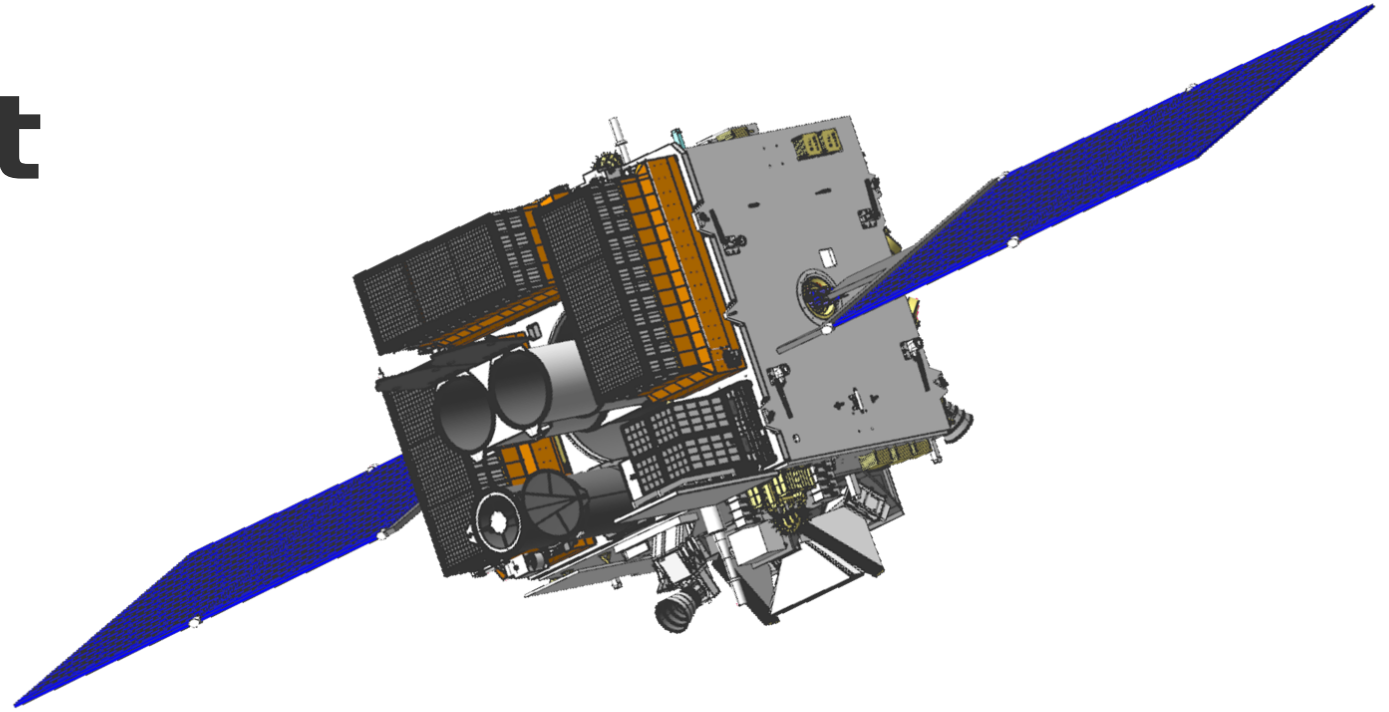




# Three Years of AstroSat

V Girish  
ISRO, Bangalore

# AstroSat



- India's first multi-wavelength Astronomy satellite
- Launched from Sriharikota on 28<sup>th</sup> sept 2015
- Low earth, low inclination angle



# Introduction

Five Scientific payloads and one auxiliary

- Ultra Violet Imaging Telescope (**UVIT**)
- Soft X-ray Telescope (**SXT**)
- Large Area X-ray proportional Counter (**LAXPC**)
- Cadmium Zinc Telluride Imager (**CZTi**)
- Scanning Sky Monitor (**SSM**)
- Charge Particle Monitor (**CPM**)

