



इसरो ISRO



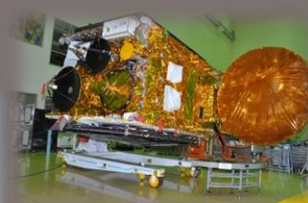
Highlights on Indian space science exploration programme

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Presentation to: 64th Session of UNCOPUOS

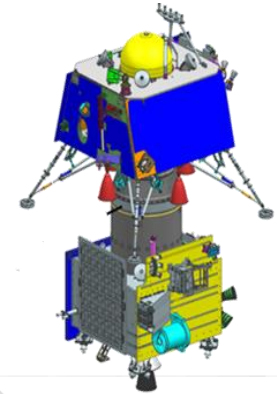
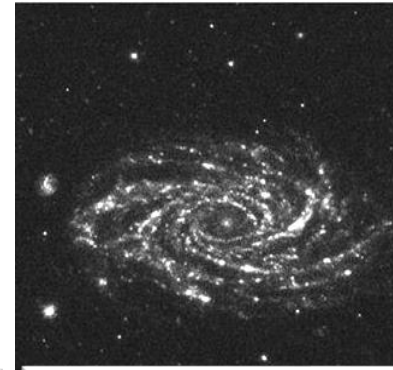
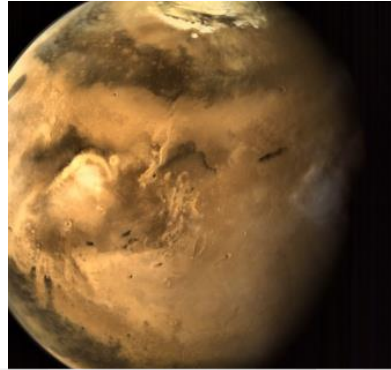
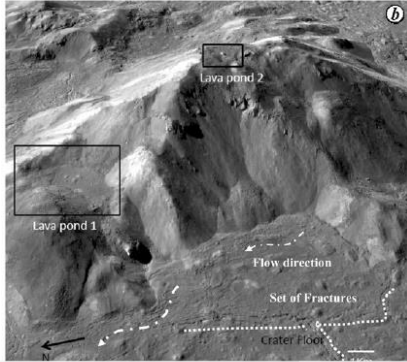
Indian Space Exploration



- Evolved to Planetary exploration and space observatory capabilities
- Chandrayaan-1,2 missions
 - Mars Orbiter Mission
 - Astrosat Mission
 - Several missions in approval phase

Started from Thumba Equatorial Rocket Launching Station (TERLS), Kerala, India in 1960s for upper atmosphere and ionospheric studies

India's Space Science Missions Till Date : A Bird's Eye View



Chandrayaan-1
Oct, 2008- Aug, 2009

Mars Orbiter Mission
Nov, 2013 - In-orbit

AstroSat
Sep 2015 - In-orbit

Chandrayaan-2
July 2019-in-orbit

The Science Data are available to public for scientific analysis

170+ publications

700+ Global users

Evidence of recent volcanism in Tycho crater

Discovered Water molecules of endogenic origin in addition to polar and exosphere

30+ publications

7000+ Global users

Found the cross-over of Oxygen domination in the evening side Martian exosphere

Detected Hot Argon in the Martian Exosphere

210+ publications

1600+ users

Crab Pulsar Polarization in OFF pulse state

Inputs to locate gravitational wave events, Solving the puzzle of a source simultaneously bright in IR and UV

