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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

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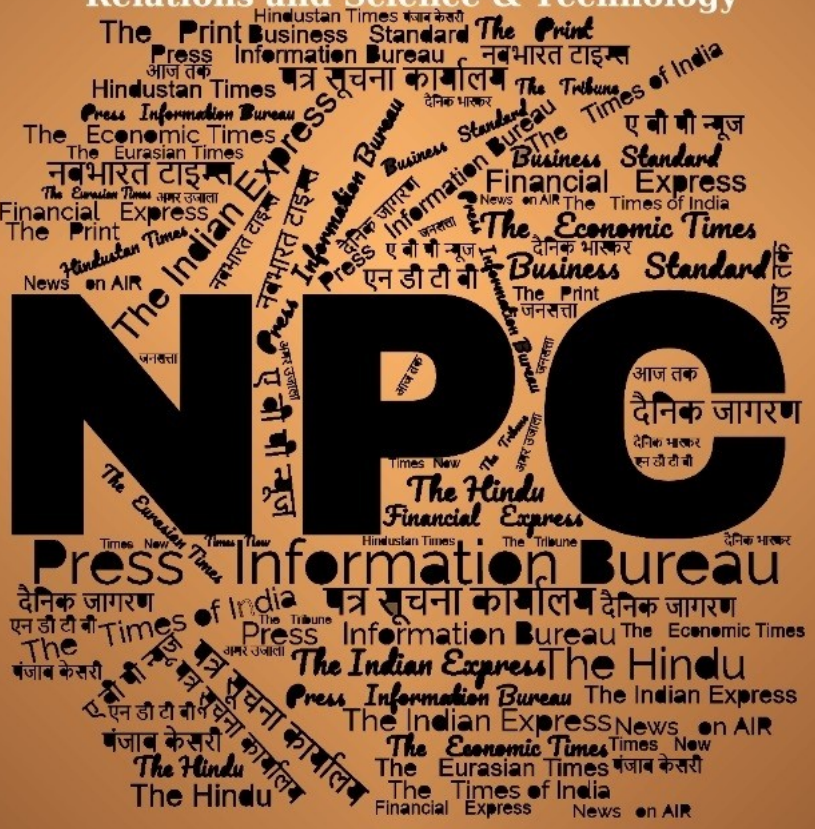

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DRDO News

Launch Of Tenth Ammunition Cum Torpedo Cum Missile (ACTCM) Barge, LSAM 24 (Yard 134)

Source: Press Information Bureau, Dt. 27 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2115597

Launching ceremony of 10th ACTCM Barge, LSAM 24 (Yard 134) was held on 26 Mar 25 at M/s Suryadipta Projects Pvt Ltd, Thane. Chief Guest for the launching Ceremony was Cmde Rahul Jagat, SPS, Submarine Overseeing Team (SOT), Mumbai.

The contract for construction of eleven (11) Ammunition Cum Torpedo Cum Missile Barge was concluded with MSME Shipyard, M/s Suryadipta Projects Pvt Ltd, Thane on 05 Mar 21. These Barges have been indigenously designed and built by the Shipyard in collaboration with an Indian Ship Design firm and Indian Register of Shipping (IRS) respectively.

Model testing was undertaken at **Naval Science and Technological Laboratory (NSTL)**, Visakhapatnam to ensure seaworthiness. The Shipyard has successfully delivered nine of eleven Barges till date and are being effectively utilised by Indian Navy for its operational evolutions.

These Barges are proud flag bearers of Make in India and Aatmanirbhar Bharat initiatives of Government of India.

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Defence News

Defence Strategic: National/International

COAS Gen Upendra Dwivedi highlights Five Pillars of Transformation encompassing Technology Absorption, Structural Changes, HRD & Increasing Cohesion between Three Services

Source: Press Information Bureau, Dt. 27 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2115917

Chief of Army Staff General Upendra Dwivedi has stressed upon the Five Pillars of Transformation encompassing technology absorption, structural changes, human resource development and increasing cohesion between the three services. Delivering the valedictory address of the Higher Defence Management Course (HDMC-20) at the College of Defence Management (CDM), Secunderabad, Gen Dwivedi gave a holistic roadmap of the Indian Army to become a future ready combat force.

The COAS highlighted the Army's commitment to becoming a technologically advanced, adaptive and self-reliant force capable of addressing complex future challenges. He stressed upon the need to move from process driven approach to outcome driven approach to transition from measure of performance to measure of effectiveness. The COAS underscored the alignment of the Army's transformative goals and deliberated upon the three phases of Era of Transition, Era of Consolidation and Era of Control.

Gen Dwivedi emphasised that Armed forces must be mobile, agile and technoligically competent; capable for contributing in all spheres of national security towards achieving vision viksit bharat by 2047 through Atmanirbharta, and remain a key pillar of national power and a preferred security partner in the region. The event marked the successful completion of the flagship Higher Defence Management Course by 167 officers from the Indian Armed Forces, including 14 officers from friendly foreign nations. HDMC is a premier program designed to equip senior military officers with strategic foresight, management expertise, and decision-making acumen crucial for higher defence management and policymaking roles.

The COAS addressed the Future Strategic Leaders on multitude of significant issues from transformation of the armed forces to role and responsibilities towards nation building. He exhorted the graduating officers to be imaginative and develop the attitude and adaptability to channelise their ability and imbibe the principles of Truth, Trust and Transparency to deal with future challenges. As a mark of recognition, the COAS felicitated meritorious officers for their outstanding performance, acknowledging their exemplary contributions and academic excellence.

The valedictory ceremony was graced by senior military officials, faculty members and distinguished guests, underscoring the significance of the occasion. The graduating officers are now poised to take on critical command and staff roles and carry forward the invaluable knowledge and strategic insights gained at CDM, reinforcing their commitment to national security and higher defence management.

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Aatmanirbhar Bharat: MoD inks Rs 2,500 crore contracts for NAMIS Tracked version of anti-tank weapon platform & 5,000 Light Vehicles

Source: Press Information Bureau, Dt. 27 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2115804

Ministry of Defence has signed a contract with Armoured Vehicle Nigam Limited for the procurement of Nag Missile System (NAMIS) Tracked version of anti-tank weapon platform and Force Motors Ltd & Mahindra & Mahindra Ltd for around 5,000 Light Vehicles for the Armed Forces at a total cost of around Rs 2,500 crore. These contracts under Buy (Indian-Indigenously Designed Developed and Manufactured) category were inked in the presence of Defence Secretary Shri Rajesh Kumar Singh in New Delhi on March 27, 2025.

NAMIS (Tr) weapon system

The total cost of contract for the procurement of NAMIS(Tr) weapon system, developed by Defence Research & Development Laboratory of DRDO, is Rs 1,801.34 crore. It marks a significant milestone in the modernisation of the anti-tank capability of Mechanised Infantry, enhancing Indian Army's operational readiness across a varied spectrum of operations.

NAMIS (Tr) is one of the most sophisticated anti-tank weapon system against enemy armour with fire-and-forget anti-tank missile and sighting system for enhanced firepower and lethality. The weapon system is set to transform the conduct of mechanised operation and offer operational advantage against the adversary.

Light Vehicles

These modern vehicles are designed as per contemporary vehicle technology with enhanced engine power to cater to a payload of 800 kgs. It will provide mobility to the Armed Forces in all types of terrain and operational conditions.

Both procurements will enhance indigenisation and national defence equipment manufacturing capabilities. The projects have immense potential of direct and indirect employment generation by encouraging the MSME sector through components' manufacturing. The procurement marks a pivotal step towards modernising the country's defence infrastructure and empowering indigenous industries, in line with the vision of Aatmanirbhar Bharat.

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BEML launches indigenous high-mobility vehicle 12x12 to strengthen India's defence capabilities

Source: ANI News, Dt. 27 Mar 2025,
URL: https://www.aninews.in/news/national/general-news/beml-launches-indigenous-high-mobility-vehicle-12x12-to-strengthen-indias-defence-capabilities20250327230821/

BEML Ltd has launched its indigenously designed and manufactured High Mobility Vehicle (HMV) 12x12 at its Palakkad complex.

BEML launches indigenous high-mobility vehicle 12x12 (Photo/BEML)

Developed for the Vehicles Research and Development Establishment (VRDE), DRDO, this state-of-the-art vehicle enhances operational mobility for India's Defence forces while advancing the nation's vision of Aatma Nirbhar Bharat in strategic military assets.

The vehicle was formally launched by Shantanu Roy, CMD, BEML Ltd, in the presence of G Ramamohana Rao, Director, VRDE, alongside BEML's functional directors and senior officials of both organizations.

The HMV 12x12 is engineered for extreme terrains and challenging climatic conditions, making it a vital asset for Defence operations. It is powered by a BSIII-compliant engine and features a 7-speed Allison Automatic Transmission, supporting a Gross Vehicle Weight (GVW) of 65 tons.

The vehicle has been developed through BEML's Futuristic Product Innovation and Incubation Centre (FPIIC), further reinforcing India's Defence self-reliance.

Speaking at the event, Shantanu Roy emphasized BEML's unwavering commitment to innovation, saying, "We are proud to introduce this cutting-edge, indigenous vehicle for our Defence forces. Developed at our Palakkad complex, this launch exemplifies BEML's philosophy of 'Beyond Possibilities."

G Ramamohana Rao said, "This collaboration with BEML to develop an advanced indigenous vehicle marks a significant milestone in strengthening India's Defence infrastructure. Congratulations to CMD and Team BEML for this achievement."

