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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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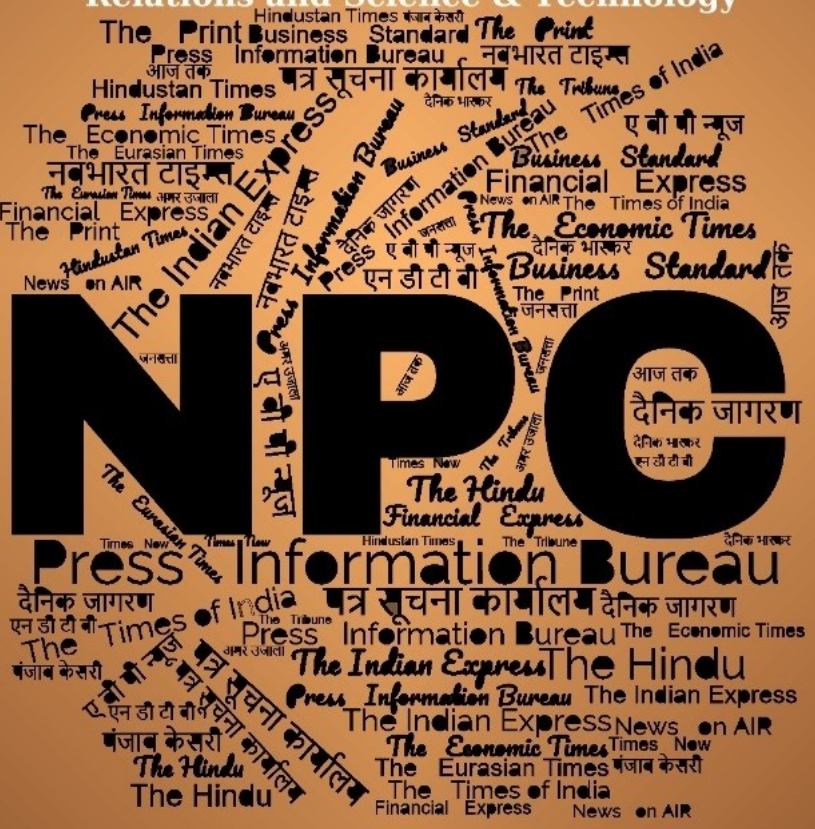

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DRDO News

Finally! ATAGS deal worth Rs 7,000 cr set to be signed next week, Army's focus shifts to TGS

Source: The Print, Dt. 20 Mar 2025,
URL: https://theprint.in/defence/finally-atags-deal-worth-rs-7000-cr-set-to-be-signed-next-week-armys-focus-shifts-to-tgs/2556134/

About eight years after it was first showcased at the Republic Day parade and 12 years after development started, the Union Defence Ministry is set to ink a nearly Rs 7,000 crore deal for 307 indigenous Advanced Towed Artillery Gun Systems (ATAGS) next week.

Sources in the defence establishment said the Prime Minister Narendra Modi-led Cabinet Committee on Security (CCS) cleared the deal Wednesday evening.

This has paved the way for the formal signing of the contract with two private Indian companies—Bharat Forge of the Kalyani Group and Tata Advanced Systems—which are the development partners for Defence Research and Development Organisation (DRDO).Sources said that 60 percent of the contract, which involves a total of 307 howitzers and 327 towing vehicles, will go to Bharat Forge, which emerged as the Lowest Bidder (L1) and 40 percent to the Tatas.ThePrint had in November last year reported that Bharat Forge had emerged as the L1 and the contract negotiations had started.

The ATAGS programme has seen a long development cycle which began in 2013, primarily due to protracted trials by the Indian Army.

The full-fledged version of the gun was unveiled in 2016 but it was only in 2020 that the winter trials were completed in Sikkim and the desert trials were completed the next year.

The gun kept undergoing longer trials and fine tuning based on the Army's requirements after each firing and mobility round.

As reported by ThePrint in 2021, one of the most significant achievements during the second phase of PSQR (weapons procurement and qualitative requirements) winter trials was moving the guns to the northern-most point of operational area (Lukrep) in the plateau areas of north Sikkim.

Movement to Lukrep meant covering 341 kilometres and the gun was tested over 10 days.

ATAGS could negotiate the otherwise inaccessible mountainous terrain with steep gradient and narrow hairpin bends with ease, without needing to unhook the gun from the tower. In similar terrain, other systems need to be unhooked and moved in self-propelled mode, thereby increasing the overall travel time.

The total distance travelled by the ATAGS in mountains and high altitude was 526 km as against 23 km mobility test done for foreign guns as part of the Army's attempts to procure a towed gun system from abroad.

The Army's contention was that ATAGS was a very heavy gun and they needed a lighter one for mountainous deployment.

The foreign guns that were competing were Nexter of France and ATHOS of Israel's Elbit Systems.

