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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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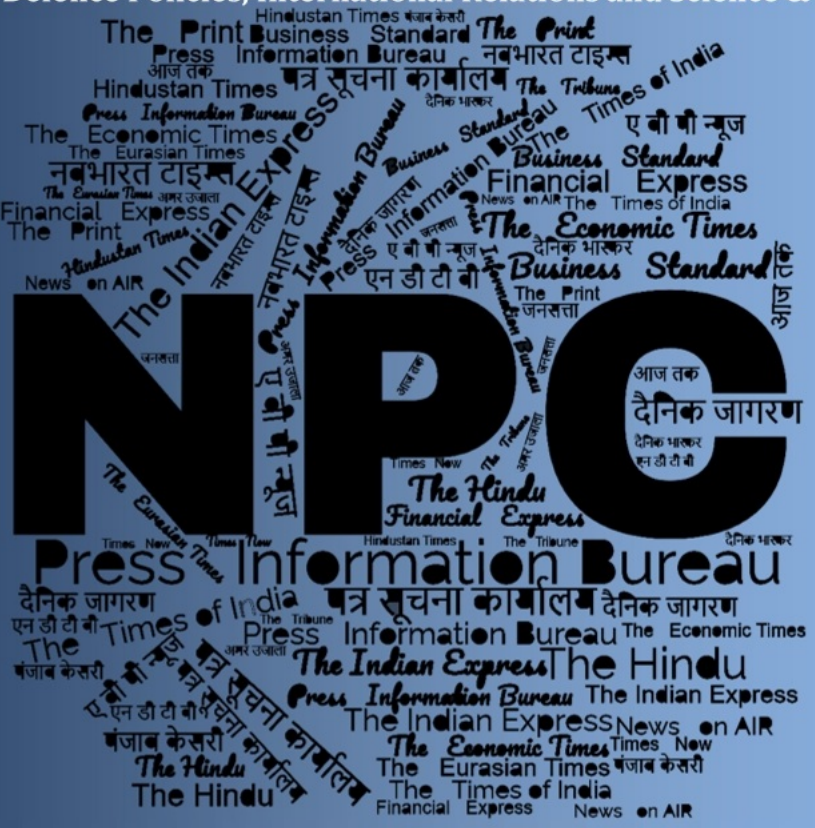

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Defence News

Keel Laying of fourth EX-GSL NGOPV (YARD 1283)

Source: Press Information Bureau, Dt. 09 Jun 2025

Keel Laying ceremony of Yard 1283, the fourth Next Generation Offshore Patrol Vessel (NGOPV) being built by Goa Shipyard Ltd. (GSL) was held on 09 Jun 2025 with Vice Adm Krishna Swaminathan, Vice Chief of the Naval Staff as the Chief Guest in the presence of Shri Brajesh Kumar Upadhyay, CMD, GSL and other senior officials from the Indian Navy and the Shipyard.

Construction of 11 Next Generation Offshore Patrol Vessels (NGOPV) is underway against contracts concluded on 30 Mar 23, wherein seven and four ships are being constructed by GSL, Goa and GRSE, Kolkata respectively.

The NGOPVs, with an approximate tonnage of 3000T, are designed for Coastal Defence and Surveillance, Search and Rescue operations, Protection of Offshore Assets, and Anti-Piracy missions. These ships are being built in consonance with the nation's vision of Aatmanirbhar Bharat and Make in India and are poised to augment the Indian Naval maritime prowess.

https://www.pib.gov.in/PressReleasePage.aspx?PRID=2135188

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How drones are the new face of warfare

Source: The Hindu, Dt. 10 Jun 2025

India's Operation Sindoor in the wake of the Pahalgam terror attack has marked a notable shift in the country's adoption of Unmanned Aerial Vehicles (UAVs) in combat. In combination with standoff weapons, India's use of UAVs in active combat represents a tactical shift in military doctrine — part of a global playbook. Ukraine's Operation Spider Web also marks a turning point in how low-cost, improvised unmanned systems can be employed with strategic impact.

Global precedents

The ubiquitous drone is rapidly becoming the weapon of choice serving as a force multiplier to achieve strategic objectives while blurring the distinctions between military-grade and commercial technologies. Building resilience in drone warfare requires India to build modularity and redundancy in mass produced drones, and nurture a responsive defence production base.

An Indian soldier pictured with a drone at the Akhnoor sector near the Line of Control (LoC) in Jammu region on May 19.

The Nagorno-Karabakh War in 2020 provided one of the first demonstrations of how drones can change the nature of aerial warfare with new capabilities. Azerbaijan's success hinged on the use of loitering munitions or Kamikaze drones, like the Israeli-made Harop drones, in destroying air defences.

Additionally, the war in Ukraine has emerged as a real-world laboratory for drone technology, with rapid innovation and counter innovation cycles defining modern warfare. However, Ukraine's most obvious innovation was the country's ability to produce and deploy a wide variety of drones. In Myanmar also, rebel groups are deploying 3D-printed drones against a better-equipped military, levelling the playing field.

As India continues to reform and modernise its military, learning and applying the right lessons from recent conflicts, including Operation Sindoor, is key. Among New Delhi's adversaries, China already has a large and diverse fleet of unmanned systems, which could provide it with an edge in a potential war along the Line of Actual Control (LAC). Pakistan too has bolstered its unmanned weapons capabilities through collaborations with China and Türkiye.

Drone resilience

Drones are vulnerable to many countermeasures such as electronic warfare, guns and air defences. The impact of drones, therefore, depends on its ability to evade or overwhelm defences against them. Countermeasures against drones in the form of air defences come with limitations and vulnerabilities and can be defeated through a range of technologies and tactics, making innovation and counter-innovation a critical part of drone warfare. India's counter-drone systems include multilayered sensors and weapon systems, as well as indigenously developed soft- and hard-kill counter-UAV systems. Both played a crucial role in thwarting Pakistan's drone and missile attacks in the recent flareup of hostilities.

To evade such systems, drones can, with advanced navigation, be made to adjust flights. Similarly, Artificial Intelligence (AI) and frequency hopping can be used to overcome jamming and spoofing autonomously. For instance, Ukraine has incorporated machine vision algorithms and pre-loaded terrain data to navigate complex routes in order to avoid air defences. By operating at low altitudes, drones can exploit gaps in radar coverage and reduce the likelihood of detection.

Some drones are also designed with electronic warfare features, allowing them to jam or spoof enemy radar and communication systems. These capabilities enhance their survivability and effectiveness in contested environments. Ukrainian developers came up with a simpler solution — tethering a drone to a fibre-optic cable for guidance.

Alternatively, employing a large number of drones and decoys to fly in mass can overwhelm and confuse air defence and surveillance systems. Russia's drone campaign, for instance, makes use of Shahed drones to saturate Ukrainian air defences. It causes dilemmas on the rate of attrition of limited air defence assets, and creates openings for precision strikes.

India's air defence systems tied together under the Integrated Air Command and Control System (IACCS) performed well against numerous Pakistani drones and missile attacks. Boosting procurement and domestic production of munition stocks for its air defence systems (S-400, MR-SAM, Akash, etc) will be key to building magazine depth in any protracted conflict. With regard to the offence debate, given the low survivability rate of current drones, India will need to invest in building volume in its drone and loitering munitions toolkit.

The military-commercial crossover

Ukraine's Operation Spider Web demonstrated that low-cost UAV's combined with accessible technologies and innovative employment strategies can have strategic impact deep into enemy lines. The operation targeted four air bases inflicting damage to Russia's long-range bomber fleet.

The fact that almost any drone can be used and modified to become an offensive weapon, coupled with the widespread use and accessibility of drones, has blurred the distinctions between military-grade and commercial drone systems. Moreover, the indiscriminate use of the term "drones" obscures distinctions in capabilities, intended uses and public perception.