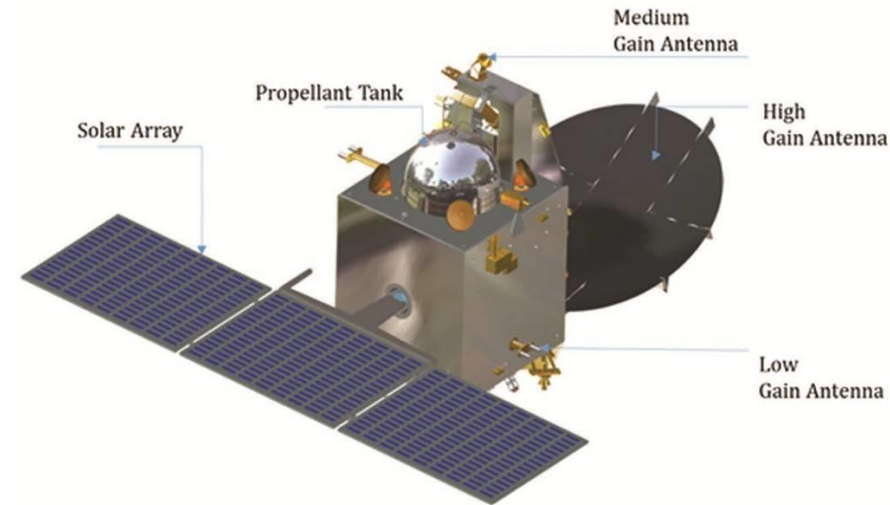
Orbiter-based remote-sensing and in-situ studies

Investigation of atmosphere, terrain, and mineralogy

Mars Orbiter Mission (MOM)

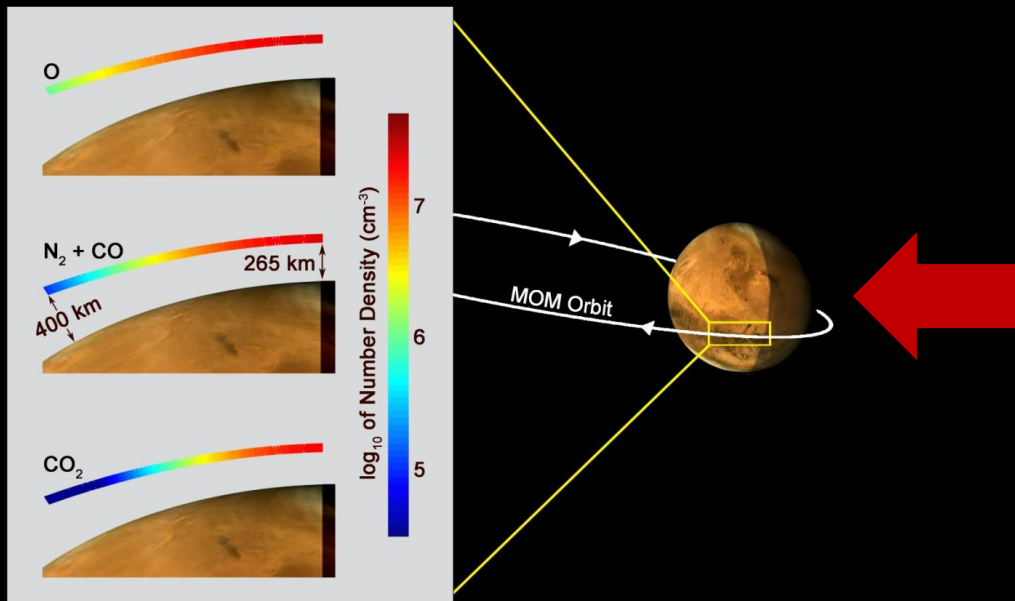
Science Domains

- Surface features, morphology,
- Mineralogy
- Exosphere



- 28 MOM data analysis projects funded by ISRO/DOS
- Scientific data is available in the ISSDC website
<https://mrbrowse.issdc.gov.in/MOMMLTA/>
- More than 300 international registered users from 50 countries for the MoM data
- More than 7000 registered users , Total no. of downloads: ~ 26,000, Downloaded more than 700 GB of data