With the unveiling of the HMV 12x12, BEML continues to play a pivotal role in advancing India's Defence mobility solutions, leveraging its in-house expertise and world-class manufacturing capabilities to fortify national security and readiness.

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Indian Armed Forces conduct tri-services Exercise Prachand Prahar

Source: The Economic Times, Dt. 27 Mar 2025,
URL: https://economictimes.indiatimes.com/news/defence/indian-armed-forces-conduct-tri-services-exercise-prachand-prahar/articleshow/119586911.cms

Three defence forces carried out a tri-service integrated multi-domain exercise codenamed Prachand Prahar in the high-altitude terrain of the Himalayas along the Northern Borders in Arunachal Pradesh.

The three-day exercise from March 25-27, commenced with deployment of advanced surveillance resources of all three services including long-range surveillance aircraft of the IAF and the maritime domain awareness aircraft of the Indian Navy, helicopters and Unmanned Aerial Vehicles (UAVs) along with space resources and Indian Army's elite Special Forces to create seamless domain awareness and detect simulated targets.

Once identified, these targets were swiftly destroyed through the synchronised joint firepower of Fighter aircrafts, long-range rocket systems, medium artillery, armed helicopters, swarm drones, loitering munitions and kamikaze drones in an electronically contested environment.

Eastern Army Commander Lieutenant General Ram Chander Tiwari,Eastern Air Commander Air Marshal Surat Singh, and Navy's Commodore Ajay Yadav, reviewed the exercise and congratulated the participants on their high professional standards.

This exercise is in continuation with Exercise Poorvi Prahar held in November 2024, which had focused on the integrated application of aviation assets.

In a post on X, the Eastern Army Command said, "Indian Army's Eastern Command along with the Indian Air Force and Indian Navy showcase their integrated multi-spectrum operational capability in the arduous mountainous terrain along the Northern Borders --Long Range Vectors, Precision Artillery, Swarm Drones, Loiter Munitions and Attack Helicopters struck multiple targets with lethal precision in a contested Electronic environment. "

Ex Prachand Prahaar validated integrated planning, command and control as well as seamless execution of surveillance and firepower platforms across the three services, covering the entire spectrum of conflict.

Ex Prachand Prahaar underscored the Armed Forces' unwavering commitment to jointness, precision and technological superiority. It reinforced the ability to execute multi-domain operations with unparalleled synergy, ensuring India's preparedness to deter and decisively engage any emerging threat along its strategic frontiers.

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China's PLA says willing to work with Indian counterpart for fair solution to boundary issue, stable military ties

Source: The Economic Times, Dt. 27 Mar 2025,
URL: https://economictimes.indiatimes.com/news/defence/chinas-pla-says-willing-to-work-with-indian-counterpart-for-fair-solution-to-boundary-issue-stable-military-ties/articleshow/119599843.cms

The Chinese military on Thursday said it is willing to work with its Indian counterpart to implement a fair and just solution to the border issue besides sound and stable defence ties. A spokesman for China's National Defence, Sr. Col Wu Qian, made the remarks at a media briefing here while replying to a question about the disengagement and the follow-up process at the eastern Ladakh part of the Line of Actual Control (LAC).

"The Chinese military is willing to work together with our Indian counterparts to implement a fair and just solution on the border issue," Wu told reporters.

Wu said the Chinese military would also like to "contribute our wisdom and strength to the beautiful vision of a shared dance between the dragon and elephant and a sound and stable military-to-military relationship."

The dragon elephant dance has become a constant theme of China of late as the two countries ended the over four-year freeze of relations after reaching agreement over the disengagement process in eastern Ladakh in October last.

This was followed by a meeting between Prime Minister Narendra Modi and President Xi Jinping on the sidelines of the BRICS summit in Russia last year and a number of high-level meetings to normalise relations.

Chinese Foreign Minister Wang Yi, in his annual press conference on March 7, said "cooperative pas de deux", a ballet between the dragon and the elephant is the "only right choice for both sides".

On March 17, the Chinese foreign ministry reiterated the same while welcoming Modi's remarks on the Sino-Indian ties favouring dialogue over discord.

"China appreciated Prime Minister Narendra Modi's recent positive statements on China-India relations," Foreign Ministry spokesperson Mao Ning told a media briefing while responding to a question about Modi's remarks in conversation with American podcaster Lex Fridman.

On Tuesday, India and China held a fresh edition of diplomatic talks in Beijing focusing on ensuring effective border management and early resumption of cross-border cooperation and exchanges, including on trans-border rivers and Kailash-Mansarovar Yatra.

In the meeting of WMCC (Working Mechanism for Consultation & Coordination) on China-India Border Affairs, the two sides explored various measures and proposals to give effect to the decisions taken during talks between NSA Ajit Doval and Chinese Foreign Minister Wang Yi at the Special Representatives (SR) dialogue in December.

On Wednesday, Gourangalal Das, Joint Secretary (East Asia) in the Ministry of External Affairs, who led the Indian delegation at the WMCC meeting met Liu Jinsong, the director general at the Chinese foreign ministry's Department of Asian Affairs, during which they explored ways to rebuild ties and agreed to initiate efforts to promote people-to-people exchanges, including arrangements for resumption of direct flights and resume Kailash Manasarovar Yatra this year.

In the meeting, the two sides also discussed the resumption of dialogue mechanisms in a "step-by-step" manner to utilise them to address each other's priority areas of interest and concern and move the relations to a "more stable and predictable path", the Ministry of External Affairs (MEA) said in a press release.

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HAL revises Tejas Mk1 contract to ₹6,542 crore amid delay and production hurdles

Source: The Economic Times, Dt. 27 Mar 2025,
URL: https://economictimes.indiatimes.com/news/defence/hal-revises-tejas-mk1-contract-to-6542-crore-amid-delay-and-production-hurdles/articleshow/119598493.cms

Hindustan Aeronautics Limited (HAL) has officially amended its contract with the Indian Air Force (IAF) for the delivery of Light Combat Aircraft (LCA) Tejas Mk1 Final Operational Clearance (FOC) fighter jets. The original contract, signed on 23rd December 2010, was valued at Rs 5,989.39 crore. Due to revisions in the delivery schedule, the contract's value has now been updated to Rs 6,542.20 crore.

In a regulatory filing on Thursday, HAL confirmed, "We wish to inform that the company has signed today an amendment to the LCA Mk1 FOC Contract dated 23rd December, 2010. The value of the contract has been revised from Rs 5,989.39 crore to Rs 6,542.20 crore, on account of revision in the delivery schedule."

This adjustment comes amid growing expectations for the Tejas jets to become the backbone of the IAF's fleet in the coming years.

Tejas Mk1A: India's Indigenous Fighter Jet Takes Shape

The Tejas aircraft, developed domestically, is a versatile combat platform. It is primarily designed for air combat and offensive air support missions, with reconnaissance and anti-ship operations as

secondary capabilities. The Tejas Mk1A, an upgraded variant, boasts state-of-the-art technologies, including an Active Electronically Scanned Array (AESA) Radar, Beyond Visual Range (BVR) missile capability, an Electronic Warfare (EW) Suite, and Air-to-Air Refuelling (AAR).

This marks the first "Buy (Indian-Indigenously Designed, Developed, and Manufactured)" category procurement of combat aircraft. The indigenous content currently stands at 50%, with plans to increase it to 60% by the programme's completion. Out of the 344 systems fitted into the aircraft, 250 are sourced from Indian manufacturers.

GE Aerospace Delivers First Engine for Tejas Mk1A

A major boost to the programme came as American defence manufacturer GE Aerospace delivered the first of 99 F404-IN20 engines to HAL. This marks a key step in ramping up production and fulfilling India's demand for advanced fighter jets.

On Tuesday, GE Aerospace stated, "We were excited to deliver the first of 99 F404-IN20 engines to our valued customer Hindustan Aeronautics Limited (HAL) for the Tejas Light Combat Aircraft Mk1A fighter jet. It is an important milestone in our 40-year relationship with HAL and in our efforts to ensure a strong future for India's military by developing next-generation fighters while enhancing the country's defence manufacturing capabilities."

The F404-IN20 engine is specifically tailored for India's single-engine fighter programme. It features a high-thrust design, advanced turbine blades, and a modified high-flow fan to meet the IAF's operational needs. GE and HAL engineers have worked closely for years to ensure the engine aligns with Tejas' unique requirements.

Challenges and Delays in Delivery

Despite the contract updates and the delivery of the first engine, the Tejas Mk1A programme has faced delays. The Indian Defence Ministry had signed a Rs 48,000 crore deal in 2021 for 83 Tejas Mk1A jets, with deliveries originally scheduled to begin in March 2024. However, HAL has yet to deliver a single aircraft, citing project-related issues.

Restarting the F404-IN20 production line after a five-year dormancy was no small feat, particularly during the COVID-19 pandemic. GE Aerospace noted, "Restarting a jet engine production line is a challenging process. The pandemic added further complications, but with a strong focus on safety and quality, we managed to restart the line successfully."

With the supply of F404 engines now underway, HAL is expected to accelerate the production and delivery of Tejas Mk1A fighters. The IAF is keen to induct these aircraft as part of its long-term modernisation efforts.

A Look at HAL's Market Performance

HAL's financial health remains strong despite delays. On March 27, HAL shares closed 1.01% higher at Rs 4,170 per share on the National Stock Exchange (NSE), with a market capitalisation of Rs 2.78 lakh crore. Over the last five trading days, HAL's stock gained 7.5%, and over the past month, it surged by 28.6%.

