



AstroSat Proposal Preparation

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Proposal/Observing Cycles

ISRO has established AstroSat as an astronomical observatory and over the last few years, has periodically released announcements of opportunity (AO) calls, soliciting proposals from national and international Astronomy community to observe using AstroSat instruments.

***AO-9 (Announcement of Opportunity) cycle :
1 April 2020 – 30 September 2020***

The last date for submission of proposals: 14th November, 2pm (IST)

Current allocation of Observing Time on AstroSat
~65% (Indian observers) and 20% (International Observers.)

Astrosat Proposals:

Scientific Justification: (4-page limit)

- Describe scientific background & 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.
- **New Section : Report on previous successful AstroSat proposals by PI if any.**

Technical Justification: (2-page)

- Target visibility: Astroviewer output, AVIS output.
- 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) Regular pointing (with or without any time constraints):

- Simplest type of proposal is without any time constraint.
- Proposals for one or more targets requesting one pointing per target.
- Time Constraint proposals needs stronger science justification then a regular without time constraint proposals
- 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, then write monitoring proposal or seperate proposal.

Proposal Types

(b) Monitoring proposals : In this cycle, 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 observation.
- Successive observations need not equally spaced.
- Constraints on the mission operation-- Strong justification needed.
- Recommended to propose only one target in one Monitoring Proposal.

Two additional inputs required:

- (i) Number of observations
- (ii) 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 needed.

Three additional inputs required:

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

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.

Astroviewer Tool: web based tool

<https://webapps.issdc.gov.in/astroviewer/jsp/UserInput.jsp>

AstroSat visibility period for observations of a target of interest.

Inputs :


- Name of the source.
- Right Ascension and Declination of the source in degrees.
- Start/End Time of the proposed duration of observation in UT.

DEFAULT WRITTEN IN THE webpage: Angle Limits between Roll and Sun (ROS), Angle Limits between Negative Roll and Sun, Angle Limits between Roll and Moon (ROM), Angle Limits between Roll and velocity vector (RAM), Earth Limb angle.


To avoid any damage to coating of the primary mirror of UVIT/SXT, due to atomic oxygen, a minimum angle of 12° is kept between the ram direction and the roll-axis, i.e. axis of UVIT.

To avoid damage/UV-assisted contamination due to radiation from Sun/bright-Earth/ Moon, a minimum angle of $45^\circ/12^\circ/15^\circ$ is kept between the axis and Sun/ bright-Earth/Moon at all times even if UVIT is not observing.

Astroviewer Web-interface



ASTROSAT
India's Space Observatory
View Profile Portal



[Home](#) | [Feedback](#) | [Report a Problem](#)

Downloadable version available here, For Linux: [64bit](#) [32bit](#)

- The reference frame taken is J2000. The step size taken for plot is 1 min.

User Details:

UserName

guest

Celestial Source

CygnusX1

View profile:

Right Ascension

299.587

i.e. Degree/Hrs:Min:Sec

Declination

35.201

i.e. Degree/Deg:ArcMin:Sec

Start Time

2020

Mar

1

00

00

00

End Time

2020

Oct

1

00

00

00

Standard Inputs: [change/default](#)

Roll-Sun Vector Angle

65

Negative Roll-Sun Vector Angle

30

Roll-Moon Vector Angle

15

Roll-Velocity Vector Angle

12

Angle Limit From Earth Limb

12

Advanced Options:

Generate Plot

☒

The following Inputs are given for Successful processing

User Name:

Name of celestial Source:

Right Ascension of celestial Source:

Declination of celestial Source:

Time (In UT)

Angle between Roll and Sun vector(ROSV):

Angle between -Ve Roll and Sun vector(-ve ROSV):

Angle between Roll and Moon vector(ROM):

Angle between Roll and Velocity vector(RAM):

Angle limit from Earth limb:

Generation of Plots:

guest

CygnusX1

299.587 degrees

35.201 degrees

From: 2020-3-1 0:0:0 To: 2020-10-1 0:0:0

65 degrees

30 degrees

15 degrees

12 degrees

12 degrees

YES

[Confirm and Proceed](#)

[Confirm](#)

[Reset](#)

Processing completed, files are ready to view

[View File](#)

[View Plot](#)

