approach tested here — is limited because the signal could become saturated by background radiation and atmospheric interference.

The team's findings were published in Physical Review Applied on March 4.

*

When Crystals Behave Like Currents: Scientists Discover Hidden Link in Physics

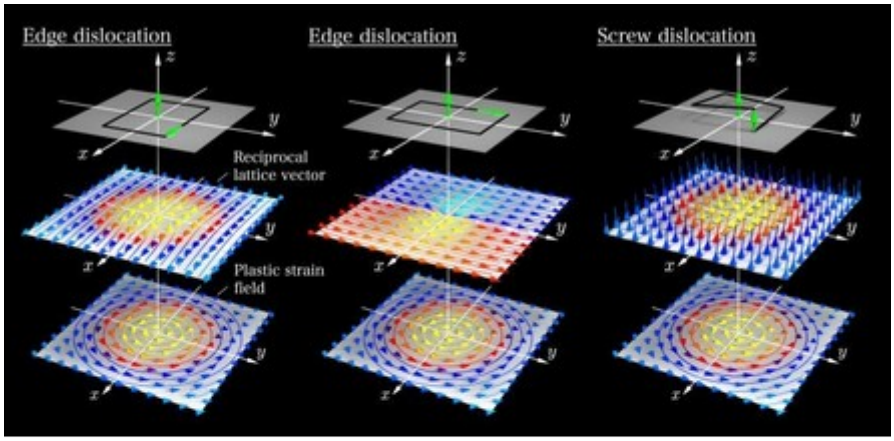
Source: SciTech Daily, Dt. 31 Mar 2025,
URL: https://scitechdaily.com/when-crystals-behave-like-currents-scientists-discover-hidden-link-in-physics/

A fundamental goal of physics is to explain a wide range of natural phenomena using the fewest possible fundamental principles. Strikingly, problems that appear unrelated on the surface often share the same mathematical structure. For example, the equation describing heat flow closely resembles the one used to model the diffusion of particles.

Similarly, wave equations govern diverse phenomena such as the motion of water and the propagation of sound. Physicists actively search for these kinds of connections, which reflect the deep "universality" of the physical laws that govern different systems.

In a study published in Royal Society Open Science, researchers at Osaka University revealed an unexpected link between the equations describing defects in crystal lattices and a well-known formula from electromagnetism.

They demonstrated that the fields representing the strain generated around lattice dislocations in crystalline materials, modeled by Cartan's First Structure Equation, obey the same equations as the more familiar Biot-Savart law. The former can be quite complex and challenging to visualize, while the latter describes how electric currents generate magnetic fields, and is essential for understanding numerous modern devices, including electric motors.



The reciprocal lattice vectors of a crystal caused by the three types of dislocations and the plastic strain fields obtained through their Helmholtz decomposition. In all cases, the plastic strain fields are observed to exhibit right-handed screw rotation along the dislocation line (the z-axis in the diagram). Furthermore, this characteristic aligns perfectly with the static magnetic fields generated around steady electric currents. Credit: Ryuichi Tarumi, Osaka University

Bridging Concepts Through Universality

"Searching for Universality relationships can be valuable in emerging scientific fields, especially when the governing equations are newly established, and the nature of their solutions remains elusive," explains lead author of the study Shunsuke Kobayashi. The Biot-Savart law states that an electrical current flowing through a wire will generate a magnetic field around itself represented by vectors that twist around like a vortex. Similarly, the effect of certain types of atomic dislocation in a crystalline lattice will induce a strain vector field on the surrounding atoms.

Using the analogous Biot-Savart law from electromagnetism, it will be possible to analytically determine the effect of dislocations, instead of the more arcane Cartan Structure Equations. "This discovery is expected to serve as a fundamental theory for describing the plastic deformation of crystalline materials, opening the way for a wide range of applications in material science," senior author Ryuichi Tarumi says. The researchers also believe that finding these kinds of connections across areas of study can spur new discoveries.

*

Scientists Just Discovered Quantum Signals Inside Life Itself

Source: SciTech Daily, Dt. 30 Mar 2025,
URL: https://scitechdaily.com/scientists-just-discovered-quantum-signals-inside-life-itself/

New research suggests this isn't just happening in brains, but across all life, including bacteria and plants.

Schrödinger's Legacy Inspires a Quantum Leap

Over 80 years ago, theoretical physicist Erwin Schrödinger delivered a series of influential public lectures at Trinity College Dublin. Drawing from both modern physics and philosophical traditions like Schopenhauer and the Upanishads, these talks were later published in 1944 under the title "What is Life?"

Now, during the 2025 International Year of Quantum Science and Technology, Philip Kurian – a theoretical physicist and founding director of the Quantum Biology Laboratory (QBL) at Howard University in Washington, D.C. – has built on Schrödinger's foundational ideas.

Using principles of quantum mechanics and recent QBL findings showing quantum optical properties in cytoskeletal filaments, Kurian has proposed a radically updated upper limit on the total information-processing capacity of carbon-based life throughout Earth's history. His findings, published in Science Advances, also suggest a possible link between this biological limit and the computational bounds of all matter in the observable universe.

"This work connects the dots among the great pillars of twentieth-century physics – thermodynamics, relativity, and quantum mechanics—for a major paradigm shift across the biological sciences, investigating the feasibility and implications of quantum information processing in wetware at ambient temperatures," said Kurian. "Physicists and cosmologists should wrestle with these findings, especially as they consider the origins of life on Earth and elsewhere in the habitable universe, evolving in concert with the electromagnetic field."