A second concern that the Army had with ATAGS besides the weight was what they said was the "inability of the gun" system to meet the critical performance parameters, especially with regard to rates of fire.

However, ATAGS programme sources had then countered the Army's assertion saying that the rate of fire includes burst firing of five rounds in one minute, intense firing of 10 rounds in two-and-a-half minutes and a sustained rate of 60 rounds in 60 minutes.

In comparison, Elbit Systems claims ATHOS can fire three rounds in 30 seconds, 12 rounds in three minutes, and 42 rounds in 60 minutes.

The third concern expressed was a September 2020 accident during internal validation trials of ATAGS in a firing range. The barrel of the gun burst while firing a round.

Sources had said the barrel burst was caused not by an engineering defect but faulty ammunition manufactured by the then Ordnance Factory Board.

Incidentally, the cost is also a factor. While the ATHOS will cost less than Rs 11 crore per piece, the ATAGS is said to be costing anywhere between Rs 16 and Rs 18 crore.

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Defence ministry clears key 'eye in the sky' project to catch up with Pakistan

Source: The Print, Dt. 20 Mar 2025,
URL: https://theprint.in/defence/defence-ministry-clears-key-eye-in-the-sky-project-to-catch-up-with-pakistan/2557708/

The Defence Ministry on Thursday approved the procurement of six additional Airborne Early Warning & Control (AEW&C), which would be an upgraded version of the current two in-service India-developed systems called the Netra.

The new system is likely to be fitted on board six Embraer aircraft like the existing two. India operates three AEW&C, of which one is operated by the Centre For Air Borne System (CABS), which comes under the Defence Research and Development Organisation (DRDO).

Known as the 'eyes in the sky', the AEW&C can detect and track all flying objects, including incoming fighters, cruise missiles and drones, faster than ground-based radars. They can also act as an aerial control room for missions while also keeping track of ships out at sea.

The Defence Acquisition Council (DAC) clearance for AEW&C is significant as the Indian Air Force (IAF) needs to induct more systems at the earliest.The air force plans to induct six more Netra systems including Netra Mk1A, besides possible replacement for the two it currently

operates. Also, there are plans to induct another six AEW&C systems being developed by the DRDO and to be mounted on Airbus A321 aircraft, which will be known as Netra Mk2.

Six of these aircraft for Mk2 have been procured from Air India and are currently with the communications squadron of the IAF. These aircraft will be fitted with India made indigenous Active Electronically Scanned Array (AESA) radar.

India also operates three Air Borne Warning and Control Systems (AWACS), which are integrated with the Russian Il-76 aircraft.

Pakistan, on the other hand, operates nine state-of-the-art Saab 2000 Erieye AEW&Cs, besides the four Chinese ZDK03 Karakoram Eagle AWACS. Given its size, Pakistan has the capability to carry out round-the-clock surveillance, a capability not present with India currently.

The criticality of the AEW&C was felt during the aerial duel between India and Pakistan on 27 February 2019. Pakistan, which then had six Saab 2000, took advantage of IAF's changeover of the 'eye in the sky', when launching the attack.

While India's Netra currently has a range of about 200 km, the Il76-based system has a range of 400 Km and has a 360 degree coverage to a slightly lesser one for the former. It is understood that the Netra Mk 1A and the Mk2 will have much higher range and capabilities.

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Paras Defence Space Technologies bags Rs 142-cr order to develop anti-drone laser system

Source: The Week, Dt. 20 Mar 2025,
URL: https://www.theweek.in/wire-updates/business/2025/03/20/dcm100-biz-paras-defence-order.html

Defence engineering company Paras Defence & Space Technologies Ltd on Thursday said it has secured a contract worth Rs 142.31 crore from DRDO arm CHESS to develop a high-powered anti-drone laser system.

Centre for High Defence Systems & Sciences (CHESS) is a part of the Defence Research and Development Organisation (DRDO). The development roadmap for the project is set to be executed in 24 months. Paras Defence is proud to be the first company in India to develop such a state-of-the-art system, the company said in a statement. "Securing this contract from DRDO underscores our commitment to advancing India's defence capabilities through homegrown innovation," said Munjal Sharad Shah, Managing Director, Paras Defence & Space Technologies. High-power laser technology represents a pivotal advancement in modern warfare, offering precise, cost-effective and rapid-response solutions to emerging aerial threats, according to Shah. The project involves development of a laser source module and integration with beam control system on mobile platform, meant for anti drone/UAV and anti-missile applications, the company said.

The total addressable market (TAM) for high-power laser defence systems is estimated to be Rs 25,000 crore, positioning the company for substantial future growth, it said.

The undertaking will stimulate job creation for highly skilled professionals in research, development, and manufacturing, it said, adding the indigenous system opens avenues for exports as countries seek advanced solutions to counter the escalating threat posed by rogue drones.