While advanced military-grade drones offer greater capabilities, they also come with higher costs and logistical challenges. Easily available commercial systems, open-source software, and modular engineering have lowered the entry barrier for the adoption of drone technologies. There is a trade-off between adding capabilities to drones and an increase in cost, size, and complexity. For example, drones such as China's Wing Loong, Iran's Shahed, or Turkey's TB-2 incorporate low-cost and dual-use technologies.

Innovation in technology has not been the only novelty in drone use, for manufacturing has also changed. 3D printing is rapidly becoming a key multiplier. For instance, in conflict zones such as Ukraine (Titan Falcon) and Myanmar (The Liberator MK1 and MK2) 3D printers provide alternate sources to mitigate manufacturing shortages. The adaptive employment of off-the-shelf drone technologies by non-state actors is providing states with valuable lessons in asymmetric and low cost aerial capabilities. For example, the U.S. and the U.K. are exploring commercial 3D printing ventures to mass produce drones at scale in order to manufacture bespoke components of weapons systems, thereby bypassing complex, expensive and often slow moving logistics supply chains.

India needs to prepare for the inevitability of easily weaponised commercial drones being used by terrorist organisations and non-state actors against its strategic and civil infrastructure. Counter-drone systems and tactics cannot be the purview of the military alone and should also be prioritised by internal security agencies.

Implications for India

The widespread adoption of drones in warfare signifies a shift in military strategy and operations. By deploying standoff weapons along with drones during Operation Sindoor, India has introduced a layer of strategic ambiguity — one that expands its toolkit vis-a-vis Pakistan in the space between conventional and nuclear. Meanwhile, China's export of drones, among other platforms, to Pakistan adds a layer of complexity to India's security challenge.

China's own drone capabilities are rapidly advancing as significant investments have been made in building up a diverse fleet of drones, including long-range systems like the Soaring Dragon, BZK-005, TB-001, and Wing Loong II alongside affordable kamikaze drones, like the CH-901, designed to overwhelm enemy defences through swarm tactics. This poses a significant and evolving military threat to India along the LAC.

For India, drones complement other weapons and can partially offset capability gaps as part of an asymmetric defence strategy vis-à-vis China. However, India needs to view the wars in Ukraine, Nagorno-Karabakh, and Myanmar as cautionary tales for the need to mass produce an affordable mix of drones.

Of the many lessons from the ongoing war in Ukraine, one stands out — the importance of a defence industrial base that can keep pace with the high-intensity of modern conflict. To fully realise India's drone potential, the Ministry of Defence (MoD) needs to support the defence industrial base to be able to scale production and create surge capacity. The ability to reconstitute and quickly replace drones, loitering munitions after losses, and surface-to-air missiles will make India more resilient.

India's anaemic procurement of systems has generally discouraged industry from ramping up its production capacity. Addressing underlying structural issues that lead to uncertain demand is key in order to incentivise industry to ramp up production capacity and innovation in defence.

https://www.thehindu.com/news/national/how-drones-are-the-new-face-of-warfare/article69674623.ece

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Army to get new air defence boost with Rs 30,000 crore QR-SAM deal

Source: The Times of India, Dt. 10 Jun 2025

The defence ministry will soon take up the case for a preliminary nod to a Rs 30,000 crore proposal to procure three regiments of the new indigenous quick reaction surface to air missile (QR-SAM) systems for the Army.

The Rajnath Singh-led defence acquisitions council will consider granting acceptance of necessity (AoN) for the highly-mobile QR-SAM systems, which are designed to intercept hostile fighters, helicopters and drones at a range up to 25-30 km, later this month.

The move comes soon after India's existing multi-layered air defence network played a crucial role in thwarting multiple waves of Turkish-origin drones and Chinese missiles launched by Pakistan during Operation Sindoor - the May 7-10 hostilities.

The DRDO and the Army have over the last three-four years tested the QR-SAM systems against high-speed aerial targets mimicking various types of threats to evaluate their capability under different day and night operational scenarios. Defence PSUs Bharat Electronics and Bharat Dynamics will co-produce the QR-SAM systems.

"The QR-SAM systems can operate on the move with search and track capability and fire at short halts. They are tailor-made to move along with tanks and infantry combat vehicles to provide them air defence in the tactical battlefield," an official said.

The Army Air Defence (AAD), which performed exceedingly well during Operation Sindoor, in fact, requires 11 regiments of the QR-SAM, even as it progressively also inducts regiments of the indigenous Akash system, which has an interception range of about 25-km at present.

The induction of the QR-SAM systems will add to the existing air defence network of the IAF and the Army, which ranges from the long-range Russian S-400 'Triumf' surface-to-air missile systems (380 km interception range) and Barak-8 medium range SAM systems (70 km), jointly developed with Israel, to the Russian shoulder-fired Igla-S missiles (6 km), the upgraded L-70 anti-aircraft guns (3.5 km) and the indigenous integrated drone detection and interdiction systems (1km-2 km).

While the DRDO is also readying the very short-range air defence missile systems (VSHORADS), which have a 6 km interception range, the real game-changer will be an air defence system with a 350 km range being developed under the ambitious Project Kusha.

India plans to operationally deploy this long-range system by 2028-2029, with the defence ministry in Sept 2023 approving the AoN for procurement of five of its squadrons for the IAF at a cost of Rs 21,700 crore, as was first reported by TOI.

https://timesofindia.indiatimes.com/india/army-to-get-new-air-defence-boost-with-rs-30000-crore-qr-sam-deal/articleshow/121737382.cms

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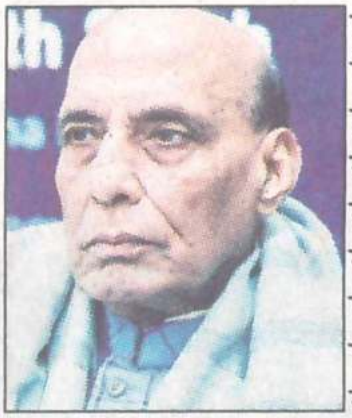
रक्षा क्षेत्र में आत्मनिर्भर बना देश: राजनाथ

Source: Punjab Kesari, Dt. 10 Jun 2025



नई दिल्ली, (पंजाब केसरी): नरेंद्र मोदी ने भारत के प्रधानमंत्री के रूप में 9 जून को 11 साल पूरे कर लिए। इस अवसर पर रक्षा मंत्री राजनाथ सिंह ने कहा कि पिछले 11 साल में नरेंद्र मोदी के नेतृत्व में हम रक्षा क्षेत्र में आत्मनिर्भर बने हैं। सोशल मीडिया प्लेटफॉर्म एक्स पर राजनाथ सिंह ने लिखा, प्रधानमंत्री नरेंद्र मोदी के 'आत्मनिर्भर भारत' के दृष्टिकोण से प्रेरित होकर रक्षा क्षेत्र आत्मनिर्भरता की ओर मजबूती से आगे बढ़ा है। भारत अब दुनिया की शीर्ष पांच अर्थव्यवस्थाओं में गर्व से खड़ा है। देश आज हर कीमत पर अपनी संप्रभुता और क्षेत्रीय अखंडता की रक्षा करने के अपने संकल्प में पूरी तरह से सुसज्जित, आश्वस्त और अडिग है। राजनाथ सिंह ने लिखा, 11 साल हमारे उन स्वतंत्रता सेनानियों और संविधान निर्माताओं के सपनों को साकार करने की कहानी है, जिन्होंने एक ऐसे लोकतंत्र की कल्पना की थी, जो न केवल राजनीतिक हो, बल्कि सामाजिक और आर्थिक प्रकृति का भी हो। प्रधानमंत्री मोदी के गतिशील नेतृत्व में, भारत न केवल प्रगति कर रहा है, बल्कि राष्ट्रों के समुदाय में अपना उचित स्थान पाने के लिए आगे बढ़ रहा है। आखिर में रक्षा मंत्री ने लिखा, उल्लेखनीय 11 साल पूरे होने पर, मैं हर उस भारतीय को बधाई देता हूं, जो इस विकास की कहानी, विकास यात्रा और इतिहास निर्माण का गौरवशाली हिस्सा रहा। हम सब मिलकर और अधिक मजबूत, गौरवान्वित भारत के लिए एकजुट होकर आगे बढ़ते हैं। पुरी से लोकसभा सांसद संबित पात्रा ने भी नरेंद्र मोदी के 11 साल पूरे करने पर सोशल मीडिया प्लेटफॉर्म 'एक्स' पर एक मिनट तीन सेकंड का वीडियो साझा किया है।

