APOGEE PRESENTS

BRAHMAND

WITH SPACE TECHNOLOGY INCUBATION CENTRE (S-TIC)

Release
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Issue 02 : Bharat beyond Boundaries

APOGEE

ISSUE 02

Bharat Beyond Boundaries

FROM THE EDITOR

Dear Readers,

Every journey has milestones, but some milestones feel like heartbeats —alive, eternal, and unforgettable. With this second edition of Bramhand, we are not just turning pages, we are turning dreams into ink, thoughts into vision, and imagination into a shared universe.

Last year, when we launched our first edition, it was the spark. Today, with this second edition, that spark has grown into a steady flame—a flame of curiosity, courage, and collective passion. This magazine is not just about space; it is about our space—where young minds of Bharat dare to ask questions, where stories of science meet the spirit of culture, and where every word reminds us that the sky is not the limit, but the beginning.

Space has always been a mirror. When we look up, we don't just see stars; we see ourselves—small, yet infinite; fragile, yet powerful. And in this reflection lies our inspiration: to keep exploring, to keep dreaming, to keep reaching.

These pages contain the hard work and essence of love and passion of many space enthusiasts for our Nation.

My heartfelt gratitude to all the members of APOGEE for making Bramhand possible again.

And let me leave you with a thought that may touch your heart-

"सितारों की खामोशी में,
शायद एक रोशनी ऐसी हो
जो तुम्हारे संकल्प से जन्म ले
और भारत के आकाश को अनंत तक प्रकाशित कर दे।"

Jai Hind!
Samridhi Saini
(Editor)

APOGEE

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ISRO S-TIC

It has been a great privilege for me to be associated with the Space Technology Incubation Centre (S-TIC) at NIT Jalandhar since its inception in 2019. In course of our activities, I also had the wonderful opportunity to know and interact with the enthusiastic members of the APOGEE Space Club since 2024.

While the participation towards S-TIC projects earlier was mainly from MTech and PhD students, a fresh infusion of enthusiastic participation was brought about by the members of the APOGEE Space Club, who were mainly from the second year of our BTech programmes. Since then they have been vigorously planning and organizing space related activities with an aim to attract their classmates and friends towards Space related activities. They were instrumental in organizing the National Space Day celebrations on 22nd and 23rd August 2024 in close association with S-TIC
.
They have been doing a lot of ground work in identifying available projects under RESPOND and RAS 2025 schemes of ISRO and motivating students and faculty to submit project proposals under these schemes. They are also actively involved in the celebrations of the National Space Day 2025. They have since been actively participating in facilitating the Joint Management Committee (JMC) meetings of S-TIC at NIT Jalandhar.

I am sure their passionate enthusiasm will motivate several students and faculty members to have better awareness about various initiatives in space related science and technology, with vigorous participation. My best wishes are always with the members of the APOGEE Space Club and the S-TIC at NIT Jalandhar.

Dr Joseph Anand Vaz
Vice Chairman, ISRO S-TIC

FACULTY INSIGHTS

A Message from -

Dr. Harleen Dahiya

Faculty Coordinator, APOGEE

“As Faculty Coordinator, I warmly invite students to join APOGEE - a vibrant platform to explore space, foster curiosity, build skills, and embark on a journey of discovery together.”

Harleen Dahiya

Dr. Sateesh Kumar Awasthi

Faculty Coordinator, APOGEE

“I congratulate APOGEE on the release of its 2nd edition of magazine and extend my best wishes for the club’s future endeavors in space research, innovation, and knowledge building.”

Sateesh Kumar Awasthi

”

SPACE NEWS 2025

JANUARY

ISRO SPADEX DOCKING MISSION

On January 16, 2025, ISRO accomplished its first in-orbit docking of two satellites—SDX-01 and SDX-02—as part of the Space Docking Experiment (SpaDeX) mission. This achievement makes India the fourth country in the world, after the US, Russia, and China, to demonstrate autonomous space docking using indigenous technology.

ISRO'S 100TH LAUNCH FROM SRIHARIKOTA

ISRO successfully completed a century of launches from its spaceport at Sriharikota on January 29, 2025, with the 17th launch of GSLV. In this mission, the NVS-02 navigation satellite was successfully injected into the intended Geosynchronous Transfer Orbit

GSLV-F16 MISSION WITH NISAR SATELLITE

In February 2025, ISRO prepared for the launch of the GSLV-F16 mission, which is set to carry the NISAR satellite. NISAR (NASA-ISRO Synthetic Aperture Radar) is a highly advanced Earth observation satellite jointly developed by ISRO and NASA. This mission is significant for its dual-frequency radar imaging technology, which will provide critical data for agriculture, disaster management, and climate monitoring

FEBRUARY

ASTROFORGE'S BROKKR-2 MISSION

AstroForge is an aerospace company based in Huntington Beach, California . AstroForge's Brokkr-2 mission was launched on February 27, 2025, to perform a flyby of a near-Earth asteroid and assess its metal content.

MARCH

SPHEREX AND PUNCH

NASA's SPHEREx (Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer) and PUNCH (Polarimeter to Unify the Corona and Heliosphere) missions were launched together aboard a SpaceX Falcon 9 rocket from Vandenberg Space Force Base on March 11, 2025. SPHEREx aims to map the entire sky in infrared to study the origins of the universe

SPACEX'S FRAM2 MISSION

On April 1, 2025, SpaceX launched the Fram2 mission, sending a four-person civilian crew into a polar orbit for a duration of three to five days. The mission focused on studying Earth's polar regions and human biology in space, and made history by capturing the first human X-ray images in orbit.

CHANDRAYAAN-4 MEET

On April 16, 2025, ISRO organized a national science meeting focused on the upcoming Chandrayaan-4 lunar sample return mission, scheduled for launch in 2027–2028. Scientists and experts discussed the mission's goals, including the return of lunar samples to Earth and the scientific opportunities this presents for India's planetary science community

APRIL

MAY

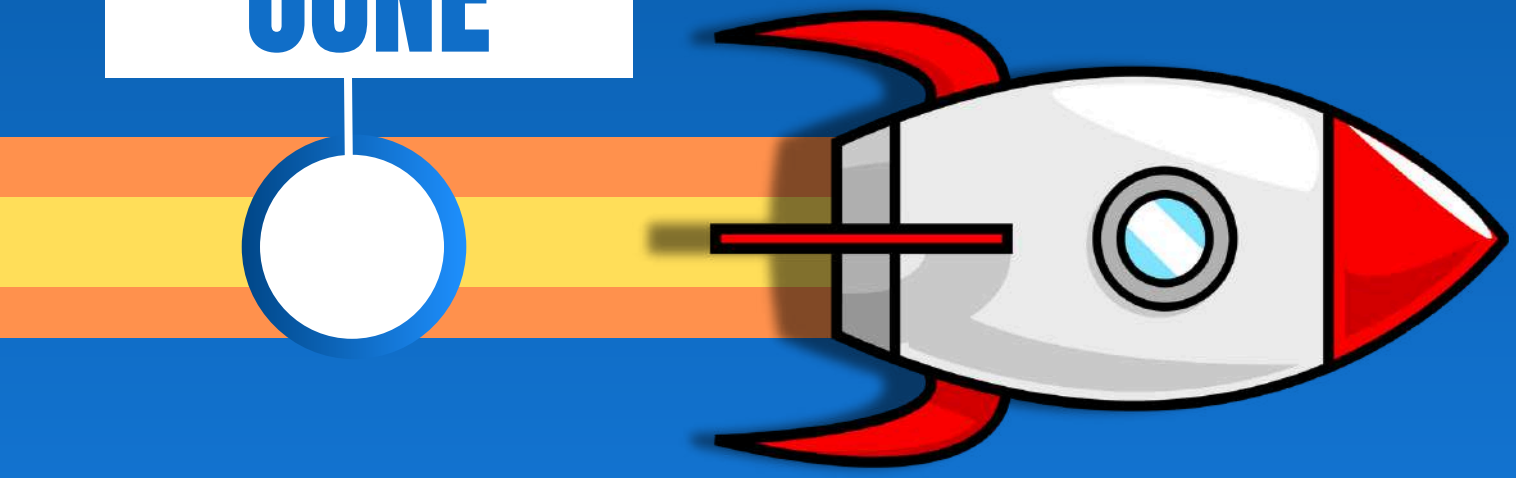
KOSMOS 482'S FIERY RETURN

On May 10, 2025, the 53-year-old Soviet Venus descent module, Kosmos 482, re-entered Earth's atmosphere, crashing into the Indian Ocean west of Jakarta. Built to survive Venus's harsh environment and encased in titanium, its uncontrolled descent reignited global concerns over aging space debris

AXIOM-4 MISSION

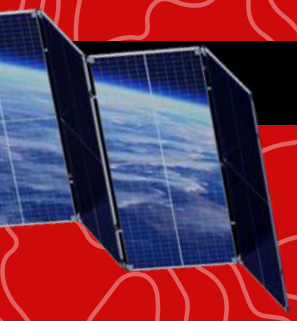
On June 25, 2025, Group Captain Shubhanshu Shukla became the first Indian to board the ISS via Axiom Mission-4. Conducting vital space research, he is leading experiments in microgravity that support future missions like Gaganyaan. This marks a major milestone in India's journey toward human spaceflight and international space collaboration.

JUNE



“If anyone can do it, we can also do it; if no one can do it then we must do it.”

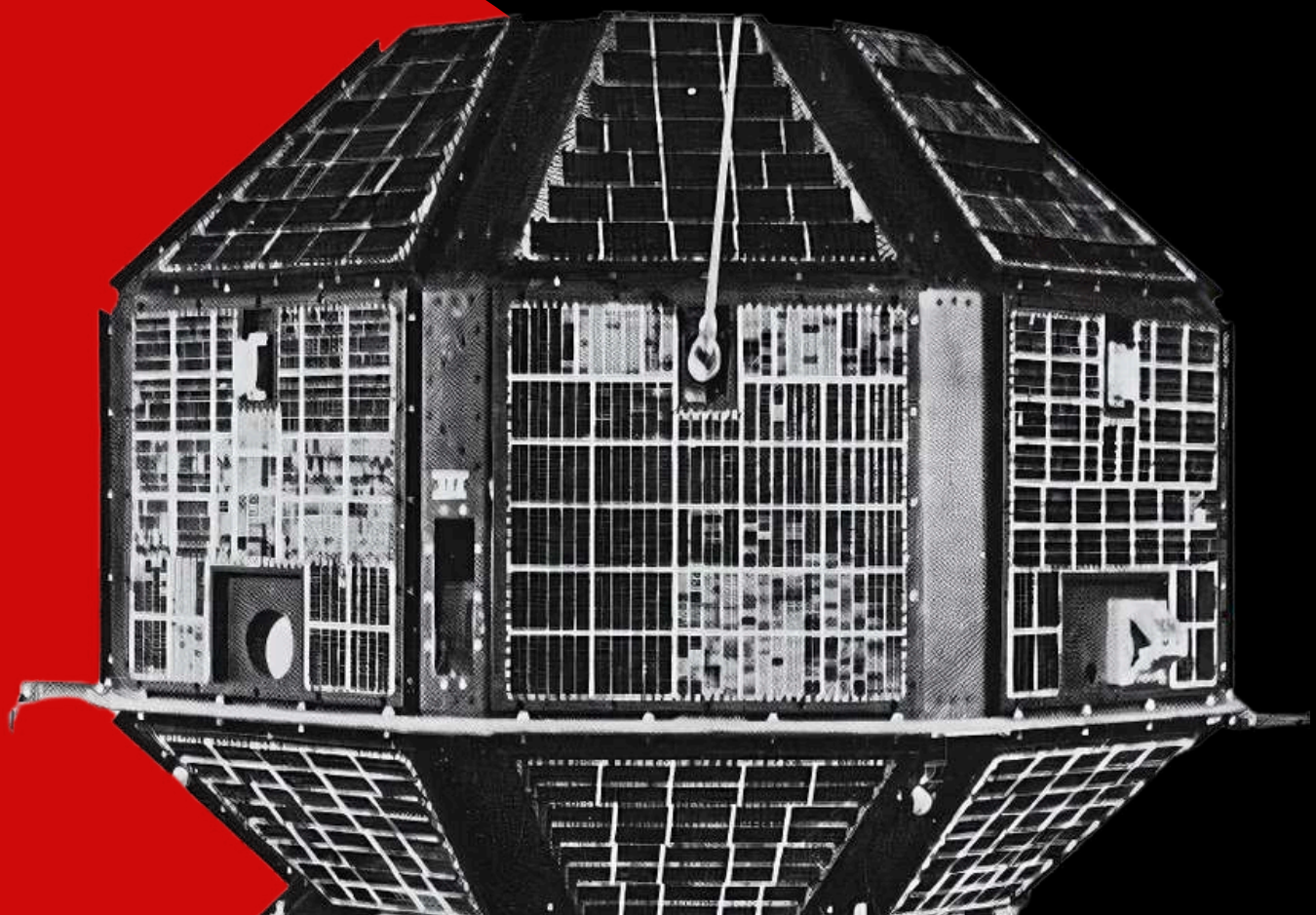
- DR. UDUPI RAMACHANDRA RAO



THE SATELLITE VISIONARY

Dr. UR Rao

In **1972** Dr. Udupi Ramachandra Rao took the initiative to establish satellite technology in India. Just three years later, under his leadership, India successfully launched its first satellite, **"Aryabhata"**, marking a historic moment in India's space journey.



