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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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CONTENTS

S. No.	Title	Source	Page No.
	DRDO News		1-2
1	STAR मिसाइल टेस्टिंग के आखिरी पड़ाव में लेगी ब्रह्मोस की जगह!	Aaj Tak	1
	Defence News		3-18
	Defence Strategic: National/International		
2	Chief of Defence Staff Visits Forward Military Bases	Press Information Bureau	3
3	Army Chief and CDS laud armed forces, stress need for readiness	The Indian Express	4
4	India confronts two-front threat as China aids Pakistan in border clash	The Economic Times	4
5	Gun systems L-70, Zu-23, Schilka extremely effective in thwarting Pakistan's drone swarm attacks: Top Army Air Defence officer	The Economic Times	6
6	Success rate is 100%, can be 101%, but it cannot be less: Indian Army on early warning radar of the air defence system	The Economic Times	8
7	In Operation Sindoor, 'Akashteer' played the most crucial role: Army explains how it struck down every drone with 100% kill rate	The Economic Times	9
8	Indian Army's artillery gunners showcase precision in Operation Sindoor	The Economic Times	11
9	AI bomb, the new weapon	The Economic Times	11
10	(AI)ding the frontline	The Economic Times	13
11	Niti paper for defence laws' update to boost 'Make in India'	The Economic Times	14
12	After Sukhoi, 3 more jets to be mated with BrahMos	The Tribune	15
13	Indian Navy stood tall in Operation Sindoor	The Tribune	16
	Science & Technology News		18-28
14	Supercharging the future: India's Scientists design fast- charging & long-lasting sodium-ion battery	Press Information Bureau	18
15	ISRO EOS-09 mission failure: What are the alternatives for India in the Earth observation space?	The Week	20
16	IIT Guwahati develops fluorescent sensor to detect cyanide in water and human cells	The Economic Times	22
17	'Minimal' model captures neurons, flow of opinions, exotic matter	The Hindu	23

Renewable Resources	

DRDO News

STAR मिसाइल टेस्टिंग के आखिरी पड़ाव में... लेगी ब्रह्मोस की जगह!

Source: Aaj Tak, Dt. 19 May 2025,

URL: <u>https://www.aajtak.in/defence-news/story/india-to-get-new-affordable-</u> <u>brahmos-missile-as-star-missile-testing-reaches-final-stage-dskc-2243909-2025-05-19</u>

रक्षा अनुसंधान और विकास संगठन (DRDO) अपने स्टार मिसाइल प्रोजेक्ट को तीसरे चरण (Phase-III) में ले जा चुकी है. इस चरण में मिसाइल को पूरी तरह तैयार करके कई बार उड़ान परीक्षण किए जा रहे हैं. स्टार मिसाइल एक खास स्वदेशी मिसाइल है, जो वायुसेना, थलसेना और नौसेना के लिए तेज गति वाले खतरों की नकल करती है. मतलब टारगेट प्रैक्टिस कर सकते हैं. यह मिसाइल सस्ती होने के साथ–साथ ब्रह्मोस जैसे मिसाइलों का विकल्प बन सकती है. तीसरे चरण में डीआरडीओ के इंजीनियर मिसाइल के सभी हिस्सों, जैसे इंजन, नेविगेशन सिस्टम और नियंत्रण प्रणाली को एक साथ जोड़कर पूरी मिसाइल बनाते हैं. फिर इसे युद्ध जैसी परिस्थितियों में कई बार उड़ाया जाता है. इन परीक्षणों से पता चलता है कि मिसाइल कितनी सटीक, भरोसेमंद और प्रभावी है.



परीक्षणों में मिली जानकारी से मिसाइल को और बेहतर किया जाता है, ताकि यह सेना की जरूरतों को पूरा कर सके. डीआरडीओ अलग–अलग मौसम और परिस्थितियों में मिसाइल का परीक्षण कर रहा है. यह भी जांचा जा रहा है कि मिसाइल जमीन और हवाई उपकरणों के साथ ठीक से काम करती है या नहीं. अगर ये परीक्षण सफल रहे, तो डीआरडीओ मिसाइल का सीमित उत्पादन शुरू कर सकता है, जिसे सेना प्रशिक्षण और आगे के परीक्षणों के लिए इस्तेमाल करेगी.

STAR मिसाइल की स्पीड ब्रह्मोस जैसी

स्टार मिसाइल को इस तरह बनाया गया है कि यह आधुनिक मिसाइलों की तरह तेजी से उड़े और उनके व्यवहार की नकल करे. यह 2.5 मैक (लगभग 3,062 किमी/घंटा) से ज्यादा तेजी से उड़ सकती है. यह तेजी से दिशा बदल सकती है. ऊंचाई कम–ज्यादा कर सकती है. यह प्रशिक्षण सैनिकों को असली युद्ध में तेजी से फैसले लेने और सही प्रतिक्रिया देने के लिए तैयार करता है.

हर जगह इस्तेमाल की जा सकने वाली मिसाइलस्टार मिसाइल का डिज़ाइन ऐसा है कि इसे अलग–अलग मिशनों और जरूरतों के हिसाब से आसानी से बदला जा सकता है. यह वायुसेना, थलसेना और नौसेना तीनों के लिए काम कर सकती है. ऑपरेशन सिंदूर में भारत ने "बंशी टारगेट" ड्रोनों को छलावा (डिकॉय) के रूप में इस्तेमाल किया था. स्टार मिसाइल ऐसे कामों में और भी उपयोगी हो सकती है.



हवाई मिसाइल: ज्यादा पहुंच

डीआरडीओ स्टार का एक ऐसा संस्करण बना रहा है, जिसे तेजस जैसे लड़ाकू विमान से छोड़ा जा सकता है. यह हवा से हवा में या हवा से जमीन पर हमला करने में मदद करेगी. यह मिसाइल दुश्मन के रडार या AWACS (हवाई चेतावनी प्रणाली) को नष्ट करने के अभ्यास में भी उपयोगी होगी. हवाई मिसाइल ऑपरेशन सिंदूर जैसे बड़े अभियानों में भारत की ताकत बढ़ाएगी.

जमीनी मिसाइल: लंबी दूरी

स्टार मिसाइल को जमीन से भी छोड़ा जा सकता है. इसके लिए बूस्टर जोड़े जाते हैं, जिससे यह दूर तक उड़ सके. इसे गाड़ियों या स्थिर मंचों से लॉन्च किया जा सकता है. यह जमीन से जमीन पर या तट से जहाज पर हमले का अभ्यास करने में मदद करती है. इसे बिना महंगे उपकरणों के कठिन इलाकों में भी इस्तेमाल किया जा सकता है.

रैमजेट इंजनः तेज और हल्का

स्टार मिसाइल में लिक्विड फ्यूल रैमजेट इंजन है. यह इंजन हवा से ऑक्सीजन लेता है, जिससे मिसाइल को कम ईंधन ले जाना पड़ता है. इससे मिसाइल हल्की रहती है. लंबे समय तक तेज गति से उड़ सकती है.

भविष्य की मिसाइलों के लिए मददगार

स्टार मिसाइल सिर्फ प्रशिक्षण के लिए नहीं है. यह डीआरडीओ के रैमजेट इंजन और नई मिसाइलों के लिए एक टेस्टिंग प्लेटफॉर्म भी है. इस पर आजमाई गई तकनीकें AWACS किलर, एंटी–रेडिएशन मिसाइल और सस्ती क्रूज मिसाइल जैसी परियोजनाओं में इस्तेमाल होंगी. इससे नई मिसाइलें बनाने में समय और जोखिम कम होगा. स्टार मिसाइल भारत को तेज और आधुनिक मिसाइलें बनाने में मदद करेगी.

स्टार मिसाइलः खास बातें

- गति: 1.8 से 2.5 मैक
- ऊंचाई: 100 मीटर से 10 किलोमीटर तक
- दूरी: 55 से 175 किलोमीटर तक
- उड़ान समय: 50 से 200 सेकंड

स्टार मिसाइल भारत की रक्षा को और मजबूत करने का एक शानदार कदम है. यह सस्ती, तेज और लचीली मिसाइल सेना को युद्ध की तैयारी में मदद करेगी. यह भविष्य की नई मिसाइलों के लिए रास्ता बनाएगी.