Astroviewer Source Visibility: Cygnus X-1

ASTROSAT														
View Opportunity Duration														
System(RUN) time in U.T: 2019 11 8 10 26 48 0														
Celestial Source Name : CygnusX1										RA(deg): 299.58700		Dec(deg): 35.20100		
Epoch(UT): 2020 3 1 0 0 0 0														
Propagation duration in days: 214.000000														
Entry and Exit timings of the source viewing														
orbno		Entrance(UT)						Exit(UT)						dur(min)
024160	2020 03 17 11 41 00 000	2020 03 17 12 10 00 000										29.000		
024161	2020 03 17 12 23 25 328	2020 03 17 13 03 56 430										40.518		
024162	2020 03 17 13 31 00 000	2020 03 17 13 54 00 000										23.000		
024162	2020 03 17 14 00 49 799	2020 03 17 14 41 21 143										40.522		
024163	2020 03 17 15 19 00 000	2020 03 17 16 18 45 956										59.766		
024164	2020 03 17 17 05 00 000	2020 03 17 17 56 10 771										51.180		
024165	2020 03 17 18 49 00 000	2020 03 17 19 33 35 501										44.592		

Total View duration(does not account all operational constraints) of the source(RA: 299.587000(degrees) Dec: 35.201000(degrees) for the given user period is : 284421.000000(min)

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

Astroviewer

Source

Visibility:

Cygnus X-1

ASTROSAT View opportunity duration in Eclipse(UVIT)

Celestial Source Name : CygnusX1
Epoch(UT): 2020 3 1 0 0 0 0
Propagation duration in days: 214.000000

RA(deg): 299.58700 Dec(deg): 35.20100

Entry and Exit timings of the source viewing duration in eclipse(UVIT)

orbno	Entrance(UT)							Exit(UT)							dur(min)
024161	2020	03	17	12	40	40	524	2020	03	17	13	03	56	430	23.265
024162	2020	03	17	14	18	06	370	2020	03	17	14	41	21	143	23.246
024163	2020	03	17	15	55	32	454	2020	03	17	16	18	45	956	23.225

ASTROSAT occult duration

Celestial Source Name : CygnusX1
Epoch(UT): 2020 3 1 0 0 0 0
Propagation duration in days: 214.000000

RA(deg): 299.58700 Dec(deg): 35.20100


Entry and Exit timings of the Occult duration of source

orbno	Entrance(UT)							Exit(UT)							dur(min)
023917	2020	03	01	00	13	20	587	2020	03	01	00	52	55	993	39.5901
023918	2020	03	01	01	50	46	144	2020	03	01	02	30	21	413	39.5878
023919	2020	03	01	03	28	11	732	2020	03	01	04	07	46	959	39.5871
023920	2020	03	01	05	05	37	362	2020	03	01	05	45	12	490	39.5855
023921	2020	03	01	06	43	02	846	2020	03	01	07	22	37	967	39.5854
023922	2020	03	01	08	20	28	554	2020	03	01	09	00	03	602	39.5841
023923	2020	03	01	09	57	54	046	2020	03	01	10	37	29	016	39.5828
023924	2020	03	01	11	35	19	717	2020	03	01	12	14	54	645	39.5821

Avis Online Interface

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

AstroSat
SCIENCE SUPPORT CELL
An ISRO-IUCAA joint initiative



ASTROSAT VISIBILITY CALCULATOR

TARGET NAME

RA [J2000]

DEC [J2000]

Settings ⚙

cygnus x-1

19 58 21.67

+35 12 05.7

+

START TIME

:

01-03-2020 00:00:00

END TIME

:

01-10-2020 00:00:00

Generate

Reset

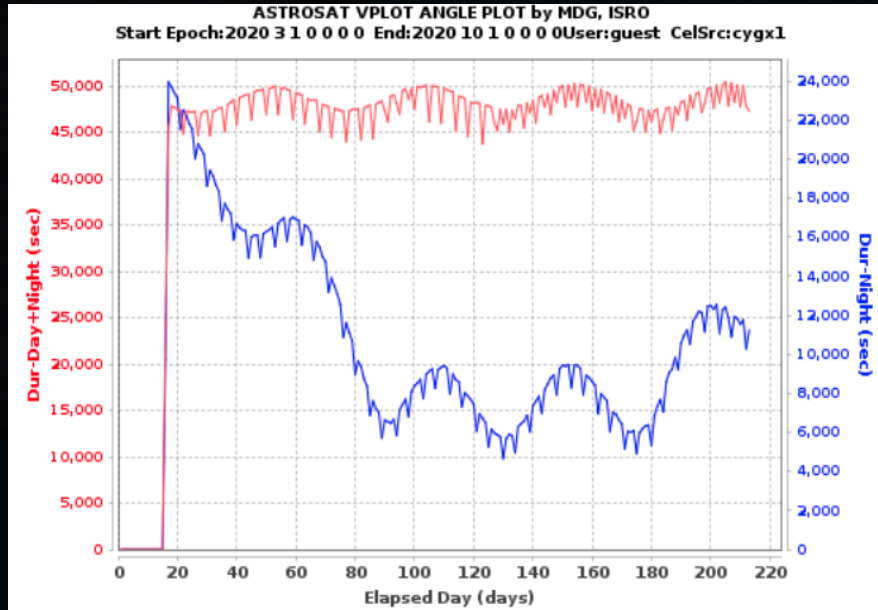
AO-9 period

AVIS Source Visibility: Cygnus X-1

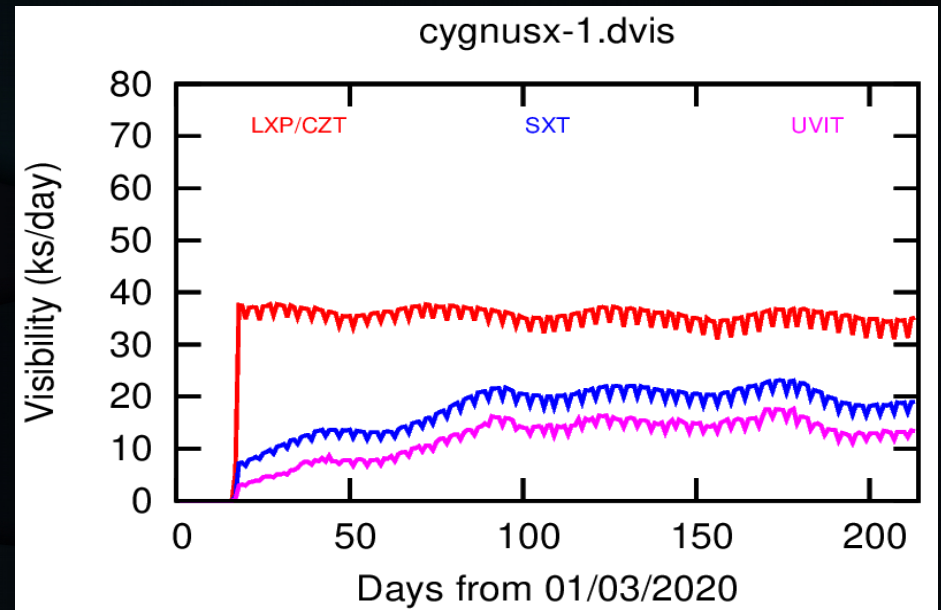
```
# Astrosat Mission. Orbital Period 5860.38 s
# Visibility for cygnusx-1 RA2000: 299.5903 deg Dec2000: 35.2016 deg
# Starting on 1/3/2020 0:0:0.0UT : MJD 58909.0000000
# Constraints: Sun 65.0 Moon 15.0 Ram 12.0 Limb 12.0 NegRollSun 30.0
# SAA Trapz LatRef -6.0 Long Min -110.0 Max 0.0 Slope L 3.50 R 0.00
# St.MET, elapsed days, MJD, min Ram, Sun ang, Moon ang, vis (s): LXP/CZT, SXT, UVT
#-----
320716800.00 0.0680556 58909.0680556 41.2 58.6 97.5 0.0 0.0 0.0
320722660.38 0.1361111 58909.1361111 41.2 58.6 97.9 0.0 0.0 0.0
320728520.76 0.2041667 58909.2041667 41.2 58.7 98.3 0.0 0.0 0.0
320734381.15 0.2715278 58909.2715278 41.2 58.7 98.8 0.0 0.0 0.0
320740241.53 0.3395833 58909.3395833 41.2 58.7 99.2 0.0 0.0 0.0
320746101.91 0.4076389 58909.4076389 41.2 58.7 99.6 0.0 0.0 0.0
320751962.29 0.4750000 58909.4750000 41.3 58.7 100.0 0.0 0.0 0.0

323816942.28 35.9493056 58944.9493056 32.8 74.4 114.9 2160.0 1080.0 710.0
323822802.66 36.0173611 58945.0173611 32.8 74.5 114.5 2100.0 1140.0 770.0
323828663.04 36.0854167 58945.0854167 32.9 74.5 114.1 1920.0 1080.0 710.0
323834523.43 36.1527778 58945.1527778 32.9 74.5 113.7 2220.0 1140.0 770.0
323840383.81 36.2208333 58945.2208333 32.9 74.6 113.3 2520.0 1140.0 770.0
323846244.19 36.2888889 58945.2888889 33.0 74.6 113.0 2820.0 1080.0 710.0
323852104.57 36.3562500 58945.3562500 33.0 74.6 112.5 3180.0 1140.0 770.0
```

