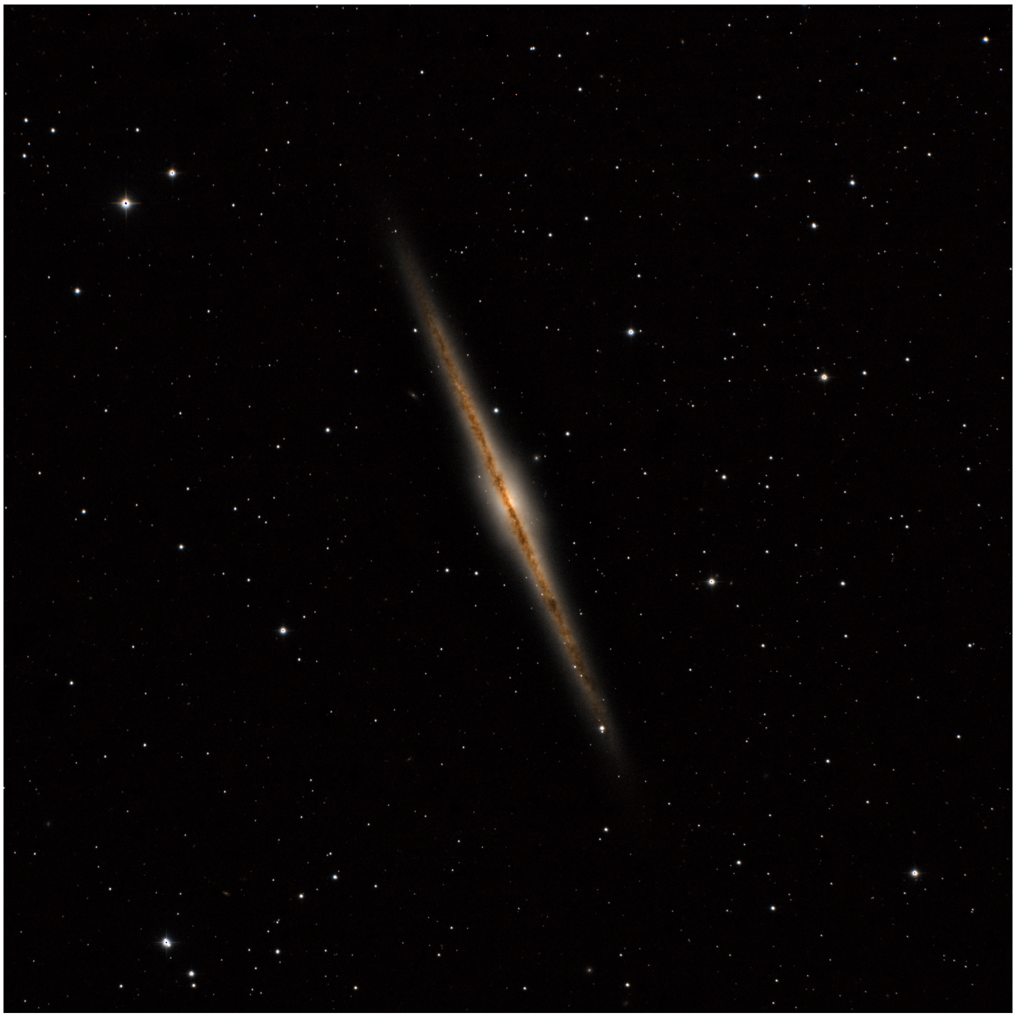
PANIC User's Manual



NGC891 - Date: 25-01-2024 - Instrument: PANIC - Telescope: 2.2m (CAHA) - Filters: H, J, Ks

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1 Acronyms

OT	Observing Tool
OP	Observing Program
OB	Observing Block
OS	Observing Sequence
PAPI	PAnic PIpeline
GEIRS	GEneric InfraRed Software
GUI	Graphic User Interface
QL	Quick-Look
FWHM	Full Width at Half Maximum
MFWHM	Moffat Full Width at Half Maximum
PSF	Point Spread Function
FoV	Field of View

2 Introduction to observing with PANIC

PANIC is a wide-field near-infrared camera for the 2.2m telescope. The instrument has been developed by the Instituto de Astrofísica de Andalucía (IAA-CSIC) and the Max Planck Institute for Astronomy (MPIA) to deliver the instrument to CAHA.

2.1 PANIC in a nutshell

Instrument/telescope	**PANIC/2.2m**
FOV	26.3 x 26.3 arcmin
Pixel scale	0.37 arcsec/px
Detector	4096x4096 pixels, monolithic HAWAII-4RG
Pixel Size	15 micron
Intrinsic image quality DEE80	≤1.84 px, 0.68 arcsec
Image distortion	<1.3%
Wavelength range	0.8 μm to 2.5 μm
Standard broad band filters	Z, Y, J, H, Ks
Narrow band filters	H2, Br-gamma

2.2 Filters

PANIC is equipped with four filter wheels, each capable of holding up to 6 filters. At present, there are 7 filters installed and 8 empty positions available. The filters are positioned within a converging beam, making it impossible to combine two filters from different wheels. The optical design allows for the use of narrow-band filters, defined as those with a bandwidth of $\leq 1\%$ of the central wavelength, without significant degradation of their bandpass. The filter parameters are specified under operational conditions of 100 K and a converging beam. In the following tables, all wavelengths and Full Width at Half Maximum (FWHM) values are given in microns.

Filter	Central wavelength	FWHM	50% cut-on	50% cut-off	T
Z	0.874	0.106	0.821	0.927	85%
Y	1.023	0.105	0.971	1.075	75%
J	1.247	0.157	1.169	1.326	84%
H	1.638	0.285	1.495	1.780	93%
Ks	2.150	0.328	1.986	2.314	95%

Figure 1: Standard broad band filters.