The Martian Exosphere: Results from MENCA/MOM

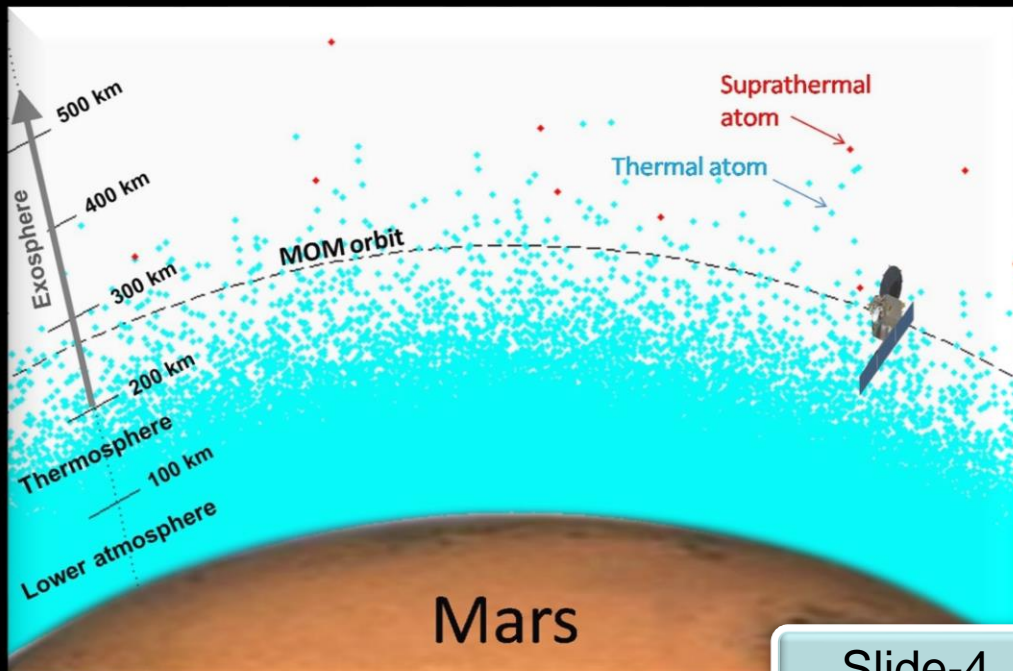


The first *in situ* Composition measurements of the Martian dusk sector.

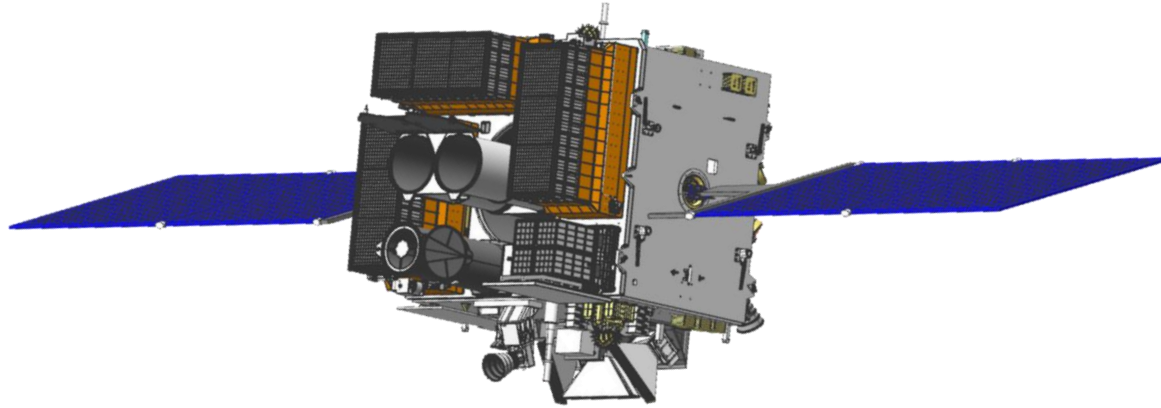
Major exospheric species : amu 44, amu 28, and amu 16.
Altitude region : 260 –375 km.
(Exosphere of Mars)

MENCA observed suprathermal Argon-40 in Mars exosphere....