Astroviewer Source Visibility

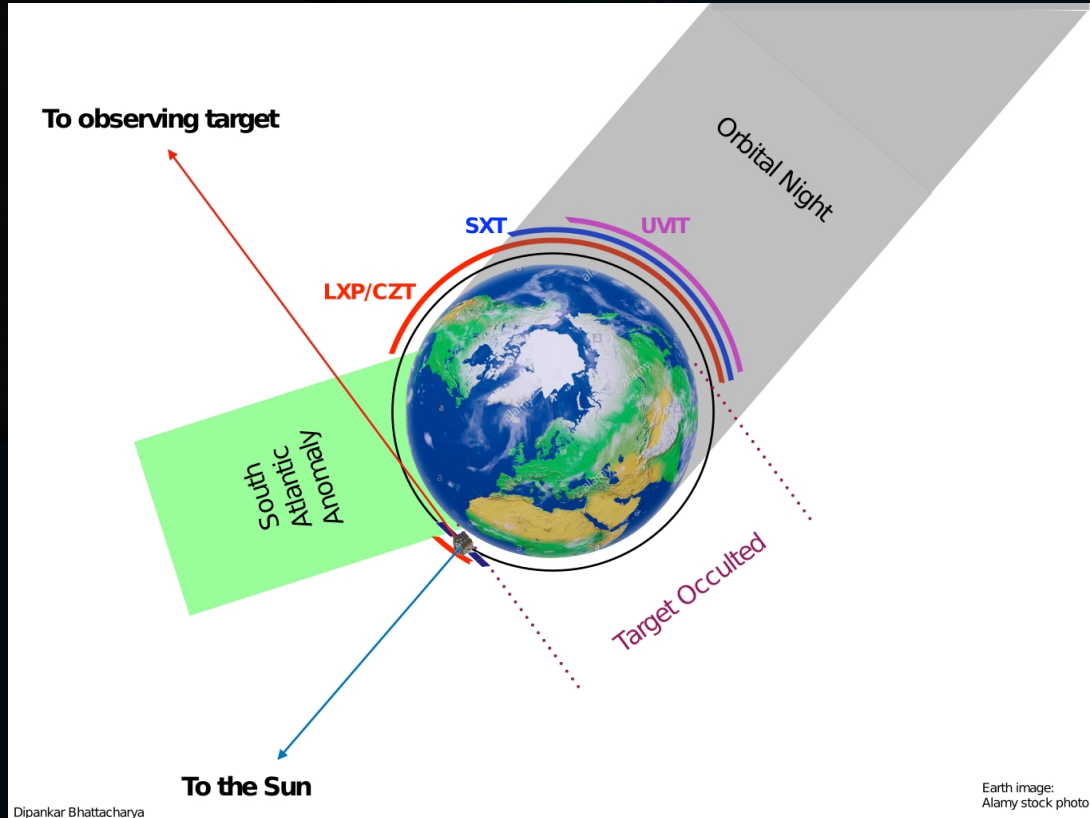


AVIS Source Visibility



Cygnus X-1

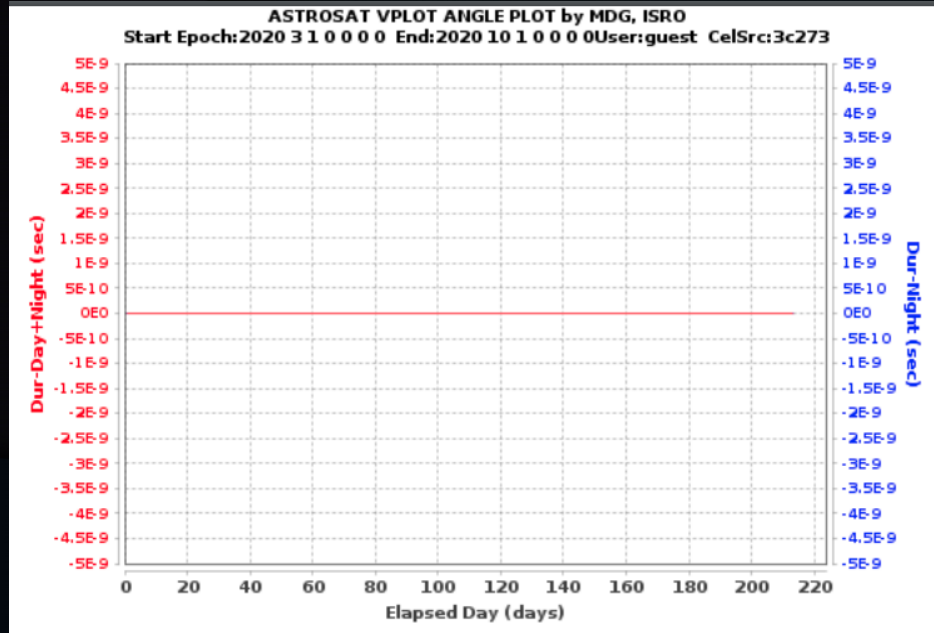
AstroSat payloads receive different exposures per orbit.