Space Science for Social Good

Dr. Rao had a clear vision to build a self-sustained Indian space program that serves society. Not just being limited to science and tech, he aimed to bring changes in areas like communication, education, weather forecasting, and disaster management using satellite technology.

At the designation of ISRO's chairman, he led the successful launch of the Augmented Satellite Launch Vehicle (ASLV) in 1992.It was a step toward making space technology change everyday life of Indians.

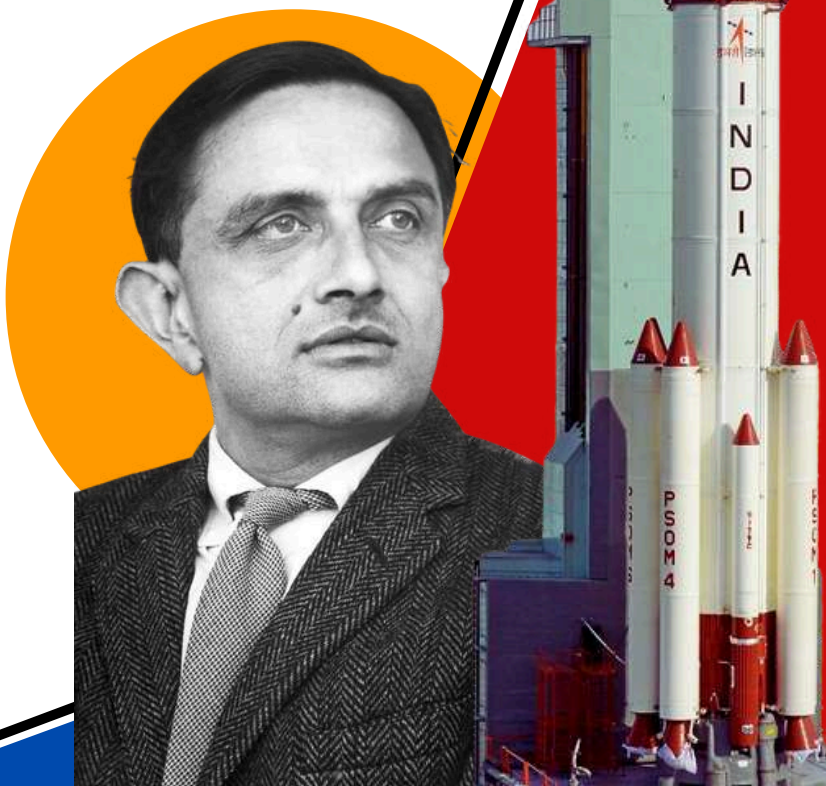
PSLV: Lifting India's Dreams

One of Dr. Rao's biggest contributions was the development of the Polar Satellite Launch Vehicle (PSLV) in 1995. It gave India the ability to launch its own satellites and later became the one to carry major missions like Chandrayaan-1 and the Mars Orbiter Mission (Mangalyaan) to their destinations successfully and helped India to get international recognition for its cost-effective and innovative approach to space exploration.

He also initialised the GSLV project and began work on indigenous cryogenic engine technology in 1991. These efforts ensured India would not have to depend on others for future space launches.

Three Decades of Vision and Impact

Dr. Rao began his journey from the guidance of Dr. Vikram Sarabhai, and over the next three decades, from launching satellites to building rockets, all those effort shaped India's future in space. He was a visionary leader who worked for India's space program to get global recognition . With his tireless efforts ISRO became not just a launch agency but a tool for national growth. Even today, his work continues to inspire scientists and serves as a foundation for India's ongoing missions, keeping the spirit of "space for the benefit of all" alive.



PIONEER OF THE DISTANT STARS

Edwin P. Hubble

Equipped with his five senses, man explores the universe around him and calls this adventure science.

- EDWIN P. HUBBLE

The **Name** Edwin Powell Hubble is widely known today because of the **"Hubble Space Telescope"**, named in his honour. But more than the name, it's his groundbreaking contributions to astronomy that changed how we see the universe.

In 1924, at a time when people still believed the Milky Way was the entire universe, Hubble introduced the extragalactic view – the idea that there are many other galaxies beyond our own.

Not a Cloud, but a Galaxy

Working most of his life at the Mount Wilson Observatory in California with a 100-inch reflector telescope, Hubble made a key discovery. He studied a special kind of star – a pulsating variable star – in what was then thought to be the Andromeda "nebula".

By using the relationship between the star's brightness and its pulsation period, he estimated its distance from Earth. The result was surprising – it was far too distant to be part of the Milky Way.

This meant Andromeda wasn't a nebula at all. It was a galaxy, just like our own. That one observation gave the world a whole new perspective: the universe is much, much bigger than we thought.

A Vision Beyond Time

Hubble's work revolutionized our understanding of the universe. His discoveries opened up an entirely new way of thinking about space, time, and the cosmos.

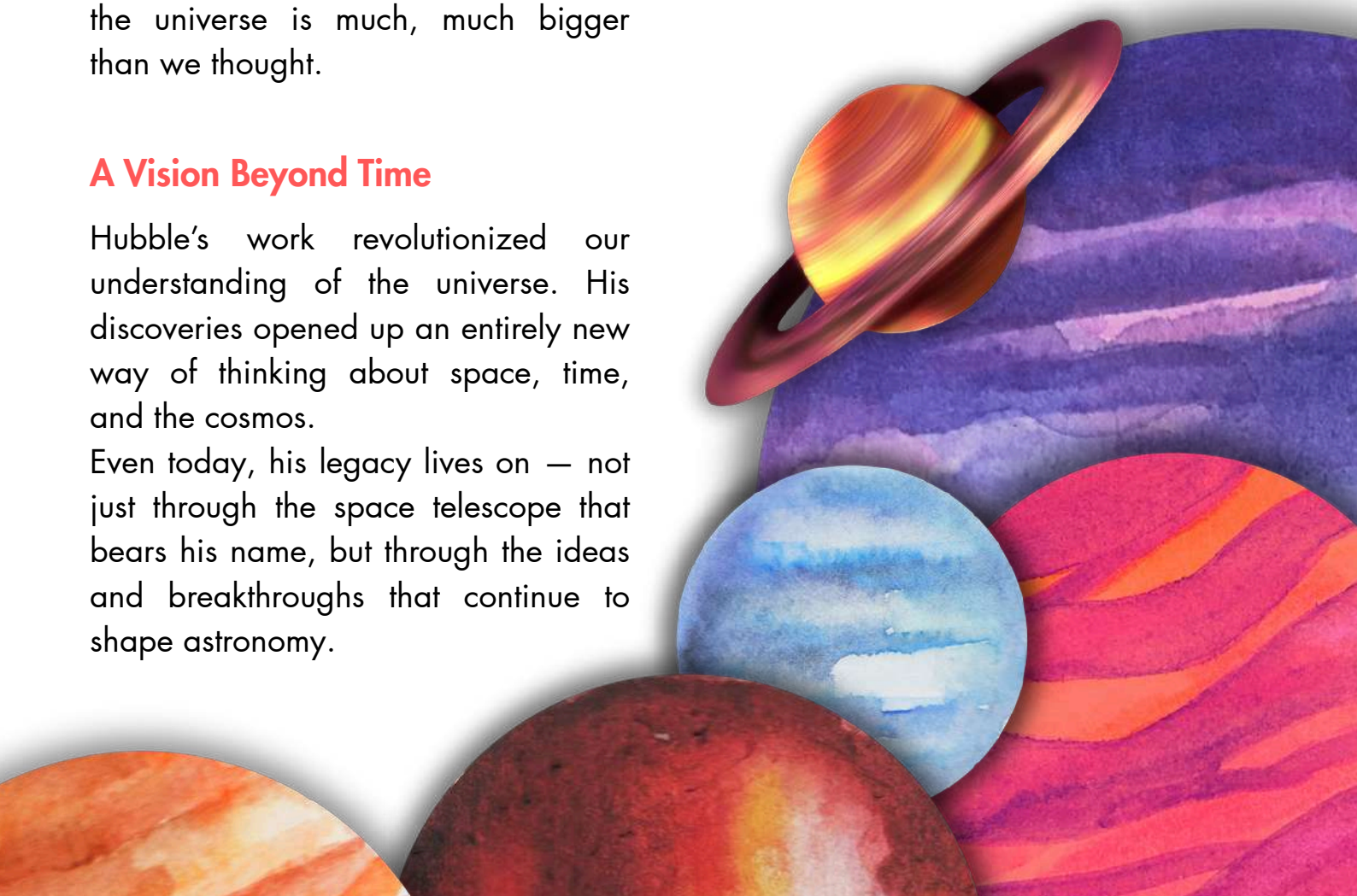
Even today, his legacy lives on — not just through the space telescope that bears his name, but through the ideas and breakthroughs that continue to shape astronomy.

Foundation for the Big Bang Theory, A Modern Understanding

Hubble also observed that light from distant galaxies was shifted toward the red end of the spectrum – a phenomenon now known as redshift.

This redshift showed that galaxies were moving away from us. The farther away a galaxy was, the faster it was receding. This led to what we now call Hubble's Law.

His findings gave the first solid evidence that the universe is expanding, laying the foundation for the Big Bang theory. He also introduced a method to classify galaxies, helping scientists study their evolution and understand the structure of the cosmos.



Failure is something that happens when we quit, but as long as we try, that moment is a hurdle, not a failure.

- KALPANA KALAHASTI

THE SILENT STAR BEHIND INDIA'S MOON DREAMS

Kalpana Kalahasti

"**We** have achieved our goal flawlessly," said Kalpana Kalahasti, a few minutes after India's space agency safely landed its first probe near the Moon's south pole on August 23, 2023 making the **Chandrayaan-3** a successful and historic mission. Further adding she said–"This will remain the most memorable and happiest moment for all of us.".

A Woman of Courage and Genius

Born in Chennai, Tamil Nadu, from childhood Kalpana harbored the ambition to work with India's space agency and her academic path –B.Tech in Electronics and Communication Engineering – aligned well with her dream of contributing to missions at ISRO. All her efforts have resulted in Kalpana becoming a seasoned aerospace engineer at ISRO.

The loss of Chandrayaan-2's lander was a defining moment for Kalpana and her team members, who poured all of their efforts into bouncing back. Soon after, she was named the Associate Project Director of Chandrayaan-3, playing a pivotal role in what became a landmark moment in global space exploration.