In the quarter ending December 2024, HAL reported a net profit of Rs 1,432.60 crore, a 14.28% increase compared to Rs 1,253.51 crore in the same period last year. The company's revenue from operations also saw a 15% rise, reaching Rs 6,956.93 crore.

As one of India's premier defence public sector undertakings (PSUs), HAL plays a crucial role in designing and manufacturing military aircraft, helicopters, jet engines, and marine gas turbine engines. With Tejas production ramping up and new orders on the horizon, HAL's trajectory appears promising.

India's Tejas fighter jet programme is at a crucial juncture. With the contract amendment finalised, engine supplies secured, and production hurdles being addressed, the next step is timely delivery to the IAF. The upcoming months will determine whether HAL can meet its revised schedules and solidify Tejas' position as India's primary indigenous combat aircraft. The world will be watching.

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Cleared in 2017 for Mountain Strike Corps, 72 Division now being raised in Ladakh. Here's why

Source: The Print, Dt. 27 Mar 2025,
URL: https://theprint.in/defence/indian-armys-new-72-division-being-raised-in-eastern-ladakh/2567292/

The Indian Army is rejigging its formations internally and raising a new 72 Infantry Division, which will operate under the Leh-based 14 Corps, reinforcing security in Eastern Ladakh.

Originally approved in 2017 for the 17 Mountain Strike Corps (MSC), the division was initially planned to be based in Pathankot, focusing on operations in Eastern Ladakh.

However, following the 2020 standoff with China, the Indian Army made significant changes to its operational strategies, leading to the new positioning of the division.

Sources within India's defence establishment told ThePrint that the Army had initially received clearance to raise the 72 Division for the 17 MSC, which at the time only had the 59 Division.

"The 72 Division was originally meant to be under the Mountain Strike Corps but based in Pathankot for operations in Eastern Ladakh while 59 Division would have taken care of the areas under Eastern Command, one source told ThePrint."

However, in response to the growing tensions with China, operational plans were modified, including shifting focus towards strengthening forces in the northern borders. As a result, the 72nd Infantry Division has been placed under the Northern Command.

Sources said the headquarters is being raised first, which will have 25 officers, 30 Junior Commissioned Officers (JCOs) and 112 jawans. They clarified that this is not a new raising in terms of increasing manpower.

The changes began after the clash with China in the Galwan Valley in 2020, when the Army took several key steps to enhance its defense capabilities along the China border.

A significant decision during this period involved reorienting the Mathura-based 1 Strike Corps, originally designated for Pakistan-centric operations, to focus on China. This move, first reported by ThePrint in 2021, reflected the heightened security concerns in the region.

In line with these adjustments, the Uniform Force (Division level), initially stationed in Reasi in the Jammu Sector, was moved to Eastern Ladakh to take charge of the critical areas in and around the Galwan Valley.

While this redeployment strengthened India's position in Ladakh, it also led to a weakening of security in Jammu, leaving the region vulnerable to increased terrorist activity from Pakistan-based groups.

This rise in terrorism prompted the Army to redeploy forces from other regions to Jammu to counter these security threats.

This is when a decision was taken to actually shift the 72 Division from the MSC to the 14 Corps for which fresh permissions were sought and given.

These were all part of the changes made to the Order of the Battle, known as ORBAT, under which an existing Division was attached to the Mountain Strike Corps.

"The 72 Division will continue to be northern border focused but will now operate under Northern Command," the source quoted above further said, adding that the ORBAT changes include the transfer of a Division to the 17 MSC.

Once the 72 Division is fully raised and operational, the process which is on, the Uniform Force will be redeployed back to Jammu and Kashmir to bolster security there.

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Indian Army soldier churns out a 'jugaad' combat drone

Source: The Week, Dt. 27 Mar 2025,
URL: https://www.theweek.in/news/defence/2025/03/27/indian-army-soldier-churns-out-a-jugaad-combat-drone.html

The Indian military never ceases to surprise and to truly inspire. With 'Atmanirbharta' and innovation being the abiding themes of the times, such surprises are happily becoming more frequent in the Indian Army.

While on one hand, India is contracting to buy 31 MQ-9B Remotely Piloted Aircraft Systems or drones at a stupendous $3.5 billion from the United States, an infantryman from the 22 Sikh Regiment has done much more than his bit by designing a drone that can fight and fire, mount surveillance and monitor, and deliver payloads. In other words, a drone as versatile as can be!

What Hawaldar Varinder Singh has done is to make a 35 kg Octacopter drone, equip it with real-time video capability that is displayed on a remote screen and shareable with command centres, and then fit it with both automatic and remote remote-firing capability in an amazing showcasing of that wonderful Indian spirit of 'jugaad' or making do with whatever is available to churn out the optimum solution.

The weapons that have been tried, tested and fired from the 'jugaad' drone include AK-47 assault rifles, multi-grenade launchers, high explosive grenades, and even the Light Machine Gun in an under-slung fitment.

With an operational range of 8-10 km in plains and high-altitude areas, the Octacopter is proving to be a versatile platform as it can be used for transporting weapons, ammunition, medicines, or mission-critical supplies to forward and difficult locations.

In order to enhance its effectiveness, the Octacopter now comes equipped with GPS, night-enabled zooming cameras for surveillance, and autonomous flight capabilities via mission-planning software. It is also compatible with both Defence Series Maps and open-source mapping systems, further enhancing its deployment flexibility.

What Hawaldar Singh began with a little tinkering around with a humble hexacopter prototype in 2023 has become a versatile mission-ready military drone now, with its operational credibility already being proved during Operation Teesta after the Glacial Lake Outburst Flood in Sikkim in October 2023 and in war games like Bharat Shakti.

Hawaldar Singh has been awarded Vishisht Seva Medal by President Droupadi Murmu for the development of the drone. The award is presented to Indian armed forces personnel to acknowledge their "distinguished service of a high order."

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China's Rocket Force and the manifestation dilemma

Source: The Week, Dt. 27 Mar 2025,
URL: https://www.theweek.in/news/defence/2025/03/27/chinas-rocket-force-and-the-manifestation-dilemma.html

Historically, Beijing always maintained a muted stance on nuclear vectors, even though its first nuclear test was conducted way back in 1964. Mao himself was assertive about nuclear weapons, calling it "paper tiger", though immediately after the establishment of the People's Republic of

China (PRC), the country started its nuclear weapons and Intercontinental Ballistic Missile (ICBM) programme.

During a discussion with E.F. Hill an Australian communist leader and founder of the Communist Party of Australia in 1968, Mao stated “Our country, in a sense is still a non-nuclear power, with this little nuclear weaponry, we cannot be counted as a nuclear country. If we are to fight a war, we must use conventional weapons”.

Though China’s official stance remains as ‘No First Use’, the present thought process among Chinese strategists have evolved and internal debates are raging in China about the maintenance of unconditional 'No First Use policy'.

Today, Chinese strategists as per the renewed thinking, seek to maintain a portion of Chinese strategic assets in Launch on Warning posture (LOW). Under a LOW posture, the People’s Liberation Army Rocket Force (PLARF) would launch nuclear weapons in retaliation for an incoming strike that has been detected by intelligence, surveillance, and reconnaissance (ISR) systems but not yet detonated on Chinese territory.

It is important to notice the 2023 US Department of Defence’s Annual Report to Congress where a caution is alarmed on China’s NFU. “The PRC’s current approach to nuclear force includes a declaratory ‘No First Use’ (NFU) policy, stating it will never use nuclear weapons first at any time under any circumstances. This includes unconditionally not to use or threaten to use nuclear weapons against any non-nuclear weapon state or in nuclear-weapon-free zones. Despite this policy, China’s nuclear strategy probably includes consideration of a nuclear strike in response to a non-nuclear attack threatening the viability of China’s nuclear forces or C2, or that approximates the strategic effects of a nuclear strike. Beijing probably would also consider nuclear use to restore deterrence if a conventional military defeat in Taiwan gravely threatened CCP regime's survival”.

The PLARF is an important pillar of PRC’s nuclear deterrence plan, which ensures Chinese Autonomy and deters any third-party intervention in a regional conflict. PRC’s 2019 defence White Paper declares that the PLARF is working towards “enhancing its credible and reliable capabilities of nuclear deterrence and counter attack, strengthening intermediate and long-range precision strike force, and enhancing strategic counterbalance capability, so as to build a strong and modernised force”

The PLARF has grown in strength even as PLA downsised as part of the military reforms of 2015. China’s missile classification is based on the Dong Feng/DF and Hong Niao/HN series.

Dong Feng, meaning East Wind which are the Ballistic Missile Series, while the cruise missiles are of Hong Niao (Red Bird) or Chang Jian/CJ (Long Sword) series.

An informed estimate of China’s ballistic missiles stands at 2,200, including 90 ICBMs and it also holds approximately 320 nuclear warheads as of 2021. The PLARF holds more than half of it, while the rest are stockpiled or earmarked for submarine-based vectors. Even though the Chinese nuclear warhead count seems relatively low, its arsenal is being upgraded continuously. China intends to hold 700 deliverable nuclear warheads by 2027 and 1,000 warheads by 2030, indicating that China is moving beyond its Minimum Deterrent levels.

It seems, PRC is progressing as planned, as per the latest inputs from the Bulletin of Atomic Scientists, which estimates 346 nuclear warheads for land-based systems, the sea and air systems hold 72 and 20 respectively, 62 produced or under production warheads, total amounting to 500.