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Defence News

Defence Strategic: National/International

Chief of Defence Staff Visits Forward Military Bases

Source: Press Information Bureau, Dt. 19 May 2025, URL: <u>https://www.pib.gov.in/PressReleasePage.aspx?PRID=2129669</u>

To boost the morale of the Armed Forces, the Chief of Defence Staff (CDS), General Anil Chauhan paid a visit to the strategically important Suratgarh Military Station and Naliya Air Force Station today on May 19, 2025.

He interacted with the troops emphasizing the importance of operational readiness and resilience in the face of evolving security challenges.

He commended the Operational preparedness and high morale of the personnel and expressed confidence in their ability to respond effectively to future threats.

CDS was accompanied by Lieutenant General Manjinder Singh, Army Commander South Western Command and Air Marshal Nagesh Kapoor, Air Officer Commanding-in-Chief, South Western Air Command.

The visit was marked by a spirit of pride in recognition of the exemplary courage displayed by soldiers during Operation Sindoor.

He was apprised of the latest and robust Air Defence systems deployed in the operation. General Chauhan also held strategic discussions with senior military commanders during the visit.

General Chauhan lauded the exceptional valour and professionalism of the soldiers during the active phase of the Operation.

Highlighting their selfless dedication, resolute courage and steadfast commitment in neutralizing multiple attempts by the western adversary of breaching the security, he said that they uphold the highest standards of military professionalism.

CDS put emphasis on the need to remain ever prepared for responding to any challenge with decisive force. During his address, the CDS praised the inter service synergy. General Chauhan also extended his appreciation to the local civil administration for their support, underlining the importance of military – civil synergy in such critical situation.

The visit reaffirmed the nation's gratitude towards its armed forces and reinforced the message of unity, readiness, and unwavering national commit.

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Army Chief and CDS laud armed forces, stress need for readiness

Source: The Indian Express, Dt. 20 May 2025,

URL: <u>https://indianexpress.com/article/india/army-chief-and-cds-laud-armed-forces-</u> stress-need-for-readiness-10016619/

Days after the cessation of military actions by India and Pakistan, Army Chief General Upendra Dwivedi Monday visited Longewala in the forward areas of the Konark Corps and lauded troops for their exceptional performance during Operation Sindoor. He also reviewed operations conducted in coordination with the Indian Air Force (IAF) and the Border Security Force (BSF).

Separately, Chief of Defence Staff (CDS) General Anil Chauhan visited the strategically important Suratgarh Military Station in Rajasthan and the Naliya Air Force Station in Gujarat, where he engaged with personnel and highlighted the need for operational readiness and resilience considering the evolving security challenges. The Konark Corps, also known as Desert Corps, is charged with protection of the desert sectors of the country along the western states of Rajasthan and Gujarat.

According to an Army statement, during the recent hostilities with Pakistan, the desert stretches from Jaisalmer to Kutch region witnessed a swift and coordinated operational response from Army, IAF and BSF. "These joint actions not only blunted enemy intent, but also established a new normal in maintaining operational dominance along the western front," the statement said.

As part of Operation Sindoor, the statement said, the Army undertook rapid deployment of surveillance assets and air defence systems, in close coordination with the IAF and BSF. "The calibrated positioning of weapon systems and other operational enablers, aligned with civil administration support, ensured effective area domination and neutralisation of potential threats," it added.

General Dwivedi acknowledged the valour of the soldiers of the Konark Corps in defending the International Boundary. During his visit to the Military and the Air Force stations, CDS General Chauhan commended the operational preparedness and high morale of the personnel and expressed confidence in their ability to respond effectively to future threats.

India confronts two-front threat as China aids Pakistan in border clash

Source: The Economic Times, Dt. 19 May 2025,

URL: <u>https://economictimes.indiatimes.com/news/defence/india-confronts-two-front-</u> <u>threat-as-china-aids-pakistan-in-border-clash/articleshow/121259294.cms</u>

China provided Pakistan with air defense and satellite support during its clash with India this month, according to a research group under India's Ministry of Defence, suggesting that Beijing was more directly involved in the conflict than was previously disclosed. China helped Pakistan

reorganize its radar and air defense systems to more effectively detect India's deployments of troops and weaponry, Ashok Kumar, director general at the New Delhi-based Centre For Joint Warfare Studies, said in an interview.

China also helped Pakistan adjust its satellite coverage over India during the 15-day interval between an April 22 massacre that killed 26 mostly Indian tourists and the start of hostilities between the two nations, he said. "It helped them to redeploy their air defense radar so that any actions which we do from the aerial route is known to them," Kumar said at the group's headquarters in New Delhi.

India's government hasn't publicly detailed China's involvement in the conflict. While Pakistan has said it used Chinese-supplied weapons, Kumar's assessment — if correct — indicates that China's involvement went even further, offering logistical and intelligence support to Islamabad.

The Centre for Joint Warfare Studies describes itself as an autonomous think tank focused on integration and transformation of India's armed forces. Its advisory board includes Defense Minister Rajnath Singh as well as India's top military commander and the heads of the army, air force and navy.

China's Foreign Ministry and Defense Ministry didn't respond to requests for comment placed over the weekend. Representatives for India's Foreign Ministry, Ministry of Defence, armed forces and Prime Minister Narendra Modi's office didn't respond to requests for comment. Pakistan's Foreign Ministry and Information Ministry also didn't respond to emailed queries on Sunday.

The clash was the worst between the nuclear-armed neighbors in half a century, with both sides trading air, drone and missile strikes, as well as artillery and small arms fire along their shared border. It was triggered by the bloodshed on April 22, which India has called an act of terrorism orchestrated by Pakistan. Leaders in Islamabad have denied involvement.

The conflict drew in world powers, with President Donald Trump taking credit for helping to mediate a ceasefire that started May 10 — an assertion that generated anger in India, which said the truce was negotiated bilaterally. On Thursday, Pakistan's deputy prime minister said the ceasefire would be extended to Sunday, while the Indian Army has said it would continue to work on confidence-building measures with Pakistan.

Pakistani Deputy Prime Minister and Foreign Minister Ishaq Dar is set to visit China on Monday to hold in-depth discussions "on the evolving regional situation in South Asia and its implications for peace and stability," according to a statement from the Foreign Ministry in Islamabad.

Kumar said China used the conflict as a testing ground for its weapons. The performance of the Chinese defense systems were below average and "failed miserably" in some instances, Kumar said, citing an Indian military assessment. He didn't provide specifics.

India's defense systems reacted well to Pakistan's use of hundreds of drones in the conflict, Kumar said, adding that India's integrated network of sensors gave it an edge. He didn't comment on China's J-10C fighter or Pakistan's claims that it downed Indian warplanes. Prime Minister Shehbaz Sharif on Friday said Pakistan shot down six Indian fighter jets, an assertion that hasn't

been independently verified. India's government hasn't commented on whether it lost aircraft in the fighting.

Chinese weapons like the J-10C fighter and the PL-15 air-to-air missile had never seen documented live fighting before, and their use has raised concerns among Beijing's rivals across the region, including in Taiwan. China's government hasn't commented on the use of its equipment, and Pakistan hasn't presented evidence to back up its claims. Kumar said that India's planning for conflicts with Pakistan now accounts for the probability that China will provide assistance to Islamabad. China may not intervene on behalf of Pakistan unless the situation is "critical," but Pakistan will enter a conflict between India and China, Kumar said.

'Two-Front Situation'

"India now factors in a two-front situation in almost all its calculations," Kumar said. "Anything which is with China today can be deemed to be with Pakistan tomorrow."

China has long been a backer of Pakistan dating back to the Cold War, and more recently has invested billions of dollars into the country via its Belt and Road infrastructure program. In recent years, India has shifted more military resources to its disputed border with China, where a 2020 clash left 20 Indian soldiers and an unknown number of Chinese troops dead. More recently, India and China had made strides toward normalizing ties.

Gun systems L-70, Zu-23, Schilka extremely effective in thwarting Pakistan's drone swarm attacks: Top Army Air Defence officer

Source: The Economic Times, Dt. 19 May 2025, URL: <u>https://economictimes.indiatimes.com/news/defence/gun-systems-l-70-zu-23-schilka-extremely-effective-in-thwarting-pakistans-drone-swarm-attacks-top-army-air-defence-officer/articleshow/121275136.cms</u>

Air defence gun systems played a crucial role in neutralising drone swarm threats from Pakistan, with a top Army official describing their performance as "extremely effective." Following the success of Operation Sindoor, Lieutenant General Sumer Ivan D'Cunha, Director General of the Army Air Defence, underlined how India's decision to retain and upgrade its gun-based air defence system proved to be a strategic advantage.

