PhysicA

-A digital version of the wall magazine

Theme of the year, 2024

A SPACE ODYSSEY

ISRO – NAVIGATING THE COSMOS

DEPARTMENT OF PHYSICS

ARYAVIDYAPEETH COLLEGE (AUTONOMOUS)

ARYA NAGAR, GUWAHATI 781016

MESSAGE FROM THE HEAD OF THE DEPARTMENT OF PHYSICS

DEPARTMENT OF PHYSICS
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The students of the Department of Physics always take a humble initiative to showcase the recent developments in science and technology and portray them artistically in the Wall Magazine. I feel proud that the students this year have come out with an exciting theme - ***Space Exploration*** commemorating the success stories of the **Indian Space Research Organization (ISRO)**. Besides this, the Nobel Prize winners in Physics along with their works have been very nicely depicted. I am confident that this effort of the students will fulfill the objective of spreading awareness in society and will encourage many more young aspirants to pursue space science.

I extend my heartiest congratulations and greetings to all the members of the Editorial Board and wish them to continue the spirit in the coming days.

Dr. Subir Sarkar
Head & Associate Professor
Department of Physics.

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Message from the Editorial Board

Dear Readers,

Welcome to our special edition dedicated to the marvels of physics and the boundless universe that surrounds us. As we journey through the pages of this digital magazine, we delve into the fascinating world of space exploration led by the Indian Space Research Organisation (ISRO) and the groundbreaking discoveries that have been awarded the Nobel Prize in Physics.

ISRO, a beacon of scientific achievement for India, has been at the forefront of space research, pushing the boundaries of our knowledge about the cosmos. Their tireless efforts and remarkable achievements serve as an inspiration to us all, reminding us that the sky is not the limit, but rather the beginning of our exploration.

In this edition, we also celebrate the Nobel Prize in Physics, an accolade that recognizes those who have made significant contributions to our understanding of the physical world. The laureates' work, often the result of a lifetime of dedication, has shaped our understanding of the universe and our place within it.

As the editor of this magazine, I invite you to embark on this journey of discovery with us. Let's explore the mysteries of the universe together, let's marvel at the wonders of physics, and let's celebrate the human spirit that continually seeks to understand the world around us.

Thank you for joining us on this exciting adventure. We hope that the stories and insights shared in this magazine will inspire you, ignite your curiosity, and deepen your appreciation for the incredible world of physics and for space exploration.

Yours in exploration,

Editors of the Digital Magazine

PhysicA 2024

VISITORS NOTEPAGE

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OUTLINE OF THE MAGAZINE

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ISRO

INDIAN SPACE RESEARCH ORGANIZATION

BIRTH & ESTABLISHMENT

The **Indian Space Research Organisation (ISRO)** is the national space agency of India, responsible for performing tasks related to space-based operations, space exploration, international space cooperation, and the development of related technologies. It was formed on **August 15, 1969**, superseding the Indian National Committee for Space Research (INCOSPAR), which was set up in 1962.

Dr. Vikram Ambalal Sarabhai

DIRECTORS

The **first director** of ISRO was **Dr. Vikram Ambalal Sarabhai**, who served from 1963 to 1971. He is widely regarded as the father of the Indian space program, and his efforts led to the creation of ISRO.

The **current director** of ISRO is **S. Somanath**, who has been serving since January 15, 2022. He succeeded K. Sivan, who took charge in January 2018. Somanath had previously been the Director of the Vikram Sarabhai Space Centre.

Sreedhara Panicker Somnath

ACHIEVEMENTS

The **Indian Space Research Organisation (ISRO)** has made numerous significant achievements since its inception. Here are some of the major ones:

1. **First Satellite - Aryabhata**: Named after the eminent Indian astronomer and mathematician of the 5th century, Aryabhata was the first satellite developed by India. It was launched on April 19, 1975, to conduct experiments in X-ray astronomy, aeronomics, and solar physics.
2. **Orbital Launch Capability**: On July 18, 1980, ISRO successfully launched SLV-3, making India only the seventh nation in the world to possess the capability to send objects into orbit using its own launch vehicles.
3. **Discovery of Water on the Moon**: ISRO made a significant contribution to lunar science by discovering the presence of water on the moon.
4. **Mars Mission**: ISRO became the first organization to reach Mars in its maiden attempt.
5. **World Record of Satellite Launch**: ISRO created the world record of the largest number of satellites launched on a single flight by any space agency.

A.P.J Abdul Kalam

These achievements have not only put ISRO on the world map but also significantly contributed to the advancement of space research and technology. ISRO's programs have played a significant role in the socio-economic development of India and have supported both civilian and military domains in various aspects.

India's first Rocket

IMPACT ON THE MODERN SOCIETY

The **Indian Space Research Organisation (ISRO)** has had a profound impact on modern society, particularly in India, but also globally. Here are some key areas where ISRO's work has made a significant difference:

1. **Healthcare**: ISRO's space technology has led to advancements in healthcare, such as the development of artificial limbs, artificial jaw bones, left ventricular assist devices, and ventilators.
2. **Education**: ISRO's satellite communication technology has been instrumental in reaching educational resources to remote areas, thus promoting literacy and learning.
3. **Communication & Broadcasting**: ISRO's satellites have revolutionized communication and broadcasting, making information more accessible to the masses.
4. **Disaster Management**: ISRO's satellite imagery and data have been crucial in predicting and managing natural disasters, thus saving lives and property.
5. **Safety & Security**: ISRO's space technology has contributed to safety and security measures, including the development of flame-proof coatings for fire safety and distress alert systems.
6. **Resource Management**: ISRO's satellite data has been used for efficient land and water resource management, aiding in agriculture, irrigation, and conservation efforts[1].
7. **Economic Impact**: ISRO has incubated and nurtured over 400 companies in the space sector, contributing to economic growth and job creation.
8. **Global Presence**: ISRO's cost-effective and successful missions have earned it a global reputation, making it a favorite among international space agencies.

Bharat Krishi Satellite programme

ISRO Satellite for Weather Forecasting

2 ARYABHATA

Aryabhata, India's first satellite, was a significant milestone in the country's space research journey. Named after the renowned Indian astronomer and mathematician from the 5th century, Aryabhata, the satellite was completely designed and fabricated in India.

