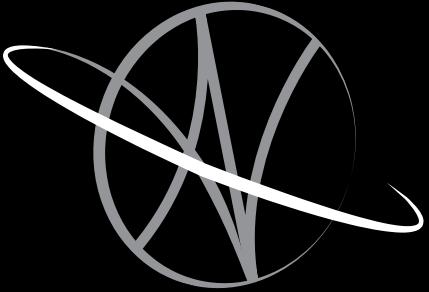


# Kshitij

NISER ASTRONOMY CLUB MAGAZINE



ASTRO-PHYSICS, CHEMISTRY, BIOLOGY: ALL IN ONE ISSUE!

## A visit to India's largest optical telescope **DEVASTHAL OPTICAL TELESCOPE**

PULSARS:  
LABORATORIES  
OF SPACE

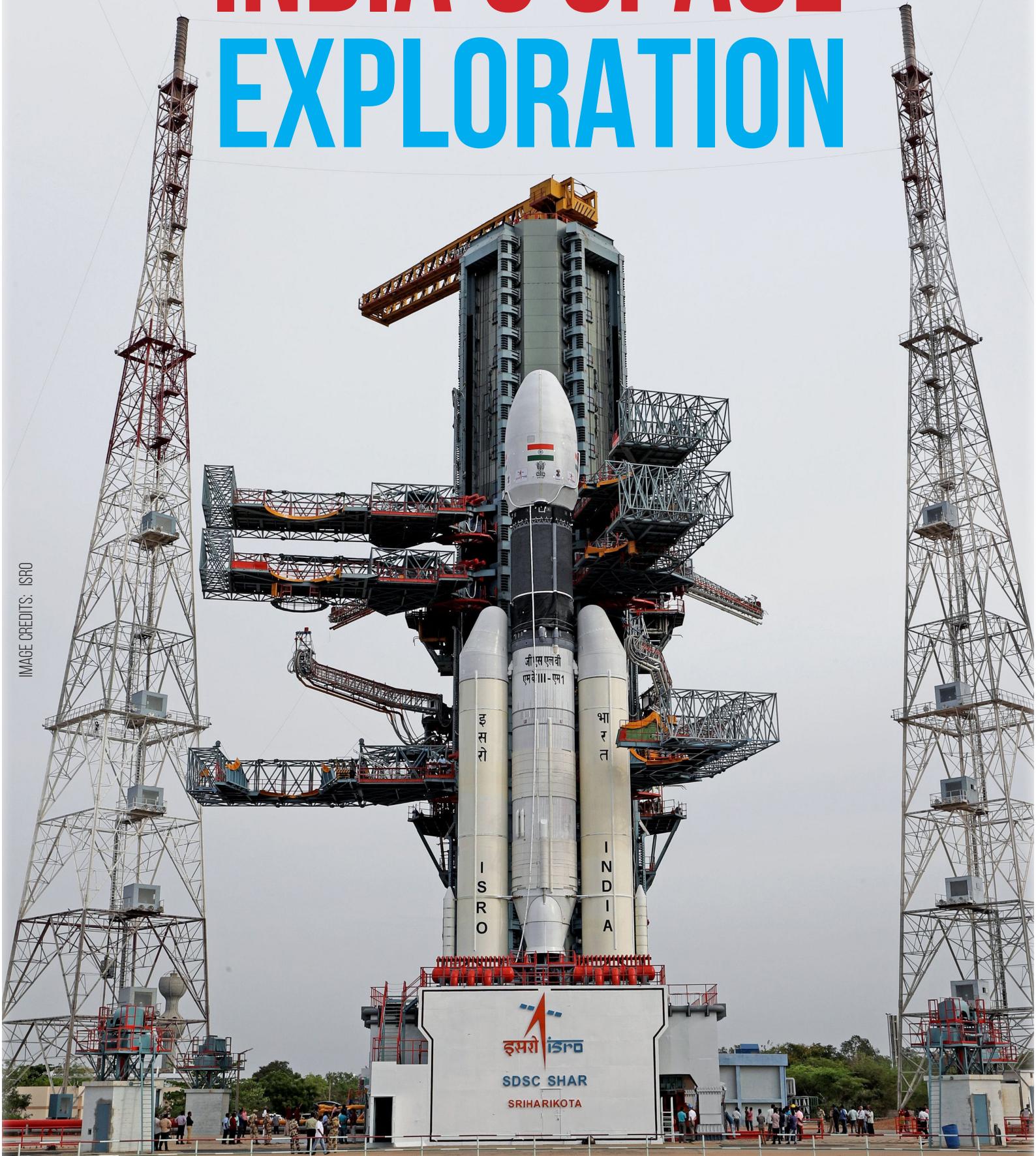
EXPLORING  
INTERSTELLAR  
SPACE

ON THE COURSE OF  
INDIA'S SPACE  
EXPLORATION

*And More!*

# ON THE COURSE OF INDIA'S SPACE EXPLORATION

IMAGE CREDITS: ISRO



# The Initial Days

India currently belongs to an elite group of space-exploring countries in the world. Indian Space Research Organization (ISRO) has gained respect from all over the world as a reliable space organization. But it was not always the same. India's journey to being a significant name in the history of space exploration started rather slowly. Individual efforts in India to understand outer space can be traced to the 5th-7th century when Aryabhata, Brahmagupta, Varahamihira, and Bhaskara made significant progress in understanding astronomical phenomena. The earliest astronomical text in India, Vedaanga Jyotisa details several astronomical attributes generally applied to timing social and religious events. Raja Jai Singh II made five 'Jantar Mantars' across his kingdom for astronomical observations and calculations. Jantar Mantar, Jaipur, has 19 different astronomical calculators. But, a more scientific approach towards astronomy was developed in the 19th century when Pathani Samanta (December 13, 1835-August 11, 1904) measured the distance between the Sun and the Earth and predicted many astronomical events with his self-made instruments made of wood sticks and bamboo.

