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Exploring the Cosmos: India's Journey into Space

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Abstract:

India decided to explore space systematically and use it for the benefit of its citizen in the decade of 1960. Over the past 60 decades it has come a long way. Apart from designing its own satellites it has developed vehicles to launch heavy satellites into the space. This development has enhanced the capability of telecommunication, weather forecasting and remote sensing. Indian Space Research Organization (ISRO) could successfully send its spacecrafts to Moon and Mars. It is now preparing to send astronauts into space. This article gives a brief account of India's achievements in space science.

1. Introduction:

Our cosmos is full of surprises. Human beings are always curious to know its secrets. Astronomers, all over the world, attempted to understand the movement of planets through keen observations. Earlier they made observations through naked eyes. Later, when the telescope became available, they tried to use this gadget to observe the movement of celestial bodies. In the middle of twentieth century scientists attempted to send satellites into the space. These efforts enable us to understand our cosmos better. India entered this field in the decade of 1960 and have achieved remarkable success over the past six decades.

2. Astronomical Studies in Ancient and Medieval Period in India:

Indian intellectuals in ancient and medieval period concentrated on understanding the universe. Through detailed observations they could find out how planets and stars move. Based on these studies they could guess when will the solar and lunar eclipses occur. Prominent among them were Aryabhatta (5th century) and Bhaskaracharya (12th century). Aryabhatta wrote *Aryabhatiya*, a treatise that gives a detailed account of the movement of planets. Bhaskaracharya, has written a treatise named *Siddhant Shiromani*. It is in four parts, one of them is devoted to the study of heavenly bodies (Filliozat, 2019). This tradition of astronomical studies continued in various parts of India. Huge information was, thus, collected about heavenly objects by Indian astronomers (Apte, Rao and Joshi, 2003).



3. India's Entry into Space Exploration:

USSR started the practice of sending satellite into space by launching Sputnik in 1957. Just four years later (1961) Department of Space was established as a part of Atomic Energy Commission. In 1969 it became a separate department with the establishment of Indian Space Research Organization (ISRO) under the leadership of Dr. Vikram Sarabhai. With their hard work the scientists and engineers could build a first satellite named after a famous ancient Indian astronomer Aryabhata. It was launched into the earth's orbit with the help of Russian Launch Vehicle in 1975. Just four years later yet another satellite named after another Indian astronomer Bhaskara was launched with the help of USSR. Meantime, the work of designing a rocket to put the satellite into the orbit was undertaken at ISRO. The first satellite to be launched using indigenously built Satellite Launch Vehicle (SLV) was Rohini. It was sent into earth's orbit from Sriharikota in Andhra Pradesh on 20 July 1980.

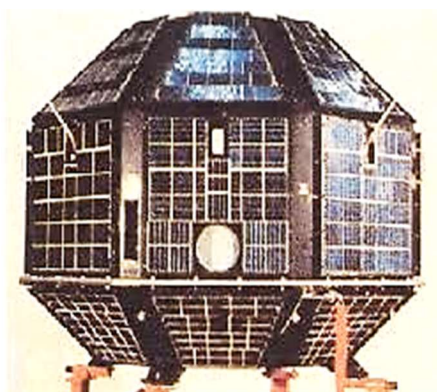


Figure-1: Aryabhata: India's first Satellite

Source: Wikipedia

4. Satellite Instructional Television Experiment:

As ISRO headquarter as Bangalore was engaged in designing better and better rockets, the Space Application Centre at Ahmedabad began a the most transformative experiment in global communication on August 1, 1975. Named as Satellite Instructional Television Experiment (SITE) it was conducted using ATS-6 satellite of the National Aeronautics and Space Administration (NASA) of the United States of America (USA). This experiment enabled the first-ever direct broadcasting from space. It benefited around 200,000 people from about 2400 villages of six states of the country. Although NASA provided the satellite the Earth stations and chicken mesh antennas were made in India. Arthur C. Clarke, the famous science fiction writer then called it the greatest communication experiment in history. It paved the way for the present Direct to Home (DTH) service (Pallava Bagla, 2025).



5. Geostationary Satellites:

After the success of putting satellites in the orbit at a short distance from the earth ISRO embarked on launching the series of satellites in the geostationary orbit. Named as Indian National Satellites (INSAT) they circle around the earth at about 36,000 kilometers away from the earth. The INSAT system was commissioned with the successful launch of INSAT-1B in August 1983. This system brought a revolution in India's Television and Radio broadcast. A large number of television channels could be initiated. Likewise, the scope of the radio broadcast could be widened. Telecommunication service in the country improved. Moreover, weather forecasting could be made with greater accuracy.



Figure-2: INSAT 3E (Source: Wikipedia)

6. Satellites in Polar Orbits:

Polar orbits are a type of orbit where the satellite passes over the Earth's poles as it circles the planet. Satellite in the Sun-Synchronous Polar Orbits (SSO) enable us to observe the same area of the Earth at the same local time each day. ISRO has developed Polar Satellite Launch Vehicle (PSLV) to place the satellite into Sun-Synchronous Polar Orbits. It has successfully launched numerous Indian satellites as well as foreign satellites in this orbit. Thus, India could establish itself as a major player in the international space market.