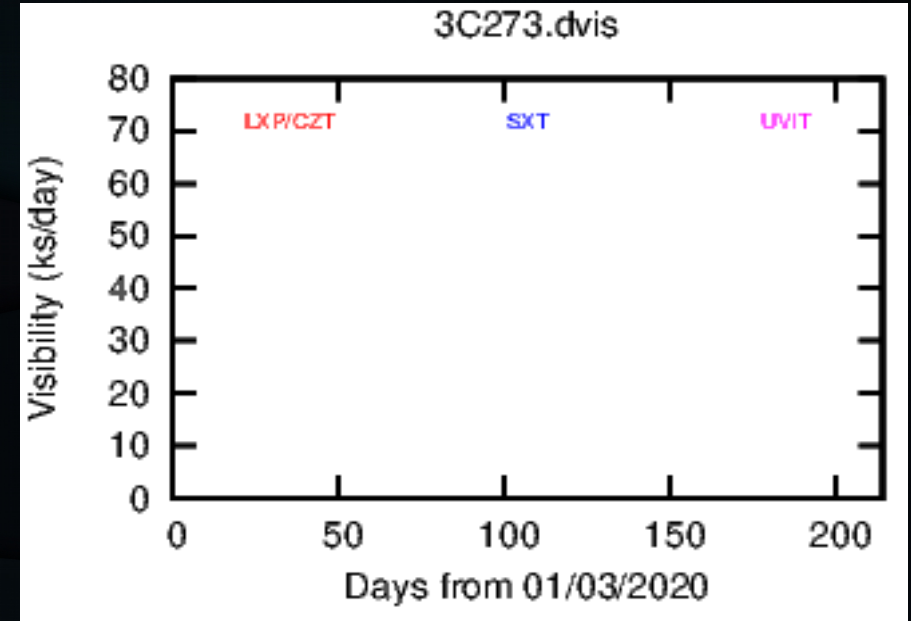
SXT and UVIT can observe only during orbital night. For UVIT there is the additional overhead of switching on after the orbital night begins and switching off before orbital night ends. SXT does not undergo such an on-off sequence.

All instruments are switched off during SAA.

Astroviewer Source Visibility



AVIS Source Visibility



3C 273

(R.A. : 12 29 06.699, Dec. : +02 03 08.598)

Astroviewer Source Visibility:

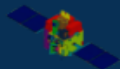
3C 273

ASTROSAT															
View Opportunity Duration															
System(RUN) time in U.T: 2019 11 8 10 8 48 0															
Celestial Source Name : 3c273							RA(deg): 187.27500			Dec(deg): 2.05200					
Epoch(UT): 2020 3 1 0 0 0 0															
Propagation duration in days: 214.000000															
Entry and Exit timings of the source viewing															
orbno	Entrance(UT)							Exit(UT)				dur(min)			
no time all the attitude constraints were met for this source for the given period															

ASTROSAT															
View opportunity duration in Eclipse(UVIT)															
Celestial Source Name : 3c273							RA(deg): 187.27500			Dec(deg): 2.05200					
Epoch(UT): 2020 3 1 0 0 0 0															
Propagation duration in days: 214.000000															
Entry and Exit timings of the source viewing duration in eclipse(UVIT)															
orbno	Entrance(UT)							Exit(UT)				dur(min)			
no time all the attitude constraints were met for this source for the given period															

ASTROSAT															
occult duration															
Celestial Source Name : 3c273							RA(deg): 187.27500			Dec(deg): 2.05200					
Epoch(UT): 2020 3 1 0 0 0 0															
Propagation duration in days: 214.000000															
Entry and Exit timings of the Occult duration of source															
orbno	Entrance(UT)							Exit(UT)				dur(min)			
023916	2020	03	01	00	00	00	000	2020	03	01	00	23	54	144	23.9024
023917	2020	03	01	01	19	24	537	2020	03	01	02	01	18	950	41.9069
023918	2020	03	01	02	56	49	345	2020	03	01	03	38	43	806	41.9077
023919	2020	03	01	04	34	14	223	2020	03	01	05	16	08	700	41.9080
023920	2020	03	01	06	11	39	091	2020	03	01	06	53	33	496	41.9067

UVIT VIS filter checking tool (Theia)



Theia (VIS Filter Checking Tool)

UVIT VIS Filter Check

Note:

- This tool is intended to check the appropriate filter for use with the VIS channel of UVIT.
- Please choose the primary instrument and provide the RA and DEC of the source in sexagesimal units.
- We suggest to use only one VIS filter for continuity of tracking.