From NUV to high energy X-rays

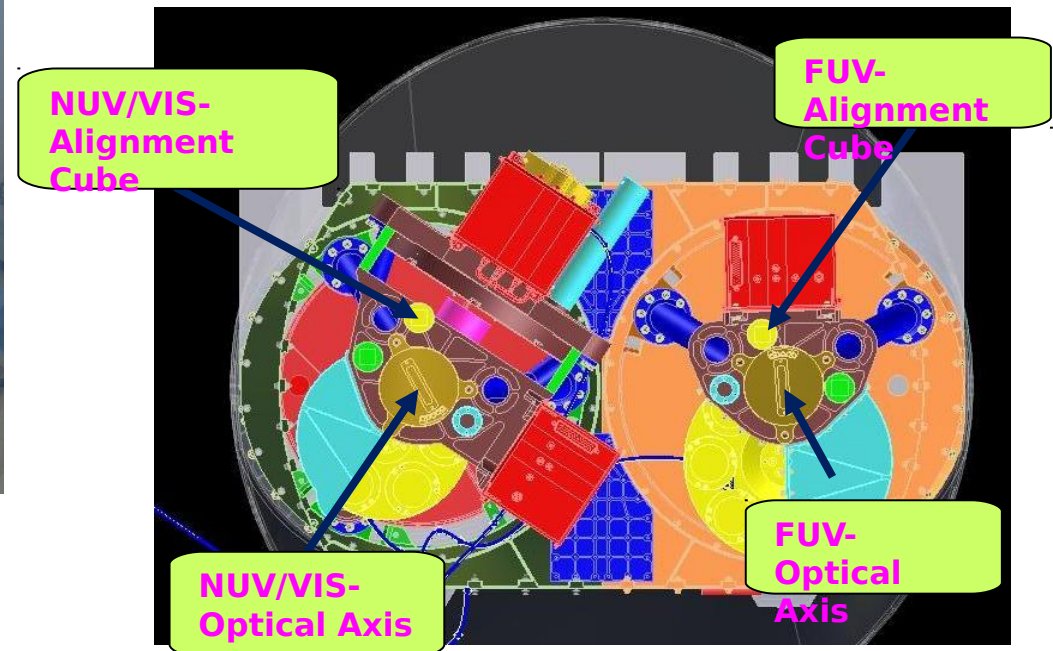
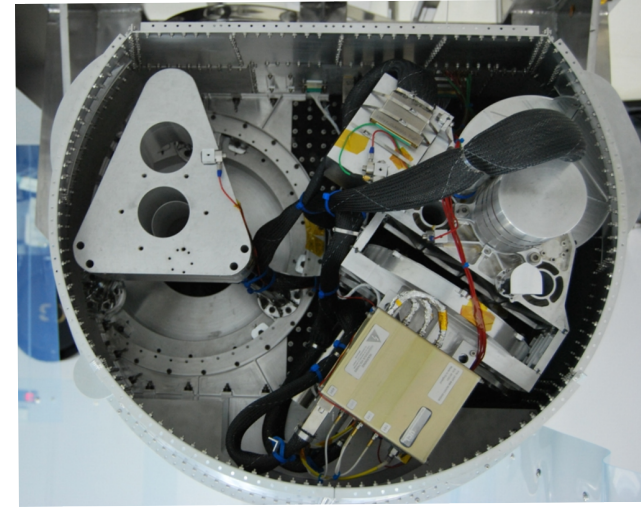
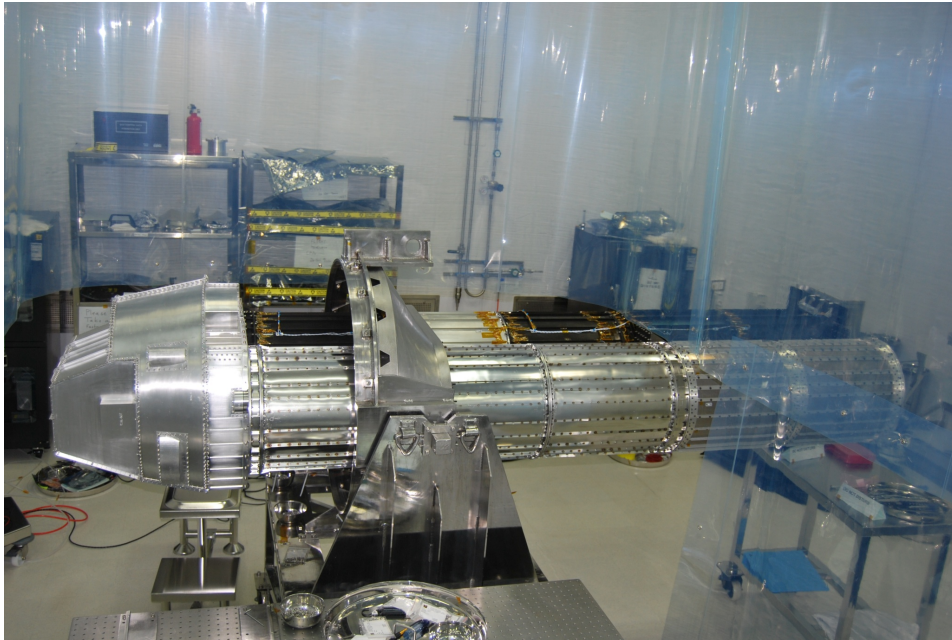
Imaging, timing and Polarimetry (!!!)

# Results till now

- Initial six months P&V phase
- Six months GTO
- Nearing 100 refereed publications
  - X-ray polarization from off pulse region
  - Solving the puzzle of faint red star bright in UV
- Data is made public now

