

# EXCITEMENT IN ASTRONOMY

By

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# INDIAN SPACE ENDEAVOUR

*There are some who question the relevance of space activities in a developing nation. To us, there is no ambiguity of purpose. We do not have the fantasy of competing with the economically advanced nations in the exploration of the Moon or the planets or manned space-flight. But we are convinced that if we are to play a meaningful role nationally, and in the comity of nations, **we must be second to none in the applications of advanced technologies to the real problems of man and society***

VIKRAM A. SARABHAI

**BUDGET**  
Rs 3148 Cr/ annum

**APPLICATIONS  
LEADERSHIP**

**LARGE USER BASE**

**INDUSTRY**

**SPACE COMMERCE**

**INSAT**

**IRS**

**LAUNCHER**

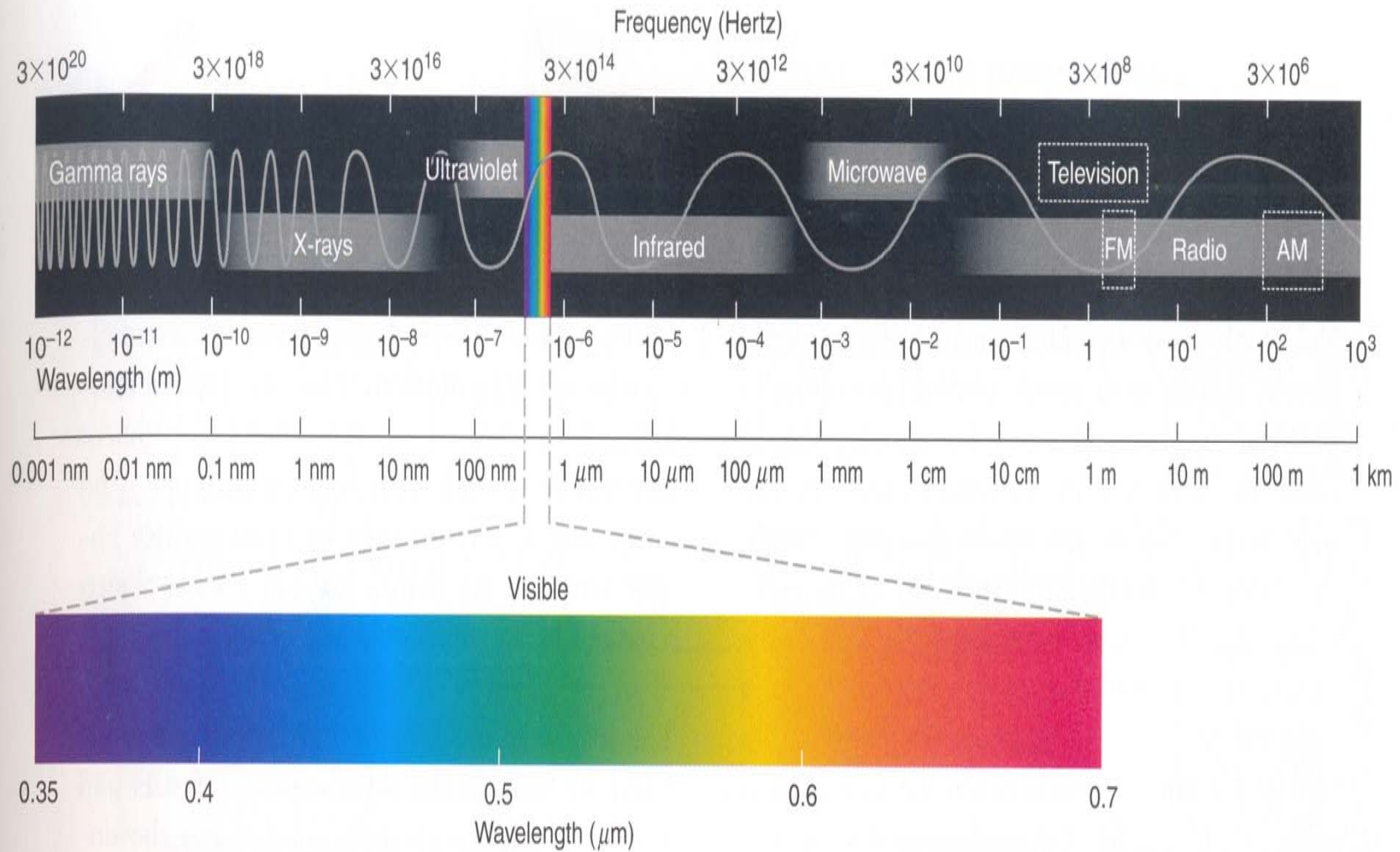
**HUMAN RESOURCES  
EXPERTISE**  
16500 strong