Filter	Central wavelength	FWHM	50% cut-on	50% cut-off	T
Br-gamma	2.191	0.055	2.163	2.218	83%
H2	2.118	0.034	2.101	2.135	93%

Figure 2: Standard narrow band filters.

The transmission curves for all the filters are shown in Fig. 3. The individual graphs can be found in the PANIC Filters section of the PANIC website.

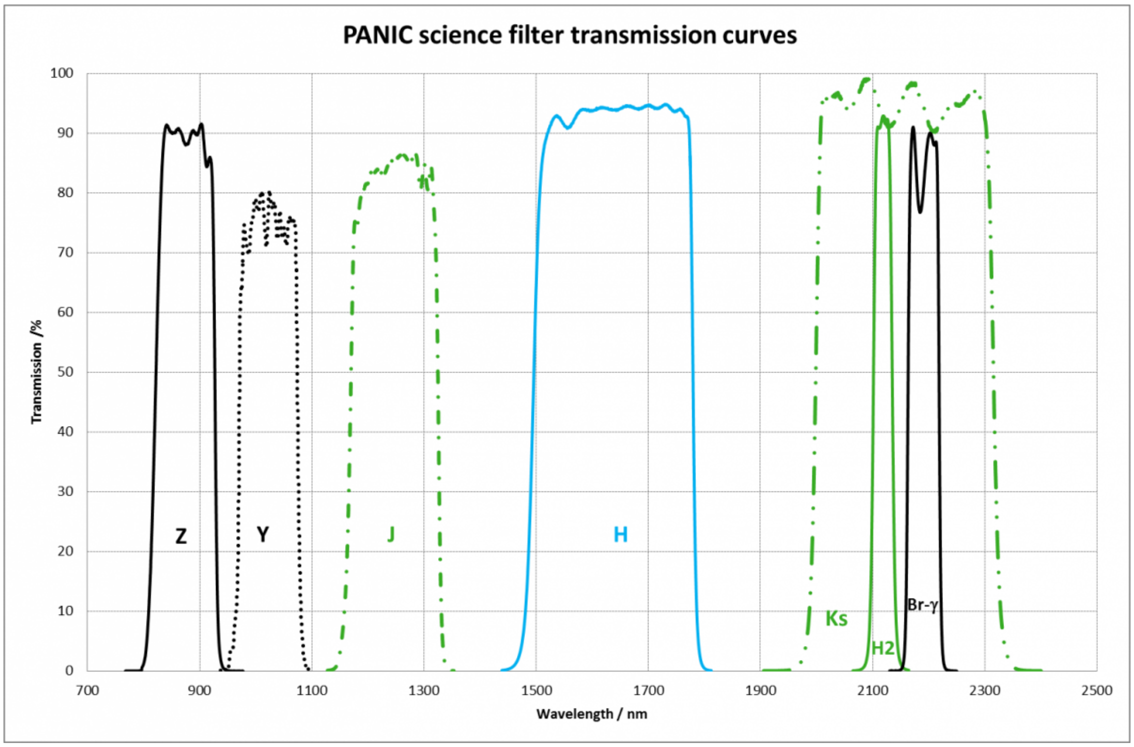

Figure 3: Broad and narrow band filters transmission curves.

2.3 Read-out modes

GEIRS has different read-out modes available, but the one designed for taking observations with PANIC and for which the instrument is calibrated is the 'cntsr' mode. The readout modes are:

cntsr: continuous sampling read. The detector is read N times during the integration time, obtaining a total of N frames. The desired number of frames is adjusted so that always a multiple of the minimum integration time is used. The image is calculated by subtracting the first frame from the last frame, ignoring all the other frames on the ramp (the user is able to additionally save all the frames on the ramp, if desired). Advantage: recommended mode por PANIC. Fully characterized. Disadvantage: only multiples of minimum integration time allowed as integration time. Minimum integration time: 2.903616 s.

srr: sample-up-the-ramp. The detector is read N times during the integration time, obtaining a total of N frames. The image is calculated by means of a linear fit through the readout frames. Advantage: reduces the effective read noise. Disadvantage: has not been characterized. Minimum integration time: 2.903616 s.

rrr-mpia: double correlated sampling. The detector is read immediately after the initial reset (first frame) and at the end of the integration (last frame). An image is calculated by subtracting the first frame from the last frame. Advantage: full dynamic range for the detector integration time already at minimum integration time. Disadvantage: has not been characterized. Minimum integration time: 2.903616 s.

lir: line interlaced read. Double-correlated sampling. The detector is read before the initial reset (i.e., at the end of the integration time of the N-1 read) and then after the initial reset of the N+1 read. An image is calculated by subtracting the first frame of the N+1 read from the last frame of the N read. Advantage: at N cycles repeats, it always has the best integration efficiency, full dynamic range, and no photon overflow after the detector integration time. Disadvantage: minimum integration time is doubled with respect to the recommended cntsr. Has not been characterized. Minimum integration time: 5.806516 s.

fecr: fast end of line correlated read. Double-correlated sampling but with an additional reset after the last frame has been readout, which acts as overflow protection. Advantage: overflow protection to reduce persistence effects. Disadvantage: has not been characterized. Minimum integration time: 3.087481 s.

mer: multiple endpoint read or fowler sampling. The array is read multiple times (N) after the initial reset and before the end of the integration time. An image is calculated by subtracting the average of the N frames after the initial reset from the average of the N frames before the end of the integration time. Advantage: reduces the read noise substantially, theoretically, by a factor of sqrt(N). Disadvantage: has not been characterized. Minimum integration time: 2.903616 s.

Additional information on read-out modes can be found in the GEIRS user's manual.

2.4 Save modes

PANIC has different modes for saving the data. These are:

Integrated All (save -i): Save the arithmetic sum of the selected images. Only the sum of the pixel values over all the cycle repetitions is saved, associated with an adjustment of the integration time in the FITS header. For the cntsr mode, it saves the sum of all the repetitions (NEXP keyword, crep command in GEIRS) in a single file.

