AstroSat Proposers Guide

Version 1.1
4 May 2017

Prepared by the AstroSat Science Support Cell,
Inter-University Centre for Astronomy & Astrophysics, Pune (India)

Revision History

<table>
<thead>
<tr>
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<th>Version No.</th>
<th>Date</th>
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<tr>
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<td>APPS</td>
<td>AstroSat Proposal Processing System</td>
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<tr>
<td>ATAC</td>
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<td>AToO</td>
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<td>AO</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
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<td>-------------</td>
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<td>CAL</td>
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<tr>
<td>CCD</td>
<td>Charge Couple Device</td>
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<tr>
<td>CZT</td>
<td>Cadmium Zink Telluride</td>
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<td>GO</td>
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<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
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<td>LAXPC</td>
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<td>Primary Observer</td>
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<td>POC</td>
<td>Payload Operation Centre</td>
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<td>RA</td>
<td>Right Ascension</td>
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<td>SSC</td>
<td>Science Support Cell (AstroSat)</td>
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<td>SSM</td>
<td>Scanning Sky Monitor</td>
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<td>SXT</td>
<td>Soft X-ray Telescope</td>
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<td>Time Constraint</td>
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<td>Target of Opportunity</td>
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<td>UI</td>
<td>User Interface</td>
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<td>UVIT</td>
<td>Ultra-Violet Imaging Telescope</td>
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1. Introduction and Scope

AstroSat is a proposal-driven, multi-wavelength observatory operated by Indian Space Research Organisation (ISRO). To facilitate the proposal-driven operation and participation of the scientific community, a web-based proposal processing software for the AstroSat mission known as the “AstroSat Proposal Processing System (APPS)” has been developed. It is available online only, it is not downloadable and cannot be used off-line.

This document assists the proposers with the AstroSat proposal preparation and submission using the APPS software, it also acts as the proposers’ manual for the APPS software. In addition to this document, proposers will need to read the AstroSat Handbook, AstroSat AO Procedures for policy on proposal and observing cycles and call for proposals for a specific cycle, and the guidelines for UVIT observations. These documents are available at the AstroSat Science Support website as mentioned below.

2. Useful links & Helpdesk

Detailed technical information on AstroSat can be found at the AstroSat home page accessible via http://astrosat.iucaa.in/.

All relevant information on AstroSat proposal preparation such as documentation, required tools, instrument response and background files, templates for scientific and technical justification, etc. is available at the AstroSat Science Support Cell (SSC) website accessible via http://astrosat-ssc.iucaa.in/


UVIT Home Page available at http://uvit.iiap.res.in/ provides details on UVIT. Proposers of UVIT will need to ensure the safety of the instrument by performing certain mandatory checks as described in the document “Mandatory checks to be done for UVIT observations” prepared by UVIT team, and available at the UVIT home page, and also as an appendix to this document, and the AstroSat SSC page for proposers.
A helpdesk for proposal-related queries is being made available. Proposers can write to astrosathelp@iucaa.in or issdc@istrac.gov.in for any queries on APPS, proposal preparation and submission. Queries will be answered on best effort basis.

Users of AstroSat can write to astrosathelp@iucaa.in for any queries on AstroSat including instruments, observation, software and data analysis, etc. The queries will be forwarded to appropriate authorities who will then respond.

Proposers can get pre-approved the UVIT filter selection before the proposal submission by writing to the UVIT ATC member C. S. Stalin (stalin@iiap.res.in).

A list of Frequently Asked Questions (FAQ) on APPS issues/bugs and other proposal related issues is available at http://astrosat-ssc.iucaa.in/?q=node/11.

3. Structure of the Document

The document first familiarizes with the different observing cycles, proposal types. It also provides an overview of proposal review process and time allocation. This is followed by detailed description of APPS, and a general guidance on proposal preparation and submission. Finally, the document provides step-by-step guide on how to enter various fields in APPS, verify and submit a proposal.

4. Proposal/Observing Cycles

ISRO will release periodic calls for proposal submission. Scientists can submit AstroSat proposals in response to the proposal calls by ISRO and within the specified period. The following proposal cycles will be available for the AstroSat mission.

(i) **AO (Announcement of Opportunity) cycle**

ISRO will periodically issue calls for proposals to the astronomy community. Each of these calls will be for a defined Announcement of Opportunity (AO) cycle. Submitted proposals will be reviewed by the AstroSat Time Allocation Committee (ATAC) and AstroSat Technical Committee (ATC).
**ToO (Target of Opportunity) cycle**

The ToO cycle will allow submission of proposals requiring the immediate observation of a sudden and unexpected astronomical event. The proposal in this cycle will be subjected to fast-track review process different from normal procedure for AO proposals. The ToO cycle will be open throughout the AstroSat mission life.

**GT (Guaranteed Time) cycle**

In this cycle, payload science teams can submit proposals utilizing their guaranteed time. Certain amount of time is reserved for these proposals and would be subjected to a selection process different from the AO proposals.

**CAL (Calibration) cycle**

In this cycle, only 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. The proposals in this cycle would be subject to verification by a responsible scientist - Cal Scientist. This cycle will be open throughout the mission life.

**5. Proposal Types**

The AO and GTO cycles can have different proposal types depending on the policy.

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

These are proposals for one or more targets requesting one pointing per target. These proposals without any time constraints are the simplest possible proposals and easiest for mission operation. Hence, these type of proposals are easier to get accepted for AstroSat observations.

One or more of the targets in a regular proposal may be time-constrained requiring AstroSat observations to be performed in a specific time window. Such time constraints can arise due to a number of reasons e. g., coordinated observations with other observatories, observations of a binary system in a specific binary phase, etc.
Proposers need to specify one or more time windows in case of time-constrained targets. Since scheduling AstroSat observations in a specific time window is difficult, time constrained proposals will generally need stronger science justification than a regular proposal without any time-constraint. Proposer will need to clearly state the reasons for time constrained observations in the technical justification (see the template for the technical justification). 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.

In case of multiple observations are required, they should be submitted as separate proposals or as in monitoring proposals given below.

(b) Monitoring proposals

These 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. For this type of proposals, proposers need to specify the number of observations, duration between observations, and instrument configuration for a single observation. APPS will automatically calculate the total observing time by multiplying the exposure time for a single observation and the number of observations. Successive observations need not equally spaced i.e., the proposers have a choice to request monitoring observations with linearly, logarithmic or any arbitrary separations. As monitoring proposals put a lot of constraints on the mission operation, proposers should provide strong justification for the need for monitoring observations.

At present, the mission is performing monitoring observations with separations between consecutive observations of 15 days or more. A few monitoring proposals requiring shorter separations i.e., less than 15 days, may be considered if science and technical justification are very strong. Proposers are also recommended to propose only one target in a monitoring proposal.

(c) Anticipated ToO proposals

The Anticipated Target of Opportunity proposals request AstroSat observations of one or more targets for which an interesting astronomical event is foreseen but the exact timing of the event is unknown. Such situations may arise e.g., in the case of catching a state transition of a known
X-ray binary. Proposers of anticipated ToO proposals will need to have an estimate of triggering probability and trigger duration, and provide relevant justification. As observation of Anticipated ToO events will disturb the planned scheduling of observation, only proposals with very strong scientific justification is likely to be accepted for observations. **Anticipated ToO proposals cannot request for follow-up observations in the same proposal.** If required, proposers may propose for normal or unanticipated ToO observations to follow-up the triggered Anticipated ToO targets.