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Defence News

Defence Strategic: National/International

DAC clears capital acquisition proposals worth over Rs 54,000 crore to enhance defence capabilities

Procurement of 1350 HP engines for T-90 tanks, Varunastra Torpedoes & Airborne Early Warning & Control Aircraft systems gets the nod

Guidelines approved to reduce timelines in capital acquisition process

Source: Press Information Bureau, Dt. 20 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2113268

Under the chairmanship of Raksha Mantri Shri Rajnath Singh, the Defence Acquisition Council (DAC), on March 20, 2025, accorded Acceptance of Necessity (AoNs) to eight capital acquisition proposals amounting to over Rs 54,000 crore. For the Indian Army, AoN for procurement of 1350 HP Engine was accorded to upgrade the present 1000 HP Engine for the T-90 Tanks. This will enhance the battlefield mobility of these tanks especially in high-altitude area by increasing the power to weight ratio.

For the Indian Navy, AoN for procurement of Varunastra Torpedoes (Combat) was accorded by DAC. Varunastra Torpedo is an indigenously-developed ship-launched anti-submarine torpedo developed by Naval Science & Technological Laboratory. Induction of additional quantities of this torpedo would enhance the Navy's capability against adversaries' submarine threats.

For the Indian Air Force, AoN for procurement of Airborne Early Warning & Control (AEW&C) Aircraft Systems was accorded by DAC. AEW&C systems are capability enhancers which can change the complete spectrum of warfare and exponentially increase the combat potential of every other weapon system.

As a part of celebrating 2025 as ‘Year of Reforms’ in the Ministry of Defence, DAC also approved the guidelines for reducing the timelines at various stages of the Capital Acquisition Process to make it faster, more effective and efficient.

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New age of terror: India pushes for high-tech countermeasures to tackle AI, cyber and drone threats

Source: The Week , Dt. 20 Mar 2025,
URL: https://www.theweek.in/news/defence/2025/03/20/new-age-of-terror-india-pushes-for-high-tech-countermeasures-to-tackle-ai-cyber-and-drone-threats.html

The use of advanced technology, cyber tools and unmanned systems by terrorist groups necessitate a cohesive, forward-looking and action-oriented approach, observed Defence Secretary Rajesh Kumar Singh during the keynote address at the 14th meeting of ASEAN Defence Ministers' Meeting (ADMM) - Plus Experts Working Group (EWG) on Counter-Terrorism in New Delhi.

He pointed out that given the geopolitical and economic significance of the Indo-Pacific region, it is particularly vulnerable to transitional terrorism and violent extremism. He called for a comprehensive, adaptive, and deeply collaborative response to emerging threats in the region. "India remains steadfast in its zero tolerance policy towards terrorism and believes in an approach that combines robust domestic mechanisms, enhanced intelligence-sharing, and strong regional cooperation," Singh said.

India looks forward to building synergy among the defence forces, security agencies, and policy frameworks to address emerging threats effectively through the ADMM-Plus platform, he added.

Observing that in the complex, hyper-connected and fast-paced world, social and ecological systems are fragile, he said, "Terrorism can destabilise governments, undermine civil society, and threaten social and economic development. We have a collective obligation to provide the decision-makers guidance to understand uncertainty and better weigh the impact on decision making."

Singh stated that in the present cycle of EWG on Counter-Terrorism, the focus will be on strengthening regional cooperation and improving interoperability among the armed forces through structured joint initiatives. He said the aim would be to counter the misuse of emerging technologies and address threats posed by terrorists through the use of AI-driven propaganda, encrypted communications, and drone technologies. Strengthening cyber resilience against online radicalisation and recruitment efforts will also be a focus area, Singh added.

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VISIT OF NEW ZEALAND PRIME MINISTER CHRISTOPHER LUXON AND ROYAL NEW ZEALAND NAVY SHIP HMNZS TE KAHA TO MUMBAI

Source: Press Information Bureau, Dt. 20 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2113261

The Hon'ble Prime Minister of New Zealand, Mr Christopher Luxon, along with RAdm Garin Golding, Chief of Navy, Royal New Zealand Navy (CN-RNZN), visited the latest **indigenously built destroyer** of the Indian Navy, **INS Surat**, at Naval Dockyard, Mumbai, on **20 Mar 25**. The Hon'ble Prime Minister was cordially welcomed aboard by VAdm Sanjay J Singh, Flag Officer Commanding-in-Chief (FOC-in-C), Western Naval Command. The dignitaries were given an **in-depth briefing on the warship's intricate design, cutting-edge technologies, and formidable capabilities**, offering a glimpse into its critical role in bolstering national maritime security. INS Surat, commissioned on 15 Jan 25, is the latest indigenous guided missile destroyer of the Indian Navy. Built by Mazagon Dock Shipbuilders, Mumbai and designed by the Indian Navy's Warship Design Bureau, the ship is a shining example of ***Aatmanirbhar Bharat*** and boasts of an indigenous content of over 75%.