**INTERNATIONAL  
COOPERATION**

**SPACE ASSETS**  
Remote sensing &  
Telecom satellite  
Constellations

**INFRASTRUCTURE**  
End-to-end capability

**STATE OF THE ART  
TECHNOLOGY**

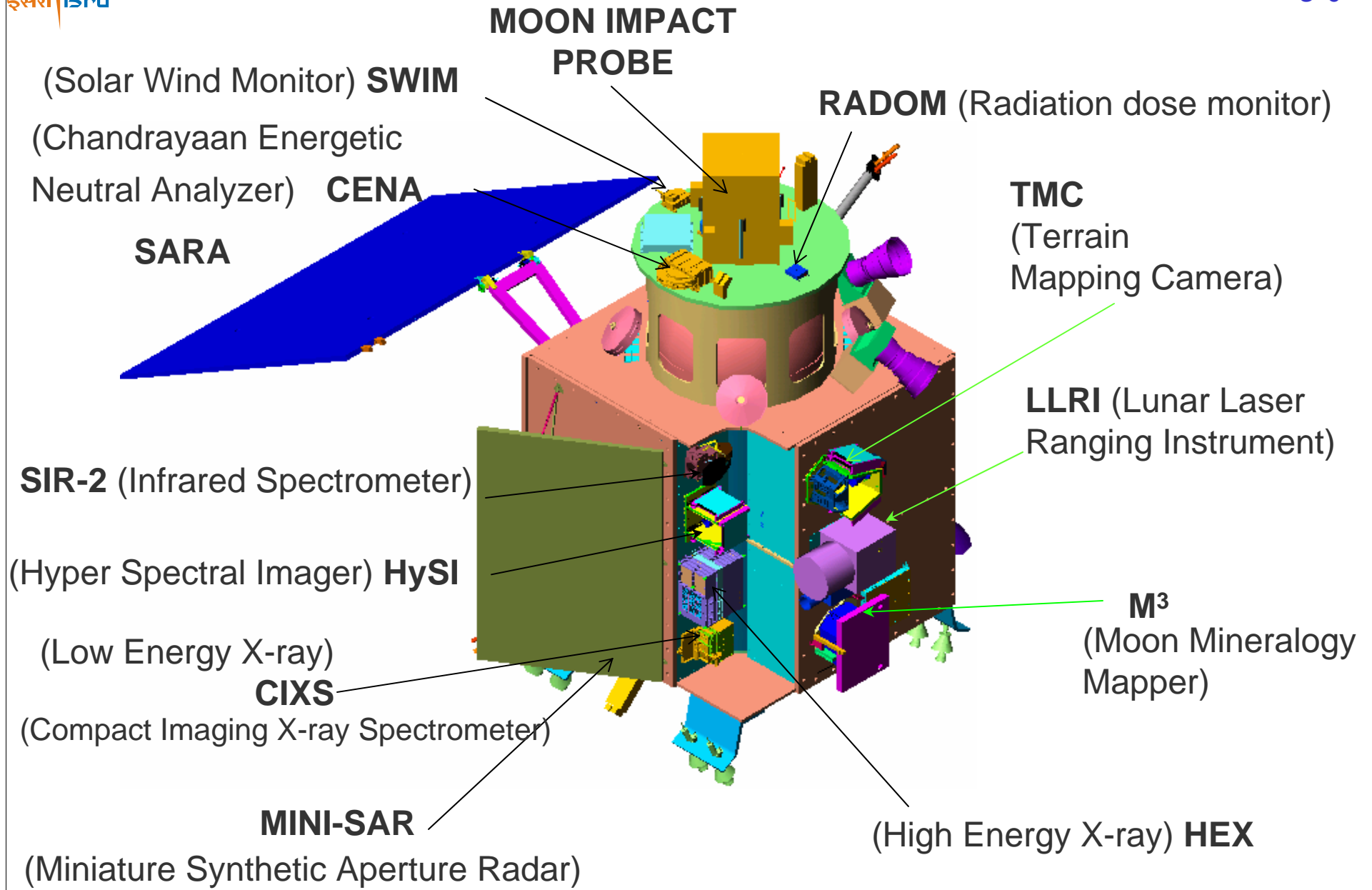


**Figure 4.9** By convention the electromagnetic spectrum is broken into loosely defined regions ranging from gamma rays to radio waves.



