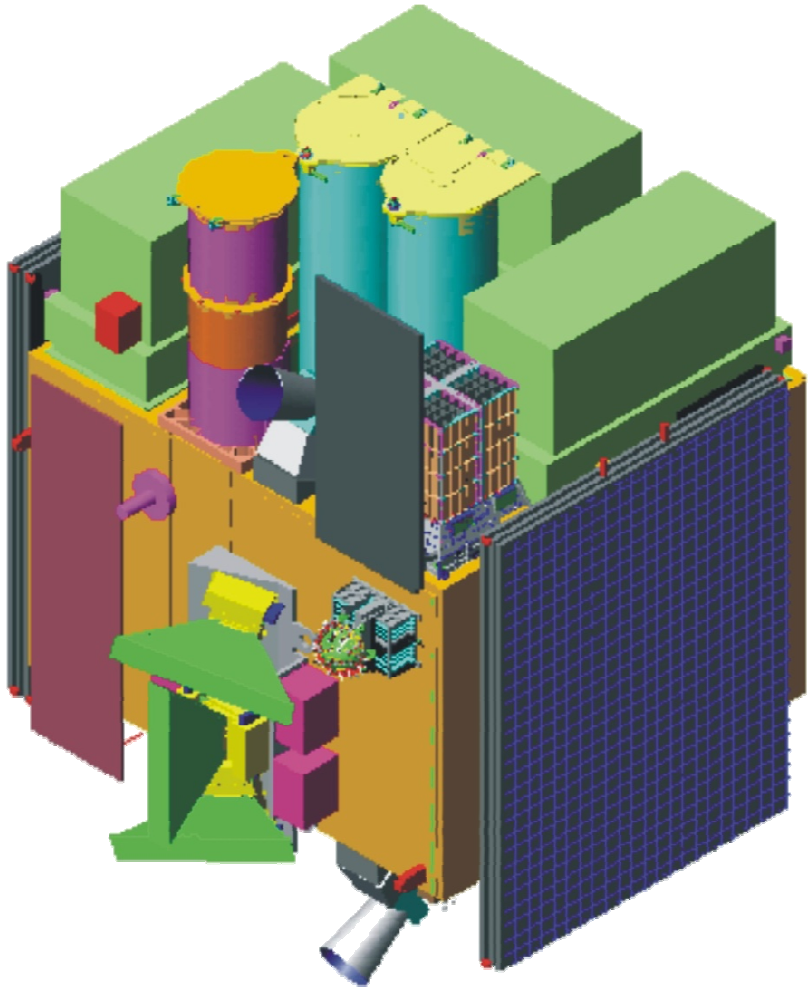
ASTROSAT

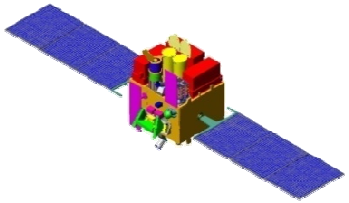


Presentation
by
Indian Delegation

to
49th STSC UNCOPUOS

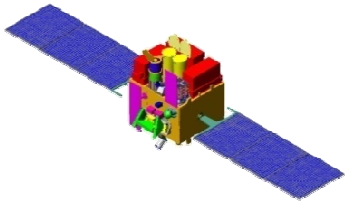
February 2012
Vienna

ASTROSAT



- Astrosat is India's first dedicated multi-wavelength astronomy satellite with a capability to observe target sources in wide spectral coverage extending over visible, ultraviolet, soft x-ray and hard x-ray regions with co-aligned instruments simultaneously.
- The Instruments onboard Astrosat provide timing, spectral, Imaging and survey of different X-ray sources

SCIENCE OBJECTIVES



a. Multi-wavelength observations:

- ASTROSAT mission is designed for multi-wavelength astronomy for a wide variety of both Galactic and extra-galactic source types (AGN, binaries, flaring stars, SNRs, clusters...)

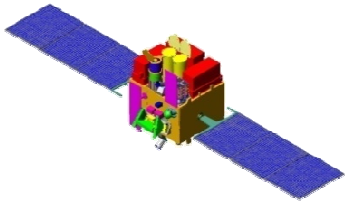
b. Broad band X-ray spectral measurements

- **-** Emission and absorption features with medium energy resolution capability in the
- 0.3 – 100 keV spectral band with 3 co-aligned X-ray instruments
- -Study both non-thermal and thermal components, reflection etc.

c . High time-resolution studies :

- -Periodic, aperiodic and chaotic X-ray variability in X-ray binaries
- - Detect new accreting milli-sec binaries and AXPs
- - Study evolution of pulse and orbital periods.

