Chandrayan Chronicles: Insights from the ISRO Scientist's Talk

Date: September 29, 2023

Venue: Institute of Engineering and Technology, Lucknow

Presenter: Er. Ritesh Sharma, Dep. Project Director - Space Application Center, ISRO

Introduction

The vast expanse of the cosmos has always beckoned humanity with its mysteries and uncharted territories. In recent years, India has emerged as a notable player in the field of space exploration, making significant strides in unraveling the enigmas of the universe. On September 29, 2023, the distinguished IET Lucknow campus had the privilege of hosting a session featuring Er. Ritesh Sharma from the Indian Space Research Organization (ISRO). The focus of this enlightening session was India's remarkable Chandrayan missions—Chandrayan 1, Chandrayan 2, and the successful Chandrayan 3.

Session Highlights

आईईटी के छात्रों को मिली चन्द्रयान 3 से जुड़ी जानकारी

पायनियर समाचार सेवा। लखनऊ

इंस्टीट्यूट ऑफ इंजीनियरिंग एण्ड टेक्नोलॉजी लखनऊ के इलेक्ट्रानिक्स एण्ड कम्युनिकेशन इंजीनियरिंग विभाग में शुक्रवार को संस्थान के निदेशक प्रो विनीत कंसल की अध्यक्षता में बीटेक ईसीई एवं बीटेक ईआईई तथा बीटेक मैकेनिकल इंजीनियरिंग के छात्र-छात्राओं के लिये चन्द्रयान.3 के सम्बन्ध में विशिष्ट अतिथि द्वारा व्याख्यान का आयोजन किया गया। इस व्याख्यान में भारतीय अंतरिक्ष अनुसंधान केन्द्र के स्पेस एप्लीकेशन सेन्टर में कार्यरत इ रितेश शर्मा, डिप्टी प्रोजेक्ट निदेशक द्वारा विद्यार्थियों को चन्द्रयान. 3 प्रोजेक्ट के विषय में विस्तृत जानकारी दी। रितेश शर्मा इंस्टीट्यूट ऑफ इंजीनियरिंग एण्ड टेक्नोलॉजी लखनऊ के इलेक्ट्रानिक्स एण्ड कम्युनिकेशन इंजीनियरिंग विभाग के एल्यूमनाई भी हैं। इस कार्यक्रम का संचालन आईईई स्टूडेंट चैप्टर, आईईटी लखनऊ के माध्यम से किया गया। कार्यक्रम के आयोजन का समन्वयन विभाग के विभागाध्यक्ष प्रो सुबोध वैरिया, प्रोफेसर एवं प्रो नीलम श्रीवास्तव, प्रोफेसर के एवं डा आरसीएस चौहान द्वारा किया गया। इस व्याख्यान में विभाग के अन्य शिक्षकगण डा राजीव कुमार सिंह, अगित कुमार एवं प्रो एसआरपी सिन्हा (सेवानिवृत्त) विशेष अतिथि के रूप में उपस्थित रहे। व्याख्यान में बीटेक ईसीई, बीटेक ईआईई तथा बीटेक मैकेनिकल इंजीनियरिंग के लगभग 100 छात्र-छात्राओं द्वारा पूरे उत्साह के साथ प्रतिभाग किया गया।

In the following sections, this report will encapsulate the highlights of the session, presenting a comprehensive overview of the topics discussed, insights shared, and the audience's engagement. We will journey through the significant achievements of Chandrayan 1 and 2, exploring the vast lunar landscape and its implications for scientific discovery. Additionally, we will touch upon the promising endeavors of Chandrayan 3 and the potential it holds for further lunar exploration.

Life at ISRO

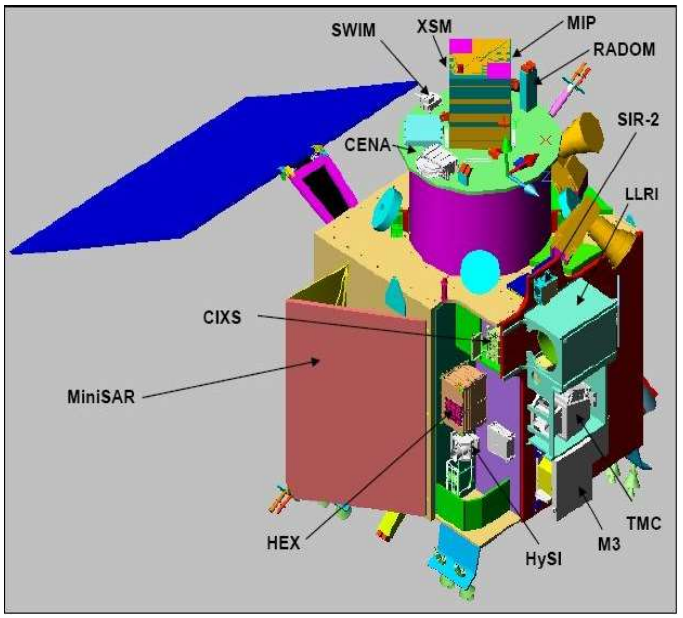
ISRO has a gargantuan hierarchy, starting from technicians to scientists of distinguished class. A job at ISRO comes with respect and special perks, and people working there feel incredibly awesome. There, you'll be interacting with some of the brightest minds in the country. There are people who have spent more than 35 years on a particular work. These are people who have risen from the bookish preachings and realized things that fly.