# LAUNCH VEHICLE EVOLUTION





## CHANDRAYAAN-1 PAYLOADS



# PSLV – C11: Lift Off



# Chandrayaan-1 Mission Profile

**Initial Orbit by PSLV: 255 km X 22860 km**

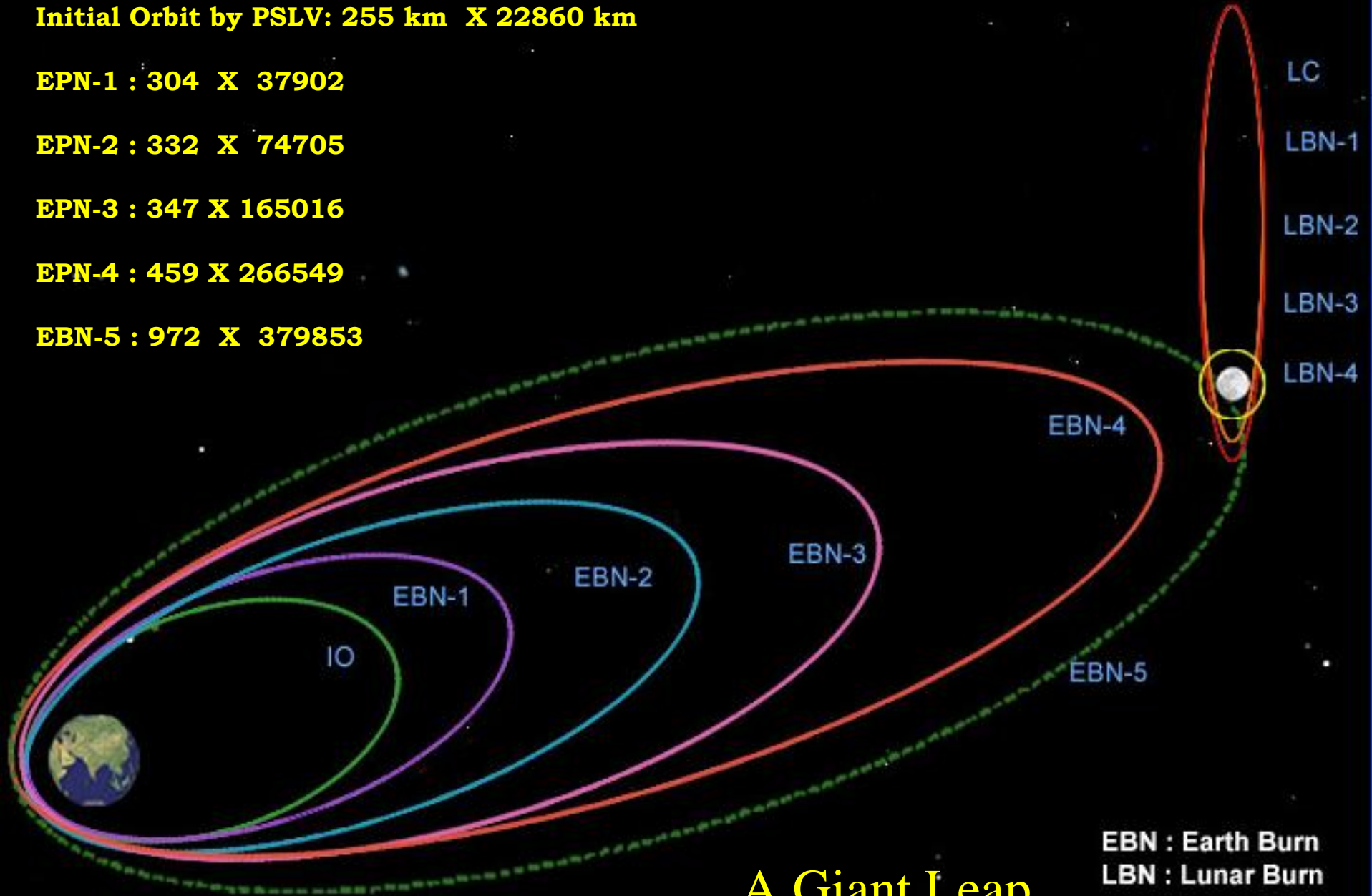
**EPN-1 : 304 X 37902**

**EPN-2 : 332 