

X-ray SPECTroscopy and Timing Payload (XSPECT) Proposer Guide

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1. Introduction

X-ray SPECTroscopy and Timing (XSPECT) is an X-ray Spectrometer and Timing payload, on-board XpoSat mission, which is providing fast timing and good spectroscopic resolution in soft X-rays. Taking advantage of the long duration observations required by POLIX to measure polarization, XSPECT can provide long-term monitoring of spectral state changes in continuum emission, changes in their line flux and profile, simultaneous long term temporal monitoring of soft X-ray emission.

Feasibility studies for the targeted objects of POLIX were carried out from the science point of view of XSPECT. These studies show that significant science outcome can be expected from the observation of these sources. XSPECT has been observing the X-ray sources from past one and half year. First 3 months were dedicated to the Performance Verification of the instrument. After that it has looked several celestial X-ray sources which include: Neutron star low-mass X-ray binaries, Blackhole binaries, X-ray pulsars and Active Galactic nuclei. Long term monitoring gives XSPECT the following unique advantages.

- Long term and high cadence observation of selected X-ray sources in soft energy band (0.8-15keV) is possible with XSPECT. Such continuous long duration and high energy resolution observations of the sources have not been undertaken by previous instruments.
- Study of bright X-ray sources in soft band with pile up free observations is possible with XSPECT. Present soft X-ray instruments cannot do such observations for bright sources because of limitations in flux handling.
- The spectroscopy measurements along with polarization information can give further insight into radiative and accretion mechanisms in the X-ray sources.

2. Operational Requirements

XSPECT will be operated continuously and will be powered off

- During SAA
- Based on thermal constraints / requirements.

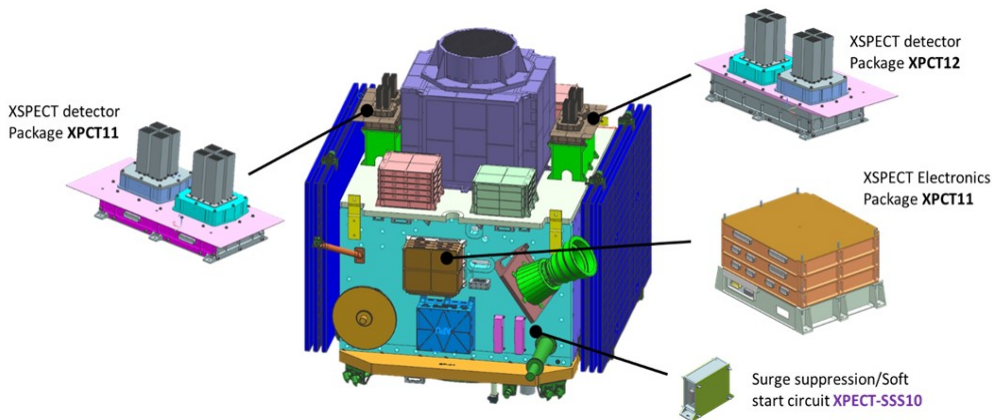


Figure 1: XSPECT payload on-board XPoSat

3. Instrument Specifications

Parameter	Design Specification	Final spec/On board performance
Energy Range	0.8 - 15 keV	0.8 - 15 keV
Energy Resolution (-20 C)	< 200 eV @ 6 keV	< 180 eV @ 6 keV
Time Resolution	1 ms	1 ms
FOV (2 types)	2° x 2° and 3° x 3°	1.94° X 1.94°, 2.93° X 2.93°
Open area fraction	73 % and 80 %	59 % and 75 %
Effective Area (all event)	~ 30 cm ² @ 6 keV	28cm ² @6keV
Sensitivity	0.6 mCrab @ 10ks	0.6 mCrab @ 10 ks

