

INTEGRAL

Science Operations Centre

Announcement of Opportunity for Observing Proposals



INTEGRAL AO Tools Software User Manual

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1 Introduction

The purpose of this document is to describe the use of the software tools made available to observers who wish to submit a proposal for INTEGRAL observations.

The Integral AO Tools provided by the INTEGRAL Science Operations Centre (ISOC) include: the Proposal Generation Tool (PGT), the Observation Time Estimator (OTE) and the Target Visibility Predictor (TVP). The latest version of these tools together with the associated documentation is available from the ISOC web page: <https://integral.esac.esa.int>.

If you discover a problem with any of the tools, please read the Frequently Asked Questions (FAQ) at <https://www.cosmos.esa.int/web/integral/faq>. If you do not find the answer to your question, please contact the INTEGRAL Helpdesk: inthelp@sciops.esa.int.

2 Proposal Generation Tool (PGT)

PGT can be downloaded from: <https://www.cosmos.esa.int/web/integral/ao21-pgt>. Installation instructions and answers to FAQ are also provided there.

Once PGT has been successfully installed, it is launched by running an executable script called ‘pgt’ on UNIX-like platforms, clicking on the icon of the “Application” folder on Mac systems or by double-clicking on the desktop icon on Windows systems.

2.1 Entering data

2.1.1 The Main Panel

The **Admin Details**, the **Proposal Details**, the **Observation Details** and the **Data Rights Panel** are accessed by clicking the corresponding button in the top half of the Main Panel (see Figure 1).

Below the buttons that open the different panels, is the **Check Proposal** button that can be clicked at any time, and runs checks on the contents of required fields in the proposal. Warnings and failed checks are shown in a pop-up window. Finally, the button **Submit Proposal to ISOC** sends the proposal to which a unique ID is assigned that you will receive in the email confirmation of a successful submission. Enter this proposal ID in the designated field if submitting updated versions of the same proposal.

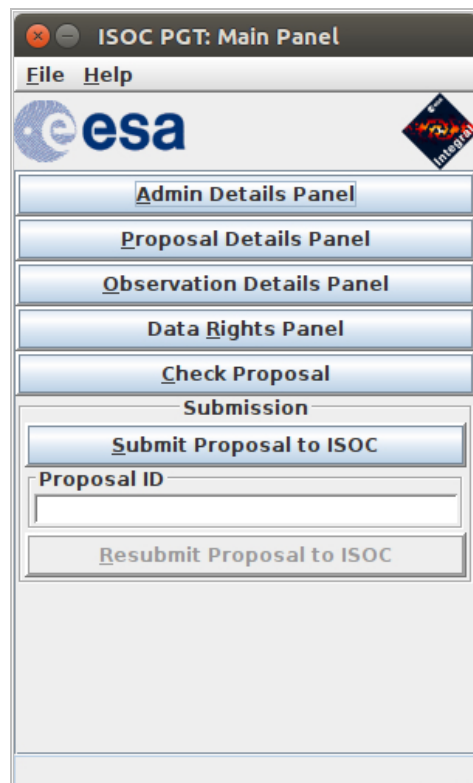


Figure 1 – The Main Panel

2.1.2 The Admin, Proposal, Observation and Data Rights Details panels

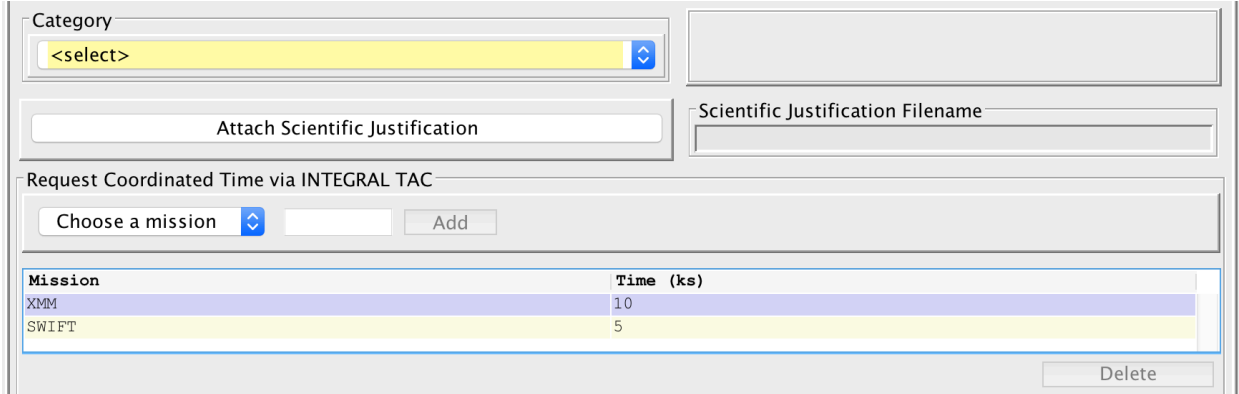
PGT provides four "details" panels that encompass all the information about the proposal. These are labelled: Admin Details Panel, Proposal Details Panel, Observation Details Panel and Data Rights Panel. *Fields with a light yellow background are mandatory.*

2.1.2.1 Admin Details Panel

To specify the contact information of the principal investigator.

2.1.2.2 Proposal Details Panel

To specify the title, abstract, scientific category and justification.



The screenshot shows the bottom part of the Proposal Details Panel. It includes a 'Category' dropdown menu with '<select>' as the current selection. Below this is an 'Attach Scientific Justification' button and a 'Scientific Justification Filename' text box. A section titled 'Request Coordinated Time via INTEGRAL TAC' contains a 'Choose a mission' dropdown menu, an input field, and an 'Add' button. At the bottom, there is a table with two columns: 'Mission' and 'Time (ks)'. The table contains two rows: 'XMM' with a time of 10, and 'SWIFT' with a time of 5. A 'Delete' button is located at the bottom right of the table.