In an exclusive interview with ANI, when asked which weapon system emerged as the hero of the conflict, Lt Gen D'Cunha said, "It is indisputable that the air defence gun system has been extremely effective. We in the army have to thank my predecessors. Unlike other countries, which started moving away from guns into the realm of missiles, the Indian Army held on to its guns."

He added that even the next-generation gun system, set to begin trials in July, reflects the enduring importance of guns in modern air defence. "Even our successor gun, which is to come up for trials in July, we realised over some time that the gun is an irrepressible form of air defence. Whether it's

the L-70, the Zu, the Shilka, or even an LMG or MMG in ACAC role, which the infantry has, is going to make a huge difference as far as drone destruction goes." When asked about the effectiveness of the guns, the officer said that estimating that they brought down 60 per cent of the drones would be a "reasonable assumption."

"In a span of four days, Pakistan sent -- large, small, and medium-sized drones, anything between maybe 800 to 1000, across the whole western border, and all UCAV (Unmanned Combat Aerial Vehicle) drones carrying payloads aimed at civilian targets were intercepted, preventing any civilian casualties," he said. "The proof of the pudding is that there were no civilian casualties," Lt Gen D'Cunha noted. "But this is something that we've got to be very, very careful of in the coming years ahead because if this is a form of conflict, then our civil population areas are as important, if not more than, anybody else's border," he added.

In response to questions about protecting urban and civilian areas, Lt Gen D'Cunha stressed the need to evolve India's air defence strategy to protect not just military and VVIP zones but also population centres, especially those near the borders. He cited international models like the US C-RAM system and Israel's Iron Dome, which are specifically designed to protect civilian infrastructure from aerial threats.

"The US has a very interesting system called the C-RAM. It is counter to rockets, artillery and mortars. So, they have a gun that fires at about 4,500 rounds per minute, and are largely in population centers. So they are meant to protect population centers. The Iron Dome is another concept and a form of population center protection," he said. When asked whether India has now joined the elite club of nations with fully integrated and automated air defence command and control capabilities, Lt Gen D'Cunha was cautious in his assessment and said, "There's tremendous work in progress that is required. While we have been successful in tackling the current challenge, we must not rest on our achievements."

He called for a robust, multi-layered air defence system that can detect, identify, and neutralise enemy drones swiftly. "To truly dominate this domain, we need to expand our detection systems, include more and better types of sensors, and rapidly disseminate information across command networks to ensure interdiction occurs as far forward as possible. So that you can make sure that you bring them down in as many numbers as come. A very minuscule number will be able to cross. If you've got a couple of layers."

While the Akash series of missile systems has proven effective against larger aerial threats like UAVs, helicopters, and aircraft, Lt Gen D'Cunha admitted it still needs refinement to handle smaller drones, which played a key role in the recent conflict. "The Akash-Thir system hasn't yet been fully configured to handle the drone warfare domain. We must evolve our drone management systems accordingly." He also revealed that Pakistan had used Kamikaze drones in the conflict, but failed to cause damage due to India's preparedness. Pakistan first sent cheap drones in large numbers to low altitudes to saturate the radar system. Still, the Army had anticipated the drone threat and conducted a simulation exercise on April 26-28 to prepare for potential drone attacks.

India's Operation Sindoor showcased its preparedness in modern warfare, particularly in neutralising drones and other advanced technologies. The operation highlighted India's integrated command structures, enabling seamless coordination between different military branches.

Operation Sindoor reflected India's "Shishupala Doctrine," which involves exercising patience until a predefined threshold of provocation is crossed, followed by decisive action.

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Success rate is 100%, can be 101%, but it cannot be less: Indian Army on early warning radar of the air defence system Source: The Economic Times, Dt. 19 May 2025,

URL: <u>https://economictimes.indiatimes.com/news/defence/success-rate-is-100-can-be-101-but-it-cannot-be-less-indian-army-on-early-warning-radar-of-the-air-defence-system/articleshow/121274781.cms</u>

The Indian Army's early warning radar system played an important role in detecting and destroying enemy targets during recent hostilities. The radar system with long-range capability, successfully searched and detected enemy drones, UAVs, and aircraft.

"The radar you can see right behind me is an early warning radar of the air defence system, and this early warning radar is the most modern radar of today. This radar has long-range capability, which means that it has the ability to search and detect the enemy's target from a long range. Due to its long range, it searched and detected all the enemy targets, be it a drone, a UAV or an aircraft, very well," the Indian Army soldier told on Monday. The soldier further explained that the radar system passed target data to the fire controller, which then directed the attached weapon system to open effective fire, resulting in the destruction of the targets in mid-air.

"It passed the data of the target to the fire controller, and the weapon system attached to the fire control radar opened an effective fire on that particular target, due to which it was destroyed in the air itself. We detected their targets through those radars and destroyed them in the air through our weapon system before they could reach their destination." the soldier said.

"Its success rate has been 100%, and it can be 101%, but it cannot be less than that. There is no doubt that if the enemy country dares to do something like this in the future, it will have to pay a lot more than this," the soldier added. The soldier recounted the loss faced by Pakistan due to this system, "Our army jammed their (Pakistan) air defence system, and they could not do anything, and due to this, they suffered heavy losses."

Earlier in the day, an Indian Army major stated that the Indian Army's 'Akashteer' system played the most important role in Operation Sindoor. The Akashteer system is a centrally automated command and control system integrated with air force and army radars.

Speaking to ANI, the Major said, "In our Operation Sindoor, 'Akashteer' system has played the most important role. This system is a centrally automated command and control system that is integrated with all the air forces and the army radars." "The enemy's drones came to our locations in a very large number. At that time, our Akashteer system declared them as hostile, and according to their location, the nearest weapon system was designated that you have to destroy them. Due to which we effectively destroyed all the drones that came into our territory," the Major said.

The Major lauded the system's effectiveness, stating that it played a crucial role in achieving the mission's objective of preventing the enemy from accomplishing their goals. "It was 100% effective. We destroyed all the drones and our mission and objective was not to let the enemy accomplish any of their objectives, we have been successful in it." the Major added. The Major highlighted the system's indigenous origins, stating, "This system is made in India. It is helping us to destroy enemy drones and aircraft in a good way."

Earlier, in a demonstration of India's rising defence prowess, the Indian Army showcased the indigenous Akashteer system and upgraded L-70 Air Defence Guns, both of which played a decisive role in intercepting every missile and drone during Pakistan's deadliest aerial assault on May 9-10. Speaking to ANI about the upgraded air defence system's competence, an L-70 Air Defence Gun operator said, "This gun system is very effective... We showed that we also have a system capable of destroying any target. It can track targets from a long distance and lock onto them. As soon as they enter the effective range, firing action is taken."

The soldier added that the L-70 system achieved a 100 per cent success rate in destroying enemy drones during the conflict. "We destroyed all the drones. Its success rate is 100 per cent," he said. The soldier also expressed confidence in the Indian Army's ability to respond to future aerial threats. "Even in the future, if the enemy country tries to attack us by sending drones, aircraft, or missiles, we will give them a befitting reply, and we have the capability to destroy them in the air itself..."

Meanwhile, Akashteer, India's fully indigenous, automated Air Defence Control and Reporting System, which intercepted and neutralised every inbound projectile amid India-Pakistan hostilities, is no longer a concept confined to defence journals, but a sharp edge of India's air defence.

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In Operation Sindoor, 'Akashteer' played the most crucial role: Army explains how it struck down every drone with 100% kill rate

Source: The Economic Times, Dt. 20 May 2025, URL: <u>https://economictimes.indiatimes.com/news/defence/in-operation-sindoor-akashteer-played-the-most-crucial-role-army-explains-how-it-struck-down-every-drone-with-100-kill-rate/articleshow/121274743.cms</u>

India's home-made air defence system, Akashteer, has proven to be a strong shield during Pakistan's large-scale drone and missile attack from 7 to 10 May. According to the Indian Army, the system worked with 100% accuracy and stopped every single threat, making it a key part of the country's next-generation air defence network.

During those dark nights, as Pakistan launched its deadliest wave of attacks using kamikaze drones and missiles, Akashteer quietly came into action. It didn't make noise or flash, instead, it listened, calculated, and hit targets with sharp accuracy. "This invisible shield is Akashteer," said an Army

Major who supervised its operations at a forward location. "Every threat was detected. Every target was destroyed."

What Makes Akashteer Special?