The Prime Minister's visit coincides with the Royal New Zealand Navy Ship *HMNZS Te Kaha's* visit to Mumbai from **20 to 24 Mar 25**. In addition, Cmde Rodger Ward, Commander of Combined Task Force (CTF) 150, is also visiting HQWNC. These visits mark a significant step towards furthering the relationship between the RNZN and the Indian Navy (*IN*).

As a part of the ship visit, the CN-RNZN called on VAdm Sanjay J Singh, FOC-in-C, WNC, and discussed strategic naval engagements, which was followed by a briefing on the command's role. He thereafter visited the Heritage Hall at ND, Mumbai and held discussions with the Admiral Superintendent of Dockyard regarding technical support for ***HMNZS Te Kaha's*** **upcoming visit in April 2025**. The Admiral also laid a wreath at the *Gaurav Stambh* at ND Mumbai and paid homage to personnel who made supreme sacrifices in the service of the nation.

As part of the Ship's visit, several activities aimed at enhancing cooperation and strengthening bilateral ties have been planned, including Cross-Deck visits, sports fixtures, and social events. On departure, the ship is scheduled to undertake a Maritime Partnership Exercise (MPX) with the Indian Navy, enhancing operational coordination and showcasing a shared commitment to maritime collaboration.

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AFMS and NIMHANS, Bengaluru Ink MoU for Collaborative Research & Training

Source: Press Information Bureau, Dt. 20 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2113261

In a significant step towards improving the mental well-being of the nation's defense personnel, the Armed Forces Medical Services and the National Institute of Mental Health and Neurosciences (NIMHANS) have signed a Memorandum of Understanding (MoU), for collaborative research and training aimed at enhancing mental health support and care for the Armed Forces.

The MoU was signed by Surgeon Vice Admiral Arti Sarin, AVSM, VSM, Director General Armed Forces Medical Services and Dr Pratima Murthy, Director of NIMHANS in a ceremony attended by senior officials from both institutions. The collaboration between AFMS and NIMHANS will focus on strengthening mental health services, conducting specialized training for medical

personnel, and developing innovative programs to address the mental health issues faced by Soldiers, Sailors, Airmen, their families and dependants.

The key objectives of the MoU include **collaborative research, faculty exchange and academic activities.** NIMHANS, with its expertise in Neuropsychiatry, will provide help in conducting research on advanced Psychiatric care and support to military personnel, addressing common issues such as Post Traumatic Stress Disorders (PTSD), Anxiety, and Depression.

Surg VAdm Arti Sarin, in a statement said that the mental health of our soldiers is as important as their physical health. This partnership with NIMHANS will ensure that our personnel receive the best possible support to cope with the challenges they face while serving our country.

Dr Pratima Murthy, Director of NIMHANS, stated that it is an honor to collaborate with the Armed Forces Medical Services to bring the Institute's expertise in mental health care to the defence sector. The aim will be to provide world-class support to those who serve our nation, ensuring they receive the mental health care they deserve.

This collaborative venture is a critical step in recognizing the importance of mental health for Armed Forces personnel and is expected to set a benchmark for similar initiatives across the country. Both organizations are committed to providing comprehensive mental health services that contribute to the overall welfare of the Armed Forces.

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Science & Technology News

PARLIAMENT QUESTION: AMRIT GYAAN KOSH PORTAL

Source: Press Information Bureau, Dt. 20 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2113320

Amrit Gyaan Kosh is a knowledge repository of governance good practices in the form of case studies. It focuses on India-centric ideas and scalable governance models, offering content accessible to government officials in Centre, State, ULBs, and Panchayats.

Amrit Gyaan Kosh Portal contributes towards improving Public Service Delivery across various government departments in the following manner:

i. Serving as valuable examples of real-life, solution-oriented approaches to governance challenges enabling officials to address similar issues more effectively.
ii. Providing actionable insights to tackle governance challenges, foster continuous innovation, and promote practical knowledge-sharing.
iii. Inspiring public servants, offering them successful governance models to emulate and adopt innovative strategies to improve public service delivery.
iv. Incentivizing high performance among government officials by recognizing their contributions on platforms like the iGOT Portal, motivating public servants to strive for excellence in their roles.

The Amrit Gyaan Kosh Portal is integrated with the iGOT (Integrated Government Online Training) platform, which is a key digital learning tool under the Mission Karmayogi initiative offering online training and capacity-building content for government officials.

All government training institutions are being encouraged to integrate Amrit Gyaan Kosh case studies into their training programs, strengthening the problem-solving and decision-making capabilities of government officials.

