2. Coronal Mass Ejection on Lunar Exposure - S & T

Chandrayaan-2 Makes First Ever Observation of Sun's Coronal Mass Ejections' Effects on the Moon. ISRO's Chandrayaan-2 mission, using its CHACE-2 payload, made the first-ever observation of how the Sun's Coronal Mass Ejection (CME) affects the Moon's exosphere, revealing changes in pressure and molecular density. The finding deepens understanding of solar–lunar interactions and aids future lunar missions.

Chandrayaan-2 Detects Sun's Coronal Mass Ejection (CME) Effects on the Moon

1. Context

The Chandrayaan-2 mission has made a first-of-its-kind scientific observation — detecting the effects of the Sun's Coronal Mass Ejection (CME) on the Moon. This marks a major advancement in understanding the interaction between solar activity and the Moon's exosphere. The finding was achieved using the onboard scientific payloads of Chandrayaan-2, operated by the Indian Space Research Organisation (ISRO).

2. About the Observation

The observation was made by Chandra's Atmospheric Composition Explorer-2 (CHACE-2), one of the payloads onboard Chandrayaan-2's orbiter.

Instrument Role - CHACE-2 is designed to study the composition, distribution, and variability of the Moon's thin atmosphere, known as the exosphere.

Key Finding - During a Coronal Mass Ejection (CME) event, CHACE-2 detected a sharp rise in total pressure and molecular density within the Moon's sunlit exosphere. This is the first-ever recorded evidence of a CME influencing the lunar atmosphere.

3. Understanding Coronal Mass Ejection (CME)

CMEs are large-scale eruptions from the Sun's outer atmosphere (the corona). These eruptions involve the expulsion of massive quantities of plasma and magnetic field lines into space.

Composition -

1. Predominantly composed of Hydrogen ions (protons) and Helium ions (alpha particles).
2. May also include trace heavier ions and electrons.

CMEs travel through the solar system, interacting with planetary atmospheres, magnetic fields, and, in this case, the Moon's exosphere.

4. Impact of a Coronal Mass Ejection on the Lunar Exosphere

When a CME reaches the Moon, it directly impacts its surface and exosphere because the Moon lacks a global magnetic field to deflect charged particles. The high-energy solar plasma from the CME increases the particle density and pressure within the lunar exosphere. This results in temporary changes in the composition and behaviour of the Moon's atmosphere. The observation by CHACE-2 thus confirms that solar events can directly alter the lunar environment.

5. Composition of the Lunar Exosphere

The Moon's atmosphere is extremely tenuous, and is classified as an exosphere — the outermost layer of an atmosphere where - Gas atoms and molecules are so sparse that they rarely collide with one another. The boundary of this exosphere is the Moon's surface itself, meaning particles are directly released and lost to space — this is termed a surface boundary exosphere.

Major Sources of the Lunar Exosphere -

1. **Solar Radiation -** Causes surface atoms to escape into space through photo-desorption.
2. **Solar Wind -** Bombardment by charged particles (mainly hydrogen and helium ions) releases atoms from the lunar surface.
3. **Meteorite Impacts -** Impact events eject surface atoms and molecules into the exosphere.

Absence of Magnetic Shield - Unlike Earth, the Moon does not have a magnetic field or a dense atmosphere. Therefore, it is directly exposed to the solar wind and CMEs, allowing such interactions to be

clearly observed and measured.