Akashteer is fully developed in India by Bharat Electronics Limited (BEL) in Ghaziabad. It is linked to both Army and Air Force radars, forming an automated command and control system. This means it can quickly understand what's happening in the air, tell the difference between friendly and enemy objects, and direct nearby weapons to take action.

During Operation Sindoor, Akashteer was used in live combat for the first time. It helped Indian forces shoot down Pakistani drones, including Turkish-origin kamikaze drones and tiny drones like Songatri and eYatri.

"We detected and shot them with precision," said the Major. "Despite the massive scale of the attack, Pakistan could not break through our air defence." Akashteer doesn't rely on brute force. Instead, it uses real-time data to control radars, weapons and command rooms.

It automates everything, detecting, tracking, and attacking drones, missiles or enemy aircraft quickly. Gun systems closest to the enemy were automatically told to fire, based on live tracking. "Every drone was stopped before it could reach us," the officer said. Another officer added, "Even with such a large attack, our defence was not broken. We always stayed a step ahead of the enemy."

How Does It Compare to Other Systems?

Experts are now comparing Akashteer to Israel's famous Iron Dome. While the Iron Dome focuses more on missiles, Akashteer has shown it can tackle a wider range of threats, especially low-flying, hard-to-detect drones. According to a junior officer, "Thanks to Indian-made early warning radars, no drone hit the ground.

Everything was picked up in real-time and sent to Akashteer. The system then handled the threat." He said not a single drone completed its mission. "This is a big achievement. Akashteer has performed even better than the Iron Dome."

Proof of Success on the Ground

Indian troops recovered the broken parts of many drones, proof of how many were destroyed midair. A JCO confirmed, "No drone touched the ground. All were shot down." An Army Colonel said, "Akashteer gives a full air picture. It detects threats, ranks them by danger, and assigns weapons to take them out instantly. That's how we stopped every single drone."

The morale of Indian troops stayed high throughout the battle. "We got stronger each day," said a Major. "We proved that our systems, made in India, cannot be breached." In the end, India's Akashteer system didn't just stop an attack, it showed the world that India now has one of the most advanced and reliable air defence networks, built entirely at home.

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Indian Army's artillery gunners showcase precision in Operation Sindoor

Source: The Economic Times, Dt. 19 May 2025, URL: <u>https://economictimes.indiatimes.com/news/defence/indian-armys-artillery-</u> gunners-showcase-precision-in-operation-sindoor/articleshow/121274353.cms

In a powerful display of courage and precision, the Indian Army's artillery gunners in the Akhnoor Sector delivered a crushing response during the recent India-Pakistan tensions. On Monday, the Indian Army's artillery gunners demonstrated how they delivered a crushing response during ceasefire violations by Pakistan. Speaking on this, a soldier of the Indian Army stated that the objective of Operation Sindoor was to target and neutralise the posts that were supporting terrorists, adding that their firing was so accurate that the adversary faced heavy losses.

"... The objective of Sindoor was quite clear to us, which was to target and neutralise the posts supporting terrorists... Our countermeasures were there, so we did not suffer any losses. Our firing was so accurate that the enemy started targeting our civilian areas to divert our attention...The enemy has suffered heavy losses," he said. Another soldier, who exhorted the same sentiments, stated that their task was to target the adversary's forward posts, which were supporting the terrorists' infrastructure and infiltration, and had to neutralise them accurately.

He said, "...Our task under Operation Sindoor was very clear. We had to target the enemy's forward posts, which were supporting the terrorists' infrastructure and infiltration, and had to neutralise them accurately. When the enemy violated the ceasefire and tried to target our forward posts, our response was very strong, accurate and effective. Every round fired from the Gun was very accurate and neutralised the target. The enemy suffered a lot of damage, and there was a lot of panic in their camp and military base... The enemy will remember this firing for many decades..."

Operation Sindoor, launched on May 7, targeted terror infrastructure in Pakistan and Pakistanoccupied Jammu and Kashmir, leading to the death of over 100 terrorists affiliated with terror outfits like the Jaish-e-Mohammed, Lashkar-e-Taiba and Hizbul Mujahideen.

After the attack, Pakistan retaliated with cross-border shelling across the Line of Control and Jammu and Kashmir as well as attempted drone attacks along the border regions, following which India launched a coordinated attack and damaged radar infrastructure, communication centres and airfields across 11 airbases in Pakistan.

AI bomb, the new weapon

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Source: The Economic Times, Dt. 20 May 2025,

URL: <u>https://economictimes.indiatimes.com/tech/artificial-intelligence/ai-bomb-the-new-weapon/articleshow/121276389.cms?from=mdr</u>

Warfare has gone from bulking up your arsenal to stepping up the technology stack. If the latest tension between India and Pakistan is any indication, technology is playing a key role and so is artificial intelligence. A recent European Parliament briefing highlighted that AI is rapidly changing

warfare and the EU and its member states have expanded their investments in AI-driven military technologies over the past decade. ET's Swathi Moorthy and Suraksha P look at AI in the defence landscape globally.

Al Bomb, the New Weapon

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The US





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(AI)ding the frontline

Source: The Economic Times, Dt. 20 May 2025, URL: <u>https://economictimes.indiatimes.com/tech/artificial-intelligence/aiding-the-</u> <u>frontline/articleshow/121275717.cms</u>

Artificial Intelligence (AI) is increasingly playing a big role in modern-day warfare. A case in point is 'Operation Sindoor'. Even when GPS signals were jammed and communications went dark, India's indigenous drones found their way back, guided not just by remote pilots but also majorly by AI-powered vision systems.

"The integration is evolving fast, AI is becoming central to future warfare strategies, especially for situational intelligence and autonomous mission execution," said Satyabrata Satapathy, chief executive of BonV Aero, a drone maker.

During 'Operation Sindoor', the armed forces deployed unmanned aerial vehicles (UAVs) sourced from startups across Bengaluru, Hyderabad, Mumbai and Delhi, which acted as autonomous scouts trained on real combat data in the form of drones. Defence technology experts said that in the current scenario, AI is being used for processing payload data, such as recognising features, detecting vehicles or troop movement, and performing artillery fire correction.

Today's drones are designed to handle complex scenarios, said Rahul Singh, co-founder and vice president of engineering at ideaForge, a Mumbai-based UAV manufacturer for defence.

"Navigational autonomy is similar to what you'd expect in a self-driving car. It ensures the drone doesn't crash or veer off course," he said. "With vision-based systems, drones recognise terrain patterns using onboard cameras and AI algorithms, allowing them to navigate and return home autonomously, even if GPS is jammed."

IDeaforge's solutions—Netra-5 and Switch UAVs, and the swarm drones of Bengaluru-based Newspace Research and Technologies (NRT) were extensively deployed during 'Operation Sindoor'. Another startup, Zebu Intelligent Systems, has tethered drones with AI-driven threat detection systems that autonomously identify and track aerial threats such as helicopters, missiles and rogue drones.

For NRT, its Sheshnaag series swarming systems have a layered suite of autonomy and AI/ML (machine learning) algorithms, which enable distributed intelligence, adaptability and mission resilience, said Sameer Joshi, the startup's founder.

"These drones are trained for coordinated movement and task allocation," he said, adding that some drones perform strikes, while the others perform reconnaissance, jamming, automatic target recognition (ATR), and conflict resolution, among other tasks. Experts have attributed the AI pivot in defence-tech to multiple startups funded through the government's iDEX programme. For instance, in electro-optical (EO) and infrared (IR) systems, where India was previously fully dependent on imports, the country now has domestic capability.

Manu Iyer, an IIT-Madras alumnus who runs Bluehill Capital, an early-stage deeptech VC fund, said defence has always been seen as a "big boys' game". "However, through programmes like ADITI (Acing Development of Innovative Technologies) under iDEX, startups are now receiving

grants ranging from Rs 1.5 crore to Rs 25 crore," said Iyer. "The problem statements are clearly defined and give access to work alongside key stakeholders, the army, navy, coast guard, Bharat Electronics, and others."

The Rs 200 crore GTE (global tender enquiry) restriction has also created a level playing field for Indian startups and manufacturers in high-tech sectors like drones, electronics, and defence tech. It prohibits government departments and public sector undertakings (PSUs) from issuing global tenders below Rs 200 crore.

The end-to-end battle

With the battlefield evolving, drone startups are no longer just hardware vendors. They are emerging as full-stack solution providers, integrating AI and delivering real-time intelligence. They are also heavily investing in R&D in their hardware and software stack.