Primary Instrument UVIT ▼

RA For eg.: 12:12:12 (hms)

DEC For eg.: -20:10:14 (dms)

Source : M81

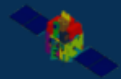
Primary Instrument:	UVIT	RA:	09:55:33	DEC:	+69:03:55				
RA (hms)	DEC (dms)	mag	B-V	SpecType	VIS3	VIS2	VIS1	ND1	BK7
09:57:00.78	+68:54:06.444	9.25	1.045	K4	6067.5	417.7	253.6	136.4	7161.5
09:55:04.176	+68:54:05.724	9.256	0.415	F5	10800.0	1733.3	1334.8	242.4	14100.0
09:55:04.176	+68:54:05.724	9.284	0.482	F5	10500.0	1689.2	1300.9	236.2	13800.0
09:58:01.5648	+68:57:24.336	10.258	0.422	F5	4273.5	688.8	530.4	96.3	5615.8
09:53:17.676	+69:02:48.156	10.446	1.335	K7	1756.0	103.4	47.7	39.3	2050.8
09:55:01.0296	+68:56:22.488	10.591	0.712	G8	2459.1	290.4	225.6	54.8	3099.8
09:55:02.6808	+68:56:21.984	10.657	0.668	G5	2314.0	273.3	212.3	51.6	2917.0

Safe VIS filter(s) for this field: VIS2, VIS1, ND1

(Safe limit for VIS filter: 4800 cps)

"Further, for good tracking of the aspect, there should be at least 2 stars within 12' radius of the target with count rates greater than 30 c/sec (for good S/N) and lesser than 1000 c/sec (to avoid saturation) in the chosen filter. "

UVIT FUV/NUV filter checking tool (Gaia) : M81



Gaia (UV Filter Checking Tool)

Note:

- This tool has certain caveats. Please read the [document](#) to know more about the procedures that this tool performs and the drawbacks if any.
- This tool is **"NOT RECOMMENDED"** when the coverage of the field is partial (which the tool outputs in any case), that includes zero coverage by GALEX.
- This tool is intended to check the appropriate filter for use with the UV channels.
- Please choose the primary instrument and provide the RA and DEC of the source in sexagesimal units.

Primary Instrument

RA For eg.: 7:36:51 (hms)

DEC For eg.: 65:36:9 (dms)

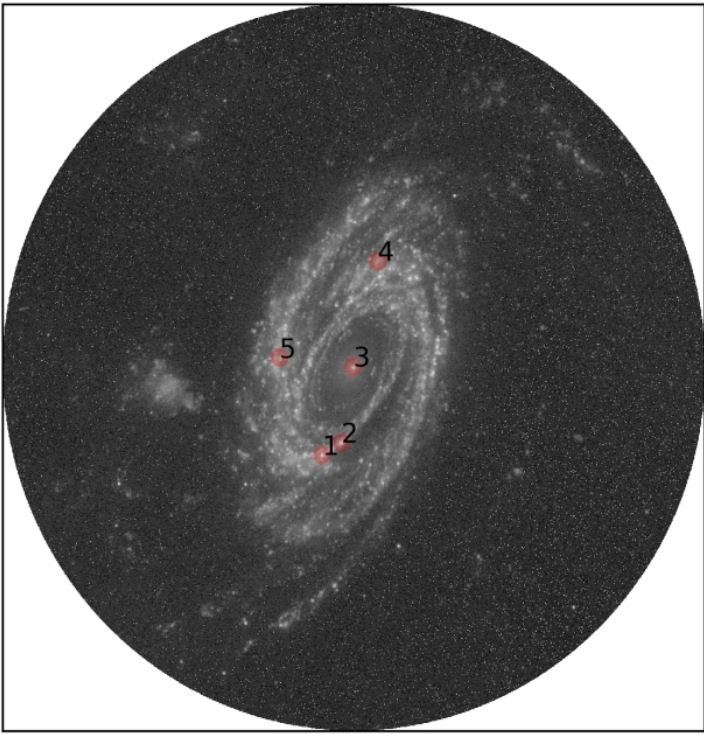
Your input conditions:

Primary Instrument: UVIT RA: 09:55:33 DEC: +69:03:55

- The UVIT ~20 arc-minute field of view can have potential bright objects that can trigger a BOD (Bright object detection).
- Due to offsets relative to UVIT :(1) SXT : primary instrument search 25 arc min around TOI and (2) LAXPC: primary instrument search 28 arc min around TOI.
- The filters for which the count rates are lesser than 1500 in both NUV and FUV are safe for observations.