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The dragon's shadow on India-Pak conflict

-by Lt Gen Syed Ata Hasnain, Retd

Source: The Tribune, Dt. 10 Jun 2025

LT GEN SYED ATA HASNAIN (RETD)
EX-GOC, 15 CORPS, AND
CHANCELLOR, CENTRAL
UNIVERSITY OF KASHMIR

MUCH has been said and written about the Pahalgam terror attack of April 2025 and the subsequent Indian military response under Operation Sindoor. Analysts have dissected Pakistan's motivations, the tactical build-up and India's assertive countermeasures. However, mostly missing from much of this debate is the one power that did not feature in the headlines, but perhaps emerged with the greatest strategic dividend — China.

China may not have launched drones or mobilised troops during the crisis, but its fingerprints are increasingly visible in the architecture of instability that surrounds India's western border. Understanding how and why China benefits from these episodes requires us to step back from the immediate headlines and look at the longer arc of Beijing's strategy; a virtual back-to-basics kind of analysis.

China's interest in Pakistan-Occupied Kashmir (PoK) and Gilgit-Baltistan is not incidental. These are critical arteries for the China-Pakistan Economic Corridor, which, in turn, forms a backbone of China's Belt and Road Initiative. Beijing has invested billions of dollars into this corridor, which passes through territory that India rightly claims as its own. It is, thus, in China's interest to ensure that this region remains out of Indian hands. Every spike in Kashmir-related tensions helps Beijing secure its economic assets in the region. It creates a justification — at least in China's narrative — for further involvement in Gilgit-Baltistan and closer defence ties with Pakistan, which are always packaged under the guise of "regional stability." In many ways, Pakistan's economic waywardness and its focus on asymmetry as a weapon appears to be appreciated by China for its own interests.

The strategic calculus doesn't stop there. China's anxieties about India are rooted in its own vulnerabilities in the maritime domain. For years, Beijing has been concerned about what it calls the "Malacca Dilemma" — the fact that a large proportion of its energy and trade routes pass through the Malacca Strait and the wider Indian Ocean, both areas where India and its Quad partners have growing influence. A confident and assertive India, expanding its naval footprint from the Gulf of Aden to the Strait of Sunda, poses a silent but serious challenge to Chinese geoeconomic ambitions.

CHINA'S ASSET: Gilgit-Baltistan is critical for the China-Pakistan Economic Corridor. REUTERS

This anxiety is not theoretical. It explains why China has repeatedly tried to pin India down on the continental front. The 2017 Doklam standoff and the 2020 Eastern Ladakh crisis were not isolated events. Both were calibrated attempts to stifle India's strategic rise without inviting full-scale war. Doklam was a signal over the Siliguri Corridor — an attempt to test India's resolve in protecting a narrow but vital link to its northeast. Eastern Ladakh was a broader attempt to alter the status quo under the pretext of border disagreements, but the underlying message was unmistakable: curb India's momentum, dilute its confidence and tie down its forces in high-altitude deadlock.

The 2020 misadventure in eastern Ladakh, in particular, was a telling moment. China likely expected that its rapid deployments and creeping intrusions would coerce India into negotiation. Instead, India responded with a firm resolve, force build-up and counter-posturing. However, even without achieving its immediate tactical aim, only enhanced assertiveness, Beijing succeeded in forcing Indian diversion of attention and resources.

> In Beijing's vision of the region, a distracted India is a manageable India. And, that is the shadow war that India must prepare itself to counter.

A similar logic applies to Pakistan's role in stoking the Kashmir conflict. The message is simple: if India can be kept engaged on its western frontier, it cannot exert sustained influence in the maritime theatre or beyond South Asia.

Pakistan plays this role with a mix of its own motivations and China's backing. The timing and scale of the Pahalgam attack, its sophistication and the broader ecosystem of disin-

formation that accompanied it suggest that this was no rogue action. It fit well into a pattern of hybrid warfare, where conventional and non-conventional tactics are blended, supported by external intelligence, surveillance and cyber capabilities. While there is no direct evidence of China's operational involvement in the planning or execution of the attack, one cannot ignore the cumulative technological edge that Pakistan has acquired through Chinese aid. From drone systems to cyber capabilities and ISR (Intelligence, Surveillance and Reconnaissance) tools, China has quietly helped Pakistan modernise in ways that are changing the character of conflict in J&K.

Post Pahalgam attack, China remained conspicuously silent. There was no condemnation of the terror strike. No expression of concern over the loss of civilian lives. No outreach to de-escalate. In international forums, Beijing offered Pakistan the usual diplomatic cover, just as it has done in the past — be it over the greylisting at the FATF or the UN resolutions on terrorism. This silence is not a neutral stance. It is a signal. China backs its proxy not just with technology and investment, but also with silence when it matters most.

Beyond the tactical and diplomatic realms, China's role in narrative warfare must also be noted. In the days following Operation Sindoor, various fringe and proxy media platforms began to push stories that sought to undermine India's unity, question the legitimacy of its actions and reframe J&K as an "unresolved global concern." Many of these narratives echo themes that China itself has promoted — non-interference, multilateral resolution and the myth of regional destabilisation by unilateral Indian actions. The lines between Pakistani propaganda, Chinese influence and third-party media manipulation are increasingly blurred.

All this points to a cold and calculated approach by China. It seeks to maintain a strategic advantage over India through actions that do not trigger open conflict. It avoids confrontation because the international system today does not give it the bandwidth to manage a war or have any guarantee of victory. Instead, it chooses a strategy of pressure by proxy. Pakistan serves as the visible actor, but China is the actual player reaping the dividends.

Operation Sindoor may have begun as a response to Pakistani aggression, but its strategic implications go far beyond the LoC.

For India, the challenge lies in recognising that behind the overt threats lie deeper, more patient adversaries — ones who understand that the best victories are those won without fighting (China's core belief). In Beijing's vision of the region, a distracted India is a manageable India. And, that is the shadow war that India must prepare itself to counter.

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Troop deployment along LoC remains intact despite ceasefire

Source: The Tribune, Dt. 10 Jun 2025

A month after India and Pakistan agreed to pause hostilities, the Army's operational readiness along the Line of Control (LoC) remains unchanged since the launch of Operation Sindoor on May 7. Field commanders have been authorised to respond to any violations by Pakistan, officials said.

The ceasefire was agreed upon on May 10, following a call from Pakistan's Director General of Military Operations (DGMO) to his Indian counterpart, Lt Gen Rajiv Ghai.

Despite the truce, India has maintained its force posture along the international border, particularly to deter any retaliatory moves by the Pakistan Army following the Indian Air Force (IAF)'s strikes on 11 Pakistani airbases.