"The battlefield is changing; your hardware might come from one company, the software from another, and the AI agents from a third," said Smith Shah, president, Drone Federation of India (DFI). He said this fragmented ecosystem is the new normal, and defence needs to start looking at warfare through this lens.

Data training

Industry body DFI, which has about 5,500 members, said today most startups are training their AI systems on a mix of open-source data, simulated environments and proprietary datasets generated through real-world testing.

"There are a lot of companies that are using existing data to create a general model, and then they participate in various demos as well as exercises, and work with the user to generate samples," the organisation said. DFI president Shah also said that while over time the entire stack in design, supply and hardware will develop, which will also enhance the capability of other weapons and equipment—supply chain remains an issue. "We've seen good outcomes so far, but we need to institutionalise this capability and repeat it consistently."

Niti paper for defence laws' update to boost 'Make in India' Source: The Economic Times, Dt. 20 May 2025,

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URL: <u>https://economictimes.indiatimes.com/news/economy/policy/niti-paper-for-</u> <u>defence-laws-update-to-boost-make-in-india/articleshow/121276067.cms?from=mdr</u>

A Niti Aayog working paper has proposed changes to defence laws to facilitate a resilient domestic supply chain for in-house manufacturing and address challenges of cybersecurity more comprehensively. Amidst evolving geopolitical tensions, cybersecurity threats and global supply chain disruption, the paper said this is vital for national security and operational readiness.

The security and law division of the Aayog has proposed these changes. The other suggestions include strategies to enhance economic competitiveness and growth, global partnerships and strategic influence, and legal reforms and good governance.

The working paper is under review by the top officials of the Aayog and could soon be shared with stakeholder ministries for consideration and action.

"A strong security framework is essential for long-term peace and prosperity. This involves modernising defence forces, enhancing cybersecurity infrastructure and improving border security," it said, adding it is crucial to strengthen internal security to address threats such as terrorism, cyberattacks and internal conflicts.

The proposed amendment to the Defence of India Act (1962) seeks to address cyber resilience, supply chain security and geopolitical risks. The paper also calls for the enhancement of the Defence Production and Export Policy (2020) to provide incentives for domestic manufacturers and simplify export regulations. It has proposed a review committee for periodic updates to defence procurement and cybersecurity laws. Revision of Defence Acquisition Procedures (2020) is suggested to simplify procurement processes and mandate domestic sourcing for critical components.

"Introduce blockchain-based legal frameworks for supply chain tracking, contract integrity and compliance automation, and enforce mandatory cybersecurity audits while imposing penalties for non-compliance," it added.

"Additionally, India should strengthen international defence cooperation through technology transfers, strategic alliances with countries like the US, Russia and Israel, and joint cybersecurity initiatives to counter emerging digital threats," it suggested.

India's annual defence production stood at ₹1,27,265 crore in 2023-24, an increase of 174% from ₹46,429 crore in 2014-15 and the target is to achieve ₹3 lakh crore of indigenous production by 2029. Other proposals include structural reforms to simplify taxation, reduce bureaucracy and create a more investor-friendly environment.

After Sukhoi, 3 more jets to be mated with BrahMos

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Source: The Tribune, Dt. 20 May 2025, URL: <u>https://www.tribuneindia.com/news/india/after-sukhoi-3-more-jets-to-be-mated-with-brahmos/</u>

Amid the success of BrahMos missile launched from the Sukhoi30-MKI jets during 'Operation Sindoor', India now plans a 'next generation' version of the missile that can be fitted onto three other types jets in the Indian Air Force (IAF) fleet.

Going forward, the IAF and the BrahMos – a joint venture of India and Russia that has same name as the missile -- is looking at the next-generation (NG) BrahMos or a lighter version. This could be fitted on to the smaller platforms like MiG-29, Mirage 2000 or even the Light Combat Aircraft (LCA), Tejas. The BrahMos NG is planned to be about 1.3 tonnes in weight and will be the primary deterrent weapon of the IAF, sources said.

Over the past two decades Indian defence scientists worked on two aspects -- first, modify the Sukhoi to carry the missile and, second, to reduce some 500 kg of weight of the BrahMos and

bring it down to 2.5 tonnes while embedding 'fins' on the missile for stability when launched from air.

Several targets in Pakistan were hit by the air launched version in the early hours of May 10. Sukhoi 30-MKI jets, flying well within the Indian territory, released the BrahMos missile which each of them was carrying. All these Pak bases are 100-200 km inside Pakistan from the border with India, hitting these bases turned out to be a turning point for the decision makers in Pakistan, who had dialled the US on May 10.

The IAF keeps BrahMos missile capable Sukhoi in almost all its squadrons. The missile can travel at 2.8 Mach (approximately 3,400 km per hour). At that speed its interception with the technology Pakistan has, was impossible. BrahMos is the only supersonic cruise missile in the world that can be fired from a fighter jet.

This alteration to the Sukhoi did not come easy. Starting from 1997 India had been using the Sukhoi. In December 2005, the Lok Sabha was informed " Indian and Russian scientists have jointly established the feasibility of integrating the BrahMos missile with Sukhoi". In 2012, the Cabinet Committee on Security (CCS) approved structural and software modifications on 42 of the Sukhoi jets and acquire 216 air-launched Brahmos missiles.

In January 2020, the IAF inducted the first squadron consisting of modified Sukhoi jets, armed with the air launched BrahMos missiles.

The range was 290 km, in line with the limitations of the Missile Technology Control Regime (MTCR). After India joined the grouping in June 2016, the range was extended to 450 km, and it's to be further extended to 600 km. The supersonic Brahmos armed with a conventional warhead can penetrate hardened command, control and communication centres.

Indian Navy stood tall in Operation Sindoor

Source: The Tribune, Dt. 20 May 2025, URL: <u>https://www.tribuneindia.com/news/comment/indian-navy-stood-tall-in-operation-sindoor/</u>

OPERATION Sindoor has served as a compelling demonstration of India's growing military capabilities in several key areas. The technical means to acquire intelligence of targets deep inside the opponent's territory; to strike them with long-range missiles with pinpoint accuracy — all the while maintaining a multi-layered, impervious air defence of its own assets. This capacity for waging "non-contact warfare", using guided weapons and unmanned aerial vehicles (UAVs) without ground troops or air forces crossing borders, marks a paradigm shift in warfare.

In this context, maritime power has, historically, specialised in employing strategies that aim to achieve political objectives through their presence and "non-contact" force projection rather than by engaging in direct combat. Decades ago, Admiral Sergey Gorshkov (Commander-in-Chief, Soviet Navy, 1956-85) had described the perennial utility of naval power: "Demonstrative actions

by the fleet, in many cases, have made it possible to achieve political ends without resorting to armed action, merely by application of pressure and threat of military operations."

The Indian Navy's (IN) 2015 maritime strategy offers, in detail, various options for potential force projection. These include maritime strikes with carrier-borne aircraft or long-range weapons like the ship-launched BrahMos, or the ship/submarine-launched Klub land-attack missiles. In order to apply "strategic leverage, including economic and psychological pressure", the strategy also envisages disruption/denial of the adversary's use of the sea for military purposes and maritime trade.

The IN, while drawing up its contingency plans for Operation Sindoor in coordination with sister services, would have taken note of Pakistan's maritime vulnerabilities stemming from its geography, relatively limited naval capabilities and economic dependence on key coastal infrastructure.

Pakistan's 1,000-km-long coastline, stretching mostly across the troubled province of Balochistan, hosts just a handful of ports. Of these, only Karachi, Port Qasim and Gwadar handle merchant ship traffic, while Ormara is a naval base and the rest are fishing harbours. Pakistan's economy, already strained, relies heavily on maritime trade, mostly through Karachi and Port Qasim. Disruption of shipping traffic to and from these ports, even temporarily, can cause a significant impact on Pakistan's economy, industry and military operations, apart from affecting public wellbeing and morale.

As far as naval strength goes, the IN is a diverse and substantial force organised into two fleets, each fielding an aircraft carrier and a cohort of missile-armed destroyers and frigates as well as fleet support vessels. India's submarine force of nuclear and diesel-powered submarines is strategically deployed on both seaboards. The Pakistan Navy (PN) is relatively smaller and lacks many of these key assets.

While the IN aspires to play the role of a blue-water navy, with power-projection capabilities across the Indian Ocean and beyond, the PN's focus is primarily on coastal defence and maintaining credible maritime deterrence against India through a strategy of "sea denial". Although the past few decades have seen both navies growing in size and capabilities, the IN has managed to retain its significant edge.

