# PSLV-C30 / ASTROSAT Mission

28 September, 2015

## THE MISSION

PSLV-C30 carrying on-board the ASTROSAT Satellite lifted-off from the Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota on September 28, 2015. ASTROSAT and six other satellites from International Customers were launched into a 650 km orbit inclined at an angle of $6^0$ to the Equator by PSLV-C30. The co-passengers of this flight included LAPAN-A2 from Indonesia, NLS-14 (Ev9) from Canada and 4 identical LEMUR satellites from USA.

ASTROSAT is India's first dedicated Multi-wavelength Space Observatory. The scientific satellite mission endeavours for a more detailed understanding of our Universe. One of the unique features of ASTROSAT mission is that it enables the simultaneous multi-wavelength observations of various astronomical objects with a single satellite.

This satellite will observe the Universe in the optical, ultraviolet, low and high energy X-ray regions of the electromagnetic spectrum, whereas most other scientific satellites are capable of observing a narrow range of wavelength band. Multi-wavelength observations of ASTROSAT can be further extended with co-ordinated observations using other spacecraft and ground based observations. All major astronomy institutions and some universities in India will participate in these observations.

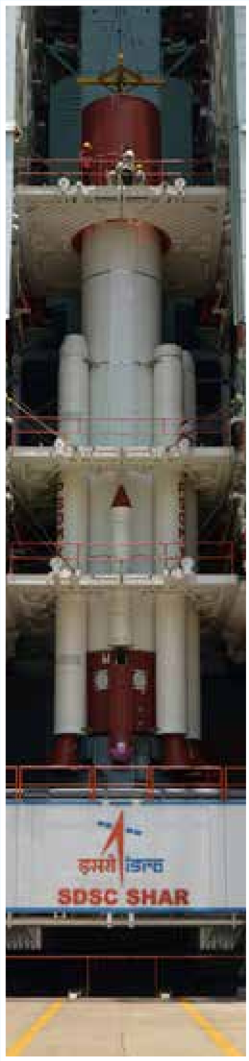
## PSLV-C30

### THE LAUNCH VEHICLE

PSLV-C30 was in its 31st flight for this mission.
The 'XL' variant was used.

### SPECIFICATIONS

| | | |
|---|---|---|
| **Height** | 44.4 m | |
| **Lift-Off Mass** | 320.2 t | |
| **No of Stages** | 4 | |
| **Payloads** | ASTROSAT | **6 INTERNATIONAL CUSTOMER SATELLITES**<br>Indonesia (1), Canada (1), USA (4) |
| **Orbit Height** | 650 km | |
| **Inclination (deg)** | $6^0$ | |
| **Launch Pad** | First Launch Pad (SDSC, SHAR) | |




| STAGE CHARACTERISTICS | | | | |
|---|---|---|---|---|
| | **Stage-1** | **Stage-2** | **Stage-3** | **Stage-4** |
| **Nomenclature** | Core Stage PS1 + 6 Strap-on Motors | PS2 | PS3 | PS4 |
| **Propellant** | Solid (HTPB based) | Liquid (UH25 + $N_2O_4$) | Solid (HTPB based) | Liquid (MMH + MON-3) |
| **Propellant Mass (T)** | 138.2 (Core), 6 x 12.2 (Strap-on) | 41.35 | 7.6 | 1.6 |
| **Stage Dia (m)** | 2.8 (Core), 1 (Strap-on) | 2.8 | 2.0 | 34 |
| **Stage Length (m)** | 20 (Core), 12 (Strap-on) | 12.8 | 3.6 | 3.0 |

# ASTROSAT

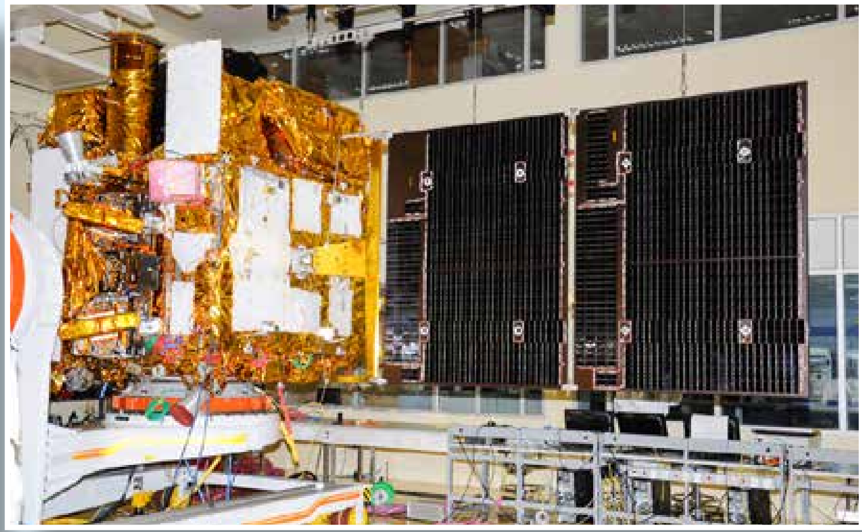
## THE SATELLITE

The cuboid shaped ASTROSAT has two solar arrays consisting of Triple Junction Solar Cells that generate 2100 W of electrical power. Sun and Star sensors as well as gyroscopes provide orientation reference for the satellite. Special thermal control schemes have been designed and implemented for some of the critical payload elements. The Attitude and Orbit Control System (AOCS) of ASTROSAT very accurately maintains the satellite's orientation with the help of reaction wheels, magnetic torquers and thrusters.