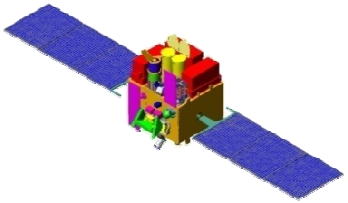
ORBIT CHOICE

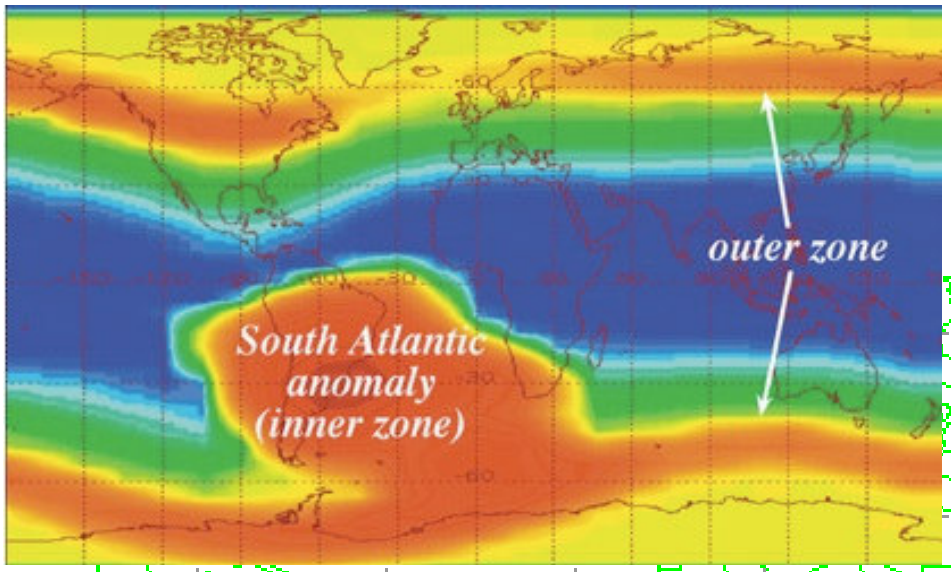


- Back ground radiation
  - Photon background
  - Charged particles
  - Minimum SAA transit
- Sky coverage
- Residual atmosphere
  - Drag –mission life
  - Atomic oxygen
- Communication –TTC and Data links /visibilities
- Launch capability

» ASTROSAT – LEO and low inclination
650Km,8deg inclination

SAA Impact





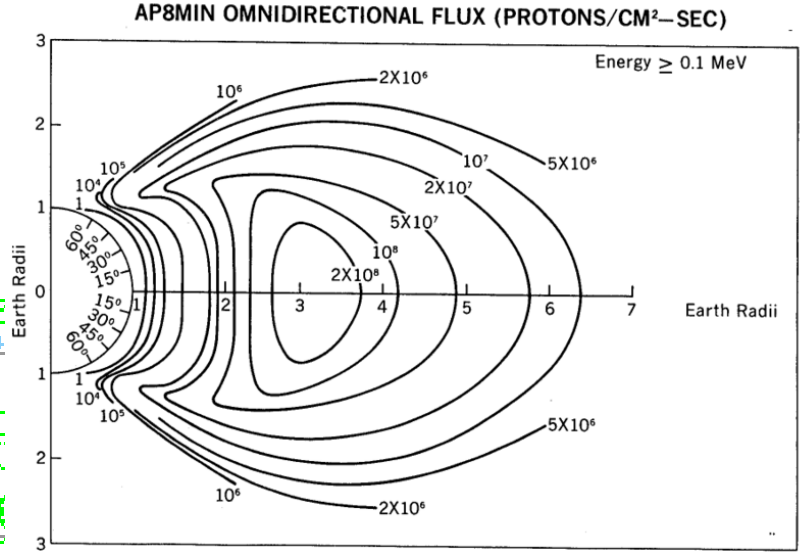
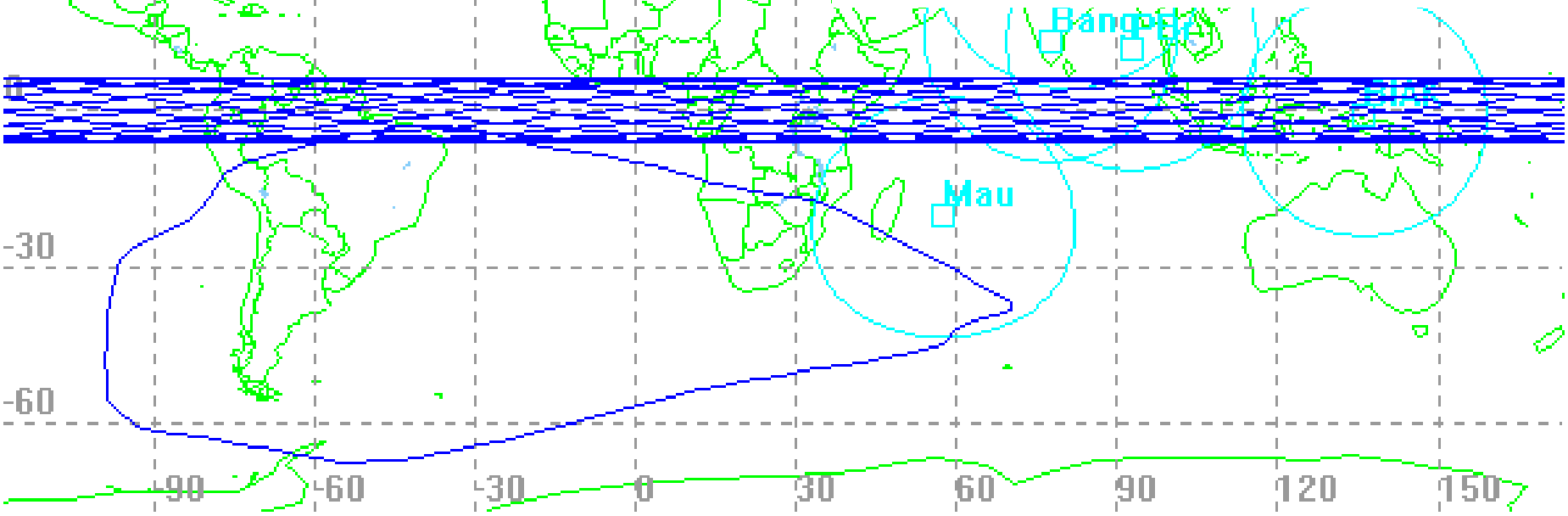
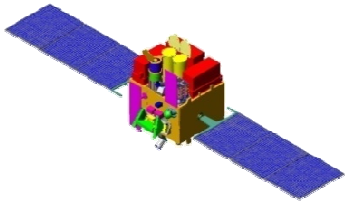