In the 1971 war, India's maritime power had played a key role in the outcome of the operations in both theatres of war. In the west, it had undertaken two attacks with ship-launched surface-tosurface missiles, inflicting attrition on the PN and heavy damage to the Karachi port, bringing its operations to a halt. In the eastern theatre, the IN's carrier-borne aircraft had ranged far and wide over East Pakistan and inflicted heavy damage on ports, shipping and riverine traffic. The trauma of this conflict has lingered in the Pakistani psyche, and PN units did not venture forth during Operation Sindoor.

Today, a major advantage accrues to the IN from its comprehensive capability for "maritime domain awareness". This is a dynamic framework that receives inputs from satellites, aircraft, UAVs, ships and coastal radars to compile a real-time operational picture of all activities at sea in the region. The availability of "situational awareness" on a 24x7 basis in all three dimensions

enables the IN to keep track of the adversary's moves and respond with alacrity to any suspicious activity. The PN lacks a similar facility.

"Naval compellence" has, historically, been a useful instrument of state policy to influence the behaviour of others and force an adversary to do something he does not want to do, or to stop him from doing something that he intends to do. This is achieved by the deployment of coercive seabased forces, which may or may not involve actual violence.

During media briefings by the three armed forces, the Director General of Naval Operations announced that within hours of the Pahalgam terror attack, the IN had deployed a powerful task force composed of destroyers, frigates and submarines, led by the aircraft carrier, INS Vikrant, in the Arabian Sea, south of Karachi. Posing a serious challenge in numbers and capability to the Pakistani fleet, this force established a de facto blockade, confining PN units to their harbours. Units of the task force are understood to have conducted live missile firing drills to revalidate crew readiness and ensure operational preparedness of units.

From its location in international waters, where it could have remained poised for prolonged periods, the IN carrier group acted as a force for "compellence". Through rapid deployment and strategic positioning of overwhelming maritime power, India confined Pakistan's navy to harbour, disrupted its maritime operations and reinforced its dominance in the Arabian Sea.

The IN task force had ample firepower to target ships, harbours and shore facilities with missiles having a range up to 300-450 km at sea. But the Navy, true to its sobriquet of the "Silent Service", has not said so.

Science & Technology News

Supercharging the future: India's Scientists design fastcharging & long-lasting sodium-ion battery

Source: Press Information Bureau, Dt. 19 May 2025, URL: <u>https://www.pib.gov.in/PressReleasePage.aspx?PRID=2129649</u>

In a world racing towards electrification—from cars to villages—one thing remains crucial: affordable, fast, and safe batteries. While lithium-ion batteries have powered this revolution so far, they are costly. Besides, lithium resources are limited and geopolitically constrained. But scientists in Bengaluru may have just found a powerful alternative.

A research team at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), an autonomous institute of the Department of Science and Technology (DST) has developed a superfast charging sodium-ion battery (SIB) based on a NASICON-type cathode and anode material, that can charge up to 80% in just six minutes and last over 3000 charge cycles.

Unlike conventional SIBs that suffer from sluggish charging and short lifespan, this new battery uses a clever mix of chemistry and nanotechnology. The scientists led by Prof. Premkumar Senguttuvan and Ph.D. scholar Biplab Patra, engineered a novel material for the anode—Na1.oVo.25Alo.25Nb1.5(PO4)3—and optimized it in three critical ways --shrinking the particles to nanoscale, wrapping them in a thin carbon coat, and improving the anode material by adding a small amount of aluminium. These tweaks made sodium ions move faster and more safely, enabling both speed and durability.



(Left) Fast charging sodium ion battery; (Right) Researchers of this discovery - Mr. Biplab Patra (Ph.D student, JNCASR) and Prof. Premkumar Senguttuvan, Associate Professor, JNCASR

Sodium is cheap and abundantly available in India, unlike lithium which is scarce and largely imported. A battery built on sodium instead of lithium could help the country to become self-reliant in energy storage technology—a key goal of the Indian government's Atmanirbhar Bharat mission.

Beyond just cost, these sodium-ion batteries could power everything from electric vehicles and solar grids to drones and rural homes, making clean energy accessible where it's needed the most.

The technology has been tested and validated through high-end methods, including electrochemical cycling and quantum simulations. What makes it especially exciting is that it not only supports rapid charging but also avoids the fire and degradation risks of traditional batteries.

While more development is needed before these batteries hit the market, the discovery marks a significant step forward. Peers in the scientific community have begun to take notice, and with continued support, we may soon see India leading the global race in green battery technology.

ISRO EOS-09 mission failure: What are the alternatives for India in the Earth observation space?

Source: The Week,Dt. 19 May 2025,URL: https://www.theweek.in/news/sci-tech/2025/05/19/isro-eos-09-mission-failure-what-are-the-alternatives-for-india-in-the-earth-observation-space.html

On May 18, 2025, the Indian Space Research Organisation (ISRO) faced a rare setback when its 101st mission, the PSLV-C61, failed to place the Earth Observation Satellite-09 (EOS-09) into orbit. A technical glitch in the rocket's third stage caused the mission to fail, leaving India without a key satellite meant for all-weather surveillance. What is next for India? Does India have other satellites to fill the gap? What was EOS-09 going to replace? How does ISRO plan to recover?

EOS-09, also known as RISAT-1B, was a 1,696 kg satellite designed to capture high-resolution images of Earth's surface, day or night, even through clouds, rain, or fog. It used C-band Synthetic Aperture Radar (SAR) technology, which is perfect for monitoring borders, tracking natural disasters, managing agriculture, and supporting urban planning. With a one-meter imaging resolution, EOS-09 was meant to strengthen India's security and resource management by providing real-time data.

The satellite was part of India's growing constellation of Earth observation satellites, aimed at ensuring constant watch over the country's 15,000 km of land borders and 7,500 km of coastline. Its ability to see through bad weather made it a vital tool for national security and disaster response.

EOS-09 was a repeat of the EOS-04 satellite, launched in 2022, and a follow-on to the RISAT-1 satellite. EOS-04, also known as RISAT-1A, is still operational and uses similar C-band SAR technology for all-weather imaging. RISAT-1, launched in 2012, was designed for a five-year mission but stopped functioning in 2017. EOS-09 was meant to enhance the frequency of observations and provide backup to EOS-04, ensuring continuous data for critical applications like border surveillance and disaster management.

So does India have other alternate Earth observation satellites still working? "India has several operational Earth observation satellites that can partially fill the gap left by EOS-09's failure. ISRO's fleet includes satellites like EOS-04 (RISAT-1A), Resourcesat, Cartosat, and RISAT-2B, which are equipped for various imaging tasks. EOS-04, in particular, shares EOS-09's C-band SAR technology and can handle all weather surveillance, though it may not match the planned frequency of observations that EOS-09 would have provided," explained space expert Girish Linganna.

Explaining further this expert says that other satellites, like those in the Cartosat series, offer highresolution optical imaging for mapping and urban planning but struggle in cloudy or dark conditions. "RISAT-2B, with its X-band SAR, provides sharper images for military surveillance but is less suited for broader tasks like monitoring vegetation or water bodies. While these satellites ensure India's Earth observation capabilities remain strong, the loss of EOS-09 delays plans for a more robust 52-satellite surveillance constellation," added Linganna.

ISRO is already taking steps to recover from this setback. The ISRO Chairman V Narayanan, has promised a detailed technical analysis to understand the third-stage anomaly, suspected to be a flex nozzle control system failure. ISRO's track record shows only three PSLV failures in over 60 missions since 1993, proving its reliability. Scientists are confident this is a temporary hiccup, as ISRO has four more PSLV launches planned for 2025.

To make up for EOS-09's loss, ISRO may fast-track the launch of another Earth observation satellite with similar capabilities. The agency could also rely on EOS-04 and other satellites to handle urgent tasks while preparing a replacement mission. ISRO's focus on sustainability, like including deorbiting fuel in EOS-09, shows its commitment to responsible space operations, which will continue in future missions.

Experts observe that the failure also highlights the need for a larger satellite constellation. ISRO is likely to accelerate its ambitious plan to build a network of 52 surveillance satellites, ensuring no single failure disrupts India's monitoring capabilities. Collaborations with private companies and international partners could further boost ISRO's ability to launch replacements quickly.

The EOS-09 failure is a rare stumble for ISRO, which has earned global respect for its costeffective and reliable space missions. With operational satellites like EOS-04 and a clear recovery plan, India's ability to monitor its borders, manage disasters, and support development remains intact.