Along the international border spanning Jammu & Kashmir, Punjab, Rajasthan and Gujarat, troop deployment remains intact. Sources said while the frequency of drills may vary based on threat perception, readiness levels are continuously calibrated to ensure swift response in case of escalation.

"The drills help fine-tune each unit's response in a real-time conflict scenario," a senior official said.

Chief of Defence Staff General Anil Chauhan has already stated that "Operation Sindoor is still on". While the ceasefire remains in effect, Indian surveillance assets, including land-based radars and coastal systems, continue to monitor for any unusual activity. The IAF's air defence network remains on high alert for potential aerial threats.

India launched Operation Sindoor to target terror infrastructure in Pakistan and Pakistan-occupied Kashmir (PoK). The operation triggered a sharp response from Pakistan, which launched missile attacks on Indian airbases. This led to intense military exchanges before diplomatic interventions led to a cessation of hostilities across land, air and sea.

Following the ceasefire, India adopted a firm strategic stance, reinforcing its zero-tolerance policy towards terrorism and ramping up international diplomatic outreach. As part of this effort, New

Delhi dispatched multi-party delegations to 33 global capitals to explain the rationale behind Operation Sindoor and counter Pakistan's disinformation campaign.

Prime Minister Narendra Modi has since declared that such preemptive and punitive operations would be the "new normal", signalling India's resolve to take decisive action against cross-border terrorism when necessary.

https://www.tribuneindia.com/news/india/troop-deployment-along-loc-remains-intact-despite-ceasefire/

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Science & Technology News

Axiom-4, piloted by Shubhanshu Shukla, delayed; launch June 11

Source: The Indian Express, Dt. 10 Jun 2025

AS GROUP Captain Shubhanshu Shukla gets ready to become the first Indian to go to space in over 40 years, an 18-member team from the Indian Space Research Organisation (ISRO), led by chairman V Narayanan, has reached NASA's Kennedy Space Center in Florida to witness the launch of Axiom-4 mission, which has been postponed by a day due to weather conditions. It is now set for lift-off on Wednesday, 5.30 pm India time.

Astronauts Tibor Kapu (Hungary), Shubhanshu Shukla (India), Peggy Whitson (US) and Slawosz Uznanski-Wisniewski (Poland) on Sunday after a rehearsal of launch day activities

Shukla is the designated pilot for the Axiom-4 mission that will travel to the International Space Station (ISS) — after a journey of 28 hours in space. The mission's Crew Dragon spacecraft is

scheduled to dock with ISS around 10 pm India time on Thursday. The transfer of astronauts, from the spacecraft to the ISS, could take another couple of hours after the docking. Shukla is the first Indian to go to the ISS, a permanent space laboratory, that has been orbiting the Earth for the last 25 years, and is constantly manned by astronauts. He is only the second Indian to go to space, more than 40 years after Rakesh Sharma went on a Soviet mission in 1984.

“We are all very excited right now. This is a very important mission for ISRO. This will increase our exposure and confidence for our own Gaganyaan (human spaceflight) mission,” Narayanan told The Indian Express from Florida. Shukla’s participation in the Axiom-4 mission has been facilitated by an agreement between ISRO and NASA. Axiom Space, a private US company, has been enabled by NASA to carry crewed missions to the ISS as part of the effort to encourage private sector participation in space transportation, to low-Earth orbits and the ISS. NASA allows the use of its infrastructure and training facilities for these missions.

Axiom-4 is carrying four astronauts who will spend two weeks at the ISS. Besides Shukla, there is an astronaut each from Poland and Hungary, countries that, like India, are returning to space travel after over four decades. This is the reason why the theme of the mission is ‘Realize the Return’. The fourth member, also the commander of the mission, is space travel veteran Peggy Whitson, who holds the record for spending the maximum number of days, 675, in space over multiple trips.

Shukla’s flight comes months ahead of the scheduled launch of Gaganyaan mission, which is ISRO’s maiden attempt at sending a crewed mission to the Moon. In fact, Shukla had been selected and trained for the Gaganyaan programme, along with three others. But, the Axiom-4 opportunity intervened, and Shukla got the chance to travel earlier than his colleagues.

“So far, we only had the experience of Rakesh Sharma for space travel. At that time (1984), we did not have a human spaceflight of our own, but now we do. And Shukla’s experience would be very important for that. It is a great learning opportunity,” Narayanan said. Shukla, referred to as Shux by his crew mates, will conduct seven experiments designed by ISRO for this mission. He will participate in several other international science experiments during his stay at ISS. From the space station, he will also interact with students, academia, people from the budding Indian space industry, and dignitaries.

Hailing from Lucknow, Shukla has previously said that he would be embarking on the journey on behalf of 1.4 billion people. Science and Technology Minister Jitendra Singh, who also has the charge of Department of Space, said the entire country was looking forward to Shukla’s flight.

“While all four astronauts were trained for the country’s Gaganyaan mission, the offer for this collaboration (with Axiom) came during the Prime Minister’s visit to the Washington in 2023. What we learn during this mission will be important not only for the human spaceflight mission, but also for our planned Chandrayaan-4 and Bharatiya Antariksh Station missions,” Jitendra Singh told The Indian Express. There are some key differences between the Axiom-4 mission and the spaceflight undertaken by Rakesh Sharma in 1984.

India now has its own human spaceflight mission in the works — the rocket has been human rated, the crew escape systems and parachutes have been tested in various conditions, the astronauts have completed their training. India’s first crewed mission is scheduled for 2027. And, the learnings from the Axiom-4 mission will feed into it.

“When Rakesh Sharma went to space in 1984, India did not even have a launch pad. The first launch pad came up in 1993 and the second in 2005. Now, we are already gearing up for our own human mission. India is now a partner and is at the forefront of research,” said Singh, adding that

Shukla was the second most important person on the mission. At the time, the country only had one launch vehicle, the now-retired SLV.

“During the current mission, the astronauts will also be docking with and undocking from the International Space Station, an experience that will be extremely important for our planned Chandrayaan-4 mission as well as the Bharatiya Antariksh Station, both of which will require multiple dockings and undockings,” Singh said.

He added that India is also carrying out cutting-edge research, including several life sciences and biomedical research, that will not only help India but inform other human spaceflight missions as well. While Rakesh Sharma’s flight was a Soviet diplomatic programme, Interkosmos, meant to help its allies with spaceflight, the current mission is a commercial one. India has paid around Rs 50 crore to cover the cost of Shukla’s training, travel and stay at the ISS.

The first mission to ISS by Axiom Space — a private company that plans to set up its own space station — took place in April 2022. The second mission was in May 2023, with the first woman commander for a commercial spaceflight. And, the third took place in January 2024.

https://indianexpress.com/article/india/axiom-4-piloted-by-shubhanshu-shukla-delayed-launch-june-11-10057471/

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India comes of space age again: Group Capt Shukla set to fly out on NASA spaceflight tomorrow

Source: The Economic Times, Dt. 10 Jun 2025

It’s been a long time coming —41 years, to be precise. On April 3, 1984, Wing Commander Rakesh Sharma became the first Indian in space. He flew aboard the erstwhile Soviet Union’s Soyuz spacecraft to Salyut-7 space station and spent nearly eight days orbiting the planet.

On Wednesday, 15,044 days later, Indian Air Force Group Captain Shubhanshu Shukla is scheduled to be launched into space as pilot on the Nasa/SpaceX/ Axiom Mission 4 (Ax-4) to the International Space Station (ISS). Once the 40-year-old crosses the Kármán Line — defined as the boundary between earth's atmosphere and outer space, at a distance of 100 km from the surface — he will become the first Indian to be part of a Nasa mission.