Key Roles at ISRO

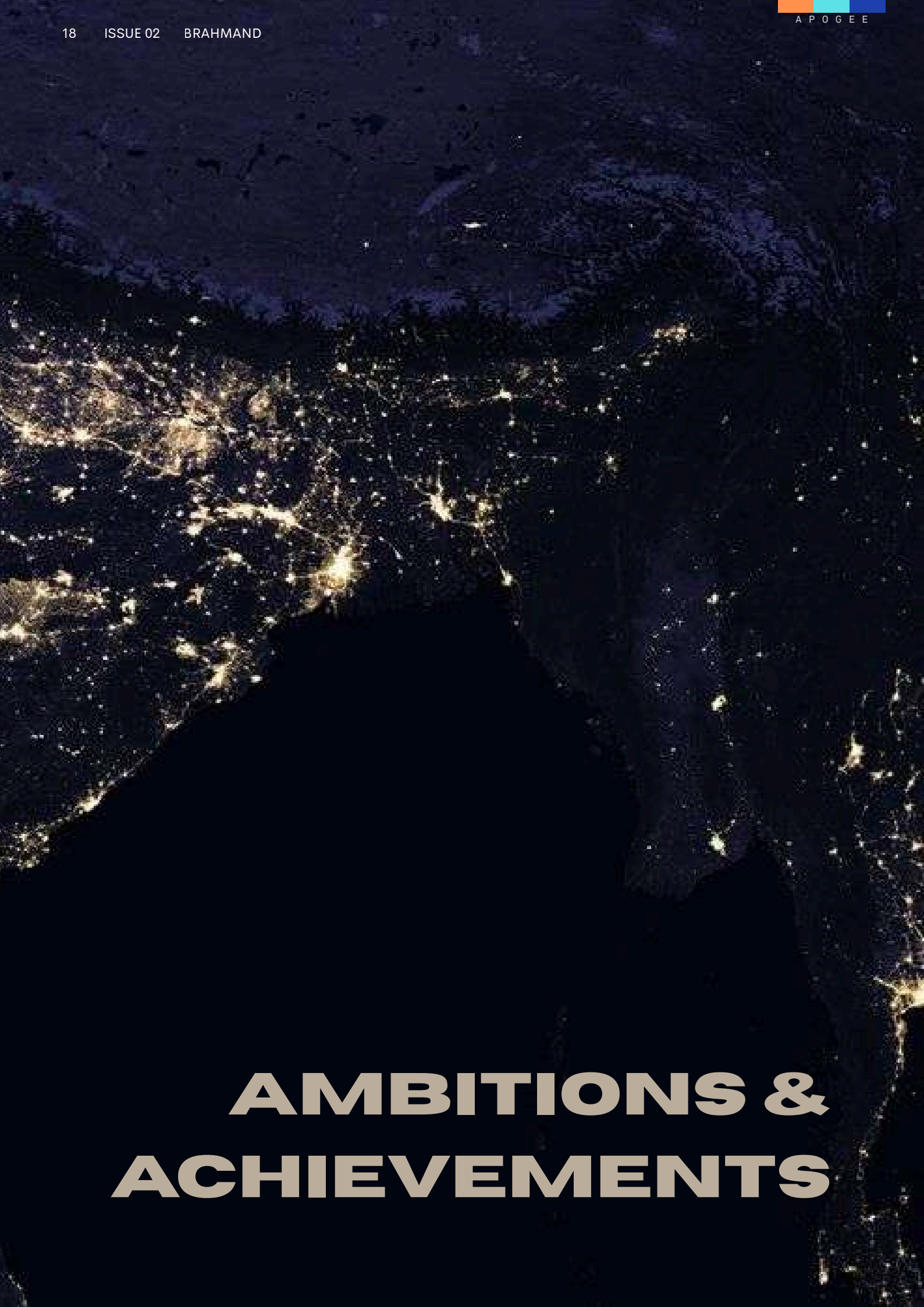
In the early years, Kalpana worked on various satellite projects and played a key role in the successful launch of several communication and remote sensing satellites. From developing propulsion systems for accurate satellite positioning to designing advanced imaging equipment to capture high-resolution images of the Earth she has been at the forefront. All these efforts by her made her way to become a part of the landmark project Mars Orbiter Mission (Mangalyaan) as a satellite and systems specialist. She then was entrusted with the role of Associate Project Director in the lunar missions of both – Chandrayaan-2 and Chandrayaan-3.

Inspiring the Next Orbit of Dreamers

In a world where female STEM professionals all too often fight for attention, Kalpana Kalahasti has her work to do the talking. Her story is what it really means to break down barriers—not only because she's a woman in a male-dominated field, but because she helped the country reach beyond the planet itself.

Kalpana's tale is an inspiring message for aspiring young dreamers: it doesn't take chasing after the limelight to make history. Sometimes you can write it behind control panels, in the vocabulary of physics, engineering, and unadulterated imagination.

INDIA IN SPACE



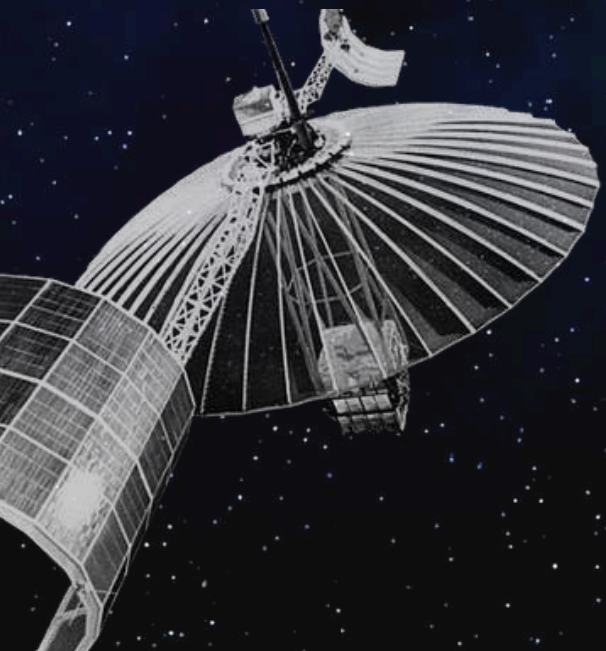
AMBITIONS & ACHIEVEMENTS

UNITY IN ORBIT

INDIA'S SPACE TIES WITH NASA

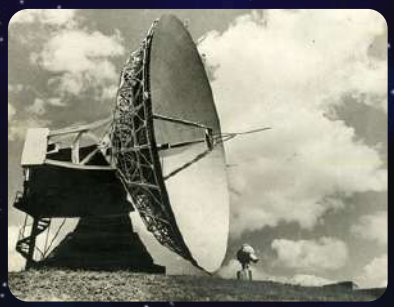
India and NASA's New Era of Space Collaboration

India's journey into space began with practical ambitions—using satellites to help farmers, forecast weather, and connect remote communities. Today, the Indian Space Research Organisation (ISRO) stands shoulder-to-shoulder with the world's top space agencies, and its partnership with NASA is opening new frontiers for both nations.



From Early Rockets to Global Missions

The collaboration between India and NASA traces back to the 1960s, when NASA helped India launch its first sounding rockets from a humble site in Kerala.



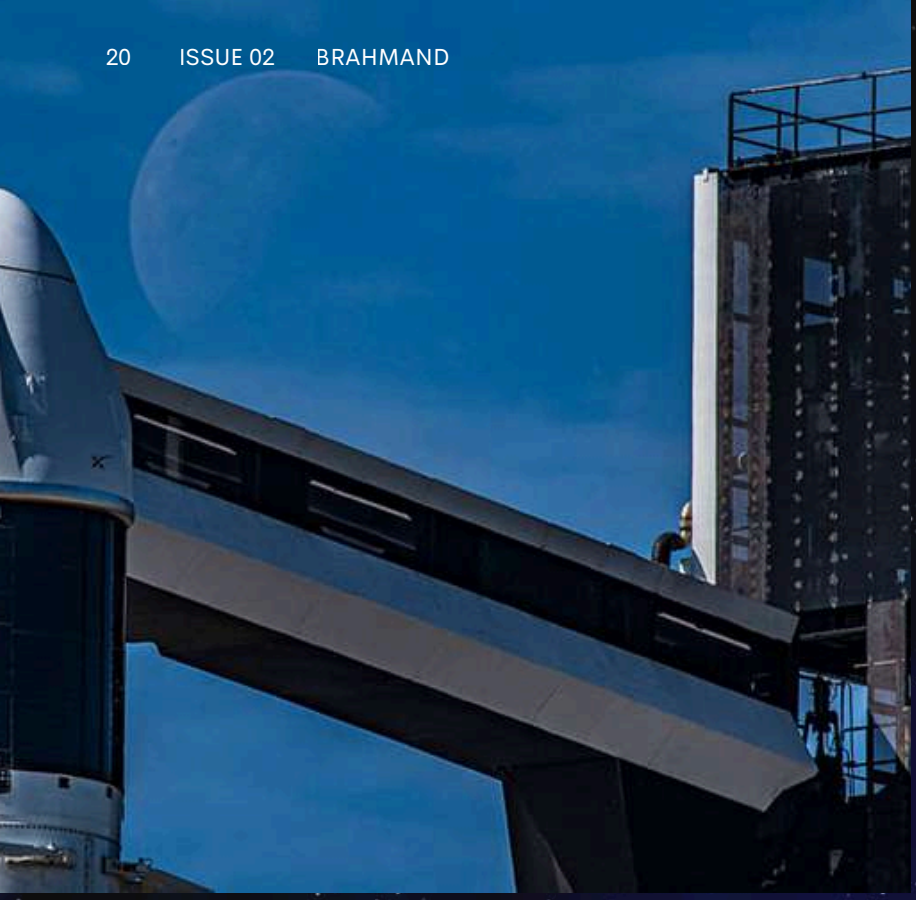
A view of the antenna at the prime earth station of Satellite Instructional Television Experiment (SITE).

Over the decades, this cooperation evolved from technical assistance to joint missions. A landmark early project was the Satellite Instructional Television Experiment (SITE), which used American satellites to beam educational programs to rural India—powerful demonstration of how space technology can drive social progress.

Major Milestones in Partnership

Chandrayaan-1 (2008): NASA's instruments aboard India's lunar orbiter helped discover water molecules on the Moon, a breakthrough that transformed lunar science and showcased the value of international collaboration.

Source - ISRO



Mars Orbiter Mission (MOM, 2013):
India's first Mars mission, with NASA providing critical tracking and navigation support, made India the first Asian nation to reach Mars orbit—accomplished at a fraction of the cost of similar missions.

5 Years Of Mangalyaan - India's Mars Orbiter Mission | Photo Credit: ISRO

An artist's concept of the NISAR satellite in earth orbit. The radar antenna reflector is deployed on top. | Photo Credit: NASA

NISAR Mission (2025):
The upcoming NASA-ISRO Synthetic Aperture Radar (NISAR) satellite will use advanced radar to monitor changes on Earth's surface, helping track disasters, climate shifts, and natural resources. NASA provides the L-band radar; ISRO supplies the S-band radar and the launch vehicle

Training for the Future: The Axiom-4 Mission

A new era of human spaceflight is unfolding. In 2025, Group Captain Shubhanshu Shukla became the first Indian to visit the International Space Station as part of the historic Axiom-4 mission, a collaboration involving NASA, ISRO, and SpaceX. Shukla conducted several India-specific experiments and marked a proud moment for India's space ambitions, following in the footsteps of Rakesh Sharma.. NASA and ISRO are now working together to train Indian astronauts for future missions, including possible long-duration stays aboard the ISS. This partnership is not just about technology, but about building trust, sharing knowledge,and preparing for the next era of exploration.

Did You Know?

- India was the first Asian nation to reach Mars orbit, with NASA's support.
- NISAR will scan nearly all of Earth's land and ice surfaces every 12 days, providing vital data for disaster management and environmental monitoring.

INDIA'S SPACE TIES WITH JAXA

Lifting Off Together: How ISRO and JAXA Launched a New Era of Space Collaboration

India and Japan formalized their space cooperation in 2016 through a Memorandum of Understanding between ISRO and JAXA, followed by an agreement in 2017 for the joint LUPEX mission. This collaboration covers lunar exploration, disaster management, solar science, and satellite-based Earth observation—underscoring a shared vision for peaceful and strategic use of space.

The Pragyan rover mounted on a ramp with the Vikram Lander. Photo Credit: ISRO

Scientists of ISRO and JAXA, who jointly conducted the third face-to-face technical interface meeting, towards the Chandrayaan-5/LUPEX mission, seen at ISRO headquarters, Bengaluru. (DC)

LUPEX: Exploring the Moon's South Pole

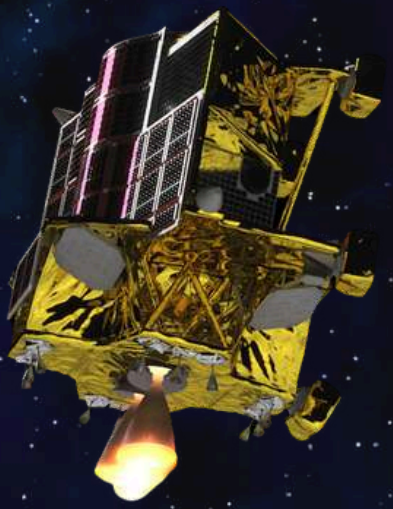
LUPEX, the Lunar Polar Exploration Mission, is the centerpiece of India-Japan cooperation. ISRO will provide the lander, while JAXA develops a rover capable of drilling 1.5 meters into the Moon's south pole to search for water ice. With support from NASA and ESA, LUPEX is expected to launch by 2028–29 and could pave the way for future lunar settlements.

