Technical Aspects of AstroSat Proposal writing

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Proposal/Observing Cycles

(i) AO (Announcement of Opportunity) cycle :

ISRO will periodically issue calls for proposals to the astronomy community.

(ii) ToO (Target of Opportunity) cycle :

To facilitate observations of unpredicatbale, sudden astronomical events

e.g., outburst of a supernova or nova, observation of a new transient source

or X-ray nova, major flares, state transisions in X-ray binaries, etc.

ToO proposal is short, upto 1000 words maximum, and is free-format.

An abstract of length 150 words maximum.

(iii) CAL (Calibration) cycle:

Proposals aimed at calibration of the space craft / payloads and diagnosis of their health can be submitted by Payload Operation Centre (POC) team which includes the instrument PI.

Allocation of Observing Time on AstroSat

Instruments	*PV Phase (6 months from launch)*	*Guaranteed Time (6 months after PV)*	*Second Year (after launch)*	*Third year (after launch)*	*Fourth year (after launch)*
X-ray Inst. Teams	67%	4 months	32.5%	20%	-
UVIT Team	33%	2 months	17.5%	10%	-
Indian Proposals	-	-	35%	45%	65%
International Proposals	-	-	-	10%	20%
Canadian Proposals	-	-	5%	5%	5%
LU (UK) Proposals	-	-	3%	3%	3%
Targets of Opportunity Proposals (ToO)	-	-	5%	5%	5%
Calibration time	-	-	2%	2%	2%

Proposal Types

(a) Regular pointing (with or without any time constraints):

- Simplest one to get accepted without 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 :

- Request 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

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

Example: 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.

Photon Counting Mode and Integration Mode of UVIT:

- In the PC mode is for bright sources. Each photo-electron generated in the short exposure (<100 ms) is detected as a light pulse in the CMOS imager, and its centroid is found. The expected spatial resolution in this mode is < 1.8” FWHM. If in a single exposure two or more photon events occur within a separation ~< 3 pixels of the CMOS imager (~ < 10”), these are detected as a single event or rejected as unacceptable event.
- In IM mode, many (weak) pulses of light, from many photo-electrons, could fall at the same location; the signal at any location is a measure of how many photo-electrons were detected. The expected spatial resolution in this mode is ~ 5” FWHM.
- Imaging in the VIS channel is normally done in integration mode.
- Exposure time calculation for each orbit the total data for FUV and NUV images ((Number of FUV frames + Number of NUV frames) * 32000 + Time of exposure * 500000) < 10^{10}.

Relative angle :

Payload	Angle between Payload Boresight and Body Roll as on launch day (deg)	Angle between Payload Boresight and Body Roll as on today (after misalignment correction) (deg)
UVIT	0.02026	0.0419
SXT	0.11090	0.0512
LAXPC-10	0.04157	0.1605
LAXPC-20	--	0.1844
LAXPC-30	--	0.1486
LAXPC-Mean	--	0.1514

The details of proposal preparation and required resources can be found at http://astrosat-ssc.iucaa.in/?q=proposal_preparation Note that there is an offset between the SXT pointing and the pointing of LAXPC, CZTI and UVIT. 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

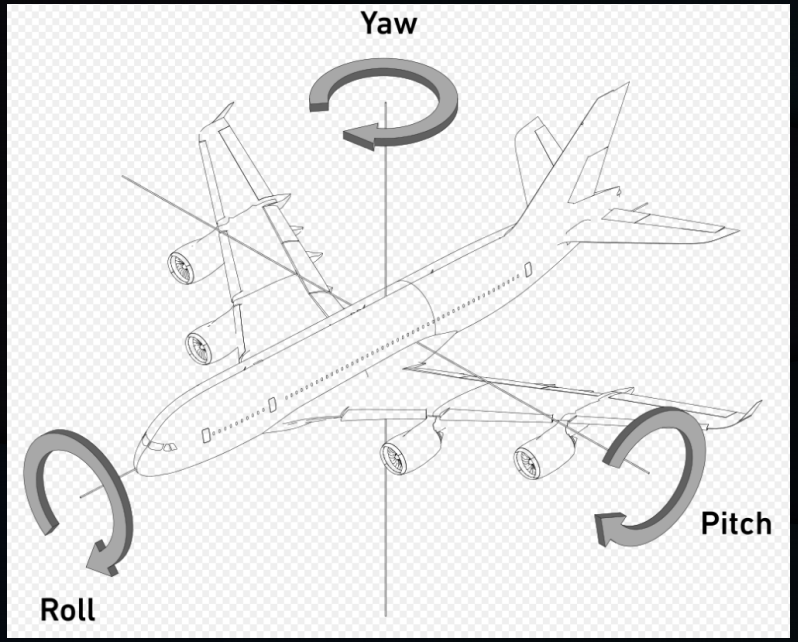
https://webapps.issdc.gov.in/astroviewer/jsp/UserInput.jsp

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.
- Angle Limits between Roll and Sun, Angle Limits between Negative Roll and Sun,Angle Limits between Roll and Moon, Angle Limits between Roll and velocity vector, Earth Limb angle.