Behind every successful space mission is a team of hard working, hardly sleeping, and passionate scientists. They strategized, designed, implemented, tested, and launched the mission that carved India's name in red!

"IT'S ROCKET SCIENCE, NOT SCIENCE FICTION!"

Chandrayaan 1: Key Components and Achievements

Chandrayaan-1, India's first lunar mission, launched in October 2008. It orbited the Moon at 100 km altitude, conducting experiments, creating lunar maps, and searching for water. Its success included discovering water molecules on the moon. The spacecraft, based on an Indian meteorological satellite called Kalpansat, was approximately the size of a refrigerator, weighing around 525 kilograms (1,160 lbs.) without fuel, and powered by solar panels charging lithium-ion batteries.



Key Components:

- ➔ Terrain Mapping Camera
- ➔ Hyper Spectral Imager
- ➔ Lunar Laser Ranging Instrument
- ➔ High Energy X - ray Spectrometer
- ➔ Moon Impact Probe
- ➔ Chandrayaan-1 X-ray Spectrometer
- ➔ Near Infrared Spectrometer
- ➔ Sub keV Atom Reflecting Analyzer
- ➔ Miniature Synthetic Aperture Radar
- ➔ Moon Mineralogy Mapper

Key Findings:

The scientific findings of Chandrayaan-1 include the following:

- ➔ Detection of sub-surface water-ice deposits in the base of craters in permanent sun shadow
- ➔ An indication of possible existence of water molecules in the lunar environment
- ➔ Validation of Lunar Magma Ocean Hypothesis
- ➔ Detection of reflection of 20% of solar wind protons
- ➔ Detection of presence of Mg, Al, Si, and Ca on the lunar surface
- ➔ Three-dimensional conceptualization of many lunar craters of interest

Chandrayaan 1: The Inspiration for Chandrayaan 2

The story of Chandrayaan 2 cannot be fully appreciated without understanding the pioneering mission that laid its foundation - Chandrayaan 1. The confirmation of water on the Moon and the wealth of data gathered during the first mission fueled the desire to explore further and delve deeper into lunar mysteries.

Chandrayaan 1's achievements laid the groundwork for Chandrayaan 2's ambitious goals, particularly in terms of expanding our understanding of lunar geology, mineralogy, and the Moon's potential as a destination for future scientific research and human exploration.

Chandrayaan 1's pioneering mission served as the catalyst and inspiration for Chandrayaan 2, propelling India further into the realm of lunar exploration and reinforcing ISRO's commitment to advancing our understanding of the Moon and beyond.