Expanding Frontiers: From Solar Science to Debris Management

Beyond the Moon, ISRO and JAXA are working together on sharing data from missions like Aditya-L1 and Chandrayaan-3, while improving regional climate resilience using Earth observation platforms. Their cooperation extends to satellite navigation, space debris mitigation using laser-equipped satellites, and building sustainable orbital practices.

A Strategic Tech Partnership in Asia

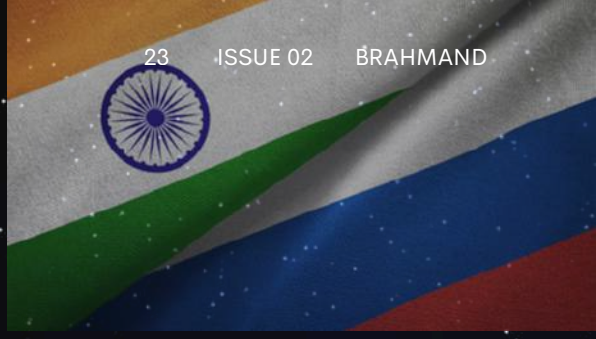
Japan's advanced space technologies and India's reliable launch capabilities form a strong alliance. Startups from both nations are joining forces on innovations like space-debris-clearing satellites. Their joint work under the Quad Space Working Group further promotes standards, data sharing, and regional security in space



Artist's impression of the Ariane 5 with its payload of four satellites. Photograph: Pierre Carril/ESA

Challenges and the Way Ahead

Despite budget constraints and technical dependencies, India and Japan remain committed to their shared space vision. With growing private-sector involvement and regional cooperation, ISRO and JAXA aim to shape an Asian-led model for collaborative, peaceful, and sustainable space exploration.



INDO-RUSSIAN COOPERATION IN SPACE

Orbit allies : India and Russia's shared space dreams

> "India and Russia share a legacy of mutual trust in space research. This partnership is built not just on technology, but on shared values and friendship."
>
> — Dr. K. Sivan, Former Chairman, ISRO

The story of Indo-Russian space collaboration isn't just about rockets or satellites—it's about trust, perseverance, and shared dreams. From launching India's first satellite Aryabhata in 1975 using a Soviet rocket to training Indian astronauts like Rakesh Sharma—who famously said "Sare Jahan Se Achha" from space—this partnership has stood strong through decades. Even in the Cold War era, when global tensions were sky-high, the Soviet Union remained India's most reliable partner in space.

Milestones That Matter

Gaganyaan: India's Human Spaceflight Dream:

India's ambitious Gaganyaan mission owes much to Roscosmos. From astronaut training in Russia to technical support and a crew escape system tested successfully in 2023, Russia is helping India prepare for its first independent human spaceflight.

The Gaganyaan test Crew Module. (Image credit: ISRO)

Shukrayaan: Unraveling the Secrets of Venus:

Teaming up once again, India and Russia are joining forces for Shukrayaan-1, India's upcoming mission to Venus (2028). With Russia's experience from its past Venera missions and co-developed tools like the VIRAL instrument, this mission aims to decode Venus's toxic atmosphere and geological mysteries.

Government Approves ISRO's Venus Orbiter Mission 'Shukrayaan'

NavIC + GLONASS: A Navigation Power Duo:

By setting up ground stations in each other's countries, India's NavIC and Russia's GLONASS are enhancing global navigation accuracy—helping with everything from defense and disaster response to everyday smartphone maps.

Cryogenic Engines: A Story of Grit and Guidance:

Russia once provided India with essential cryogenic engines.But India's scientists,driven by failures and fire, developed their own by 2014. This success now fuels ISRO's rockets and upcoming reusable spacecraft like Pushpak, inspired by Russia's legendary Buran shuttle.

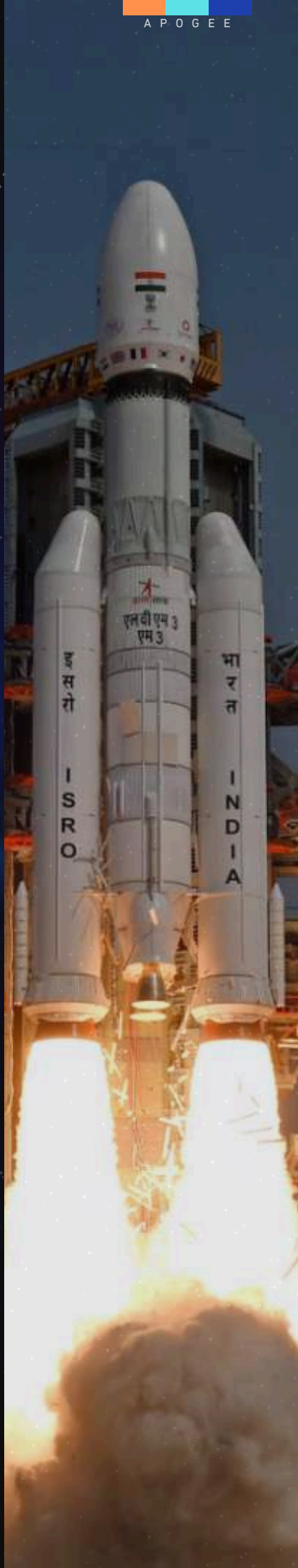
C25 Cryogenic Stage of the Indian Space Research Organisation's (ISRO) LVM3 (Launch Vehicle Mark-3).

Space Diplomacy in Action

Beyond science, this partnership symbolizes strategic alignment. Through forums like BRICS and the UN, both nations champion peaceful use of space. Russia even invited India to join its International Lunar Research Station (ILRS)—a sign of deep rooted mutual respect.

Looking ahead what's next

The future of Indo-Russian space cooperation looks promising and filled with possibilities. From teaming up on lunar missions like the International Lunar Research Station (ILRS) to jointly developing reusable rockets, advanced satellites, and space sustainability technologies, both nations are poised to explore new frontiers together. Their shared commitment to peaceful space exploration and innovation will not only strengthen bilateral ties but also contribute to the global scientific community in meaningful ways. As space becomes the next frontier of diplomacy and development, India and Russia are ready to lead with trust, vision, and partnership.



CHANDRAYAAN - CYCLE SE CHAND TAK

Being an Indian, the mere mention of 'Chandrayaan' fills our hearts with immense pride. The journey from the heartbreak of 2019 to the glorious redemption in 2023 showcases ISRO's phenomenal growth as a world-class space organization.

CHANDRAYAAN - 1

The saga began with Chandrayaan-1, our first-ever lunar mission was launched on October 22, **2008,** which rewrote lunar science by discovering water molecules on the Moon. What made this mission extraordinary was its Moon Impact Probe that successfully crashed near Shackleton Crater, proving India's capability to reach lunar terrain. The collaboration with NASA's Moon Mineralogy Mapper(M3) instrument provided irrefutable evidence of lunar water, forcing textbooks to be rewritten worldwide. This pioneering mission not only put India on the global space map but also laid the foundation for our future interplanetary ambitions.

PSLV C11 carrying Chandrayaan-1 | SOURCE: ISRO

CHANDRAYAAN - 2

The emotional rollercoaster continued with Chandrayaan-2 on July 22, 2019, which aimed to soft-land the Vikram module and deploy Pragyan rover on the South Pole of the moon. While the nation watched with bated breath waking up late till night, a last-minute software glitch caused Vikram to lose control just 2.1 km above the lunar surface. It was a heartbreak for our scientists as well as for the nation. Yet, the whole country was all praises for the brave effort. .The mission's unsung hero - the orbiter - continues its valuable work even today, mapping water ice deposits in polar craters and maintaining its position as one of the most enduring lunar satellites.

Launch of Chandrayaan-2 | SOURCE: ISRO

CHANDRAYAAN - 3

Our moment of ultimate triumph came with Chandrayaan-3 on August 23, 2023, when India made history by landing near the Moon's south pole - a world first achieved at just $75 million, cheaper than a SpaceX Falcon 9 launch! This strategic location was chosen for its potential water ice reserves in permanently shadowed craters, crucial for future lunar bases. The Pragyan rover's discovery of sulphur, iron and oxygen provided vital clues about the Moon's volcanic past, cementing India's position as a leading spacefaring nation.

Top : Vikram Lander
Bottom: Pragyan Rover
Source : ISRO

GAGANYAAN: INDIA'S VOYAGE TO THE STARS

As **Abdul Kalam** once said, **"You have to dream before your dreams can come true."** Gaganyaan is that dream. Made real by thousands of scientists, engineers, and visionaries working silently across decades.

The Dream and the Declaration

It all began as a whisper—a spark—in the minds of ISRO scientists back in 2004. What seemed like science fiction back then is today a fully operational dream with rocket engines roaring and astronauts readying themselves for history. In 2018, Prime Minister Modi announced from the Red Fort that by the 75th year of Independence, an Indian would soar into space under the tricolor. A declaration, yes—but also a dare to the stars.

The Rocket and Modules

India's powerful LVM3 rocket is being upgraded for human-rating. This three-stage rocket (solid, liquid, cryogenic) is an affordable engineering marvel. The Crew and Service Modules, astronauts' orbital home, are rigorously tested. The capsule is designed for safe re-entry, withstanding 1000°C, and uses a 100% Indian, DRDO-tested parachute system for landing.

Mission Objectives and Challenges

The mission is a tightrope walk between life and vacuum. Every component—launch vehicle, crew capsule, life support systems, escape module—has to work flawlessly. Gaganyaan isn't just technical excellence. It's scientific poetry in motionAt its core, Gaganyaan aims to launch 2–3 astronauts to 400 km above Earth, keep them safe for up to 7 days, and bring them back home. Sounds easy? Think again. Space doesn't allow do-overs..

Building the Backbone

This mission is about:

- Technology: Human-rating India's most powerful rocket, the LVM3.
- Science: Running experiments in microgravity.
- Strategy: Laying the groundwork for a space station by 2035 and lunar missions by 2040.
- Self-Reliance: Building nearly everything indigenously—from space food to life support systems.

The People and Partnerships

ISRO's Human Space Flight Centre (HSFC) is mission control central. Imagine a Marvel-style base, but staffed by humble geniuses.Names like R. Hutton and Dinesh Kumar Singh lead the show, but the real strength lies in collective effort. DRDO developed 70+ space-grade food items and emergency systems. International help? Russia trained our astronauts; France shared space medicine wisdom; Australia and ESA joined in tracking and landing support.

Roadmap to the Stars

Gaganyaan's roadmap is broken into carefully staged missions:

- Test Vehicle Abort Missions (like TV-D1): Checked if astronauts can safely escape mid-launch.
- Uncrewed Missions (G1, G2, G3): Enter Vyommitra—a half-humanoid robot that speaks Hindi and English and will do science in microgravity.
- Crewed Flight (H1): Slated for 2027, with Indian astronauts orbiting Earth for 3–5 days.

THE ROCKET RANGE

A Simple Guide to India's Space Launchers

GSLV – Big Rocket for Big Satellites

The GSLV (Geosynchronous Satellite Launch Vehicle) is one of ISRO's biggest rockets. It is used to send large communication satellites into a special orbit far away from Earth. This orbit is called GTO (Geosynchronous Transfer Orbit).

GSLV has three parts (stages). Each part has different types of fuel: solid, liquid, and very cold fuel (cryogenic). The cryogenic engine is a big achievement for India. It was used for the first time in 2014.

This rocket is 51.7 meters tall and can carry heavy satellites weighing up to 2.5 tonnes. The first flight was in 2001. GSLV is used mostly to send satellites that help with communication, like TV and internet.

PSLV – India's Trusted Rocket

The PSLV (Polar Satellite Launch Vehicle) is a rocket that ISRO has used many times. It is very reliable and trusted. It can launch satellites into different orbits, including polar orbits, low Earth orbits, and even GTO.

PSLV is famous because it can carry many satellites at once. This makes it useful for India and also for other countries. The first successful flight was in 1994.