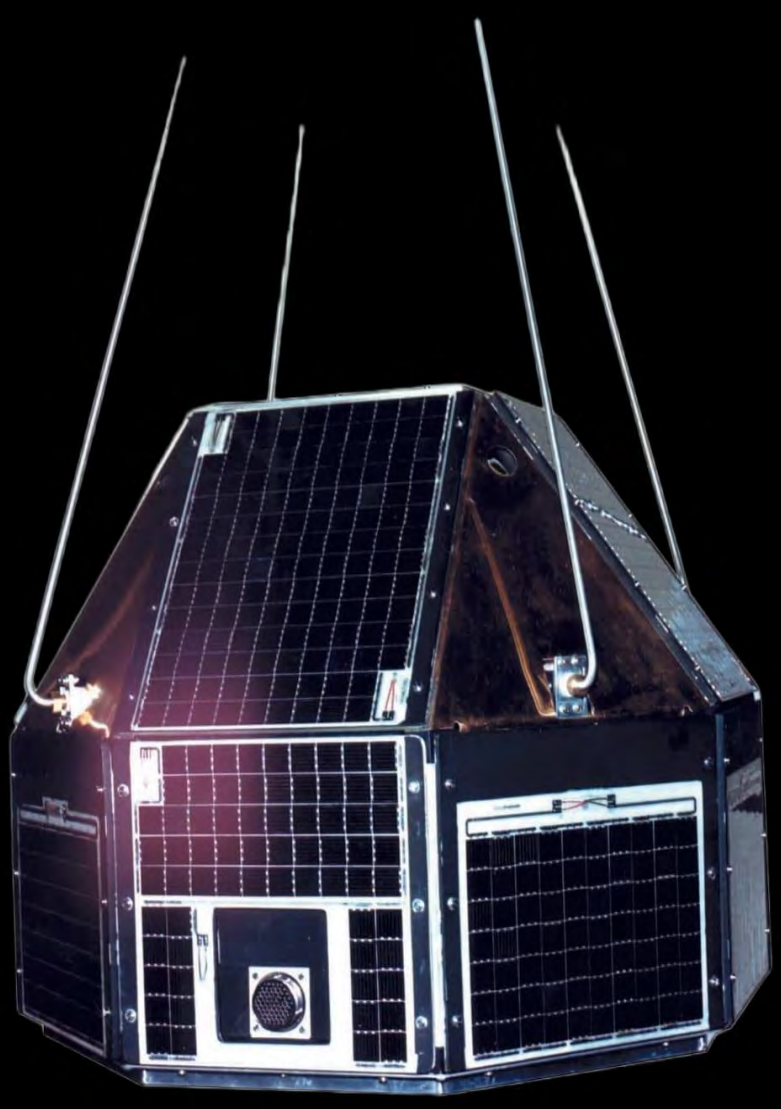
The satellite was assembled at Peenya, near Bangalore. However, it was launched from within the Soviet Union by a Russian-made rocket on April 19, 1975. This launch was part of the Soviet Interkosmos programme, which provided access to space for friendly states. The launch came from an agreement between India and the Soviet Union directed by UR Rao and signed in 1972. It allowed the USSR to use Indian ports for tracking ships and launching vessels in return for launching various different Indian satellites.

Aryabhata weighed 794 pounds (360 kg) and was instrumented to explore conditions in Earth’s ionosphere, measure neutrons and gamma rays from the Sun, and perform investigations in X-ray astronomy. The satellite had a launch mass of 360 kg with a power of 46 watts. Its orbit was for 96.46 minutes with an apogee of 619 km and a perigee of 563 km. The purpose of the mission was research in astrophysics such as conducting experiments in X-ray astronomy, solar physics, and aeronomics.

The spacecraft was a 26-sided polyhedron 1.4 metres (4.6 ft) in diameter. All faces (except the top and bottom) were covered with solar cells. A power failure halted experiments after four days and 60 orbits, with all signals from the spacecraft lost after five days of operation. Despite this, the spacecraft mainframe remained active till March 1981. The satellite entered Earth's atmosphere on 10 February 1992 due to orbital decay.

The Aryabhata satellite was commemorated by stamping its imprint on the Indian 2 rupees bank note from 1976 to 1997. Despite the short operational time, the launch of Aryabhata marked a significant milestone in India's space program. It paved the way for future space missions and contributed to the development of India's space capabilities.

ROHINI



The Rohini series of satellites were launched by the Indian Space Research Organisation (ISRO). The series consisted of four satellites, each of which was launched by the Satellite Launch Vehicle (SLV), and three of which made it successfully to orbit. The series were mostly experimental satellites, with the first launch being in 1979.

The first satellite in the series was the Rohini Technology Payload (RTP). It was a 35 kg experimental spin-stabilized satellite that used 3 W of power and was launched on 10 August 1979 from the Satish Dhawan Space Centre (SDSC). The satellite contained instruments to monitor the launch vehicle. However, the satellite could not be placed into its intended orbit.

The second satellite, RS-1, was also a 35 kg experimental spin-stabilized satellite that used 16 W of power and was successfully launched on 18 July 1980 from the Satish Dhawan Space Centre. This was India's first indigenous satellite launch, making it the seventh nation to possess the capability to launch its own satellites on its own rockets. It provided data on the fourth stage of SLV. The satellite had a mission life of 1.2 years and an orbital life of 20 months.

The third satellite, RS-D1, was a 38 kg experimental spin-stabilized satellite that used 16 W of power and was launched on 31 May 1981. The launch of the SLV was a partial success as the satellite did not reach the intended height and thus it only stayed in orbit for 9 days. It achieved an orbit of 186 km × 418 km with an inclination of 46°. The satellite carried a solid-state camera for remote sensing applications (Landmark Tracker) and performed to specifications.

The fourth and final satellite, RS-D2, was a 41.5 kg experimental spin-stabilized satellite that used 16 W of power and was launched successfully on 17 April 1983. The satellite was in operation (mission life) for 17 months and its main payload, a smart sensor camera, took over 2500 pictures. The camera had the capability to take pictures both in visible and infrared bands. After an orbital life of 7 years, the satellite reentered the Earth's atmosphere on 19 April 1990.

PSLV

POLAR SATELLLITE LAUNCH VEHICLE

PSLV - Polar Satellite Launch Vehicle (PSLV) is the third generation launch vehicle of India. It is the first Indian launch vehicle to be equipped with liquid stages. After its first successful launch in October 1994, PSLV emerged as a reliable and versatile workhorse launch vehicle of India. The vehicle has launched numerous Indian and foreign customer satellites. Besides, the vehicle successfully launched two spacecraft "Chandrayaan-1 in 2008 and Mars Orbiter Spacecraft in 2013"that later travelled to Moon and Mars respectively. Chandrayaan-1 and MOM were feathers in the hat of PSLV. The launch of PSLV-C48 marks the 50th Launch of PSLV. Besides, the vehicle successfully launched two spacecraft " Chandrayaan-1 in 2008 and Mars Orbiter Spacecraft in 2013"that later travelled to Moon and Mars respectively. Due to its unmatched reliability, PSLV has also been used to launch various satellites into Geosynchronous and Geostationary orbits, like satellites from the IRNSS Constellation.

GSLV

GEOSYNCHRONOUS SATELLITE LAUNCH VEHICLE

GSLV - The Geosynchronous Satellite Launch Vehicle (GSLV) project was initiated in 1990 with the objective of acquiring an Indian launch capability for geosynchronous satellites. The Geosynchronous Satellite Launch Vehicle (GSLV) is an expendable launch system used by the Indian Space Research Organisation (ISRO) for launching satellites into geosynchronous transfer orbits. The GSLV Mark II is equipped with liquid strap-on motors powered by Vikas engines. On the other hand, the GSLV Mark III is a more advanced version with a height of 43.5m, a vehicle diameter of 4.0m, and a cryogenic stage height of 13.5m. The GSLV, especially when employing a cryogenic stage, is designed to carry heavier satellites weighing around 2200 kg into geosynchronous orbits.