Later, in the 20th century, Indian astronomers pushed the boundaries further. Meghnad Saha came up with his famous 'Saha Ionization Equation', which accurately described a star's physical and chemical conditions. Vikram Sarabhai and Homi J. Bhabha made significant contributions to space science. Cosmic radiations and the upper atmosphere were studied. Deep underground experimentations were also conducted in Kolar

mines to study the high-energy particles from space. But all these advancements were either theoretical or based on ground-based observations. India still had a momentous leap awaiting, as it set its sights on making astronomical observations from outer space. When the USA and Russia were competing with each other in the race of space exploration, India was struggling with diverse issues of both internal and international politics, starvation and refugee problems. In this situation, focusing on scientific advancements, especially in space science, which has no

solutions to current practical issues, was considered a luxury. But passion knows no restriction. After a long struggle, Prime Minister Jawaharlal Nehru established the Indian National Committee for Space Research (INCO-SPAR) at the urging of Vikram Sarabhai. But the leap was yet to be made. INCOSPAR's activities continued to function under the Department of Atomic Energy (DAE), as no dedicated ministry for space programs existed.



Figure I: The Father of the Indian Space Program: Vikram Sarabhai on a 1972 Indian stamp.

Image Credits: ISRO, Wikipedia

## The First Shot in the Sky

Finally, on November 21, 1963, US Nike Apache sounding rocket was launched from a church in Thumba, near Thiruvananthapuram, marking the beginning of India's spaceward odyssey. The rocket parts were carried to the launching site by bicycles, and bullock carts and cattle sheds were used to assemble the rocket parts displaying the enormous effort and use of indigenous methods put into the mission.