Figure 65. AP8MIN R-λ Plot of Constant Intensity Flux Contours with an Energy of ≥ 0.1 MeV

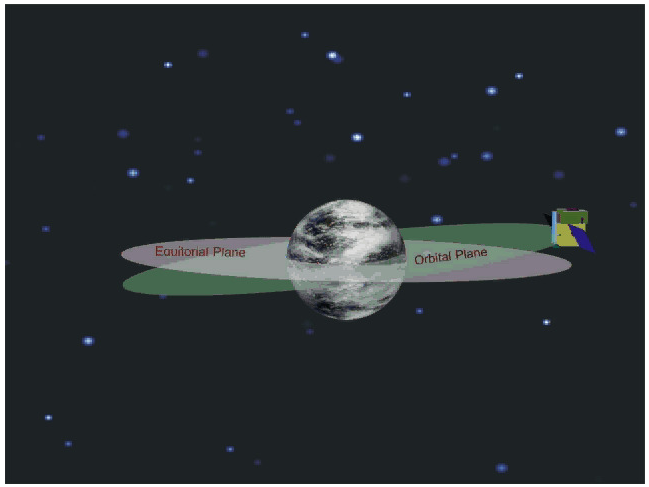


MISSION

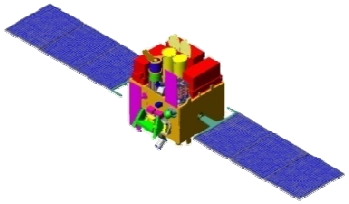


- Altitude : 650 km
- Inclination : 8 deg.
- Mass of 1530 kg. (855 kg. Payloads)
- Power requirement of 940 watts
- PSLV launch from India
- Launch by End of 2012
- Operational life of minimum 5 years
- Ground Stations :
  - ISTRAC TTC Network –TTC

    10 orbits visability over Bangalore station
  - Bangalore Station –ISSDC for Payload data

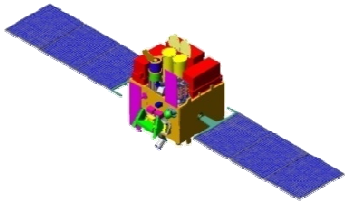


SPACECRAFT



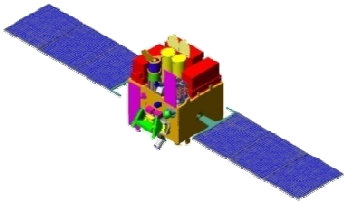
- 2 KW High Power generation to support payloads all time
- Three axis stabilized inertial pointing. Re-orientation for new target observations.
- Thermal control to meet varying orientations and stringent control of payload elements.
- 160 Gb solid state recorder and 210 Mb/sec data transmission
- Bus management unit. Special control algorithms to compensate attitude disturbance during SSM motion and sun avoidance during re-targeting.
- Star sensor and gyros for attitude control to realize 0.05 deg pointing and 0.2 arc sec/sec drift
- Magnetic torquers for momentum dumping
- Satellite Positioning System for orbit and time data
- Contamination Control

