AstroSat Proposal Preparation

Announcement of Opportunity (AO-13)

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Proposal/Observing Cycles

ISRO has periodically released announcements of opportunity (AO) calls, soliciting proposals from national and international Astronomy community to observe using AstroSat instruments.

AO-13 (Announcement of Opportunity) <u>Cycle:</u>
<u>October 01, 2023 - September 30, 2024</u>

Last date for submission of proposals: <u>March 31, 2023, 3:30pm</u> (IST)

Current allocation of Observing Time on AstroSat

~55% (Indian observers) and ~20% (International Observers)

Astrosat Proposals:

Scientific Justification: (4-page limit)

- ❏ Describe scientific background, target of interest & motivation for the proposed observation.
- ❏ Scientific objectives, selection of targets, & demonstrating scientific feasibility with estimates of signal-to noise, flux/count rate expected.
- ❏ Justification of requested observing time: spectral and/or temporal simulations.
- ❏ Justification of why the science case requires new observations if prior data is available in the archive.

Report on previous successful AstroSat proposals by PI if any.

Astrosat Proposals:

Technical Justification: (2-page limit)

- ❏ Type of the Proposal
- ❏ Selection of the primary & secondary instruments.
- ❏ Target visibility: Output from AVIS or Astroviewer tool.
- ❏ Details of bright UV sources in the field of UVIT and near the field as per the list of mandatory safety checks.
- ❏ Selection of filters, S/N for the requested exposure (after accounting for source counts, background, nearby source).
- ❏ Details of time constraint: Coordinated observations with other observatories, etc. Monitoring duration and frequency, Trigger criteria of AToO.

Proposal Types

(a) <u>Regular pointing</u> (with or without any time constraints)**:**

- Simplest type of proposal is without any time constraint.
- Proposers can propose one or more targets requesting one pointing per target.
- Time Constraint proposals need stronger science justification than a regular proposals without time constraint.
- For each target in a proposal with time constraint, only one observation will be made. Multiple time constraints may be given only for the ease of scheduling.
- If multiple observations are required, it is advisable to write either a monitoring proposal or seperate proposal.

Proposal Types

(b) <u>Monitoring proposals</u> : Proposers can request monitoring observations with a minimum interval of 3 days between two consecutive observations.

- ❏ Multiple observations of a single target with specified intervals between successive observations.
- ❏ All observations are identical i.e., exposure time and instrument configuration do not change from one observation to another.
- ❏ Successive observations need not be equally spaced. It depends upon scientific goals. Constraints on the mission operation-- Strong justification needed.
- ❏ Recommended to propose only one target in one Monitoring Proposal.

Two additional inputs required:

- Number of observations
- Interval between successive observations (in days)

Proposal Types

(c) Anticipated ToO proposals:

- ❏ Interesting astronomical event is foreseen but the exact timing of the event is unknown. Estimate of triggering probability and trigger duration, and provide relevant justification.
- ❏ Anticipated ToO proposals cannot request for follow-up observations in the same proposal.
- ❏ Strong scientific justification is needed as it can interfere the other scheduled observations.

Three additional inputs are required:

1. Triggering criteria (e. g., the source flux crosses certain threshold or a black X-ray binary makes a transition to a particular state, etc.)
2. Estimated probability of occurrence (between 0 and 1)
3. Expected duration of the event (in hours)

Proposal Types

(d) AstroSat long term key proposals (limit to 6 pages):

ALTKP target specific science problems demanding long term observations.

- ❏ Address key science that cannot be achieved with the currently available data. Preference shall be given to proposals which will have wider interest in Astronomical community.
- ❏ Preference will be given to proposals utilizing simultaneous multi-wavelength observation capability of AstroSat. Use of multiple payload will be encouraged.
- ❏ A detailed and extended Scientific Justification (up to six pages) must be provided, addressing:
    1. *The scientific merits, by giving examples of previous similar surveys/monitoring programmes of other observatories and how the proposed programme improves upon them.*
    2. *A stronger justification for monitoring proposals.*
    3. *A proven expertise in analysing AstroSat data and listing of the earlier accepted AstroSat proposals and publications based on them.*
    4. *PDFs and young researchers are encouraged to lead the project*

Observing efficiencies for different payloads:

OBSERVATION TIME / OBSERVING EFFICIENCY = STARE TIME

STARE TIME >> OBSERVATION TIME

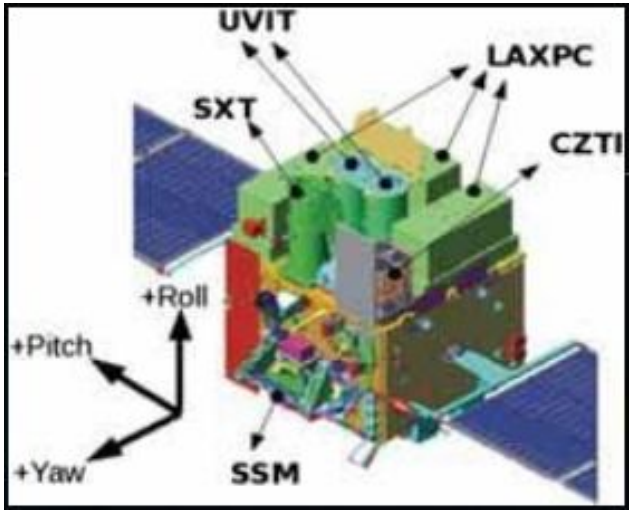
payload	observing efficiency
UVIT[1]	15% (for field sizes 250x250 or larger) < 15% (for smaller fields, see table below)
SXT	25%
LAXPC	45%
CZTI	45%

fuv/nuv field size	frame rate	maximum exposure time per orbits (subjected to 15% observing efficiency)
100x100	640/sec	200 sec
150x150	300/sec	454 sec
200x200	180/sec	769 sec
250x250	115/sec	1162 sec
300x300	82/sec	1470 sec
400x400	61/sec	2500 sec
full field	29/sec	3571 sec

SXT observing time of 10ks will result in a total stare time of 40ks, and the observing time of 6ks for UVIT (full field), and 18ks for LAXPC and CZTI.

Relative Angle:

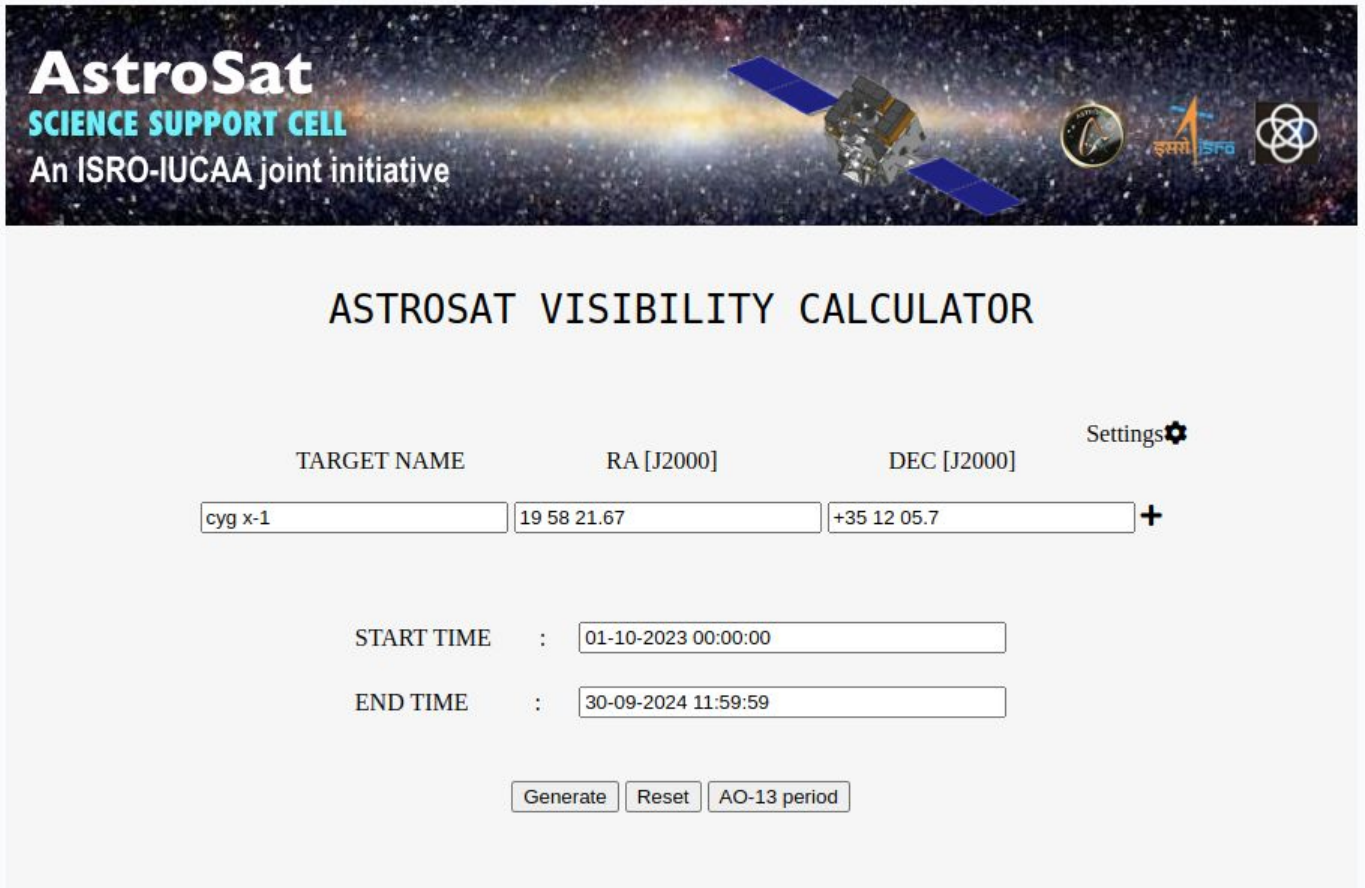
Payload	Angle between Payload Boresight and Body Roll (deg)
UVIT	0.0419
SXT	0.0512
LAXPC 10	0.1605
LAXPC 20	0.1844
LAXPC 30	0.1486
LAXPC-MEAN	0.1514
CZTI	0.0041