Fits Cube (save -1): Stack all images into FITS cubes. This option has no effect if there is only one image, which means a single image still leads to the standard 2D image format. For the cntsr mode, all repetitions (NEXP) are stored as individual slices into a FITS cube, where each slice or plane represents a 2D image or frame. No summation is performed.

Single Frame Cube (save -S -1): Save the individual frames of what has been read, without regard of the cycle type (correlation type) that was active during the exposure. The option essentially unbundled all the implicit associations between the frames; it may be used to implement pipeline stages that act on these FITS files with refined correction methods beyond the simple add or fit schemes implemented in GEIRS. The SAVEMODE keyword will then be set to single.frame.read and will differ from the value of the READMODE keyword. Also, the NFRAMES will refer to the single frame count, not the number of (correlating) images. This mode can be seen the raw mode, where all the frames of the ramp (including the initial reset frame) are saved into a FITS cube, taking into account also the number of repetitions (NEXP); for example, in the cntsr mode, if we have an ITIME=5.8 secs and NEXP=5, we will get a FITS cube of 15 frames. As result, this mode will require an important extra disk space to store the data.

Individual (save): Save frames in shared memory formatting them according to the current readout mode/cycle type (ctype). Similarly as in the FITS cube mode, but saving all the repetitions in individual files instead of a FITS cube; and therefore, no summation is performed.

The previous saving mode names are those used in the OT GUI, while the names in parentheses refer to the commands used by GEIRS. For more information on save modes, see the GEIRS user's manual.

3 Planning your observations

PANIC has a software used for planning and taking observations called OT (Observation Tool). The OT allows the user to design all the observations beforehand in a user-friendly environment and serves as the high-level interface for on-site observations. This tool greatly facilitates and streamlines the use of PANIC, as there is no need to use commands or scripts to carry out the observations.

To start the OT open a panic22 terminal (or log in with *obs22@panic22.caha.es*), then write the command *start_ot.sh*. You fill find two options: create a new program or open an existing one. The OT has a tree structure, which can be seen in the left panel of the OT in Fig. 4, composed of:

Observing Program (OP). Is the top-level entity that contains a full set of observations. This is the first panel shown when you open a program. The astronomer can create an OP and save it as an XML file to execute later in the observatory. There are some blank spaces to fill in with general information, as shown in Fig. 4, considering that the information regarding Data Store Setup is mandatory.

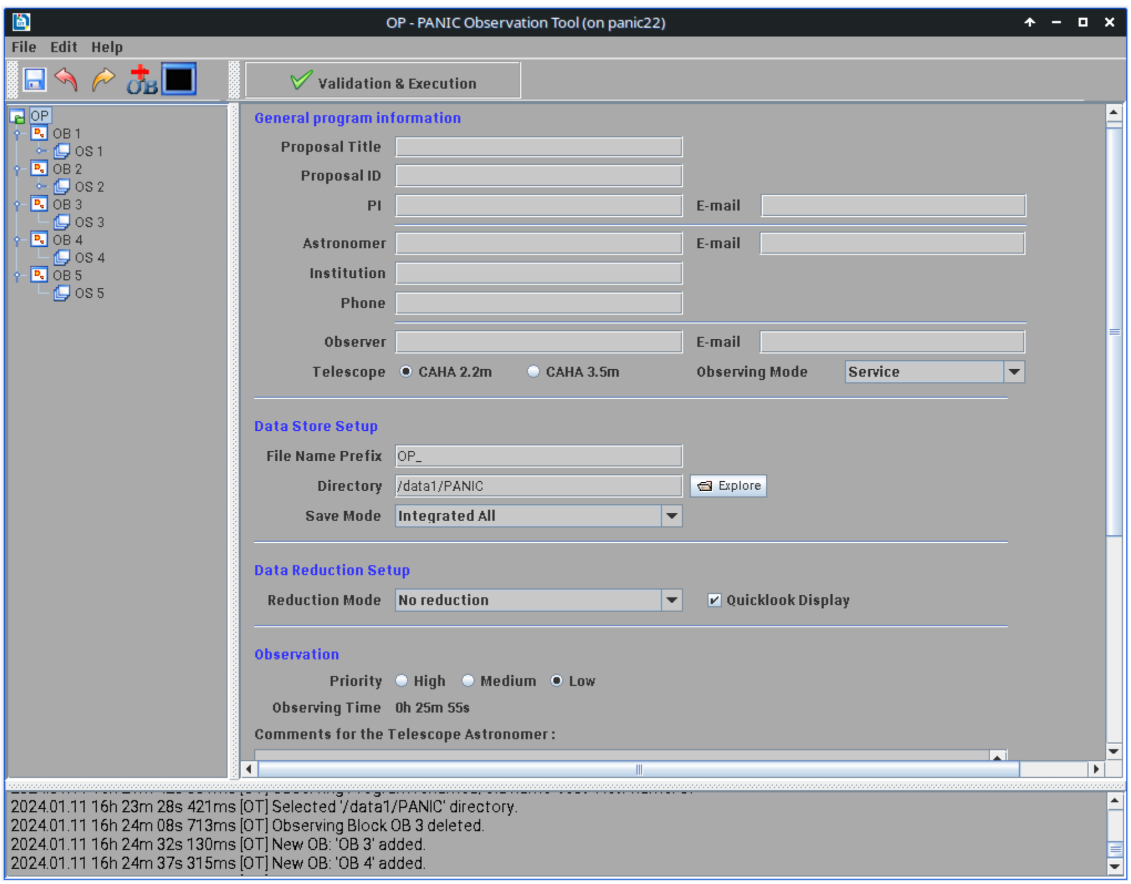

Figure 4: Observing Program panel

Observing Block (OB). Inside an OP it is possible to create multiple Observation Blocks (OB). An OB can be created by clicking on the '+OB' icon in the button bar, or right-clicking on the OP and selecting 'Add Observing Block'. There, information about the target coordinates[1] and the instrument setup has to be included, as depicted in Fig. 5. In this panel, it is also possible to have a preview of the

[1]The OT resolve the coordinates using Simbad database.