There are two additional proposal types, tracking and scan mode proposals which are not available for AO-1 cycle as these have not been tested in the performance and verification phase but may be made available in future depending on the proposal policy.

### 6. Proposal review process and time allocation

The submitted proposals in each cycle will be subjected to an evaluation process by the ATAC and ATC. Each cycle will have an ATAC and ATC. If a cycle is set to have a two level hierarchy, then members of the ATAC may chair subcommittees called Sub-TACs. The ATAC chairperson is the final authority. (S)he is assisted in the evaluation process by the members of the ATAC or sub-TACs, depending on the level of hierarchy (one or two). Note that only the AO cycle has the choice of operating in a single or a two level hierarchy. The following are the steps envisaged in the review process:

**For a cycle having one level hierarchy**

- ATAC chair will nominate external referees to review the proposals. Comments and ratings given by the referees are taken into account by the ATAC for the selection of proposals to which observation time is to be allotted.

- ATAC Chair with other ATAC members collects the feedback from external referees and technical comments from the ATC and takes the final call on which of the proposals are to be allotted time. Each target in the final set of selected proposals is given A, B or C priority. (Normally, A is considered the highest priority and C the lowest.)
(b) For a cycle having two level hierarchy

- ATAC Chairperson categorizes proposals submitted (say based on the science category they fall in) and distributes them to different Sub-TACs.
- Sub-TAC chair will nominate external referees to review the proposals. (S)he along with other Sub-TAC members selects proposals from the lot allotted to them as candidates for allotting observing time. Comments and ratings given by the referees are taken into account by the Sub-TAC for this selection. Sub-TAC decides a rating and comments for each proposal.
- ATAC Chair with other ATAC members collects the feedback from Sub-TACs as well as technical comments from the ATC and makes the final decision on which of the Sub-TAC suggested proposals are to be allotted time. Each target in the final set of selected proposals is given A, B or C priority.

When the observations are scheduled for observations, `A' priority targets are given preference followed by `B' priority targets. If any `A' or `B' priority targets cannot be scheduled in the ongoing cycle, they will be scheduled in the next cycle. `C' priority targets which cannot be scheduled in the current cycle will be discarded.

7. Proposal Revision

It is expected that a majority of successful proposals will be fully allocated AstroSat observing time. The ATAC may ask some proposers to reduce the observing time, the number of targets or to change the instrument configuration in a proposal. Such proposals will be made available to PIs for revision. The proposers will be able to submit a revised proposal before the set deadline only for changes recommended by the ATAC. Such partially allocated proposals, if not revised before the deadline, will be excluded from the list of successful proposal.

8. Configuring the leftover instruments – the piggyback revision by the instrument teams

AstroSat is a multi-instrument mission and it is possible that a proposer may not configure all the instruments. If one or more of the secondary instruments are left unconfigured, such proposals will be made available to the concerned instrument team members. These members will be able to configure the leftover instruments. Proposers will have no right on the data from
any secondary instrument which was not not configured by the proposer. The data acquired
by the instruments configured by the instrument team members will go to the concerned
instrument teams.

It is recommended that in case of any doubt on instrument configuration, proposers should
discuss with the instrument teams (see ASSC website for contact details) or leave
unconfigured if the proposed scientific objective can be achieved without the data from one or
more of the secondary instruments.

9. Proposal Preparation & Submission

The software AstroSat Proposal Processing System (APPS) is designed to facilitate the
proposal driven operation of the AstroSat mission. This software will assist scientists in
proposal preparation, submission, review and selection process. APPS is a web-based tool
which will cater to different types of users including the General or Guest Observers, Payload
operation centre team members, Payload scientists and proposal reviewers. APPS will be able
to validate submitted proposals including syntax checking, allowed parameter ranges and
proposal completeness thus allowing proposers to detect errors. APPS will provide a complete
and flexible interface for the users to specify instrument configurations appropriate to their
science requirements. APPS will allow proposers to update accepted proposals with changes
in requested observing time or number of targets as per recommendations of the technical
and/or scientific peer-review processes. This will maximize the scientific output ensuring
effective operation of the mission. The APPS will also extract important proposal/observational
parameters which will be used for mission planning and scheduling of observations. An
overview of the APPS architecture along with the flow of various kinds of information into
and out of the APPS can be seen in the following flow diagram shown in Figure 1.

At the input end, APPS will interact with various types of users e.g., Proposers, Chairpersons,
ATAC members, etc. The users are classified according to the role they play in the APPS.
Relevant information will be collected from different classes of users which will help the
ATAC in deciding which proposals merit allotment of observation time on the AstroSat
satellite. In addition to proposal submission and acceptance, APPS will also serve as a common
point of contact for the referees and the ATAC members and will facilitate evaluation of
submitted proposals.

On the output side, output will be produced in the form of user and proposals database by APPS. In addition to this, APPS will also output information of proposals which are selected by ATAC in a format suitable to be ingested into Mission Control and Proposals (MCAP) database.

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*Figure 1 APPS flow diagram*
10. Planning an AstroSat proposal

Proposals for observation with AstroSat can be submitted in response to announcement of observing opportunity by ISRO. Subject to the availability observing time for different types of proposals, proposers from all over the world are welcome to submit AstroSat proposals (see Table : AstroSat time share plan).

Depending on the scientific requirement, proposals to AstroSat can be submitted for observation with a single or more instruments. AstroSat proposals will require the following information at the minimum.

- Source coordinates, source angular size, V magnitude, 2-10 keV flux, estimated count rates for different instruments, exposure times
- Instrument configuration parameters (e.g., instrument mode, filter, etc.)
- Scientific and technical justification, details on UVIT bright sources, Astroviewer output in pdf format.

11. Observing efficiencies and exposure limitations for the UVIT partial fields

The four co-aligned payloads onboard AstroSat have different operational constraints (see AstroSat handbook). This results in different observing efficiencies for the four payloads. The average observing efficiencies achieved during the previous observing cycles are listed in the Table below.

<table>
<thead>
<tr>
<th>Payload</th>
<th>Observing efficiency</th>
</tr>
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<tbody>
<tr>
<td>UVIT&lt;sup&gt;1&lt;/sup&gt;</td>
<td>15% (for field sizes 250x250 or larger)</td>
</tr>
<tr>
<td></td>
<td>&lt; 15% (for smaller fields, see Table below)</td>
</tr>
<tr>
<td>SXT</td>
<td>25%</td>
</tr>
<tr>
<td>LAXPC</td>
<td>45%</td>
</tr>
<tr>
<td>CZTI</td>
<td>45%</td>
</tr>
</tbody>
</table>

<sup>1</sup> UVIT observing efficiency depends on the window size (see Table 2 UVIT FUV/NUV frame rate and the maximum exposure per orbit in the Photon Count Mode)
### Table 2 UVIT FUV/NUV frame rate and the maximum exposure per orbit in the Photon Count Mode

<table>
<thead>
<tr>
<th>FUV/NUV field size</th>
<th>Frame rate</th>
<th>Maximum exposure time per orbit (subjected to 15% observing efficiency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100x100</td>
<td>640/sec</td>
<td>200 sec</td>
</tr>
<tr>
<td>150x150</td>
<td>300/sec</td>
<td>454 sec</td>
</tr>
<tr>
<td>200x200</td>
<td>180/sec</td>
<td>769 sec</td>
</tr>
<tr>
<td>250x250</td>
<td>115/sec</td>
<td>1162 sec</td>
</tr>
<tr>
<td>300x300</td>
<td>82/sec</td>
<td>1470 sec</td>
</tr>
<tr>
<td>400x400</td>
<td>61/sec</td>
<td>2500 sec</td>
</tr>
<tr>
<td>Full field</td>
<td>29/sec</td>
<td>3571 sec</td>
</tr>
</tbody>
</table>