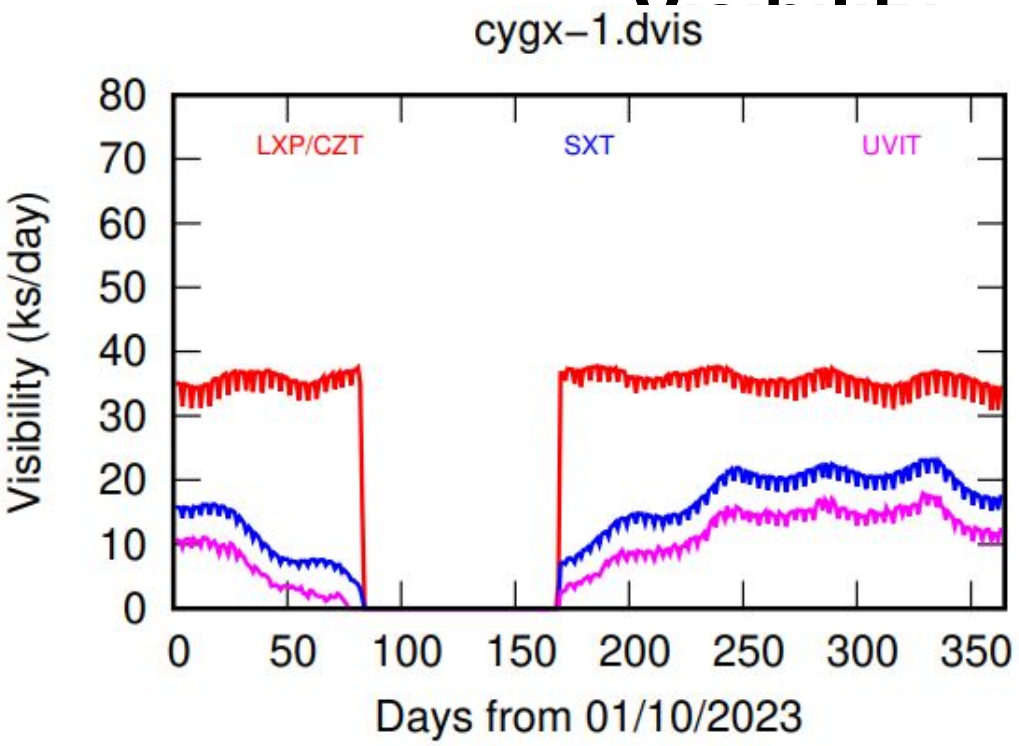
These offsets are of the order of a few arcmins. Therefore, the proposers should use the PC mode when SXT is not the primary instrument. This is because, the source may be out of the SXT FoV for the FW mode in this case. However, one may need to use the SXT FW mode for some science goals in order to reduce pile-up and/or to have better time resolution. In such a case, proposers should make SXT the primary instrument, even if SXT does not serve the primary science.