On the account of latest missile count, an independent study estimates that China holds at least 1950 missiles, including 300 ICBMs, hypersonic glide vehicles and anti-ship ballistic missiles.

Over the last seven decades, PLARF has been grown in strength with a primary focus on Taiwan and South China Sea, with capabilities to contest India, Japan and the US. The long-term state goal as declared by President Xi during the address to 19th National Congress intends at achieving its cherished Middle Kingdom stature in contemporary times.

Under that umbrella China intends to settle its boundary claims, however absurd it may be, in its own terms by all possible means and the PLARF plays a major role in the gambit by providing strategic deterrence.

The PLARF posturing varies with the country against which it is manifesting. In the Taiwan scenario, PLARF nuclear capable vectors act as deterrence to any Western influence, primarily the US. On the Russian front, the historical rivalry between the communist states of the past, doesn't exist anymore.

On India-China relationship, the boundary disputes and the growing stature of India in the geopolitical spectrum have resulted in China perceiving India as a regional contestant. Under this scope, a deliberate analysis of PLARF posturing, strategy and vector capabilities is a prudent way-forward for Indian strategists. Such an analysis would assist in identifying the silos which need immediate attention.

The strategic forces of China may manifest in the Indian context on a Misinterpreted LOW or an opponent operational victory marker or de-stabilisation in Tibet/ Xinjiang. Any erroneous interpretation of ISR reports on LOW posture, may result in the activation of Chinese strategic forces which is a likely scenario and Indian planners need to plan for such contingencies.

As for the conventional conflict, an operational victory marker may be perceived as a threat to the CCP regime which may result in manifestation of PLARF. Also, any destabilisation activity in TAR/XAR during an ensuing conventional conflict is a viable trigger for the employment of PLARF.

Even though the strategic equipment engagement strategy, is not oriented and aligned to the base location and operational orientation, these factors do give out certain predictable posturing and manifestation outcomes.

Any Chinese Base that houses Intermediate Range Ballistic Missile (IRBM) and ICBMs can cover the entire Indian subcontinent. However, Base 64 located at Lanzhou, Gansu province and its units have a high probability of manifesting in the Indian context.

Further analysis of the equipment profile of PLARF on the basis range and quantum, indicates towards DF 26 held with the 64 series Brigades are the most likely vectors that may have been earmarked by the PLARF for the Indian contingency.

With this as a marker, the Indian strategic planners may envision capability building and strategy review. Capability building needs focus under two silos, defence and diplomacy. The defense silo needs early operationalisation of Ballistic Missile Early Warning and Anti-Ballistic Missiles systems. Also, to guard against precision strikes by cruise missiles and aerial vectors investment into Missile Silo systems along with mobile systems seems mandatory.

Lastly, full-fledged operationalisation of the Nuclear Triad and strengthening its capabilities continuously. The diplomatic silo must address and explore new fronts to strengthen the WMCC (Working Mechanism on Consultation and Coordination on India-China Border Affairs) and use it to de-escalate a conflict from growing, with a longterm goal of resolving the border issue with China amicably as per established systems and procedures.

Any such resolution of long-pending issue in the Indian context will make the path much easier to reach our goal of Viksit Bharat by 2047, the centenary year of our independence.

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U.S. defence ties — India needs to keep its eyes open

- By Air Vice Marshal Manmohan Bahadur (retired) (former Additional Director General, Centre for Air Power Studies)

Source: The Hindu, Dt. 28 Mar 2025,
URL: https://www.thehindu.com/opinion/op-ed/us-defence-ties-india-needs-to-keep-its-eyes-open/article69382667.ece

It is no state secret that the defence public sector undertakings have the Indian armed forces as their captive customers. In fact, with the ‘Aatmanirbhar Bharat’ campaign, this dependence has only increased and has added to the stress of planners in the Indian Air Force (IAF) as they juggle with a depleting squadron strength in the IAF due to a poor production rate by Hindustan Aeronautics Limited. After the IAF chief made his angst clear at the Aero India-2025 show in Bengaluru in February, there has been a flurry of media statements about how a reinvigorated environment is now geared up to supply Tejas MK1A Light Combat Aircraft (LCA) jets. This month, the handing over event of the first rear fuselage for the Tejas, made by a private manufacturer — with the Defence Minister and the IAF chief present — has also been highlighted in the media.

Even as the report of the Ministry of Defence committee looking into the IAF’s needs (including imports) is being evaluated, there are three facts that should help keep us grounded.

SIPRI report and U.S. policyFirst, the latest Stockholm International Peace Research Institute (SIPRI) report for 2020-24 shows that India is still the second highest arms importer in the world. However, the fact that India’s imports have reduced by 9.3% from 2015-19 is good news, but with a rider — expensive weapon systems such as aircraft, tanks, top end radars, and specialised armament, would continue to be imported for many more years and contribute to the import bill.

Second, the IAF has thrown its full weight behind indigenous fighter aircraft — LCA Tejas Mk1A, Tejas Mk2 and the Advanced Medium Combat Aircraft (AMCA), all of which are planned with American engines. The IAF’s kinetic operational potential would, thus, become a function of

America's calculations of India's worth in its strategic calculus. Would India be weaned away from its heavy dependence on Russia, which contributes to 36% of its arms imports? The IAF's inventory of 270 Sukhoi Su-30 fighters, S-400 missile systems and similar big-ticket items for the Indian Army and the Indian Navy stand out against a positive affirmation.

Third, the frequent coinage of fancy-sounding new policies in India-U.S. relations in the past two decades should keep India on its toes vis-à-vis their demonstrated short shelf life. Whatever became of the 'Defence Technology and Trade Initiative' of 2012 which was much tom-tommed, and also said to bring in niche cutting-edge technology and usher in a new paradigm in defence cooperation? Are we sure that the end result of the recently announced framework for the 'U.S.-India Major Defence Partnership in the 21st Century' would be any different considering the tempestuous churn in American foreign policy with a transactional new U.S. administration under President Donald Trump?

'Partnership' is the key word

There is historical reality to back this negative appreciation. The joint statement, after U.S. Secretary of Defence Ashton Carter's visit to India in April 2016, said that [a] "defense relationship is a key component of the strategic partnership between India and the US." Similar sentiments have been expressed recently after the Trump-Modi talks.The key word is 'partnership'. But the million-dollar question is whether two nations that are culturally, financially and with differing world outlooks, be true partners. An article by Anna Simons, Professor of Defence Analysis, in the Winter 2013-14 issue of the U.S. Army War College magazine, Parameters, says that "..a partnership can succeed only if it is grounded in mutual indispensability", since "..anything less creates a dependency, and a dependency by definition is not partnership." This raises the question whether India and the U.S. are indispensable to each other. And if they are not, then can Washington and New Delhi be true partners?

The indispensability factor can be tested by seeking answers to three pointers. First, are both parties equals, interchangeable and can blend seamlessly? Second, is a division of tasks possible for joint programmes? Third, can the expertise possessed by each nation complement and fill the gaps that exist in the other's capabilities? A truthful analysis of their respective defence research and development and manufacturing sectors shows that there is great asymmetry in the capabilities, and the follow up can only result in India's stifling dependency on the U.S.

But the same questions can be asked about the other relationships of India too, say with Russia, Israel or France. The answer lies in whether India has a political indispensability quotient in such strategic relationships or whether it is like the U.S.-Pakistan 'partnership' that broke when Islamabad outlived Washington's geo-political interests and was dumped like a fly in a tea cup. Or, even the recent unravelling of the U.S.'s decades long and iron-clad trans-Atlantic partnership with Europe, leading to questions being asked about the reliability of the Trumpian friendship.

Looking ahead

This brings us back to the theme of this article. Are we heading the correct way as we look to the U.S. for our strategic armament needs? The answer, surprisingly, actually lies with Washington on whether the U.S. wants a 'true partnership', in which case it has to make India politically

indispensable to itself (the U.S.) by imbuing a special friendly slant in our relations. On India's part, New Delhi must ensure that its decisions 'insure' its interests against any U.S. policy reversal in the geopolitical environment that it is placed in. Even as India imports vitally needed aircraft and other equipment, its eyes need to be wide open to avoid a dependency that would negatively affect its strategic autonomy.

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Expert Explains: Why India needs to develop its deep sea capabilities

- By Biswajit Dasgupta (former Commander-in-Chief of the Eastern Naval Command)

Source: The Indian Express, Dt. 28 Mar 2025,
URL: https://indianexpress.com/article/explained/expert-explains-why-india-needs-to-develop-its-deep-sea-capabilities-9910215/

Last month, India completed wet testing of its Matsya-6000 submersible, capable of diving up to 6 km below the surface to look for underwater minerals off the coast. The launch of the first deep-sea manned vehicle is planned for later this year — it will put India in a select group of nations with the capability to send humans to these depths.

Last week, China unveiled a compact deep sea cable-cutting device that can be mounted on certain submersibles — and which is capable of severing the world's most fortified underwater communication or power lines. China reportedly operates the largest fleet of submersibles in the world.

Deep sea challenge

The intense oceanic activity around the world over the past two decades has focused on the Deep both for its economic resources and as the theatre of possible future conflicts. According to the United Nations Convention on the Law of the Seas (UNCLOS), the Exclusive Economic Zone (EEZ) of a country extends from the baseline of its coast to 200 nautical miles (about 370 km) into the sea. A nation has exclusive rights to living and non-living resources in the waters and on the seabed within its EEZ.