The Lucknow-born test pilot will also become the second — or third — Indian in space, depending on whether you count space tourist Gopichand Thotakura, something on which space nuts are divided. Thotakura crossed the Kármán Line for a few seconds last year on a Blue Origin spacecraft as an astronaut.

Other oft-repeated names such as Kalpana Chawla, Sunita Williams, Raja Chari and Sirisha Bandla were or are US citizens of Indian origin. Last year, four were shortlisted for India’s Gaganyaan spaceflight mission. They are Group Captains Prashanth Nair, Angad Prathap, Ajit Krishnan and Shubhanshu Shukla.

The latter’s experience aboard Ax-4 should prove invaluable as the Indian Space Research Organisation (Isro) prepares for that journey. The Gaganyaan mission is slated to take off in 2027.

“I grew up reading about him in textbooks, and listening to his stories from space,” says Shukla, referring to Sharma in a video on the Axiom Space website. Shukla came to know he was the chosen one for this mission just a week before he came to Axiom Space’s facilities in the US.

“You don’t know how to respond to such things,” he says in the video, beaming.

Isro had hailed the move as “a significant milestone toward the goal of mounting a joint Isro-Nasa effort to the ISS, as envisioned in the India-US joint statement during the official state visit of Prime Minister Narendra Modi to the US in June 2023.” That statement was released during the signing of the Space Flight Agreement between Axiom Space, a private space company, and Isro, to fly an Indian astronaut aboard the mission.

What is not well known is that this mission marks the rekindling of human spaceflight cooperation between Nasa and Isro after more than four decades. This is not the first time an Indian was scheduled to fly on a US spacecraft. Back in the early 1980s, Isro scientists P Radhakrishnan and NC Bhat received extensive training and were scheduled to become astronauts with Nasa on space shuttle missions in the second half of the eighties.

The Challenger disaster on January 28, 1986, that killed all seven crew members, meant that those plans never came to fruition, as space shuttle missions were halted for 32 months. There is another little-known name on the list of Indians who missed flying to space in the 1980s—Ravish Malhotra. In 1982, he was chosen for spaceflight training under the Soviet Union's Interkosmos programme, along with Sharma. Malhotra served as backup for Sharma but never went to space himself.

ISRO is currently working on the Gaganyaan mission, with a number of tests of various systems and subsystems scheduled for later this year.

https://economictimes.indiatimes.com/news/science/india-comes-of-space-age-again-group-capt-shukla-set-to-fly-out-on-nasa-spaceflight-tomorrow/articleshow/121737155.cms?from=mdr

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शुभांशु शुक्ला को लेकर अब कल अंतरिक्ष रावण होगा ड्रैगन

Source: Jansatta, Dt. 10 Jun 2025

जनसत्ता ब्यूरो
नई दिल्ली, 9 जून।

भारतीय वायुसेना के पायलट शुभांशु शुक्ला को अंतरिक्ष में लेकर जाने वाले 'एक्सिओम स्पेस' का प्रक्षेपण एक दिन के लिए टल गया है। अब इसका प्रक्षेपण 11 जून को भारतीय समय के अनुसार शाम 5:30 बजे होगा।

यह दूसरा मौका है जब प्रक्षेपण टला है। पहले यह आठ जून को होना था। भारतीय अंतरिक्ष अनुसंधान संगठन (इसरो) ने एक्स पर बताया कि मौसम की स्थिति के कारण, भारतीय गगनयात्री **बाकी पेज ८ पर**

खराब मौसम से एक दिन टली रवानगी

उड़ान से पहले पूर्वाभ्यास के दौरान अंतरिक्ष यात्री तिबोर कापू (हंगरी), शुभांशु शुक्ला (भारत), पेगी विटसन (अमेरिका) एवं स्लावोज (पोलैंड)।

को अंतरराष्ट्रीय अंतरिक्ष स्टेशन (आइएसएस) पर भेजने के लिए एक्सिओम-4 मिशन का प्रक्षेपण 10 जून, 2025 से 11 जून, 2025 तक स्थगित कर दिया गया है। अब प्रक्षेपण 11 जून को शाम 5:30 बजे होगा। इससे पहले इसरो ने एक्स पर लिखा था, 'इसरो-नासा मिशन आइएसएस' भारत अंतरराष्ट्रीय अंतरिक्ष स्टेशन की ओर!'

विंग कमांडर राकेश शर्मा के 41 साल बाद भारत एक और अंतरिक्ष यात्री को मानव मिशन के तहत अंतरिक्ष भेजने जा रहा है। भारतीय वायुसेना के पायलट शुभांशु शुक्ला अब 'एक्सिओम स्पेस' के 'एएक्स-4' मिशन के पायलट बनकर अंतरिक्ष में जा रहे हैं। ग्रुप कैप्टन शुक्ला ने अपने प्रस्थान से पहले उत्साहवर्धक संदेश साझा किया।

वहीं, 'एक्सिओम स्पेस' की ओर से जारी वीडियो में उनकी तकनीकी दक्षता की प्रशंसा की गई और उन्हें 15 वर्षों से लड़ाकू विमान पायलट बताया गया। अपने संदेश में ग्रुप कैप्टन शुभांशु शुक्ला कहते हैं, 'नमस्ते। मैं ग्रुप कैप्टन शुभांशु शुक्ला हूं। पहले भारतीय अंतरिक्ष यात्री विंग कमांडर राकेश शर्मा ने 1984 में अंतरिक्ष की यात्रा की थी। मैं उनके बारे में किताबों में पढ़कर और अंतरिक्ष से जुड़ी उनकी कहानियां सुनकर बड़ा हुआ हूं। मैं उनसे बहुत, बहुत प्रभावित हुआ। यह यात्रा जिस पर मैं हूं, मेरे लिए बहुत लंबी रही है। इसकी शुरुआत यहीं से हुई थी।'

उन्होंने कहा, 'मुझे नहीं पता था कि अंततः यही वह रास्ता है जिस पर मुझे चलना है। मैं कहूंगा कि मैं बेहद भाग्यशाली रहा हूं कि मुझे पहले पूरे जीवन उड़ान भरने का अवसर मिला, जो मेरे लिए एक सपना था और फिर अंतरिक्ष यात्री कोर में आवेदन करने का अवसर मिला और अब परिणामस्वरूप यहां हूं।'

उन्होंने कहा कि 'एक्सिओम' पहुंचने से एक सप्ताह पहले ही मुझे पता चल गया कि मैं वहां जा रहा हूं। मैं यहां आकर बेहद उत्साहित था। मैं बहुत खुश था क्योंकि यह मेरे लिए अंतरिक्ष में उड़ान भरने की संभावना को लेकर आया। मैं नहीं जानता कि ऐसी चीजों पर कैसे प्रतिक्रिया दी जाए। ग्रुप कैप्टन

शुभांशु शुक्ला 'एक्सिओम स्पेस' के चौथे निजी अंतरिक्ष यात्री मिशन (एक्स-4) का हिस्सा हैं, जो नासा के साथ भारत के अंतरिक्ष सहयोग के लिए एक ऐतिहासिक क्षण है।

एक्सिओम स्पेस के अनुसार, एक्स-4 मिशन भारत, पोलैंड और हंगरी के लिए मानव अंतरिक्ष उड़ान की 'वापसी' को साकार करेगा, जो 40 से अधिक वर्षों में प्रत्येक देश की पहली सरकार प्रायोजित उड़ान होगी।

यद्यपि यह इन देशों के लिए इतिहास में दूसरा मानव अंतरिक्ष उड़ान मिशन है, लेकिन यह पहली बार होगा जब तीनों देश अंतरराष्ट्रीय अंतरिक्ष स्टेशन पर मिशन को अंजाम देंगे। यह ऐतिहासिक मिशन इस बात पर प्रकाश डालता है कि किस प्रकार 'एक्सिओम स्पेस' पृथ्वी की निचली कक्षा तक पहुंच को पुनर्परिभाषित कर रहा है तथा राष्ट्रीय अंतरिक्ष कार्यक्रमों को वैश्विक स्तर पर आगे बढ़ा रहा है। यह मिशन 60 शोध करेगा।