UVIT FUV filter checking tool Output (Gaia) : M81

Detected bright sources marked

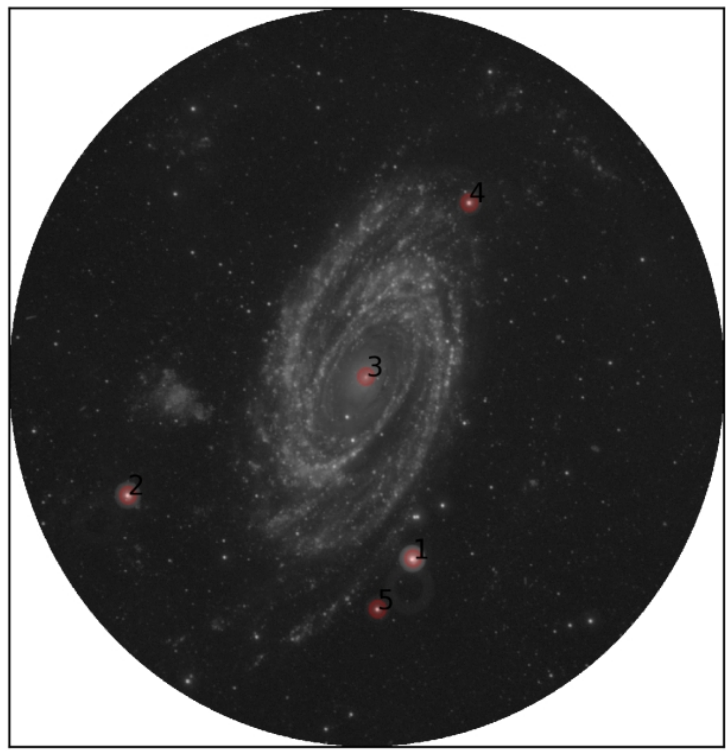


Sl No.	RA (hms)	DEC (dms)	Mag	Mag_corrected	CaF2	BaF2	Sapphire	Silica
1	09:55:52.9035	+68:59:04.1618	17.00	17.00	3.07	2.61	1.94	0.68
2	09:55:40.836	+68:59:45.6445	17.47	17.47	1.99	1.70	1.26	0.44
3	09:55:33.3968	+69:03:54.9094	17.86	17.86	1.40	1.19	0.88	0.31
4	09:55:17.8651	+69:09:45.5203	19.03	19.03	0.47	0.40	0.30	0.10
5	09:56:20.5133	+69:04:24.0355	18.71	18.71	0.64	0.54	0.40	0.14

Safe filters in FUV: ['CaF2', 'FUV-grating', 'BaF2', 'Sapphire', 'Silica']

UVIT NUV filter checking tool Output (Gaia) : M81

Detected bright sources marked



Sl No.	RA (hms)	DEC (dms)	Mag	Mag_corrected	Silica	B4	B13	B15	N2
1	09:55:04.023	+68:54:04.5626	13.62	13.27	493.37	108.54	133.21	36.51	27.14
2	09:58:01.5542	+68:57:24.1729	14.18	13.94	265.16	58.34	71.59	19.62	14.58
3	09:55:33.3968	+69:03:54.9094	16.95	16.95	16.56	3.64	4.47	1.23	0.91
4	09:54:28.6523	+69:13:21.7527	15.01	15.01	98.90	21.76	26.70	7.32	5.44
5	09:55:25.8475	+68:51:21.1462	15.68	15.68	53.25	11.72	14.38	3.94	2.93

Safe filters in NUV: ['Silica', 'NUV-grating', 'NUV-B4', 'NUV-B13', 'NUV-B15', 'NUV-N2']

Special cases in using the GAIA tool :

- Choice of FUV/NUV filters (Only NUV GALEX images are available) :
If only NUV images are in the GALEX archive, the tool gets the magnitude in NUV using the algorithm if $\text{mag_diff} < 1.2$ and $\text{PSF FWHM} < 0.0043$ deg, then NUV magnitude is considered from galex catalogue else from image photometry. The FUV (GALEX) magnitude is calculated using Rayleigh – Jeans approximation as,

$$m^{\text{FUV}} = m^{\text{NUV}} - 1.65.$$

If the required field is not covered by GALEX NUV images, there is a lot of uncertainty.