Average depth in the Indian EEZ is 3,741 metres — this is more than four-and-a-half times the height of Burj Khalifa, the world's tallest building. But it is shallow compared to the deepest ocean — the bottom of the Challenger Deep in the Mariana Trench in the western Pacific lies more than 10 km under the surface, more than the cruising altitude of most aircraft.

Operating in the deep sea requires a distinct technology and extremely specific capabilities that are challenging and expensive to develop. Consider:

* While sound can travel long distances underwater, its propagation is seriously affected by hydrological conditions such as temperature, pressure, and salinity. Generally speaking, the lower the frequency of the sound wave, the better the propagation of sound underwater. Very low frequency (VLF) and extremely low frequency (ELF) sound technologies represent the cutting edge of science, and require deep research and enormous funding to develop.

* Pressure underwater increases by approximately one atmosphere (atm) for every 10 metres of ocean depth. One atm is roughly equivalent to the mean sea-level atmospheric pressure on Earth, or 101,325 Pascals. The pressure at the ocean bed in the Indian EEZ is upwards of 380 atm, or 380 times that on the surface of the Earth.

Vessels that descend to such depths need to be constructed using particular material and processes in order for them to operate safely. (Remember the OceanGate Titan submersible disaster of June 2023?)

Need for such technology

It is, however, imperative that India overcomes the challenge posed by the deep sea. To be able to ride on the blue economy in the future, India must have the technologies to harness the resources of the ocean and the seabed.

The ocean is a storehouse of resources, from fish, minerals, gas hydrates, oil and gas, and nutraceuticals to oceanographic data that may help in combating climate change and contribute to meteorological research. It is essential to harness these resources to maximise India's economic potential. This will require the development of technologies for hydrographic research and exploration activity, as well as supporting capabilities such as diving, salvage, and submarine rescue.

Then there is the development of underwater infrastructure. Undersea cables crisscrossing the oceans are the backbone of modern communications technology. They are responsible for transmitting more than 95% of the intercontinental Internet traffic, seamlessly enabling activities from digital communication and transmission of video to banking transactions worth billions of dollars.

Developing the capability to lay and maintain these cables is critical to provide millions of Indians with digital connectivity, and to sustain an economy that increasingly relies on the same.

Apart from undersea cables, other deep sea infrastructure can include oil pipelines, equipment for mining, and scientific research.Beyond exploiting the oceans' resources, mapping of the deep sea and maintaining a high degree of underwater domain awareness is critical for safeguarding maritime and security interests. Take for instance the deep sea cable-cutter that China has announced. The development of complex underwater sensors and response mechanisms to act against any such disruption will be crucial to tackling any threats from hostile actors.

What India must do

As for every niche technology, the essential prerequisites for developing deep sea tech are financial strength, academic and research capabilities, and highly qualified and skilled human capital.

It is not surprising, therefore, that China, France, Japan, Norway, Russia, South Korea, and the US are far ahead of the rest of the world in this area. Chinese investments in deep sea science and engineering centres are paying rich dividends today.

In 2018, the Indian government launched the Deep Ocean Mission under the Ministry of Earth Sciences. The development of the Matsya-6000 submersible is a part of this mission. While this is

welcome, the fact is India currently does not have even decent deep sea fishing capability — and needs to do much more.

The establishment of institutes of excellence in deep sea research will nurture academic excellence, expertise, and skill in the area. India also needs to incentivise every aspect of deep ocean science and engineering through generous funding and a strong, empowered body to drive this multi-dimensional mission forward at a faster-than-usual pace.

It is time to upgrade the Department of Ocean Development to a full-fledged ministry, led by a cabinet-rank minister, and make all departments and agencies responsible for ocean development accountable to this minister.

Well-funded, time-bound and result-oriented projects must be executed in "mission-mode", with quick approvals, ease of doing business, and high accountability of stakeholders. A "ten year plan" will be helpful in this regard.Lastly, India must remember that all these deep sea technologies are inherently "dual use" — the very vessels and equipment developed for ocean research and exploitation could also have disruptive uses in conflict. This too needs active consideration in its deep ocean strategy.

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Vladimir Putin to visit India, boosting Russia-India's strategic ties

Source: The Times of India, Dt. 28 Mar 2025,
URL: https://timesofindia.indiatimes.com/india/putin-to-visit-india-boosting-russia-india-strategic-ties/articleshow/119616941.cms

India-Russia relations have a solid material base as economic cooperation expands steadily, and bilateral trade exceeds $60 billion, successfully overcoming the attempts of "individual ill-wishers" to prevent this, said Russian foreign minister Sergey Lavrov. With Russian President Putin expected to visit India this year for the annual summit, Lavrov said preparations are underway for his visit. PM Modi had visited Moscow last year for the same event. This will be Putin's first visit to India since the Russia-Ukraine war started.

"Relations between our countries have a long history...They have stood the test of time more than once. Today, Russia and India are developing equal cooperation based on mutual respect and consideration of each other's interests. It is difficult to overestimate contribution of our leaders to this process," said the minister, addressing a conference on Russia-India ties in virtual mode.

Lavrov expressed gratitude for the fact that India, and PM Modi particularly, took a "consistently balanced position" on Ukrainian crisis and advocated its resolution through dialogue. Addressing the same event, Lavrov's counterpart S Jaishankar said further enhancement of the Special and Privileged Strategic Partnership between India and Russia continued to be a shared foreign policy priority. He said this was going to be important in the era of multipolarity, as the two countries navigate a complex geopolitical landscape.

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Science & Technology News

Development Of Country's Quantum Computing Ecosystem

Source: Press Infprmation Bureau, Dt. 27 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2115862

The following developments have been made under National Quantum Mission(NQM) since its launch:

1. The Department of Science and Technology (DST) has established four Thematic Hubs (T-Hubs), in key technology verticals namely Quantum Computing at Indian Institute of Science, Bengaluru; Quantum Communication at Indian Institute of Technology, Madras in association with Centre for Development of Telematics, New Delhi; Quantum Sensing & Metrology at Indian Institute of Technology, Bombay and Quantum Materials & Devices at Indian Institute of Technology, Delhi.
2. Defense Research and Development Organization (DRDO), in collaboration with Tata Institute of Fundamental Research (TIFR) Mumbai has demonstrated 6-qubit quantum processor based on superconducting circuit technology.
3. Department of Space (DOS) has demonstrated free-space Quantum Key Distribution over a distance of 300m with real-time processing and live exchanges of quantum-secured text, images and video calls.

The funds allocated and utilized for quantum research and development projects in 2024 is given below:

S.No.	Ministry/Department	Fund Allocated (Rs. In Crore)	Fund Utilized (Rs. In Crore)
1.	Department of Science & Technology	31.848	19.915
2.	Ministry of Electronics and Information Technology	68.032	28.823
3.	Defense Research & Development Organization	8.570	2.57
4.	Department of Space	18.5	18.5

The four T-Hubs have been established under NQM in consortia that foster collaborative synergy among academic institutions, with a provision for the involvement of private industry to accelerate quantum technology development.These hubs bring together a total of 152 researchers from 43 institutions across India.

This information was given by Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science and Technology, Department of Atomic Energy, Department of Space, in a written reply in the Rajya Sabha today.

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National Mission On Interdisciplinary Cyber Physical Systems

Source: Press Information Bureau, Dt. 27 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2115867

The Government has launched a National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS) for boosting technology development in cyber-physical domains like AI, Robotics, IOT.

The Department of Science & Technology (DST), Government of India is implementing the NM-ICPS, which was approved by the Cabinet on December 6, 2018 with an outlay of Rs. 3,660.00 crore.

Under this mission, 25 Technology Innovation Hubs (TIHs) have been established in reputed academic institutions across India. Each TIH specializes in cutting-edge domains such as Artificial Intelligence (AI) & Machine Learning (ML), Robotics, Internet of Things (IoT), Cybersecurity, and FinTech etc.

Major activities under the mission include,

1. Technology Development,

2. Human Resource Development

3. Entrepreneurship Development

4. International Collaborations.

Significant achievements have been made under NM-ICPS, with a large number of technologies/ technology products developed in the various domains of cyber-physical systems.

Some of the major technologies and technology products developed by the TIHs established under NM-ICPS are given in Annexure I. The details of other outcomes and achievements of the Mission are as follows:

S. No.	Mission Activity	Outcome	Total Number Achieved
1	Technology Development	Technologies / Technology Products commercialized	389
		Publications, IPR and other Intellectual activities	2710
		Increase in CPS Research Base	2895
2	Human Resource Development	Fellowships	6483
		Training Programs	2716
		Skill Development Beneficiaries	208669
3	Entrepreneurship Development	Start-ups & Spin-off companies	888
4	International Collaborations	Number of Collaborations	148

The year-wise details of the budgetary provisions allocated under NM-ICPS by the Government since its inception are as follows:

S. No.	Financial Year	Total Budget Allocation (Amount in Rs. Crores)
1	2018-19	0.01
2	2019-20	123.83
3	2020-21	270.85
4	2021-22	0
5	2022-23	300
6	2023-24	435
7	2024-25	815
TOTAL		**1944.69**

About 45,000 jobs have been created through the Mission by imparting advanced skills and generating skilled manpower.