4 VIKAS ENGINE

The Vikas (a portmanteau from initials of VIKram Ambalal Sarabhai) is a family of hypergolic liquid fuelled rocket engines conceptualized and designed by the Liquid Propulsion Systems Centre in the 1970s. The design was based on the licensed version of the Viking engine with the chemical pressurisation system. The early production Vikas engines used some imported French components which were later replaced by domestically produced equivalents. It is used in the Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV) and LVM3 for space launch use.

Vikas engine is used to power the second stage of PSLV, boosters and second stage of GSLV Mark I and II and also the core stage of LVM3. The propellant loading for Vikas engine in PSLV, GSLV Mark I and II is 40 tons, while in LVM3 is 55 tons.

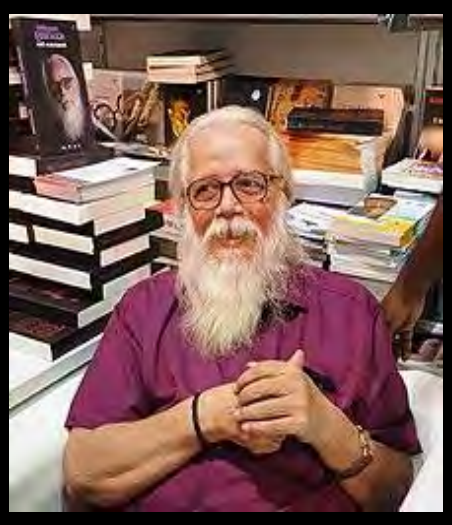
In 1974, Societe Europeenne de Propulsion agreed to transfer Viking engine technology in return for 100 man-years of engineering work from ISRO. The first engine built from the acquired technology was tested successfully in 1985 by Nambi Narayanan and his team at ISRO and named it Vikas.

Design and Development

The design of the Vikas Engine was inspired by the European Viking Engines. Initially, these engines incorporated imported French components, which were later replaced with domestically manufactured counterparts. The technology for the Vikas engine was transferred from Societe Europeenne de Propulsion in 1974. The first engine built using the acquired technology was tested successfully in 1985.

Technical Details

The Vikas engine operates on a combination of 40 metric tonnes of Unsymmetrical Dimethylhydrazine (UDMH) as the fuel and Nitrogen Tetroxide (N2O4) as the oxidizer. It achieves a maximum thrust of 725 kN. An upgraded version of the engine has a chamber pressure of 58.5 bar as compared to 52.5 bar in the older version and produces a thrust of 800 kN.



S. Nambi Narayan
The scientist behind Vikas engine

Applications

The Vikas engine is used to power the second stage of the Polar Satellite Launch Vehicle (PSLV), boosters and second stage of the Geosynchronous Satellite Launch Vehicle (GSLV) Mark I and II, and also the core stage of LVM3. The propellant loading for the Vikas engine in PSLV, GSLV Mark I and II is 40 tons, while in LVM3 is 55 tons.

Variants

There are different types of Vikas Engines. Some of them are already developed and some are under-development stage. There are two main types of Vikas engines:

- HTVE (High Thrust VIKAS Engine):

  The HTVE are modified VIKAS-2B engines. This engine has a chamber pressure of 62 bar, which is 6% higher than the older version of the engine. This gives it a thrust of 800 kN. The HTVE engine is used for the second stage of the GSLV.

- HPVE (High Pressure or High-Speed VIKAS Engine):

  This engine is still under development. It is a significantly modified version of the Vikas engine with a higher chamber pressure and thrust.

  The Vikas Engine has played a crucial role in powering India's space missions and continues to be a significant part of ISRO's future plans.

5

CHANDRAYAAN-1

10

INDIA’S FIRST LUNAR PROBE

Chandrayaan-1, from Sanskrit: Chandra, "Moon" and yāna, "craft, vehicle", was the first Indian lunar probe under the Chandrayaan programme. It was launched by the Indian Space Research Organisation (ISRO) in October 2008, and operated until August 2009. The mission included an orbiter and an impactor.

Launch and Mission Duration

India launched the spacecraft using a PSLV-XL rocket on 22 October 2008 at 00:52 UTC from Satish Dhawan Space Centre, at Sriharikota, Andhra Pradesh. The mission was a major boost to India's space program, as India researched and developed indigenous technology to explore the Moon. The vehicle was inserted into lunar orbit on 8 November 2008. On 14 November 2008, the Moon Impact Probe separated from the Chandrayaan orbiter at 14:36 UTC and struck the south pole in a controlled manner. The probe hit near the crater Shackleton at 15:01 UTC. The location of impact was named Jawahar Point. After almost a year, the orbiter started experiencing several technical issues including failure of the star tracker and poor thermal shielding; Chandrayaan-1 stopped communicating at about 20:00 UTC on 28 August 2009, shortly after which the ISRO officially declared that the mission was over.

Achievements

With this mission, ISRO became the fifth national space agency to reach the lunar surface. Other nations whose national space agencies to have done so prior were the former Soviet Union in 1959, the United States in 1962, Japan in 1993, and ESA member states in 2006. The most significant achievement was its discovery of the presence of water on the Moon. In its 10-month orbit around the moon, Chandrayaan-1's X-ray Spectrometer (C1XS) has detected titanium, confirmed the presence of calcium, and gathered the most accurate measurements yet of magnesium, aluminium and iron on the lunar surface.

Instruments

Chandrayaan-1 carried scientific equipment from the United States, the United Kingdom, Germany, Sweden, and Bulgaria. Among its suite of instruments, it carried NASA's Moon Minerology Mapper (M3), an imaging spectrometer helped confirm the discovery of water locked in minerals on the Moon. The orbiter also released an impactor that was deliberately crashed into the Moon, releasing debris that was analyzed by the orbiting spacecraft's science instruments.

Findings and Discoveries

Chandrayaan-1 made several significant discoveries during its mission:

- Water on the Moon: The most significant discovery made by Chandrayaan-1 was the detection of water molecules on the lunar surface. The Moon Mineralogy Mapper (M3), a NASA instrument on board Chandrayaan-1, detected wavelengths of reflected light that would indicate a chemical bond between hydrogen and oxygen in materials on the thin layer of upper soil.

- New Lunar Craters: Chandrayaan-1's Terrain Mapping Camera (TMC) captured images that led to the discovery of more than 600 new craters on the lunar surface.

- Lunar Topography: The TMC also created a high-resolution atlas of the lunar surface and the Lunar Laser Ranging Instrument (LLRI) obtained detailed topographical maps of the Moon.

- Chemical and Mineralogical Mapping: The Hyper Spectral Imager (HySI) and the Moon Mineralogy Mapper (M3) carried out chemical and mineralogical mapping of the lunar surface.

- Lunar Atmosphere: The Sub keV Atom Reflecting Analyser (SARA) studied the lunar ionosphere.