Mission	Time (ks)
XMM	10
SWIFT	5

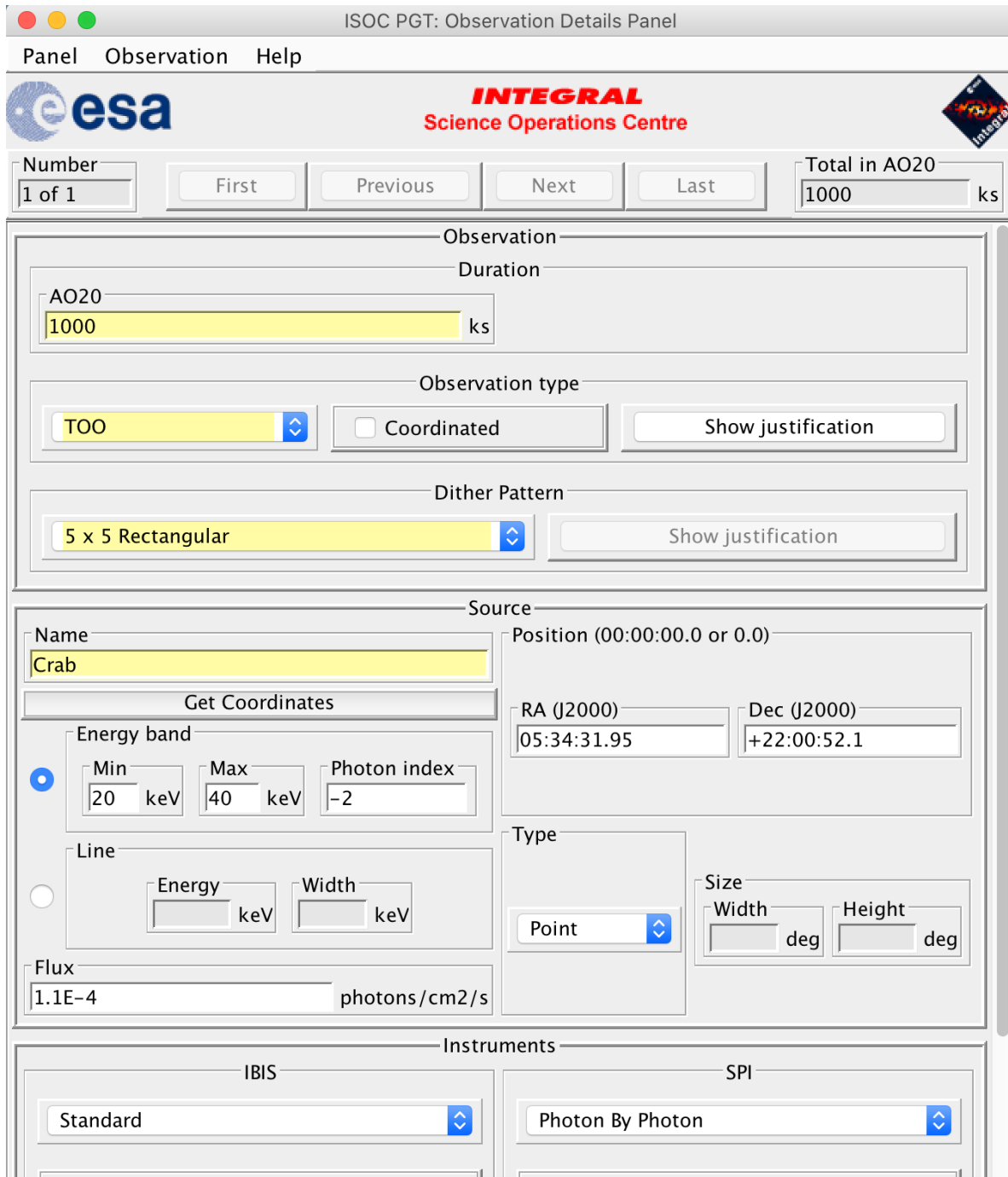
Figure 2 – The Proposal Details Panel (bottom part)

Having selected the attachment, the name of the file will be shown in the Scientific Justification Filename box of the Proposal Details Panel (see Figure 2). Saving the proposal does not save the attachment, but the full path to access it. Hence, there is no need to re-attach the file every time the proposal is loaded, except if you have changed the location of the file. Clearly, before submitting, if you make changes to the scientific justification after the file has been attached to the proposal, you must override the previous attachment by attaching the new version. There is no need to remove an attachment; only the last attachment is used. Selecting **Panel** → **Reset** will clear all fields and also remove the attachment.

The panel allows for the request of additional coordinated time from other missions such as **XMM-Newton, SWIFT or NuSTAR**. Simply select the mission from the drop down list, type in the desired amount of time (kiloseconds) and click on the 'Add' button. Now the mission is added to the table at the bottom of the panel, ready to be submitted. If you change your mind and want to modify the requested time, repeat the process again with the new value. You can also discard the request by selecting the target mission from the table and clicking the 'Delete' button.

2.1.2.3 Observation Details Panel

To specify the technical details of each observation included in the proposal (see Figure 3).