In the photon counting mode with partial fields or windows, the data rate can be very high as each frame carries an overhead of 4kBytes and the maximum data rate allowed for the total of FUV and NUV images is 10 Gbits/orbit (see section on “Observing with partial fields” in the UVIT chapter of AstroSat handbook). The requested exposures should respect this limit, i.e. for each orbit the total data for FUV and NUV images should be such that

\[
(Number \text{ of } FUV \text{ frames} + Number \text{ of } NUV \text{ frames}) \times 32000 + \text{exposure time in sec} \times 500000 < 10^{10}.
\]

The maximum exposure time listed in Table 2 is purely due to the limitations in the data download rate per orbit and different amount of data generated in the partial UVIT FUV/NUV fields. The maximum exposure time need to be subjected to the 15% observing efficiency. The achievable exposure time would be the lowest of the maximum exposure quoted in Table 2 and 15% of the orbital period. UVIT observations requiring FUV/NUV partial fields may result in long view period or stare time. Since proposals are generally awarded based on “maximum science” and “minimum total view period” or stare time, proposers should exercise caution when choosing partial FUV/NUV fields. It should be noted that the default for NUV/FUV is the full field and the partial fields are only used if the source of interest is bright and can have > 0.5 counts/frame for full field. In such cases, largest possible partial fields should be used to get a rate about 0.5 counts/frame (certainly < 0.8 counts/frame).

Proposers will need to choose one of the instruments as the primary instrument depending on the scientific merit. Depending on the observing efficiencies, the requested observing time (i.e., the sum of exposure time) for the primary instrument will result in different allowed observing time for the secondary instruments. For example, an 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. The AstroSat Proposal Processing System software (see below) calculates the total stare time, and the allowed maximum observing time for the secondary instruments.

12. Proposal Preparation Tools

Proposers can use the following tools in order to prepare an AstroSat proposal.

(i) **Astroviewer**

This is a web-based tool that proposers need to use in order to determine AstroSat visibility period for observations of a target of interest. Proposers can access the astroviewer tool at [http://issdce.gov.in/astroviewer/index.html](http://issdce.gov.in/astroviewer/index.html). Proposers can also use the command line version of astroviewer tool which is available at the SSC site [http://astrosat-ssc.iucaa.in/?q=proposal_preparation](http://astrosat-ssc.iucaa.in/?q=proposal_preparation) (see source visibility estimator).

Please note that the moon avoidance angle for UVIT is 15 degrees. If you plan to observe with any of the UVIT channels including the VIS channel for tracking purposes, please change the “Roll-moon vector angle” to 15 degrees before you run the Astroviewer tool.

(ii) **UVIT Exposure Time Calculator**

Available at [http://uvit.iiap.res.in/Software/etc](http://uvit.iiap.res.in/Software/etc), the UVIT Exposure Time Calculator (ETC) can be used to estimate required exposure time for an astronomical source (see [http://uvit.iiap.res.in/Software/etc/Help](http://uvit.iiap.res.in/Software/etc/Help) for detailed help).

The ETC calculates the expected count rate from a source in various UVIT filters, followed by either (a) the signal-to-noise ratio (SNR) achieved for a given exposure time, or (b) the time required to reach a given SNR. Users may choose from a range of astronomical sources such as a star, black-body, galaxy, power law, etc. or upload their own source spectrum.

(iii) **UVIT bright source warning tool (BSWT)**

Available at [http://uvit.iiap.res.in/Software/bswt](http://uvit.iiap.res.in/Software/bswt), the BSWT gives a list of all the bright visible stars in the field of a given target. The data on visible magnitude and B-V colour of these stars can be used to select the visible filter. The count-rates for the UV-filters, based on modelling from visible magnitude and B-V colour, are only indicative and should not be used for drawing
any inferences about exposures with the FUV and NUV filters. For the FUV and NUV channels, proposers need to perform mandatory checks as described in the document “Mandatory checks to be done for UVIT observations” (see Section 13 below) and Appendix A.

(iv) **AstroSat WebPIMMS**


(v) **Spectral simulation tools such as XSPEC and ISIS**


### 13. Mandatory checks for successful observation with UVIT

The UVIT is not designed to observe very bright sources and the presence of a bright source in the UVIT field of observation can cause “Bright Object Trigger” in the hardware that would switch OFF all three detectors. In addition, the presence of an ultra-bright source near the UVIT field of view will scatter excessive radiation beyond the allowed limit. One of the UVIT channels, the VIS channel is primarily used for the spacecraft tracking. It is the proposers responsibility to ensure smooth tracking during their proposed observations. Hence the proposers need to exercise extra caution in preparing a proposal for UVIT observations. It is strongly recommended that the proposers follow the guidelines described in detail in the document “Mandatory checks to be done for UVIT observations” available as an appendix to this document (see Appendix A) and also at the UVIT home page at IIA ([http://uvit.iiap.res.in/Observing](http://uvit.iiap.res.in/Observing)) and the Proposer’s page in the AstroSat SSC website.

*It should be noted that wrong selection of UVIT filters will lead to rejection of proposals. If required, proposers can get approved the filter selection by the UVIT ATC member before the proposal submission. Proposers can write to C. S. Stalin (email: stalin@iiap.res.in).*
For observations with any of the UVIT channels including the VIS channel for tracking purposes, proposers need to set the moon avoidance angle to 15 degrees and then check the visibility period using the astroviewer tool (see section 12).

14. Preparing an AstroSat proposal

Due to a number of instruments available and associated observing constraints and limitations, observers need to carefully plan their proposals. Proposers must first determine one or more suitable target for their science case, and ensure target visibility during the observing period. Proposers will need to determine if their science case requires a single pointing or multiple pointings, and if the observations need to be performed within a known or unknown specific time period, and accordingly determine the proposal type – regular (with or without time constraints), monitoring and Anticipated ToO. Proposers will need to estimate S/N, expected count rates for different instruments and determine required observing time. They should also perform imaging/spectral/timing simulations (as required) and demonstrate scientific feasibility of the proposal. If UVIT is to be used, proposers will additionally need to demonstrate suitability of the field by careful choice of the filters as described in the document “Mandatory checks for UVIT observations”. Proposers should clearly describe the scientific objective, scientific and technical feasibility using the templates available for downloads.

AstroSat is a multi-wavelength observatory, and a number of proposals are expected to be aimed at multi-wavelength science. The proposers of multi-wavelength proposals should exercise caution in choosing the primary instrument due to different observing efficiencies. The observing efficiency of UVIT is ~15% compared to that of X-ray instruments (SXT: ~31%, LAXPC: ~40% and CZTI~45%). Thus, if UVIT is the primary instrument, then the actual observing time available for X-ray instruments in more than that requested for UVIT. Current version of APPS does not allow the proposers to set the exposure times for secondary instruments to exceed the exposure time for the primary instrument. Proposers can, however, set the exposure time for the secondary instruments less than that for the primary instruments. It should be noted that due to a number of operational constraints, the available exposure times for the secondary instruments corresponding to the set exposure time of the primary instrument are not exactly known before the scheduling of observations. The secondary instruments perform observations for the durations available for the requested exposure time for the primary instrument, and this is done irrespective of the exposure time set for the secondary
instruments. Proposers should also note that UVIT observations may not be performed at all if the primary instrument is one of the X-ray instruments and requested exposure time is less than one orbital period or 98 minutes. Proposer should also note that observations are performed at the aim-point of the primary instrument according to the current observing policy.