Annexure - I

Major Technologies and Technology Products developed under NM-ICPS

1. Information Technology–Operational Technology (IT-OT) Security Operations Centre (SoC), for monitoring of cyber threats on both IT and OT infrastructure of an organization.
2. Self-Sovereign Identity (SSI), for secure storage and management of Digital Credentials.
3. Blockchain-based technology, for maintaining tamper-proof records of Land Registry.
4. Transferable Development Rights (TDR) system, for maintaining secure, transparent and tamper-proof Development Rights Certificate used in land trading.
5. Crypto forensic tools for use by Law Enforcement Agencies (LEAs).
6. CharakDT Platform (Integrated Human Digital Twin System), for healthcare applications.
7. Robotic Arms and soft grippers, for automatic handling of objects in various manufacturing industries.
8. Technology products for fully automated Drone operations viz. Smart charging support, safe drone batteries, uninterrupted power supply for continuous drone operations etc.
9. TiHAN Testbed, a state-of-the-art testbed for autonomous navigation technology development, for both aerial and terrestrial autonomous vehicles.
10. Agri-IoT Farm Management System, to facilitate data-driven decision making by enabling real field monitoring for critical parameters viz. soil health, weather conditions, micro-climate conditions etc.
11. Holographic Technologies for Mining, for visualization of remote mines.
12. ORAN (Open Radio Access Network) Massive MIMO (Multiple Input Multiple Output) 32TR (Transmit-Receive) radio unit, to enhance 5G technology by utilizing large antenna arrays, thus enabling long-range connectivity for rural areas.
13. iRASTE, an application for enhancing road safety by using predictive capabilities of Artificial intelligence (AI).
14. Artificial intelligence (AI) – based Oral Cancer screening and detection App, incorporating Data collection features.
15. Autonomous Weather Station: Smart Climate Monitoring Solution, integrated with IoT enabled sensors, AI driven analytics and mobile-based alerts, to provide critical meteorological insights including temperature, humidity, rainfall, wind speed and soil moisture, thus enabling data driven decision-making.

This information was given by Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science and Technology, Department of Atomic Energy, Department of Space, in a written reply in the Rajya Sabha today.

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Parliament Question: Inspire Scheme

Source: Press Information Bureau, Dt. 27 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2115859

The Department of Science and Technology (DST) is implementing Innovation in Science Pursuit for Inspired Research (INSPIRE) scheme to attract, nurture and retain meritorious youth to study natural sciences areas at the college and university level and to pursue research careers in both basic and applied science areas including engineering, medicine, agriculture and veterinary sciences. The ultimate objective is to expand the R&D base of the country. It is implemented on pan India scale through four components. INSPIRE schemes component-wise salient features are given below:

INSPIRE Internship component of INSPIRE aims at providing exposure to the top 1% students at Class X Board level by organizing Science Camps either during summer or winter and provide opportunity to them to interact with Science icons from India and abroad, including Nobel Laureates, to experience the joys of scientific pursuit. These science camps nourish the curiosity of students in science, help them to think out-of-the box and attract students at an early age of 16-17 years to choose science subjects for further studies.

For Higher Education (SHE) component of INSPIRE aims to enhance the rate of attachment of talented youth to undertake higher education in science intensive programs by providing scholarships and mentorship support. The scheme offers 12,000 scholarships of 5 year duration @ Rs 0.80 lakh per year to undertake Bachelor and Masters level education in basic and natural Sciences area for the top 1% talented youth as per central and state education board data in the age group 17-22 years.

INSPIRE Fellowship component of INSPIRE aims to provide fellowship to M.Sc. 1st Rank holders in Basic & Applied Sciences including engineering, medicine, agriculture, veterinary at the University/ academic institute of national importance i.e. IITs, NITs, IISERs level examination as well as Inspire Scholars having secure 70% marks in aggregate at the MSc level who are eligible for admission to the Ph.D. program in any recognized university/ academic institutions in the country every year. The Fellowships are tenable for maximum 5 years (2 years as JRF @ Rs.37000/pm + HRA + Contingency grant of Rs.20000/annum and 3 years as SRF @ Rs.42000/pm + HRA + Contingency grant of Rs.20000/annum) or completion of PhD, whichever is earlier to pursue full-time Ph.D. program. Maximum 1000 INSPIRE Fellowships per year are tenable.

INSPIRE Faculty Fellowship component of INSPIRE aims to provide opportunities to post-doctoral researchers in the age group of 27-32 year (the upper age limit for SC/ST/Women candidates and persons with benchmark disabilities is 37 and 42 years respectively) for 5 years in

both basic and applied sciences area including engineering, agriculture, veterinary and medicine every year. Aspirants having Ph.D. degree with strong academic and research track record are considered on competitive basis. It grants an attractive fellowship for a duration of 5 years with a consolidated emolument of Rs. 1,25,000/- p.m. with annual increment of Rs.200 per annum and a research grant of Rs.7 lakh per annum. This scheme has motivated young researchers to pursue high-quality post-Ph.D. research within the country. Maximum 150 INSPIRE Faculty Fellowships per year are tenable.

The details of the number of students selected from the States/Union Territories during 2024-2025 till 21.03.2025 under the said scheme are given below:

S. No.	State/UT	INSPIRE-Internship	INSPIRE-SHE	INSPIRE-Fellowship	INSPIRE-Faculty Fellowship
1	Andhra Pradesh	530	5	11	0
2	Arunachal Pradesh	0	0	2	0
3	Assam	0	84	24	4
4	Bihar	0	172	6	1
5	Chandigarh	0	3	10	0
6	Chhattisgarh	150	421	13	0
7	Delhi	200	61	53	8
8	Goa	0	6	10	0
9	Gujarat	350	93	21	0
10	Haryana	0	66	7	1
11	Himachal Pradesh	450	138	7	1
12	Jammu And Kashmir	150	2	21	3
13	Jharkhand	0	23	5	3
14	Karnataka	150	60	46	16

15	Kerala	150	376	31	3
16	Madhya Pradesh	0	573	28	2
17	Maharashtra	200	198	34	8
18	Manipur	0	138	2	1
19	Meghalaya	0	49	1	0
20	Mizoram	0	13	4	0
21	Nagaland	0	9	1	0
22	Odisha	0	108	23	2
23	Puducherry	0	2	3	0
24	Punjab	550	61	30	2
25	Rajasthan	0	2879	9	0
26	Sikkim	0	0	2	0
27	Tamil Nadu	975	44	59	6
28	Telangana	450	31	36	4
29	Tripura	0	3	1	0
30	Uttar Pradesh	1200	5374	40	4
31	Uttarakhand	400	387	22	0
32	West Bengal	350	362	52	9

This information was given by Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science & Technology and Earth Sciences, in a written reply in the Rajya Sabha today.

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Leveraging Science And Technology For Nation Building

Source: Press Information Bureau, Dt. 27 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2115860

As per the latest available R&D Statistics, 2022-23, the total investments in research and development by government and private sector is as under:

(Rs. Crore)

Year	Public Investment	Private Investment	Total Investment
2016-17	63974.55	39124.71	103099.26
2017-18	71969.15	41855.88	113825.03
2018-19	82250.19	42489.95	124740.14
2019-20	87813.47	44753.54	132567.01
2020-21	80992.83	46388.13	127380.96

Source: *Data collected and compiled by NSTMIS, DST, GoI.*

Note : Public Investments in R&D = Central Government Ministries/Department + Public Sector/joint sectorindustries+ State Government + Higher Education

The government through various mechanism like constitution of Project Advisory Committee, Task Forces, Executive Council, Governing Board, etc. avails the expertise from industry, research institutions, and academics for implementation of different strategic programmes, technology missions, etc. Additionally, towards strengthening the research ecosystem in the country, government is utilizing expertise available with the industry, research institutions and public sector enterprises for promotion of technology development in the area of clean energy, water technology, nano-technology, cyber-physical system, biotechnology, industrial technologies, AI, semiconductor, advanced military technology, etc. through the research fundings of Department of Science and Technology (DST), Department of Biotechnology (DBT), Council of Scientific and Industrial Research (CSIR), Defence Research and Development Organisation (DRDO), Ministry of Electronics and Information Technology (MeitY), etc.

The government has taken several initiatives to address global tech competition and establish India as a global leader in the technology domains. Some of the key initiatives include launch of mission mode programmes, such as National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS), National Quantum Mission (NQM), India AI mission, India Semiconductor mission, etc. with the aim to boost innovation and technology development. The DRDO has established a

network of DRDO Industry Academia Centre of Excellence (DIA-CoEs) for collaborative directed research to help in developing critical and futuristic technologies for defence and security applications. The Technology Development Fund (TDF) scheme executed by DRDO aims at funding private industries for development of defence and dual use technologies that are not currently available with the Indian defence industry or have not been developed so far. Government has initiated a Research, Development and Innovation (RDI) fund with the aim to extend financial assistance to the industries, especially for innovation and technology development in the sunrise sectors. The Technology Business Incubators (TBIs) established through various programmes such as the National Initiative for Developing and Harnessing Innovations (NIDHI) programme of DST, the Biotechnology Industry Research Assistance Council (BIRAC) of DBT, etc. has been nurturing the startups in the deep-tech areas. Through these initiatives, the government is fostering and enhancing strategic research and innovation capabilities of the country to address global tech competition.

This information was given by Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science & Technology and Earth Sciences, in a written reply in the Rajya Sabha today.

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New data keeps search for rare subatomic mystery going

Source: The Hindu, Dt. 27 Mar 2025,
URL: https://www.thehindu.com/sci-tech/science/new-finding-forces-search-for-ultra-rare-decay-process-to-continue/article69281791.ece

Last month, Microsoft announced a new quantum computing chip called Majorana 1 that it expected would “realise quantum computers capable of solving meaningful, industrial-scale problems in years, not decades”. Independent scientists soon raised doubts about this claim — grandiose as it is — but also acknowledged Microsoft had taken on a great challenge to build such a chip and that its efforts in this direction couldn’t or shouldn’t be written off altogether.