# UVIT

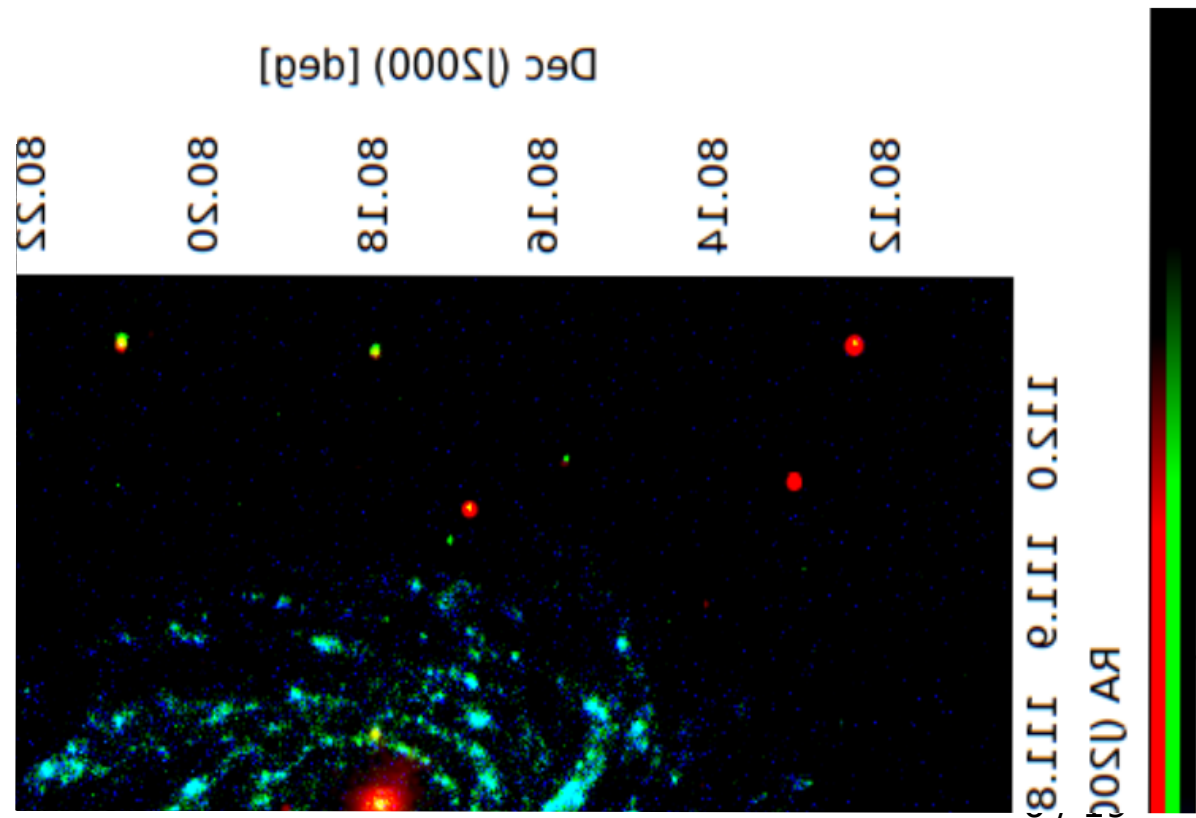
- Two 40 cm RC telescopes





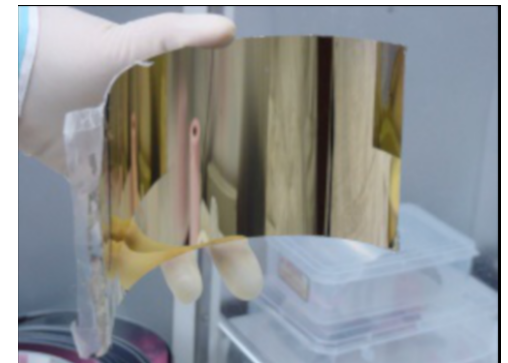
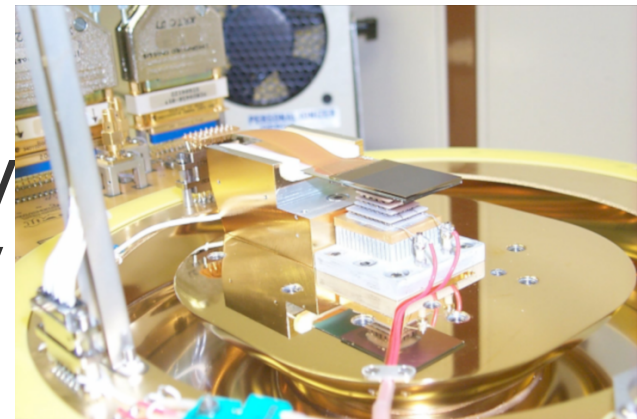
# UVIT

- Two 40 cm RC telescopes
- Astrometry 1.2 – 1.4'
- Multiple filters

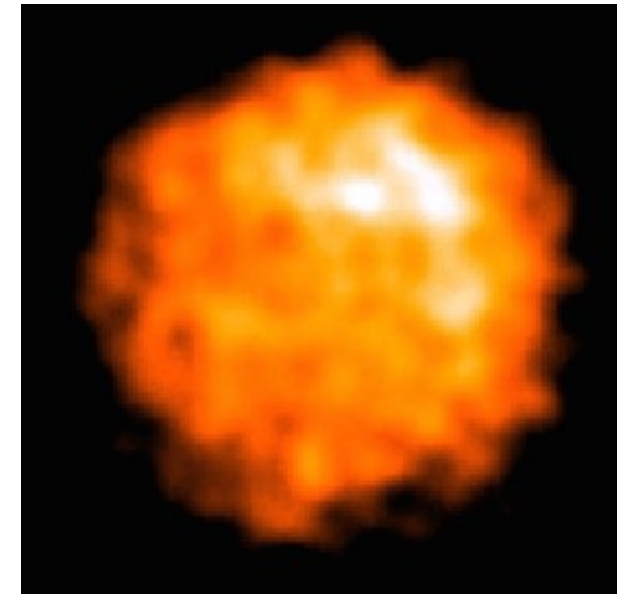
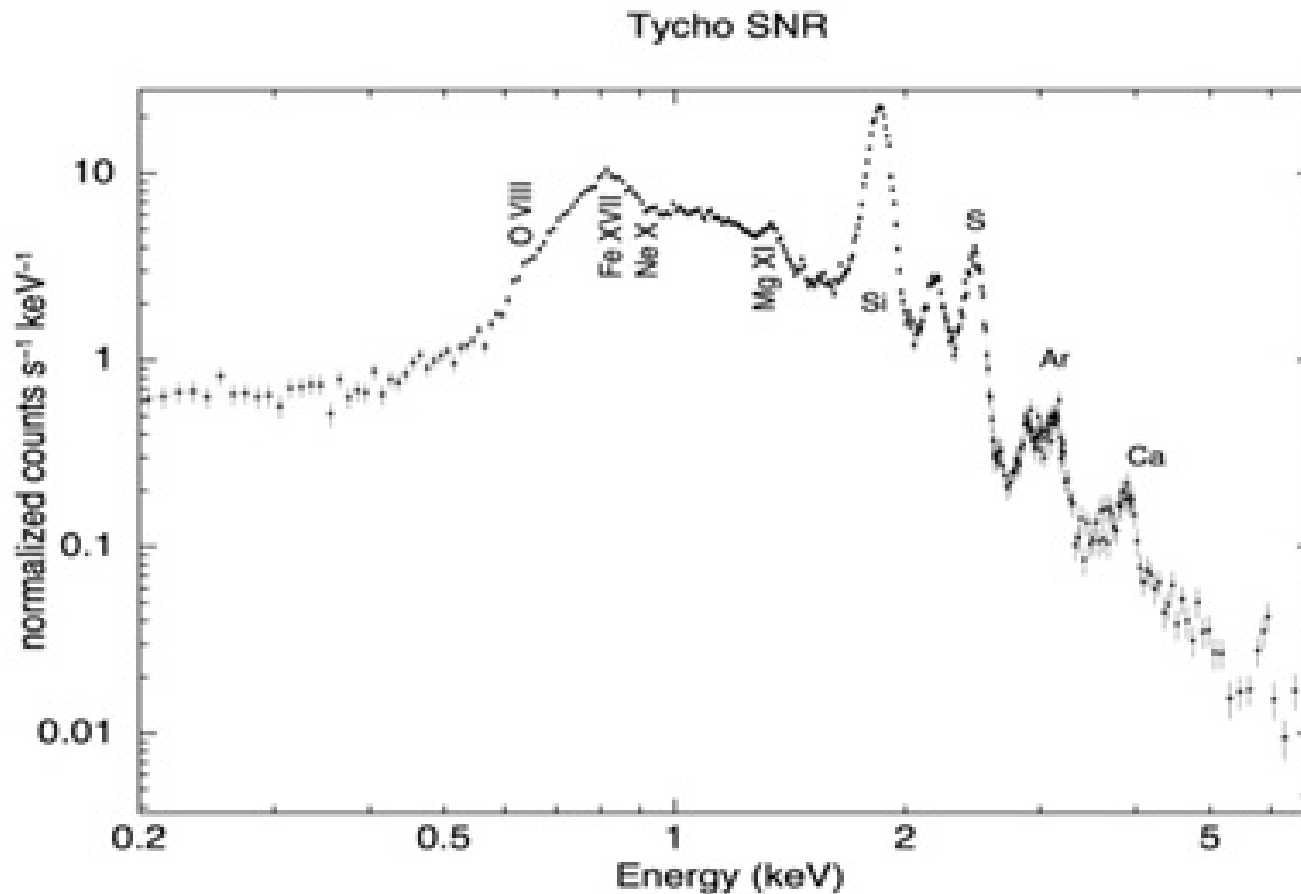