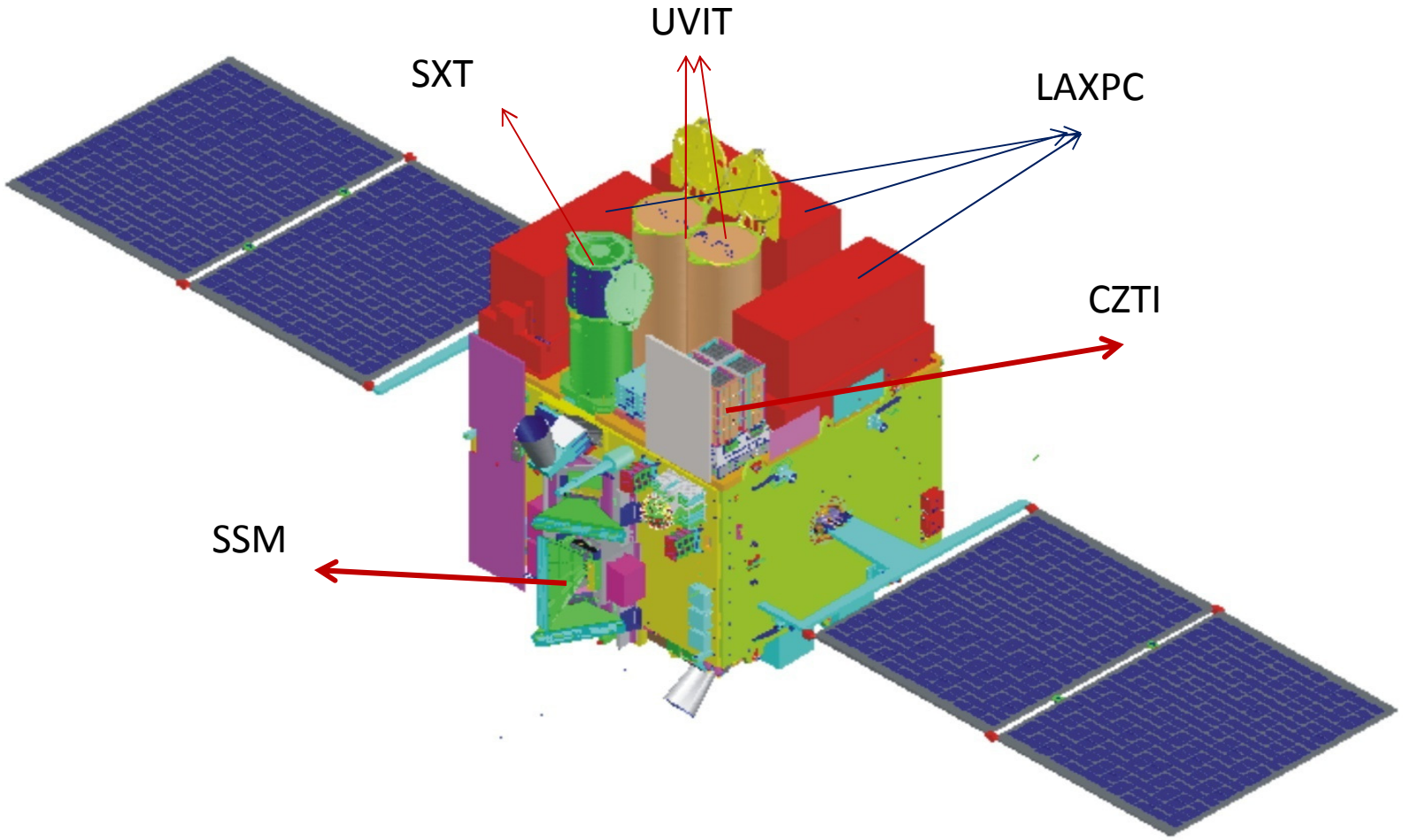
ASTROSAT INSTRUMENTS



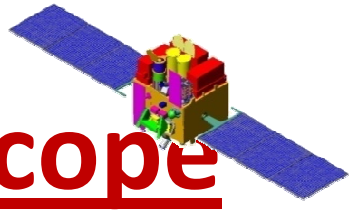
- Large Area X-ray Proportional Counters (LAXPCs)
- Cadmium zinc Telluride Imager (CZTI)
- Soft X-Ray Telescope (SXT)
- Ultraviolet Imaging Telescope (UVIT)
- Scanning Sky Monitor (SSM)