X 74705**

**EPN-3 : 347 X 165016**

**EPN-4 : 459 X 266549**

**EBN-5 : 972 X 379853**

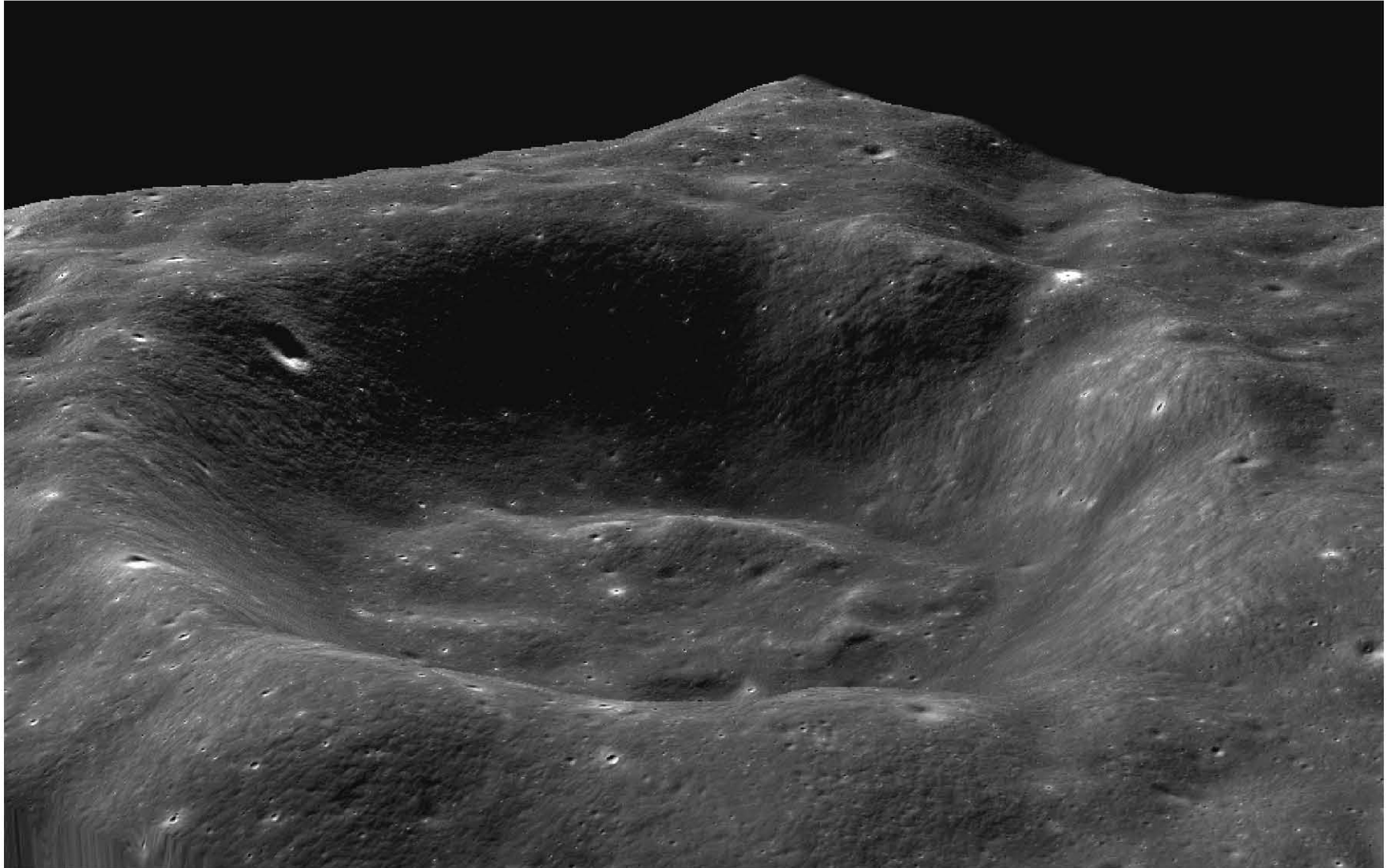


**A Giant Leap**

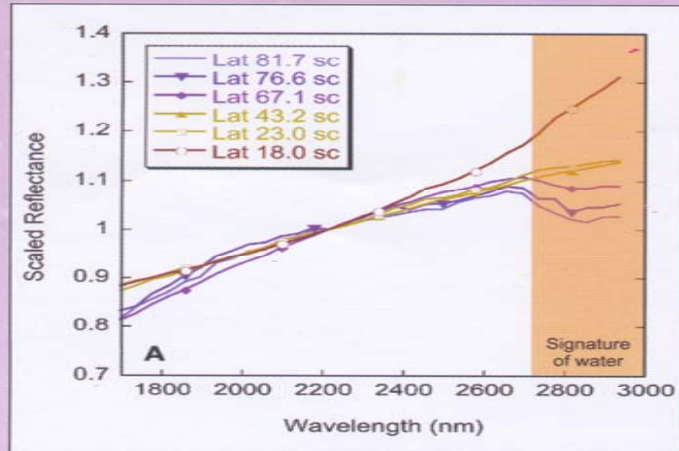
**EBN : Earth Burn  
LBN : Lunar Burn**