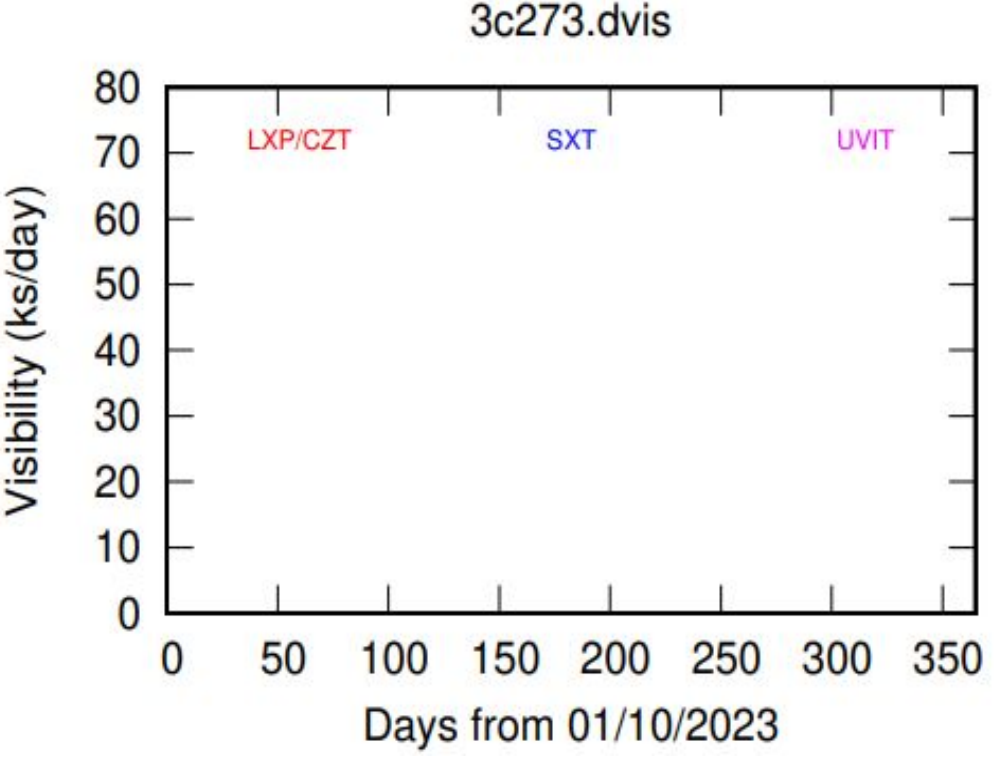
Avis Online Interface

http://astrosat-ssc.iucaa.in:8080/AstroVisCal/



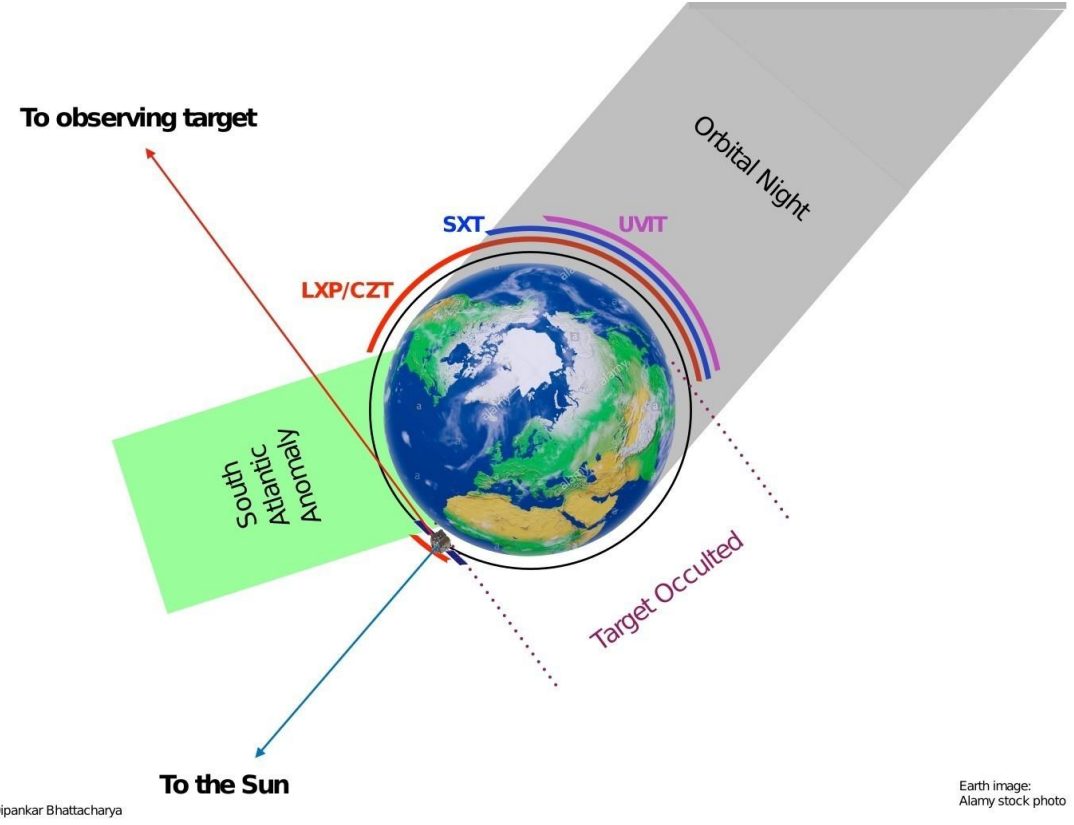
AVIS Source Visibility





If your science case requires time constraints, ensure that the time constraints are covered by the visibility windows.

AstroSat payloads receive different exposures per orbit