Later, Indian Space Research Organisation (ISRO) was established on August 15 1969. ISRO superseded INCOSPAR. In 1972, the Department of Space (DOS) and ISRO was brought under DOS. On April 19 1975, India's first satellite, Aryabhata, was launched from Russia using the Russian rocket Kosmos-3M. In 1984, Rakesh Sharma became the first Indian astronaut when he flew aboard the Soviet rocket Soyuz T-11. Now the goal was to make India



Figure II: First rocket launch from Thumba.  
Image Credits: *blog, OpenScienceFoundation*



Figure III: Rocket parts being carried on a bicycle.  
Image Credits: *blog, OpenScienceFoundation*

self-reliant in space science. Substantial efforts were put into developing a satellite-launching vehicle. After several years of hard work, ISRO finally succeeded in creating an orbital launch vehicle named Satellite Launch Vehicle-3 (SLV-3). But the first move is always the most difficult.



Figure IV: The Aryabhata Satellite.  
Image Credits: *ISRO*

On August 10 1979, India launched its satellite with its indigenous rocket for the first time. Rohini Technology Payload mounted on SLV-3 was launched from the Sriharikota launching site. However, it failed to meet success. Due to a faulty valve, it could not reach its desired orbit, and the mission was regarded as a failure. Even the Indian media criticized ISRO for perceived irresponsibility and for misusing public funds. A year after this failure, ISRO made a strong comeback by putting RS-1 perfectly into its orbit. This achievement showed the determination and dedication of the scientists working in ISRO, among whom were Dr Satish Dhawan, the then chairman of ISRO and Dr APJ Abdul Kalam, future president of India. India became the seventh country in the world to reach Earth's orbit. Later, ISRO built several launchers like Augmented Satellite Launch Vehicle (ASLV), Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV) and Geosynchronous Satellite Launch Vehicle Mark-III (LVM3), each with its unique capabilities and applications. With these vehicles, India has successfully launched hundreds of satellites, including indigenous and foreign ones. In the IRS-P3 mission launched with PSLV-D3, the remote-sensing satellite hosted a scientific instrument, the Indian X-ray Astronomy Experiment (IXAE), which

