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Shukla concludes space odyssey, returns to Earth

Group Captain Shubhanshu Shukla is assisted out of the Dragon spacecraft after the return of the Axiom 4 crew to Earth on Tuesday. "...He has inspired a billion dreams through his dedication, courage and pioneering spirit," PM Narendra Modi said. AXIOM SPACE

(Left) Shubhanshu Shukla's parents Shambhu Dayal Shukla and Asha Shukla celebrated the return of Axiom-4 crew to Earth, in Lucknow; parachutes of the Dragon Grace spacecraft carrying crew members of the Axiom-4 mission were deployed before splashing down near California. ANI; X-AXIOM_SPACE

Shukla returns, Prez hails it as a 'milestone for India'

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MUMBAI: At 3.01pm IST Tuesday, SpaceX's Dragon Grace spacecraft splashed down in the calm waters of the Pacific Ocean off the west coast of the US at the end of a 22.5 hour journey from the International Space Station (ISS).

Inside were Group Captain Shubhanshu Shukla, only the second Indian to go to space, and the Indian to have spent most time there, and three of his Axiom-4 (Ax-4) mission crew mates.

Shortly after Shukla, who was all smiles, was assisted out of the capsule onto the recovery vessel, Prime Minister Narendra Modi on X said, "I join the nation in welcoming Group Captain Shubhanshu Shukla as he returns to Earth from his historic mission to Space. As India's first astronaut to have visited (the) International Space Station, he has inspired a billion dreams through his dedication, courage and pioneering spirit. It marks another milestone towards our own Human Space Flight Mission - Gaganyaan."

Congratulating Shukla, President Droupadi Murmu said on X, "A hearty welcome to Group Captain Shubhanshu Shukla as he comes back on Earth after his space journey. His role in piloting of Axiom Mission 4 to the International Space Station has created a new milestone for India's space exploration as well as for international collaboration in science and technology."

> I don't have words to express my happiness... we are very proud
>
> **ASHA SHUKLA,** Shubhanshu Shukla's mother

As per protocol, the crew underwent the first medical examination in SpaceX's recovery vessels. They will undergo about a week's rehabilitation programme under the supervision of flight surgeons to enable them to adapt back to Earth's gravity. After 20 days in space of which 18 days were spent living and working in the lower orbiting laboratory, the Ax-4 crew took in their first breath of fresh air.

On June 25, Falcon 9 rocket lifted off the spacecraft from Launch Complex 39A at Kennedy Space Centre in Florida. It reached ISS on June 26 after a 28-hour journey. Shukla became the second Indian astronaut in space since 1984, and the first in the country on ISS. Alongside Shukla, the Ax-4 mission marked the return to human spaceflight programme for India, Poland and Hungary in over four decades.

Representing the Indian Space Research Organisation (Isro), Shukla's return with all the learnings and experience from the Ax-4 mission is an important step for the Gaganyaan mission and setting up the Bharatiya Antariksh Station (the Indian Space Station).

Union minister for science and technology Jitendra Singh also congratulated the Ax-4 team.

"Congratulations Team #Axiom4! A moment of pride for the world as "Dragon" successfully splashes down, off the California coast near San Diego. A moment of glory for India as one of her illustrious sons returns from a successful voyage... having conducted for the posterity, life-bearing experiments in microgravity, never done before. Bharat today finds an enduring Space in the world of Space!" he said on X.

The Department of Space has termed Shukla's mission as one of strategic importance and India's resolve to emerge as a serious contender in human space exploration. Former Isro chairperson S Somanath said, "Super excited to witness the successful return of Group Captain Shubhanshu Shukla and fellow astronauts to Earth just moments ago! The insights and experience gained by Shux during this mission will add immense value to Team Gaganyaan as we prepare for India's first human spaceflight."

On July 14 at 4.45pm IST, the Ax-4 crew began their journey to Earth after the Dragon spacecraft autonomously undocked from the space-facing port on the Harmony module of ISS after spending approximately 433 hours, 18 days, and 288 orbits around Earth covering nearly 7.6 million miles.

Twenty minutes before splashdown, there was around a six-minute communication blackout as the capsule, on entering Earth's atmosphere, got heated due to the plasma buildup pushing the temperature to 1926.6 degrees Celsius.