SXT and UVIT can observe only during orbital night. For UVIT there is an additional overhead of switching on after the orbital night begins and switching off before orbital night ends. SXT does not undergo such an on-off sequence.

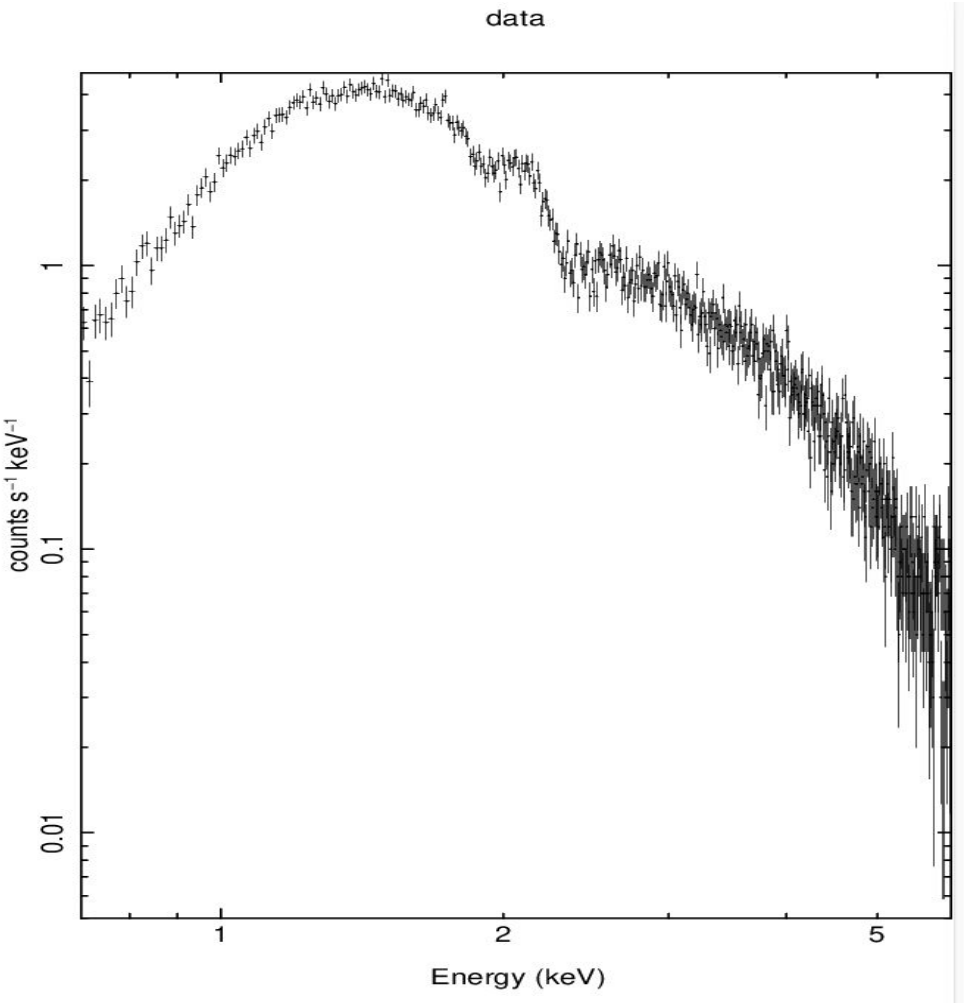
All instruments are switched off during SAA.

