The Indian EXPRESS
JOURNALISM OF COURAGE

Expert Explains: Why Axiom-4 matters

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

Written by Somak Raychaudhury
New Delhi | Updated: June 10, 2025 08:24 IST

7 min read

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

The travel of Indian astronaut Shubhanshu Shukla to the International Space Station (ISS) on the Axiom-4 mission on Wednesday 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.

Also Read | Why a seat for Shukla on Axiom-4 is a big moment for India's space programme

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.

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.

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.

Source: Axiom Space

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

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.

Also Read | Axiom Mission 4 is set for launch with Indian Astronaut Shubhanshu Shukla onboard; here's all your questions answered

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.

Somak Raychaudhury is an astrophysicist and Vice Chancellor and Professor of Physics at Ashoka University. He spoke to Amitabh Sinha