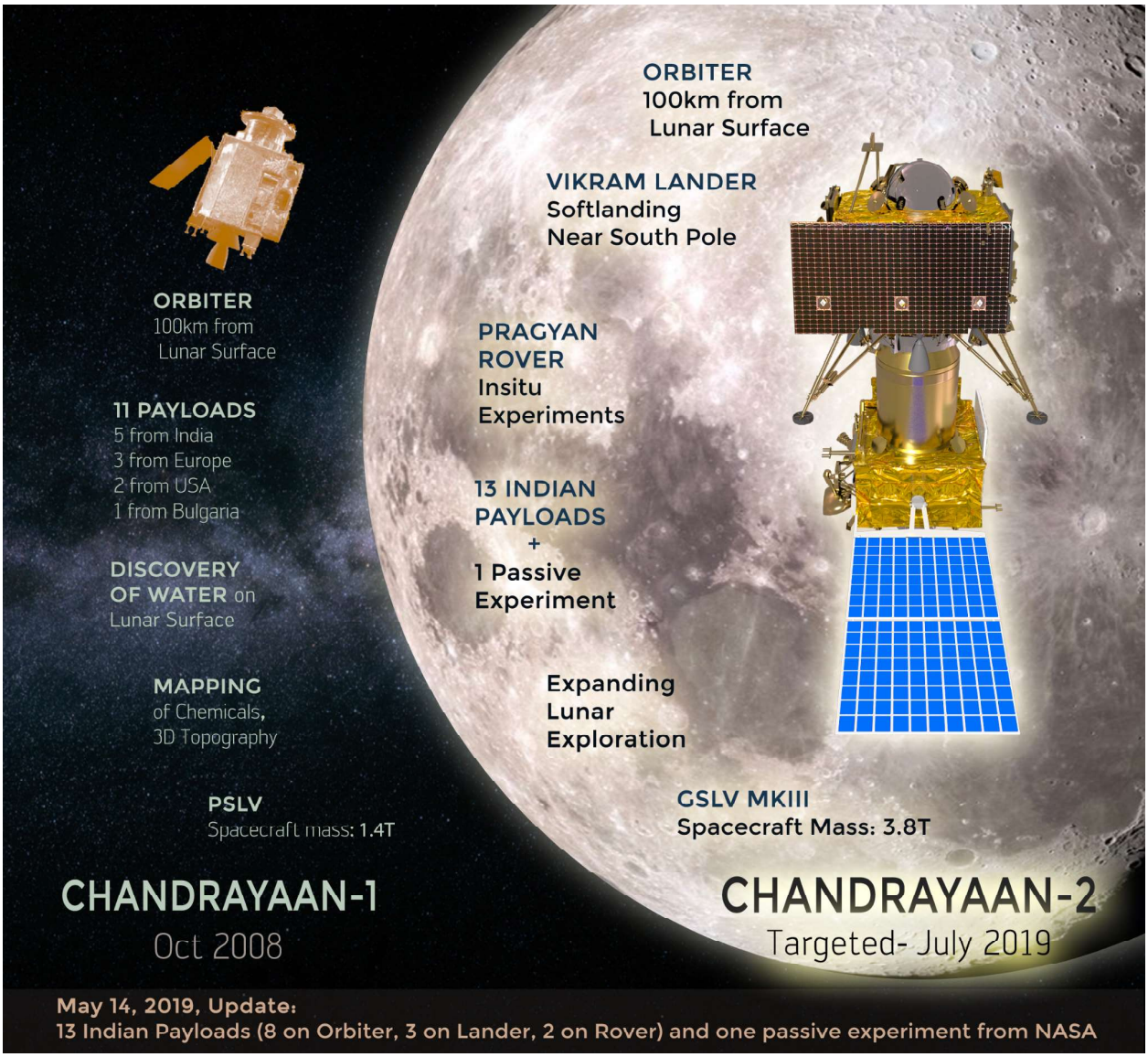
Chandrayaan 2: Mission Overview and Components

The mission was launched on 22 July 2019 at 09:13 UTC by a LVM3-M1 rocket from the Satish Dhawan Space Centre in Andhra Pradesh . The spacecraft reached the lunar orbit on 20 August 2019 and began orbital positioning manoeuvres for the landing of the Vikram lander. The lander and the rover were scheduled to land on the near side of the Moon, in the south polar region at a latitude of about 70° south on 6 September 2019. However, the lander crashed when it deviated from its intended trajectory while attempting to land on 6 September 2019 .

Key Components:

It consists of three main components:

- ➔ A lunar orbiter
- ➔ A lander named Vikram
- ➔ A Six-wheeled rover named Pragyaan



Chandrayaan 2 Setback: A Stepping Stone to Future Success

Chandrayaan 2, India's second lunar mission launched in 2019, aimed to land a rover near the Moon's south pole for scientific experiments. Unfortunately, a software glitch during the final landing stage caused the lander Vikram to crash. The glitch went undetected, leading to a trajectory deviation and loss of communication.

The failure was attributed to navigation and guidance system issues, communication loss during descent, and challenging terrain at the landing site. Lessons from this setback led to improvements in Chandrayaan 3, including more fuel, safety measures, a larger landing site, and pre-mapped locations using Chandrayaan 2 orbiter imagery.

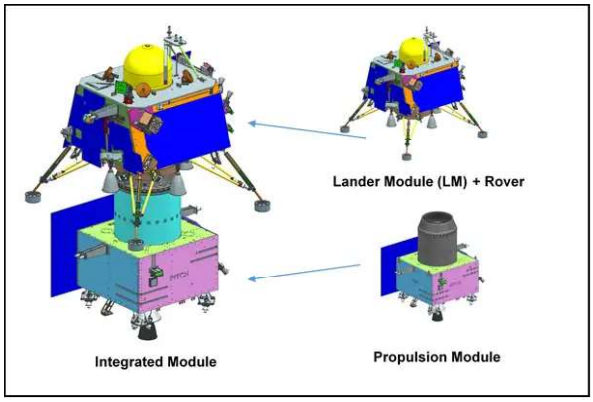
Chandrayaan 3: Mission and its Components

Chandrayaan-3 is India's third lunar exploration mission, part of the Chandrayaan program developed by ISRO. The mission consists of a lunar lander named Vikram and a lunar rover named Pragyan, similar to those launched on Chandrayaan-2 in 2019. Launched on 14 July 2023, the spacecraft entered lunar orbit on 5 August and reached the lunar south pole on 23 August. This marks India's fourth successful landing on the Moon and the first near the lunar south pole. The South Pole, which is not visible to Earth due to unpredictable lightning, holds great mystery for researchers.