# Soft X-ray Telescope (SXT)

- Gold plated foils; Wolter I configuration
- 600 x 600 pixels
- 0.8 – 8.0 keV range
- Energy Resolution: 90 eV at 1.5 keV  
136 eV at 5.9 keV
- Time resolution  $\sim 2.4$  s (full frame)  
 $\sim 0.278$  s (window mode)
- Effective Area  $\sim 90 \text{ cm}^2$  at 1.5 keV



# Soft X-ray Telescope (SXT)

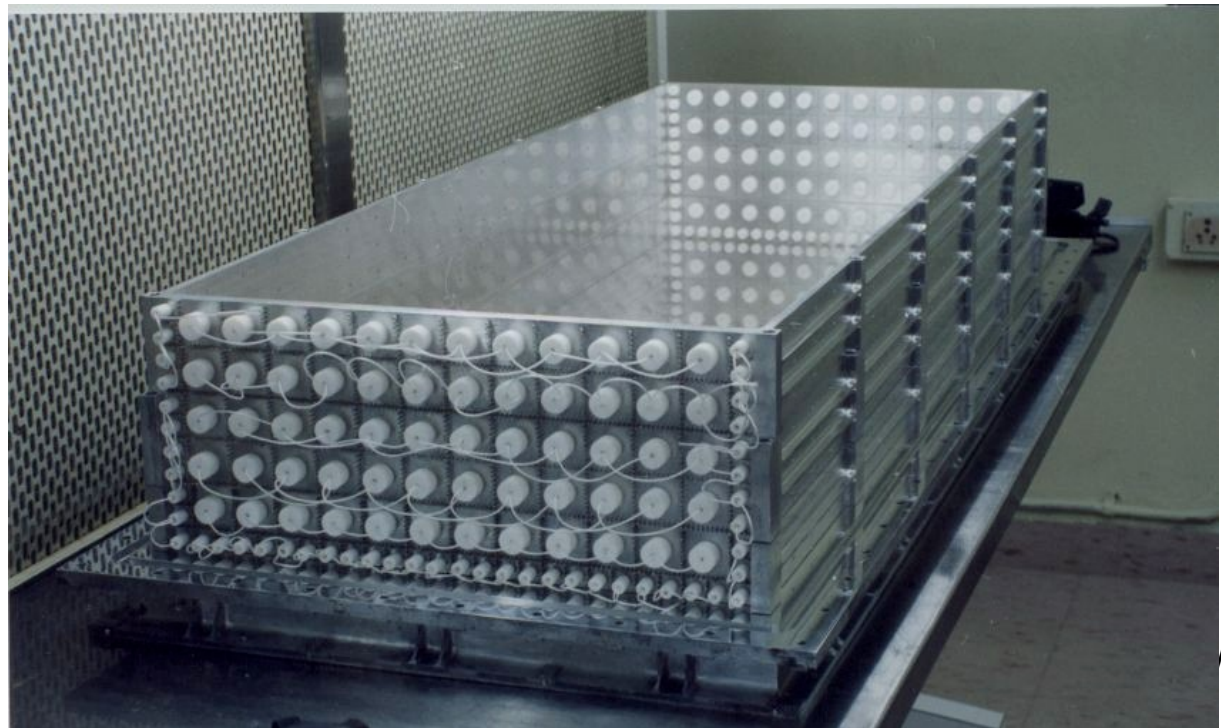
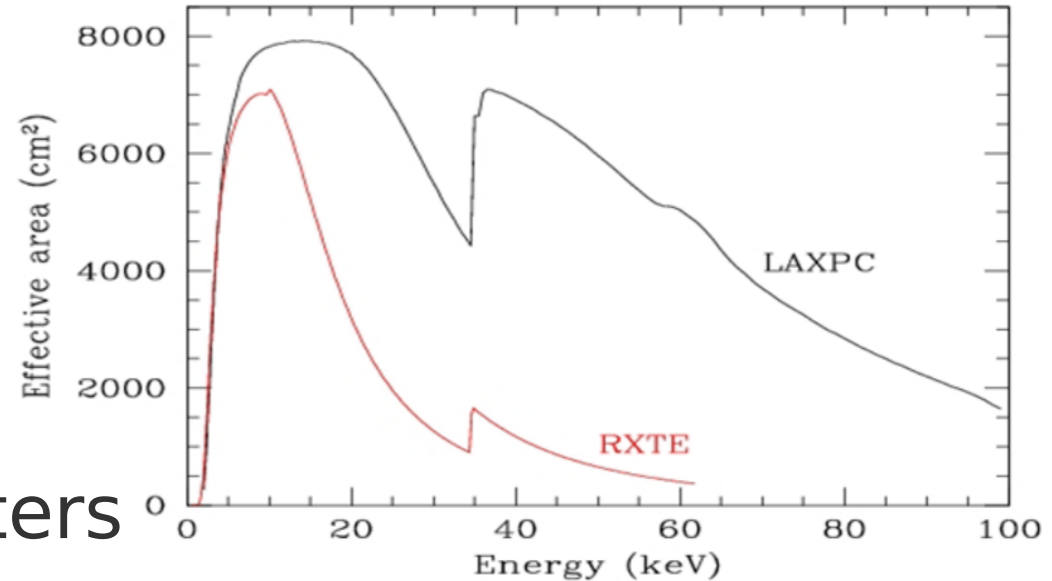


