






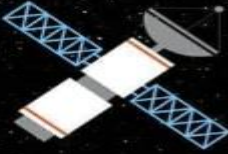
## ISRO MISSIONS: SCIENCE & TECHNOLOGY

**NEWS:** New rocket, plus moon and Venus missions, herald new beginnings

### WHAT'S IN THE NEWS?

The Indian government has approved various new projects in space exploration, enhancing India's role in lunar, planetary, and satellite missions. These projects include the development of a new rocket, missions to the Moon and Venus, and upcoming satellite launches like NISAR and Proba-3. The private sector is also contributing with satellite development and green propulsion technology.

### UPCOMING MISSIONS OF ISRO

- 1. Chandrayaan-3 (2021) :**  
*Mission repeat of Chandrayaan-2 with lander, rover and a propulsion module to attempt soft landing of Lunar surface.*  

- 2. Gaganyaan (2021) :**  
*Gaganyaan ("Orbital Vehicle") is an Indian crewed orbital spacecraft (jointly made by ISRO and HAL) intended to be the basis of the Indian Human Spaceflight Programme.*  

- 3. Aditya-L1 (2022) :**  
*Aditya-L1 is the first Indian Solar Coronagraph spacecraft mission to study solar corona in visible and near IR bands.*  

- 4. NISAR (2022) :**  
*NASA-ISRO Synthetic Aperture Radar (NISAR) is a joint project between NASA and ISRO to co-develop and launch a dual-frequency synthetic aperture radar satellite to be used for remote sensing.*  


### Recent and Upcoming ISRO Missions

#### Gaganyaan Human Spaceflight Programme:

- **Goal:** India's first crewed space mission for human spaceflight capability.
- **Components:** Includes two uncrewed and one crewed Low Earth Orbit (LEO) missions.
- **Funding:** ₹11,170 crore for an additional uncrewed flight (total four missions).



- **Timeline:** Crewed flight expected by 2025.

## Bharatiya Antariksh Station 1 (India's Space Station):

- **Objective:** First Indian space station for space science research.
- **Plan:** Four missions to test key technologies.
- **Budget:** ₹11,170 crore.
- **Timeline:** Completion expected by 2028.

## Next Generation Launch Vehicle (NGLV):

- **Purpose:** New rocket to replace PSLV and GSLV, supporting diverse missions.
- **Funding:** ₹8,240 crore, covering three test flights.
- **Industry:** ISRO and private sector collaboration.
- **Significance:** Enhances India's space launch capabilities.

**'Next Generation Launch Vehicle' Development**

91m

NGLV NGLV-H

- Partially reusable, cost effective, commercially viable launch vehicle to achieve the goals defined in the expanded vision of the Indian space program.
- For operating the Bharatiya Antariksh Station missions and for the first time, Landing on Moon by 2040.
- Boost the Indian space ecosystem in terms of capacity for commercial missions in operational phase.
- Development with maximal industry participation in development and production.

**Salient Features**

- LEO: 30 ton
- GTO: 12 ton
- 5m Diameter
- 1094 ton Lift-off mass
- 2 Variants
- Maximum Payload capability of 30 ton to Low Earth Orbit (LEO)
- 3-stage vehicle with Liquid Oxygen-Methane & Cryo propulsion
- Reusable Booster stage with clustered engines
- 3X payload capability at 1.5X cost compared to LVM3
- Scalable configuration to support future crewed lunar missions

<b>Scope</b>	: Technology Development & Three development flights
<b>Total Cost</b>	: Rs 8239 Cr
<b>Schedule</b>	: 96 Months (First flight in 84 months)

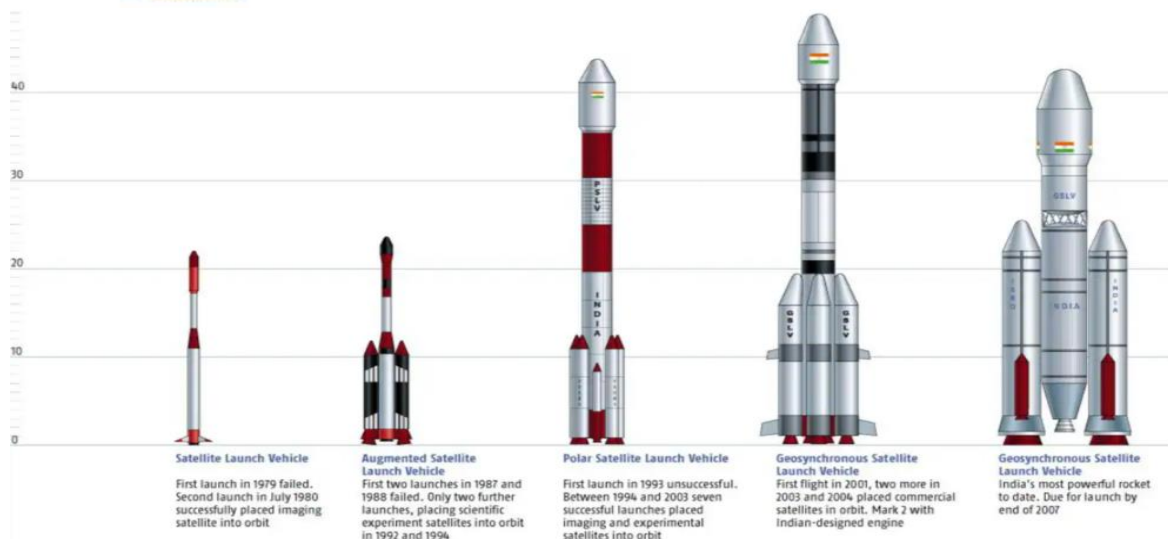
## PSLV by Private Sector:

- **Objective:** First PSLV fully developed by Hindustan Aeronautics Ltd. and Larsen & Toubro.
- **Launch:** By end of 2024 or early 2025.
- **Significance:** Shift to industry-driven launch capabilities.



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## Chandrayaan-4 Moon Mission:

- **Type:** Lunar sample-return mission.
- **Launch Vehicle:** Components on LVM-3, docked in Earth orbit.
- **Landing:** Near Chandrayaan-3 site for sample collection.
- **Budget/Timeline:** ₹2,104 crore; launch by 2027.

**CHANDRAYAAN 4**

**INDIA'S FIRST LUNAR SAMPLE RETURN MISSION**

**LANDING SITE:**

- Near Shiv-Shakti point of Chandrayaan 3

**LAUNCHERS:**

- LVM3 : For direct injection of AM+DM+PM to TLI/GTO
- PSLV : For injection of RM+TM together to Sub-GTO

**MISSION LIFE:**

- 1 Lunar Day

**FOUR MODULES:**

- Transfer Module (TM), Reentry module (RM), Lander Module (LM), Ascender Module (AM)

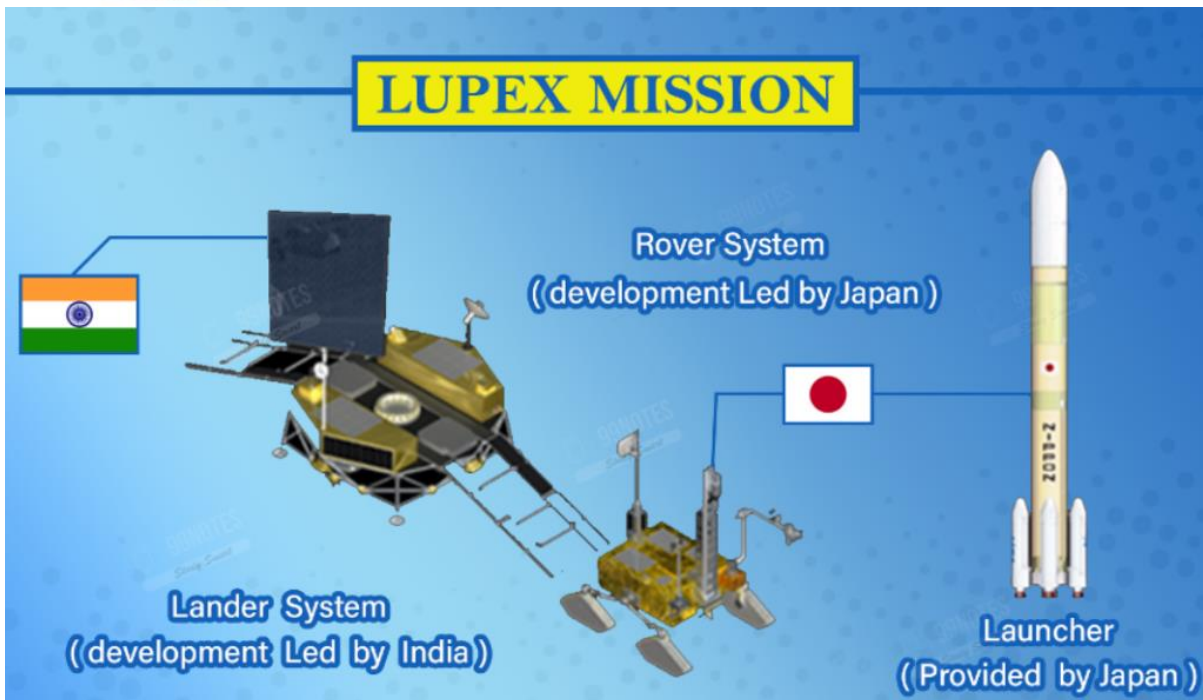
**MISSION STRATEGY:**

- RM+TM will be parked in Lunar Orbit favourable for Ascender docking
- AM+DM will descend to lunar surface
- Robotic Arm in DM for sample collection & transfer to AM
- AM-DM separation and AM lift off from lunar surface
- AM docking with TM
- Robotic Arm in TM for transfer of lunar samples -- AM to RM
- AM undocking from TM, RM+TM reaching earth orbit
- RM-TM separation, RM re-entry and touch down on Earth