The screenshot shows the 'ISOC PGT: Observation Details Panel' window. At the top, there is a menu bar with 'Panel', 'Observation', and 'Help'. Below the menu bar is the ESA logo and the text 'INTEGRAL Science Operations Centre'. A toolbar contains a 'Number' field showing '1 of 1', navigation buttons for 'First', 'Previous', 'Next', and 'Last', and a 'Total in AO20' field showing '1000 ks'. The main panel is divided into several sections:

- Observation**: Contains a 'Duration' field with a value of '1000 ks'.
- Observation type**: Includes a dropdown menu set to 'TOO', a 'Coordinated' checkbox (unchecked), and a 'Show justification' button.
- Dither Pattern**: Includes a dropdown menu set to '5 x 5 Rectangular' and a 'Show justification' button.
- Source**: Contains a 'Name' field with 'Crab', a 'Get Coordinates' button, and fields for 'RA (J2000)' (05:34:31.95) and 'Dec (J2000)' (+22:00:52.1). It also has sections for 'Energy band' (Min: 20 keV, Max: 40 keV, Photon index: -2), 'Line' (Energy and Width in keV), 'Type' (set to 'Point'), and 'Size' (Width and Height in degrees).
- Instruments**: Contains two dropdown menus: 'IBIS' set to 'Standard' and 'SPI' set to 'Photon By Photon'.

Figure 3 - The Observation Details Panel (upper part)

Each observation in a proposal is numbered sequentially, as shown in the **Number** field on the left of the tool bar at the top of the Observation Details Panel. Here, you can see the number of the currently displayed observation and the total number of observations in the proposal.

In the **Observation** section of the panel, enter the **Duration** for the current AO. The **Dither pattern** and **Observation type** must be selected from the drop-down menus.

There are three types of observations: Normal, Fixed Time and TOO, and a flag to identify the observation as coordinated. For all observations other than Normal, you must click on the **Show Justification** button and enter the details of the observation. These should include a short justification for Fixed Time or TOO observations, or an explanation of how the observation is to be coordinated with other observatories. It is not possible to mix TOO observations with Normal or Fixed Time ones into the same proposal. Selecting a dither pattern other than 5x5 must also be justified by clicking **Show Justification** and explaining the reason.

In the **Source** section of the panel, the name of the source entered in the **Name** field is checked against the Simbad, NED and VIZIER astronomical databases when pressing the **Check Proposal** button in the Main Panel. If the source name is not found (i.e. because it is unknown), a warning will appear in the Failed Checks Panel. The coordinates of the source specified in RA and Dec (J2000), either in HMS or decimal degrees, define the centre of standard dither patterns.

In addition to the two menu items that appear on all PGT panels, namely **Panel** and **Help**, the Observation Details Panel has another one labelled **Observation** (see Figure 4). Under this menu item, you can perform a number of actions: **add** a new observation (the display will show the new observation), **delete**, **duplicate** or **check** the currently displayed observation and **go to** a particular observation. The option **copy n**, makes “n” copies of the current observation, and **delete n**, deletes the specified range of observations. The option, **import source list** allows importing a list of sources either from a text file containing for each source (one per line), its tab-separated Name, RA and Dec, or by typing in these values in the table. Using the button labelled ‘Generate Observations’ in the Import Source List panel (see Figure 5) will create an observation for each source in the list. Finally, the option **Web tools** offers the possibility to run the OTE (Observation Time Estimator) or the TVP (Target Visibility Predictor) tools, which will open in a web browser window.

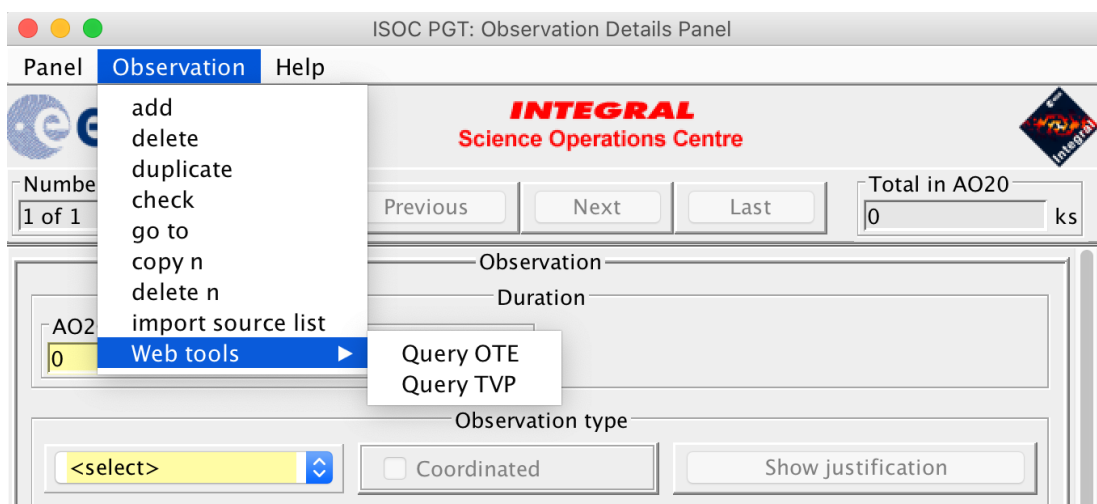


Figure 4 - The Observation Menu

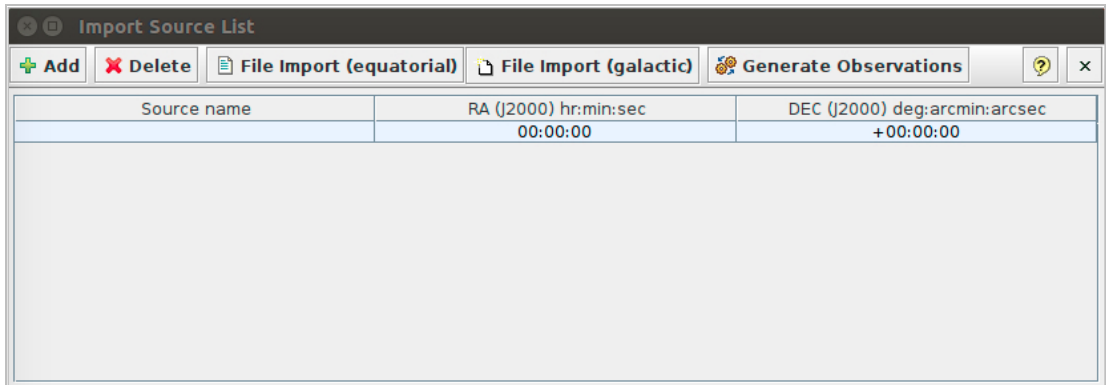


Figure 5 - Import Source List

2.1.2.4 Data Rights Details Panel

To claim data rights on specified observations. They can be automatically generated from the observations list or they can be manually inserted using the fields in the panel (see Figure 6).