Az/Elev/Airmass (STARALT[2]) of the target for a specific date by clicking on the respective button on the right.

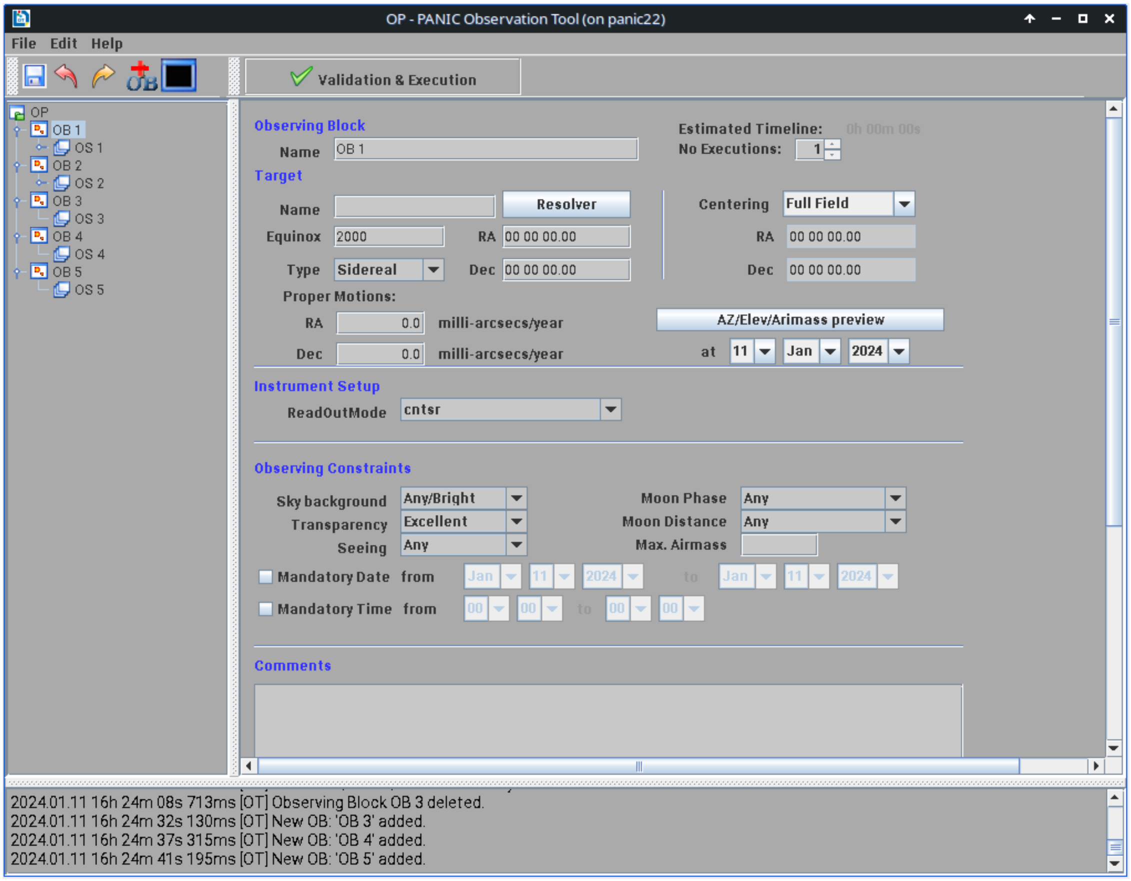

Figure 5: Observing Block panel

Observing Sequence (OS). The last entity is the Observing Sequence. Each OB has an OS (automatically created with the OB) in which the astronomer can design the observation itself, establishing information such as exposure times, filters, or repetitions.

When clicking on the 'Validation & Execution' button, and then clicking on 'Validate', the panel shown in Fig. 6 will display, with the information of the different sequences generated by the OBs. The predicted execution time is displayed on the top left. This time takes into account all the overheads. To execute the observation, click on 'Run'. To avoid dome vignetting, it is recommended to click on 'Pause' at the beginning of the script and wait until the dome is in the correct position. Then click on 'Resume'.

This section will cover how to create and design observations with PANIC using the OT, which specifically focuses on the OS configuration. Additional information about this software can be found in the Observation Tool User Manual.