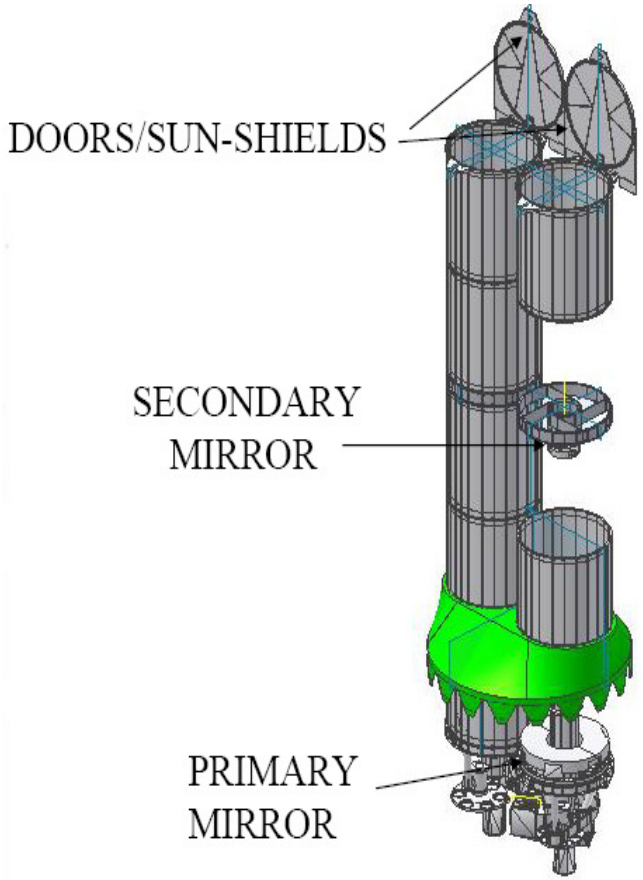
ASTROSAT CONFIGURATION

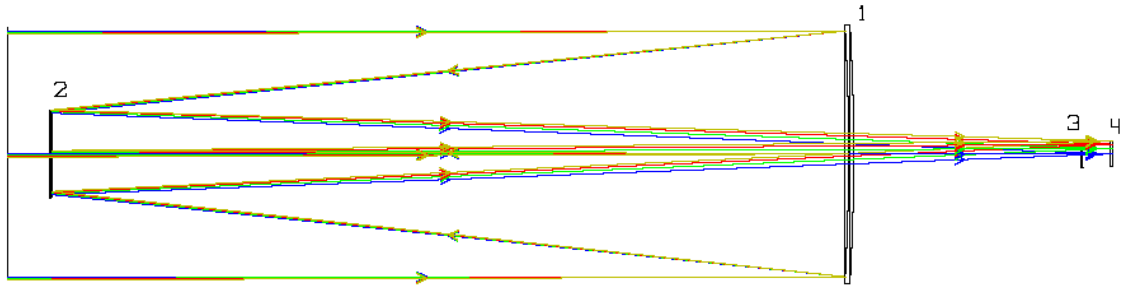




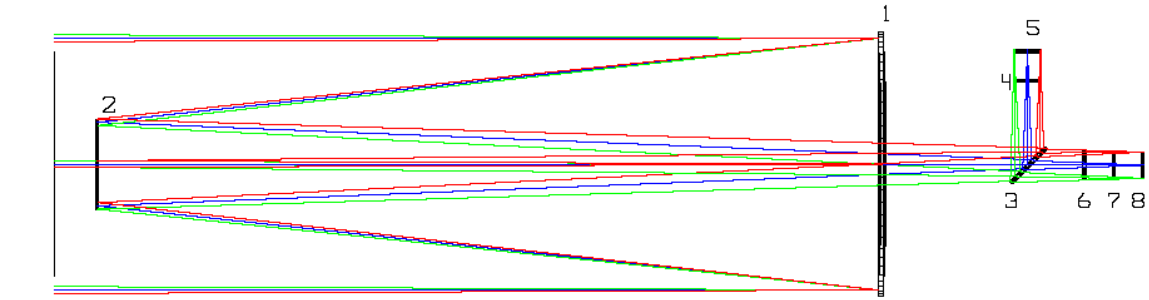
UVIT- Ultra Violet Imaging telescope







1- PRIMARY MIRROR
2- SECONDARY MIRROR
3- FILTER
4- DETECTOR WINDOW



1- PRIMARY MIRROR
2- SECONDARY MIRROR
3- BEAM SPLITTER
4- NUV FILTER
5- NUV DETECTOR WINDOW
6- VIS CORRECTOR
7- VIS FILTER
8- VIS DETECTOR WINDOW

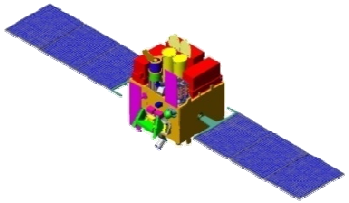
Twin RC telescope-each 40 cm aperture

<1.8 arc sec. resolution

FUV : 130 – 180 nm

NUV : 180 – 300 nm & VISIBLE : 350 – 600 nm

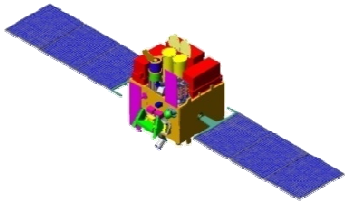
UVIT Characteristics

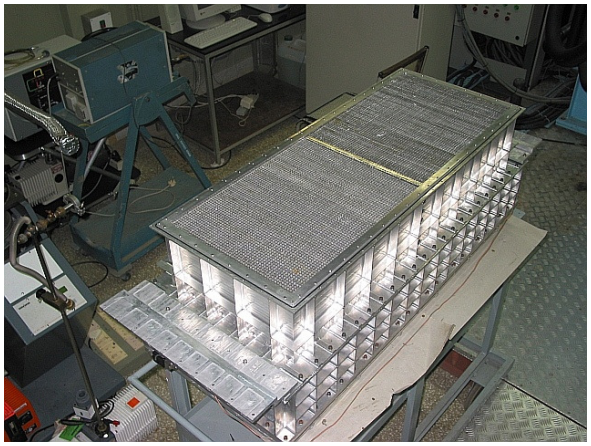


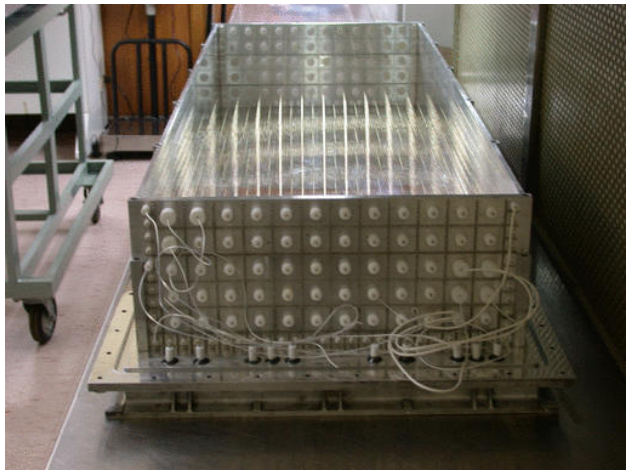
- UVIT observes simultaneously in FUV (130-180 nm), NUV (200-300 nm), and VIS (320 – 550 nm).
- Detector : UV Photon counting CCD /opt CCD photometer
- The field of UVIT is ~ 29 arcmin circle
- Images are made in FUV and NUV with an angular resolution better than 1.8 arcsec.
- The Energy resolution depends on filter used