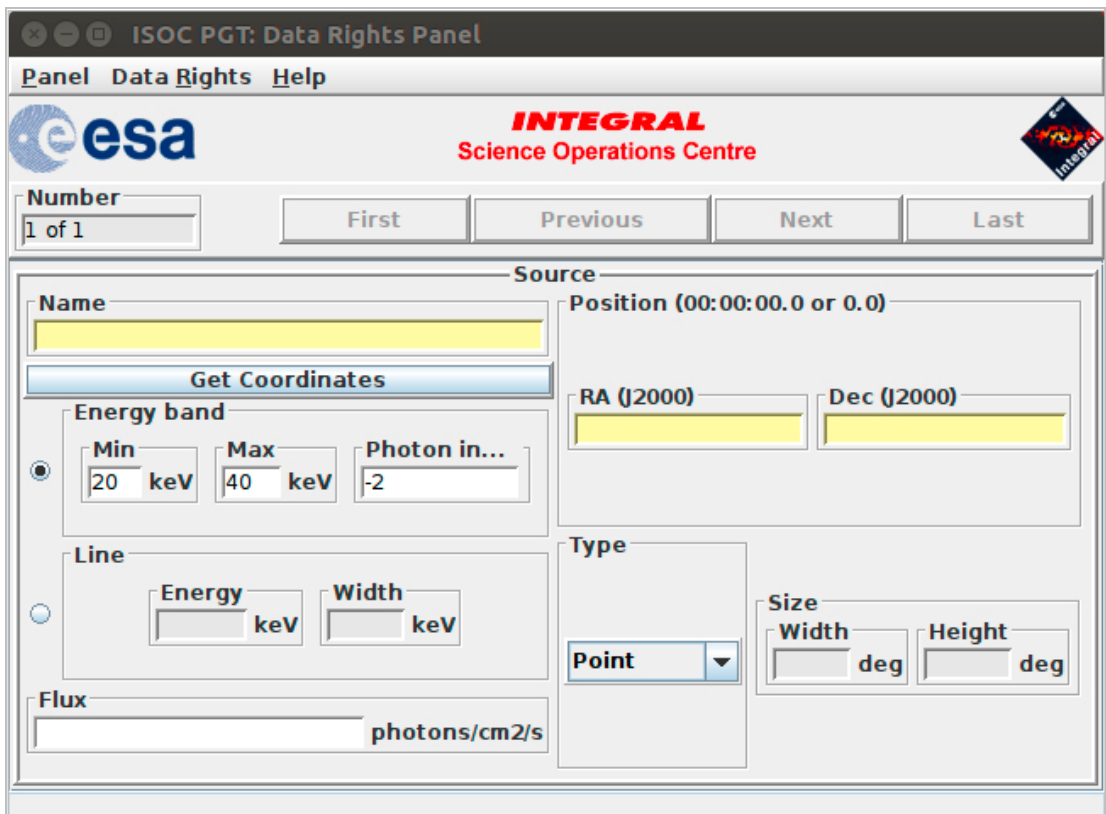


Figure 6 - The Data Rights Details Panel

If no data rights are specified, the data will be considered as **public** and a warning will be shown when checking the proposal. The Data Rights Details Panel has a menu option labelled **Data Rights** in addition to the **Panel** and **Help** menu items (see Figure 7). From it, you can: **add** new data rights (the display will show the new data rights), **delete**, **duplicate** or **check** the currently displayed data rights and **go to** a particular one. The item **copy n** makes “n” copies of the current data rights, and **delete n** deletes the range of data rights specified. The item **import source list** works exactly as in the Observation Details Panel, and similarly the button “Generate Data Rights” creates data rights for each source in the list. Finally, **Create data rights based on observations’ sources** will create data rights from the observations in the proposal, but will also **delete the currently defined data rights**.

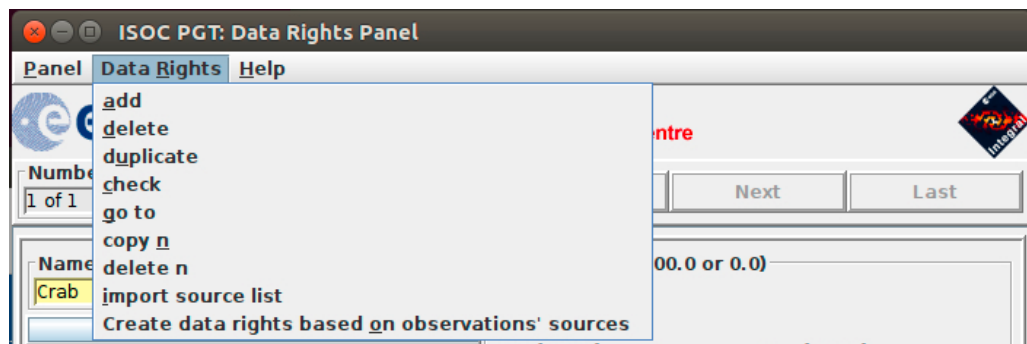


Figure 7- The Data Rights menu

2.2 Saving, loading and printing

2.2.1 Saving

To save a proposal at any time, select **File** → **Save** in the menu of the Main Panel.