This rocket has four stages, using both solid and liquid fuel. It has been used to launch satellites for weather, earth observation, and even space research. PSLV is known as ISRO's "workhorse" because it has done so many successful missions.

SSLV – Small Rocket for Small Satellites

The SSLV (Small Satellite Launch Vehicle) is a small rocket made to launch small satellites. It is cheap, quick, and perfect for startups and schools that want to send satellites into space.

SSLV had its first test in 2022, but it was not successful. In 2023, the rocket had a successful flight.

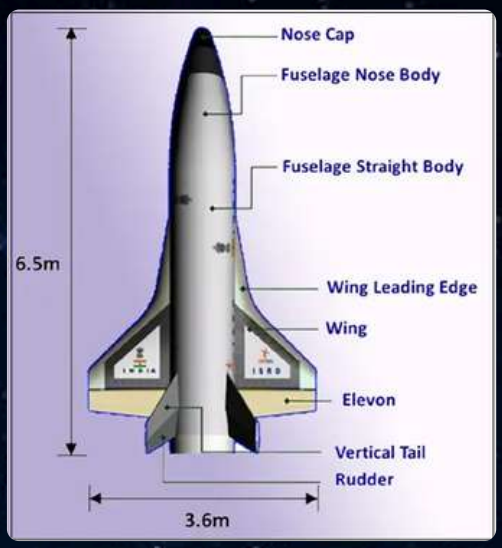
It has three solid-fuel stages and a special last part called VTM (Velocity Trimming Module). This part helps to put the satellite in the right orbit. The rocket is 34 meters tall and can carry up to 500 kg.

SSLV is useful when a quick and low-cost launch is needed.

REUSABLE LAUNCH VEHICLES: REVOLUTIONIZING SPACE TRAVEL

About

A Reusable Launch Vehicle (RLV) is a rocket designed for multiple space missions. Unlike traditional rockets that are discarded after one use, RLVs are built to return to Earth, be refurbished, and launched again. This approach is similar to how airplanes operate and marks a major shift in making space travel cheaper, more efficient, and sustainable.



India's Push in Reusable Technology

India is advancing rapidly in this field. ISRO's RLV-TD, also known as Pushpak, is a key milestone in India's indigenous RLV development. In April 2023, ISRO successfully demonstrated autonomous landing of Pushpak under conditions mimicking space re-entry, marking a significant achievement.

Resembling a space shuttle, Pushpak represents a vision of lower launch costs and increased mission frequency for India in the future.

How Reusable Rockets Work

Reusable rockets are engineered to survive both launch and re-entry. After delivering their payload, the first stage of the rocket detaches and returns to Earth using engines or parachutes, landing on ground pads or floating platforms. Once recovered, the rocket is inspected, repaired if needed, and prepared for reuse—saving cost and resources.

Global Leaders and Indian Innovation

Global pioneers like SpaceX's Falcon 9 and Starship, Blue Origin's New Shepard, and NASA's retired Space Shuttle have shown the success of reusability. India's Pushpak now joins this elite league, proving its capability in autonomous descent and landing.

SpaceX Release Epic Footage Of Last Month's Falcon 9 Landing

Image: STS115 Atlantis undock ISS | Source: NASA

Benefits and Challenges

Advantages:

- Lower cost of access to space
- Increased reliability through repeated testing
- More frequent launches
- Environmental benefits through reduced waste

Challenges:

- Designing durable rockets
- Refurbishment costs
- Added weight reduces payload capacity

Conclusion

The future of space travel is clearly reusable. With innovations like ISRO's Pushpak, India is set to be a major player in this transformative shift. As technology evolves, reusable launch vehicles will not only reduce costs but also democratize space, enabling broader participation in space missions

ISRO - OUR EVERYDAY HERO

"It's Not Just About Rockets, It's About India's Future"

About

When we hear about ISRO, we often think of rockets, Chandrayaan, or Mars missions. But ISRO's real work goes far beyond space. Quietly and efficiently, it strengthens India every single day.
What's surprising is how little it runs on

Last year, ISRO received just ₹13,399 crore—only 0.04% of India's GDP. That's far less than what we spend on defence or education. Yet ISRO supports both. According to the OECD, every ₹1 spent on ISRO returns ₹7 to the economy. That's a return most investors would dream of

The Hidden Work ISRO Does Every Day

- ISRO plays a life-saving role during disasters. Its satellites give early cyclone warnings—like during Cyclone Fani in 2019—helping evacuate lakhs of people to safety.

- In agriculture, programs like FASAL and CHAMAN give farmers satellite-based insights into crop health and planning. This not only increases yield but also protects crops from risks.

In many rural schools and clinics, ISRO works silently behind the scenes. Through EDUSAT, remote schools can access lessons from expert teachers. Telemedicine networks connect rural patients to doctors in cities, without needing physical travel.

Even your daily commute might be supported by ISRO. The NAVIC system —India's version of GPS—helps track trains, guide emergency services, monitor public transport, and strengthen defence operations.

Why We Must Invest More in ISRO

Some ask, "Why invest in space when poverty still exists?" But ISRO is fighting poverty—by improving farming, education, healthcare, and disaster response. Over 80% of its missions are focused on Earth.

With limited resources but limitless vision, ISRO has helped India become one of the few countries to land on the Moon, launch its own navigation system, and send satellites for 40+ nations. It does all this at incredibly low cost—Mangalyaan cost ₹450 crore, less than a Hollywood movie; Chandrayaan-3 cost ₹615 crore.

Antrix Corporation Limited, the commercial arm of the Indian Space Research Organisation (ISRO)

The Bigger Picture

ISRO is not just building rockets—it's building the future. Its upcoming projects include space-based solar power, rural internet, climate monitoring, deep space research, and more.

It's also inspiring space startups like Pixxel and Skyroot, creating jobs and new industries.

Supporting ISRO isn't a luxury. It's a smart investment in a stronger, smarter, self-reliant India.

THE BUSINESS ORBIT

ISRO's Commercial Rise

From Rocket Science to Market Strategy

India's space journey has evolved from a purely scientific mission to a powerful economic engine. What began as ISRO's government-led venture is now a growing commercial ecosystem, with both public and private players driving innovation. While ISRO continues its hallmark missions like Chandrayaan and Gaganyaan, private companies like HAL and L&T are now involved in manufacturing launch vehicles and building infrastructure.
Meanwhile, new-age Space startups are supported by government under ISRO's NewSpace India Limited (NSIL) and IN-SPACe, two departments designed to open the sector to private players.

What are NSIL & IN-SPACe:

NSIL is ISRO's commercial arm, turning scientific progress into business deals. From launching satellites for global clients to licensing ISRO's technologies, NSIL helps monetize India's space capabilities. One notable success: the launch of 36 OneWeb satellites, which showed India's global reach.

IN-SPACe acts as a facilitator, easing entry for private players. It offers approvals, access to ISRO's facilities, and technical support to startups and industries alike. Thanks to these efforts, Indian firms are now developing launch vehicles, satellites, and space services for domestic and international markets.

Why the World is Choosing ISRO

India is fast becoming the launch partner of choice for countries across Asia and Africa. Why? Affordability, reliability, and neutrality. While a launch in the U.S. or Europe may cost $60–90 million, India offers it for just $15–20 million. Projects like the South Asia Satellite (GSAT-9) and collaborations on BhutanSat prove India's focus on regional cooperation, free from political strings.

The Neighbourhood First and Act East policies further enhance India's appeal, offering technical help and satellite services as public goods. With startups also stepping in, India is becoming a hub for affordable and inclusive space access.

Partnerships with HAL, L&T, and Startups

HAL is now in charge of producing ISRO's Small Satellite Launch Vehicle (SSLV)—a step toward full private manufacturing. L&T, too, contributes to rocket parts and launch infrastructure. Private players like Skyroot and Agnikul are racing to develop low-cost launch options, with SSLV missions now costing as little as $4 million.

As the global space economy heads to $1.8 trillion by 2035, India is carving a niche—affordable, innovative, and future-ready.

Competing Globally, Investing Locally

India's value proposition is simple: reliable missions at a lower cost. Already, over 36 nations have launched more than 380 satellites through India. ISRO's Mangalyaan and Chandrayaan-3 missions showcased our capability, and new players are building on that legacy.

Future Scope: A Billion-Dollar Orbit

India's current space economy, valued around $8–8.4 billion, is expected to hit $44 billion by 2033. With over 200 active startups and reusable launch vehicle (RLV) tech under development, costs are expected to fall by 80%, boosting competitiveness.

India–Bhutan Satellite Ground Station inaugurated in Thimphu, marking a new milestone in space cooperation.

INDIA'S PRIVATE SPACE REVOLUTION

These agreements were signed at Skyroot's facility in Hyderabad during a visit by a French business delegation.

Reaching for the Stars

The stars are no longer the sole domain of governments. In the last decade, a wave of private companies has transformed space from government-only missions to a fast-growing commercial frontier. The United States led this transformation with companies like SpaceX and Blue Origin. Today, the rest of the world, including India, is catching up fast.

India's Big Leap into Space

India is now writing its own space story with a private twist. The government's bold reforms since 2020 have opened the space sector to private players, allowing companies to build their own satellites, rockets, and even launchpads. Over 300 Indian companies have already applied for licenses to build space systems, marking a sharp shift from when ISRO was the sole space player.

The successful development of Vikram-1 by SKYROOT

Rocketing Into History

Private companies have already started launching into space—literally.

In November 2022, Skyroot Aerospace from Hyderabad became the first Indian private company to launch a rocket, named Vikram-S, into space.

Then, in May 2024, Agnikul Cosmos from Chennai launched Agnibaan, its own two-stage rocket, from India's first private launchpad.

These missions were suborbital, but they proved that Indian startups can now build and fly rockets—something only governments could do a few years ago.

Building Satellites & Beyond

While some companies focus on rockets, others are innovating in satellites and data services.

Pixxel, based in Bengaluru, is building a constellation of hyperspectral imaging satellites to monitor Earth for agriculture, climate, and disaster response. It even attracted investment from Google!

Dhruva Space, from Hyderabad, has already launched satellites for clients using ISRO rockets.

Startups like SatSure, Digantara, Astrome, and Bellatrix are working on satellite data analytics, space traffic tracking, broadband services, and space tugs.

Together, these companies are diversifying India's space offerings—not just launching rockets, but using space for solving problems on Earth.

The Big Picture: India vs The World

India's private space sector is still young, but it's catching up.

The United States has hundreds of space startups and launches dozens of missions each year.

India's space economy is around $8 billion, just 2–3% of the global total—but it's growing fast.

The government has set a goal to grow the space economy five-fold by 2033 and boost exports massively.