Fake Spectrum: SXT

```
XSPEC12>energies reset

All model energies will be taken from non-extended response energies.

XSPEC12>data none
XSPEC12>
XSPEC12>fakeit SkyBkg_comb_EL3p5_Cl_Rd16p0_v01.pha
For fake spectrum #1 response file is needed: sxt_pc_mat_g0to12.rmf
   ...and ancillary file: sxt_pc_excl00_v04_20190608.arf
 Use counting statistics in creating fake data? (y): y
 Input optional fake file prefix:
 Fake data file name (sxt_pc_mat_g0to12.fak): sxt_spec.fak
 Exposure time, correction norm, bkg exposure time (244694., 1.00000, 244694.): 10000.0 1.0 10000.0
***Warning: Detected response matrix energy bin value = 0 (or neg).
     XSPEC will instead use small finite value (response file will not be altered).
```

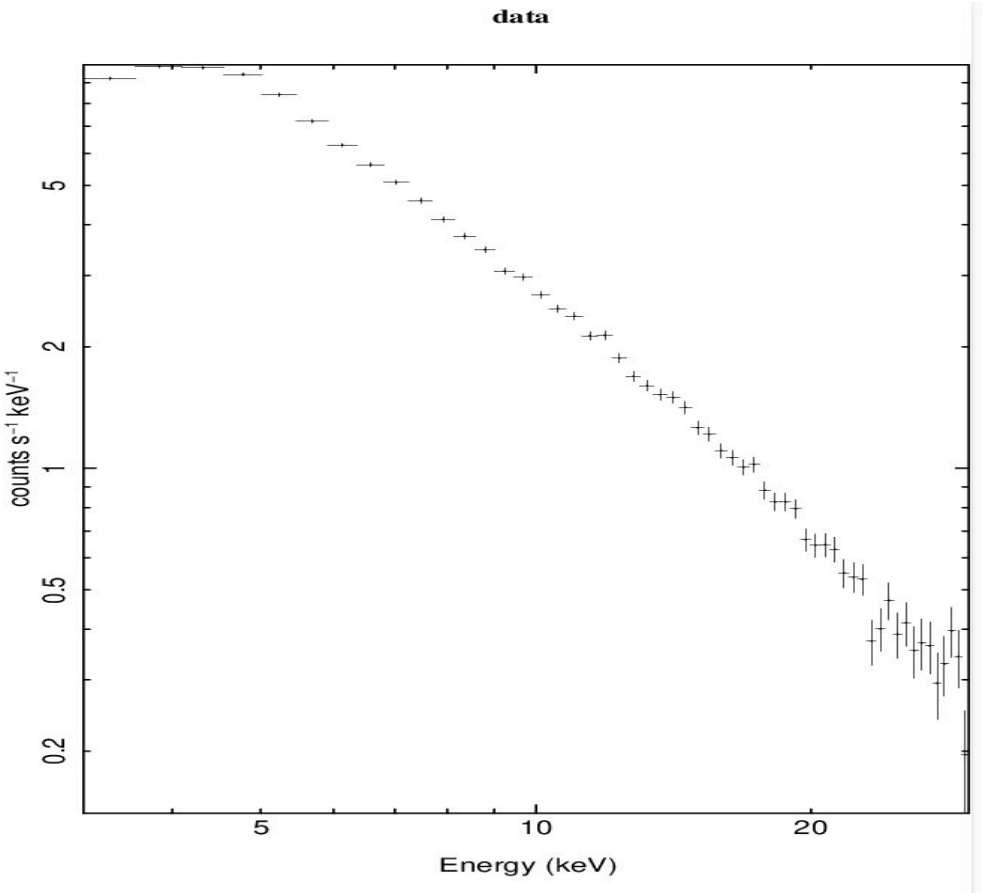


Count rate ~6 cts/s

Fake Spectrum: LAXPC

```
XSPEC12>data none
XSPEC12>
XSPEC12>fakeit backlx20mar16.pha
For fake spectrum #1 response file is needed: lx20v1.0.rsp
   ...and ancillary file: none
 Use counting statistics in creating fake data? (y): y
 Input optional fake file prefix:
 Fake data file name (lx20v1.0.fak): laxpc_spec.fak
 Exposure time, correction norm, bkg exposure time (48583.0, 1.00000, 48583.0): 18000.0 1.0 18000.0

No ARF will be applied to fake spectrum #1 source #1
```



Count rate ~62 cts/s