मिशन पर अपने साथ जा रहे दल के बारे में बताते हुए ग्रुप कैप्टन शुक्ला ने कहा कि मैं जिस दल के साथ इस मिशन पर जा रहा हूं, वह शानदार है। मुझे लगता है कि मेरे पास असाधारण दल है। उन्होंने कहा कि ये सदस्य मेरे साथ इस एक उड़ान पर रहेंगे लेकिन इस मिशन के बाद ये मेरे जीवन भर के दोस्त बन जाएंगे।

उन्होंने कहा कि अभी तक की यात्रा अद्भुत रही है। ये ऐसे पल हैं जो वास्तव में आपको बताते हैं कि आप किसी ऐसी चीज का हिस्सा बन रहे हैं जो आपसे कहीं अधिक बड़ी है। मैं केवल इतना कह सकता हूं कि मैं इसका हिस्सा बनकर भाग्यशाली महसूस कर रहा हूं।

ग्रुप कैप्टन शुक्ला ने कहा कि यह मेरे मिशन के माध्यम से मेरा ईमानदार प्रयास है कि मैं देश की एक पूरी पीढ़ी को प्रेरित करूं। मैं इस अवसर का उपयोग बच्चों में जिज्ञासा जगाने के लिए करना चाहता हूं। अगर यह कहानी, मेरी कहानी, किसी एक की जिंदगी बदलने में भी सक्षम है, तो यह मेरे लिए बहुत बड़ी सफलता होगी।

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Axiom-4 will represent India's readiness in space exploration

Source: The Times of India, Dt. 10 Jun 2025

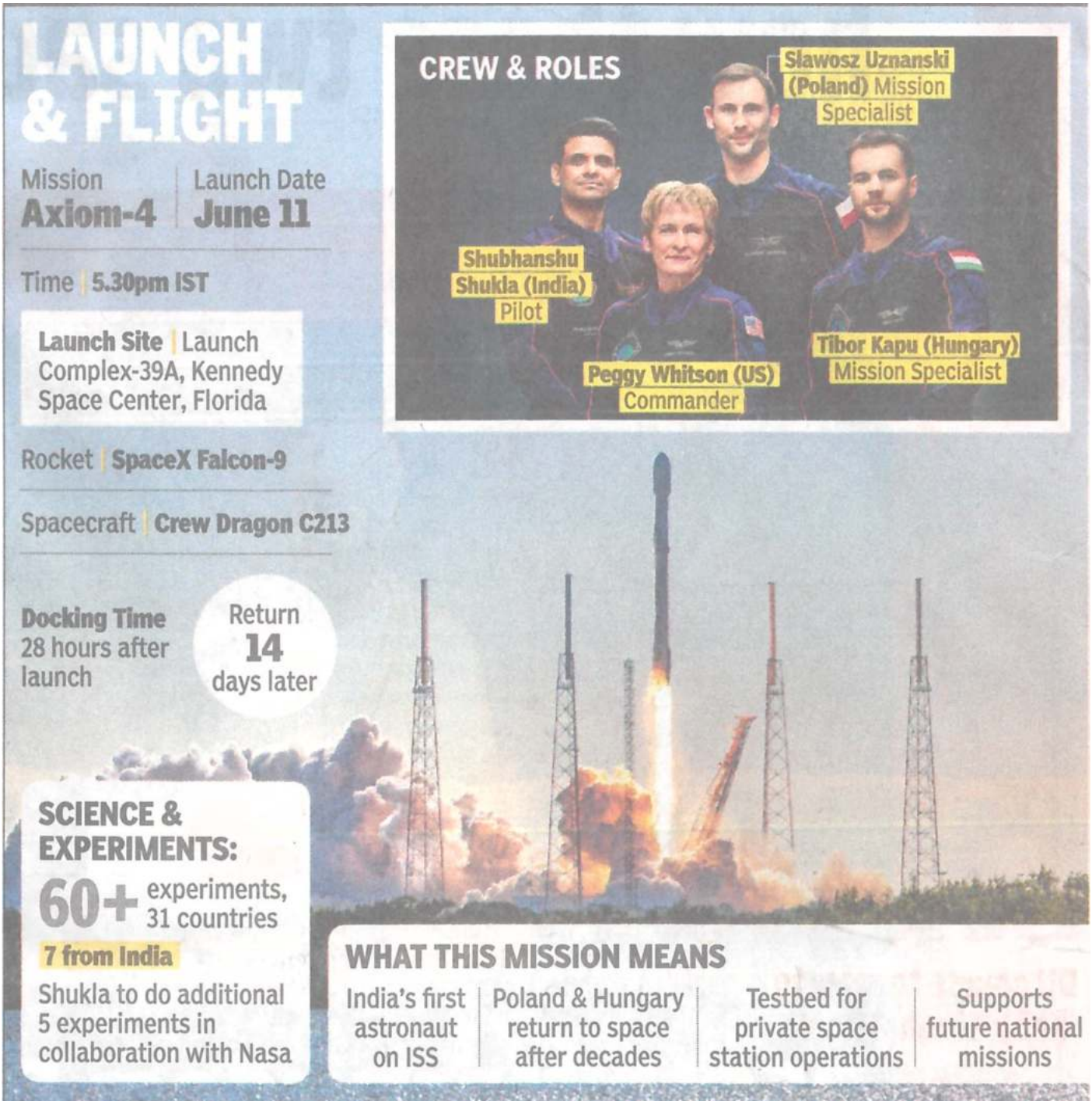
Four decades after Wing Commander Rakesh Sharma touched the stars, history beckons India again as Group Captain Shubhanshu Shukla prepares to buckle into SpaceX's Dragon capsule for lift-off from Kennedy Space Centre's (KSC) Launch Complex-39A at 8am Eastern Time (5.30pm IST) on Wednesday.

As designated pilot of the Axiom-4 mission, Shukla will become only the second Indian to reach space, and the first to serve in a critical operational role aboard the ISS. "Even stars are attainable," he said last week about being primed for the mission. Shukla iterated he won't be carrying just instruments and equipment, but the "hopes and dreams of a billion hearts".

While Wg Cdr Sharma was India's space torchbearer, Shukla's mission represents a quantum leap. He's not merely flying to space; he will be a pilot on one of the most research-intensive commercial missions to the ISS ever attempted.

The four-member crew will spend about 14 days aboard the ISS, during which they will carry out more than 60 science experiments, including seven from India. These include experiments on

metabolic diseases, microgravity's effects on muscle and plant growth, microbial behaviour, cognitive function, and materials testing. Researchers from more than 30 countries have contributed to the mission payload.



The crew includes veteran astronaut Peggy Whitson (US) as commander, Polish engineer Slawosz Uznanski, Hungarian researcher Tibor Kapu, and Shukla, an IAF test pilot, whose role is part of a broader Indian ambition to gain spaceflight experience ahead of the Gaganyaan programme, the country's first crewed space mission.

SpaceX's Dragon capsule, designated C213, will take roughly 28 hours after being in orbit to reach the ISS. Once their science experiments are complete, the crew will undock and splash down off the coast of California.

Shukla's responsibilities encompass monitoring critical flight systems, executing manual docking procedures, if required, and supporting crew safety during launch and return. His extensive

preparation spans months of training with Axiom, Nasa, ESA and SpaceX for this mission. He was also in Russia's Gagarin Centre as part of Gaganyaan, adding to 2,000-odd flying hours as a test pilot.