Singh et al., 2017



# LAXPC

- Highest collecting area in 3 - 60 keV
- Three proportional counters

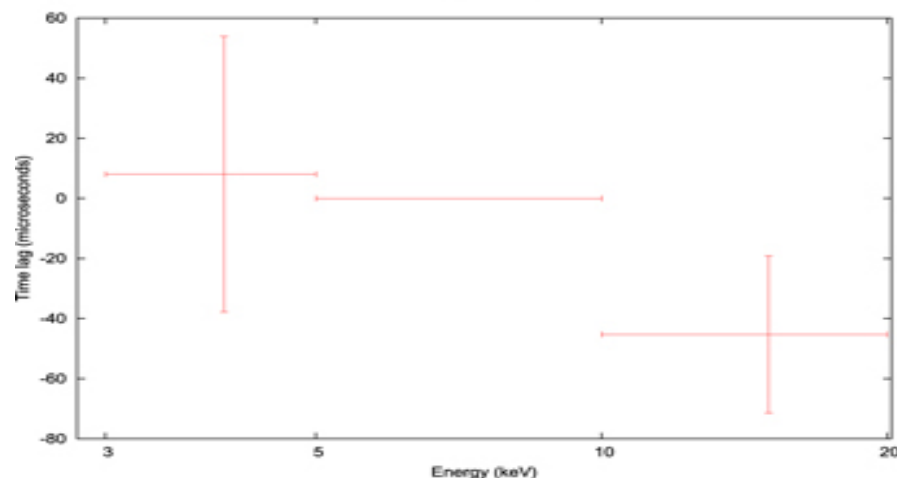
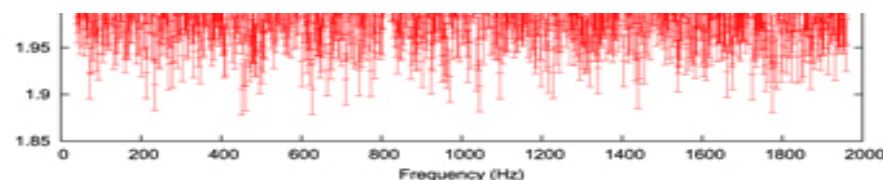
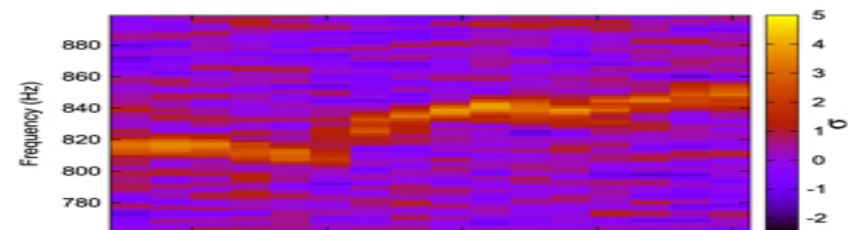
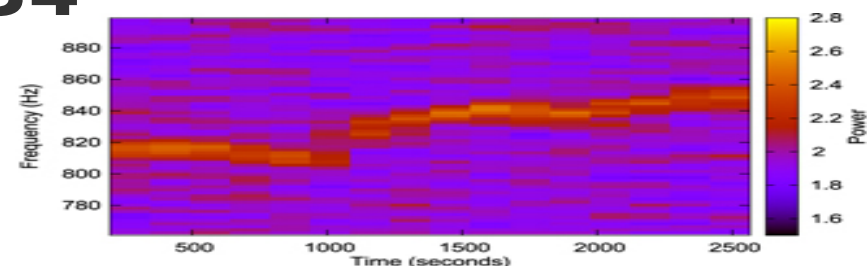


# LAXPC

## ms phenomena in 4U 1728-34

QPO in high energies and measuring delay between energy bands

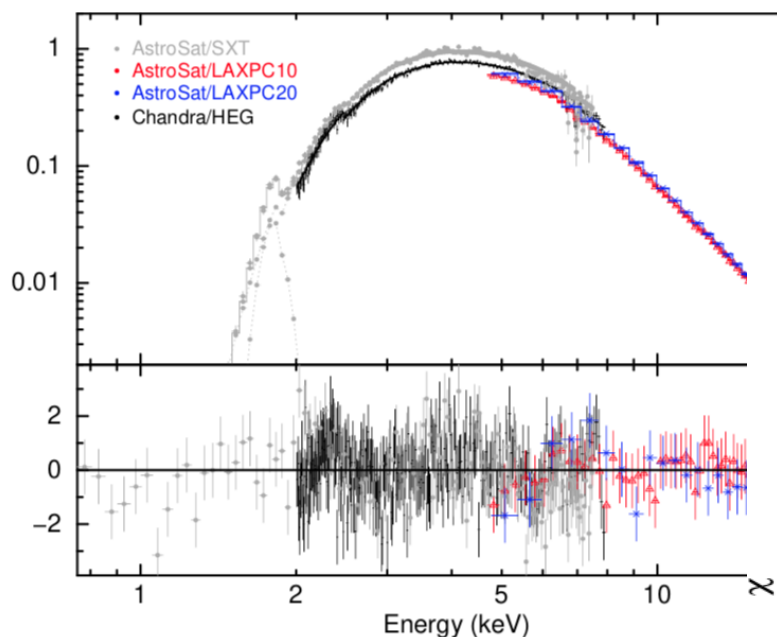
- Changing frequency  
820 – 850 Hz
- Time lag :  
with-in 2500 s observations
- Type-1 burst too



# LAXPC multi-wavelength/Co-

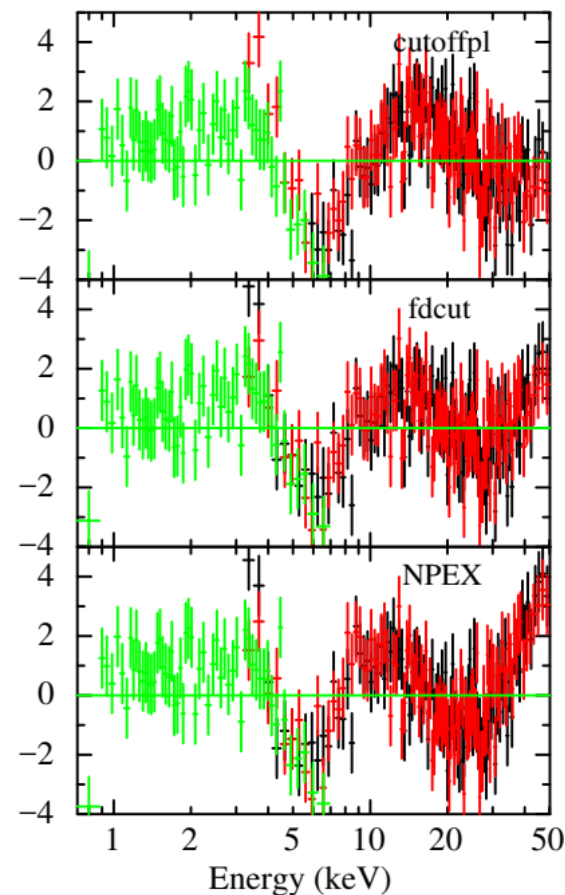
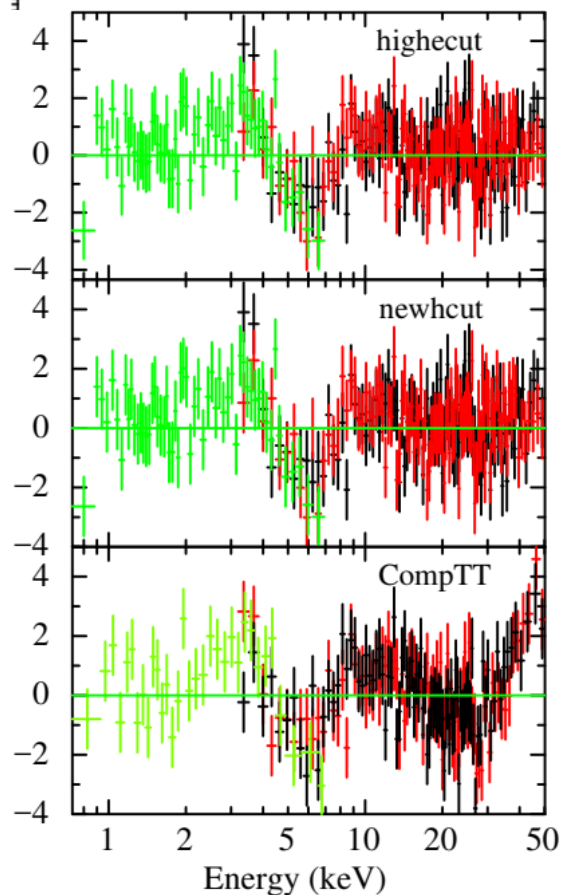
## 4U 1630-47 Evidence of rapid spin/disk wind