Event file simulator: LAXPC

The simulated event file for LAXPC can be used to construct simulated energy dependent lightcurves, power spectra, energy and frequency dependent time-lags using the laxpc data analysis software.

Compilation: ***gfortran simul.f libcfitsio.a -o Event_simul***

Input files: input_fak_specfiles and input_simul

Usage: ./Event_simul

Output: simul_level2.event.fits

Light curve simulator: LAXPC (MAXI J1659-152)

Input_fak_specfiles:

1. Spectrum (fake it/real) file: **Spectra.fak**
2. Background spectrum file: **Backspec.fak**
3. Response file: **lx20v1.0.rsp**
4. No. of proportional counters on: **1**
5. Name of output event file: **simul_level2.event.fits**

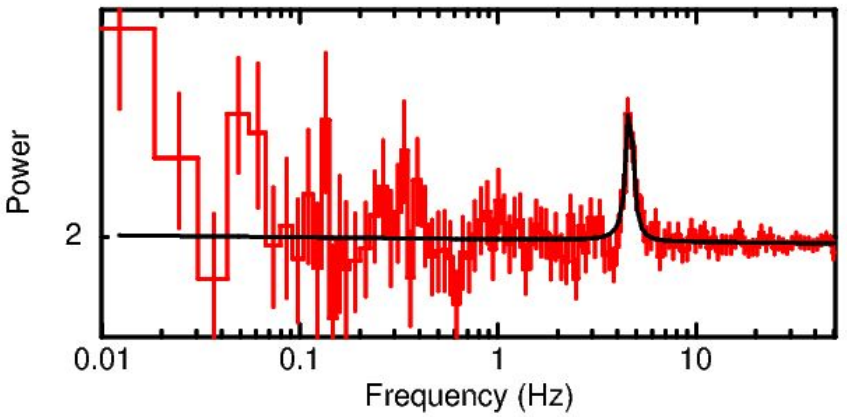
input_simul :

1. Exposure time for simulation in seconds : **5000**
2. Frequency of QPO in Hz : **4.6**
3. Width of QPO in Hz : **0.25**
4. R.M.S of QPO : **0.06**
5. Index of power-law continuum of powerlaw spectrum : **1**
6. Normalization of power-law continuum : **1e-4**

Simulated QPO in 15-25 keV using LAXPC lightcurve

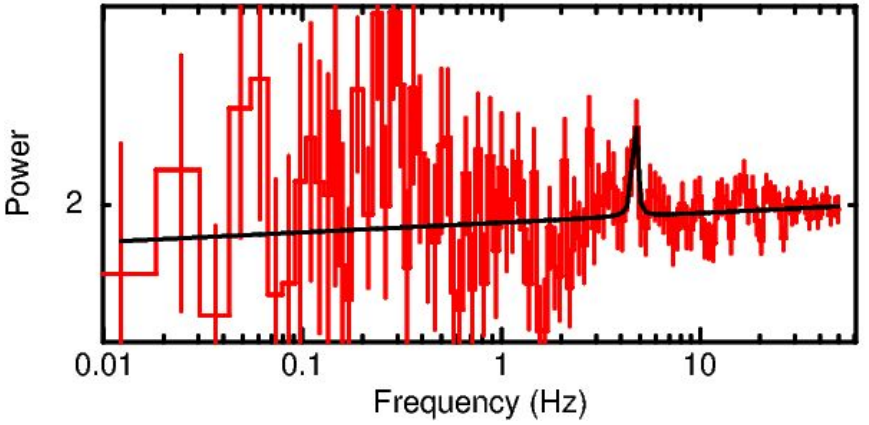
1. > laxpc_find_freqlag -l 0.01 -h 50.0 -f 4.6 -p 1 -e eneinput simul_level2.event.fits
   >gnuplot>plot '1Pow_level2.event' u 3:8 w l (this will plot power as a function of frequency)