If the science case requires multiple observations of a single target with the same exposure time, proposers must choose proposal type as “monitoring”. In this case, only one pointing need to be configured and the instrument configuration including the exposure time for additional pointings will exactly be the same. If a science case requires multiple pointings with different instrument configuration, proposers can define multiple targets with the same source name and specify time constraints for each of the targets/pointings. At present, mission cannot handle multiple observations of the same target i.e., the same RA/DEC if the interval between successive observations is less than 15 days. Please note that time constraints apply to targets and not to individual exposures. Thus one cannot define time constraints for individual exposures in the case of multiple exposure of a single target. This can be changed in a future cycle after the scheduling software is suitably modified to accept exposure-based time constraints.

AstroSat proposals must contain scientific and technical justifications and a large number of observing parameters such as the coordinates of the proposed targets, primary instrument, required total observing time, instrument configurations, etc. Only valid submitted proposals will be reviewed. The entry of necessary observing parameters is facilitated by APPS. It is mandatory to use APPS to prepare and submit AstroSat proposals. Proposers will need to register into the APPS before they can prepare proposals. There are four sections in APPS that proposers will need to complete in order to prepare a valid proposal.

I. **Cover Page**

The cover page contains an overview of the proposal in the form of proposal type, title and abstract, scientific category, requested observing time, and personal information such as the names of proposers, contact information of the Principal Investigator (PI) or Primary Observer. If a PI is a theoretician or wants to appoint a Co-Investigator (Co-I) as the primary contact person for any technical information on the proposal, the PI can assign one of the Co-Is as the PO. The cover page also contains fields for total observing time and total stare time. These
fields will automatically be calculated from the exposure time requested for the primary instrument in the instrument configuration page (see below). In the AO cycle, proposers can choose one of the following three proposal types only.

- Regular proposals (with or without any time constraints)
- Monitoring proposals
- Anticipated ToO proposals

In APPS, there are two additional proposal types - tracking and scan mode proposals. These are yet to be tested and proposers should not create these proposal types. Such proposals will be treated invalid.

**II. Target list & Instrument configuration**

The target list contains information about each proposed target such as Target name, coordinates, target angular size, variability, V magnitude and 2-10 keV X-ray flux. The observing time and stare time for the target will automatically be calculated from the exposure details for the primary instrument. Target names can be resolved with NED or Simbad and coordinates can be fetched from these servers. If there are more than one target, one can add targets by clicking “Add Source”. In case of multiple targets, proposers should order the targets according to their priority which can be helpful to the reviewers if a subset of targets is accepted. The targets can be moved up and down in the list with the help of buttons given below the target list.

The target list table for Monitoring proposals requires two additional fields to be filled compared to a regular pointing proposal.

(i) Number of observations

(ii) Interval between successive observations (in days).

Please note that the number of entries for field “Interval between successive observations (in days)” is one less than the number of observations. The duration between successive observations need not be the same.

Proposers of “Anticipated ToO” proposals will need to fill the following three additional fields in the target table.
(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)

For each target in the list, proposers need to configure instruments by clicking the “configure” button. A new window will open which allows the proposer to select the primary instrument from a drop-down menu. Proposers should carefully select the primary instrument to suit the scientific objective of their proposal. The primary instrument can be configured by clicking on the “configure” button and adding exposures in a new window. Proposers could also select other instruments and configure all of them. Proposers can independently configure individual LAXPC units or they can copy configuration parameters of LAXPC1 for LAXPC2 and LAXPC3 with a click of a button. The same mechanism is implemented for the four CZTI detectors.

Please refer to AstroSat Handbook for information on configuration parameters such as mode, filter, window size etc. of individual instruments. Proposers will also need to fill the estimated count rates for the selected instruments. The count rates can be estimated by the tools such as UVIT exposure time calculator for FUV, NUV and VIS channels or spectral simulation tools such as XSPEC/ISIS/Sherpa along with the instrument responses for X-ray instruments. The count rates for X-ray instruments can also be estimated using the PIMMS tool. Please refer to AstroSat SSC website.

III. Time Constraints

A proposed target may be time constrained i.e., available for observations during one or more limited periods for a number of reasons e.g., coordinated observation with other observatories, observations during a particular phase of a binary system, etc. If a proposed observation of a target is constrained in time, proposers need to mention this and enter start and end date and time for the observations of their proposed targets. One can enter multiple time constraints. It is recommended that proposers enter the most suitable e.g., the one with the longest duration as the first time constraint. It should be noted that any time constraints entered for a target in a monitoring proposal will apply to the first pointing only, the successive pointings are
determined by two parameters – number of pointings and duration between pointings.

**IV. Attachments**

The following files in pdf format must be attached to complete an AstroSat proposal.

(i) **Scientific Justification**

A pdf file describing scientific background and motivation for the proposed observation, scientific objectives, selection of targets, and demonstrating scientific feasibility with estimates of signal-to-noise, simulations of expected results, and the justification of requested observing time. Proposers are strongly recommended to provide spectral and/or temporal simulations to demonstrate the scientific feasibility of their proposed observations. These simulations are very useful to ATAC and increase the chances of proposal selection. A latex template for the scientific justification is available for download. Proposers are strongly encouraged to use the template. The scientific justification should not exceed the 4 page limit.

(ii) **Technical Justification**

A 2-page long pdf file providing information on technical aspects such as target visibility, details of bright VIS and UV sources in the field of UVIT and near the field as per the list of mandatory checks (see appendix A), selection of filters, S/N for the requested exposure (after accounting for source counts, background, point spread function, nearby source), safety concerns, details on time constraints, coordinated observations with other observatories, etc. In case of monitoring proposals, proposers should provide acceptable durations within which the individual observations need to be performed. Such information may ease the scheduling of observations and hence the chance of proposal selection. A latex template is available and proposers must use this template.

(iii) **Checks for UVIT Bright Sources**

A pdf document with details on UVIT Bright Sources within and near the UVIT field of view as per the document on “Mandatory checks to be done for UVIT observations” (see Appendix A or visit UVIT home page http://uvit.iiap.res.in/Observing).
Astroviewer output

Proposers must ensure that the proposed targets are visible to AstroSat during the observing period. The astroviewer tool can be used to generate the visibility durations. The output of the astroviewer tool in the pdf format should be attached with the proposal. The visibility of targets should be clearly mentioned in the technical justification. For proposals with UVIT configuration, visibility during eclipse should also be included.

V. Supplementary Information (Optional)

Proposers can provide supplementary information e.g., any special requirement.

VI. Proposal verification and submission

Proposers can validate their proposals for completeness by clicking the “Verify and Submit” tab. Note that this action does not submit the proposals, instead it outputs missing or incomplete entries in various sections. Proposers can edit different section to complete any missing field. The proposal submission button appears only after the verification is successful.