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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Dr. Jitendra Singh, Bill Gates Discuss Biotech Collaboration, Private Sector Role in India's Innovation Push

Both Discuss Biotech Startups, Global Health Innovation in India

Source: Press Information Bureau, Dt. 20 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2113225

In a significant step towards strengthening technology driven collaboration, Microsoft co-founder and philanthropist Bill Gates, currently on India visit, called on Union Minister Dr. Jitendra Singh and held detailed discussions to expand private sector and StartUp participation in India's innovation push and biomanufacturing surge.

The meeting, assisted by delegations from both sides, covered advancement in gene therapy, vaccine innovation, biotechnology manufacturing, and India's evolving startup ecosystem.

Dr. Jitendra Singh emphasized that under Prime Minister Narendra Modi, India has witnessed a surge in biotech innovations, supported by policies like Bio E3—biotechnology for economy, employment, and environment. He highlighted the growing role of private players and startups in driving India's bio-revolution, with structured mechanisms like the Biotechnology Industry Research Assistance Council (BIRAC) fostering collaborations.

Bill Gates praised India's biotech advancements, acknowledging its leadership in vaccine development, including partnerships that led to the HPV and COVID-19 vaccines. He also expressed interest in supporting India's efforts in tackling diseases like tuberculosis and malaria, stating that India's research ecosystem presents immense opportunities for global health breakthroughs.

A key topic of discussion was India's biotechnology startup boom, with over 10,000 startups now operating in the sector. Dr. Jitendra Singh pointed out that 70% of these are focused on medical and health biotech, with the rest contributing to agriculture, environment, and industrial biotechnology. He underlined the government's commitment to scaling up these innovations, with increased funding and policy measures aimed at enabling faster commercialization.

Gates and Dr. Jitendra Singh also explored opportunities for direct investments in Indian biotech startups through Gift City, a financial hub designed to facilitate global investments. Gates noted that while the Bill & Melinda Gates Foundation primarily operates in the philanthropic space, leveraging new financial structures could enable direct investments into promising Indian startups.

As India accelerates its biotechnology growth, Dr. Jitendra Singh reaffirmed the government's focus on fostering public-private partnerships to ensure that the sector continues to thrive. With increased R&D funding and international collaborations, India is poised to become a global hub for biotechnology innovation.

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PARLIAMENT QUESTION: SUPPORT MECHANISMS FOR WOMEN SCIENTISTS FACING CAREER BREAKS

Source: Press Information Bureau, Dt. 20 Mar 2025,
URL: https://pib.gov.in/PressReleasePage.aspx?PRID=2113278

The Department of Science and Technology (DST) is implementing a comprehensive initiative, Women in Science and Engineering-KIRAN (WISE-KIRAN*)* to address the problems of Women Scientists due to "break-in-career" and strengthen women's participation in STEM (Science, Technology, Engineering, and Mathematics) fields. This initiative includes multiple programs that provide opportunities for women in STEM at different career stages. Department implemented the

Women Scientist Scheme (WOS), which included three programs: WOS-A for research in basic and applied sciences, WOS-B for lab-to-land translational research for societal benefit and WOS-C for training in Intellectual Property Rights (IPR). Following a third-party review, these programs have been restructured into four new initiatives under WISE-KIRAN. The WISE Fellowship for Ph.D. (WISE-PhD) program supports women pursuing doctoral research in basic and applied sciences. The WISE Post-Doctoral Fellowship (WISE-PDF) and WISE-Societal Challenges with Opportunities (WISE-SCOPE) programs provide opportunities for women to conduct lab based basic/applied or translational lab-to-land research respectively in STEM. WISE-PDF focuses on laboratory-based research in basic and applied sciences, while WISE-SCOPE supports translational research with lab-to-land aspect that addresses societal challenges. The WISE Internship in Intellectual Property Rights(WISE-IPR) program provides training in the field of Intellectual Property Rights, with the goal of enabling self-employment opportunities in this sector. DST is also implementing the WIDUSHI program, which supports senior women scientists in two categories: retired women scientists and women scientists who are not in regular employment. This program allows them to continue contributing to the scientific advancements.

The eligibility criteria and financial assistance provided under programs of WISE-KIRAN Scheme is given below:

Sl. No.	**Name of Program**	**Eligibility Criteria**	**Financial Assistance**	**Duration**
1	WOS-A	Post-Graduation in Basic or Applied Sciences/ PhD degree in STEM area. Age: 27-57 years.	Up to 38 Lakh fund for project (including fellowship @ Rs. 67000 per month and HRA as per norms)	3 Years
2	WOS-B	Post-Graduation in Basic or Applied Sciences or PhD degree in STEM area. Age: 27-57 years.	Up to 38 Lakh fund for project (including fellowship @Rs. 67000 per month and HRA as per norms)	3 Years
3	WISE-PhD	Post-Graduate Degree in Basic/ Applied Science or equivalent degree like M. Phil., M. Tech., M. Pharm., etc. or B.Tech. Age: 27-45 years	Up to Rs. 35.69 Lakh fund for project (including (@ Rs. 37000 per month fellowship and HRA as per norms)	5 Years