2. > laxpc_make_lightcurve -p 1 -t 0.01 -e eneinput simul_level2.event.fits



15000 sec exposure

Frequency = 4.6±0.05 Hz
Width = 0.41±0.19 Hz
Q-factor = 11.3, 7 sigma



2000 sec exposure

Frequency = 4.6±0.1 Hz
Width = 0.18±0.8 Hz
Unable to constraint 1 sigma error on normalization 0.6

Announcements

- Cycle A12
- Cycle A11
- Cycle A10
- Cycle A09
- Cycle A07
- Cycle A05
- Cycles A04 and G08
- Cycles A03 and G07
- Target of Opportunity (ToO) proposals

List of Successful Proposals in Different Cycles

Online tools

- AstroSat Proposal Processing System
- Scientific justification LaTeX template
- Technical justification LaTeX template
- AstroSat source visibility calculator Astroviewer
- Avis online interface
- UVIT exposure time calculator at IIA
- UVIT exposure time calculator at Calgary
- UVIT bright source warning tool
- UVIT VIS filter checking CanUVIT tool (updated)
- UVIT FUV/NUV filter checking CanUVIT tool (updated)
- AstroSat WebPIMMS
- UVIT 9-Point Coordinate Generator

New!!

Press Release

- The mysteriously bright flash is a black hole jet pointing straight towards Earth, astronomers say !
- Witnessing the 'live' formation of dwarf galaxies with AstroSat's ultraviolet-eye
- Black hole bonanza: India's AstroSat witnesses black hole birth for the 500th time

07.02.23 A13 cycle will be opening for proposal submission from 13.2.2023

13.12.22 A new CZTI software version (3.0), caldb version and Software User Guide (Version 3.0) is released

15.08.22 A new Format A LAXPC software version August 15, 2022 having individual routines to extract spectrum and light curve is released with the improved background

30.05.22 A new LAXPC software version (3.4.3) having a single routine to extract spectrum and light curve is released with the improved background

26.03.22: Upcoming workshop: Three-day workshop on High Energy Astrophysics from 9th-11th May 2022. Last date of application is 31st

Documents

- CanUVIT: A python package to check whether a field is safe for observations with UVIT. Click here to view PDF New
- AstroSat Proposers Guide
- Mandatory checks to be done for UVIT observations
- List of all accepted proposals with targets till A12 Cycle
- Red Book: A10 proposals allocated time till September 2020
- Red Book: GT and AO proposals allocated time till September 2019
- Red Book: Proposals allocated time till 2017-2018
- AstroSat Handbook
- Relative Alignment of AstroSat payloads, ISRO Mission document, 15 July 2016

Downloadable Resources

Source visibility estimator

- Astroviewer -- a linux command line version (64 bit)
- Astroviewer for linux 32-bit
- Orbital elements for use with Astroviewer
- UVIT 9-point coordinate generator script

UVIT simulator

- UVIT Imaging Simulator
- Simulator Manual
- Sample Images

X-ray resources

- PIMMS package
- Response files for AstroSat X-ray instruments
- LAXPC event list simulator: For feasibility of QPO detection and energy dependent time lags

11th May 2022. Last date of application is 31st March 2022

07.09.21: Problem of gaps in X-centroid in the L1 data of UVIT

01.09.21: The JAA has published a special issue titled "AstroSat: 5 years in orbit"

13.08.21: Videos/talks of the Advanced AstroSat data analysis workshop are now available

12.08.21: ASIMOV (Astronomical Satellites: Is My Object Visible)

12.08.21: Sky Plot of AstroSat Observations

Thank you