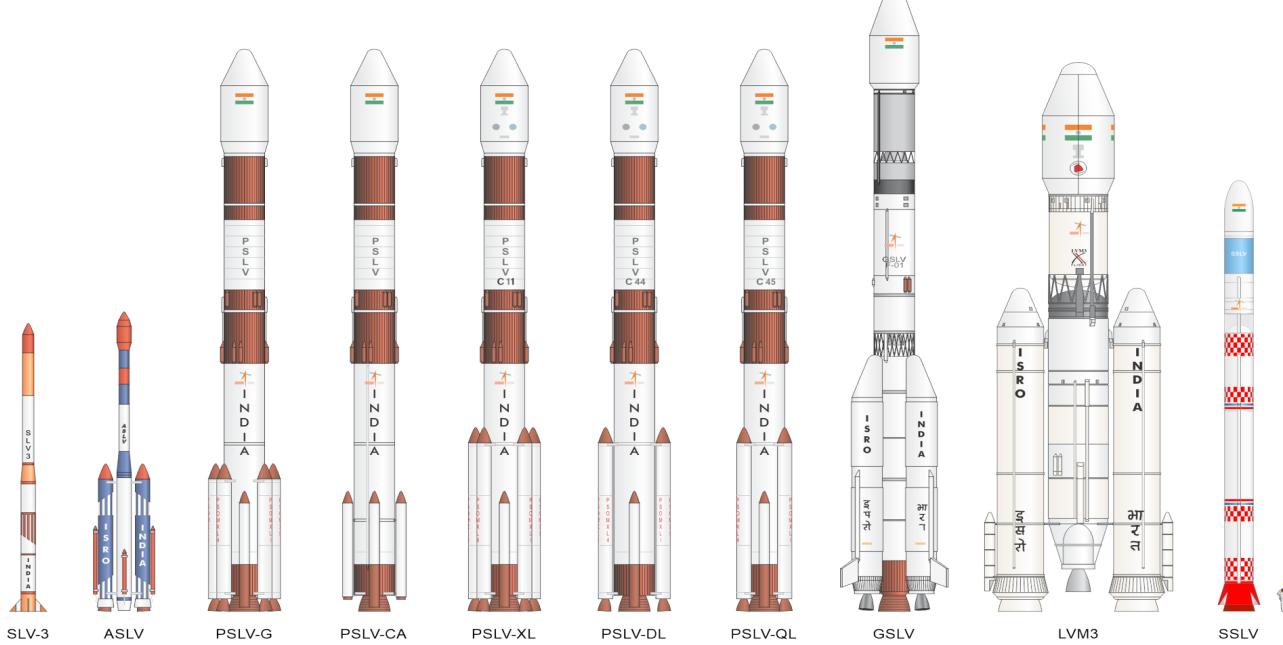


Figure VI: ISRO's arsenal of launchers  
Image credits: *Indian Rockets, historicspacecraft*

carried out studies related to cosmic X-rays.

## In the Limelight

In 2008, ISRO launched Chandrayaan-1 to study the lunar surface and its chemical compositions. It captured the world's attention as Chandrayaan-1's Moon Impact Probe (MIP) detected the presence of water on the moon. Later, a NASA payload on board the Chandrayaan-1 orbiter confirmed the discovery.

With it, ISRO became the fifth national agency to reach the lunar surface. In 2014, ISRO recorded its name on another page of history as it completed its fully indigenous Mars Orbiter Mission



Figure V: Dr APJ Abdul Kalam and R. Aravamudan assembling a rocket at Thumba.

Image Credits: ISRO

(MOM). India became the fourth country to reach the Martian orbit and the first country to achieve it in the first attempt. This mission was remarkable in many aspects. The budget constraint was a significant issue. The ingenuity of the Indian scientists made the entire mission cost less than the Hollywood science-fiction movie 'Gravity'. The budget for MOM was \$74 million, while NASA's sophisticated MAVEN mission enjoyed a budget of \$671 million. The satellite's development was fast-tracked and completed in a record 15 months. Although India gained some



Figure VI: PSLV C11 carrying Chandrayaan-1.  
Image Credits: ISRO, Wikipedia

respect all over the world for this remarkable achievement, some western media even mocked India. A notable example is the controversial cartoon depicting India as a beggar attempting to join the ‘Elite Space Club’. ISRO didn’t stop there and continued to reach new highs in space science. After the success of the IRS-P3 mission,

## The Future

achieve a soft landing on the moon’s surface. India continues to make significant strides in space science with several planned missions by ISRO. In mid-2023, ISRO successfully launched the Aditya L-1 mission, India’s first mission to