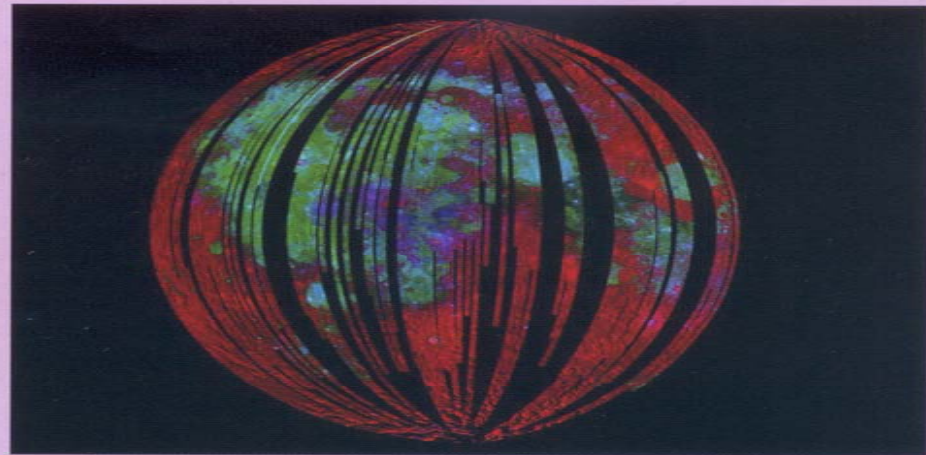
## 2.5D Visualisation (Coulomb C Crater)



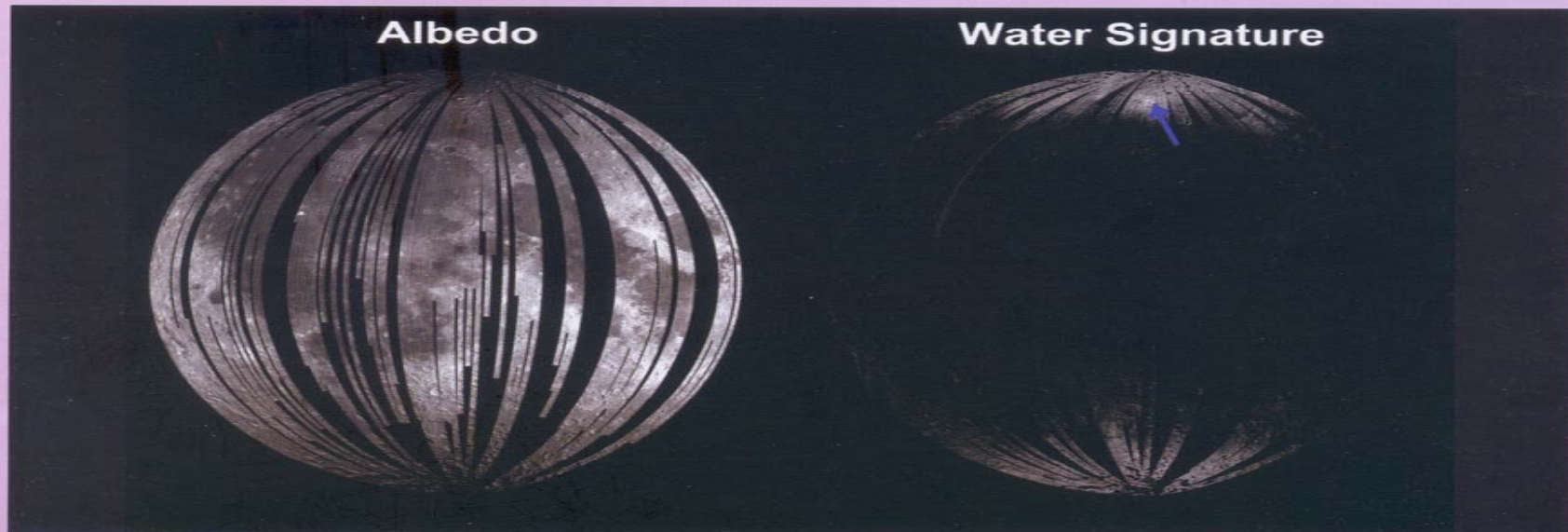




The reduction in the reflectance at wavelengths beyond 2.7 micrometers is the signature used by M<sup>3</sup> to detect water