All proposal information is stored in a well-defined XML file.

2.2.2 Loading

To load a saved proposal, select **File** → **Open** in the menu of the Main Panel. The PGT proposal file format is XML. If you wish to use a proposal from the previous AO, request it through the ISOC Helpdesk (inthelp@sciops.esa.int) by specifying the Proposal ID. You should not edit the XML file by hand.

2.2.3 Printing

To print a proposal or parts of it, first choose the printing options by selecting **File** → **Print** → **Options** in the menu of the Main Panel. This will open the *Print Options* dialog (see Figure 8).

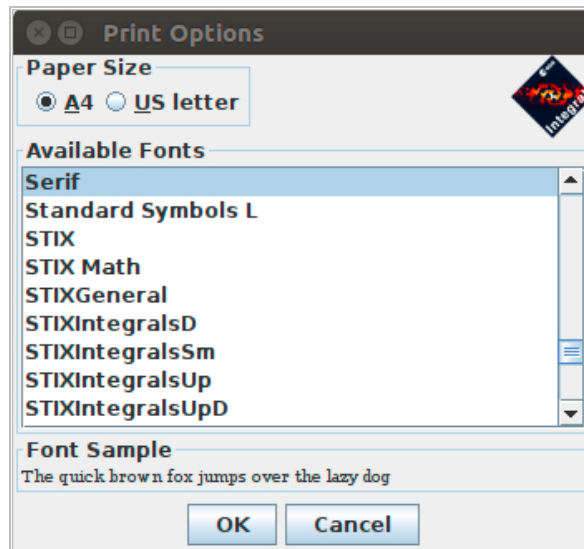


Figure 8 - The Print Options dialogue

Two paper sizes are supported, A4 and US letter. Click on the appropriate button at the top of the dialogue to choose the paper size. The list of fonts from which you can select will appear below. After having selected the paper size and font, set them by clicking **OK**, or **Cancel** to disregard the selection and close the dialogue.

To print the *entire proposal*, select **File** → **Print** → **Proposal** in the menu of the Main Panel. A Print dialogue will appear to allow you to select a destination (printer or file) and start the print job. The exact appearance of this dialogue will depend on the platform you are using. The administrative details and the proposal details can be printed individually by selecting **Panel** → **Print** in the menu bar of the corresponding panel.

Observation details can be printed by selecting **Panel** → **Print** → **All Observations** to print all the observations, or by selecting **Panel** → **Print** → **Current Observation** to print an individual observation. To print a summary of all the observations in the proposal (one observation per line), select **Panel** → **Print** → **Summary**.

2.3 Submitting a proposal to ISOC

The PGT allows you to send your proposal electronically to the ISOC. To do this, your computer must be connected to the Internet.

2.3.1 Submitting for the first time

Clicking the **Submit Proposal to ISOC** button in the lower part of the Main Panel starts the submission process. PGT will first check your proposal. If there are any warnings or checks that fail, they will appear in the Failed Checks Panel. Fails will abort the submission process and require you to make the necessary corrections. Warnings should be reviewed carefully and corrected if possible, but they will not prevent from submitting the proposal. When all checks pass, the Summary Panel will show an overview of the requested time and observations (Figure 9). Click **Submit** to send the proposal or **Cancel** to abort the submission.

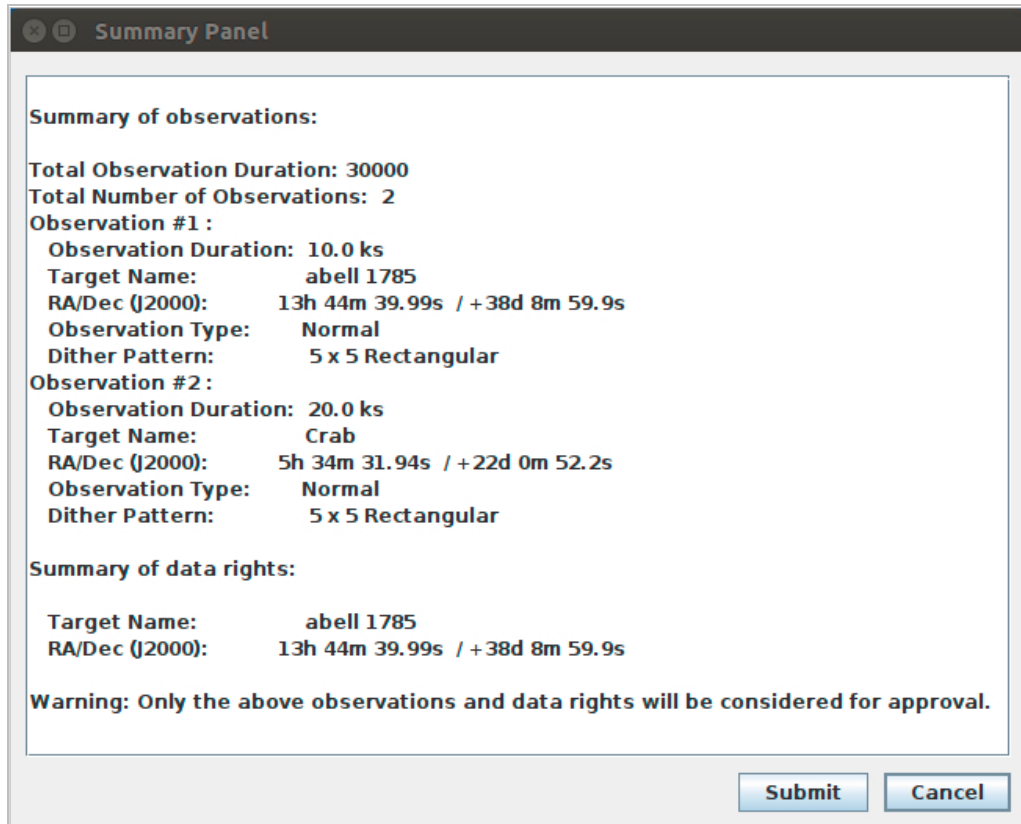


Figure 9 - The Summary Panel

By clicking **Submit**, PGT will attempt to establish a connection with a computer at ISOC that has been set up to receive proposals. Once it is established, the proposal will be sent. If the proposal was sent successfully, the following dialogue will be displayed (Figure 10).