Sl. No.	Name of Program	Eligibility Criteria	Financial Assistance	Duration
4	WISE-PDF (Lab based research)	PhD or Equivalent Degree in STEM area. Age: 27-60 years.	Up to Rs. 42.6 Lakh for project. (including Fellowship @67000 per month and HRA)	3 Years
5	WISE-SCOPE (Lab-to-Land Research work)	PhD or Equivalent Degree in STEM area. Age: 27-60 year	Up to Rs. 44 Lakh for project. (including Fellowship @67000 per month and HRA)	3 Years
6	WIDUSHI	Two categories 1. Category A: For retired Women Scientists, Age: 57-62 years 2. Category B: For Women Scientists not in regular employment. Age: 45-62 years. All applicants must have Ph.D. in Basic/ Applied Science or equivalent degree like MD, MS, MDS.	Category A: Up to Rs. 90 Lakh (including Rs. 75000/- fellowship per month) Category B: Up to Rs. 95 Lakh (including @Rs.85,000/- fellowship per month)	5 Years

The Department of Biotechnology, Ministry of Science & Technology, Govt. of India had initiated a special scheme "Biotechnology Career Advancement and Re-orientation (BioCARe)" in the year 2011 with the aim to enhance participation of women scientists in India towards research in Biotechnology and allied areas. It provides a unique opportunity to the unemployed women researchers/ scientists or those not working on regular positions up to age of 55 years and having a qualification of Ph.D.in any discipline of Life Sciences or allied areas/interdisciplinary sciences/ MD/ MDS/ M.V.Sc. (Category-I) or M.Tech. in Biotechnology or in allied areas/M. Pharma degree holders (Category-II). Women researchers/ scientists supported under BioCARe Scheme are being supported with a Research Grant up to Rs. 40.00-Rs.60.00 lakh for a period of 3 years to carry out their research endeavour's in Indian universities, research institutions and laboratories which also includes consolidated monthly fellowship of Rs. 75,000/- (for Category-I) and Rs. 85,000/- (for Category-II).

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Need to scale up commercial applications of space tech to drive economic growth: Former ISRO chairperson S Somnath

Source: Deccan Herald, Dt. 20 Mar 2025,
URL: https://www.deccanherald.com/india/need-to-scale-up-commercial-applications-of-space-tech-to-drive-economic-growth-former-isro-chairperson-s-somnath-3454716

India's space sector is on the cusp of a significant transformation but there is a need to scale up commercial applications of space technology to drive economic growth, former ISRO chairperson S Somnath said on Thursday.

Speaking at a conference organised by the Confederation of Indian Industry (CII), the former Chairman of the Indian Space Research Organisation (ISRO) highlighted the shift required to unlock the full potential of space technology. Somnath highlighted the shift required to unlock the full potential of space technology. Somnath highlighted that while India has made remarkable strides in space technology, its application has largely been confined to government programs.

"The application of space technology has been focused on societal and governmental programs. Now, bringing it into the commercial domain and monetising it is key," he said. He pointed out that the penetration of space applications in India remains limited, with only about 10 per cent of the potential market being explored. "India is a huge country with 145 crore people, but the application penetration is very small. We are serving only a limited domain," Somnath said.

He stressed the need to convert space technology into viable business opportunities, citing examples such as fisheries, where satellite data could revolutionise traditional practices. "We have been able to predict the presence of fish schools using ocean satellites, but this information is mostly disseminated through government channels. Has it made an economic impact? Not really. We need to create a business case where fishermen can buy this data to improve their catch," he said. Somnath also emphasised the untapped potential of satellite data in sectors like logistics, traffic management, and railway monitoring. "Why not use space technology to monitor railway tracks instead of relying on physical inspections? satellite data can optimise logistics and reduce costs," he said.

He called for the creation of case studies to demonstrate how space technology can be monetised, particularly in areas like the blue economy, agriculture, and disaster management. Chairman IN-SPACe Dr. Pawan Goenka echoed these sentiments, emphasising the need to bridge the gap between space technology providers and end-users.

"The space economy is already worth 440 billion globally and is expected to reach 1 trillion by 2040. India's share, however, is just 8 billion.We aim to grow this to 44 billion by 2033, but this cannot happen without scaling up demand," he said.

Goenka highlighted the government's efforts to boost the space sector, including incentives worth Rs 4,000 crore and projects worth Rs 25,000 crore for space-based surveillance by the Ministry of Defence.

"The government has created a robust pipeline for upstream activities, but the real value lies in

downstream applications. We need to create demand for space technology across industries," he said. He also announced the approval of a Rs 1,000 crore venture capital fund to support space startups.