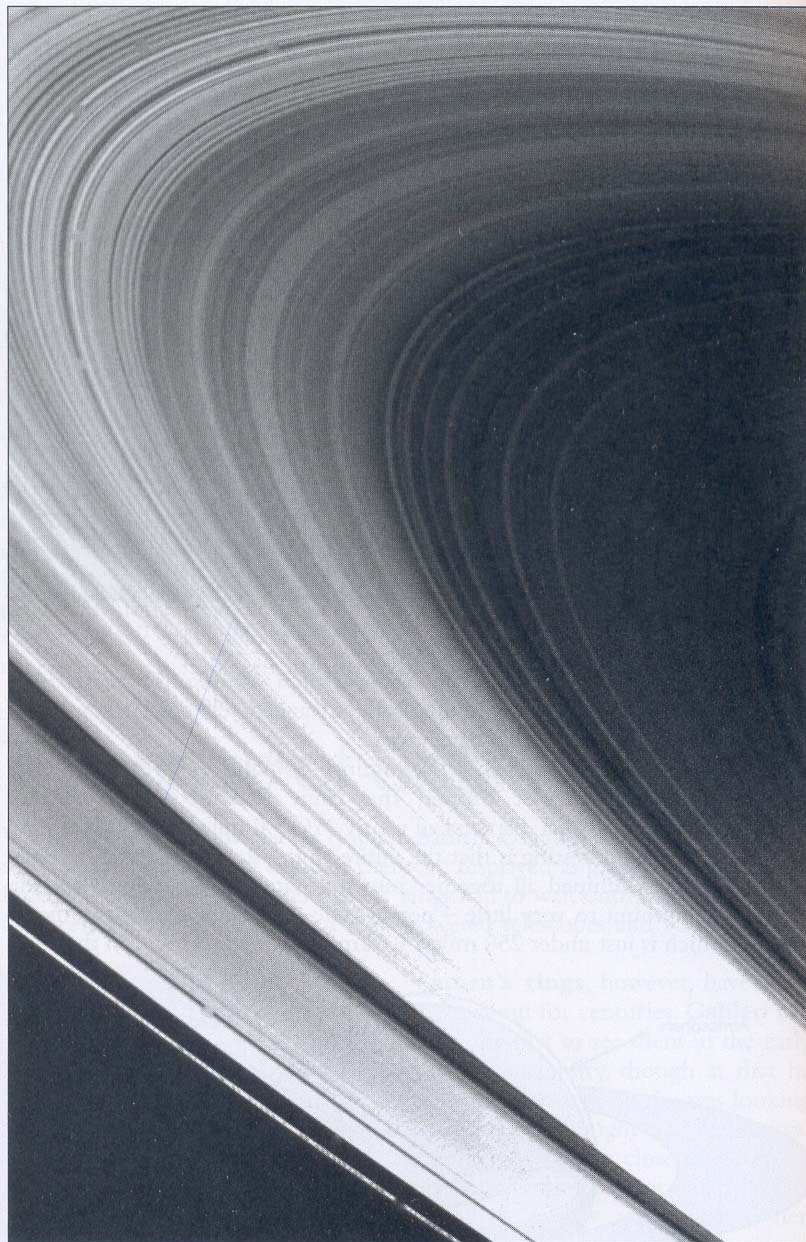
Early mineral map : The green, purple and blue areas are covered with iron-rich lava flows. The red and pink regions contain the mineral plagioclase (one of the minerals found in granite rocks on Earth)