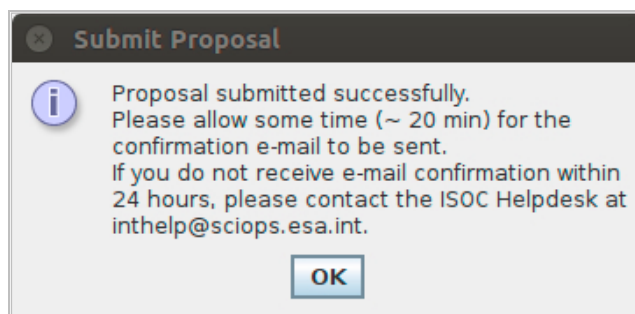


Figure 10 - Successful Submission dialogue

When a proposal is received at ISOC, further automatic checks are performed on the proposal. If all checks pass, a proposal ID is assigned and included in the confirmation email sent to the PI. If

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some checks fail, however, no proposal ID is assigned and the information about the failed checks is sent in the receipt-confirmation email.

2.3.2 Resubmitting a proposal

If you want to update a proposal you have already submitted, you can resubmit a proposal using the *Proposal ID* as follows.

Update your proposal and enter the *Proposal ID* in the box provided at the bottom of the Main Panel (see Figure 1). The **Resubmit Proposal to ISOC** button will be enabled and the **Submit Proposal to ISOC** button will be disabled. When you click the **Resubmit Proposal to ISOC** button, PGT will repeat the proposal submission process, described above.

The computer at ISOC will use the *Proposal ID* entered to find the previous version of the proposal in the ISOC database. If it is found, the resubmitted proposal will replace the previous one. If it is not found, the receipt confirmation email message will inform you of that fact (make sure the *Proposal ID* is correct).

PGT cannot prevent a proposer from submitting the same proposal multiple times as new proposals. A new *Proposal ID* will be generated for each new submission. Therefore, be cautious when resubmitting a modified version of the same proposal.

2.3.3 Obtaining a copy of a submitted proposal from ISOC

After submitting a proposal, it should be saved for future reference, and to allow for the possibility of resubmitting the proposal at a later date.

You can also request a copy of your proposal by writing to the ISOC Helpdesk (inthelp@sciops.esa.int); refer to it by its *Proposal ID*. You will receive it by email.



3 Observing Time Estimator (OTE)

The Observing Time Estimator (OTE) is a web-based tool running at the INTEGRAL Science Operations Centre at ESAC and made available to potential observers.

The purpose of OTE is to give users a reliable guide as to the feasibility of their proposed observation. For example, given specific source characteristics (spectrum, flux), OTE computes the signal-to-noise ratio (S/N) achievable in a given observing time, or conversely, the integration time needed to achieve a desired S/N. The underlying instrument response data is kept up to date for each AO.

OTE can currently be used only for INTEGRAL's main instruments: SPI and IBIS (interested users should refer to the JEM-X and OMC Observer's manual for details).

All INTEGRAL proposers shall use OTE in determining the duration of their proposed observations. Output of the OTE will be used by ISOC during the technical feasibility assessment and during the proposal evaluation by TAC.

OTE is accessed via the ISOC web site, <http://integral.esac.esa.int>, under 'Observation Tools'.

3.1 Using OTE

3.1.1 Input

- *Select an instrument:* SPI or IBIS.
- *Select Intensity: continuum or line*
 - For a *continuum* calculation the user must set the lower and upper energies, *E_{min}* and *E_{max}*. The allowed range is 15 keV–10 MeV. OTE assumes a power law spectrum so the photon spectral index must be specified. If you wish to perform calculations for continuum, please make sure to read section 3.2.
 - For *line* calculation, input the central energy, *Energy*, and line width (*FWHM*). If the line is unresolved, a line width of 0.1 keV is sufficient.
- *Specify the source flux.*
 - This is the integrated broad-band flux, in units of photons cm⁻² s⁻¹, in either the selected energy range (for the continuum) or integrated over the full width at zero intensity (FWZI) for a line. Beware! The continuum sensitivity curves in the SPI and IBIS Observer's manuals are presented using different units: monochromatic flux density, i.e., photons cm⁻² s⁻¹ keV⁻¹.
- *Specify the S/N or the exposure time.*
- *Select the desired dither pattern.*
 - This will take into account the off-axis response of the instruments as INTEGRAL dithers: a very important effect for SPI but not for IBIS (staring or HEX are not recommended). We generally recommend the 5x5 dither pattern (see the IBIS and SPI Observer's Manuals).
- *Click the 'Query' button.*

INTEGRAL Observation Time Estimator

Instrument			
<input checked="" type="radio"/> IBIS			
<input type="radio"/> SPI			
Spectral Information			
Intensity:	Flux (photons/s/cm ²) <input type="text" value="1.0E-3"/>		
<input checked="" type="radio"/> Continuum:	Emin (keV): <input type="text" value="30.0"/>	Emax (keV): <input type="text" value="50.0"/>	Power-law photon index: <input type="text" value="-1.5"/>
<input type="radio"/> Line:	Energy (keV): <input type="text" value="511.7"/>	FWHM (keV): <input type="text" value="1.0E-2"/>	
Observation Time Estimation			
<input checked="" type="radio"/> Time to achieve this signal to noise ratio:	<input type="text" value="3.0"/>		
<input type="radio"/> Signal to noise ratio achieved in this time (ks):	<input type="text" value="100"/>		
Dither pattern			
<input checked="" type="radio"/> 5 X 5			
<input type="radio"/> Hexagonal			
<input type="radio"/> Staring			
<input type="button" value="Query"/>			