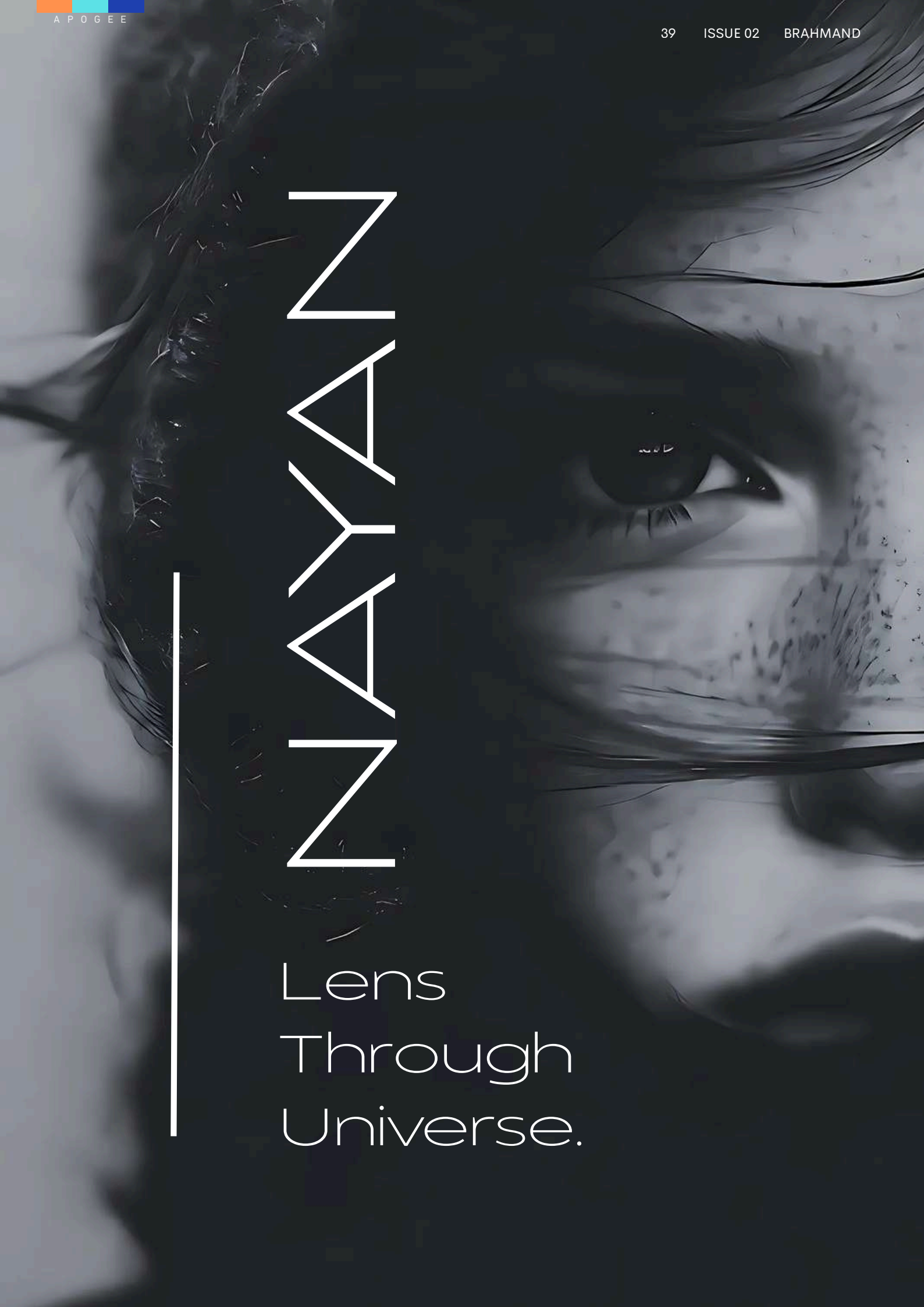
While India's private companies are just starting to launch rockets and deploy satellites, they are backed by strong government support and growing investor interest.

The Journey Ahead

India's space journey is entering an exciting chapter. With powerful rockets, smarter satellites, and ambitious startups, the private space sector is poised to play a major role in future Moon, Mars, and Earth missions.

As investors say, *"The next 12 months will be crucial."* The world is watching, and India is rising—one rocket at a time.

As ISRO Chairman S. Somanath puts it, *"Going to the Moon is a costly affair... We must create business opportunities."*

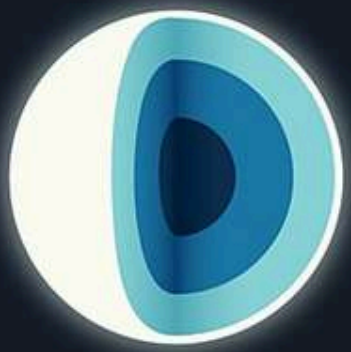


NAYAN

Lens Through Universe.

A beginner-friendly, bite-sized exploration of cosmic wonders.

Born from a blast: The Secret Life of a Neutron Star



NEUTRON STARS

A neutron star is a dense core left behind after a massive star goes supernova and explodes. Though only about 10 to 20 miles (15 to 30 kilometers) wide, they can have three times the mass of our Sun, making them some of the densest objects in the universe, second only to black holes. A teaspoon of neutron star material would weigh 4 billion tons on Earth. There are several types of neutron stars.

DIFFERENT NEUTRON STAR TYPES

MAGNETAR

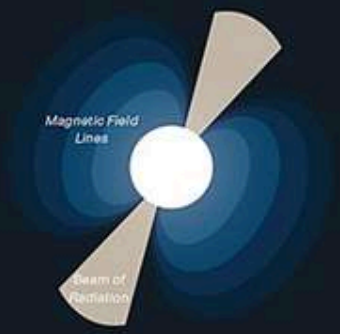
A magnetar is a neutron star with a particularly strong magnetic field, about 1,000 times stronger than a normal neutron star. That's about a trillion times stronger than Earth's magnetic field and about 100 million times stronger than the most powerful magnets ever made by humans. Scientists have only discovered about 30 magnetars so far.

PULSAR

Most of the roughly 3,000 known neutron stars are pulsars, which emit twin beams of radiation from their magnetic poles. Those poles may not be precisely aligned with the neutron star's rotation axis, so as the neutron star spins, the beams sweep across the sky, like beams from a lighthouse. To observers on Earth, this can make it look as though the pulsar's light is pulsing on and off.

MAGNETAR + PULSAR

There are now six known neutron stars that are both pulsars and magnetars.



What is a Neutron Star?

Neutron stars are the smallest and densest currently known class of stellar objects, Neutron stars have a radius on the order of 10 kilometres and a mass of about 1.4 solar masses (a standard unit of mass used in astronomy, equivalent to the mass of the Sun).

The Discovery of the First Neutron Star: Pulsar PSR B1919+21

The first neutron star, also known as the first pulsar, was PSR B1919+21 (also referred to as Little Green Men). It was discovered in 1967 by Jocelyn Bell Burnell and her supervisor Antony Hewish.

How are they formed?

Stars more than eight times the mass of the Sun can end their lives as neutron stars. During most of their lives, they stay balanced—gravity pulls inward, while pressure from nuclear fusion pushes outward. Eventually, fusion creates iron, which can't release energy. As the iron core grows and nears 1.4 times the Sun's mass, electron degeneracy pressure fails, and gravity causes the core to collapse rapidly. In seconds, matter is packed so tightly that it bounces, creating a massive shockwave that causes a supernova explosion.

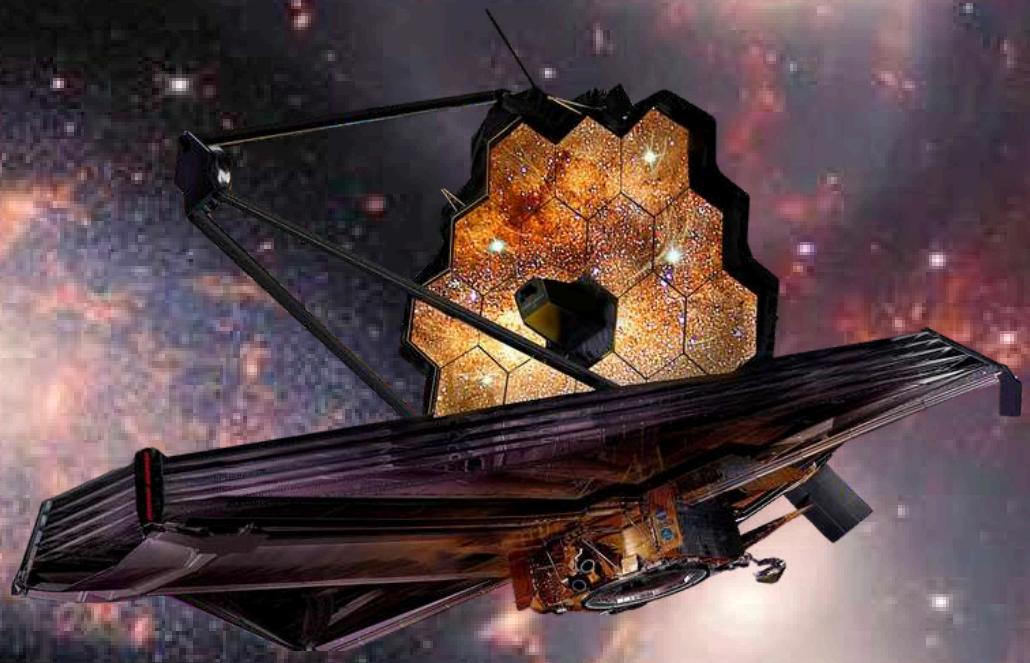
Under extreme pressure, protons and electrons merge into neutrons, forming an ultra-dense core. When the core shrinks to about 20 km wide and remains under 2.8 solar masses, neutron degeneracy pressure halts further collapse. What remains is a neutron star—an incredibly dense, small object made mostly of neutrons, surrounded by a crust of compressed matter, and among the strangest things in the Universe.

Their Fascinating Properties:

- At birth it's very hot—100 billion to 1 trillion degrees, after a few years the temperature of the neutron star is reduced 1 million degrees Kelvins.
- A neutron star does not generate any light or heat of its own after its formation.
- The magnetic field strength on the surface of neutron stars ranges from 10^4 to 10^11 tesla.

The neutron stars known as magnetars have the strongest magnetic fields, in the range of 10^8 to 10^11 tesla. Because neutron stars are so dense, they have intense gravitational and magnetic fields. The gravity of a neutron star is about a thousand billion times stronger than that of the Earth.

JAMES WEBB TELESCOPE



Peering Back in Time

Imagine a telescope so powerful it peers back over 13.5 billion years, revealing the universe's first stars, galaxies, and cosmic dawn. The James Webb Space Telescope (JWST), humanity's most advanced space observatory, uses infrared light to unveil hidden corners of the cosmos.

James Webb Telescope

Mission Across Cosmic History

Webb's mission spans the universe's entire history: from the first light after the Big Bang, through galaxy formation and star birth, to planetary systems—including our own. It reveals stars cloaked in dust, water vapor in distant atmospheres, and the earliest galaxies, opening a new window on cosmic evolution.

Unveiling the Cosmic Dawn

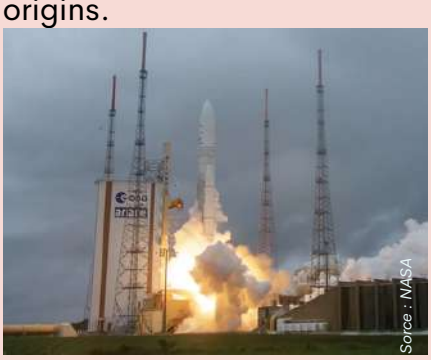
After the Big Bang, the universe was a hot, opaque particle soup. About 300,000 years later, neutral atoms formed, making the universe transparent but still dark until the first massive stars ignited, ending the cosmic dark ages. Webb's ultra-deep infrared surveys detect these faint, distant galaxies and analyze their composition, helping answer when and how this transformation occurred.

Tracing the Galaxy Evolution

Webb's infrared sensitivity lets astronomers compare early faint galaxies to mature spirals and ellipticals today. Galaxies form and grow through collisions, guided by invisible dark matter scaffolding. Galaxy assembly continues, with future mergers like the predicted Milky Way-Andromeda collision. Webb studies thousands of galaxies, tracing their growth and chemical evolution.

Star Birth and Planet Formation

Webb also penetrates dusty stellar nurseries like the Pillars of Creation, revealing newborn stars and planet-forming disks. Infrared light passes through dust like a thermal camera, allowing Webb to detect organic molecules vital for life's origins.



Ariane 5 rocket lifts off from Europe's Spaceport powering into space on a landmark mission.

Searching for the Habitability

Beyond distant galaxies, Webb analyzes exoplanet atmospheres for water, methane, and sodium—key habitability markers—using imaging and spectroscopy. It also studies solar system bodies, monitoring weather on gas giants, and searching for organics on Mars.

Engineering Marvel

Technically, Webb's 6.5-meter primary mirror consists of 18 gold-coated beryllium segments, collecting over six times Hubble's light. Its tennis-court-sized, five-layer sunshield cools the telescope to about -370°F (50 K). Webb orbits the Sun at the second Lagrange point (L2), 1.5 million km from Earth, ensuring a stable, cold environment.

Flawless Launch and Deployment

Launched December 25, 2021, aboard an ESA-provided Ariane 5 rocket, Webb was folded origami-style for launch and unfolded flawlessly in space. After six months of alignment and calibration, it began science operations.

A New Era in Astronomy

In just three years, Webb has revolutionized astronomy, discovering early galaxies, characterizing exoplanet climates, revealing galactic structures, and tracking asteroids. Led by NASA with ESA and Canadian Space Agency contributions, Webb surpasses Hubble's capabilities, inspiring scientists worldwide. It stands as a beacon of human ingenuity, destined to illuminate cosmic mysteries for decades.

VOYAGER

A Bottle Adrift in the Cosmic Ocean

Once upon a time, Earth spoke — and the Universe listened.