[2]https://astro.ing.iac.es/staralt/

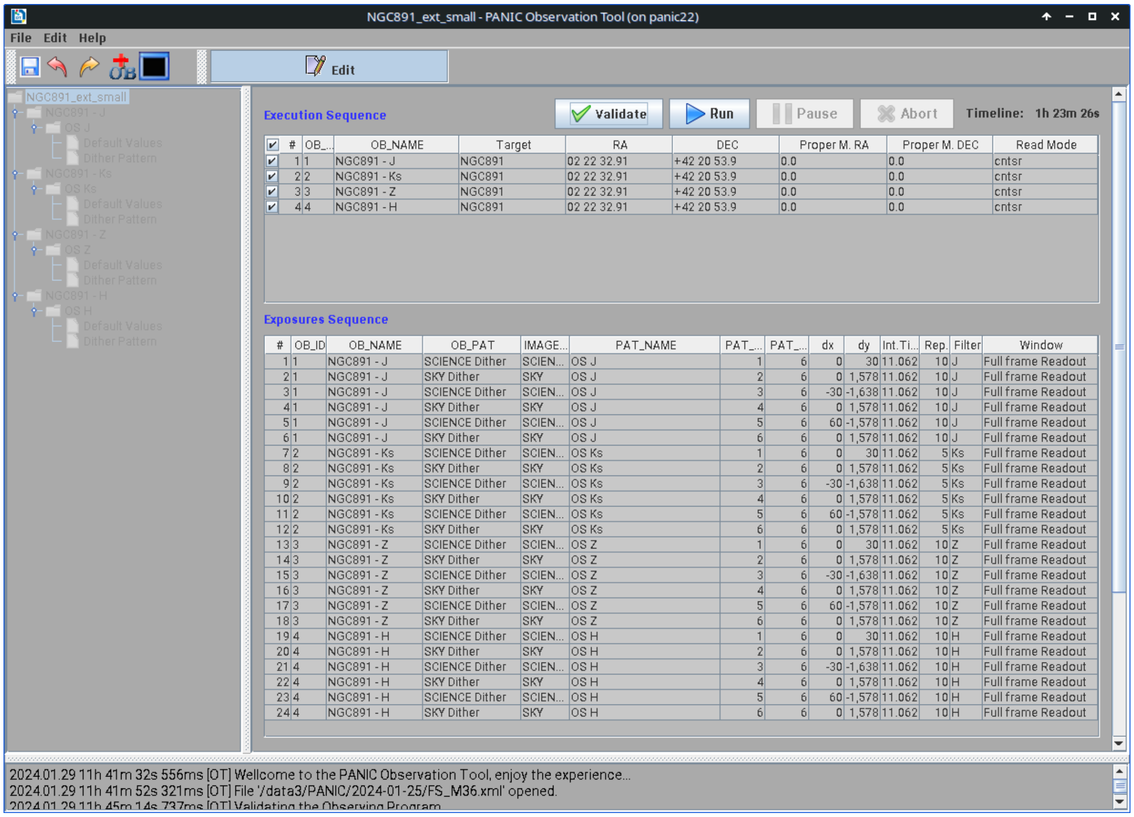

Figure 6: Validation & Execution panel.

3.1 Calibrations

The following will describe how to prepare OBs for the calibrations of observations with PANIC. If the position is set with the coordinates RA = 00 00 00 and DEC = 00 00 00 the telescope will not move.

To prepare the flat field calibration OPs, it is advisable to know in advance which filters will be used to save time. If this is not known, take flats for all filters.

3.1.1 Dome Flats

In order to design an OP for dome flats, it is mandatory to have as many OBs as filters you want to use, since each OB allows for only one filter. Do not add any coordinates for this kind of OBs. Then, right-click on the OS of each OB and choose 'Add Dome Flats.' A new branch will appear under the respective OS entity. In this new panel, you will find the options to configure the exposures, as seen in Fig. 7.

It is possible to select the lamps and exposure times freely, but the OT is already configured to select them correctly for each filter, so you can simply establish the Counts Level by selecting the 'Calculated' option. Then, choose the filter, number of repetitions, and cycles. It is recommended to do at least 5 cycles. PANIC pipeline (PAPI) is configured to use a minimum of 5 images, however, it is possible to readjust this number in the PAPI configuration file (see section 5.3.4).

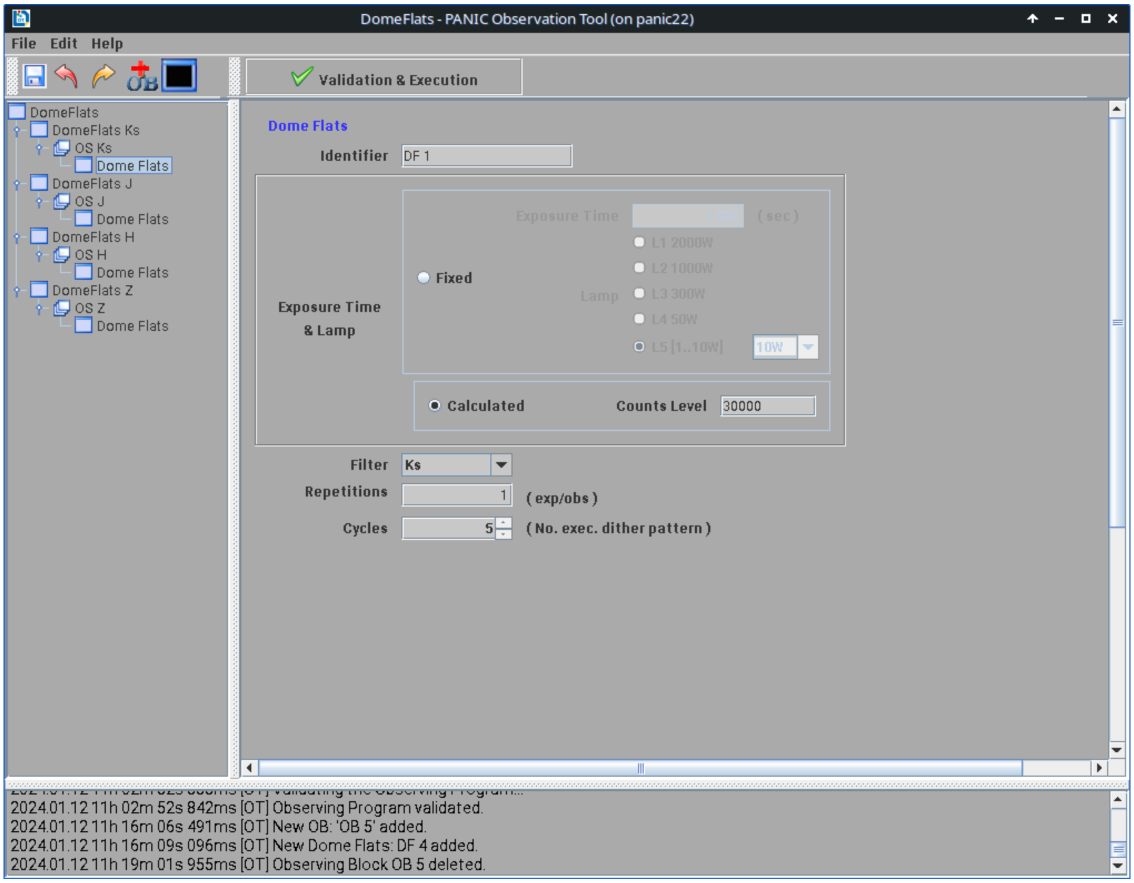

Figure 7: Configuration panel for Dome Flats sequence.