- Lunar Radiations: The High Energy X-ray Spectrometer (HEX) and the Lunar X-ray Spectrometer (LEX) studied the lunar radiation environment.

6 MANGALYAAN

The Mars Orbiter Mission (MOM), unofficially known as Mangalyaan (from Sanskrit: Maṅgala, 'Mars', and yāna, 'craft, vehicle'), was a space probe launched by the Indian Space Research Organisation (ISRO) on 5 November 2013. It was India's first interplanetary mission and made ISRO the fourth space agency to achieve Mars orbit.

Launch and Mission Duration

The MOM probe lifted-off from the Satish Dhawan Space Centre, Andhra Pradesh, using a Polar Satellite Launch Vehicle (PSLV) rocket C25 at 09:08 UTC on 5 November 2013. The MOM probe spent about a month in Earth's orbit, where it made a series of seven orbital maneuvers before trans-Mars injection on 30 November 2013. After a 298-day transit to Mars, it was put into Mars orbit on 24 September 2014.

Goals and Objectives

The mission was a technology demonstrator project to develop the technologies for designing, planning, management, and operations of an interplanetary mission. It carried five scientific instruments. The objective was to explore Martian surface features, mineralogy, morphology, and atmosphere using indigenous scientific instruments.

Achievements

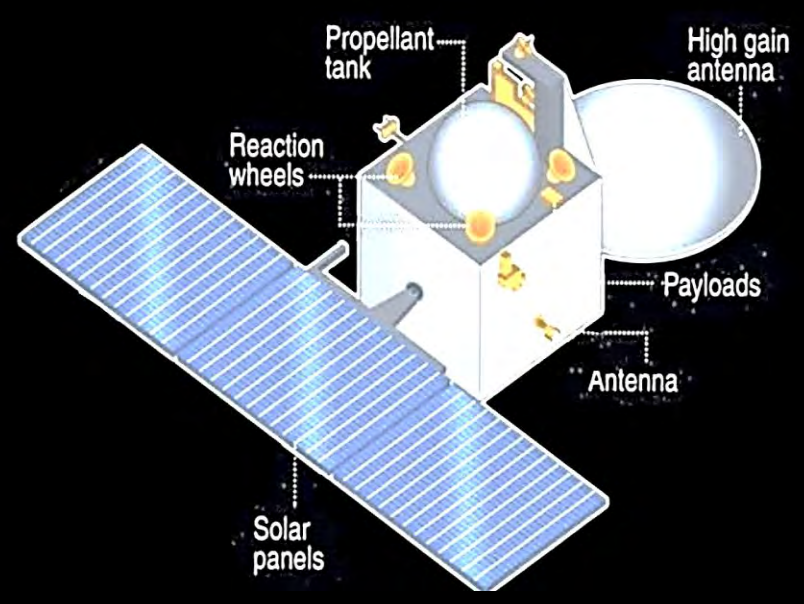
Mangalyaan was the first Asian nation to reach the Martian orbit and the first nation in the world to do so on its maiden attempt. The mission represented a leap for India in developing technologies to explore the inner solar system.

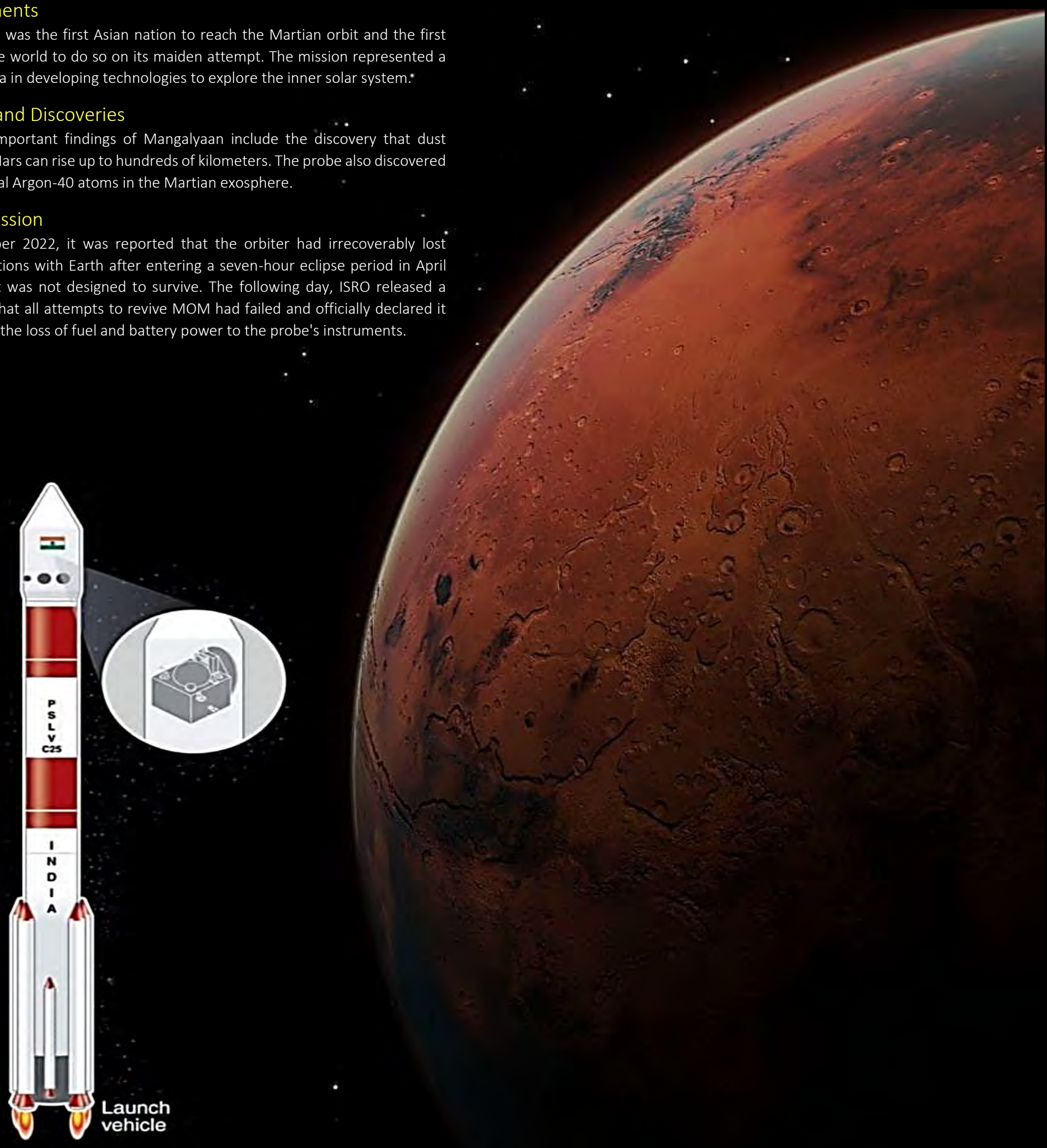
Findings and Discoveries

The most important findings of Mangalyaan include the discovery that dust storms on Mars can rise up to hundreds of kilometers. The probe also discovered suprathermal Argon-40 atoms in the Martian exosphere.