"We are focusing on creating new business models using space data. For instance, logistics companies can reduce fuel costs by 20 per cent using satellite-driven route optimisers. The possibilities are endless," Goenka said.

Both -- Somnath and Goenka -- called for greater collaboration between the government, private sector, and startups to unlock the full potential of space technology. Somnath suggested that entrepreneurs focus on edge computing, AI, and analytics to process satellite data faster and create actionable insights. "We need to support entrepreneurs who can build tools for remote sensing data analytics. This will be crucial for scaling up applications," he said.

Goenka emphasised IN-SPACe's role as a facilitator, connecting businesses with space technology providers. "If you come to us with a problem, we will work with ISRO and private players to create pilot solutions. This is just the beginning of a transformative journey for India's space economy," he said.

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Hofstadter's Butterfly Lands at Last – A 50-Year Quantum Mystery Solved

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Scientists at Princeton University have made a groundbreaking discovery in quantum materials, revealing that electron energy levels in certain systems follow a fractal pattern known as Hofstadter's butterfly.

This phenomenon was first theorized in 1976 but had never been directly observed in a real material until now. The discovery was an unexpected outcome of an experiment on superconductivity in moiré-patterned graphene, where an accidental misalignment created the perfect conditions for visualizing the elusive fractal energy spectrum.

Fractal Patterns in Quantum Materials

A team of scientists at Princeton University has successfully measured the energy levels of electrons in a new type of quantum material and discovered that they follow a fractal pattern, a repeating structure that looks the same at different scales. Fractals are commonly found in nature, in things like snowflakes, ferns, and coastlines. In the quantum world, a similar pattern called Hofstadter's butterfly was theorized back in 1976. Now, for the first time, researchers have directly observed this pattern in a real material.

Breakthrough in Materials Engineering

This breakthrough was made possible by advances in materials engineering. The researchers stacked and twisted two layers of graphene, sheets of carbon atoms arranged in a hexagonal

pattern, creating a repeating interference pattern known as a moiré design, similar to the layered texture of some French fabrics.

“These moiré crystals provided an ideal setting to observe Hofstadter’s spectrum when subjecting electrons moving in them to a magnetic field. These materials have been extensively studied, but up to now the self-similarity of the energy spectrum of these electrons had remained out of reach,” said Ali Yazdani, James S. McDonnell Distinguished University Professor at Princeton, whose team has applied their powerful quantum microscopy technique to study the problem.

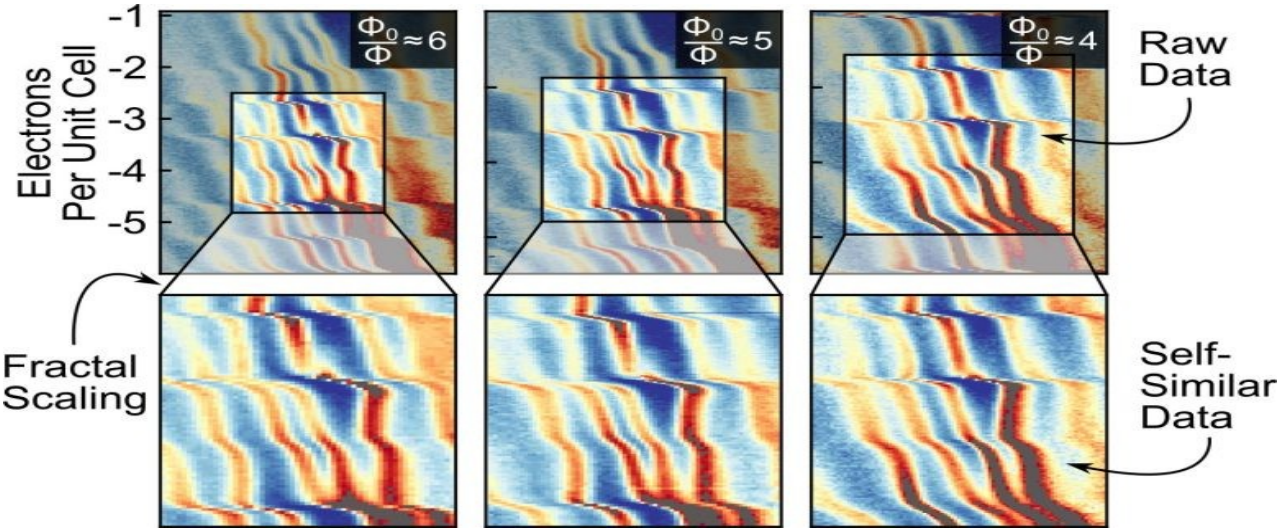
Hofstadter’s Butterfly: A Quantum Fractal

Hofstadter’s butterfly represents the principal finding of a seminal 1976 paper by Douglas Hofstadter. In this work, he predicted that the energy levels of electrons confined within two-dimensional crystals under the influence of a strong magnetic field would display a characteristic fractal energy spectrum. The “butterfly” moniker is used because the emerging pattern, when plotted against energy and magnetic field, evinces an elegant and intricate configuration that resembles a butterfly’s wings.