- Important clue to understand the energy budget of exosphere of Mars
- Clue to understand the escape of atmosphere from Mars



AstroSat: India's Multi-wavelength Observatory in Space



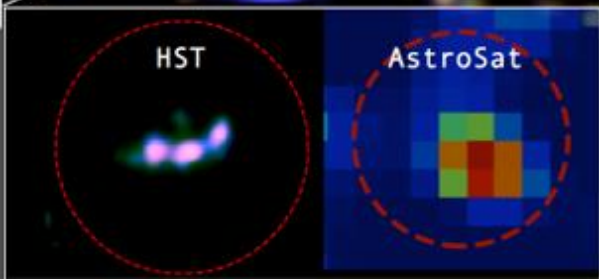
- Multi-wavelength space observatory
- First dedicated Astronomy satellite from ISRO
- Launched from Sriharikota on 28th sept 2015
- Operating as proposal based observatory

Scientific Payloads

- Ultra Violet Imaging Telescope (UVIT)
- Soft X-ray Telescope (SXT)
- Large Area X-ray Proportional Counters (LAXPCs)
- Cadmium Zinc Telluride Imager (CZTI)
- Scanning Sky Monitor (SSM)

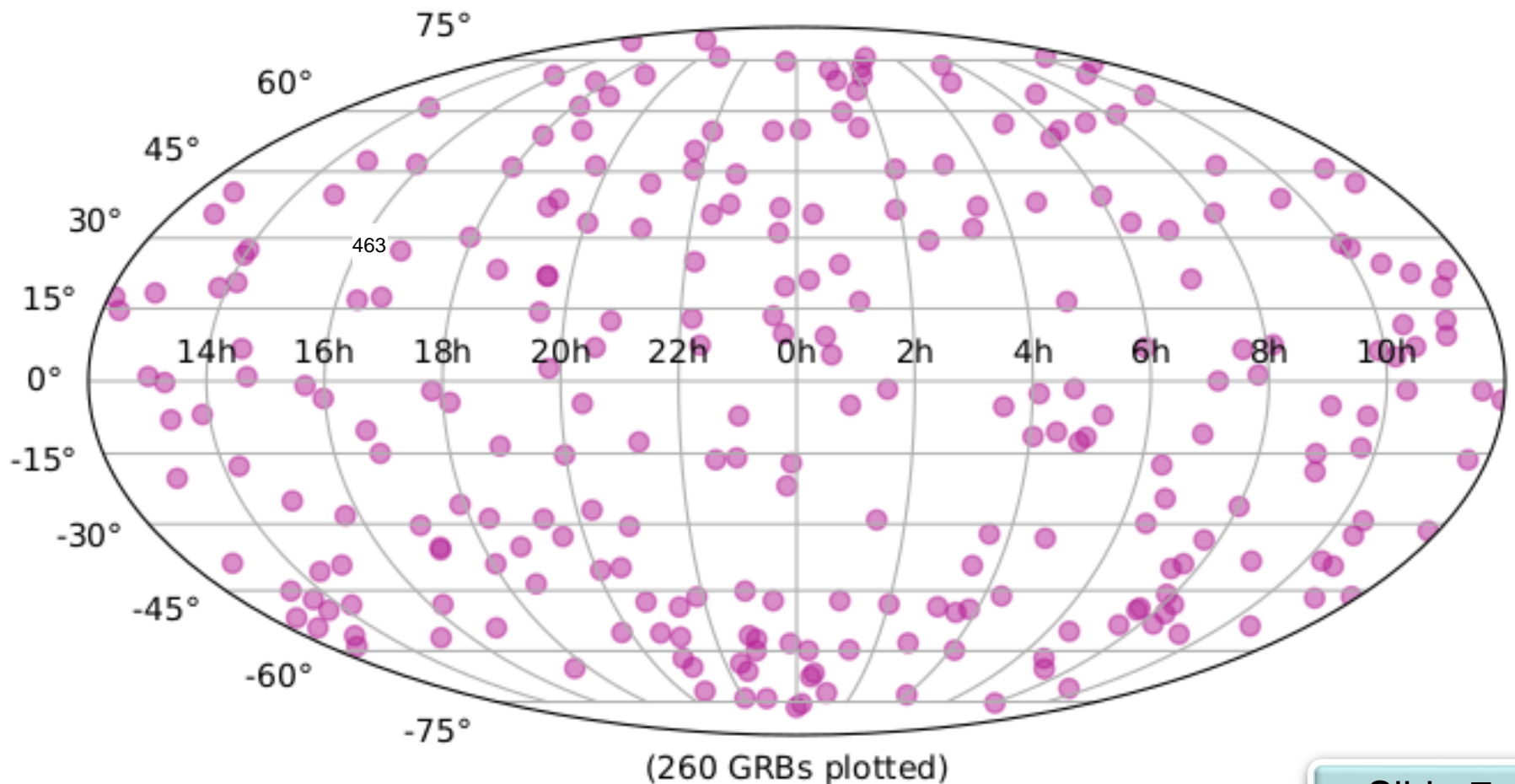
AstroSat: discovery of extreme Ultra-Violet light from earliest galaxies