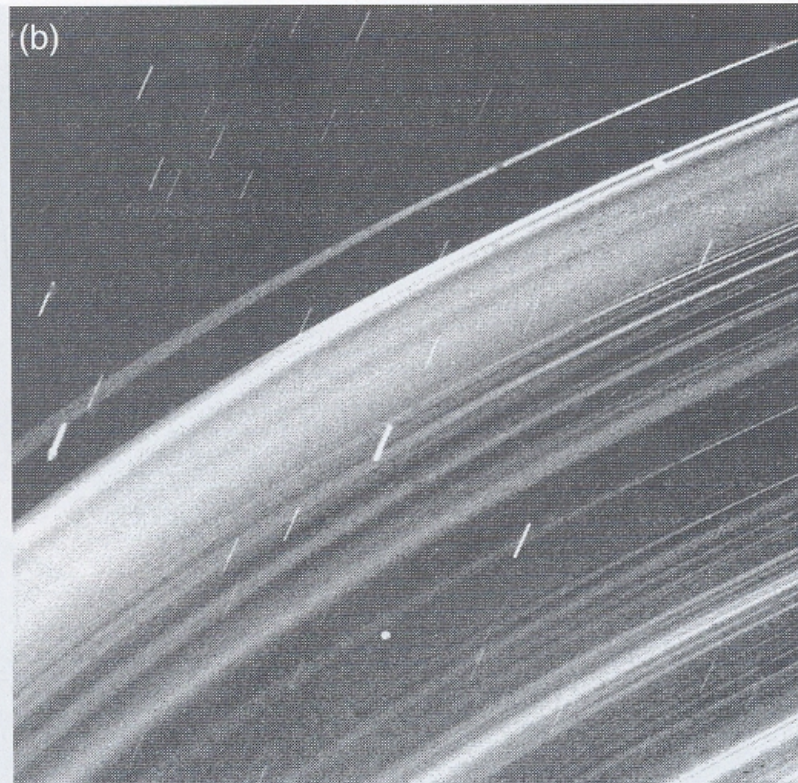
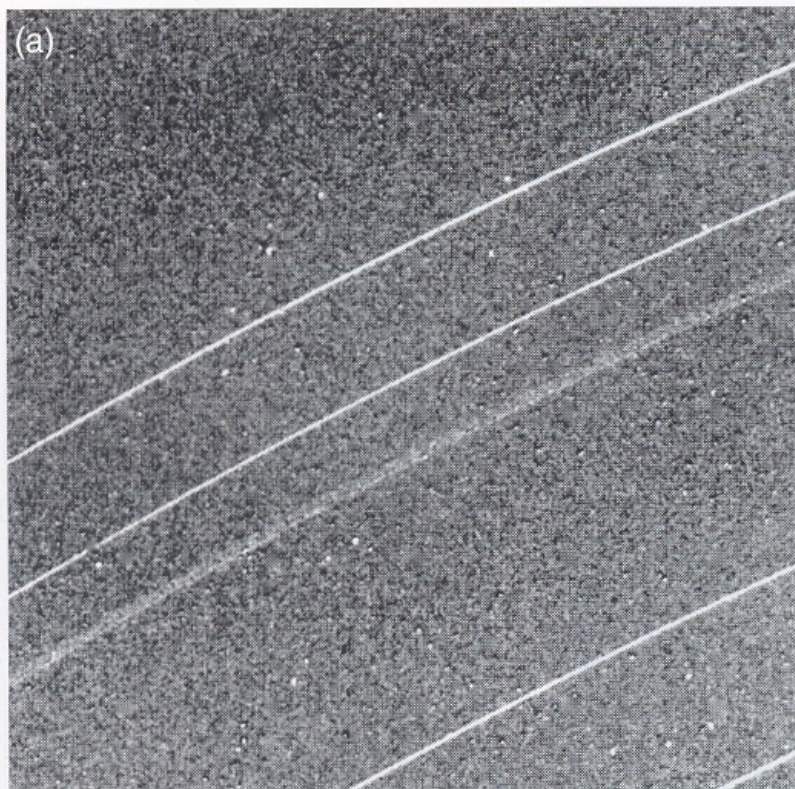
Nearside images :: The image on the left shows albedo, or the sunlight reflected from the surface of the moon. The image on the right shows where infrared light is absorbed by water and hydroxyl molecules, largely concentrated towards the lunar poles. The blue arrow indicates Goldschmidt crater, a large feldspar-rich region with a higher water and hydroxyl signature.