At 2.54pm, Axiom Space live streamed the first visuals of the capsule. As the two drogue parachutes were released at around 5.5km to stabilise descent, the seats inside the capsule underwent a rotation that caused the crew to sit upright in preparation for the final descent and splashdown. About 1.8km away, main parachutes were deployed to further slow down the capsule to a safe splashdown speed from 350 miles per hour to 15 miles per hour.

Soon after the splashdown off the coast of California teams from SpaceX and Axiom got into swift action. Overnight, SpaceX had prepositioned its recovery teams, two fast boats and the recovery vessel to extract the capsule from the waters with a hydraulic lift. While teams from one fast boat undertook leak checks of the capsule and the second team picked up the parachutes, teams on the recovery vessel were pressed into action.

At 3.40pm, the side hatch of the partially burnt Grace was opened. Sliding out of the capsule, the crew who had spent 18 days floating in microgravity were assisted to take their first few steps in gravity. The crew also returned with more than 580 pounds of cargo, including NASA hardware and data from over 60 experiments conducted throughout the mission.

For India, Shukla completed seven indigenously developed microgravity experiments and undertook five scientific experiments as part of an Isro-NASA collaboration.

Shukla's family celebrated his return on Tuesday. His mother Asha Shukla told ANI, "I don't have words to express my happiness...PM Modi also congratulated him...Excitement is endless and we are very proud. We were afraid at first... The upcoming generation should take inspiration and move ahead as well..."

The Group Captain's father expressed his urge to meet his son as soon as possible. "Now we want to meet him as soon as possible...We were praying for his safe return to earth..." Shambhu Dayal Shukla told ANI.

Isro, in a statement on Tuesday, said Shukla's return "marks a proud moment both for ISRO and India". "Shukla is now undergoing a structured post-mission medical evaluation," the statement said.

India's moonshot moment for research and innovation

India has long grappled with an uncomfortable truth: Our research and development spending, despite being the world's fifth-largest economy and a global talent hub, remains among the lowest in the world. At under 0.7% of GDP, our national research and development spend pales not only in comparison with countries like the US (3.5%) or China (2.7%), but also with smaller economies such as South Korea (5%) and Brazil (1.2%). This has had a compounding effect. It has limited our scientific ambition, discouraged patient capital from entering deep-tech, and left India too often a consumer rather than a creator of advanced technology.

Against this backdrop, the government's announcement of a ₹1 lakh crore Research, Development and Innovation (RDI) scheme is both timely and transformative. It is not just an economic intervention but an institutional one. Structured through the Anusandhan National Research Foundation (ANRF), the scheme aims to correct a deficit in India's innovation ecosystem. It is a bold signal of intent to move from being a user of imported technology to a nation that creates and commercialises its own, and eventually, exports it to the world.

Kunal Bahl

The scheme to be implemented through a Special Purpose Vehicle will have oversight from an empowered group of secretaries and will be chaired by the Prime Minister (PM). The architecture signals not just administrative backing, but clear political ownership, suggesting that this is not a routine policy measure but a national priority.

The scheme's emphasis on sunrise sectors, including clean energy, climate tech, robotics, Artificial Intelligence (AI) in key areas, biotech, agritech is encouraging. To maximise impact, India must also identify areas where it has both strategic interest and a strong potential to lead. In agritech, for instance, the opportunity is not abstract but deeply national. With more than 45% of India's workforce employed in agriculture, targeted R&D in precision farming, climate-resilient seeds, and AI-driven supply chains can yield enormous social and economic dividends. In clean tech, rather than replicating global models, India can lead in areas that suit its own realities, such as decentralised solar, high-temperature grid storage, or waste-to-energy solutions for peri-urban areas.

India also has a unique structural advantage that few countries possess at the same scale: A billion-plus population layered with a maturing digital public infrastructure stack. Aadhaar, UPI, DigiLocker, ONDC, Ayushman Bharat Health Account (ABHA), Automated Permanent Academic Account Registry (APAAR) and other platforms give Indian innovators a homegrown testbed that is unmatched in size and complexity. Combined with AI and blockchain, this can unlock innovations in financial inclusion, digital health, micro-credit, and public service delivery. It is not just a policy advantage but a technological edge and must be treated as such in our national R&D priorities.