End of Mission

On 2 October 2022, it was reported that the orbiter had irrecoverably lost communications with Earth after entering a seven-hour eclipse period in April 2022 that it was not designed to survive. The following day, ISRO released a statement that all attempts to revive MOM had failed and officially declared it dead, citing the loss of fuel and battery power to the probe's instruments.





CHANDRAYAAN 2

Chandrayaan-2 is an Indian lunar exploration mission developed and launched by the Indian Space Research Organisation (ISRO).

It is the successor to Chandrayaan-1, India's first lunar probe, which was launched in 2008. Chandrayaan-2 aimed to further advance India's space exploration capabilities and expand its scientific understanding of the Moon.

Launch Date and Vehicle:

- Chandrayaan-2 was launched on July 22, 2019, aboard a Geosynchronous Satellite Launch Vehicle Mark III (GSLV Mk III) rocket.

Components:

- The mission consisted of three main components: the Orbiter, the Lander named Vikram, and the Rover named Pragyan.

Orbiter:

- The Orbiter is designed to orbit the Moon and perform remote sensing observations. It is equipped with various scientific instruments, including spectrometers, cameras, and a synthetic aperture radar.
- The Orbiter's mission was expected to last about one year.

Vikram Lander:

- The Vikram lander carried the Pragyan rover and was designed to make a soft landing near the lunar south pole.
- Vikram was equipped with instruments to study the Moon's surface, seismic activity, and thermal properties.
- Unfortunately, the Vikram lander lost communication during the descent, and the planned soft landing was not successful.

Pragyan Rover:

- Pragyan was a six-wheeled robotic rover designed to move on the lunar surface and conduct experiments.
- It carried instruments to analyze soil samples and study the lunar regolith.

PM Modi consoling ISRO Chief K. Sivan during crash landing of Chandrayan -2 on moon’s surface.

Scientific Objectives:

- Chandrayaan-2 aimed to study the lunar topography, mineral composition, exosphere, and various other aspects to enhance scientific understanding of the Moon.
- The mission also sought to search for water ice in the polar regions of the Moon.

Mission Challenges

- Although the Orbiter successfully continued its mission, the Vikram lander faced challenges during its descent, leading to a loss of communication. Despite this setback, the Orbiter continued to provide valuable data.

Significance:

- Chandrayaan-2 marked a significant step in India's space exploration program, showcasing its capability to undertake complex missions beyond Earth's orbit.
- The mission contributed to the global understanding of the Moon's geology and provided valuable data for future lunar exploration endeavors.

While the lander portion of Chandrayaan-2 faced challenges, the overall mission has been considered a partial success due to the Orbiter's continued functionality and successful data collection. India continues to build on the experience gained from Chandrayaan-2 for future lunar and space exploration missions.

CHANDRAYAAN 3

OVERVIEW

Chandrayaan-3 is the third mission in tha Chandrayaan Programme, a series of lunar-exploration missions developed by the ISRO. The mission consists of a lunar lander named

Vikram and a lunar rover named Pragyan. It launched from Satish Dhawan Space Centre on 14 July 2023. The spacecraft entered lunar orbit on 5 August, and the lander touched down near the lunar south pole on 23 August at 18:03 IST.

DISASSEMBLY

The next crucial operation after the lunar-bound maneuvers involved the separation of the lander module from the propulsion module. This process was scheduled for August 17.

LANDING:

The lander touched down near the lunar south pole on 23 August at 18:03 IST. The landing site was Shiv Shakti Point. The lander module consists of a lander called Vikram. The lander payloads include-

1. Radio Anatomy of Moon Bound Hypersensitive ionosphere and Atmosphere

(RAMBHA)

2. Chandra's Surface Thermo-Physical Experiment (ChaSTE)

3. Instrument for Lunar Seismic Activity (ILSA)

4. Laser Retroreflector Array (LRA)

ROVERS:

The rover is named Pragyan. It weighs just 26 kilograms (57 pounds) and flew to the moon inside the lander. The rover's payload include-

1. Rover: Alpha Particle X-Ray Spectrometer (APXS)

2. Rover: Laser Induced Breakdown Spectroscope (LIBS)

FINDINGS:

The rover confirmed the presence of Sulphur on the moon's surface. It also found a host of chemicals such as Aluminium, calcium, iron, chromium, titanium, manganese, silicon, and oxygen. The lander's instrument for the Lunar Seismic Activity (ILSA) system recorded some odd, 'seemingly natural' vibration that lasted a few seconds. The Chandra's Surface Thermophysical Experiment, or ChaSTE payload, measured thermal behaviour underneath the Lunar surface.

Chandrayaan-3 is equipped with several scientific instruments to carry out its mission. Here are seven of them:

- Radio Anatomy of Moon Bound Hypersensitive ionosphere and Atmosphere (RAMBHA): This instrument is designed to study the lunar ionosphere.

- Chandra's Surface Thermo physical Experiment (ChaSTE): This experiment is intended to measure the thermal properties of the lunar surface.

- Instrument for Lunar Seismic Activity (ILSA): This instrument is designed to measure seismic activity on the Moon.

- Laser Retroreflector Array (LRA): This array is used for precise measurements of the distance between the Earth and the Moon.