- The object is at redshift of about 1.4 - far from the epoch of reionisation
- AUDFs01 in the redshift range 0.4 – 2.5 from which FUV photons were not detected till now

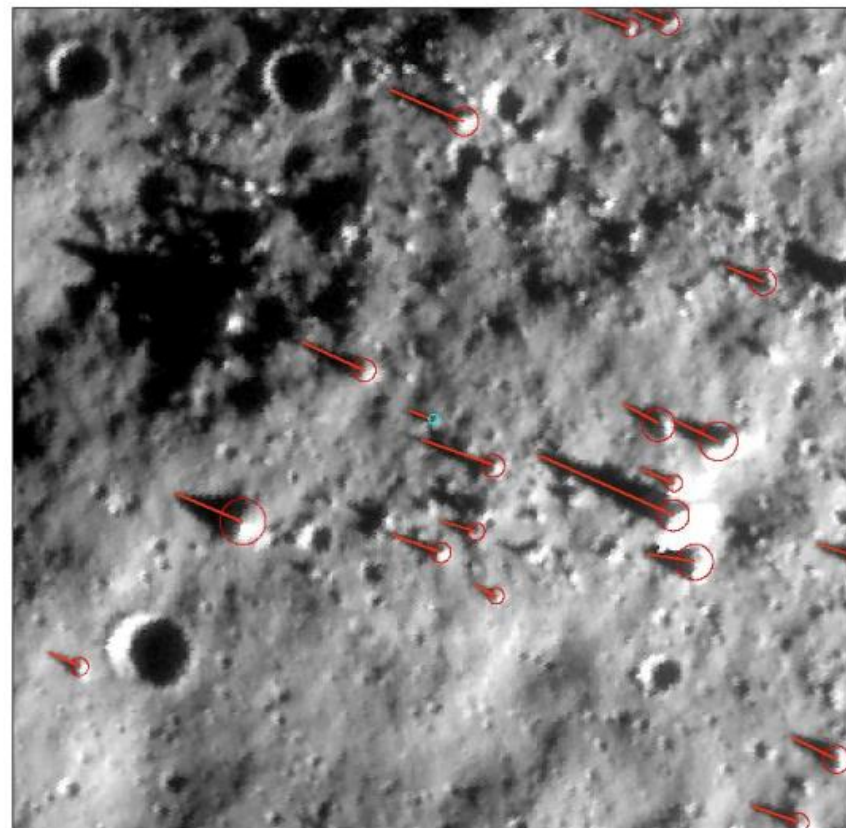
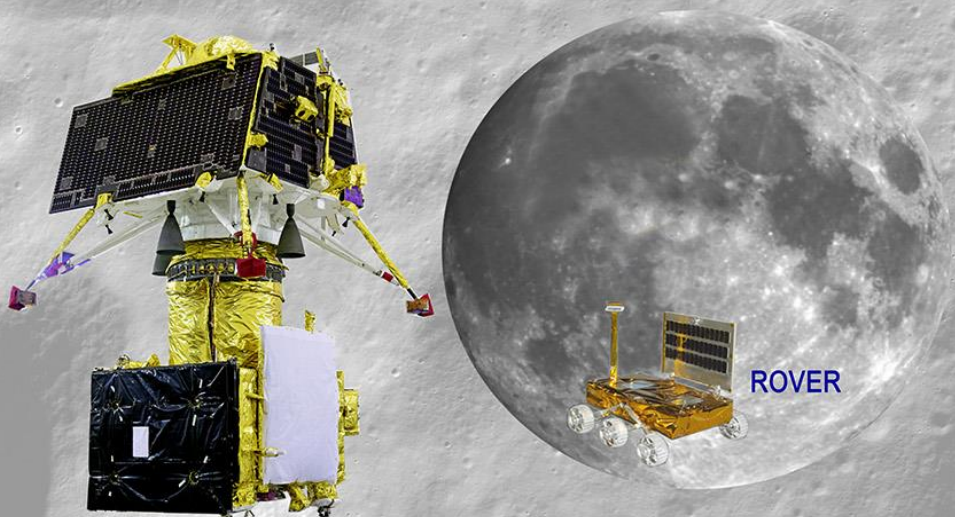