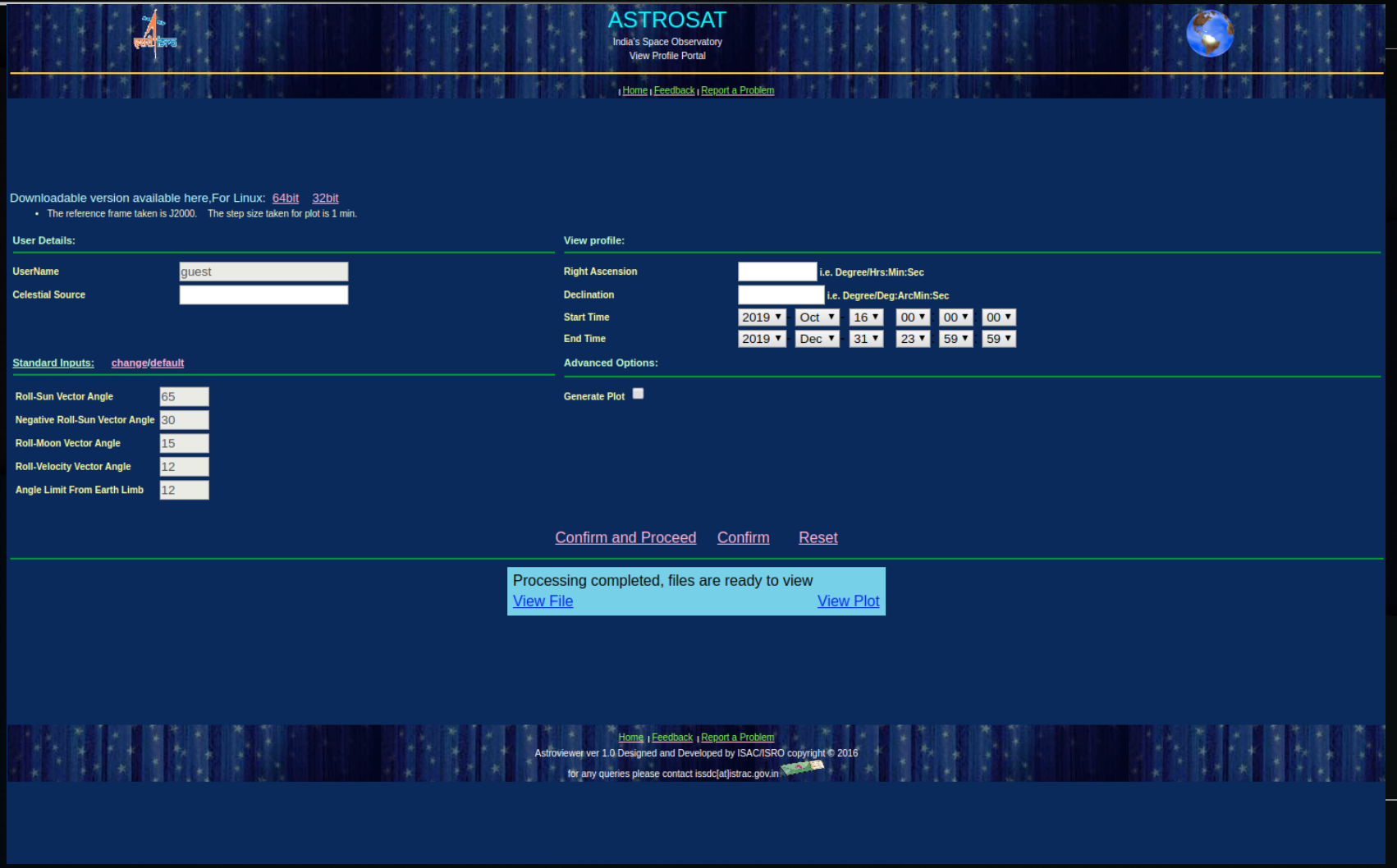
Orientation of satellite



Avoidance of ram-angle, Sun, and bright-Earth for safety: In order to avoid any damage to coating of the primary mirror, due to atomic oxygen, a minimum angle of 12^0 is kept between the ram direction and the roll-axis, i.e. axis of UVIT. In order to avoid damage/UV-assisted contamination due to radiation from Sun/bright-Earth/ Moon, a minimum angle of $45^0/12^0/15^0$ is kept between the axis and Sun/ bright-Earth/Moon at all times even if UVIT is not observing.