Figure 11 - Observation Time Estimator (OTE) input

3.1.2 Output

OTE returns (see Figure 12):

- The original input values
- Warnings, if part of the selected energy band for the source calculation is outside the energy range of the selected instrument
- Calculated exposure time, or S/N for the entire input energy range (for continuum calculations) or for the FWZI (line calculations)
- For continuum calculations, the calculated exposure time, or S/N for the individual sub-bands used in the back-end calculations (see section 3.2). These may be useful, for example, for determining the energy above which the source fades into the background.

Source parameters:	
flux:	1.0e-3 photons/s/cm ²
Emin:	30.0 keV
Emax:	50.0 keV
photon index:	-1.5
Instrument parameters:	
Instrument set:	IBIS
Dithering	5x5
Calculating exposure time for	S/N = 3.0
Results	
Instrument	exposure time
ISGRI:	4.0e0 ks
PICsIT:	N/A

Figure 12 - Observation Time Estimator (OTE) output (bottom part)

3.2 Continuum calculations: a note on energy ranges

While a broad energy range is allowed in the OTE input, the OTE back-end calculations themselves do not allow the use of a broad energy band, e.g., 20 keV to 10 MeV. The underlying algorithm in OTE calculates the *average* performance across a user defined continuum energy band given the flux of the source in that band. However, the sensitivity of the instruments can vary enormously over their energy ranges. In addition, the gamma-ray instruments can have very rapid changes in sensitivity in a comparatively small range of energies (especially around 511 keV). Also, many (most) gamma-ray sources exhibit steep spectra so that they are very much fainter at higher energies. Even for hard sources, including the highest energies will result in very low S/N due to the relatively high background at MeV energies, compared to the source flux.

For these reasons, in previous AOs, OTE was restricted to energy bands which are narrower than the entire instrumental bandpass. Of course the prospective observer may be in a situation where the continuum range of interest is rather wide. For this reason, it is possible to specify a wide energy band in the interface. OTE splits the input energy range into narrower sub-bands and, assuming a power law spectrum (with the flux and spectral index as user inputs), calculates the flux within each sub-band. It then performs individual calculations on these sub-bands, of the S/N, or observation duration, and finally combines these results into a global figure for the entire input energy band.



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3.3 Hints and warnings

(i) Units: Please be careful with units!

- Input and output time are in kiloseconds (ks).
- All fluxes, both for lines and continua, should be given in units of photons $\text{cm}^{-2} \text{s}^{-1}$.

(ii) Prospective IBIS users should also note the following:

- The continuum range of interest can straddle the energy ranges of ISGRI and PICsIT and be only partially inside the energy range of one or both. If only one calculation is done for the entire range of interest, both detector arrays might report a poorer response than is truly available. If one does go beyond the energy range of a detector array, a warning is given.
- In such a case, we recommend calculating the broad-band flux for the energy range of interest covered by ISGRI and by PICsIT separately and combining the results later.

(iii) The contributions of Compton photons to the S/N or observing time are not considered.

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4 Target Visibility Predictor (TVP)

The Target Visibility Predictor (TVP) is a web-based tool running at the INTEGRAL Science Operations Centre at ESAC and made available to potential observers.

TVP is used to determine when a source is visible by INTEGRAL. This is especially useful in determining whether INTEGRAL observations can be coordinated with other observatories, and if phase-dependent observations of binary systems, for example, can be performed.

TVP is accessed via the ISOC web site, <http://integral.esac.esa.int>, under ‘Observation Tools’.

4.1 Viewing constraints

INTEGRAL celestial viewing constraints are defined by power and thermal constraints (Sun), as well as star-tracker blinding constraints (Sun, Earth and Moon). The viewing constraints used in this tool are such that the pointing direction of the spacecraft must be greater than 50 degrees away from the Sun and the anti-Sun and within 15 deg of the Earth's limb, or within 10 degrees of the Moon's limb.

Since the Earth and Lunar orbits can be predicted very accurately, it is also possible to predict when any part of the celestial sphere is visible by INTEGRAL.

4.2 How visibility is calculated

Sky visibility is calculated by dividing the sky into approximately rectangular cells of 10 x 10 degrees referred to as *skybins*. The visibility of each corner of a skybin is determined for every revolution in the mission, whenever INTEGRAL is above the Van Allen belts. If all four corners are simultaneously visible, that area of sky is deemed visible. The calculation is therefore (slightly) conservative. The results are stored in a *Data Base of Observable Bins* (DBOB), which contains the open and close times for every skybin during the mission, and the resulting available duration. This “open interval” never crosses revolution boundaries since science operations are not performed in the Van Allen belts around perigee.

4.3 Using TVP

4.3.1 Input

- *Source Name* (Optional) Entering the source name and pressing “Get Simbad Coordinates” will fill in RA and Dec coordinates. If the name is not found in the Simbad database you will need to fill in RA and Dec.
- *RA and Dec (J2000)* In either of the formats shown on the web page.
- *Dither pattern* For hexagonal or 5x5 dither patterns, the TVP checks whether all points in the dither pattern are visible, not just the centre.
- *Start and End date* For the period of interest. Defaults are start and end dates of the current AO cycle, although it is strongly recommended to cover only the period of interest. Input should be in the format shown on the web page.
- *Minimum Duration* In kiloseconds. TVP will only return visibility of bins open for longer than this value. In the DBOB, bins can be open for as short as one second (if the



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bin is at the edge of the Earth or Moon constraint). However, the short term observation scheduling system would never attempt to use such a bin. We suggest 1.8 kiloseconds as a reasonable value, which currently is the minimum exposure time.