In the summer of 1977, at a time when computers were the size of rooms and satellites barely reached the Moon, humanity built two messengers: Voyager 1 and Voyager 2. Not to return. Not to land. But to wander. They were launched not with the promise of return, but with the hope of being heard — out there, in the quiet dark beyond our Sun.

The Launch of a Dream

Voyager 2 left first — on August 20, followed by Voyager 1 on September 5. They used a rare alignment of the outer planets — a 176-year opportunity — to ride gravitational slingshots from Jupiter, Saturn, and beyond. Each probe, no bigger than a car, carried a 20-watt transmitter, a few instruments, and a secret weapon — the Golden Record: Earth's mixtape to the stars.

What They Saw

Voyager 1 flew past Jupiter in 1979 and Saturn in 1980, capturing something no human had seen — the volcanoes of Io, the dancing rings of Saturn. Voyager 2 took a longer route, becoming the only probe to ever visit Uranus and Neptune, revealing Uranus' odd magnetic field, and Neptune's wild storms and the Great Dark Spot.

They sent back images not just to scientists — but to the soul of humanity. Planets that were once blurry dots became places. Real. Beautiful. Alive.

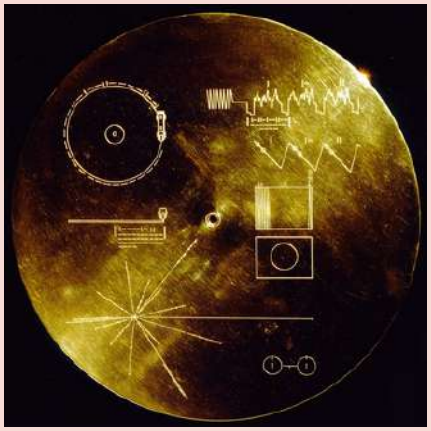
Beyond the Sun

In 2012, Voyager 1 passed the invisible line that separates our solar system from the rest of the galaxy — it entered interstellar space. Voyager 2 followed in 2018. Now, both drift in the dark — their sensors still alive, still sending back whispers about plasma waves, cosmic rays, and magnetic fields. They're showing us how the heliosphere, our solar bubble, fades into the larger Milky Way.

The Golden Record: Earth's Calling Card

Each Voyager carries a golden disc with greetings in 55 languages, 115 images of life on Earth, music from Beethoven to Bharat, and sounds — laughter, rain, footsteps, a heartbeat.

It's our resume, our attempt to say: "We existed. And we cared."



Cover of the Voyager Golden Record: engraved maps, and diagrams to guide hypothetical extraterrestrials in deciphering Earth's audio-visual time capsule.

Drifting Into Forever

By 2030, their power will run out. One by one, their instruments will sleep. And then — silence. But Voyager won't stop.

They will continue sailing — alone, untouched — through the galaxy, for a billion years or more, carrying our story long after we are gone.

Why Voyager Matters

With just 68 KB memory, weaker than your calculator, they've done what nothing else has: reached interstellar space, showed us our planetary neighbors, and carried Earth's soul into the cosmos.

"Voyager is not just a spacecraft. It's a hope. A footprint in the sky. A proof that even from a pale blue dot, we dared to speak to the stars"

From Singularity to Stars: A Journey Through the BIG BANG

What exactly is the Big Bang Theory?

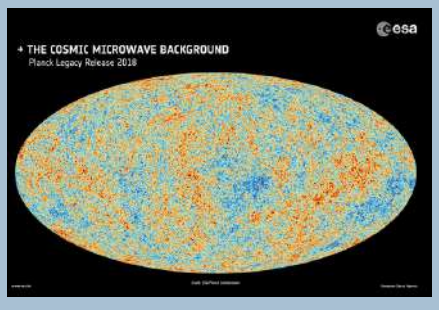
The Big Bang Theory is the most favored account for the origins of the universe - not a bang into space, but the expansion of space itself. Approximately 13.8 billion years ago, everything - matter, energy, space, and even time - exploded out of one extremely hot, dense point. The universe has been expanding, cooling, and changing ever since to the cosmic tapestry that we observe now.

When did it occur on the Cosmic Calendar?

If we collapse the whole history of the universe into a single calendar year, referred to as the Cosmic Calendar as popularized by Carl Sagan, the Big Bang occurs right at midnight on **January 1st at 12:00:00 AM (midnight)**. On this timescale, our solar system doesn't even emerge until early September, and fully modern humans don't arrive until 11:52 PM on December 31st. It's a compelling means of coming to terms with the enormity of cosmic time.

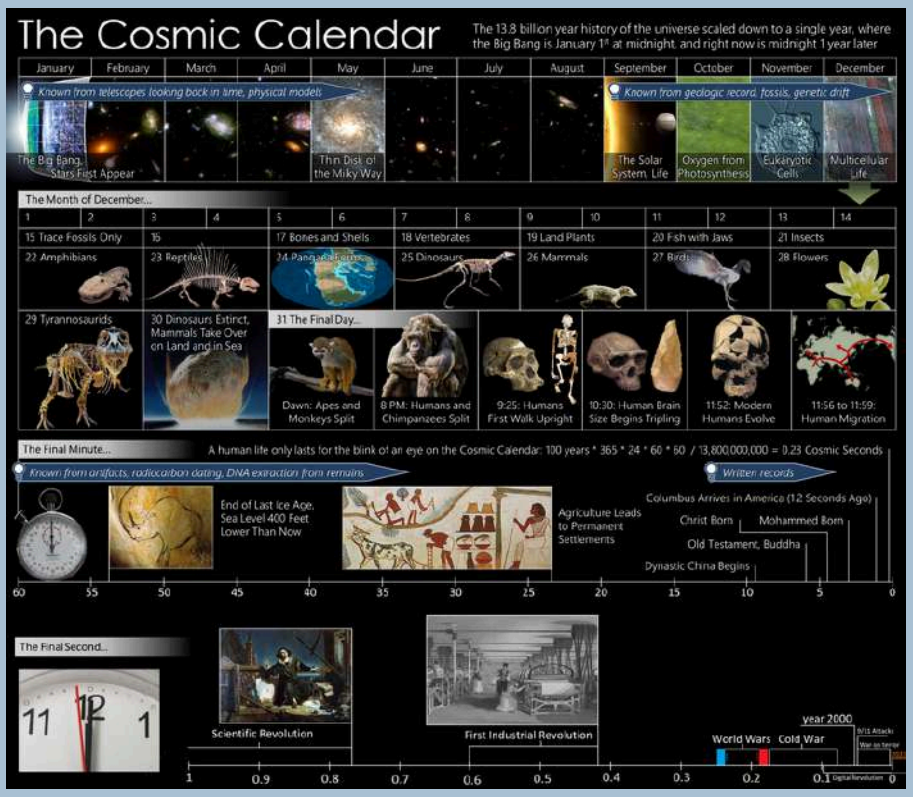
The Birth of the Theory

The Big Bang Theory didn't spring out of thin air. It was in the 1920s that Belgian priest and physicist Georges Lemaître had suggested that the universe started from a "primeval atom" Within a few years, Edwin Hubble found that galaxies are moving from us - evidence that the universe is expanding. This finding was the first big hint that the universe had a start.



The Inflation Theory: A Rapid Start

To describe the universe's amazing smoothness, physicist Alan Guth introduced the Inflation Theory in the 1980s. It posits that the universe experienced a very rapid growth - quicker than light - fractions of a second after the Big Bang. This rapid expansion smoothed out imperfections and created the universe we observe today.



Evidence That Shaped the Theory

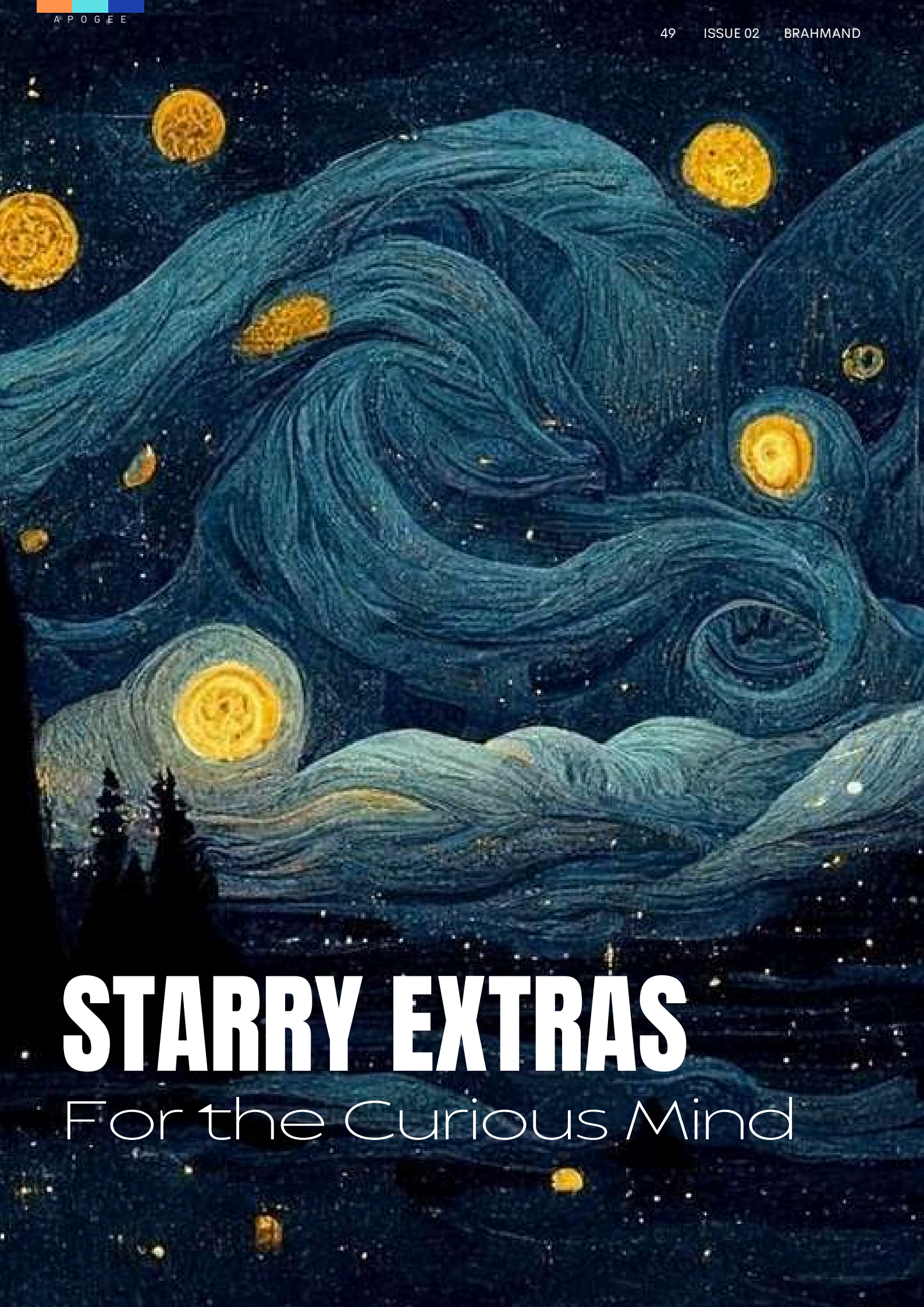
Cosmic Microwave Background Radiation (CMB) - Accidently discovered in 1965, it's the residual radiation from the Big Bang that remains detectable to this day.

Expanding Universe - Galaxies are observed to be moving away from one another, as predicted.

Elemental Abundance - The relative abundance of hydrogen and helium in the universe is in accordance with what Big Bang models predict.

Why Does It Still Matter?

The Big Bang Theory is not only about the past - it also briefs us about the universe's structure, galaxy formation, and perhaps even its ultimate destiny. Each star, each atom in your body, has its roots in that initial moment. It's not a theory, but our universal beginning.



STARRY EXTRAS

For the Curious Mind

STELLAR SHOT SPECIAL

MOBILE ASTROPHOTOGRAPHY 101

By Stellar shot – APOGEE

Let's learn about Astrophotography

Astrophotography is the capturing of the beauty of the universe with your camera lenses.

In simple words, Astrophotography is the practice of taking pictures of the night sky, like stars, the Moon, planets, and galaxies, using a camera—often with a telescope or special lens.

What do you need to start astrophotography?