Axiom-4 builds on India's long history of international space cooperation. From joint missions with Russia to partnerships with CNES (French space agency), Nasa, ESA and Jaxa (Japanese), to name a few, the country has consistently worked within global frameworks. When Dragon docks with the ISS on June 12, Shukla won't just represent India, he will demonstrate India's readiness for expanded operational roles in space exploration.

https://timesofindia.indiatimes.com/science/axiom-4-will-represent-indias-readiness-in-space-exploration/articleshow/121739585.cms

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Expert Explains: Why Axiom-4 matters

Source: The Indian Express, Dt. 10 Jun 2025

The travel of Indian astronaut Shubhanshu Shukla to the International Space Station (ISS) on the Axiom-4 mission this week marks the beginning of a new era in Indian space. In the last few years, the Indian Space Research Organisation (ISRO) has carried out a number of important missions that have placed India in a very small group of countries with cutting-edge space capabilities. The Moon-landing that ISRO achieved with the Chandrayaan-3 was the highlight of these efforts.

With Shukla's flight, we are moving into the next gear. This might still not be our own human spaceflight mission, which is supposed to happen very soon, but it is not as though we are just hitching a ride on someone else's mission. The Axiom-4 mission is closely integrated with our own space plans, and will provide some critical inputs to the Gaganyaan mission and other missions to follow.

Rakesh Sharma to Shubhanshu Shukla, India's space story

I remember how excited people of my generation were when Rakesh Sharma went into space on a Russian mission in 1984. It was a very big event. It showed where we wanted to be, and what our aspirations were.

But that event happened when India's space program was still in its very early stages. We did not have the infrastructure and the capability to make productive use of Sharma's achievement. We also did not have a definitive plan or roadmap for the future: a human spaceflight was not on the horizon. Sharma's achievement became an isolated event of sorts.

This is where Shukla's flight is fundamentally different. Sharma's flight had huge symbolic and inspirational value. Shukla's flight will have practical uses as well. ISRO has, in the intervening years, emerged as one of the leading space agencies of the world with the ability to execute very complex missions. Human spaceflight is one of the few remaining frontiers that ISRO still has to conquer.

In fact, if Gaganyaan had followed its original schedule — 2022 was a very ambitious deadline — we would already have sent humans into space by now. But it is just as well that the Axiom-4 mission is happening before that. We will benefit from Shukla's experience and learnings.

1. SLAWOSZ UZNANSKI-WISNIEWSKI
Mission Specialist, Polish

Scientist and engineer, was member of European Space Agency's Astronaut Reserve Class of 2022. Has made significant contributions at the European Organization for Nuclear Research (CERN) in Geneva, where he served as a reliability expert and project lead. From 2018 to 2020, was Engineer in Charge for the Large Hadron Collider (LHC), overseeing its round-the-clock operations.

2. PEGGY WHITSON
Commander, American

Most experienced American astronaut with more than 38 years of experience. Three previous missions to ISS; holds record among US astronauts & among women for spending the most time in space, 675 days. Trailblazer: first female commander of ISS; only woman to serve as ISS commander twice; first female commander of a private space mission (Axiom 2); most spacewalks by a woman (10 walks, 60 hours).

3. SHUBHANSHU SHUKLA
Pilot, Indian

Group Captain Shukla was commissioned into IAF's fighter wing in June 2006; has 2,000 hours of flight experience across a range of aircraft. Will pilot Axiom 4 mission to the ISS. Named on February 27, 2024, as one of four elite astronauts for Gaganyaan, India's maiden human spaceflight mission.

4. TIBOR KAPU
Mission Specialist, Hungarian

Mechanical engineer, specialist in polymer technology, has contributed to pharma and logistical industries. In 2022-23, he focused on space radiation protection at an aerospace technology company. In 2023, was selected as one of four Hungarians for the Hungarian to Orbit (HUNOR) Astronaut Program.

WHAT ASTRONAUTS WILL DO

- More than 60 scientific studies and activities scheduled to take place aboard the ISS
- This will be the most research and science-related activities conducted on an Axiom Space mission aboard the ISS to date
- Thirty-one countries involved in these studies, including the US, India, Poland, Hungary, Saudi Arabia, Brazil, Nigeria
- ISRO has designed 10 experiments. These include: growing crops in space; examining tardigrades in space; investigating muscle loss in astronauts in space; and analysing impact of gazing at computer screens in microgravity
- Astronauts will also engage in scientific outreach activities such as addressing students and people from the space industry

Source: Axiom Space

Gaganyaan ahead, importance of Shukla's critical inputs

Human spaceflight missions are extremely challenging, more so when you are doing it for the first time. They are maybe a couple of orders of magnitude more complex than uncrewed missions because of the safety protocols that have to be integrated. This is the challenge that ISRO faces with the Gaganyaan mission. And every bit of additional input that reduces the risk and increases the safety of the mission is invaluable.

That is why Shukla's experience with the Axiom-4 mission is important. He will bring real-life exposure that can be utilised in Gaganyaan. Shukla is the designated pilot of the Axiom-4 mission. He will learn a lot and gain in many ways during this mission.

Although a lot of the spacecraft is automated, it does require human intervention. It is not a point-to-point travel. The spacecraft has to follow a complicated orbit to reach the ISS, which is a moving target in space. The pilot will be required to take a number of decisions, and initiate several

processes, during the flight to the destination. This kind of experience will be critical for the other Indian astronauts who would be going on the Gaganyaan mission. Real-life experience is very different from training and simulations. Right now, we only have Rakesh Sharma with this experience, and the technologies during his time were very different. Countries that have a human spaceflight program benefit a great deal from astronauts transferring their knowledge and experience to the next generation.

Also, Shukla will be the first Indian to go to the ISS. He will have an opportunity to see how the ISS functions and operates. ISRO's next big project, after Gaganyaan, is to build its own space station. That is a massive infrastructural endeavour. After his two-week stay on the ISS, Shukla would be in a position to offer critical inputs here as well.

Muscle behaviour to moong dal: Experiments for future projects

The experiments that ISRO has designed for the Axiom-4 mission are very interesting. And again, they directly feed into ISRO's own future needs and projects. This is the first opportunity for ISRO to carry out such customised experiments in space. Many are biology-related, and a few are technology experiments.

The zero-gravity conditions in space offer a unique setting for studies that are extremely difficult to do on Earth. For example, one of ISRO's experiments relates to the study of muscle behaviour. Muscle degradation can be because of natural causes; it can also be affected by a person's weight. On Earth, it is very difficult to decouple these two causes because of gravity. Space's zero-gravity environment gets rid of the weight factor and allows the study of changes in muscles purely due to natural reasons, which that can lead to breakthroughs in the understanding of human health.

The experiments on sprouts, specifically on moong dal, on the micro-algae, and others are all very interesting, and tailored to Indian requirements. Participation in the Axiom-4 mission has given India an opportunity to carry out these experiments in space. These can be followed up with a new set of experiments on the Gaganyaan mission.

Boosting space economy and attracting new talent

Shukla's flight is the beginning of a series of steps that will lead up to the human Moon landing that ISRO has planned to undertake by 2040. An important prerequisite for that is the creation of a strong ecosystem for space activities that would also involve the participation of the private sector.

Space is a costly endeavour, and the sector can benefit hugely from private-sector participation. It will also make the sector more vibrant, facilitate innovation, expedite technology development, and attract new, young talent. It can also boost economic growth. Globally, the space market is worth about $500 billion, and is expected to double by the year 2030. India, despite being a major spacefaring nation, accounts for a just 2% share of this market. We have the ambition of increasing our share to at least 10% in the coming years.