3.1.2 Sky Flats

The OBs for sky flats are constructed by choosing 'Add Sky Flats' when right-clicking in the respective OS, and it is also required to have an OB per filter. The OB has to contain information about the target, which should be a field as blank as possible, considering the wide field of PANIC. There are some blank fields available here. **It is important to have chosen the save mode 'Integrated All' on the OP panel**.

In the configuration panel, there are several fields to design the observations, distinguishing between dusk and dawn sky flats. It is recommended to set these parameters as seen in Fig. 8 (and 120 s as monitoring time for dawn sky flats). The order of the filters at both times should be as follows in Table 1.

Dusk	H2, Ks, H, J, Z, Y
Dawn	Y, Z, J, H, Ks, H2

Table 1: Determined sky flats filter order at dusk and at dawn.

This is because the number of counts increases differently and at different times depending on the filter. Therefore, after conducting a study, these have been determined as the most appropriate orders to follow for the routine to execute all the OBs. The execution for the sky flats OBs is dynamic since it depends on the brightness of the sky in the field we are pointing at, so we do not know how long it will take beforehand. If the sky is too faint in the dusk sky flats or too bright in the dawn sky flats, the OT will abort the execution. So, in order to take the sky flats for all the filters, you should start executing the OP pointing to the east, and if you run out of light at dusk or there is too much light at dawn, move to the west. In the default PAPI configuration file, the minimum number of flat fields necessary is 3, although it is recommended to set it with no less than 5.

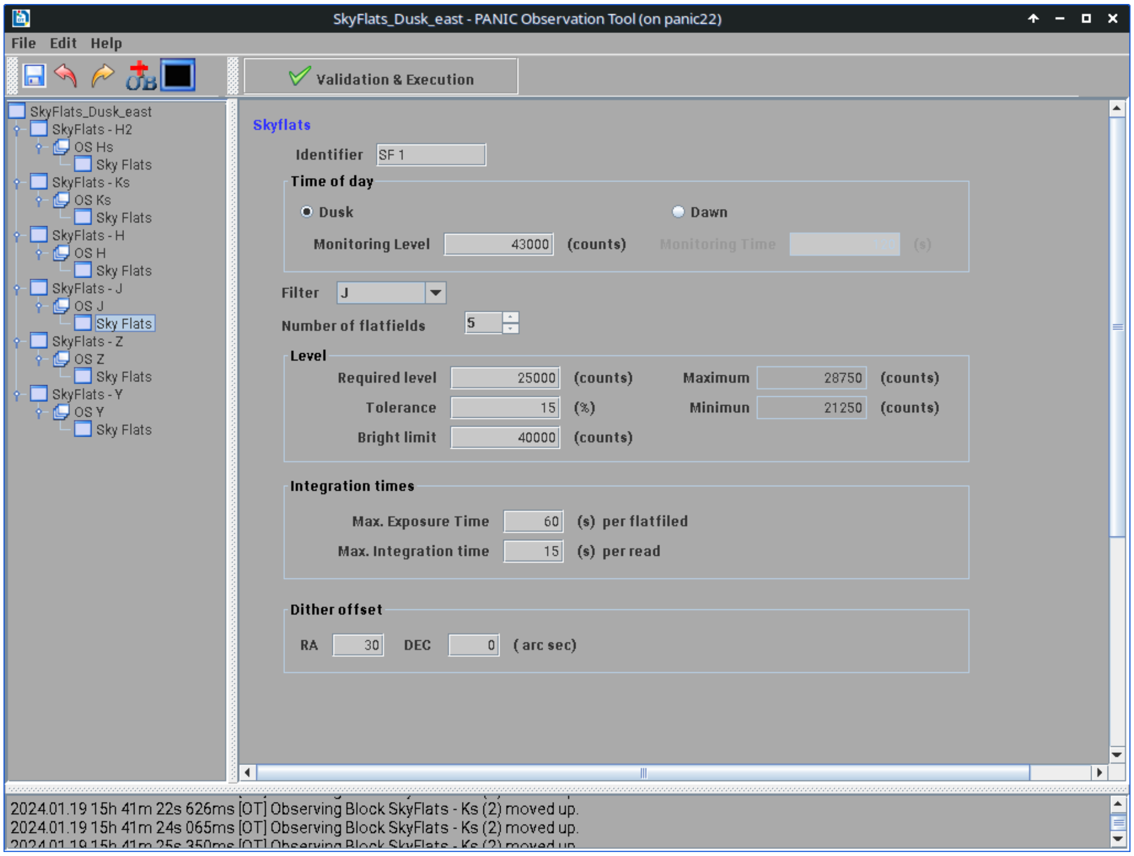

Figure 8: Configuration panel for Sky Flats sequence.

3.1.3 Darks

The OP for dark calibrations can be generated by the OT automatically, opening a new program and clicking the black square button in the button bar (see Fig. 9).

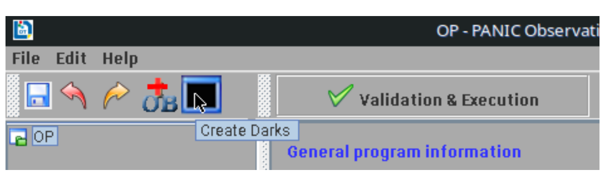

Figure 9: 'Create Darks' icon in the button bar.

This has to be done at the end of all observations of the night (including all flat fields), since this action creates a set of OBs for taking the darks for that specific night. It is necessary to set the File Name Prefix and the Directory in the OP panel. The OT will ask for the directory where look for the data to create the darks, and the number of cycles. It has to be at least 3, in order to allow the reduction pipeline to create a good master dark. This may take some time, so be patient.