**Labels in diagram:** ASCENDER MODULE, DESCENDER MODULE, PROPULSION MODULE, RE-ENTRY MODULE, TRANSFER MODULE

## Lunar Polar Exploration Mission (LUPEX) with Japan:

- **Goal:** Joint exploration of lunar poles.
- **ISRO Role:** New lander with potential for future crewed missions.
- **Focus:** Lunar south pole region.



## Venus Orbiter Mission:

- **Objective:** Study Venus's atmosphere and surface.
- **Timeline:** Launch in March 2028.
- **Budget:** ₹1,236 crore.

### Venus Orbiter Mission



- India's first interplanetary mission to the orbit of planet Venus sister planet.
- Unique instruments for new science data generation and opportunities on study of Venusian atmosphere, geological evolution for the Indian Science community.
- Technologies for future inter-planetary missions, optimal orbit insertion approaches
- Scheduled during March 2028 launch opportunity, which is the closest approach.

**Salient Features**

- Indian Science instruments to study the Venusian surface and subsurface, atmospheric processes and influence of Sun on Venusian Atmosphere
- To study the underlying causes of transformation of Venus, which is believed to be once habitable and quite similar to Earth

<b>Scope</b>	<b>: Development of Technologies &amp; Mission accomplishment</b>
<b>Total Project Cost</b>	<b>: Rs 1236 Cr</b>
<b>Schedule</b>	<b>: March 2028 launch</b>

**Scientific Studies**

- Surface topography
- Venusian dust, Venusian clouds, Lightning
- Volcanism
- Atmosphere, ionosphere & solar forcing
- Sun-Venus Interaction

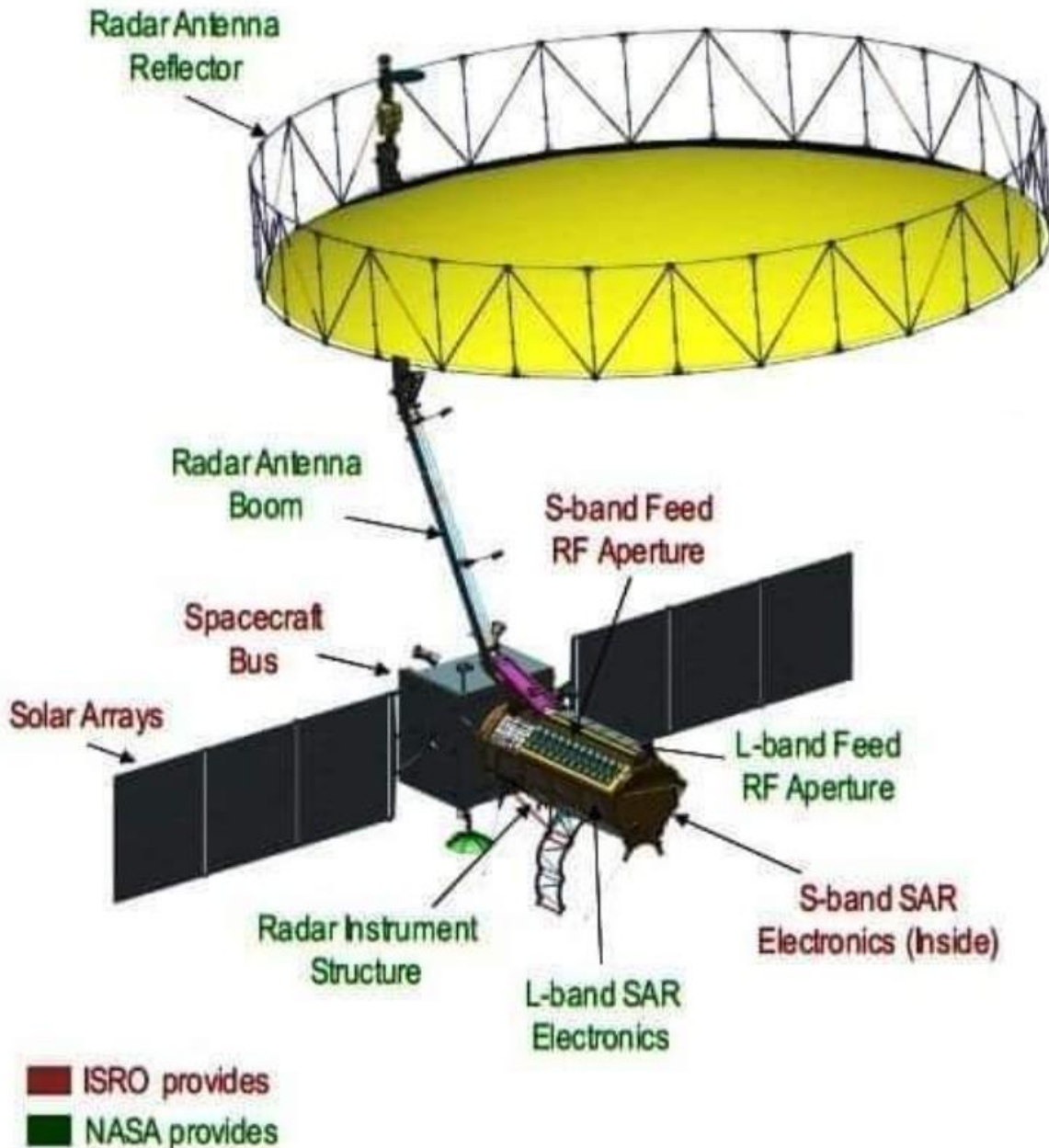
## Space Based Surveillance (SBS-3):