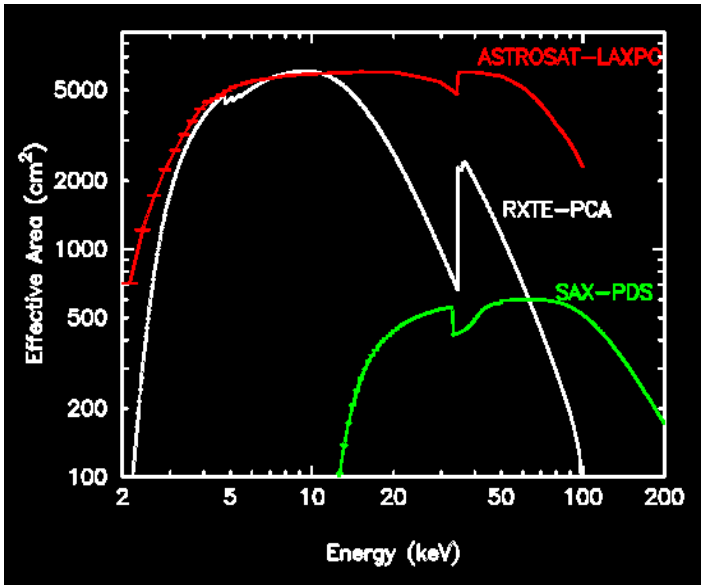
  < 100-500 A
- The instrument will have a temporal resolution of 30 ms for full frame, < 5 ms for small window.
- Typical observation time/target : 30minutes

Large Area X-ray Proportional Counter (LAXPC)

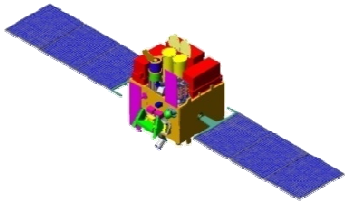






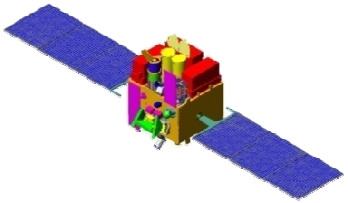


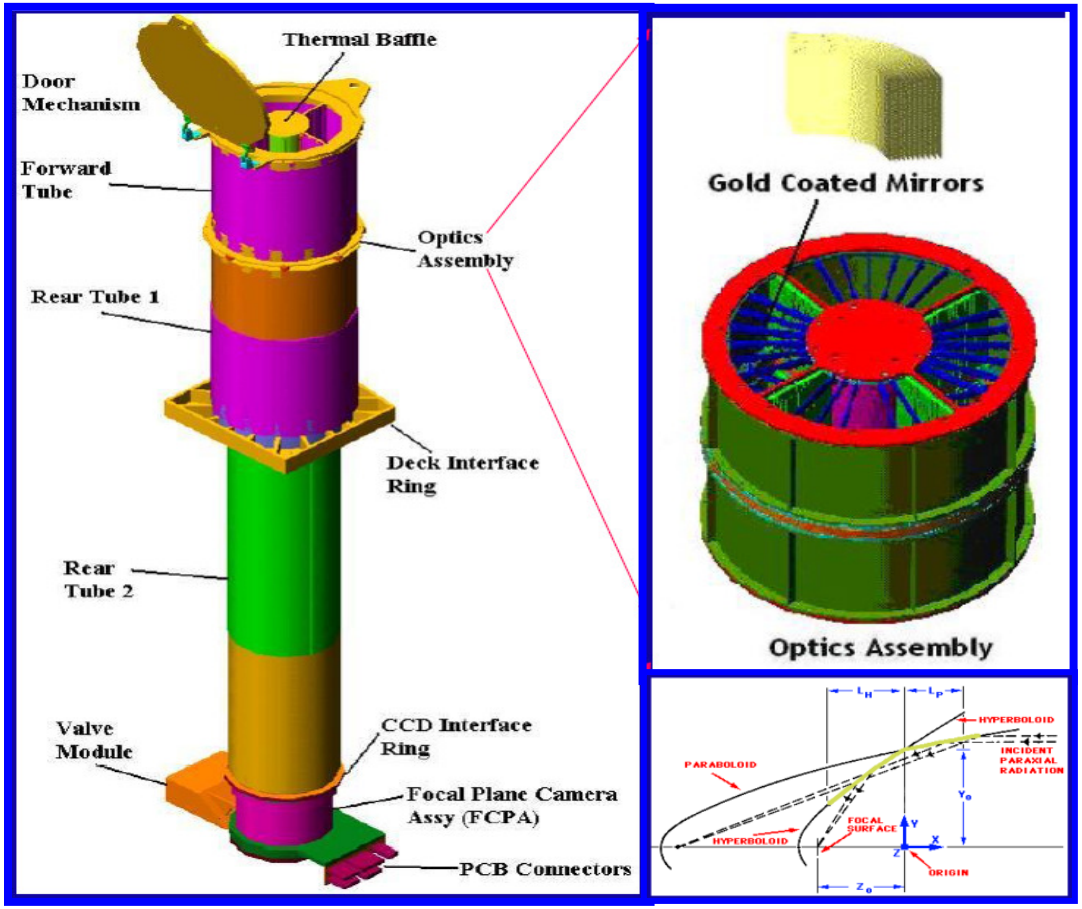
LAXPC Characteristics



- 3 identical co-aligned proportional counters in a multi-layer geometry with 1^o X 1^o field of view (FOV) covering broad energy band (3-80keV).
- The total effective area of 3 LAXPCs is about 6000 cm^2
- Each LAXPC is filled with 90% Xenon and 10% Methane at 1520 torr pressure to provide an average detection efficiency of 100% below 20 keV and 50% in 20- 80 keV.
- The energy resolution is about 20% FWHM at 6 KeV and 11% at 22 KeV.
- The angular resolution is ~ 1.5 arc min in scan mode
- Time resolution : 10 micro second
- Typical observation time /target : 1-2 days