15. APPS step-by-step instructions

A. Registration/login

(i) All proposers including Co-Is need to create an account in APPS by registering in the system. Proposers can register in the login page of APPS. Please visit APPS website and click “Create Account” and enter the required details. In the registration page, if your University/Institute is not listed, please select “Other” and submit the registration form. You will receive an email with a link which you will need to click to complete your registration. Once you have created your account, you can login, add your institute in the “Change Profile” page if you selected “Other” in the registration page.
Figure 2 APPS login page
To login into APPS, enter your user ID and password and the Captcha text verification, and then click on the “Login” button. You will see the home page. All users will see the “Home” and “Proposer” tabs. However, depending on the privileges assigned to your user accounts, you may also see other tabs, according to the roles you are performing in the AstroSat Proposal Processing System.

Click on the “Proposer” Tab. You will see the links “List Proposal” and “Create Proposal”. Default navigation is to “List Proposal”. You can view all proposals or select a subset of proposals based on cycle, proposal status, PI or Co-I.
B. Proposal Creation, Preparation and Submission

To create a new proposal, click the link “Create Proposal” button. This will list available cycles open for submission of proposals. To create a new proposals click on the link of the proposal cycle to which you wish to submit a proposal, listed under “Choose a proposal type”. This will lead you to a new subpage titled “Create New Proposal”. For successful submission of proposal you will need to complete the following five steps:

“Cover Page”, “Target List & Instrument Configurations”, “Attachments”, “Supplementary Info” and “Verify & Submit”.

Figure 4 List of Proposal page
These five steps are listed in the form of 5 tabs/links in the proposal editing subpage. It is recommended that proposers complete the five steps in sequence though the flow for these steps is not necessarily sequential, and one can navigate back and forth as required. It is useful to note the following points while filling the proposal form.

- The mandatory fields are indicated with an asterisk “*”.
- Proposers can view a short description of input headings in blue color such as “Proposal Type”, “Title”, “Quota” etc. by clicking on them which will open a new page without destroying the proposal form.
- It is advisable to select the Proposal Type before you proceed to further pages of proposal editing, as changing the proposal type at a later stage can alter other fields in the proposal, and require you to re-enter information in other steps.
• It is also advisable to click on the “Save Draft” button periodically, to save the updated information you enter as your proposal creation progresses. Also, saving draft allows you to logout and resume editing the proposal when you login at a later time.

• Navigating away from the Edit Proposal subpage without clicking on “Save Draft” will cause all information entered since the last saved draft to be lost. This kind of navigation includes:
  A. clicking on the “Logout” button
  B. clicking on the “Home”, “Proposer” or any other tabs visible in your interface
  C. clicking on the “List Proposals” or “Create Proposal” links

Complete the five steps of proposal preparation as follows.

(a) **Filling the Cover Page**

Default navigation after proposals creation is to the Cover Page. The Cover Page contains the basic proposal information (such as Proposal Type, Title, Abstract, Proposer’s details, Contact Information, and Scientific Category) and the Investigator list. The allowed word limits and on-the-fly word count for certain fields such as “Title” and “Abstract” are also shown. Complete the Cover Page as follows.

(i) Select one of the following proposal type - “Regular Pointing”, “Monitoring” or “Anticipated ToO”. There may be other proposal types available, do not select “Scan Mode” and “Tracking” even if the software allows. These proposal types are not gone through performance and verification, and may be made available in a future cycle.

(ii) Quota: Select “India” if the PI of the proposal is affiliated to an Indian institute or university. Otherwise select “International”.

(iii) Populated “Title” and fields “Abstract” within the indicated word limits. If you have submitted an AstroSat proposal in a previous cycle, please provide proposal ID.

(iv) Proposers Table: The PI of the proposal is automatically listed as the creator of the proposal. You can add a Co-I (Co-Investigator) for the proposal by clicking on the “Add Co-I” button of the proposer table. Once you click on the “Add Co-I” button, you will get a search dialog box which enables you to search the Co-I by their name or email id. The dialog will display details of registered members from the database that match your search criteria and you can select the correct entry and click on “Add” button. The selected member is then added to the Proposers table as a Co-I If you cannot find one or more of your Co-Is in APPS, please
ask them to register into the system. It is not possible to make a non-registered user as a Co-I.

(v) Scientific Category: Select an appropriate scientific category.

(i) The “Total Observing Time” which is the sum of the requested exposure time for the primary instrument and “Total Staring Time” (i.e. the total view period calculated from the total requested observing time and the observing efficiency of the primary instruments) fields will automatically be filled after instrument configuration is set.

(ii) Click on “Save Draft” and go to the next step by clicking the Tab “Target List & Instrument Configuration”.
Figure 6 Proposal Cover Page

(b) Target List and Instrument Configuration - Adding Targets

The “Target List and Instrument Configuration” page shows the Target list Table with the inputs for source properties (see Figure 7 for a regular proposal). The target ID is automatically generated by the software. The observation time is automatically
calculated as the sum of exposure times for all exposures defined for the primary instrument (see below). The stare time is total view duration required to achieve the requested exposure time for the primary instrument (see page 15). The monitoring and anticipated proposals will have additional columns in the target list as described in the section on “Proposal Types”. One can add new targets by clicking on “Add Source” and fill the editable fields by clicking on the corresponding table columns, as shown in the screen below. One can directly fetch the source coordinates by clicking the buttons “NED” or “Simbad”. If your source is not listed in NED/Simbad, you will need to enter the coordinates manually. Proposers can add targets/sources as per your requirements by clicking on “Add source” button. One can also provide comments on the target list such as the priority order that may be useful for the review committee.

The regular proposals can have multiple targets. However, it is strongly recommended that proposers should not enter more than one target in a monitoring. It is also recommended that the total observing time per target should not be below 1000 seconds.
### Figure 7 Target List Page

**Target List Page**

<table>
<thead>
<tr>
<th>Target ID</th>
<th>Source Name</th>
<th>RA J2000 (hh mm ss.ss)</th>
<th>DEC J2000 (+/- dd mm ss.ss)</th>
<th>Variable?</th>
<th>Source Size (arc min)</th>
<th>Observation Time Primary Instrument (secs)</th>
<th>Stare Time Primary Instrument (secs)</th>
<th>V Mag</th>
<th>2-10 KeV Flux (erg/cm²/s)</th>
<th>Instrument Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>T01</td>
<td>NGC4051</td>
<td>12 3 9.686</td>
<td>44 31 52.540</td>
<td>Unkown</td>
<td>0.001</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Add Source**
Move selected source(s) UP
Move selected source(s) DOWN

Resolve sources using NED, Simbad. (You can select the source by clicking on the checkbox in the table)

**Comments related to sourcelist:**

Save Draft
Figure 8 Selection of Primary Instrument

(c) Configuring Instruments

Once a target is entered, proposers can configure instruments and create exposures for any of the AstroSat instruments. For each target you can configure instruments as per your need. Under the Instrument Settings column in the Taget list Table, there is a “Configure” link for each target row. Click on the link, and a “Payload Config” dialog box will appear as shown in the screenshot below.

Now you can select the Primary Instrument from drop down menu. A “Configure” link will appear next to it (see the screenshot in Fig. 8). Clicking this will open the “Instrument Configs” dialog, with the Instrument Configuration default settings for the Proposal Cycle. After configuring the primary instrument, proposers can select and configure secondary instruments listed under “Payloads” as shown in Figure 9. Due to the different observing efficiencies, the exposure time for secondary instruments can be different. Proposers can enter exposure time for secondary instruments up to the maximum possible value. The observing efficiencies set in APPS are 15% for UVIT, 25% for SXT, and 45% for CZTI and LAXPC. Thus, if one specifies 900sec exposure for UVIT as the primary instrument, maximum exposures available for the secondary instruments are 1500sec for SXT, and 2700sec for
LAXPC and CZTI. APPS will complain and not accept if a longer exposure is entered for the secondary instruments.