Though most of ISRO satellite missions are application oriented, the remaining ones are scientific in nature. The scientific objectives of ASTROSAT missions are:

- To understand high energy processes in binary star systems containing neutron stars and black holes
- Estimate magnetic fields of neutron stars
- Study star birth regions and high energy processes in star systems lying beyond our galaxy
- Detect new briefly bright X-ray sources in the sky
- Perform a limited deep field survey of the Universe in Ultraviolet region

The five payloads of ASTROSAT are chosen to facilitate a deeper insight into the various astrophysical processes occurring in the various types of astronomical objects constituting our universe. These payloads rely on the visible, Ultraviolet and X-rays coming from distant celestial sources.



1. **Ultraviolet Imaging Telescope (UVIT)** is capable of observing the sky in the visible, near Ultraviolet and far Ultraviolet regions of the electromagnetic spectrum. The two telescopes of the UVIT payload are designed to achieve an excellent image resolution and they also have a large field of view.

2. **Large Area X-ray Proportional Counter (LAXPC)** is the second payload of ASTROSAT, which is designed to study the variations in the emission of X-rays from sources like X-ray binaries, Active Galactic Nuclei and other cosmic sources. It can make measurements of spectral characteristics of different classes of X-ray sources over a wide spectral range of 3 - 80 kilo electron Volts (keV). LAXPC has nearly five times more effective area for collecting X-ray photons with energy beyond 25 keV compared to other similar scientific satellite mission.

3. **Soft X-ray Telescope (SXT)** is designed for studying X-ray spectrum of 0.3 - 8 keV range coming from distant celestial bodies that varies with time. Such studies help in understanding the characteristics of the bodies which emitted this particular types of X-rays. This payload has a 2 meter focal length telescope with thin conical foil gold coated aluminium foil mirrors for reflecting the X-rays that are incident at a very shallow angle. The focal plane camera of this instrument has a cooled Charge Coupled Device.

4. **Cadmium Zinc Telluride Imager (CZTI)** is yet another payload functioning in the X-ray region, extends the capability of the satellite to sense X-rays of high energy 10 - 100 keV range. Thus, apart from supplementing the spectral studies afforded by the LAXPC, CZTI payload may also be able to detect gamma ray bursts and study their characteristics.

5. **Scanning Sky Monitor (SSM)** is an instrument which is intended to scan the sky for long term monitoring of bright X-ray sources in binary stars, and for the detection and locations of sources that become bright in X-rays for a short duration of time. Such transient sources of X-rays will then be studies in detail by other instruments on ASTROSAT.

In addition, there is a Charged Particle Monitor (CPM) which is a Scintillator Photodiode Detector (SPD) with a Charge Sensitive Preamplifier for detecting charged particles. Even though the orbital inclination of the satellite will be $6^0$ or less, in about 2/3rd of the orbits the satellite will spend a considerable time (15 - 20 minutes) in the South Atlantic Anomaly (SAA) region which has high fluxes of low energy protons and electrons. The high voltage will be lowered or put off using data from CPM when the satellite enters the SAA region to prevent damage to the detectors as well as to minimize ageing effect in the Proportional Counters.

## SPECIFICATIONS

| | |
|---|---|
| **Weight** | 1513 kg |
| **Power** | 2100 W, two Li-Ion batteries of 36 Ampere-Hour capacity each |
| **Stabilisation** | Zero momentum system, orientation input from Sun & Star Sensors and Gyroscopes; Reaction wheels, Magnetic Torquers and 11 Newton thrusters as actuators |
| **Propulsion** | Eight 11 Newton Hydrazine based Monopropellant Thrusters |
| **Antenna** | Phased Array Antenna (PAA)<br>TC (Uplink) – 2067.897 MHz<br>TM (Downlink)- 2245 MHz |
| **Type of Satellite** | Science and Exploration |
| **Payloads** | • Ultra Violet Imaging Telescope (UVIT)<br>• Cadmium Zinc Telluride Imager (CZTI)<br>• Scanning Sky Monitor (SSM)<br>• Soft X-ray Telescope (SXT)<br>• Large Area X-Ray Proportional Counter (LAXPC) |
| **Mission Life** | 5 Years |

# THE INTERNATIONAL CUSTOMER SATELLITES

| Satellite | No. of Satellite | Country | Mission Objectives |
|---|---|---|---|
| **LAPAN-A2** | 1 | Indonesia | A Microsatellite from National Institute of Aeronautics and Space-LAPAN. It is meant for providing maritime surveillance using Automatic Identification System (AIS), supporting Indonesian radio amateur communities for disaster mitigation and carrying out Earth surveillance using video and digital camera. |
| **NLS-14 (Ev9)** | 1 | Canada | A Nanosatellite from Space Flight Laboratory, University of Toronto Institute for Advanced Studies (SFL, UTIAS), Canada. It is a maritime monitoring Nanosatellite using the next generation Automatic Identification System (AIS). |
| **LEMUR** | 4 | USA | They are non-visual Remote Sensing Satellites, focusing primarily on global maritime intelligence through vessel tracking via the Automatic Identification System (AIS), and high fidelity weather forecasting using GPS Radio Occultation Technology. |