SOFT X-RAY TELESCOPE (SXT)

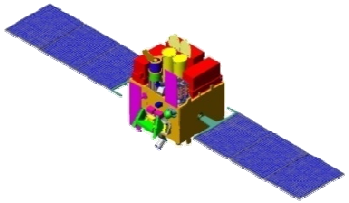




Grazing incidence optics with nested gold coated foils

2 meter focal length telescope

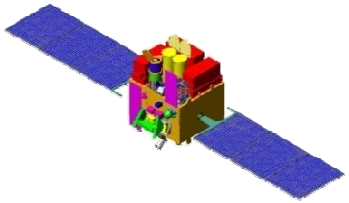
Cooled X-ray CCD detector at the focal plane

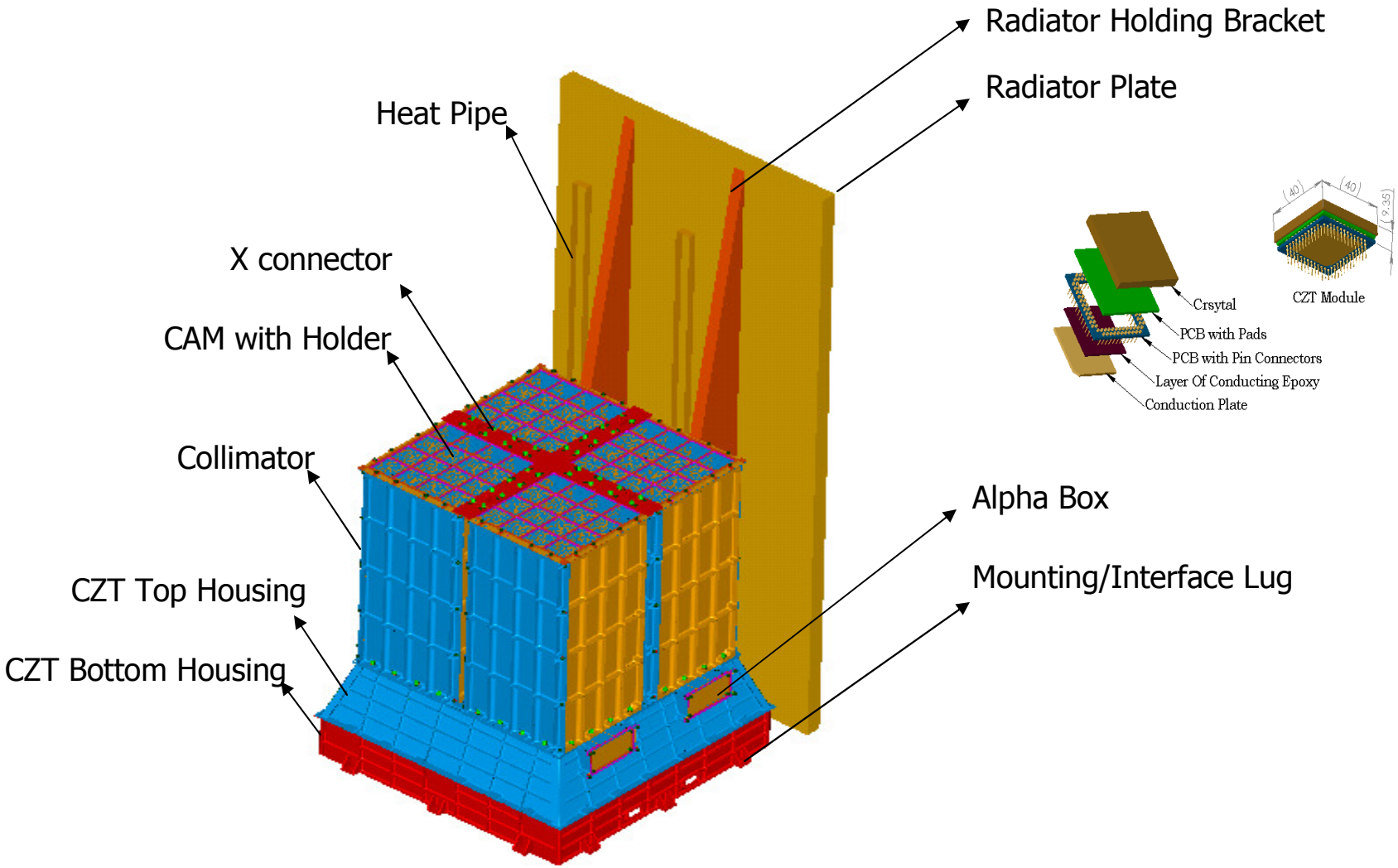


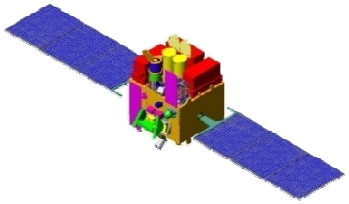
SXT Characteristics

- The bandwidth is 0.3 -8kev
- The geometric area is about 200 cm^2
- The FOV is 0.4 deg FWHM
- The energy resolution is 2.9% @ 6kev
- The Angular resolution is 3.7 arc min
- Time resolution is 2.4 sec in full frame
- Typical observation time /target 0.5 to 1 day