- In case the field lies in any of the bright areas (within ± 30 degree Galactic latitude or LMC or SMC) any exposures in NUV and FUV are not permissible.
- If the tool displays a partial field in the output, there is a possibility of bright sources outside this field and proposers are requested to check themselves the GALEX field for their availability.

Special cases in using the GAIA tool :

Choice of FUV/NUV filters (GALEX images are NOT available and the field is above the +/- 30 deg galactic latitude) : The field should be checked in TD1 catalogue and counts should be calculated for selected filters for safe limits. The absence of sources in 20 arc min radius is taken as presence of a source with a flux of 2×10^{-13} erg/sec/cm²/A and the count-rate for this flux in various UVIT filters are given in Table 3 of

http://uvit.iiap.res.in/Software/gaia/docs/gaia_procedure_1.0.pdf

Table 3: Count-rates in UVIT filters for a flux of 2×10^{-13} erg/sec/cm²/A in TD-1

FUV-filters	FUV Count-rate	NUV-filters	NUV count-rates
CaF2-1	74.5	Silica	955
CaF2-2	67.3	NUV-B15	59.6
BaF2	60.0	NUV-B13	275.8
Sapphire	50.0	NUV-B4	218.5
Silica	17.3	NUV-N2	50.6

Depending on the presence or absence of TD1 sources, the tool utilising Table 3, prints the expected count-rates in UVIT filters.

Light curve simulator: LAXPC

To simulate event file for LAXPC. The simulated event file 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:

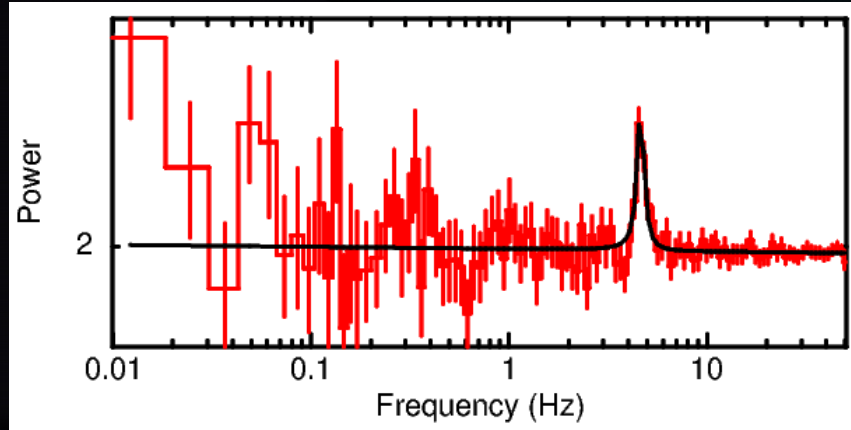
- (1) Spectrum (fake it/real) file:
Spectra.fak
- (2) Background spectrum file:
Backspec.fak
- (3) Response file : **lx20v1.0.rsp**
- (4) No. of proportional counters on: **1**
- (5) Name of output event file:
simul_level2.event.fits

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**

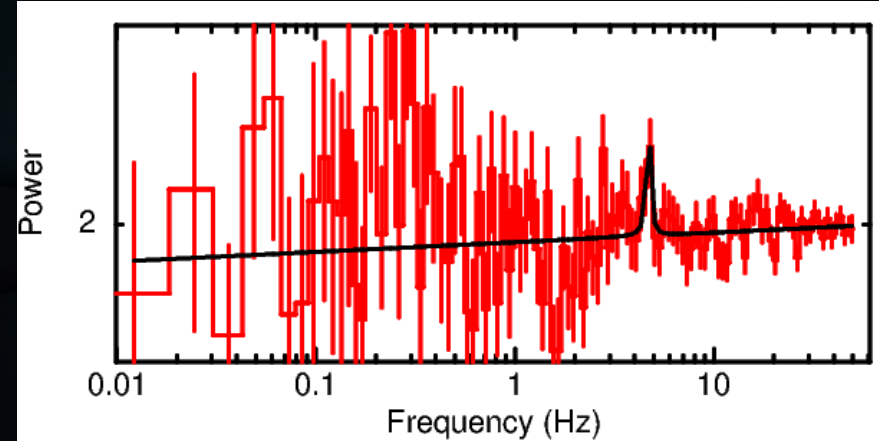
Simulated QPO in 15-25 keV using LAXPC lightcurve

```
>laxpc_find_freqlag -l 0.01 -h 50.0 -f 4.6 -p 1 -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



Thank you