Key Components:

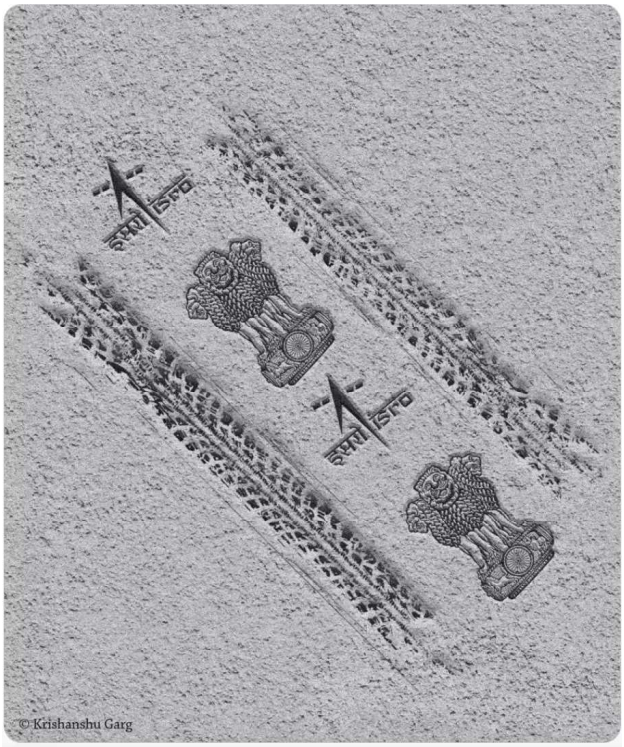
The Chandrayaan 3 mission has three modules:

- ➔ **A propulsion module**
- ➔ **A lander module**
- ➔ **A rover module**



The **propulsion module** transports the lander to lunar orbit, while the lander hosts the rover. The **lander module**, **Vikram**, has four throttleable engines for landing and maneuvering and various sensors for navigation, guidance, control, hazard detection, and touchdown. The **rover module**, **Pragyan**, can travel up to 500 meters and has two science payloads: **APXS and LIBS**. The mission is expected to last one lunar day for the lander and rover and up to six months for the propulsion module.

Chandrayaan 3: Success and its Impact



Chandrayaan-3, a space exploration mission, has had significant impacts on India and the world. It provided valuable insights into the Moon's geology, mineralogy, and environment, particularly in the south polar region, which holds great potential for future exploration and utilization of lunar resources. The mission detected elements such as aluminum, calcium, iron, chromium, titanium, manganese, silicon, oxygen, and sulfur on the lunar surface, which could shed light on the moon's formation and evolution. The lunar regolith was also found to be a good insulator, which could be useful for building habitats on the moon. The lander also conducted a successful 'hop'

experiment, demonstrating its ability to lift off from the lunar soil and land at a different location, paving the way for future sample return missions from the Moon.

The mission has established India as a major player in the space community, showcasing its technological prowess and commitment to exploration. It has also enhanced India's soft power and diplomatic influence, inspiring millions of young Indians to pursue careers in STEM. Additionally, the mission contributed to India's economic growth and development, boosting its space industry and innovation ecosystem. Chandrayaan-3 marked a new chapter in lunar exploration, highlighting the importance of bold ambitions, meticulous planning, and collaborative efforts in pushing the boundaries of human knowledge.

Conclusion

A New Era of Space Leadership and Exploration

India's recent moonshot of the Chandrayaan-3 rover marks a significant milestone in its engagement with space. The success comes as major powers seek to gain a share of space industrialization, extract extra-terrestrial mineral resources, and embark on deep space exploration. The Moon has become a critical waystation for human future space activity, with the race to the moon's south pole based on the expectation of water and other vital ingredients to support human activity. India's space program has achieved a significant milestone for its limited budget, but it needs to think big to make a difference to global activity on the Moon. The difference lies in the power of the rockets used. For India to make more impactful Moon projects, it needs bigger budgets and more powerful rockets that can arrive quicker and with heavier payloads. This will help India transform the relationship between humanity and outer space.

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