Shukla's flight, and similar events, can make an important contribution towards this. School children will be witnessing this — it is the kind of event that is likely to dominate their imagination and, at least in some cases, shape their careers and future. Unlike 40 years ago, these children have the opportunity and the ecosystem to turn their dreams into reality.

https://indianexpress.com/article/explained/expert-explains-why-axiom-4-matters-10057525/

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Explained: 'Realising the return'— how an Indian became part of Axiom-4

Source: The Indian Express, Dt. 10 Jun 2025

In June 2023, during Prime Minister Narendra Modi's state visit to Washington, India and the US announced a decision to finalise a strategic framework for human spaceflight cooperation. It was also revealed that Indian and American space agencies, Indian Space Research Organisation (ISRO) and National Aeronautics and Space Administration (NASA), would mount a joint effort to enable an Indian astronaut to travel to the International Space Station (ISS) by 2024.

The announcement came as a surprise. Till then, it was understood that the first Indians to travel to space after Rakesh Sharma's historic flight in 1984 would ride the Gaganyaan mission which ISRO had been preparing for since 2018, when Modi unveiled India's ambition to send humans into space by 2022. The 2022 timeline could not be adhered to. But astronauts had been selected and trained, and systems were under development and being tested.

The 2023 announcement offered India an opportunity to get real-life experience for one of its astronauts ahead of the Gaganyaan mission.

Only three nations — the US, Russia and China — have a human spaceflight programme of their own. Shubhanshu Shukla's flight, which came about on the back of the 2023 announcement, is thus being seen as another preparatory step ahead of the Gaganyaan mission.

A growing partnership

It has since emerged that the 2023 announcement was the result of at least a few years of discussions between India and the US. Their space agencies have been working on a joint NISAR (NASA-ISRO Synthetic Aperture Radar) mission for over a decade now, enabling a closer-than-ever partnership. That mission is finally ready now, and likely to be launched in the next few weeks from Sriharikota, Andhra Pradesh.

The need to further strengthen their partnership, possibly through a joint human spaceflight programme, had been broached several times during these interactions. This took place particularly after ISRO demonstrated its advanced capabilities with missions, such as Chandrayaan and Mangalyaan, and the development of sophisticated space systems.

This closer collaboration was formalised a couple of months after Modi's Washington visit in June 2023, when India signed the Artemis Accords, a US-devised set of principles for responsible behaviour and cooperation in space exploration, particularly in lunar and deep planetary missions.

It paved the way for unprecedented collaboration between the two countries in space-related matters, the first benefits of which have begun to unfold with the Axiom-4 mission.

Axiom Space's invitation

Shortly after the Artemis Accords were signed, Axiom Space, a private US-based space company, invited India to participate in its mission to the ISS. Axiom Space has been the first and till now the only beneficiary of a NASA programme to enable private US industry to send commercial crewed missions to low-earth orbits and the ISS. This is part of NASA's endeavour to build capabilities in the private sector while it focuses on science and planetary exploration.

Axiom Space has sent three multinational missions to the ISS so far, each carrying four astronauts. The inaugural mission, in 2022, marked the first instance of an all-private crew making

its way to the ISS. None of the astronauts were affiliated to, or selected by, any national space agency, though one of them had been a former NASA astronaut. The other three were businessmen.

The second mission in 2023 also had three private individuals, and was commanded by Peggy Whitson, a former NASA astronaut and the world record holder for having spent the maximum number of days in space. The third mission last year had an all-European crew, with the first Turkish national to ever go into space.

For its fourth mission on Wednesday, on which Shukla will travel to the ISS, Axiom Space invited three countries who had last been to space more than 40 years ago — India (1984), Hungary (1978) and Poland (1980) — with Whitson named commander once again. Aptly, the mission has been themed 'Realize the Return'.

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Explained: Why scientists study tardigrades, tiny eight-legged 'water bears', in space

Source: The Indian Express, Dt. 10 Jun 2025

Among the scientific experiments astronaut Shubhanshu Shukla will undertake during his two week stay at the International Space Station (ISS) is one that will examine the revival, survival, and reproduction of tardigrades in space. What is the Voyager Tardigrades experiment? And why do scientists study these microscopic, eight-legged organisms?

First, what are tardigrades?

Tardigrades, also known as "water bears", are robust aquatic animals that have been around for roughly 600 million years, 400 million years before dinosaurs walked the planet. They have survived all the five major mass extinction events to have taken place thus far, and scientists believe they could be around long after humanity has died out.

Tardigrades can be found almost everywhere — from the highest mountains to the deepest oceans. Their most common habitat, however, is the thin film of water found on mosses and lichens, which bestows upon these animals the moniker of "moss piglets".

Why do scientists study tardigrades?

Although these micro-animals were discovered in 1773 by German zoologist Johann August Ephraim Goeze, they have become a subject of intensive research in the past few decades. This is because tardigrades are remarkably resilient creatures, known to survive in the harshest of conditions. Water bears have been known to withstand temperatures as low as minus 272.95 degrees Celsius or as high as 150 degrees Celsius; endure ultraviolet radiation of space and pressures of 40,000 kilopascals (equivalent to what can be experienced at a depth of 4 km under the ocean's surface); and live after being stored in a freezer for 30 years, according to a report by Front Line Genomics.

A better understanding of tardigrades' survival mechanisms can potentially have several applications: from helping scientists develop more resilient crops to creating advanced sunscreens to preserving human tissues and organs for transplantation.

Why are tardigrades so resilient?

Siddharth Pandey, an affiliate research scientist with US-based Blue Marble Space Institute of Science, told The Indian Express that tardigrades owe their incredible resilience to cryptobiosis, a state in which organisms bring their metabolism to a near-complete standstill in the face of adverse environmental conditions. Tardigrades can reduce their metabolism to less than 0.01% of normal, and drop their water levels by more than 95%, a state called anhydrobiosis.

Both anhydrobiosis and cryptobiosis result in the emergence of a durable shrunken state, called tun, in which tardigrades are able to withstand extreme conditions. Also, these animals produce unique proteins such as cytoplasmic-abundant heat soluble (CAHS) proteins which are key to their resilience. "These [proteins] form a gel-like matrix within their cells, vitrifying and protecting essential cellular components from destruction. This allows them to withstand extreme temperatures, radiation, and the vacuum of space," Pandey said.

What does the Voyager Tardigrades experiment seek to do?

Scientists will take tardigrades to the ISS in a state of tun, before reviving them and examining the effects of space radiation and microgravity on their biological processes. The primary objective of the experiment is to identify the genes that are responsible for making these animals resilient. In other words, scientists hope to pinpoint the specific molecular machinery that enables tardigrades' survival and DNA repair in space.

This will help scientists develop strategies to protect astronauts during long-duration space missions, and preserve biological materials for extended space travel. For instance, the survival mechanisms of tardigrades can be used to come up with strategies that better shield astronauts from space radiation, or counteract muscle and bone density loss experienced during lengthy space stays.

Have tardigrades been taken to space before?

Tardigrades have been a part of space missions since 2007, when some 3,000 moss piglets hitched a ride to space aboard the European Space Agency's Foton-M3 mission. The tardigrades, in a state of tun, were kept in a little round box on the side of the spacecraft whose lid was opened in space. Upon returning to Earth, they were rehydrated and examined. The German and Swedish scientists undertaking the experiment found that not only did many water bears survive the harsh space environment, some were also able to reproduce successfully.

"While exposure to UV radiation did cause some damage and reduce survival rates slightly, the experiment confirmed that the vacuum of space alone was not a barrier to their survival, solidifying their status as one of Earth's most durable organisms," Pandey said. The experiment also made tardigrades the first animal to survive exposure to space. Before water bears, animals had only survived space in the safety of a spaceship or space suit.

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