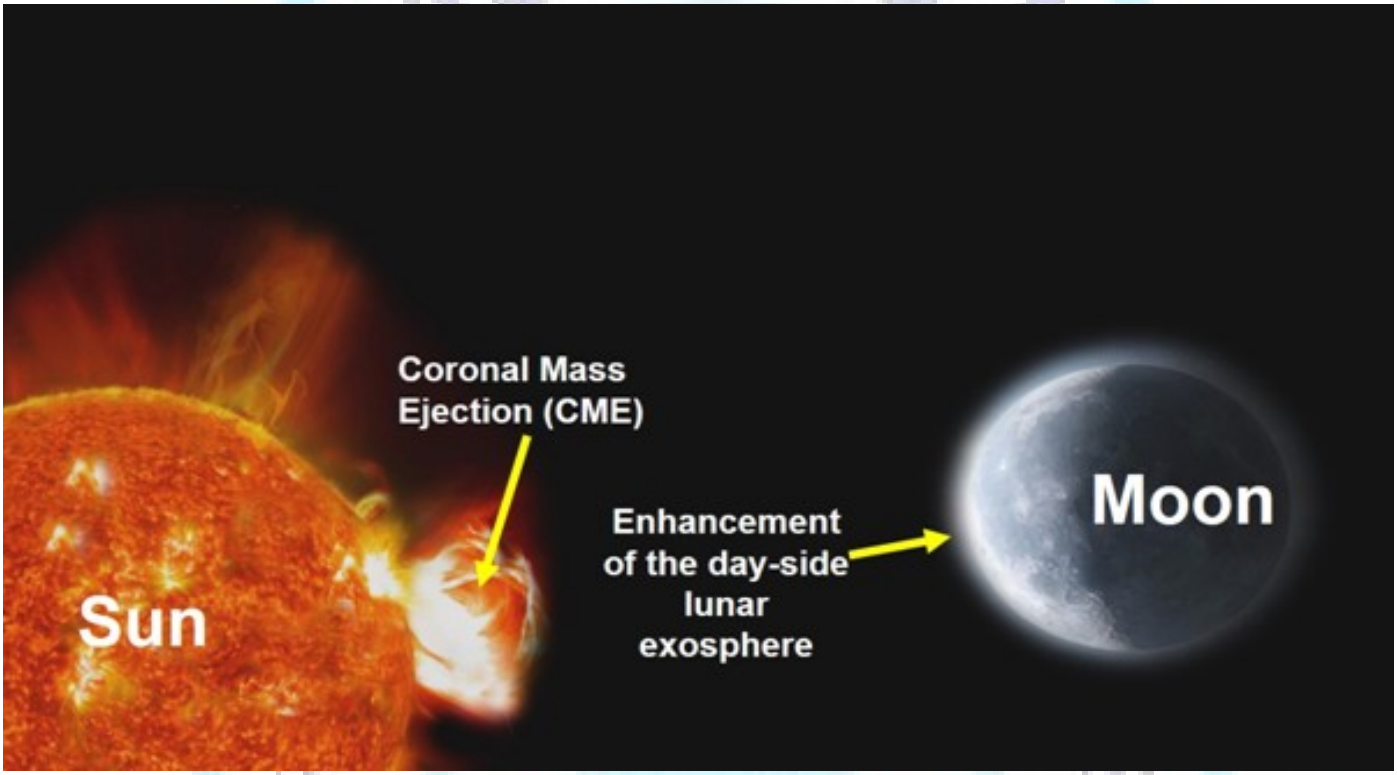
6. Chandrayaan-2 Mission Overview

Launch Year - 2019
Launched By - Indian Space Research Organisation (ISRO)
Launch Vehicle - GSLV-MkIII-M1 rocket
Mission Type - India's second lunar mission, following Chandrayaan-1 (2008).
Mission Components

1. **Orbiter -** Continues to operate successfully around the Moon.
2. **Lander (Vikram) -** Attempted a soft landing but lost communication during descent.
3. **Rover (Pragyan) -** Carried onboard Vikram, intended to explore the lunar surface.

CHACE-2 Payload Objective

1. To analyze the neutral components of the lunar exosphere.
2. To study their spatial distribution, temporal variation, and influencing factors such as solar radiation, solar wind, and micrometeorite activity.



7. Significance of the Observation

Scientific Breakthrough - Marks the first-ever detection of CME effects on the Moon's atmosphere, a significant contribution to planetary science.
Understanding Lunar Exospheric Dynamics - Provides valuable data on how solar activity alters the lunar exosphere over time. Helps model the dynamic balance between incoming solar particles and surface-released gases.
Space Weather Studies - Enhances our understanding of space weather effects on airless celestial bodies like the Moon and Mercury. This information helps improve space weather prediction models relevant to human and robotic missions.
Relevance for Future Lunar Missions - Offers critical insights for the design of future lunar habitats and scientific instruments. Understanding solar–lunar interactions is vital for ensuring the safety of astronauts and equipment during long-term missions.
India's Scientific Advancement - Demonstrates India's growing expertise in planetary science, solar–lunar interaction studies, and space environment monitoring. Strengthens India's global position in lunar research and supports its vision for human presence on the Moon by 2040.

8. Conclusion

Chandrayaan-2's CHACE-2 payload has achieved a pioneering scientific milestone by observing

the Sun's CME impact on the Moon. The study not only deepens knowledge about lunar exospheric physics but also provides practical data for space weather forecasting and future human exploration. This discovery reinforces ISRO's role as a key contributor to planetary and space environment research.
Source - https - //www.newsonair.gov.in/chandrayaan-2-becomes-first-mission-to-observe-suns-coronal-mass-ejections-on-the-moon/