(Mayukh et al., 2018)



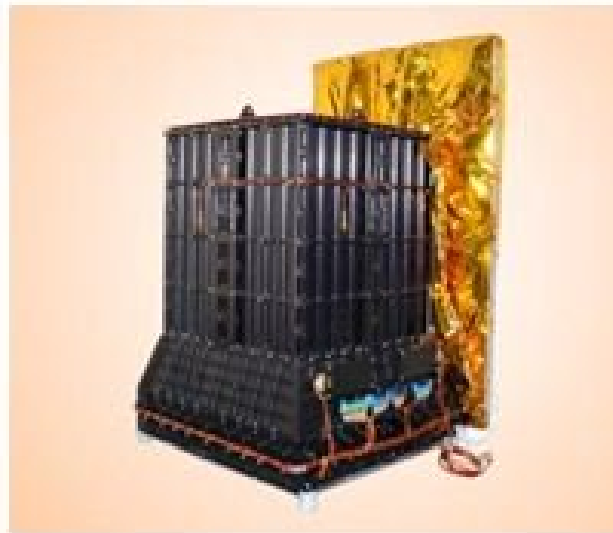
## SXP 15.3: Cyclotro

(Maitra et al., 2018)




# CZTi

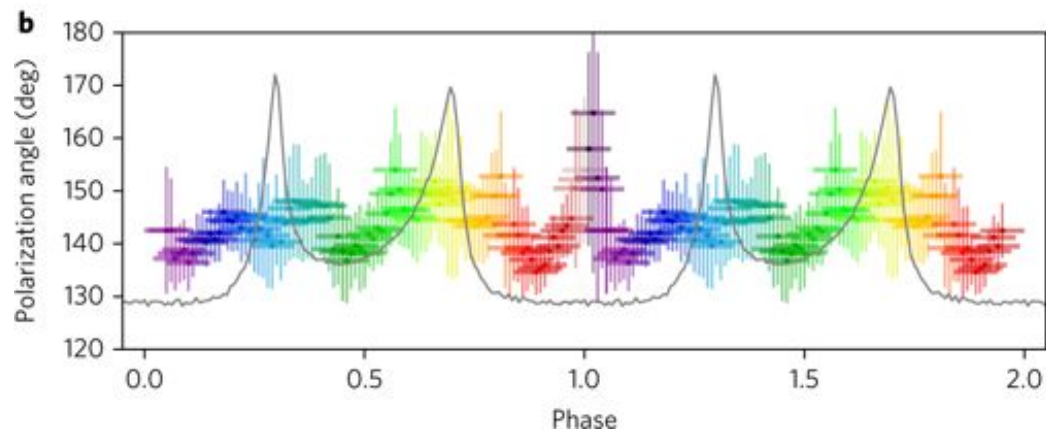
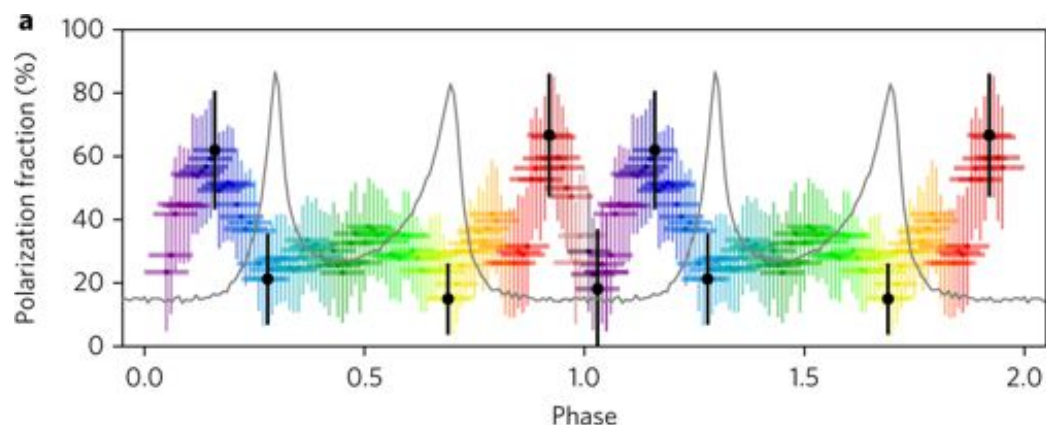
- 64 Cd Zn Te modules  $\rightarrow$  960 cm<sup>2</sup>
- Each CZT module = 16x16 = 256 pixels  
=> 16384 pixels (total)
- 10 – 100 keV, 8% at 100 keV
- Coded Aperture Mask, Open beyond 100 keV



Letter | Published: 06 November 2017

# Phase-resolved X-ray polarimetry of the Crab pulsar with the AstroSat CZT Imager

S. V. Vadawale , T. Chattopadhyay, N. P. S. Mithun, A. R. Rao, D. Bhattacharya, A. Vibhute, V. B. Bhalerao, G. C. Dewangan, R. Misra, B. Paul, A. Basu, B. C. Joshi, S. Sreekumar, E. Samuel, P. Priya, P. Vinod & S. Seetha





## PROMPT EMISSION POLARIMETRY OF GAMMA RAY BURSTS WITH *ASTROSAT* CZT-IMAGER.

TANMOY CHATTOPADHYAY,<sup>1,2</sup> SANTOSH V. VADAWALE,<sup>2</sup> E. AARTHY,<sup>2</sup> N. P. S. MITHUN,<sup>2</sup> VIKAS CHAND,<sup>3</sup> RUPAL BASAK,<sup>4,5</sup>  
A. R. RAO,<sup>3</sup> SUJAY MATE,<sup>6</sup> V. SHARMA,<sup>6</sup> VARUN BHALERAU,<sup>7</sup> AND DIPANKAR BHATTACHARYA<sup>6</sup>