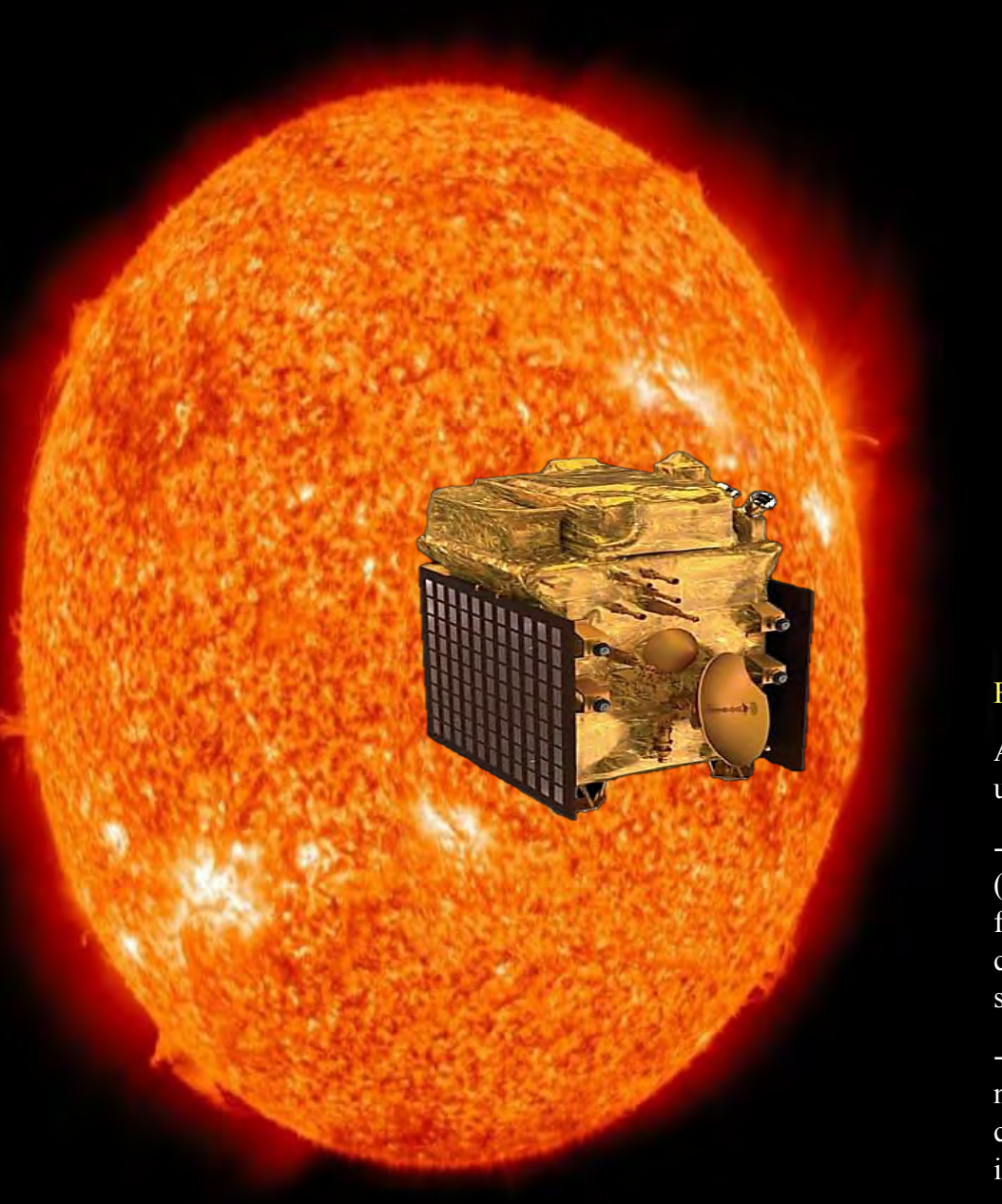
- Alpha Particle X-Ray Spectrometer (APXS): This spectrometer is used to analyze the chemical composition of lunar rocks and soil.

- Laser Induced Breakdown Spectroscope (LIBS): This spectroscope is used to analyze the elemental composition of lunar rocks and soil.

- Spectro-polarimetry of HAbitable Planet Earth (SHAPE): This instrument is used to study the polarization of light from the Earth, which can provide information about the Earth's atmosphere.

Shiv-Shakti Point

ADITYA L1



Aditya L1

Aditya L1 is a space mission designed to study the Sun, India's first of its kind. The mission is expected to improve our understanding of the solar magnetic field, solar activities, and space weather patterns. The Aditya L1 is equipped with advanced optical and magnetic instrumentation that will provide researchers with unprecedented detail of the Sun's atmosphere, including the corona, which is responsible for producing solar winds that influence space weather on Earth. The mission is operated by the Indian Space Research Organisation (ISRO) and funded by the Indian government. It was launched on 2nd September 2023. It is named Aditya L1 as 'Aditya' in Sanskrit refers to the Sun and the L1 is referring to the Lagrange point 1 which is a point between the Sun and the Earth where the satellite can remain stationary and observe the Sun without hindrance. On board are seven different components which are Visible Emission Line, Coronagraph (VELC), Solar Ultraviolet Imaging Telescope (SUIT), Solar Low Energy X-ray Spectrometer (SoLEXS), High Energy L-1 Orbiting X-ray Spectrometer (HEL1OS), Aditya Solar Wind Particle Experiment (ASPEX), Plasma Analyser Package for Aditya (PAPA) and Digital Magnetometers.

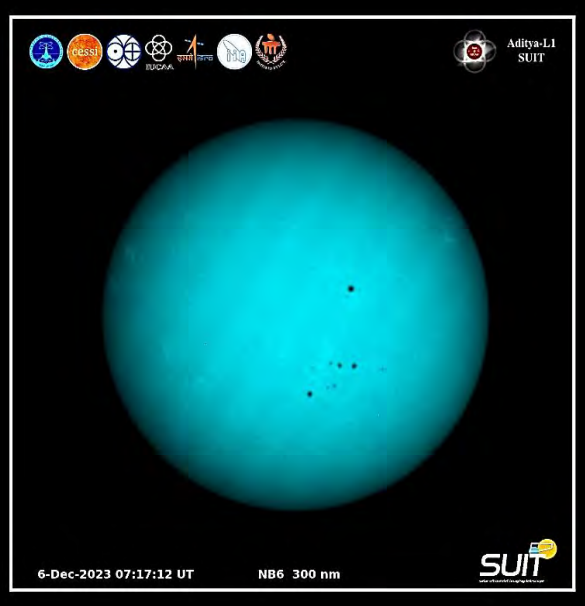
FINDINGS

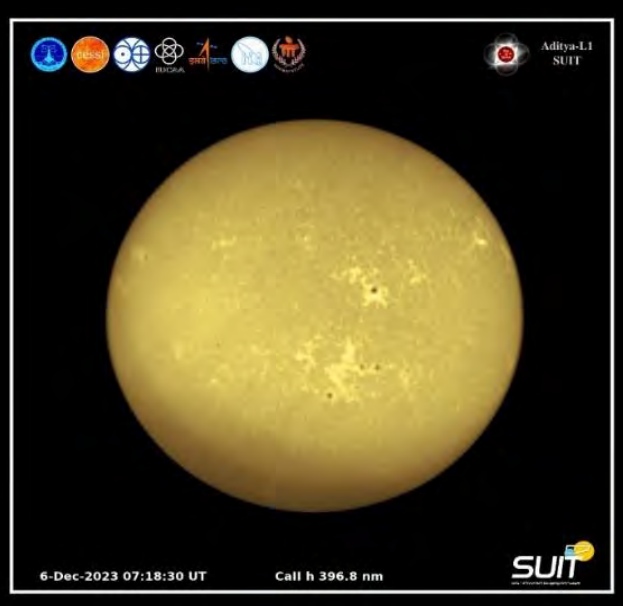
Aditya-L1, India's first solar mission, has made significant contributions to our understanding of the Sun. Here are some key findings and achievements:

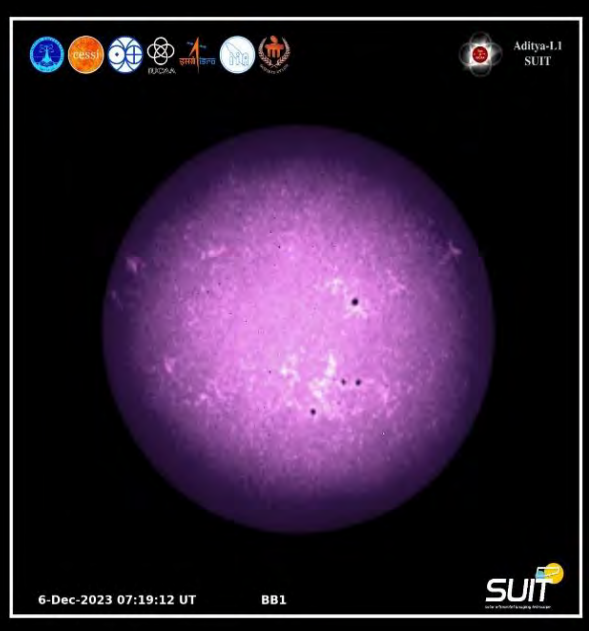
- Full-Disk Images of the Sun: The Solar Ultraviolet Imaging Telescope (SUIT) on board the Aditya-L1 spacecraft has successfully captured the first full-disk images of the Sun in the 200-400 nm wavelength range. SUIT captures images of the Sun's photosphere and chromosphere using various scientific filters.