**Note** - Instrument Configurations are dynamic, and can vary from one Proposal Cycle to other. Additionally, each instrument will have a different Instrument Configuration setup. The screenshot shown below are only a representative image of example Instrument Configuration pages.

![Instrument Configuration Screenshot](image)

**Figure 9 Selection of Secondary Instruments**

The instrument configuration consists of parameters a three levels.

**Payload configuration**: Parameters specified here apply to the all detectors of a payload e.g., STBG bin time is the LAXPC payload level parameter and applies to all three LAXPC detectors. This parameter should generally be left at the default value.

**Detector Configuration**: Parameters at this level apply to individual detectors e.g., estimated count rate for UVIT1.

**Exposure configuration**: A particular detector can have multiple exposures and the parameters listed under exposure configuration apply to individual exposures.
On selection, an instrument under “Payload”, the payload configuration parameters appear below the payload list. The “Configure” that appears after selecting an instrument opens the “Detector Configurations” and “Exposure Configurations. For exposure parameters, you will need to click “Add Exposure”. It will display the default settings. You can edit/choose the parameter values as per your observational requirements. Please note that there may not be any parameters for an instrument at the payload or detector level but all instruments have exposure level parameters.

![Figure 10 Configuring SXT](image)

On completing the Detector and Exposure Configurations, click the “OK” button, and it will lead you back to the parent Payload Config dialog.

**Note**- Scroll within the dialog box if “OK” button is not visible.

Similarly, you can configure other payloads i.e. secondary instruments, in addition to the Primary Instrument, in the Payload Config dialog. This can be done by checking the check-boxes next to the payload names. A “Configure” link will appear for each checked payload,
allowing you to specify the settings by the same procedure as above. One can define multiple exposures by adding a new exposures by clicking “Add Exposure” or selecting an existing exposure and copying by clicking the “Copy Selected Exposure” button. Please note the total exposure time for a secondary instrument cannot exceed the exposure time set for the primary instrument.

SXT Configuration

The screenshots of SXT configuration pages can be seen in Figure 10.

(i) Enter expected SXT count rate for your target. The count rate can be estimated using PIMMS or spectral simulations with XSPEC/ISIS/Sherpa.

Choose SXT operating mode – Photon Counting (PC) or fast window mode. Please refer to AstroSat handbook for more details on the operating modes of SXT. The FW mode should be used if the target is brighter than 0.5 Crab. The PCW mode available in earlier cycles has now been removed.

(ii) Enter Exposure Time in seconds.

(iii) Click “OK”. If you click on “Add exposure”, it will open another exposure configuration.

Figure 11 LAXPC1 configuration
**LAXPC configuration**

Figure 11 shows the screenshot for LAXPC1 configuration.

(i) On selecting any of the LAXPC units, two payload parameters appear in the Payload Config page.

(ii) Enter total expected count rate in the EA mode for three LAXPCs. The count rate can be estimated using PIMMS or spectral simulation software such as XSPEC/ISIS/Sherpa and response files.

(iii) Choose STBG BIN time among the available options from 16 to 2048msec.

(iv) First configure LAXPC1 by clicking the “Configure” button after selecting LAXPC1. In the exposure configuration, choose operating mode – Event Analysis (EA) or Fast Counter (FC) mode. EA mode is a combination of event mode and broadband counting mode. FC mode is appropriate for the brightest targets. Please refer to AstroSat handbook for more details.

(v) Enter exposure time in seconds.

(vi) Copy the LAXPC1 configuration for LAXPC2 and LAXPC3. One can also configure LAXPC2 and LAXPC3 independent of LAXPC1.

**CZTI Configuration**

CZTI has the simplest configuration (see the screenshot in Figure 12). The four units operate independently. Only the “Normal” operating mode is available. To configure CZTI, select CZT quadrant-1, enter expected total count rate for the CZTI payload. Click the configure button and add exposure. Enter exposure time, and press OK. Copy the configuration for CZT quadrant-1 for other three quadrants.
Figure 12 CZTI configuration page

Figure 13 Configuring FUV channel
**UVIT configuration**

The three UVIT units FUV, NUV and VIS channels operate independently and need to be configured separately. Configuring UVIT for your science requirements while ensuring safe operation of the payload is not easy. Proposers are strongly recommended to read the guidelines for UVIT proposals and perform mandatory checks for UVIT observation. It is the proposers responsibility to ensure that the “Bright Object Trigger” is not activated by the presence of bright sources in the field of view. In case of “Bright Object Trigger”, UVIT goes into the OFF mode and no data are available.

The VIS channel is used for tracking purposes and the proposers should ensure that the tracking capability is not compromised.

---

**Figure 14 Configuring NUV channel**

Once the mandatory checks are performed, the UVIT channels can be configured as follows (see the screenshots in Figure 13 and 14 for configuration of FUV and NUV channel).

(i) Enter expected count rates for the target and the full field in the CaF2 filter (FUV), Silica (NUV) or VIS3 (VIS). Use the UVIT exposure time tool to estimate the count rates.

(ii) Add exposure, and select the operating mode, filter, size of the field from the available options. Note that smaller field sizes require longer stare time due to the different amount
of data generated depending on the partial field chosen and the limitation on the data download rate per orbit (see the section on “Observing with partial fields in the UVIT chapter of handbook). For the photon counting mode available for FUV and NUV additionally choose the centroiding bits 3S (3x3 square pixels) or 5S (5x5 square pixels).

(iii) Enter the exposure time in seconds. Please note that the UVIT observing efficiency is

![Payload Config](image)

**Figure 15 Specifying time constraints for a target**

~15% and pointing is unlikely to be changing within one orbit. Hence, a single short exposure say 120s for a target will lead to very inefficient use of UVIT.

Warning : It should be noted that wrong selection of UVIT filters will lead to rejection of proposals. If required, proposers can get approved the filter selection by the UVIT ATC
member before the proposal submission. Proposers can write to C. S. Stalin (email: stalin@iiap.res.in).

The Payload Config dialog also allows you to specify time constraints for the targets, by selecting the “Yes” radio button in response to the question “Is this a time constrained source?” (Scroll within dialog box, if not visible). A table will appear allowing you to specify one or more time constraints, as depicted in Figure 15.

Once you are done with the configuration, click on the “OK” button at the bottom of the Payload Config dialog (scroll within dialog, if not visible). The focus will return to the parent “Target List & Instruments Configuration” page. Click “Save Draft” after adding targets, before moving to further steps.

(d) Attachment page

Next, click on the link “Attachments”, and the subpage shown in Figure 16 will be displayed. Attach the required files by clicking on “Browse” buttons for Scientific Justification and Technical Justification, and selecting files from your local filesystem. For UVIT Bright Source List and Astroviewer Output, you will be allowed to add one file for every target in your proposal, using the “Add Another ..” buttons respectively. See below screenshot for reference.
**Astrosat Proposal Processing System**

Create New Proposal

**Upload**

*NOTE: Attachments should be ONLY in PDF format.*

*Please attach a self-contained “SCIENTIFIC JUSTIFICATION” as per the guidelines. A brief status report on each previous APPS proposal should be appended to the scientific justification.*

*When your proposal is scheduled, the contents of the cover sheets become public information. Any supporting pages are for refereeing purpose only.*

*File upload size limit is 10 MB per attachment.*

- **Scientific Justification:** Choose File: test1.pdf
- **Technical Justification:** Choose File: test2.pdf
- **UVIT Bright Source List (one file per target):** choose a file
- **Astroviewer Output (one file per target):** choose a file

*Proposers have been allotted time in Astrosat before* ✅

Upload

---

*Figure 16 The attachment page*
Once the files have been attached, click the “Upload” button. This process might take a anywhere between a few seconds to a few minutes depending on the file sizes and connection bandwidth. Once the files have been successfully uploaded, you will get a “Save successful” message as shown below.