<sup>1</sup>*Pennsylvania State University, State College, PA, USA*

<sup>2</sup>*Physical Research Laboratory, Ahmedabad, Gujarat, India*

<sup>3</sup>*Tata Institute of Fundamental Research, Mumbai, India*

<sup>4</sup>*The Oskar Klein Centre for Cosmoparticle Physics, AlbaNova, SE-106 91 Stockholm, Sweden*

<sup>5</sup>*Department of Physics, KTH Royal Institute of Technology, AlbaNova University Center, SE-106 91 Stockholm, Sweden*

<sup>6</sup>*The Inter-University Centre for Astronomy and Astrophysics, Pune, India*

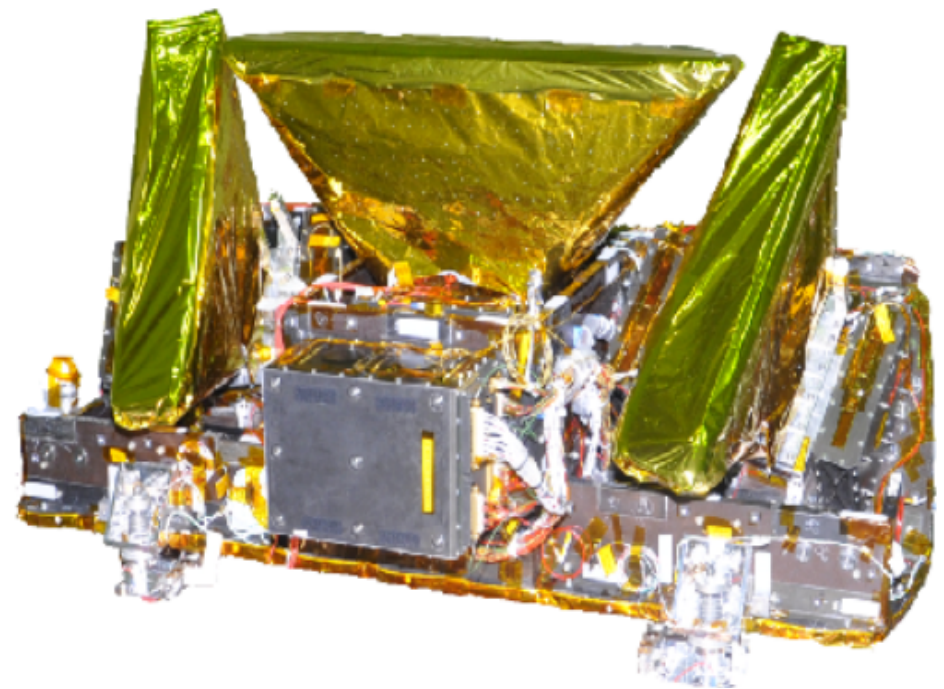
<sup>7</sup>*Indian Institute of Technology Bombay, Mumbai, India*

### ABSTRACT

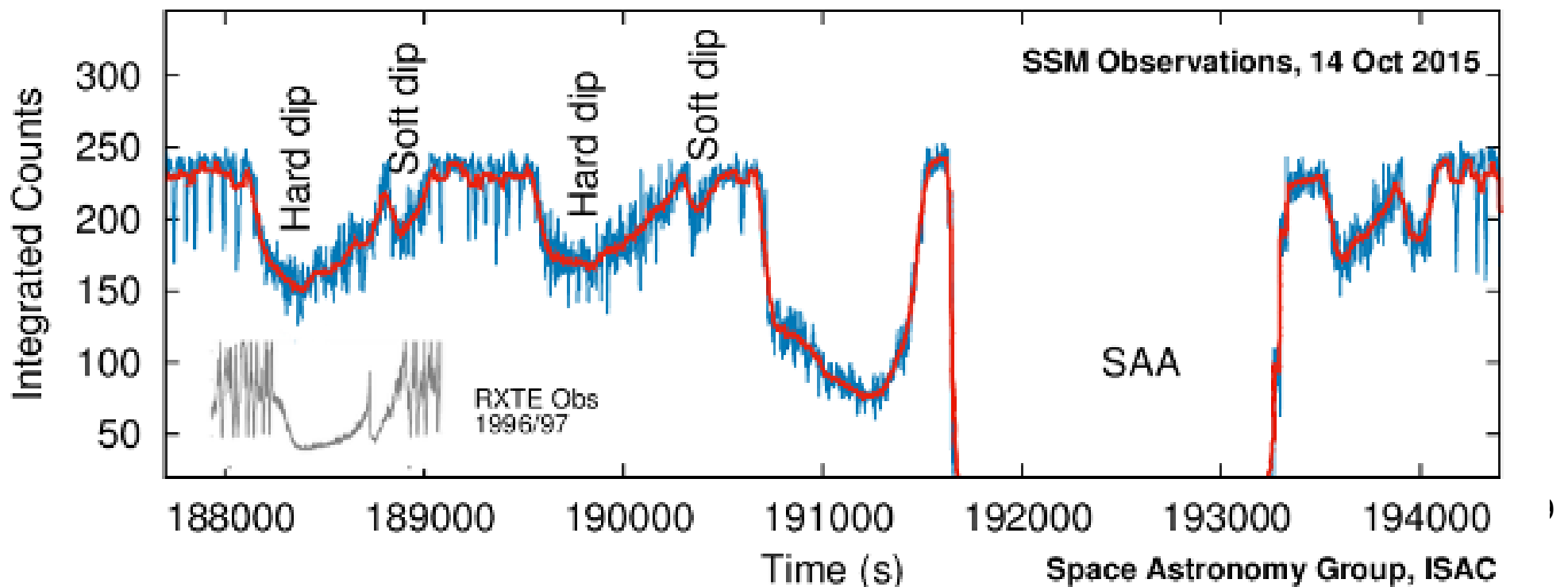
X-ray and Gamma-ray polarization measurements of the prompt emission of Gamma-ray bursts (GRBs) are believed to be an important tool to test the various models of GRBs. Although there are some reports of hard X-ray polarization measurements of the prompt emission of GRBs, the number of measurements are small to provide statistically significant inputs to the GRB models due to the extreme difficulty of measuring them and quantifying their significance. CZTi onboard AstroSat is primarily an X-ray spectroscopic instrument but works as a wide angle GRB monitor due to the increasing transparency of the CZTi support structure. It also has experimentally verified polar-



# SSM



**ASTROSAT FirstLight of Black Hole GRS 1915+105  
( $\beta$  Class)**



# SSM

[https://issdc.gov.in/SSM\\_Web/index.jsp](https://issdc.gov.in/SSM_Web/index.jsp)



## Scanning Sky Monitor

*An X-ray sky monitor on board AstroSat*

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[Home](#) [Source Catalog](#) [Light Curves](#) [Downloads](#) [Alerts](#) [Contact](#)

## Scanning Sky Monitor

The Scanning Sky Monitor (SSM) is a scientific instrument on board **AstroSat**, India's first multiwavelength mission. The main objective of SSM is to locate transient sources in the sky as well as monitor the intensity variation in known bright X-ray sources. SSM is designed to work in the X-ray energy band of 2.5 keV - 10 keV.