Figure-3: Indian Polar Satellite (Source: BBC)



7. Chandrayaan Mission:

In the beginning of 21st century ISRO initiated Chandrayaan mission with a series of Indian lunar space probes. A Polar Satellite Launch Vehicle (PSLV) launched the 590-kg Chandrayaan-1 on October 22, 2008, from Sriharikota in Andhra Pradesh. This spacecraft had a Moon Impact Probe (MIP) designed to study the thin lunar atmosphere. Chandrayaan-1 operations were originally planned to last two years, but the mission ended on August 28, 2009, when radio contact was lost with the spacecraft. Chandrayaan-2 was launched on July 22, 2019, using a Geosynchronous Satellite Launch Vehicle Mark III. The spacecraft consisted of an orbiter, a lander (Vikram) and a rover (Pragyan). Both lander and rover were designed to operate for one lunar day (14 Earth days). Unfortunately, just before the touch down the contact was lost at an altitude of 2 km. Learning from the failures of two earlier missions Chandrayaan-3 was launched on July 14, 2023. The spacecraft consisted of a Vikram lander and a Pragyan rover. The Vikram lander landed on the Moon on August 23. It became the first spacecraft to land in the Moon's south polar region. Thus, India became the fourth country to have landed a spacecraft on the Moon after USA, Russia, and China. Hence, August 23 is observed as a National Space Day to celebrate the success of Chandrayaan mission.

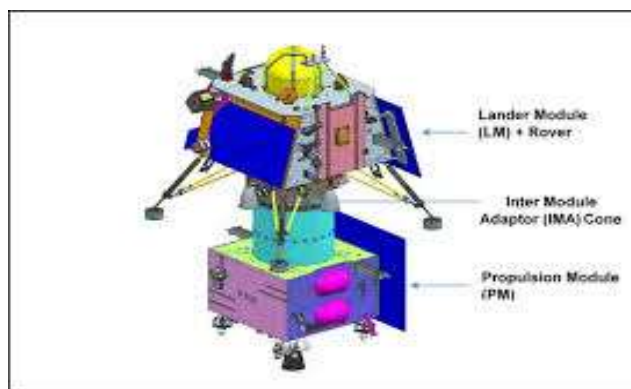


Figure-4: Chandrayaan 3 (Source: ISRO)

8. Mangalyaan:

Mangalyaan was a very ambitious programme of ISRO to reach Mars. Launched on November 5, 2013, it was successfully placed into the orbit around Mars on September 24, 2014. The mission aimed to demonstrate India's technological capabilities in interplanetary space travel and conduct scientific studies of the Martian surface and atmosphere. The spacecraft had five onboard instruments: a color camera, a thermal infrared sensor, an ultraviolet spectrometer, a mass spectrometer, and a methane sensor. It could detect suprathermal argon-40 atoms in the Martian exosphere and observed a Martian dust storm. It also studied Martian surface features, morphology, minerals, and atmosphere. While initially designed for six months, the spacecraft exceeded expectations and continued to function. After the success of Mangalyaan 1, ISRO is now planning to launch Mangalyaan 2.



Figure 5: Mangalyaan 1 (Source: Times of India)

9. Aditya L-1:

Along with moon ISRO planned to explore Sun from close quarters. In this context it decided to place a spacecraft in a halo orbit around the Lagrange point 1 (L1) of the Sun-Earth system, which is about fifteen lakh kilometers from the Earth. The spacecraft named Aditya was sent to space on September 2, 2023. After a long journey it reached its designated place on January 6, 2024. Aditya is a space-based solar observatory with seven payloads to observe the photosphere, chromosphere, and corona of the Sun. Four payloads directly view the Sun, and the remaining three payloads conduct in-situ studies of particles and fields at the Lagrange point L1. Aditya mission is expected to provide us useful clues to understand space weather and its impact on our earth.



Figure-6: Aditya L-1 (Source: Times of India)

10. Gaganyaan:

Gaganyaan, a leap forward, is India's Human Spaceflight Programme of ISRO. The spacecraft is being designed to carry three persons. In its maiden crewed mission, the capsule will orbit the Earth at 400 km altitude for up to seven days. The crew module manufactured by the Hindustan Aeronautics Limited (HAL) underwent its first uncrewed experimental flight on 18 December 2014. As of May 2019, design of the crew module has been completed. The Defence Research and



Development Organization (DRDO) will provide support for critical human-centric systems and technologies such as space-grade food, crew healthcare, radiation measurement and protection, parachutes for the safe recovery of the crew module and the fire suppression system. ISRO is planning to launch this module soon. So far, only two Indian astronauts had the opportunity to go to space. With the launching of Gaganyaan many more persons could be able to undertake space travel and conduct useful experiments in the space.



Figure-7: Gaganyaan (Source: ISRO)

11. Conclusions:

India's progress in space exploration over the last six decades has been quite appreciable. Starting from small rockets India could develop Satellite Launching Vehicle capable of lifting heavy spacecrafts. On July 30, 2025, ISRO launched NISAR (NASA-ISRO Synthetic Aperture Radar) that weighed 2,392 kilograms. Space research has proved useful in improving social life of Indian citizens. Educational facilities in the country have improved considerably. The television and radio programmes are now made available through satellites. In addition, the satellite keeps an eye on the earth and provide useful information about weather and natural disasters. Chandrayaan mission will enable us to understand the moon, Mangalyaan would give information about Mars while the Aditya mission will enable us to know details about the Sun. Gaganyaan is expected to pave the way for Indian astronauts to go to the space. The future is bright. The young Indians should seriously think of joining this field.

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