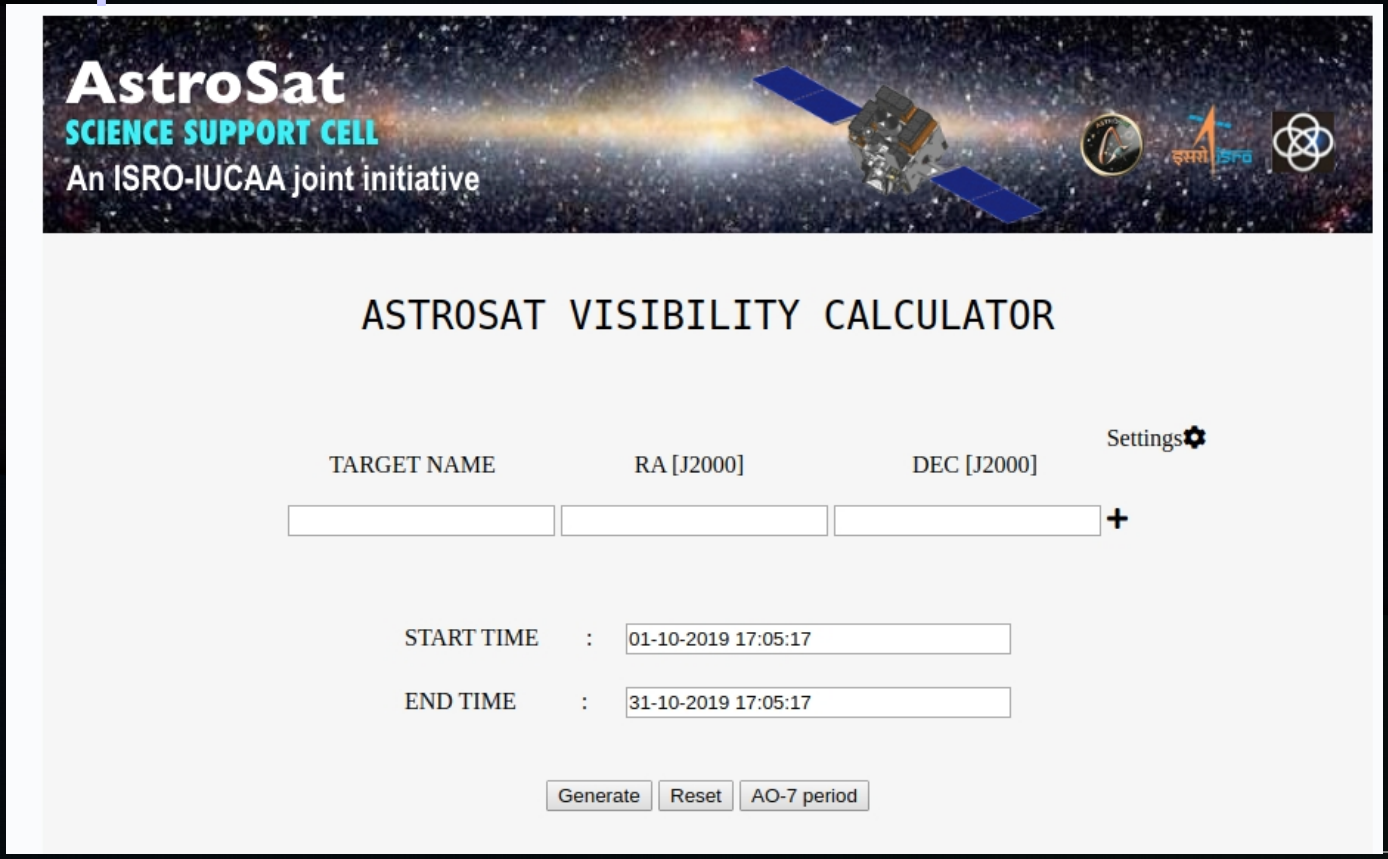
https://en.wikipedia.org/wiki/Aircraft_principal_axes#/media/File:Flight_dynamics_with_text_ortho.svg