CZT Imager Assembly



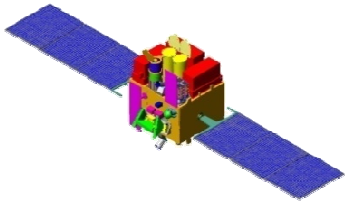


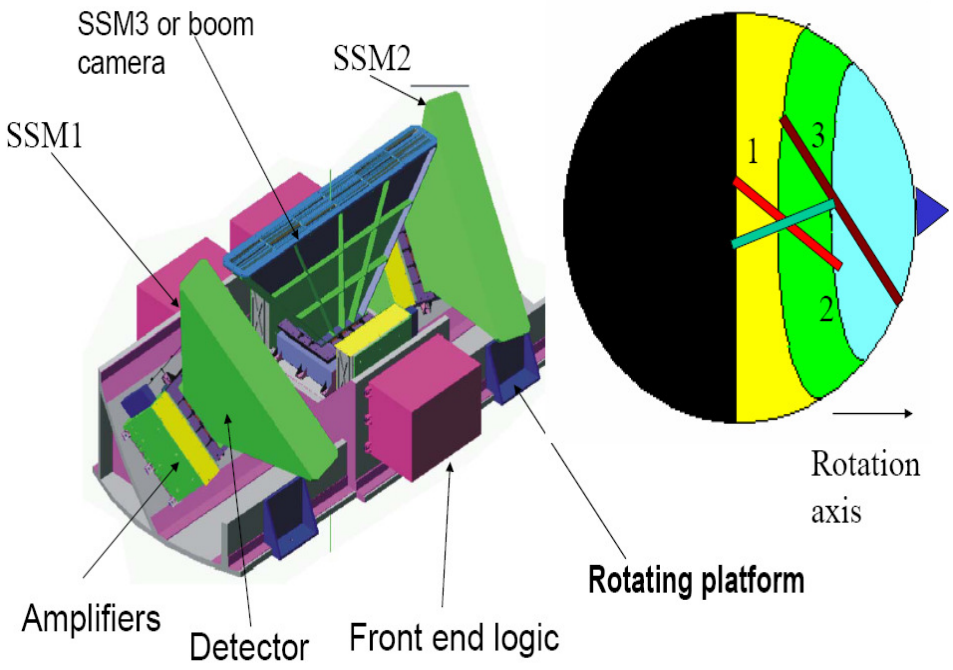


CZTI Characteristics

- Imaging (0.1 degree) in 10-100 keV
- The CZT array has a geometrical area of 1024 cm^2 made up of 64 detector modules.
- The imaging will be realized by a 2D coded aperture mask (CAM) of tantalum with 17^o x 17^o FOV
- The CZT has superior energy resolution above 40 keV with expected resolution of about 5% at 100 keV
- It has angular resolution of 8 arc min
- Time resolution : 1 milli second
- Typical observation time per target : 2 days.

SCANNING SKY MONITOR (SSM)





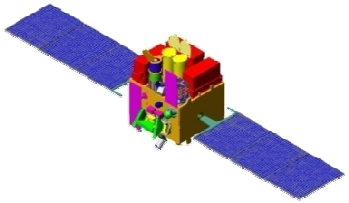
The counters are filled with P-10 or a mixture of Argon and Xenon and methane as quench gas at 800 torr.

Three detectors mounted on a rotating platform

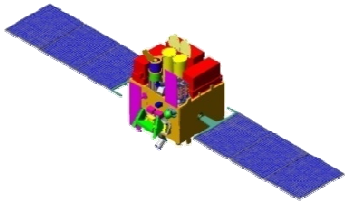
1 – D coded mask

Nominal rotation : 10 deg. Step and 10 min. stare

SSM Characteristics



- The Bandwidth is 2 -10 keV
- The FOV is 27 by 100 deg
- The energy resolution is about 18 % 6 keV
- The angular resolution is 14 arc min
- The time resolution is 0.1 milli sec
- The typical observation time for target is 10 min
- All the three SSMs are mounted on a platform which has a capability to rotate +/- 178 deg. In normal mode of operations, the platform is made to rotate in step and stare mode. The steering algorithm built makes it to step 10 deg in 30 seconds and stare the sky for 9.5 minutes. This is done to minimise disturbance to the other payloads.



Telescope covers

- The SXT telescope has a deployable cover at the top which is closed on the ground and helps to protect the telescope from contamination. In-orbit it is deployed by 256 degrees.
- Both the telescopes of UVIT also have deployable covers at the end of external baffle tubes. In-orbit these are deployed by 92 degrees. They also serve as Sun shades.

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Thank You