"Globally, military satellite programs such as the United States' KH-11 Kennen, France's Helios 2, and Israel's Ofek-13 demonstrate the strategic value nations place on exclusive defence-oriented orbital systems. The Ukraine War has further validated the indispensability of satellites in modern conflict, with commercial providers like Maxar Technologies and Planet Labs delivering real-time intelligence that has reshaped battlefield dynamics, from tracking troop movements to assessing infrastructure damage," remarked Srimathy Kesan, Srimathy Kesan, founder and CEO of Space Kidz India.

She explained that the United States maintains orbital supremacy through the National Reconnaissance Office's KH-11 Kennen satellites, which achieve sub-10 cm resolution using Hubble-class optics. During the 2020 Nagorno-Karabakh conflict, KH-11 imagery exposed Turkish Bayraktar TB2 drone deployments, enabling Armenian forces to adjust defensive positions. The satellites' thermal infrared sensors additionally track missile plumes and artillery fire, as demonstrated in Ukraine, where they identified Russian S-400 battery locations near Kyiv.

"France's Helios 2 constellation (2A and 2B) combines 35 cm resolution visible imagery with thermal infrared sensors for night operations. During Mali's Operation Barkhane, Helios 2B monitored jihadist convoys crossing the Sahara, enabling French Mirage jets to conduct precision strikes. The system's successor, Composante Spatiale Optique (CSO), launched in 2018, enhances this capability with 20 cm resolution and hyperspectral sensors for chemical detection," pointed out Kesan.

Experts observe that the Ukraine conflict has demonstrated the democratization of space-based intelligence, with commercial providers like Maxar and Planet Labs supplying 90% of Kyiv's orbital data. Maxar's Skysat constellation (0.5 m resolution) documented the Bucha massacre

within hours of its discovery, providing geolocated evidence for war crimes investigations. Planet's Dove satellites (3 m resolution) enabled daily monitoring of the Zaporizhzhia Nuclear Power Plant, detecting Russian efforts to militarize the exclusion zone.

The PSLV-C61 failure delays India's INSPACe initiative, which aimed to deploy 52 surveillance satellites by 2030. The proposed GISAT-20 (2-meter resolution thermal IR) will monitor high-altitude Chinese infrastructure along the LAC, while the NISAR mission (2026), a joint venture with NASA, will deploy L-band and S-band radars for centimetre-scale deformation monitoring-critical for detecting tunnel construction beneath disputed territories. ISRO's emphasis on controlled de-orbiting protocols for EOS-09's PS4 stage reflects growing adherence to sustainable space practices, though the satellite's loss leaves a gap in all-weather imaging until a replacement launches.

IIT Guwahati develops fluorescent sensor to detect cyanide in water and human cells

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Source: The Economic Times, Dt. 19 May 2025, URL: <u>https://economictimes.indiatimes.com/news/science/iit-guwahati-develops-fluorescent-sensor-to-detect-cyanide-in-water-and-human-cells/articleshow/121266127.cms</u>

Research team at Indian Institute of Technology Guwahati led by Prof. G. Krishnamoorthy, from the Department of Chemistry, have developed a highly responsive fluorescent sensor that can detect cyanide in water and human cells using only a UV light source.

The developed sensor changes colour and emits bright fluorescence in the presence of cyanide, contributing to both environmental safety and forensic investigations.

Cyanide is a highly toxic compound widely used in industrial processes, such as manufacturing of synthetic fibres, metal cleaning, plastics, electroplating, and gold mining. Improper disposal of Cyanide often leads to its release into the environment, contaminating soil and water sources. Consumption of this contaminated water can disrupt oxygen supply in human body. Even a small amount can cause severe health effects or death. Therefore, there is a need to develop sensors that can detect even trace amounts of cyanide in various materials.

Fluorescent chemosensors are chemicals that light up under light when they interact with specific chemicals. These sensors are popular due to their ease of use, low cost, high sensitivity, and potential for use in biological systems. While many existing sensors work by dimming their light (known as a "turn-off" response) when detecting substances, a "turn-on" response—where the signal brightens instead—is often more effective because it avoids false negatives and improves detection clarity.

IIT Guwahati team has developed a "turn-on" chemosensor based on a compound called 2-(4'diethylamino-2'-hydroxyphenyl)-1H-imidazo-[4,5-b]pyridine, which gives a weak blue fluorescence under UV light. In the presence of cyanide, this fluorescence turns on and shifts to a brighter cyan colour due to a chemical change in the molecule. This reaction is highly specific to cyanide, especially in a carefully selected solvent system that includes water. The detection limit achieved in aqueous samples is as low as 0.2 μ M, which is much less than the World Health Organisation permissible limit of 1.9 μ M in drinking water.

The research team conducted combination of lab experiments and advanced computational calculations called DFT calculations, to confirm the sensing mechanism of the developed technology.

Speaking about the developed technology, Prof. Krishnamoorthy, an expert in Molecular Fluorescence & Spectroscopy, said, "What sets this sensor apart is its versatility. The sensor works not only in lab solutions but also in river and tap water samples, with an accuracy of 75–93%. It can be embedded into paper strips for portable testing and is effective in live cell imaging. In fact, the sensor was used to detect cyanide inside biological cells, showing promise for applications in environmental and forensic investigations."

The researchers also demonstrated that this molecular sensor could function like a basic logic gate, a key element in digital electronics. This means it may have future use in developing smart, sensorbased electronic devices that can detect harmful chemicals like cyanide in real time.

The study, published in Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, was conducted in collaboration with Prof. Bithiah Grace Jaganathan, Department of Bioscience and Bioengineering, IIT Guwahati. Mongoli Brahma was the research scholar involved in the development of this sensor along with other research scholars, Arup Das Kanungo, Minati Das, and Sam P. Mathew.

As the next step, the research group is working on developing a simple kit for testing a variety of analytes.

This development opens new possibilities for easy, rapid, and reliable cyanide detection in environmental, medical, and industrial settings using a cost-effective tool and basic UV light—making it accessible for wide use.

'Minimal' model captures neurons, flow of opinions, exotic matter

Source: The Hindu, Dt. 20 May 2025,

URL: <u>https://www.thehindu.com/sci-tech/science/minimal-model-captures-neurons-flow-of-opinions-exotic-matter/article69590114.ece</u>

Biologists have the fruit fly. Botanists have the thale cress. Neurologists have the roundworm. These are model organisms: plants and animals that scientists in each of these fields study to make sense of almost all other plants and animals in the world.

For example, in the 1990s, Victor Ambros and Gary Ruvkun discovered a new form of RNA called microRNA (miRNA) in the roundworm Caenorhabditis elegans. For revealing that miRNA

regulates genes and allows certain physiological processes in all organisms — including humans — to function properly, Ambros and Ruvkun received the medicine Nobel Prize in 2024.

Similarly, scientists studying recombinant DNA have Escherichia coli, toxicologists have rats, anatomists have zebrafish, those studying hepatitis have rhesus macaques, and so on.

In the same vein, condensed-matter physicists have the Ising model.

A simple, powerful model

The German physicist Ernst Ising created the Ising model in 1924 following a suggestion by his PhD supervisor Wilhelm Lenz. The Ising model provides a simple way to solve problems involving systems where different types of units interact with each other.

For example, say there's a gas of a few million hydrogen atoms trapped in a chamber and a magnetic field is applied. You need to find out how much the energy of the gas has changed. Since each of these atoms itself is like a tiny magnet and has a north pole (or south pole) pointing in some direction, you can represent it as a grid of atoms:

 $\uparrow \uparrow \downarrow \uparrow \uparrow \downarrow \uparrow \uparrow \downarrow \uparrow \downarrow \downarrow \uparrow \downarrow$

... where \uparrow means 'north is pointing up' and \downarrow means 'north is pointing down'. This is a basic instance of the Ising model. You can say that if two neighbouring atoms are $\uparrow \downarrow$ or $\downarrow \uparrow$ (anti-aligned), it entails an energy of X, and if they're $\uparrow \uparrow$ or $\downarrow \downarrow$ (aligned), an energy of Y. This way, you have a simple mathematical way to estimate various values of X and Y throughout the grid and use them to quickly calculate the overall energy.