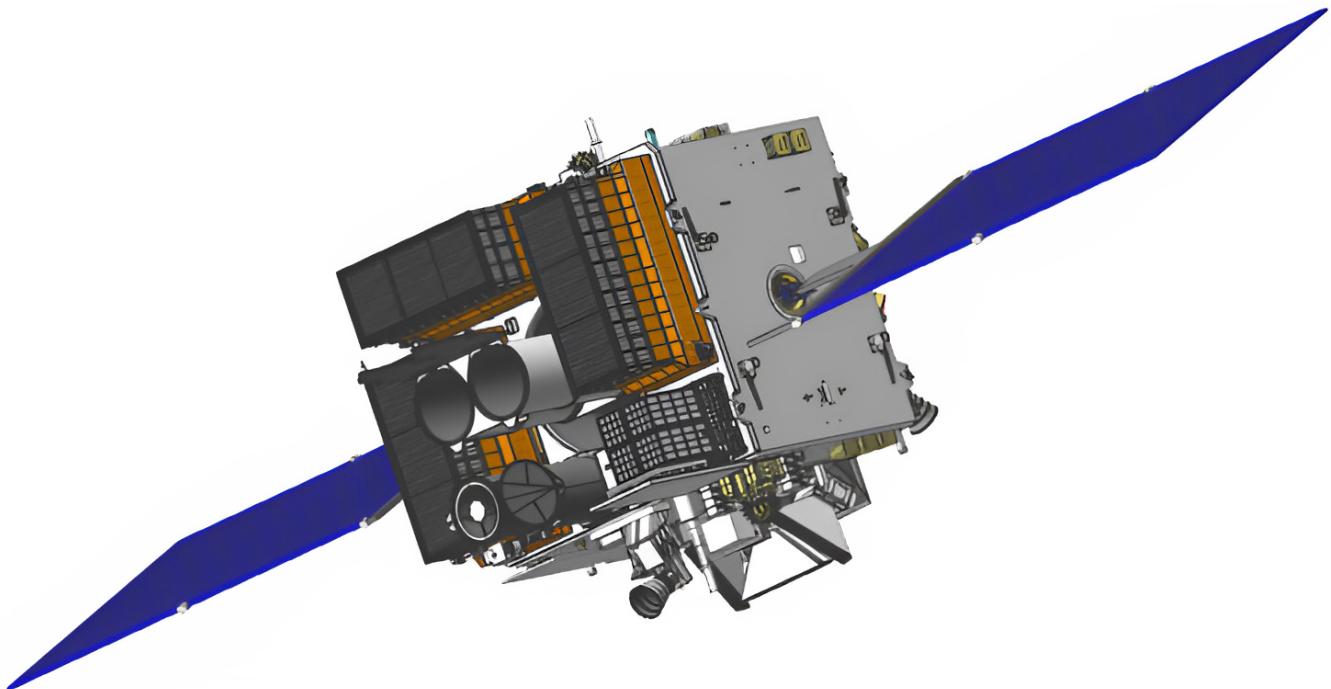


Figure VI: AstroSat  
Image Credits: ISRO, Wikipedia

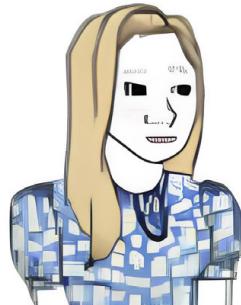
ISRO planned to develop an instrument fully dedicated to X-ray astronomy. Several astronomy research institutes in India and abroad engaged together to build the satellite. Finally, AstroSat, India’s first dedicated multi-wavelength space telescope, was launched on a PSLV-XL on November 28 2015. AstroSat has made some instrumental observations on transient X-ray sources.

ISRO holds an enviable record of deploying as many as 104 satellites in a go, which was the highest until 2021 when SpaceX launched 143 satellites in a shot. In 2019, ISRO launched Chandrayaan-2 with high expectations. While the mission successfully deployed the lunar orbiter, the lunar module failed to

study the Sun, which is conducting detailed studies of the solar atmosphere from a halo orbit around the L1 point. The Chandrayaan-3 mission, a follow-up to Chandrayaan-2, also succeeded, achieving a soft landing on the moon’s surface. In addition, ISRO plans to launch the X-ray Polarimeter Satellite in 2023, aimed at studying the polarization of cosmic X-rays and exploring some of the brightest X-ray sources in the sky, including pulsars and black holes. ISRO’s Gaganyaan mission, the next major leap in India’s space program, will be the organization’s first crewed mission. The Shukrayaan mission is planned to study the atmosphere of Venus, and another mission is in the works to study the Martian atmosphere.

As India continues to flourish as a country with incredible capabilities in space exploration, we can look forward to many remarkable achievements.

Arnab Biswas  
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I can't believe he didn't cry during Titanic!



Do men even have feelings?

The Weather Channel

Good-bye Comet NEOWISE: Glimpses of Rare Cosmic Visitor as It Takes Its Leave for Next 6,800 Years (PHOTOS)

After putting on a show at every dawn or dusk (depending on your location) for the past one month, Comet NEOWISE is all set to bid adieu to...



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