**Note**- It is NOT compulsory to upload all the files at once. You can upload one file at a time, or in batches. Every time you upload, the draft is saved as well.

**(e) Supplementary Information page**

Next, click on “Supplementary Information” link and you will navigate to a subpage that provides a text area where any special requirements can be specified (see the screenshot in Figure 17). This info is not mandatory for completion of the proposal. Click “Save Draft” once done.
In the last steps of proposal editing process, click on the link “Verify & Submit”. If any of the mandatory fields in the proposal have not been filled, a message will be displayed here corresponding to each of incomplete information, as shown in the screenshot in Figure 18. The messages are grouped section wise and you can navigate back to those sections and fill in the required fields.
Finally, once all mandatory fields have been filled, the Verify & Submit screen will appear as shown in Figure 19. Here you can suggest a referee by clicking on the “Suggest A Referee”
button. You can preview your proposal by clicking the Preview button which will open a new window with links for pdf files of the proposal to download. In order to submit your proposal, you will be required to enter your password and Captcha text verification. Once entered, click “Submit” to complete the proposal submission. The pdf version of the proposal can also be downloaded from the “List Proposal” page by clicking the “View” button at any point of time after the proposal preparation is over.

On successful submission of the proposal, you will be greeted with the message as shown in Figure 20.

![Proposal submission page](image)

**Password:** ********

**Text Verification**

Enter the text and symbols seen in the image. If the image has not loaded properly or if the text in the image is not readable, click on the refresh button besides the image.

> any gnederw

*Figure 19 Proposal preview and submission page after verification*
C. List, Edit and Withdraw Proposals

If you click on “List Proposal” under the “Proposer” tab, or click on the Proposer tab itself, you will navigate to the page as shown in Figure 21.

Proposers can filter the listed proposals by selecting the proposal cycle from the “Cycle” drop down menu and the proposal state from the “Status” drop down menu.

The listed proposal will have the following links.

- All proposals will have a “View” link which will allow you to view a PDF coversheet of the proposal, as well as attachments uploaded as part of the proposal.

- Proposals which are in the draft state will have an “Edit” link which allows you to continue editing a saved draft of the proposal, by the same steps as listed in the Create Proposal section.

- All proposals will also have a “Withdraw” link. For proposals in the Submitted status, this will withdraw the proposal submission. For proposals in the Draft state, this will delete the draft from the database.
### Figure 21
List proposal page with proposal status and withdrawal option.
Appendix A : Mandatory checks to be done for UVIT observations

Version 1.0 (15 November 2016)

The main thrust of checking for safety of UVIT is to ensure (i) there is no bright source in the field which could trigger “Bright Object Detect (BOD)” in the hardware that would put all the detectors OFF, (ii) there is no ultra-bright source near the field which would scatter excessive radiation in the field and (iii) there is enough photon flux in the VIS detector to make tracking of spacecraft feasible. The list of things to be checked before proposing for UVIT observations are outlined below:

(I) Choice of VIS filters

Run BSWT (http://uvit.iiaep.in/Software/bswt) for a field of 20' in radius and either get the PDF or ASCII output. This output gives the B-V colors of stars along with their V-band magnitudes within 20' radius of the target source. Select the five brightest stars from this list. From their colors get their closest spectral type from Table 1. This table gives the B-V colors corresponding to various spectral types. Once the spectral type is known from the table, proceed to ETC (http://uvit.iiaep.in/Software/etc) and get the expected count rate in the VIS filters. Choose the VIS filters such that none of the stars give > 4800 c/sec and attach the count rates obtained. 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. These count rates should be attached.

Table 1: Colors of stars and their spectral type (Source: http://www.stsci.edu/~inr/intrins.html) 

<table>
<thead>
<tr>
<th>Sp. Type</th>
<th>B-V</th>
<th>Sp. type</th>
<th>B-V</th>
<th>Sp. Type</th>
<th>B-V</th>
<th>Sp. Type</th>
<th>B-V</th>
<th>Sp. type</th>
<th>B-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>B0.0</td>
<td>-0.30</td>
<td>B5.0</td>
<td>-0.16</td>
<td>A2.0</td>
<td>0.05</td>
<td>F2.0</td>
<td>0.35</td>
<td>K2.0</td>
<td>0.92</td>
</tr>
<tr>
<td>B0.5</td>
<td>-0.28</td>
<td>B6.0</td>
<td>-0.14</td>
<td>A3.0</td>
<td>0.08</td>
<td>F5.0</td>
<td>0.45</td>
<td>K3.0</td>
<td>0.95</td>
</tr>
<tr>
<td>B1.0</td>
<td>-0.26</td>
<td>B7.0</td>
<td>-0.13</td>
<td>A4.0</td>
<td>0.12</td>
<td>F8.0</td>
<td>0.53</td>
<td>K4.0</td>
<td>1.00</td>
</tr>
<tr>
<td>B1.5</td>
<td>-0.25</td>
<td>B7.5</td>
<td>-0.12</td>
<td>A5.0</td>
<td>0.15</td>
<td>G0.0</td>
<td>0.60</td>
<td>K5.0</td>
<td>1.15</td>
</tr>
<tr>
<td>B2.0</td>
<td>-0.24</td>
<td>B8.0</td>
<td>-0.11</td>
<td>A6.0</td>
<td>0.17</td>
<td>G2.0</td>
<td>0.63</td>
<td>K7.0</td>
<td>1.33</td>
</tr>
<tr>
<td>B2.5</td>
<td>-0.22</td>
<td>B8.5</td>
<td>-0.09</td>
<td>A7.0</td>
<td>0.20</td>
<td>G3.0</td>
<td>0.65</td>
<td>M0.0</td>
<td>1.37</td>
</tr>
<tr>
<td>B3.0</td>
<td>-0.20</td>
<td>B9.0</td>
<td>-0.07</td>
<td>A8.0</td>
<td>0.27</td>
<td>G5.0</td>
<td>0.68</td>
<td>M1.0</td>
<td>1.47</td>
</tr>
<tr>
<td>B3.5</td>
<td>-0.19</td>
<td>B9.5</td>
<td>-0.04</td>
<td>A9.0</td>
<td>0.30</td>
<td>G8.0</td>
<td>0.74</td>
<td>M2.0</td>
<td>1.47</td>
</tr>
<tr>
<td>B4.0</td>
<td>-0.18</td>
<td>A0.0</td>
<td>-0.01</td>
<td>F0.0</td>
<td>0.32</td>
<td>K0.0</td>
<td>0.81</td>
<td>M3.0</td>
<td>1.50</td>
</tr>
<tr>
<td>B4.5</td>
<td>-0.17</td>
<td>A1.0</td>
<td>0.02</td>
<td>F1.0</td>
<td>0.34</td>
<td>K1.0</td>
<td>0.86</td>
<td>M4.0</td>
<td>1.52</td>
</tr>
</tbody>
</table>
(II) Choice of FUV/NUV filters (Case 1: Both FUV and NUV GALEX images are available)

Check if GALEX images are available covering 20 arcmin radius around the field from [http://galex.stsci.edu/GalExView](http://galex.stsci.edu/GalExView). If yes, note the details (center of the field, availability of NUV or FUV, duration of the exposure, and type of exposure-imaging/spectroscopy) of the tiles of the images and provide them in “Technical Justification”.