AstroSat: Gamma Ray Burst (GRB) observations by CZTI

AstroSat CZTI GRBs: 463 detected



CHANDRAYAAN-2



OHRC image of a fresh crater systems.

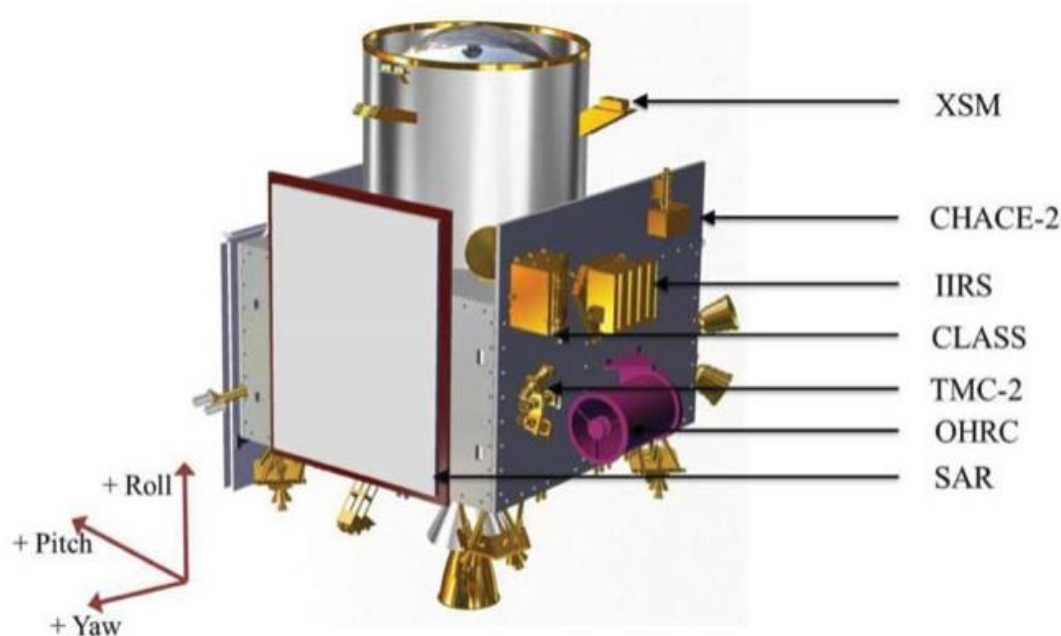
- Launched: 22nd of July 2019
- Chandrayaan-2 orbiter is studying the Moon from 100 km polar lunar orbit



Orbiter is in Science phase

- All the eight, state of the art payload instruments on Orbiter performing well
- Several new technologies demonstrated

Science from Chandrayaan-2



Science Domains

- Surface Mineralogy
- Elemental analysis
- Surface topography
- Neutral exosphere
- Ionosphere
- Lunar water-ice