Ref.: Pieters et al., Science, Sept. 2009

NASA









# GREAT POST-SPACE AGE DISCOVERIES

- 1960 Quasar 3C 273,  $300 \times 10^6$  LY away ( $>100$  Milky Way luminosity)  
Upto 12-13 B LY. Gigantic young galaxies driven by giant black holes,  
several thousands detected so far
- 1961 Solar Wind – Magnetosphere
- 1962 X-ray Astronomy (10,000 Sun's energy, temp  $100 \times 10^6$  deg )  $>60,000$   
detected
- 1965 Cosmic  $\mu$  wave background (Penzias & Wilson).
- 1967 Pulsars (Sugar lump size weighing 100 m. tons), over 700 discovered
- 1968 Gamma-ray astronomy. Several thousands, x-ray bursts, gamma ray  
bursts
- 1988 First EXO-Planet ( $>350$  now)
- 1989 COBE
- 2001 Wilkinson  $\mu$  wave anisotropy Probe (WMAP)
- 2009 Ethyl Formate (raspberry or rum flavour) in Sagittarius dense region  
Many complex molecules discovered so far (amino acid not yet)

# MAJOR CHALLENGES IN ASTRONOMY

## A. Vision for Space Exploration (VSE)

Chandrayaan-2, Manned Mission

## B. Hunt for extraterrestrial life / intelligence, over 350 exo. planets and 4 planetary systems (Max. 5 planets) discovered since 1988

## C. Extension of human presence across solar system

- Return to the Moon and establish habitat on Moon
- Colonisation of Mars

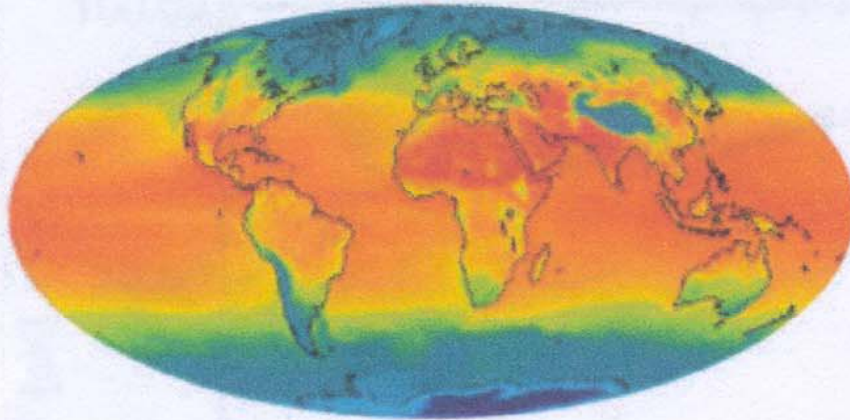
## D. Cosmology

- Big Bang (COBE)
- W.MAP (Wilkinson Microwave Anisotropy Probe)

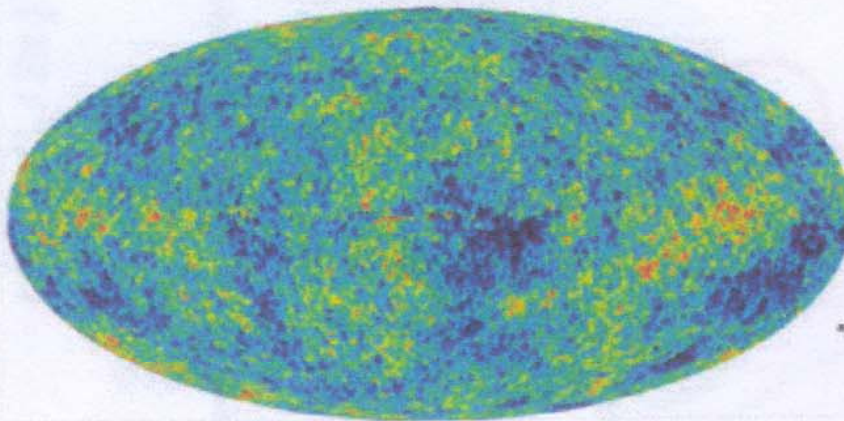
Shows face of God? Planck – HERCHEL? Launched 14 May 2009, L2 July 2010.

- GUT (Grand Unified Theory)

Space exploration & LHC (Large Hadron Collider) to enable us to read the mind of God ( $E = mc^2$ ) ?



**Earth  
Temperatures**



**Microwave Sky  
Temperatures**



The temperature variation on the Earth covers about  $100^{\circ}\text{C}$  while those measured by WMAP range only over about  $0.0004^{\circ}\text{C}$ , a smaller range by a factor of a quarter of a million.



There are more things in  
Heaven and Earth  
Than one dreamt of in our philosophy

—— Hamlet  
Shakespeare

There is “Plenty of room at the bottom”:  
But much more at the top  
Last 50 years of space exploration has been dramatic  
Next 50 years are going to be spectacular  
For those who dare to dream

“DARE TO DREAM”

**Thank You**