- **Scope:** Third phase in space surveillance.
- **Components:** 21 ISRO satellites and 31 from private sector.
- **Budget:** ₹26,968 crore.
- **Purpose:** Enhances defense and environmental monitoring.



## NISAR (NASA-ISRO Synthetic Aperture Radar):

- **Purpose:** Joint Earth observation for land and ice monitoring.
- **Challenges:** Additional thermal protection needed.
- **Timeline:** Launch via GSLV in early 2025.



## Proba-3 (ESA Mission):

- **Objective:** Sun corona study with simulated eclipse.
- **Timeline:** Launch on November 29 using PSLV-XL.



## PROBA-3: FORMATION FLYING DOUBLE SATELLITES

Proba-3 is ESA's – and the world's – first precision formation flying mission. A pair of satellites will adopt a fixed configuration in space, 144 m apart while lined up with the Sun so that one satellite blocks out the brilliant solar disk for the other. This will open up continuous views of the Sun's faint corona, or surrounding atmosphere, for scientific observation.

The cost in fuel would be too high to maintain formation continuously, so each orbit will be divided between six hours of actively controlled formation flying manoeuvres at apogee and the rest of the orbit in a passive safe trajectory.

Proba-3 will function as an orbital laboratory, demonstrating acquisition, rendezvous, proximity operations, formation flying, separation from 25 m to 250 m apart, while validating innovative metrology sensors and control algorithms, opening up novel methods of mission control.



### Astrosat:

- **Description:** India's first multi-wavelength observatory (launched in 2015).
- **Achievements:** Data for 400+ research papers; operational beyond mission life.
- **Current Status:** Expected to continue for two more years.

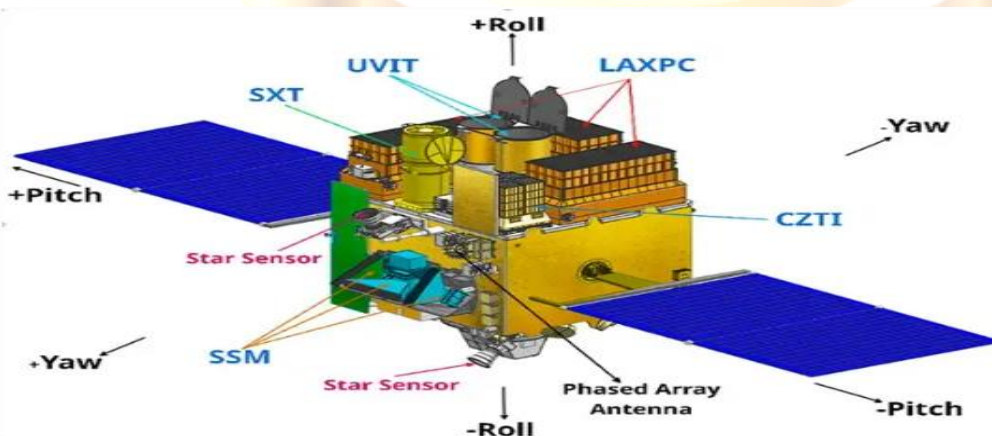


Fig: Image showing AstroSat spacecraft with various payloads.



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