3.2 Focus Series

To create an OP for focusing, add and fill an OB with the information of the target to point at, right-click on the respective OS, and choose 'Add Focus Series'. Note that in the OP panel you have to choose the **'Integrated All' save mode** so the QL can analyze the images. Then, fill in the sections. As base, exposures of 2.90 sec, 3 repetitions, and a range of 1000 microns with steps of 50 microns is appropiate, as seen in Fig. 10. It is advisable to always **use the H filter** for focusing and to choose a field with enough stars as the target. You will find some good focus fields in section 8.1.

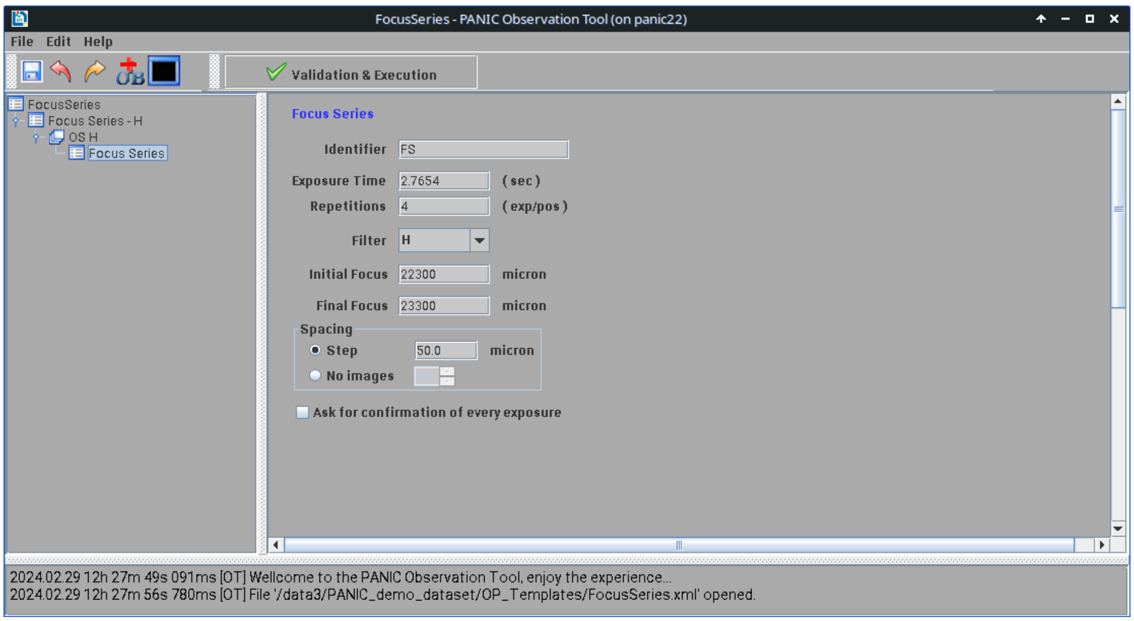

Figure 10: Configuration panel for Focus Series sequence.

The focus depends on the tube temperature, so the initial and final focus have to be set during the observation, considering that the predicted focus should be in the center of the selected range. This is, if the focus should be 22800, the initial and final focus have to be set in 22300 and 23300 respectively. In section 4.3.2, there is a reference table with some determined best focus values and their corresponding tube temperatures.

3.3 Science observations: strategies and recomendations

OPs for science observations can be defined with the 'Default Values' panel. This is, once you have the information in the OB completed (the RA and DEC coordinates and the readout mode as least), right-click on the OS and choose that option. In this panel (Fig. 11), it is possible to establish the filter, integration time, repetitions and number of cycles.

However, usually the default values are combined with a dither pattern or an iterator, and in this case, some fields of the default values panel can be disabled since their value has to be set in the new one. To add one of these extra panels, right-click on the OS and choose the respective option. In the following section, there is more information about the dither pattern design.

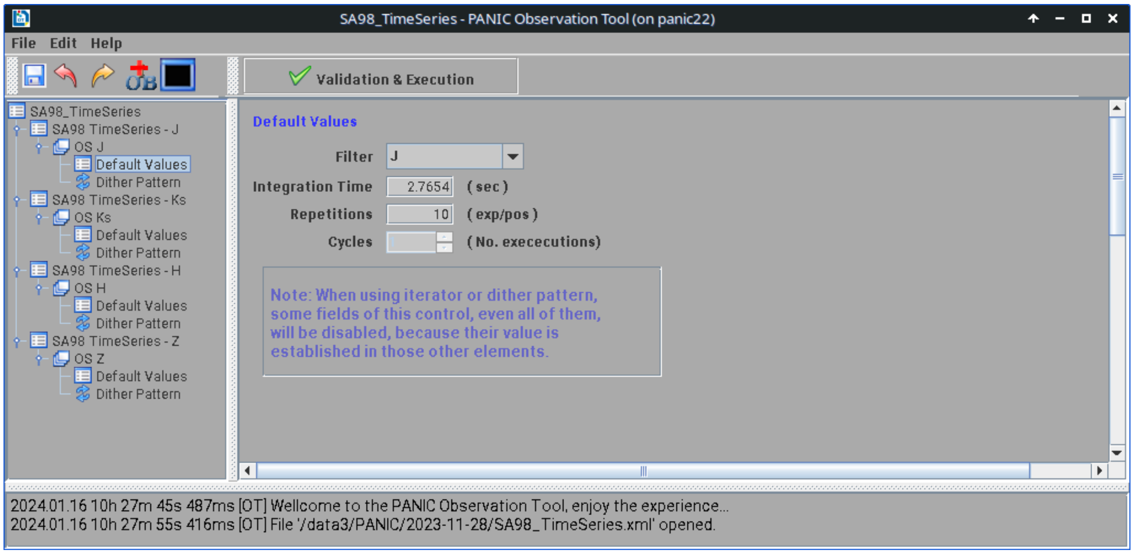

Figure 11: Configuration panel for a science sequence: Default Values.