Astroviewer Web-interface

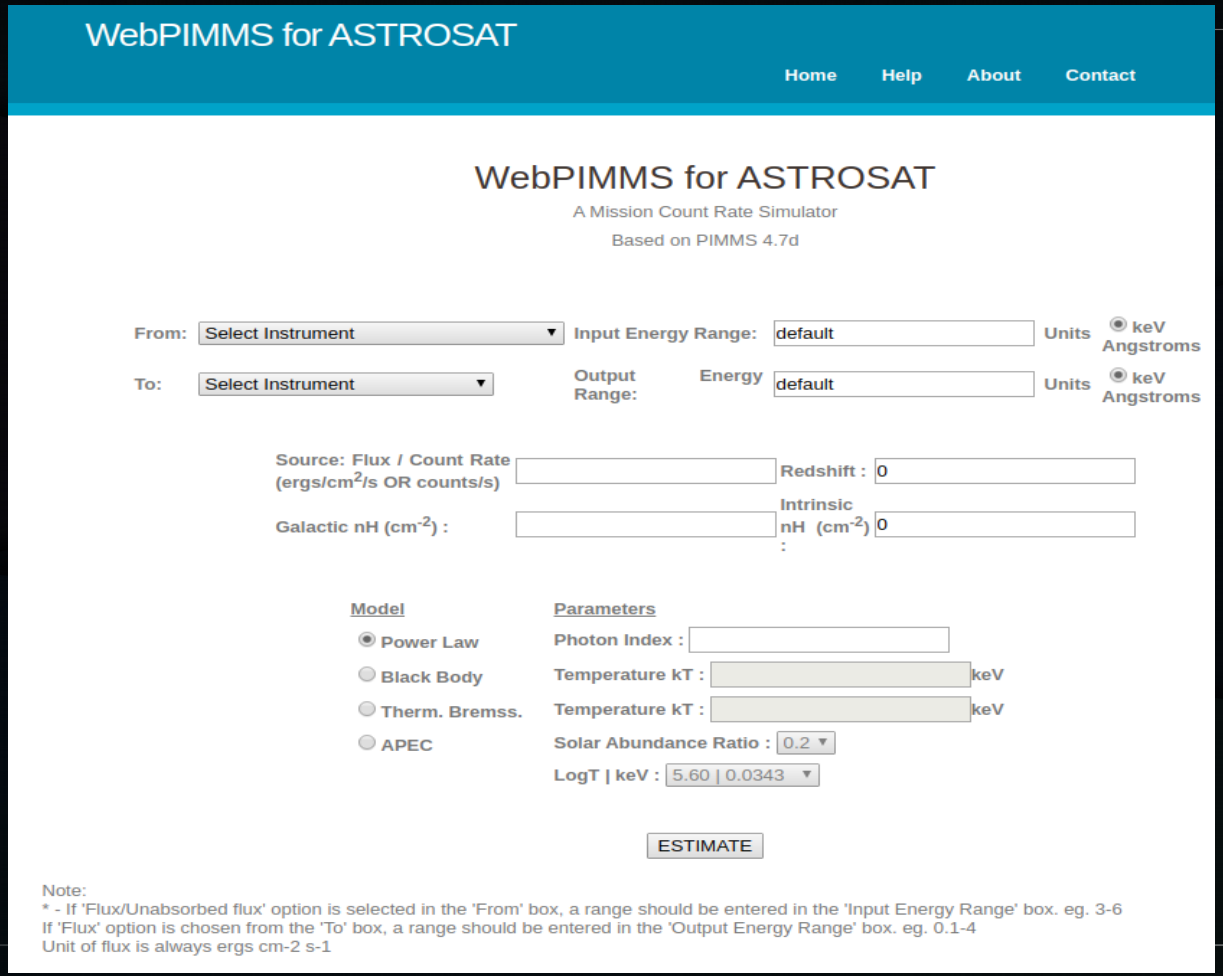


Avis Online Interface

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



Webpimms Astrosat



Light curve simulator: LAXPC

To simulate event file for LAXPC. The simulated event file can the 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

Usage: ./Event_simul

Input files: input_fak_specfiles and input_simul

Light curve simulator: LAXPC

Input_fak_specfiles:

(1) Fakeit spectrum,

(2) Background spectrum file

(3) Response file

(4) No. of proportional counters on

(5) name of output event file

input_simul:

(1) Exposure time for simulation in seconds

(2) Frequency of QPO in Hz

(3) Width of QPO in Hz

(4) r.m.s of QPO

(5) Index of power-law continuum of power spectrum

(6)Normalization of power-law continuum

XSPEC fakeit :

Common mistakes in AO proposals:

1. **Source too weak--not enough counts**. In requesting attractively low integration times, many proposers fell short of accumulating enough counts to achieve their scientific objectives, e.g., constraining the abundance of a distant cluster.

What to do?: perform a simulation.

2. **Source too weak--background ignored.** Backgrounds should not be neglected for weak sources. As well as contributing additional noise, background often has the effect of shortening the useable pass band. Detection of iron K line invisible, even with a long integration time.

What to do?: perform a simulation with background.gif

3. **Source too bright.** Can not observe arbitrarily bright sources.

What to do?: check the respective instrument chapters in this appendix for details.

4. **Look for similar observations already published/data available online reproduce to check feasibility of science case.**

5. Total staring time> Total observing time.