Microsoft named the chip “Majorana 1” because it consists of Majorana particles, which is a particular type of subatomic particle with unusual properties. One is that a Majorana particle is its own anti-particle. The particles that make up matter, called fermions, have anti-particles with distinct identities. For example, the electron’s anti-particle is a positron, not another electron. The proton’s anti-particle is the anti-proton, not another proton. But uniquely among fermions, a Majorana particle’s anti-particle is yet another Majorana particle. If two of them meet, they will annihilate each other in a flash of energy.

One of the major open questions in contemporary physics is whether neutrinos are Majorana particles.

Neutrinos, neutrinos everywhere

Neutrinos are the second-most abundant subatomic particle in the universe, after photons, the particles of light. They were produced in copious amounts during the Big Bang event. They are produced in radioactive decay, when massive stars explode, and when cosmic rays strike the earth’s atmosphere. They are also made during nuclear fusion: the sun alone is responsible for flooding every square centimetre on the earth with 60 billion neutrinos each second. These

particles are also extraordinarily hard to catch because they interact very weakly and very rarely with matter.

Yet it is crucial physicists study them: neutrinos may just be the key to answering many of the open questions about our universe. Their tremendous numbers are a sign that they're involved in many, many subatomic processes. Thus a clear view of their properties will also afford physicists a clear view of these processes, and the as-yet unresolved questions they can answer.

We don't know many things about neutrinos. Perhaps the biggest unknown is how much a neutrino weighs. We know neutrinos come in three flavours, or varieties, and we know the differences between the squares of their masses, but not the individual masses themselves. If neutrinos are found to be Majorana particles, the process that reveals them to be can be easily used to reveal their masses as well. This process is called neutrinoless double beta decay, or 0vßß for short.

Chilling with beta decay

Every atom has some energy, which it bears in its particles and the forces acting between them. Sometimes an atom's nucleus may have too much energy, rendering it unstable and looking for opportunities to shed the excess. This notion of stability comes from the fact that for every set of protons and neutrons in the nucleus, there is a number that allows the particles to arrange themselves in a way that leaves the nucleus with the bare minimum of energy.

For example, the nucleus of the actinium-227 atom contains 89 protons and 138 neutrons, forcing the nucleus to exist in a highly unstable configuration. To shed the 'excess energy', it undergoes a process called beta decay: it emits an electron and an anti-neutrino and changes to the thorium-227 nucleus. Th-227 also isn't stable and decays further, but since the beta decay process releases energy, the nucleus is better off than it was before.

With neutrinos, scientists observe our galaxy in a whole new wayIn nature, beta decay is a common way for an unstable nucleus to decay. It can happen in one of two forms depending on whether a nucleus has too many neutrons or too many protons. In the first case, a neutron is converted to a proton and releases an electron and an anti-neutrino. In the second, a proton is converted to a neutron and releases a positron and a neutrino. A third form exists where two beta decays happen simultaneously, i.e. two neutrons are simultaneously converted to two protons, emitting two electrons and two anti-neutrinos.

The conversion ability stems from the weak interaction, which is one of the four ways in which subatomic particles can interact with each other. (The others are the strong, electromagnetic, and gravitational interactions.) The weak interaction is characterised by the appearance of particles called W or Z bosons. For example, during the Ac-227 beta decay, a neutron emits a W– boson and turns into a proton, and the W– boson decays to an electron and an anti-neutrino.

A sign in the difference

As common as beta decay is, scientists are currently on the hunt for an extremely rare variant: 0vßß. It may not even exist, but just in case it does, it would prove neutrinos are Majorana particles.

In 0vßß, a nucleus emits two electrons instead of an electron and an anti-neutrino. This can happen only when the neutrino emitted by one neutron is absorbed as an anti-neutrino by the other neutron, which in turn can only happen if neutrinos and anti-neutrinos are the same thing. Each of the emitted electrons also has more energy because it 'includes' the energy of the missing anti-neutrino. Experiments looking for evidence of 0vßß can thus use this energy difference to tell whether a nucleus has undergone beta decay or 0vßß.

This is precisely what the AMoRE experiment in South Korea has been doing, with sensitive particle detectors pointed at a crystal containing 3 kg of molybdenum-100 nuclei, cooled to fractions above absolute zero. Mo-100 nuclei are known to undergo double beta decay.

The search continues

In a paper published in Physical Review Letters on February 27, the AMoRE team reported it hadn't observed evidence of 0vßß. Because the process is already hypothesised to be rare, not observing it could just as easily mean we didn't look long enough. This is why the team reported in the paper that a population of Mo-100 nuclei would decay to half their number through 0vßß in no less than 1024 years. It could also mean 0vßß might show itself in a larger sample. In a future iteration of AMoRE, the physicists plan to look for it in 100 kg of Mo-100.

Meanwhile, they've also estimated the mass of each neutrino would have to be lower than 0.22-0.65 billionths of a proton. This is an extremely low mass ceiling, but it's not the same as saying the neutrinos have zero mass. The distinction is crucial. The current theory of all subatomic particles, called the Standard Model of particle physics, says neutrinos should be massless. The presence of even a small amount of mass thus vexes the theory and indicates it has a gap somewhere. The trouble is physicists don't yet know where. So AMoRE looks forward to its upgraded form and the search continues.

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Laser allows long-range detection of radioactive materials

Source: The Hindu, Dt. 27 Mar 2025,
URL: https://www.thehindu.com/sci-tech/science/laser-allows-long-range-detection-of-radioactive-materials/article69376541.ece

In a new breakthrough, a team of physicists from the United States 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 Appliedon March 4.

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No space programme is possible without electronics: ISRO chairman

Source: The Week, Dt. 27 Mar 2025,
URL: https://www.theweek.in/news/sci-tech/2025/03/27/no-space-programme-is-possible-without-electronics-isro-chairman.html

There is no space program possible without electronics and Nanotechnology plays a very important and significant role in in space explorations. The ISRO has taken multiple initiatives for Atmanirbharatha in Electronics and Sensors and is also exploring potential research for the application of Nanotechnology in Space including developing space suits and Nanosensors. These

observations were made by the ISRO Chairman V. Narayanan during the Nano Electronics Roadshow at IISc in Bengaluru.

He said Nanotechnology can be very well used especially in human space flight missions by developing space suits and by developing environmental control and life support systems and energy harvesting with Nanogenerators. He said that Nanotechnology can also be used in developing multi-function nanostructures including radiation protection, thermal protection and energy harvesting.

Narayanan claimed that ISRO had undertaken many initiatives for developing indigenous onboard computers and control electronics such as replacing imported processors by designing and making VIKRAM1601 and VIKRAM3201 in India.

He said most of the ISRO missions were on track and the first uncrewed mission for the Gaganyaan mission will be launched later this year. The work had already started on other missions such as Chandrayaan-4 and the establishment of the space station in 2035, he added.

According to Narayanan, India which was a late starter in the space programmes has now become self-reliant in space technology and has launched around 433 satellites of 34 countries from its soil and successfully put into orbit. He remarked that now ISRO had even donated a satellite to the SAARC countries.

He further remarked that docking and undocking which was successfully achieved was not a very easy task to have been accomplished as it had to be done at great speed and proper synchronization and coordination were required for it. Narayanan said that it would be an endeavour to work for self-reliance and towards achieving Atmanirbharatha in space technology.

India had developed the C32 cryogenic propulsion system, as cryogenic technology was denied to India by other countries, said the ISRO chief. Today, India has developed three cryogenic stages.

Narayanan also spoke about how India is successfully working towards developing a reusable next-generation launch vehicle which is also a great achievement for ISRO. The Next Generation Launch Vehicle (NGLV) is a family of three-stage partially reusable Medium to Super heavy-lift launch vehicle, currently under development by the ISRO. The family of these vehicles are designed to replace currently operational systems like PSLV and GSLV.

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India bets of nano tech to power AI and Supercomputing

Source: The Week, Dt. 27 Mar 2025,
URL: https://www.theweek.in/news/sci-tech/2025/03/27/india-bets-of-nano-tech-to-power-ai-and-supercomputing.html

There are 20 billion transistors in one smartphone, and these are smaller than the size of a human hair. This advancement is leading to supercomputing, quantum computing, and, importantly, artificial intelligence, enabling us to do more computing with less time and energy consumption, Abhishek Singh, Additional Secretary, MeitY (ministry of electronics and information technology), pointed out. He was speaking on the revolution that Nanotechnology has brought into our lives and

how the whole world of technology is shrinking at India's first Nano Electronics Roadshow at IISc (Indian Institute of Science) in Bengaluru.

He said under the AI mission through the INUP programme and other initiatives, startups, entrepreneurs, and researchers are solving real-world problems, driving India to the forefront of cutting-edge technology. “Together, with the pioneering efforts of institutions like IISc Bengaluru, IIT Bombay, IIT Delhi, and others, we are building an ecosystem that ensures India remains a leader in this revolution,” said Singh.

The critical role of MeitY’s Nano Centers and how it was fostering innovation and talent development to build a semiconductor-ready workforce of 85,000 professionals were also highlighted during the roadshow.

“India’s semiconductor demand, currently at $45-50 billion, is expected to reach $100-110 billion by 2030. Expanding domestic production will not only meet local needs but also position India as a key player in global exports,” remarked S. Krishnan, Secretary, MeitY.