4. Modes of Observations:

- Source Observation mode (Nominal Flux)
In this mode, packet integration time is fixed as 512msec. This mode will be utilized for most of the sources of interest except very high flux sources like Sco-X1. This fixed time (512 msec) will help in observing unforeseen variabilities like stellar flares without losing x-ray photon information which could arise due to data transfer/packetization.
- Source Observation mode (High Flux)
In this mode, packet integration time is fixed as 256msec. This mode will be used only for source Sco-X1 (as of now). Upon analysis of data for other sources, need for this mode will be evaluated.
- Background Observation mode
Except during Source pointing mode (as per S/C Pointing mode definition), XSPECT will be operated in background observation mode. In this mode, packet integration time is 4096 seconds. Since source will not be in the FOV, in order to optimize the data generated due to background, this will be the mode of operation.
- Detector Zero-peak (Diagnostics) mode
In this mode, detector(s) 'zero' peak events i.e. events with zero energy deposit without x-ray interaction will be written in the data packets. This mode is useful for the evaluation of degradation caused by the detector's radiation. This mode will be invoked once per month or as per payload team requirement.

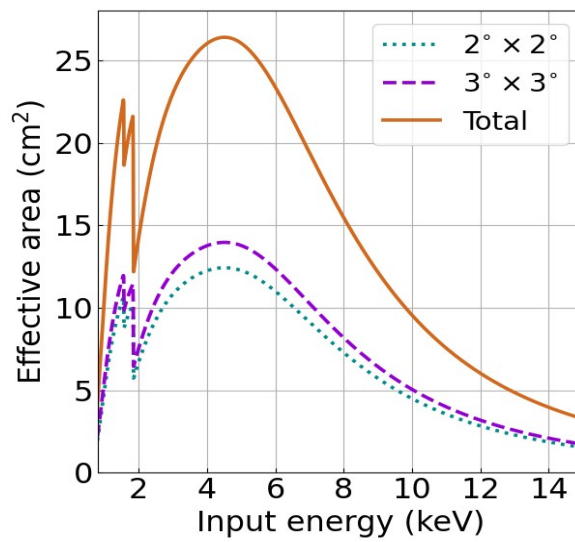


Figure 2: Effective Area of XSPECT as function of energy

5. Guidelines for proposal submission

1. Since FOV of the detector is large, two or more sources can occupy the same FOV. Hence, check for source confusion before planning for the observations.
2. Response matrices (RMF) and ancillary response (ARF) files are provided. Using XSPEC command ***fakedit*** simulate the count rates and check for required exposure time for spectral fitting.
3. Check for source flux, if source flux is > 5 Crab then while writing the proposal indicate that the high-flux mode is required.

6. Downloadables from ISSDC:

1. Level 1 data to Level 2 data processing Software.
2. Response matrix (RMF and ARF) files
3. Background files.
4. Level 1 and Level 2 Data files from Pradan website hosted by ISSDC (Indian Space Science Data Center)
5. User Handbook

7. References

1. *X-ray Spectroscopy and timing experiment on XPoSat instrument configuration and science prospects*

Vatedka Radhakrishna et al, Tyagi Anurag, Vadodariya Koushal, Agrawal Vivek Kumar, Chatterjee Rwitika, Mahendran Chellammal Ramadevi et al. 2025, 11, 035001

2. *XSPECT on-board XpoSat: Calibration and First Results*

Chatterjee Rwitika, Vadodariya Koushal, Vatedka Radhakrishna, Agrawal Vivek Kumar, Tyagi Anurag et al, 2025, arxiv2506.09918\

8. Queries

Software related queries will be addressed by Rwitika Chatterjee (e-mail: rwitika@ursc.gov.in) /Vaishali S (email: vaishali@ursc.gov.in). For science related queries please contact Dr. Vivek Kumar Agrawal, Science PI XSPECT (email: vivekag@ursc.gov.in) and for instrument related queries please contact Dr. Radhakrishna V., Instrument PI (email: rkrish@ursc.gov.in).

9. Important Links

XSPECT proposals can be submitted through XpoSat Proposal Processing System at the website hosted by ISSDC . The visibility of the source can be checked using XpoViewer software at the website hosted by ISSDC (<https://webapps.issdc.gov.in/XPoViewer>). Level 1 and Level 2 data can be downloaded from (<https://pradan.issdc.gov.in>).