The Quantum Challenge of Living Systems

The effects of quantum mechanics – the laws of physics that many scientists think apply at only small scales – are sensitive to disturbances. This is why quantum computers must be held at temperatures colder than outer space, and only small objects, such as atoms and molecules, typically display quantum properties. By quantum standards, biological systems are quite hostile environments: they're warm and chaotic, and even their fundamental components – such as cells – are considered large.

But Kurian's group last year discovered a distinctly quantum effect in protein polymers in aqueous solution, which survives these challenging conditions at the micron scale, and may also present a way for the brain to protect itself from degenerative diseases like Alzheimer's and related dementias. Their results have suggested new applications and platforms for quantum computing researchers, and they represent a new way of thinking about the relationship between life and quantum mechanics.

In his single-author Science Advances paper, Kurian considered a mere trifecta of overarching assumptions: standard quantum mechanics, the relativistic speed limit set by light, and a matter-dominated universe at critical mass-energy density. "Combined with these rather innocuous premises, the remarkable experimental confirmation of single-photon superradiance in a ubiquitous biological architecture at thermal equilibrium opens up many new lines of inquiry across quantum optics, quantum information theory, condensed matter physics, cosmology, and biophysics," said Professor Marco Pettini of Aix-Marseille University and the CNRS Center for Theoretical Physics (France), who was not associated with the work.

Quantum Signals at the Speed of Light

The key molecule enabling these remarkable properties is tryptophan, an amino acid found in many proteins that absorbs ultraviolet light and re-emits it at a longer wavelength. Large networks of tryptophan form in microtubules, amyloid fibrils, transmembrane receptors, viral capsids, cilia, centrioles, neurons, and other cellular complexes. The QBL's confirmation of quantum superradiance in cytoskeletal filaments has the profound consequence that all eukaryotic organisms can use these quantum signals to process information.

To break down food, cells undergoing aerobic respiration use oxygen and generate free radicals, which can emit damaging, high-energy UV light particles. Tryptophan can absorb this ultraviolet light and re-emit it at a lower energy. And, as the QBL study found, very large tryptophan networks can do this even more efficiently and robustly because of their powerful quantum effects.

The standard model for biochemical signaling involves ions moving across cells or membranes, generating spikes in an electrochemical process that takes a few milliseconds for each signal. But neuroscience and other biological researchers have only recently become aware that this isn't the whole story. Superradiance in these cytoskeletal filaments happens in about a picosecond – a millionth of a microsecond. Their tryptophan networks could be functioning as quantum fiber optics that allow eukaryotic cells to process information billions of times faster than chemical processes alone would allow.

"The implications of Kurian's insights are staggering," said Professor Majed Chergui of the École Polytechnique Fédérale de Lausanne (Switzerland) and Elettra-Sincrotrone Trieste (Italy), who supported the 2024 experimental study. "Quantum biology – in particular our observations of superradiant signatures from standard protein spectroscopy methods, guided by his theory—has the potential to open new vistas for understanding the evolution of living systems, in light of photophysics."

The Power of Aneural Life

By thinking of biological information processing primarily at the level of the neuron, many scientists overlook the fact that aneural organisms – including bacteria, fungi, and plants, which form the bulk of Earth's biomass – perform sophisticated computations. And as these organisms have been on our planet for much longer than animals, they constitute the vast majority of Earth's carbon-based computation.

"There are signatures in the interstellar media and on interplanetary asteroids of similar quantum emitters, which may be precursors to eukaryotic life's computational advantage," said Dante Lauretta, professor of planetary science and cosmochemistry at the University of Arizona and director of the Arizona Astrobiology Center, who was not associated with the work. "Kurian's predictions provide quantitative bounds, beyond the colloquial Drake equation, on how superradiant living systems enhance planetary computing capacity. The remarkable properties of this signaling and information-processing modality could be a game-changer in the study of habitable exoplanets."

Biology Meets Quantum Tech

This latest analysis has likewise drawn the attention of researchers in quantum computing, because the survival of fragile quantum effects in a "noisy" environment is of great interest to those who

want to make quantum information technology more resilient. Kurian has had conversations with several quantum computing researchers who were surprised to find such connections in the biological sciences.

“These new performance comparisons will be of interest to the large community of researchers in open quantum systems and quantum technology,” said Professor Nicolò Defenu of the Federal Institute of Technology (ETH) Zurich in Switzerland, a quantum researcher who was not associated with the work. “It’s really intriguing to see a vital and growing connection between quantum technology and living systems.”

In the Science Advances article, Kurian explains and revisits foundational quantum properties and thermodynamic considerations, from a long line of physicists who made clear the essential link between physics and information. With his group’s discovery of UV-excited qubits in biological fibers, almost all life on Earth has the physical capacity to compute with controllable quantum degrees of freedom, allowing storage and manipulation of quantum information with error correction cycles far outpacing the latest lattice-based surface codes. “And all this in a warm soup! The quantum computing world should take serious notice,” Kurian said.

The work also piqued the attention of quantum physicist Seth Lloyd, a professor of mechanical engineering at MIT and a pioneer in the study of quantum computing and the computational capacity of the universe. “I applaud Dr. Kurian’s bold and imaginative efforts to apply the fundamental physics of computation to the total amount of information processing performed by living systems over the course of life on Earth. It’s good to be reminded that the computation performed by living systems is vastly more powerful than that performed by artificial ones,” Lloyd said.

Life’s Place in the Universe’s Grand Design

“In the era of artificial intelligences and quantum computers, it is important to remember that physical laws restrict all their behaviors,” Kurian said. “And yet, though these stringent physical limits also apply to life’s ability to track, observe, know, and simulate parts of the universe, we can still explore and make sense of the brilliant order within it, as the cosmic story unfolds. It’s awe-inspiring that we get to play such a role.”

*