SSM has 3 cameras which will monitor and look for the cosmic sources emitting X-rays in the designated energy band. SSM will generate alerts, if there are any flux excursions in known sources or if it is a new source. Information about these alerts will be made available in this website and can be made use of by other ground and space based observatories to take up follow-up observations of the source of interest.

A catalog of the sources detected by SSM can be obtained from this website. In addition, the light curve data file for every source detected by SSM can also be obtained after proper authentication.

On 26<sup>th</sup> Chairman, ISRO opened  
AstroSat data open for public

<https://astrobrowse.issdc.gov.in/astrohtml>



## Welcome to ISRO Science Data Archive for AstroSat Mission

The science data from observations made by the instruments on board the spacecraft are available for download after the [proprietary period](#) from this portal.

ASTROSAT is India's first dedicated multi wavelength space observatory. This scientific satellite mission endeavours for a more detailed understanding of our universe. AstroSat observes universe in the optical, Ultraviolet, low and high energy X-ray regions of the electromagnetic spectrum. Multi-wavelength observations of ASTROSAT are further extended with co-ordinated observations using other spacecraft and ground based observations.

AstroSat with a lift-off mass of about 1513 kg was launched by India's Polar Satellite Launch Vehicle (PSLV) on 28th September 2015 into a 650 km circular orbit with an inclination of 6 deg. The spacecraft control centre at Mission Operations Complex (MOX) of ISRO Telemetry, Tracking and Command Network (ISTRAC) at Bangalore carries out the spacecraft health monitoring and control operations. The science data from the spacecraft is downloaded at a dedicated ground station established at Bylalu , Bengaluru and the data is made available to the users through the co-located Indian Space Science Data Centre ( ISSDC). Science data processing, archival and dissemination are carried from ISSDC, the nodal point for the interface with the global scientific and user community.

AstroSat is a proposal -driven, multi –wavelength observatory operated by Indian Space Research Organization (ISRO). ISRO releases periodic calls for proposal submission. Users can submit proposals for operating the science instruments on board using the web based utility AstroSat Proposal Processing System [APPS](#) hosted at ISSDC. **The science data along with the related software for processing can be downloaded from this portal**

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Large Area X-Ray  
Proportional Counter  
(LAXPC)

Ultra Violet Imaging  
Telescope (UVIT )

# AstroSat Support Cell

<http://astrosat-ssc.iucaa.in>



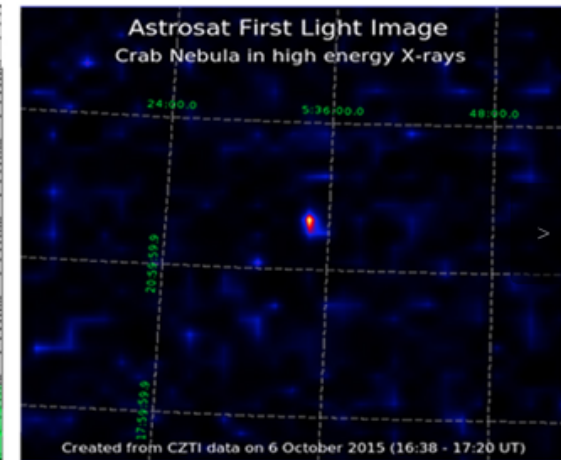
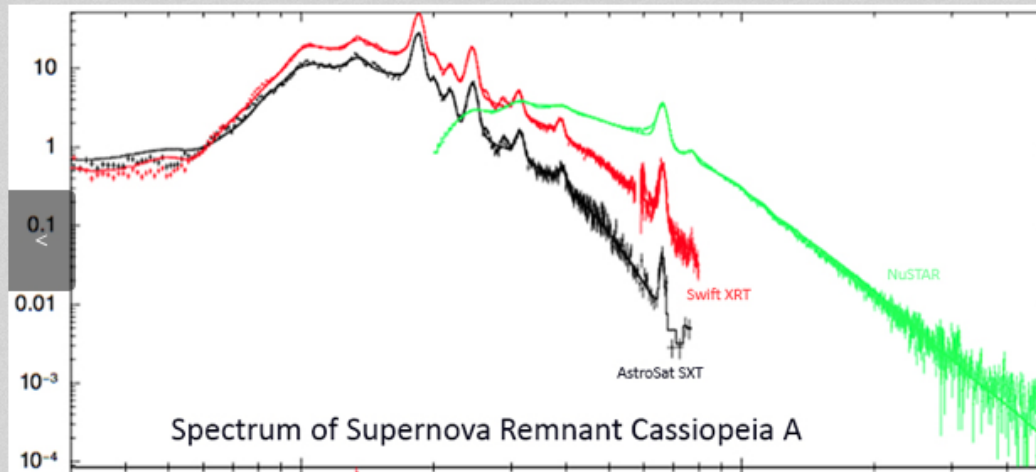
**ASTROSAT**  
Science Support Cell

Home

Data & Analysis

For Proposers

Help



## Home

### Public release of AstroSat data

The public release of AstroSat data commenced on 26 September 2018 with a bouquet of 834 datasets. Further data will be released regularly upon completion of their respective lock-in period. The data may be accessed from the [AstroSat data archive](#) hosted at the Indian Space Science Data Centre.

## Recent updates

LAXPC Individual routines software has now been updated to include more features like faint source background estimation, xspec readable rms and lag files, and more. The routines have been



# Future

- AO for next Astronomy mission
  - Short listing stage
  - X-ray polarization priority for X-ray proposals
  - Gamma ray detection
- AO for Venus mission
  - Orbiter + Balloon (~ 5kg scientific payload)

...

# Thanks