Startups will play a foundational role in realising this ambition. India has already seen a strong base of deep-tech startups emerge across sectors including medical diagnostics, space technology and battery innovation, amongst others. Companies in these sectors have shown how Indian ventures can compete globally while solving distinctly Indian problems. With the right support, this next generation of technology-led startups can do for science and engineering what the previous wave did for consumer internet and fintech.

India's academic ecosystem will be vital in sustaining the innovation pipeline. While the IITs and IISc represent some of our strongest research hubs, they would benefit from deeper investment to realise their full potential. At the same time, there is an opportunity to expand research capacity across a broader set of universities and technical institutes. By fostering a more inclusive and well-supported academic research environment, India can unlock innovation that is geographically, institutionally, and intellectually diverse.

The success of this approach is evident in countries such as the US and Germany, where deep-tech innovation is underwritten by consistent public investment in academic research, often with mechanisms for seamless technology transfer to the private sector. The US offers a compelling example through the Defense Advanced Research Projects Agency (Darpa), which has consistently backed high-risk, high-reward research in academic institutions. Over the decades, Darpa has played a pivotal role in developing foundational technologies, including the internet, GPS, voice assistants, and stealth aircraft systems, many of which originated as blue-sky research projects in universities and later, evolved into world-changing innovations. This model shows how strategic public funding, when paired with academic talent and long-term vision, can unlock breakthroughs with far-reaching economic and societal impact.

The scale of funding is a powerful beginning. The focus must now shift to world-class execution. Attracting high-quality second-level fund managers with domain expertise and entrepreneurial instincts will be critical to ensuring that capital flows to the most promising ideas. A governance framework that champions transparency, timely disbursals, and a healthy appetite for risk will enable innovation to thrive. With the right people and processes in place, this initiative can serve as a model for how bold public investment can translate into transformative national capability.

Equally important is the opportunity to align India's regulatory and compliance landscape with its innovation ambitions. By streamlining pathways for IP protection, tax processes, lab access, and international research collaboration, we can create an environment where startups and research-intensive enterprises thrive. Simplifying these frameworks will amplify the impact of the RDI scheme.

This initiative also presents an opportunity for India's private sector, not just startups, but family offices, foundations, and corporates, to co-invest in national capability. The government has taken the first step with capital. Now, industry must match it with conviction, institutions, and risk capital. Public-private co-funding platforms and industry-led R&D clusters can help align efforts and multiply outcomes.

India has missed critical moments before – the semiconductor revolution of the 1990s, the early years of industrial robotics, and the first wave of AI. The RDI scheme is a second chance. This time, the urgency is greater. Global supply chains are shifting. Climate timelines are shortening. Tech disruptions are accelerating. The countries that lead in innovation will shape the future rules of trade, security, and diplomacy.

The money has finally arrived. What we need now is thoughtful focus, nurturing of the R&D ecosystem with institutional strength and intellectual agility and above all, a long-term view. This will be a multi-decadal endeavour. The ₹1 lakh crore is a strong beginning.

Kunal Bahl is the co-founder of AceVector and Titan Capital. The views expressed are personal.

What an Indian in space means for India in space

Shubhanshu Shukla's space sojourn, as part of the Axiom-4 mission, holds significance for India for many reasons. To start with, Shukla's voyage ends a wait of little over four decades for an Indian to mark their presence outside Earth, after Rakesh Sharma became the first in 1984. In the interim, the country celebrated Indian-origin astronauts flying into space — and mourned the death of Kalpana Chawla in the Columbia disaster. It built enviable space prowess and punched much above its weight when it came to missions in Earth's neighbourhood. But it remained on the sidelines of manned spaceflight. So, Shukla in space has great symbolic value for its space ambitions.

Second, Shukla's presence on Axiom-4 is of immense learning value for the Indian Space Research Organisation (Isro) as it gears up for its manned space programme, Gaganyaan. On-ground preparations for the mission will benefit significantly from the learnings the second Indian in space brings back with him, injecting critical readiness into the training of India's future astronauts. Given spaceflight's unique aspects — the heightened safety protocols and compliance, the impact of zero gravity on the human body and task execution, among others — this is invaluable learning from lived experience.

Third, an Indian in space fires a billion imaginations and stokes aspirations. This can only be good for a country that aims to be a science and technology superpower. Inspired school and university students can mean a rich harvest of scientific minds in the years to come. To that end, Shukla's spaceflight is not his alone, but of all Indians, including many young people who have their eyes set on stars.