4.3.2 Output

The output of TVP is a summary of the input parameters, and a time-ordered list of when the source (skybin) is visible. Each line in the list contains start and end times (UTC), and duration of visibility (seconds), both for the selected dither pattern and for the target attitude. Gaps of twelve hours between successive visibility periods are usually due to Van Allen belt transit. Shorter gaps are due to Earth or Moon constraints and longer gaps to Sun/anti-Sun constraints.

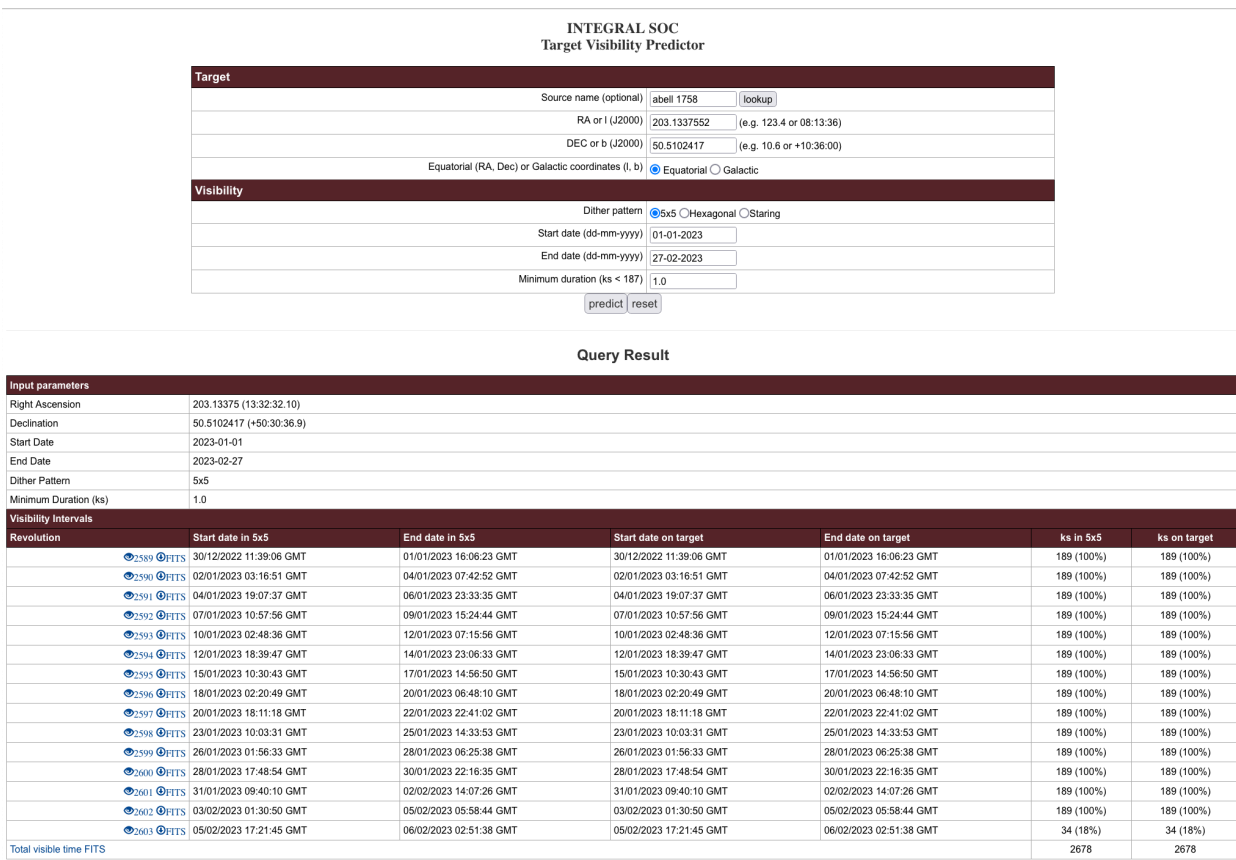


Figure 13 - Target Visibility Predictor (TVP) results

5 Exposure Map Tool (EMT)

The Exposure Map Tool (EMT) is a web-based tool running at the INTEGRAL Science Operations Centre at ESAC and made available to potential observers.

EMT is used to get the existing exposure time at a given position in the sky. The exposure time is the time INTEGRAL has observed that position according to an exposure map generated by ISOC (IBIS or SPI observation maps).

EMT is accessed via the ISOC web site, <http://integral.esac.esa.int>, under ‘Observation Tools’.

5.1 Using EMT

5.1.1 Input

- *Source Name* (Optional) Entering the source name and pressing “Get Simbad Coordinates” will fill in RA and Dec coordinates. If the name is not found in the Simbad database you will need to fill in RA and Dec.
- *RA and Dec (J2000)* In either HMS or decimal degrees.

5.1.2 Output

The output of EMT displays the sum of the total time INTEGRAL has observed the target up to the querying date plus a prediction of the time that target will be observed up to the end of the current AO, according to IBIS and SPI exposure maps.

Exposure Map Tool

Target coordinates

Equatorial coordinates
 Galactic coordinates

Queried for equatorial coordinates (203.1337552, 50.5102417)

INTEGRAL will have observed this target for:

3,579.2 kiloseconds (IBIS)

2,864.5 kiloseconds (SPI)

Estimated exposure by the end of AO19.

Figure 14 – Exposure Map Tool (EMT) results