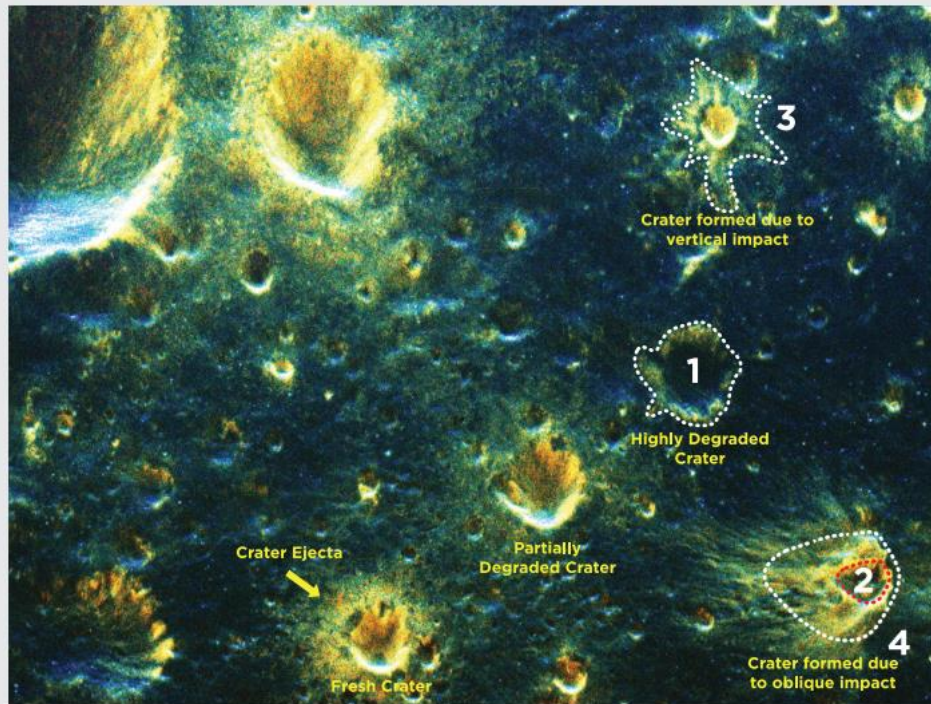
Scientific Payloads in Chandrayaan-2 Orbiter

- Chandrayaan-2 Large Area Soft X-Ray Spectrometer (CLASS)
- Solar X-Ray Monitor (SXM)
- Chandra's Atmospheric Composition Explorer-2 (CHACE-2)
- Dual Frequency Synthetic Aperture Radar (DFSAR)
- Imaging IR Spectrometer (IIRS)
- Terrain Mapping Camera-2 (TMC-2)
- Optical High Resolution Camera (OHRC)
- Dual Frequency Radio Science Experiment (DFRS)

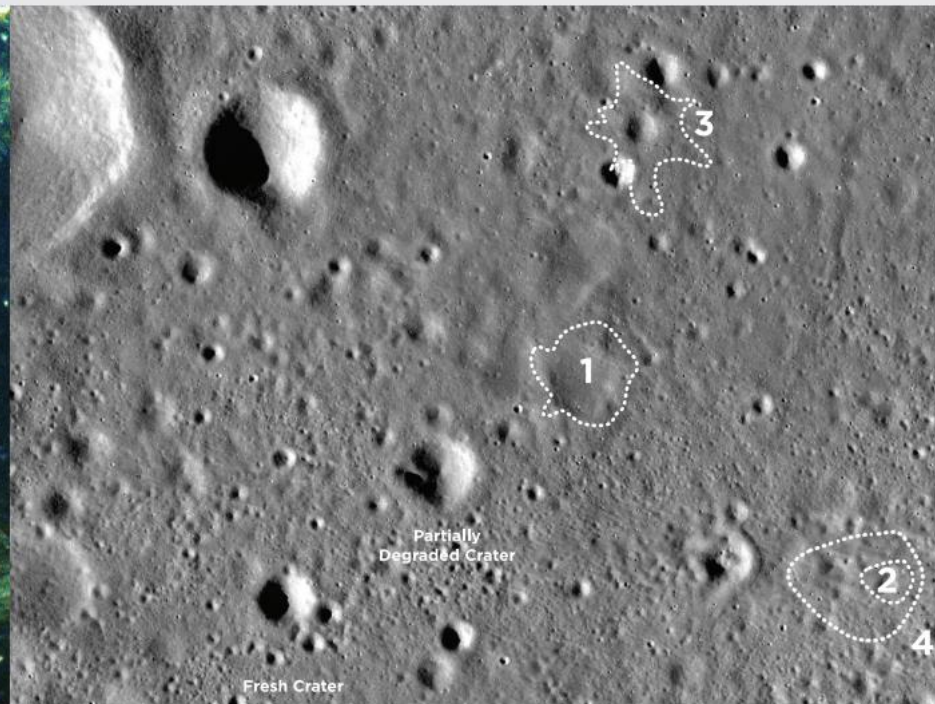
Chandrayaan-2: Sub-surface features of lunar craters