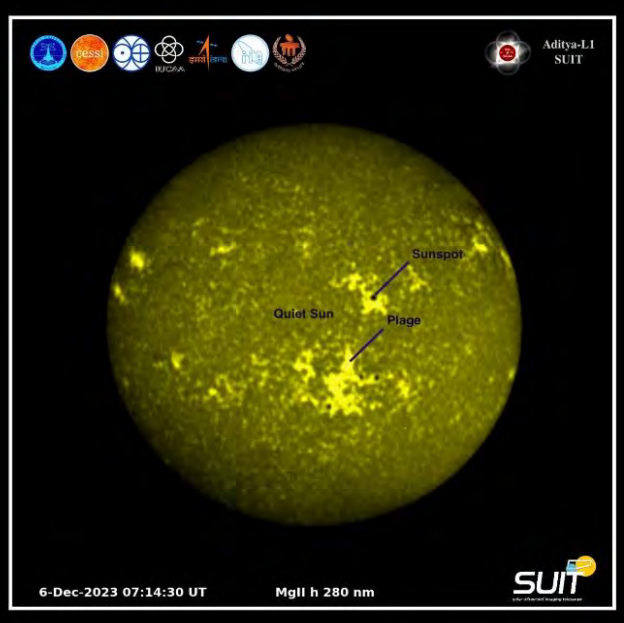
- Solar Polar Network Index: The observatory has developed the solar polar network index, which allows for predicting the strength of upcoming solar cycles. This predictive tool enhances our ability to anticipate solar activity and its potential impact on space weather.

- Stable Halo Orbit Around the Sun: Aditya-L1 has reached a point where the gravitational forces of both the Earth and the Sun cancel out, allowing it to remain in a stable halo orbit around the Sun.









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GAGANYAAN

Gaganyaan, derived from the Sanskrit words gagana and yāna meaning "celestial" and "craft vehicle" respectively, is an Indian crewed orbital spacecraft intended to be the formative spacecraft of the Indian Human Spaceflight Programme. The spacecraft is being designed to carry three people, and a planned upgraded version will be equipped with rendezvous and docking capabilities. In its maiden crewed mission, the Indian Space Research Organisation (ISRO)'s largely autonomous 5.3-metric ton capsule will orbit the Earth at 400 km altitude for up to seven days with a two- or three-person crew on board. The first crewed mission was originally planned to be launched on ISRO's LVM3 rocket in December 2021. As of October 2023, it is expected to be launched by 2025.

Vikas engine variants are used to power the second stage of the PSLV, boosters and second stage of the GSLV Mark I and II, and also the core stage of LVM 3.

- Launch Mass and Dimensions: The launch mass of the Gaganyaan is 8,200 kg (includes service module) and it has a crew capacity of 3. The dimensions are a diameter of 3.5 m and a height of 3.58 m.

- Mission Schedule: As part of this program, two unmanned missions and one manned mission are approved by the Government of India. The first crewed mission was originally planned to be launched on ISRO's LVM3 rocket in December 2021. As of October 2023, it is expected to be launched by 2025.

- Development Status: As of May 2019, design of the crew module has been completed. Defence Research and Development Organisation (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

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NOBEL LAUREATES IN PHYSICS 2023

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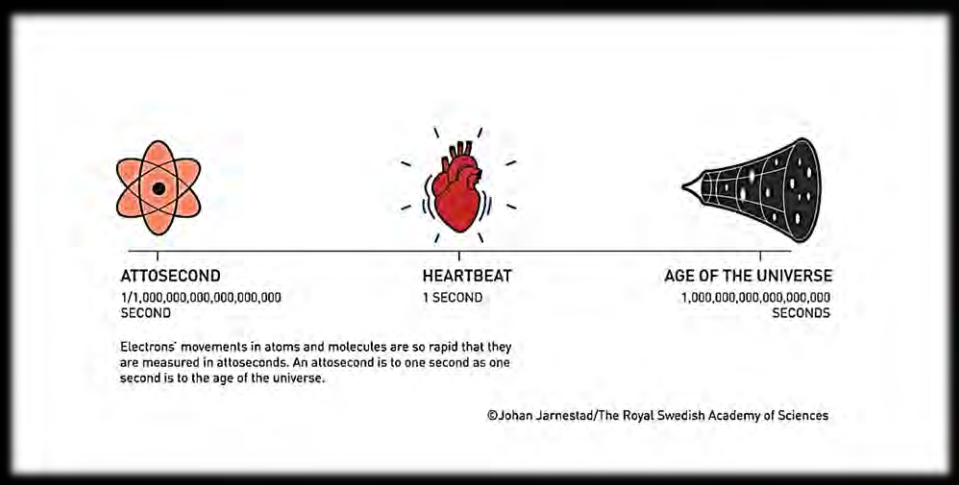
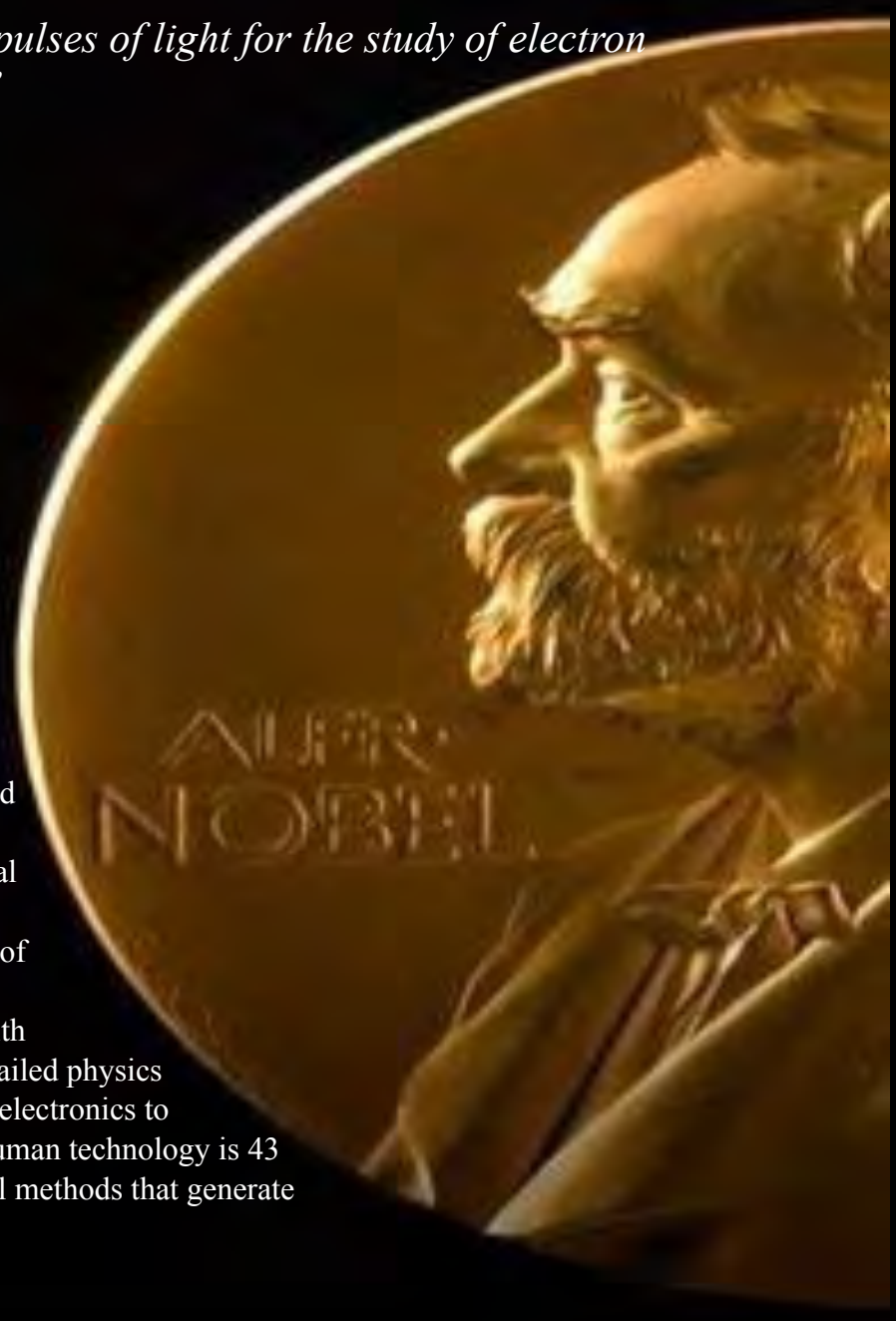
The Nobel Prize in Physics 2023 was awarded to **Pierre Agostini, Ferenc Krausz**, and **Anne L'Huillier**