The Ising model has been used to understand the properties of many solids and liquids in various conditions — including magnetism in metals and alloys and the motion of atoms. Scientists have also used it to simulate land-use change, the flow of opinions in families and religious congregations, and to make sense of neural networks and lay the foundations of modern artificial intelligence (AI). Such work won the US physicist John Hopfield a share of the physics Nobel Prize last year.

Not a two-way street

But for the great applicability and ease of use of the Ising model, there are also many natural systems whose dynamics it doesn't capture. This is disappointing. One important class of systems is where the direction of effect matters. In the first neural network that Hopfield designed, for example, information could flow in either direction in a connection between two nodes in a network. But in a subsequent version called a feedforward neural network, information could only flow from node A to node B, not from B to A. Such networks were important to build AI models with memory.

A new study published in Physical Review Letters has introduced a new form of the classic Ising model that, by incorporating non-reciprocal interactions, could recreate many properties of one-way networks. As a result, the new model can simulate a larger variety of real-world systems, including social networks, political strategies, and ecological dynamics.

Scientists develop models to understand the simplest set of rules required to explain how a given system works at different scales. "While minimalistic," the researchers wrote in their paper, the new model "contains features arising in models of the human brain, opinion dynamics, … and micromechanical oscillators". This means these features' properties can now be explored using the model.

The researchers are Yael Avni, David Martin, Daniel Seara, and Vincenzo Vitelli of the University of Chicago and Michel Fruchart of ESPCI Paris.

If a system has non-reciprocal interactions, it means the relationship between two components is asymmetric. For example, the way atom A affects atom B won't be the same way atom B affects atom A. Such interactions are prevalent in the real world, including in neuroscience, ecology, and active matter.

For example, in a hierarchical network like a political party, party members are influenced by the leader's decision but the leader isn't affected by the members' decisions. In biology, the population of a parasite species could affect the well-being of the host but the reverse relationship need not hold. Similarly, power grids often use one-way signals to manage small parts of the network — including to adjust power flow, detect faults, and to send updates between substations. To understand the behaviour of any of these systems, physicists and engineers need models that can anticipate the effects of asymmetric relationships.

Non-reciprocal systems also often display a phenomenon called a limit cycle: as changes propagate within a system, the entire system develops sustained, time-dependent oscillations. Models like the new non-reciprocal Ising model are required to understand how they evolve over time.

Two rules and one condition

In the new study, the researchers developed a non-reciprocal Ising model with two kinds of atoms, P and Q, each of which can be \uparrow or \downarrow . These atoms are arranged on two grids, one in two dimensions and the other in three dimensions. Both grids follow two rules:

(i) Ps next to Ps and Qs next to Qs tend to align. This means that over time Ps and Qs can form islands of uniform alignment.

(ii) If a P is next to a Q, then the P will try to align with the Q (\uparrow to \uparrow or \downarrow to \downarrow). However, a Q next to a P will tend to become anti-aligned with the P (\uparrow to \downarrow or \downarrow to \uparrow). This is the non-reciprocal interaction.

In the reciprocal Ising model, neighbouring atoms being $\uparrow \downarrow$ or $\downarrow \uparrow$ entailed an energy of X and being $\uparrow \uparrow$ or $\downarrow \downarrow$ entailed an energy of Y. This meant the overall energy of the system would have been some combination of X and Y. When he created his neural network in the 1980s, John Hopfield set up a similar grid, then gave each node in the grid a condition to follow: whether it was \uparrow or \downarrow depended on which state made sure the system's overall energy was lower. By minimising that energy, all the nodes in the network settled down into a given pattern of \uparrow and \downarrow .

Similarly, in the new study, the researchers gave their Ps and Qs a rule to follow. Rather than minimise the overall energy of the grid, each P or Q would have to minimise its own "selfish energy".

A clock in the grid

The properties of this non-reciprocal Ising model, whatever they are, also tell us about real-world setups that are constructed the same way, e.g. information flowing in political parties and parasites and hosts interacting in an ecosystem. So what did the researchers find?

First, they found that at any given time, the non-reciprocal Ising model could have one of three phases: disordered, where the \uparrow s and \downarrow s are all arranged too randomly for there to be an overall 'order'; ordered, where the \uparrow s and \downarrow s have a fixed arrangement that doesn't keep varying; and the swap phase, where which species has the most order — Ps or Qs — keeps alternating over time, like the tick-tock of a clock.

The researchers also found important differences between the 2D and 3D versions of the model. In 2D, both the ordered and the swap phases were suppressed whereas in 3D, the swap phase was able to attain a stable state.

(According to another paper by the same group of researchers published in Physical Review E, the 3D swap phase had the properties of a time crystal. This is wonderfully strange: time crystals are an unusual state of matter in which a material has a stable, oscillating state.)

Finally, the researchers found that if they introduced an asymmetry between Ps and Qs in some form — e.g. the rate at which they flipped from \uparrow to \downarrow or vice versa — the ordered phase was able to stabilise in the 2D grid.

Wealth of applications

The Ising model and various revisions to it revolutionised the study of condensed-matter physics — often by revealing the simple rules lying at the obscured heart of seemingly complex systems. By extending the Ising model to include non-reciprocal interactions, the researchers behind the new studies have now expanded the model's usefulness to more domains across scientific fields.

The phase transitions found in the new model may now reveal hitherto unrecognised dynamics in these domains. The findings also have potential applications in understanding rhythmic activities in biological systems and designing synthetic 'active materials' — which take in energy and perform some function, like bacteria swimming in water, starlings murmurating in mesmerising patterns in the sky, and even microscopic robots figuring out which formation to fly in.

Recycling Breakthrough Turns "Forever Chemicals" Into Renewable Resources

Source: SciTech Daily, Dt. 19 May 2025,

URL: <u>https://scitechdaily.com/recycling-breakthrough-turns-forever-chemicals-into-renewable-resources/</u>

A new technique that uses sound waves to separate materials for recycling could help prevent harmful chemicals from leaching into the environment.

Researchers at the University of Leicester have reached a major breakthrough in fuel cell recycling by developing a method to efficiently separate valuable catalyst materials and fluorinated polymer membranes (PFAS) from catalyst-coated membranes (CCMs).

This advancement tackles significant environmental concerns related to PFAS, often called "forever chemicals," which are known to pollute drinking water and pose serious health risks. The Royal Society of Chemistry has called for government action to lower PFAS levels in UK water supplies.



High-power ultrasound rapidly separates valuable catalyst from underlying polymer membranes in under a minute

Breaking down complex catalyst-coated membranes

Fuel cells and water electrolyzers, essential components of hydrogen-powered energy systems, powering cars, trains and buses, depend on CCMs containing precious platinum group metals. However, the strong adhesion between catalyst layers and PFAS membranes has made recycling difficult.

Researchers at Leicester have developed a scalable method using organic solvent soaking and water ultrasonication to effectively separate these materials, revolutionizing the recycling process.



High-power ultrasound rapidly separates valuable catalyst from underlying polymer membranes in under a minute

Dr Jake Yang from the University of Leicester School of Chemistry said: "This method is simple and scalable. We can now separate PFAS membranes from precious metals without harsh chemicals—revolutionizing how we recycle fuel cells. Fuel cells have been heralded for a long time as the breakthrough technology for clean energy but the high cost of platinum group metals has been seen as a limitation. A circular economy in these metals will bring this breakthough technology one step closer to reality."

Ultrasound blade cuts recycling time to seconds

Building on this success, a follow-up study introduced a continuous delamination process, using a bespoke blade sonotrode that uses high-frequency ultrasound to split the membranes to accelerate recycling.

The process creates bubbles that collapse when subjected to high pressure, meaning the precious catalysts can be separated in seconds at room temperature. The innovative process is both sustainable and economically viable, paving the way for widespread adoption.

This groundbreaking research was carried out in collaboration with Johnson Matthey, a global leader in sustainable technologies. Industry-academia partnerships such as this underscore the importance of collective efforts in driving technological progress.



High-power ultrasound rapidly separates valuable catalyst from underlying polymer membranes in under a minute

Ross Gordon, Principal Research Scientist at Johnson Matthey, said: "The development of highintensity ultrasound to separate catalyst-loaded membranes is a game-changer in how we approach fuel cell recycling. At Johnson Matthey, we are proud to collaborate on pioneering solutions that accelerate the adoption of hydrogen-powered energy while making it more sustainable and economically viable."

As fuel cell demand continues to grow, this breakthrough contributes to the circular economy by enabling efficient recycling of essential clean energy components. The researchers' efforts support a greener and more affordable future for fuel cell technology while addressing pressing environmental challenges.

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