A key focus of the ministry is to align various efforts to advance the India Semiconductor Mission which is one of the world’s most extensive subsidy and grant programmes. “With nearly 70-75 per cent of investments in major semiconductor facilities coming from taxpayer money, every Indian is a stakeholder in this mission. 20 per cent of work force in semiconductor design resides in India,” added Krishnan.

In order to accelerate this, MeitY is enhancing the design-linked incentive scheme beyond startups and MSMEs, attracting global talent, and co-investing with venture capitalists to scale up semiconductor design and manufacturing.

The Nano Centers established by MeitY at IISc Bengaluru and IITs (Bombay, Madras, Kharagpur, Guwahati and Kharagpur) are driving India’s edge in the deep-tech race, fostering breakthrough technologies and strategic advancements.

At the Nano Electronics Roadshow held at IISc Bengaluru, these academic hubs demonstrated their impact by bridging research with real-world applications, featuring different demos presented by students from the Nano Centers. The roadshow served as a platform for over 700 industry leaders, policymakers, and academics to explore areas of collaboration around strategies for strengthening India’s nanoelectronics ecosystem.

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Europe’s space agency retires Gaia, the cartographer of the cosmos: Its mission & significance

Source: The Indian Express, Dt. 27 Mar 2025,
URL: https://indianexpress.com/article/explained/explained-sci-tech/european-space-agency-retires-gaia-9909159/

The European Space Agency (ESA) shut down its space observatory mission, Gaia on Thursday (March 27). Launched into space over a decade ago, Gaia has been instrumental in charting the Milky Way galaxy, revealing its past and estimating its future.

Gaia was launched in December 2013 aiming to create the most precise, three-dimensional map of the galaxy. It began taking observations on July 24, 2014, finally shutting its eyes on January 15, 2025. Over the last decade, Gaia has taken 3 trillion observations of 2 billion stars and objects and helped inform at least 13,000 scientific publications.

What exactly is the Gaia mission?

Originally named Global Astrometric Interferometer for Astrophysics (GAIA), the mission was renamed Gaia. Gaia was designed for astrometry, the science of mapping the cosmos, through precise measurement of the location and movement of stars and other celestial bodies.

Gaia was positioned in the Lagrange point 2 (L2), around 1.5 million kilometres 'behind' the Earth, when viewed from the Sun. This effectively allows the spacecraft to view the larger cosmos unhindered by the planet, the Sun and the Moon.

As it twirls in space, twin telescopes, placed in different directions, direct light onto a single digital camera with nearly a billion pixels, making it the largest flown in space. The spacecraft is fitted with three instruments – an astrometer, a photometer and a spectrometer – that help interpret the location and motion of stars and other objects.

Through Gaia's eyes

Gaia has transformed the way the Milky Way galaxy is viewed. Its data allowed scientists to recreate not just a 3-D map of the galaxy, but also how it will change over time.

Scientists were able to understand the shape of our galaxy, which has a central bar and spiral arms. Viewed from its edge, the galaxy is seen as a disc with a bulge at the centre. However, Gaia shows that this disc is warped and wobbles – that is, it rocks left to right (very, very slowly). This is likely caused by collisions with a smaller satellite galaxy.

According to Professor Chris Lintott, a British astrophysicist and professor at the University of Oxford, the ripples produced by these collisions still exist and may have resulted in the formation of stars, including the Sun. "This shows how Gaia is revealing that the Milky Way's history is both more dynamic and more complex than we thought," he stated in a lecture at Gresham College on February 26.

While mapping the skies, Gaia has also uncovered a new kind of black hole – including one close to the Earth. While black holes were previously discovered by light emitted by materials falling in, those discovered by Gaia are "truly black and can only be detected by their gravitational effects," according to the ESA. It has also detected over 1,50,000 asteroids and projected their orbits, including those that may pose a threat to the Earth in the future.

Gaia's retirement plans

After the mission shuts its space eyes, scientists have been conducting tests to assess the behaviour of technologies after spending 10 years in space, and help build future missions.

On Thursday, the official X account of ESA Gaia announced that the spacecraft had been "successfully passivated", meaning it had been drained of any internal energy sources and will not

reboot again. Shortly before, Gaia used its thrusters for the final time to slowly drift into its "retirement orbit" around the Sun.

Gaia's legacy lives on

A bulk of Gaia's data is yet to be processed. Scientists at the ESA have been actively downlinking all the data collected by the spacecraft over the years, which will be released in the coming years, leading to more discoveries.

The ESA has said that a part of the remaining data will be released next year, which will cover the mission's first five-and-a-half years. Another set of data will be released at the end of this decade.

Despite its scope and magnitude, Gaia would have mapped just about 2% of the 100 billion stars in the galaxy, leaving much to be explored.

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Not So Secure: Drones Can Now Listen to Underwater Messages

Source: SciTech Daily, Dt. 27 Mar 2025,
URL: https://scitechdaily.com/not-so-secure-drones-can-now-listen-to-underwater-messages/

Researchers from Princeton and MIT have developed a method to intercept underwater communications from the air, challenging long-standing beliefs about the security of underwater transmissions. The team created a device that uses radar to eavesdrop on underwater acoustic signals, or sonar, by decoding the tiny vibrations those signals produce on the water's surface. In principle, the technique could also roughly identify the location of an underwater transmitter, the researchers said.

Researchers from Princeton and MIT developed a way to intercept underwater messages from the air using radar, overturning long held assumptions about the security of underwater transmissions. Credit: Princeton University/Office of Engineering Communications

In a paper presented at ACM MobiCom on November 20, the team described the technology and proposed strategies to defend against the new type of eavesdropping it enables. They successfully demonstrated the system on Lake Carnegie, a small man-made lake in Princeton. While applying this method in the open ocean presents far greater challenges, the researchers believe it could be achieved with substantial engineering advancements.

The researchers said their intention is not only to alert people to the vulnerability of underwater transmissions, but also to detail methods that can be used to prevent interceptions.

“I’m hoping that some of the countermeasure strategies that we propose will be picked up by people who design acoustic transmitters for underwater communication,” said Yasaman Ghasempour, assistant professor of electrical and computer engineering and the study’s principal investigator.

Transmitting messages between underwater and airborne devices was considered technically infeasible until researchers from MIT developed a system to do so in 2018. But the MIT technique relied on cooperation between the air and sea parties — sharing data rates, frequencies, and other key technical details in advance. At the time, it wasn’t clear whether this technique could be used to intercept private messages from non-cooperative underwater transmitters.

Collaborating with the MIT group, Ghasempour and her Princeton team explored the security implications of the technology and developed a way to decipher the same kinds of messages without knowing any of those technical details.

Researchers tested their eavesdropping system at Lake Carnegie in Princeton using only off-the-shelf, commercially available equipment, proving that it works in real-world environments. Credit: Princeton University/Poorva Mollahosseini

The researchers said the ability to intercept underwater communications from the air poses a wide array of security risks. They said an adversary could use the technology to intercept sensitive information transmitted by climate monitoring sensors, oil and gas rigs, and even submarines.

“This work shows that sensitive information can be leaked in ways that previously haven’t been considered,” said Poorya Mollahosseini, a graduate student at Princeton and the paper’s co-lead author with Sayed Saad Afzal, a graduate student at MIT.

How are underwater communications protected?

The security of underwater communications relies heavily on the inability of sound traveling underwater to penetrate the surface, the researchers said. Signals that carry information are transmitted underwater as sound waves. Because water and air have very different densities, the water’s surface acts as a barrier for sound. When underwater sound waves hit the surface, they mostly just bounce off.

In 2018, the MIT group realized that the impact of the sound waves on the water’s surface leaves a sort of fingerprint of tiny vibrations that correspond to the underwater signal. The team used a radar mounted on a drone to read the surface vibrations and deployed algorithms to detect the pattern, decode the signal, and extract the message.

“Underwater-to-air communications is one of the most difficult long-standing problems in our field,” said Fadel Adib, associate professor of media arts and sciences at MIT and co-author on the new paper. “It was exciting – and surprising – to see our method succeed in decoding underwater messages from the tiny vibrations they caused on the surface.”

But for the technique to work, the MIT team’s system required knowledge of certain physical parameters, such as the transmission’s frequency and modulation type, in advance.

Building on this development, the team at Princeton used a similar method to detect the surface vibrations, but developed new algorithms that capitalize on the differences between radar and sonar to uncover those physical parameters. That allowed the researchers to decode the message without cooperation from the underwater transmitter.

Using an inexpensive commercial drone and radar, the researchers tested their method in a swimming pool. The researchers deployed a speaker under the water and, as swimmers provided interference, flew a drone over the surface. The drone repeatedly sent brief radar chirps toward the water. When the radar signals bounced off the water’s surface, they revealed the pattern of vibrations from the sound waves for the system to detect and decode.

The researchers also used a boom-mounted radar for tests in a real-world environment at Carnegie Lake in Princeton. They found that the system could figure out the unknown parameters and decode messages from the speaker, even with interference from wind and waves. In fact, it could determine the modulation type, one of the most important parameters, with 97.58% accuracy.

“We wanted to show that this could be done with off-the-shelf, basic equipment,” Ghasempour said. “Imagine what someone could do with a more sophisticated radar.”

They found that the design parameters of an underwater communication link greatly impact its susceptibility to such attacks. Some types of modulation, for example, are easier to figure out than others. The paper provides recommendations on ways to design transmitters that are more resistant to eavesdropping. Ghasempour said that she hopes to follow up to provide more suggestions for ways to protect against these kinds of attacks.

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