A

B



Radar image from Chandrayaan-2 (ISRO)

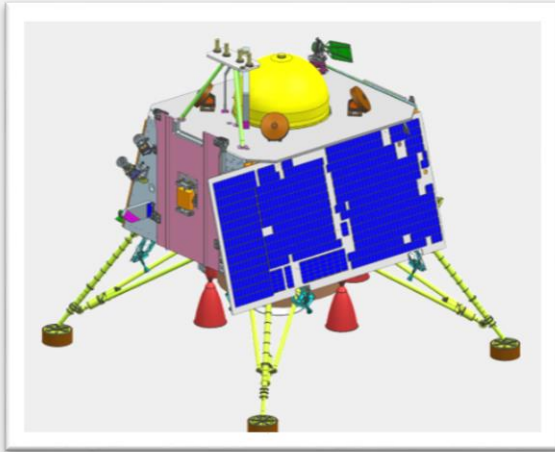


Optical image from LRO (NASA)

Chandrayaan-2 L-Band Synthetic Aperture Radar reveals craters hidden below the surface (1,2) and disturbed regions (3,4) hidden by powdery lunar soil

Future Missions ...

Chandrayaan-3



Lunar lander and rover;

- Payloads same as Chandrayaan-2 lander and rover
- Study of surface thermophysical properties, elemental composition of lunar surface, and lunar seismology.

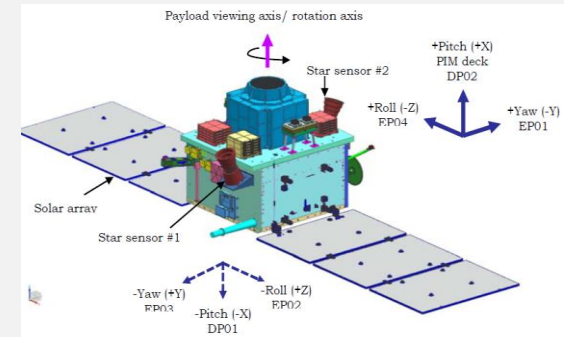
Aditya L1



Solar Observatory at the first Sun-Earth Lagrangian Point

- Seven science payloads
- Studies on solar corona, photosphere, solar wind and magnetic field

XPoSat



X-Ray Polarimeter Satellite to study the polarization of the cosmic X-Rays

Two payloads:

- POLIX: Polarimeter Instrument in X-rays
- XSPECT: X-ray Spectroscopy and Timing

LUPEX: Bilateral Co-operation between ISRO and JAXA on Lunar Polar Exploration

Lunar polar regions are the repositories of the volatiles → Clues of the early solar system and formation of the Moon

Launcher

JAXA

Lander

India

Rover

JAXA

Landing at Lunar south pole.
~ 400 kg Rover with ~70 kg for science payloads

Mission duration: 3 months

Drilling up to 1.5 m at stop points;
Drilled samples from the lunar pole to be studied.

Venus Orbiter Mission: AO for payloads from International Community



- **Science Objectives**

- To understand surface topography
- To study composition, circulation and evolution of atmosphere
- To understand interaction with the solar wind with atmosphere/ionosphere

❖ Recommended Payloads include collaborative contributions from Russia, France, Sweden, Germany

A pair of hands is shown in a prayer or thanksgiving gesture, with the palms pressed together and fingers pointing upwards. The hands are positioned centrally against a solid black background. The lighting highlights the texture of the skin and the creases on the palms. The overall composition is simple and focused on the gesture of gratitude.

Thank You for Your Kind Attention