Importantly, this butterfly pattern is a fractal, meaning it is a self-repeating pattern that is produced over different scales, again and again. While there are many examples of fractals in nature—such as coastlines and snowflakes—few are found in the quantum realm.

“Hofstadter’s butterfly is also a rare example of a problem that is solved exactly in quantum mechanics, without any approximations,” said Kevin Nuckolls, the co-lead author of the paper that details the team’s findings that appear in a recent issue of *Nature*.

“Since Hofstadter’s original work, there have been many experiments and wonderful papers on the subject but, before our work, no one had ever actually visualized this beautiful energy spectrum,” added Nuckolls.



Theoretical calculation of the allowed energy levels of electrons in twisted bilayer graphene in a magnetic field. These allowed energy levels (black dots) form a rare example of a quantum fractal known as “Hofstadter’s butterfly”, which shows self-repeating features on different scales. This plot shows how the energies (vertical axis) of electrons change as a function of magnetic field (horizontal axis), and cluster into separated Hofstadter electronic bands (multi-colored shaded regions), which were visualized directly for the first time. Credit: Yazdani group

A Stunning Discovery by Accident

Actually, the researchers did not originally set out to visualize this elaborate phenomenon.

“Our discovery was basically an accident,” Nuckolls conceded. “We didn’t set out to find this.”

Instead, the researchers were conducting an experiment to investigate superconductivity in twisted bilayer graphene, said Dillon Wong, a postdoctoral research associate and co-lead author of the paper. In 2018, a team at Massachusetts Institute of Technology (MIT) discovered that electrons confined to these moiré crystals superconduct— a state in which electrons flow freely without any resistance. Since that time, Yazdani’s group and many others around the world have been trying to understand the nature of superconductivity in these materials.

“We were aiming to study superconductivity,” Wong continued, “but we undershot the magic angle when we were making these samples.”

This mistake created a moiré pattern with a periodicity that was longer than the experimentalists intended to create, but the results turned out to be just what was needed to observe the Hofstadter spectrum.

“The spectrum has a particular magnetic field dependence that can only be verified under conditions that can be achieved in the laboratory when electrons move in a perfect periodic potential with a long periodicity, which was achieved in these accidently made samples,” said Yazdani.

Scanning Tunneling Microscopy: A Closer Look

The team used a scanning tunneling microscope to image moiré crystals at atomic resolution and examine their electron energy levels. The microscope works by bringing a sharp metallic tip less than a nanometer from the surface to allow quantum “tunneling” of electrons from the tip to the sample. When using the STM to study their sample, the resulting electron behavior indicated a pattern that the researchers recognized, not initially as Hofstadter’s butterfly, but as unique. Soon however, as they analyzed the pattern in greater detail, they realized that they were gazing at the pattern Hofstadter had hypothesized nearly fifty years ago.

“Sometimes nature is kind to you,” observed Nuckolls. “Sometimes nature gives you extraordinary things to look at if you stop to observe it.”

The STM was especially crucial to this experiment, because the tool is particularly sensitive to the energy of electrons in materials. “The STM is a direct energy probe, which helps us relate back to Hofstadter’s original calculations, which were calculations of energy levels,” said Myungchul Oh, a postdoctoral research associate and co-lead author of the paper. “Previous studies on Hofstadter’s butterfly were based on electrical resistance measurements that don’t measure energy.”

New Insights into Electron Interactions

While the research may not yield any practical applications, at least not right away, the work uncovered features of Hofstadter’s spectrum that are of interest to fundamental physics research. The researchers found that theoretical modeling of the spectrum improved if they included phenomena that are related to electrons interacting with each other, an important feature that was left out of Hofstadter’s original calculations. Including the impact of such interactions is difficult, and experiments become particularly valuable in understanding the many-electron version of this problem. The experimental team worked in close collaboration with a theoretical team led by Prof. Biao Lian of the physics department and his students, who are also co-authors of the paper.

“The Hofstadter regime is a rich and vibrant spectrum of topological states, and I think being able to image these states could be a very powerful way to understand their quantum properties,” said Michael Scheer, a graduate student in physics at Princeton and one of the paper’s co-lead authors.

Reference: “Spectroscopy of the fractal Hofstadter energy spectrum” by Kevin P. Nuckolls, Michael G. Scheer, Dillon Wong, Myungchul Oh, Ryan L. Lee, Jonah Herzog-Arbeitman, Kenji Watanabe, Takashi Taniguchi, Biao Lian and Ali Yazdani, 26 February 2025, Nature. DOI: 10.1038/s41586-024-08550-2

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