-Just a Mobile phone and You

-If possible, a tripod makes this journey easy. In the beginning if it's not available then it's okay, you can use any supporting materials like walls,bricks, book anything.

Some basic features Required in smartphone camera

For astrophotography, we basically need manual controls like ISO, shutter speed, exposure etc. In most of the smartphones nowadays, these features are available in the Pro mode of camera.

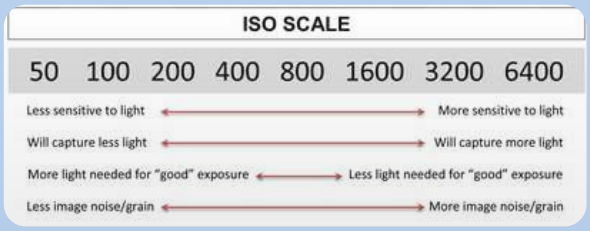
Pro Mode is not there? You can use third party camera softwares like open camera, Pro cam X

Let's dive into some features in brief:

ISO : ISO in photography controls how sensitive your camera is to light.

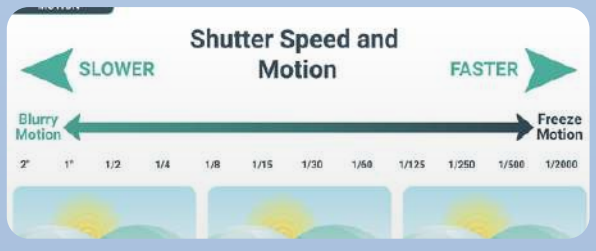
- Low ISO = less sensitive → best for bright light (like day time).
- High ISO = more sensitive → best for low light (like Night time.

Note: Higher ISO can make your photo look grainy (this is called "noise").



Shutter Speed : Shutter speed is how long your camera stays open to take a picture.

- Fast shutter speed = opens and closes quickly → good for freezing motion (like birds or cars).
- Slow shutter speed = stays open longer → good for capturing more light in dark places or motion blur (like star trails or car lights at night)



Aperture: Aperture is the opening in your camera lens that lets light in.

- A wide aperture = big opening, lets in more light → good for dark places like night sky.
- A narrow aperture = small opening, lets in less light → used in bright conditions or to keep everything sharp.

Think of it like your eye's pupil: When it's dark, your pupil opens wide to let more light in. That's what a wide aperture does!

Note: Generally it's fixed for our mobile cameras, some may have manuals.

White balance : White balance tells your camera what color "white" should look like in a photo.

It helps your camera show correct colors, especially under different lighting conditions. If your white balance is wrong, your photo may look too blue, too yellow, or unrealistic.

Let's do an activity of Capturing star trails from your mobile camera:

01

Find a dark location. There should be no direct lights and light shadow in the background. It's better to do it either on no moon or adjacent days

02

Do the following manual settings in camera (or third party camera software)
Iso : 1000-3000 (if light pollution is very less then keep it more) Shutter speed: keep it 15-20 sec
Keep the focus infinity and white balance to 4k - 5k.
Aim roughly towards "polaris"(Pole star). You can find it easily using "Stellarium".

03

Take the shots using these settings. The Mobile must be stable. Take almost 100-200 shots depending upon how long trails you want. If you want long trails, take more shots and vice versa.

04

You can use the time burst feature of the camera or autoclicker after specific intervals.
After capturing all images, we need to stack these images.You can use the " Star trails " app available on playstore.

05

Just upload all images in the app and see the wonderful result.
You can edit this image further to make it more appealing.

06

You must try to change the settings according to different locations and find a suitable one. Also it helps you to understand those features deeply and practically.

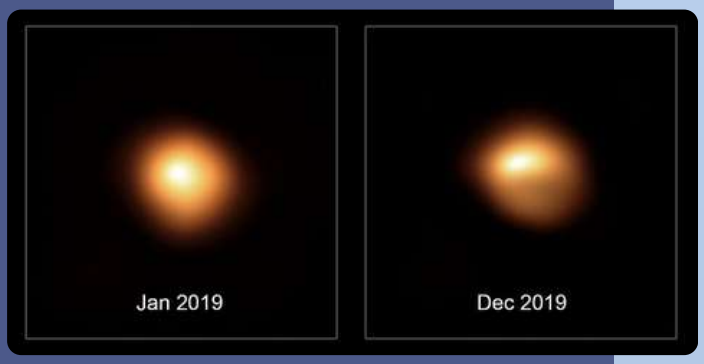
And this marks the beginning of your own journey into the stars through the lens of your mobile phone!

courtesy-Stellar Shot

STAR OF THE YEAR – BETELGEUSE

The Giant That Might Go Out With a Bang

High in the night sky, nestled in the mighty constellation Orion, glows a star unlike any other — Betelgeuse. With its unmistakable reddish hue and unpredictable brightness, this colossal star has fascinated astronomers and stargazers alike. But what makes Betelgeuse our *Star of the Year*? Let's take a closer look.



These two images of Betelgeuse, both taken with the same instrument (SPHERE) aboard the same telescope (the ESO's VLT), illustrates how Betelgeuse has changed in brightness from January of 2019 to December of 2019.

A Cosmic Titan

Type: Red supergiant
Size: If Betelgeuse replaced our Sun, it would engulf Mercury, Venus, Earth, and even Mars. Its radius is **700 times** that of the Sun!
Brightness: It shines 100,000 times brighter than our Sun — but its glow isn't steady. It pulsates, breathing in and out every ~400 days.

The Great Dimming

- In late 2019, Betelgeuse shocked the world. It dimmed so dramatically that many thought it was about to explode into a **supernova** — a once-in-a-lifetime celestial spectacle.
- Scientists later discovered it had ejected a massive cloud of gas and dust, temporarily hiding its light. It wasn't the end — but it was a warning: **this star is nearing its final act**.

Tick, Tock, Supernova Clock

Betelgeuse is only about **10 million years old** — a baby compared to our 4.6 billion-year-old Sun. But because it's so massive, it's burning through fuel fast and could explode within the next 100,000 years.
When it does, it will be so bright, we'll be able to see it in daylight for weeks. Earth will be safe — but the universe will never be the same.

Betelgeuse, the 10th brightest star in the night sky, is located on the shoulder of the Orion constellation. Credit: Lucy

QUICK STAR STATS

FEATURE	DETAILS
Constellation	Orion (shoulder of the hunter)
Distance from Earth	~500–600 light-years
Mass	15–20 × the Sun
Size	~700 × the Sun
Brightness	Variable, +0.0 to +1.6 magnitude
Stage	Late stage, near supernova

Betelgeuse sits about 650 light years from Earth and is brighter than the Sun Credit: Nasa

Why Betelgeuse Deserves the Spotlight

- It's huge, unstable, and unpredictable — the kind of star that keeps astronomers up at night.
- It gives us a front-row seat to how massive stars live and die.
- It reminds us how small we are — and how spectacular the universe can be.

TRIVIA

1 Big Bang

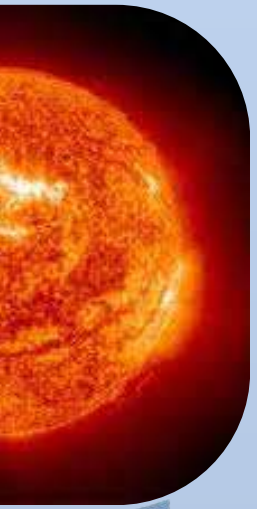
a The Big Bang was a single loud explosion that created all the stars instantly.

b The Big Bang was a rapid expansion of space-time from an extremely hot and dense state.

2 Halley's Comet

A Halley's Comet was first spotted by astronauts aboard the ISS.

B Halley's Comet returns roughly every 76 years and was seen even in ancient times.



3 Sun's Outer Layer – Corona

a The corona is visible only during solar eclipses and reaches over a million degrees in temperature.

b The corona is the Sun's core where nuclear fusion happens.

4 Event Horizon (Black Hole)

A The event horizon is a gravitational wall that repels everything around a black hole.

B The event horizon is the boundary beyond which nothing, not even light, can escape.

5 Betelgeuse

a Betelgeuse is a red giant star that may go supernova anytime in the next 100,000 years.

b Betelgeuse is a gas giant moon orbiting Neptune.

6 James Webb Telescope

a The James Webb Telescope sees the universe in X-rays and is located on Mars.

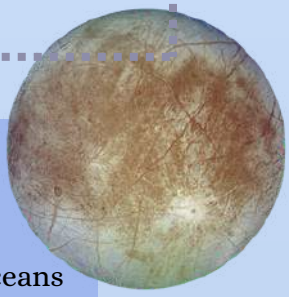
b The James Webb Space Telescope uses infrared to look deep into space and time

7 Earth's Twin – Venus

A Venus is called Earth's twin because of similar size and mass.

B Venus is called Earth's twin because it supports life just like Earth.

8 Europa – Jupiter's Moon



a Europa has underground oceans and may harbor life beneath its icy crust.

b Europa is an asteroid that orbits Earth's outer atmosphere.

9 Vikram – Moon Lander

a Vikram is India's Moon lander that explored the Moon's south pole.

b Vikram is a space station orbiting Saturn's rings.

10 JAXA – Japan's Space Agency

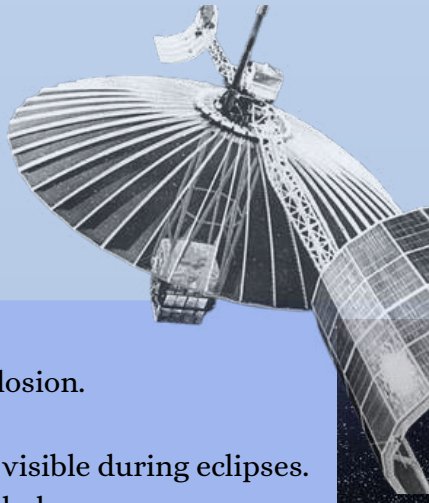
a JAXA builds ninja satellites that are invisible to radar.

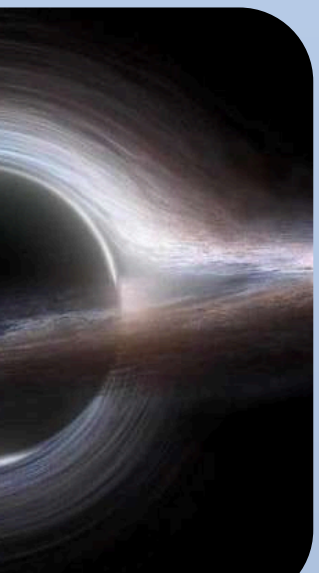
b JAXA is Japan's real space agency involved in lunar and asteroid missions.

11 Sagittarius A

a Sagittarius A is a black hole at the center of the Milky Way galaxy.

b Sagittarius A is a mythical star with magical wormhole powers.





Answers

1. **B** — The Big Bang was an expansion, not an explosion.
2. **B** — It was documented as early as 240 BC.
3. **A** — The corona is the outermost, hottest layer, visible during eclipses.
4. **B** — It's the "point of no return" around a black hole.
5. **A** — Betelgeuse may explode spectacularly, but not yet.
6. **B** — It can detect galaxies billions of years old using infrared.
7. **A** — Venus is similar in size but has a toxic atmosphere.
8. **A** — Europa is a prime candidate for life beyond Earth.
9. **A** — Vikram was part of Chandrayaan-2 and 3 missions.
10. **B** — JAXA runs missions like Hayabusa and SLIM.
11. **A** — It's a supermassive black hole with real gravitational pull.

BRAHMAND'S

"Space has always fascinated humanity, but for you personally —

When we gaze at the night sky, are we only admiring distant stars, or also reflecting on how far India has come in its own space journey—from humble beginnings at Thumba to missions reaching the Moon and beyond?

Is space just an expanse of darkness, or a mirror where humanity seeks meaning, nations like India find their place among the stars, and you discover what it truly means to you?

We invite you to share your answers in any form you love — be it writing, poetry, painting, sketching, photography, or any creative expression.

BIG WHY?

The best entries will be featured in the next edition of Bramhand, celebrating your unique perspective alongside India's ever-growing space story.

You can email us at **editorbramhand@gmail.com**

You can also share your entries on Instagram!

- Post your creation
- Tag **@APOGEE_NITJ** (official club handle)
- Use hashtag **#BramhandBigWhy**

Let your imagination take flight — because your cosmos deserves to be heard!


GSAT - 15
NaVIC
Mangalyaan
GSAT - 24