"for their experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter."





ATTOSECOND

An attosecond (as) is a unit of time in the International System of Units (SI) equal (one quintillion) of a second. To put this into perspective, an attosecond is to a second as a second is to about 31.71 billion years. This newly discovered "slice of time" is tiny but has various potential applications. It can be used to observe oscillating molecules, the chemical bonds formed by atoms in chemical reactions, and other extremely tiny and extremely fast things. For example, it takes about 320 attoseconds for electrons to transfer between atoms. The field of attosecond physics deals with light-matter interaction phenomena where in attosecond photon pulses are used to unravel dynamical processes in matter with unprecedented time resolution. These pulses have been used to explore the detailed physics of atoms and molecules and have potential applications in fields ranging from electronics to medicine. The current world record for the shortest light-pulse generated by human technology is 43 attoseconds. In 2023, the Nobel Prize in Physics was awarded for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter.

PIERRE AGOSTINI:
Pierre Agostini, a physicist born in 1941, is known for his work on ultra-short light pulses. His significant contribution is the RABBITT technique and the production of 250-attosecond light pulses. His groundbreaking research earned him the 2023 Nobel Prize in Physics.

FERENC KRAUSZ:
Ferenc Krausz, a physicist born in 1962, is recognized for his work in attosecond science and his experiment that isolated a 650-attosecond light pulse. He has held significant positions at the Max Planck Institute and Ludwig-Maximilians-Universität München. His contributions earned him the 2023 Nobel Prize in Physics.

ANNE L'HUILLIER:
Anne L'Huillier, born in 1958, is a professor at Lund University, Sweden. She is known for her discovery of multiple overtones of light when transmitting infrared laser light through a noble gas. Her continued exploration of this phenomenon has paved the way for subsequent breakthroughs in the field.

PIERRE AGOSTINI

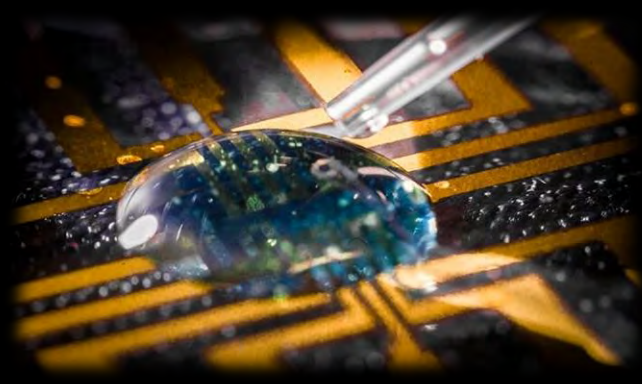
FERENC KRAUSZ

ANNE L'HUILLIER

SOME TRENDING TOPICS ON PHYSICS

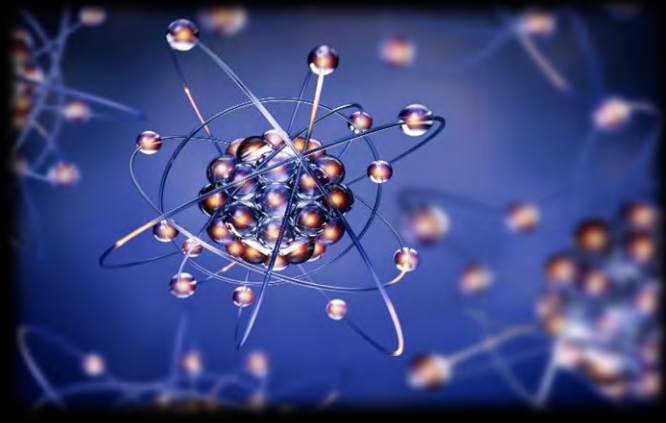
Growing electrodes inside living tissue

Scientists at Linkoping University, Lund University, and the University of Gothenburg developed a way to create electronic circuits directly inside living tissue.



Neutrons probe the proton’s structure

Researchers at the University of Rochester in the US and Canada’s York University showed how information about the internal structure of the proton can be gleaned from neutrinos scattering from a plastic target.



The ascension of AI in R&D

The AI field is impacting drug discovery, environmental research, and healthcare and applications. Scientists are keeping an eye on AlphaFold, DeepMind’s protein structure prediction software.

‘Greener’ green chemistry

Green chemistry is a rapidly evolving field that is constantly seeking innovative ways to minimize the environmental impact of chemical processes.

Quantum entanglement among quarks

A team ofscientists from Stony Brook University and BroookhavenNational Laboratory addressed longstanding problems in nuclear physics using quantum computing methods.

Wall Magazine 2023