If both NUV and FUV images of GALEX are found (i) find the GALEX magnitude of the brightest object in the GALEX field in case of points sources (however find the highest rate in any 7 x 7 pixel window in the GALEX image, in the case of extended sources) (ii) get the magnitudes (in case of extended sources) using the following two relations

\[
m_{\text{FUV}} = -2.5 \times \log (\text{CPS}) + 18.82 \\
m_{\text{NUV}} = -2.5 \times \log (\text{CPS}) + 20.08
\]

If the magnitudes (either for point sources or extended sources) obtained are brighter than 15 mag, correct for saturation using \( M_{\text{corr}} = C_0 + (C_1 \times M_{\text{obs}} + C_2)^{1/2} \) (Camarota & Holberg 2014, MNRAS, 438, 3111). This equation is valid in the magnitude range of 1.5 to 17.5 in FUV and 9.5 to 17.5 in NUV. The coefficients \( C_0 \) and \( C_1 \) for FUV and NUV bands needed for correction are given in Table 2.

**Table 2:** Coefficients to correct for saturation in the GALEX magnitudes

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>NUV</th>
<th>FUV</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_0 )</td>
<td>2.634</td>
<td>5.371</td>
</tr>
<tr>
<td>( C_1 )</td>
<td>26.316</td>
<td>20.000</td>
</tr>
<tr>
<td>( C_2 )</td>
<td>-245.329</td>
<td>-210.200</td>
</tr>
</tbody>
</table>

Once the corrected magnitudes are known get the count rates in UVIT filters using Table 3. Choose those filters for which the count rates are lesser than 1500 in both NUV and FUV.

**Table 3:** Count-rates in FUV (for a magnitude of 18.22) and NUV (for a magnitude of 20.00). This can be used to get the count-rates in any UVIT filters

<table>
<thead>
<tr>
<th>Filter</th>
<th>Count rate</th>
<th>Filter</th>
<th>Count rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaF2</td>
<td>1</td>
<td>Silica</td>
<td>1</td>
</tr>
<tr>
<td>BaF2</td>
<td>0.85</td>
<td>NUV-B4</td>
<td>0.22</td>
</tr>
<tr>
<td>Sapphire</td>
<td>0.63</td>
<td>NUV-B13</td>
<td>0.27</td>
</tr>
<tr>
<td>Silica</td>
<td>0.22</td>
<td>NUV-B15</td>
<td>0.074</td>
</tr>
</tbody>
</table>

(III) Choice of FUV/NUV filters (Case 2: Only NUV GALEX images are available)
If only GALEX-NUV images are available for 20' radius (i) Find the magnitude of the brightest source in the GALEX field (in case of point sources) or get the highest rate in any 7 x 7 pixel window (in case of extended sources), (ii) Get the NUV magnitude (in case of extended sources) using \( m_{\text{NUV}} = -2.5 \times \log (\text{CPS}) + 20.08 \) (iii) if the derived NUV magnitude (either for point sources or extended sources) is brighter than 15 mag, correct for saturation using the procedures outlined above. After correcting for saturation (if needed) get the FUV (GALEX) magnitude using Rayleigh – Jeans approximation as

\[
m_{\text{FUV}} = m_{\text{NUV}} - 1.65
\]

From \( m_{\text{FUV}} \) and \( m_{\text{NUV}} \) of GALEX, calculate the expected count-rates for FUV and NUV filters in UVIT using Table 3. Choose that filters that give count rates lesser than 1500 in both NUV and FUV.

(IV) Choice of FUV/NUV filters (Case 3. GALEX images are NOT available)

If the 20' radius 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 deg. Galactic latitude or LMC or SMC) any exposures in NUV and FUV are not permissible. Alternatively, if the field lies outside the bright areas, the brightest source within 20' radius should be checked in TD1 (http://heasarc.gsfc.nasa.gov/db-perl/W3Browse/w3table.pl?tablehead=name%3Dtd1&Action=More+Options) and the counts calculated for the selected filters, so as to check that the limits are not exceeded. Please note that the absence of source should be taken as presence of a source with a flux of \( 2 \times 10^{-13} \text{ erg/sec/cm}^2/\text{A} \), and the count-rate for this flux in various UVIT filters are given in Table 4.

Table 4: Count-rates in UVIT filters for a flux of \( 2 \times 10^{-13} \text{ erg/sec/cm}^2/\text{A} \) in TD-1

<table>
<thead>
<tr>
<th>FUV-filters</th>
<th>FUV Count-rate</th>
<th>NUV-filters</th>
<th>NUV count-rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaF2-1</td>
<td>74.5</td>
<td>Silica</td>
<td>955</td>
</tr>
<tr>
<td>CaF2-2</td>
<td>67.3</td>
<td>NUV-B15</td>
<td>59.6</td>
</tr>
<tr>
<td>BaF2</td>
<td>60.0</td>
<td>NUV-B13</td>
<td>275.8</td>
</tr>
<tr>
<td>Sapphire</td>
<td>50.0</td>
<td>NUV-B4</td>
<td>218.5</td>
</tr>
<tr>
<td>Silica</td>
<td>17.3</td>
<td>NUV-N2</td>
<td>50.6</td>
</tr>
</tbody>
</table>

(IV) Check for scattered light

Check is also required for the scattered light from any ultra bright source outside the field up to a radius of 5 deg. We note that scattered radiation from any planet at a radius > 5 degree is within acceptable limits for all the VIS/NUV/FUV filters. In photon counting mode, the count-rate for any planet or very bright star if it were in the field and observed with the chosen filter should be lesser than that given in Table 5

(V) Choice of Gratings:

For observations with grating, the following is recommended. NUV grating can be used when the count-rate in NUV Silica is less than 1133. Similarly, FUV gratings can be used when the count-rate in FUV CaF2 is less than 892. This is valid when the full window of 512 x 512
pixels is used.

**Table 5:** Allowable count-rates for bright stars/planets located at various distances from the field center

<table>
<thead>
<tr>
<th>Angle</th>
<th>Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>20° &lt; Source &lt; 30°</td>
<td>$10^4$ c/sec</td>
</tr>
<tr>
<td>0.5 deg &lt; source &lt; 1.0 deg</td>
<td>$10^5$ c/sec</td>
</tr>
<tr>
<td>Source at &gt; 1 deg</td>
<td>$10^6$ *exp((α – 1)/0.834) c/sec; alpha is the angle in degrees</td>
</tr>
</tbody>
</table>

In integration mode, the limits are about 20 times larger than this.

*** Efforts will be made to make some codes available to the proposers to accomplish many of the calculations, so that the proposer needs only to use those codes.

**Note:** The above checks are valid only when UVIT is the prime instrument. However, if SXT or LAXPC is the main instrument, there is a need to widen the search radius used in BSWT and GalexView due to the offsets of SXT (0.0721 degree) and LAXPC (0.1156 degree) relative to UVIT. Therefore, if SXT is the prime instrument increase the search radius from 20 arcmin to 25 arcmin, and if LAXPC is the main instrument increase the search radius to 28 arcmin. However, this facility with varying search radius is not available with the current BSWT.