3.3.1 Background subtraction

In order to subtract the background in the observations, it is necessary to define a Dither Pattern. This means that the full observation will consist of a defined number of observations at different positions with a specific offset between them.

If the subtraction will be performed using the PANIC reduction pipeline (PAPI), the observations have to be properly executed to ensure accurate sequence information. There are predefined patterns available in the OT, although they can be ajusted to each observation if necessary. It is also feasible to create a brand new dither pattern.

In the Dither Pattern panel, you will find three sections. The first one (blue rectangle), for creating the dithering, is divided into two alternatives: simple and custom. The second one (green rectangle) is used for extended objects. And the final one (red rectangle), the iteration configuration, is where the sequence is displayed and edited. The 'Simple' alternative to create the dithering has three predefined patterns, depends on the number of positions. The integration time is set so the pattern will adjust itself, meaning that the final number of positions will depend on the time. In the 'Custom' alternative there are four options to create the dithering:

Offset. This is the one used to create a personalized dithering. The operation is simple: fill in the desired dx" and dy" displacement and click on 'Add offset'. Take into acount that when using this option, before adding all the desired offsets, you have to configure the parameters PAT_EXPN and PAT_NEXP in the iteration configuration to have a unique sequence. PAT_NEXP represents the total number of positions, and PAT_EXPN represents the number assigned to each position. These values are set to 1 by default.

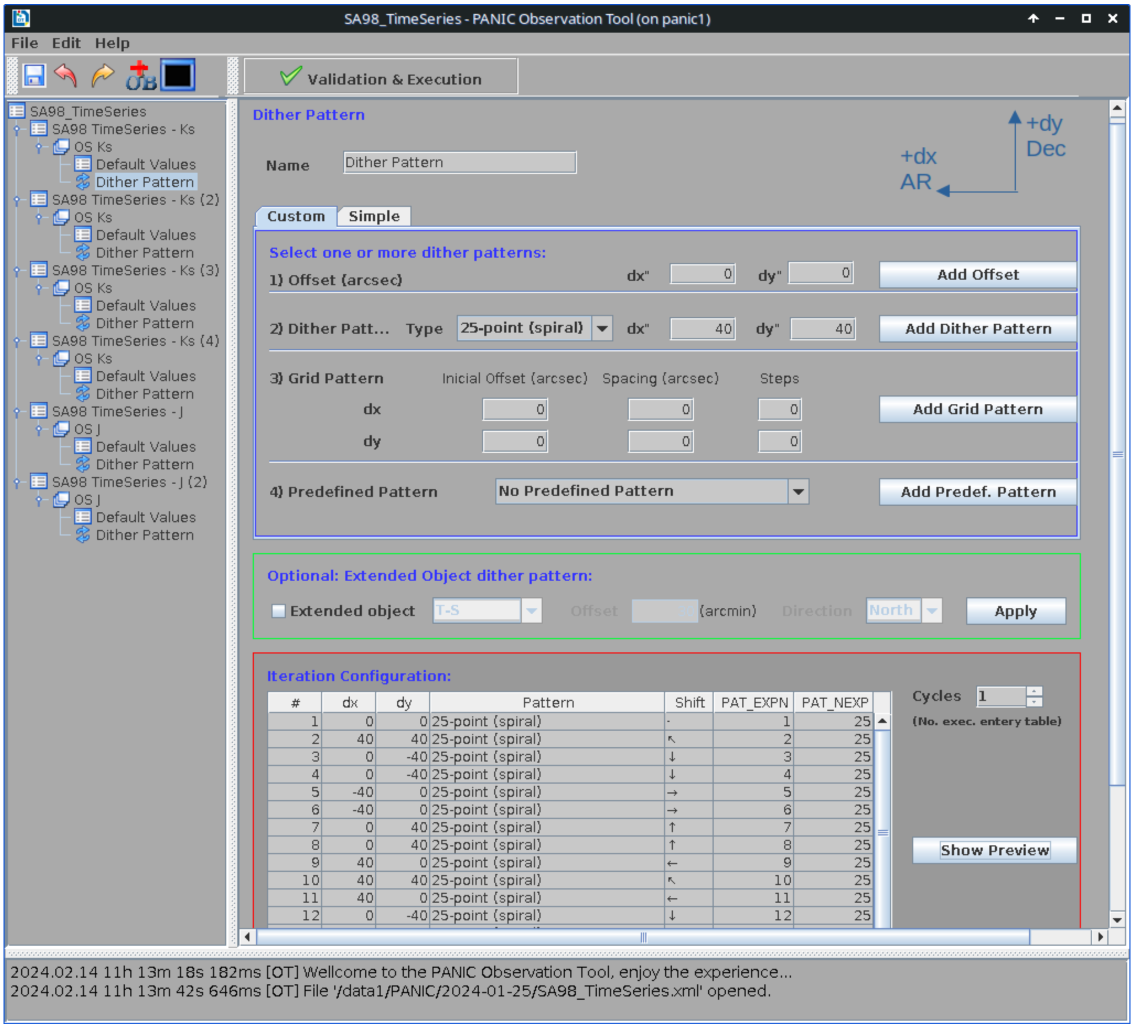

Figure 12: Configuration panel for a science sequence: Dither Pattern (point-like object).

Dither Pattern. This option allows you to create a dithering with the desired number of positions, by selecting it in the type option, and spacing, filling in the respective blanks.

Grid Pattern. Similar to the previus option, but the pattern will be a rectangle of dimensions giving by the spacing. It is necessary to set the inicial offset and the number of positions that is defined in the 'steps' field.

Predefined Pattern. The last one has the same patterns as in the simple alternative but without the time restriction.

To use the PAPI properly and perform a suitable sky subtraction, it is mandatory to have at least two sky images. Nevertheless, the number of sky images (hwidth) used to subtract the background can be modified in the configuration file.

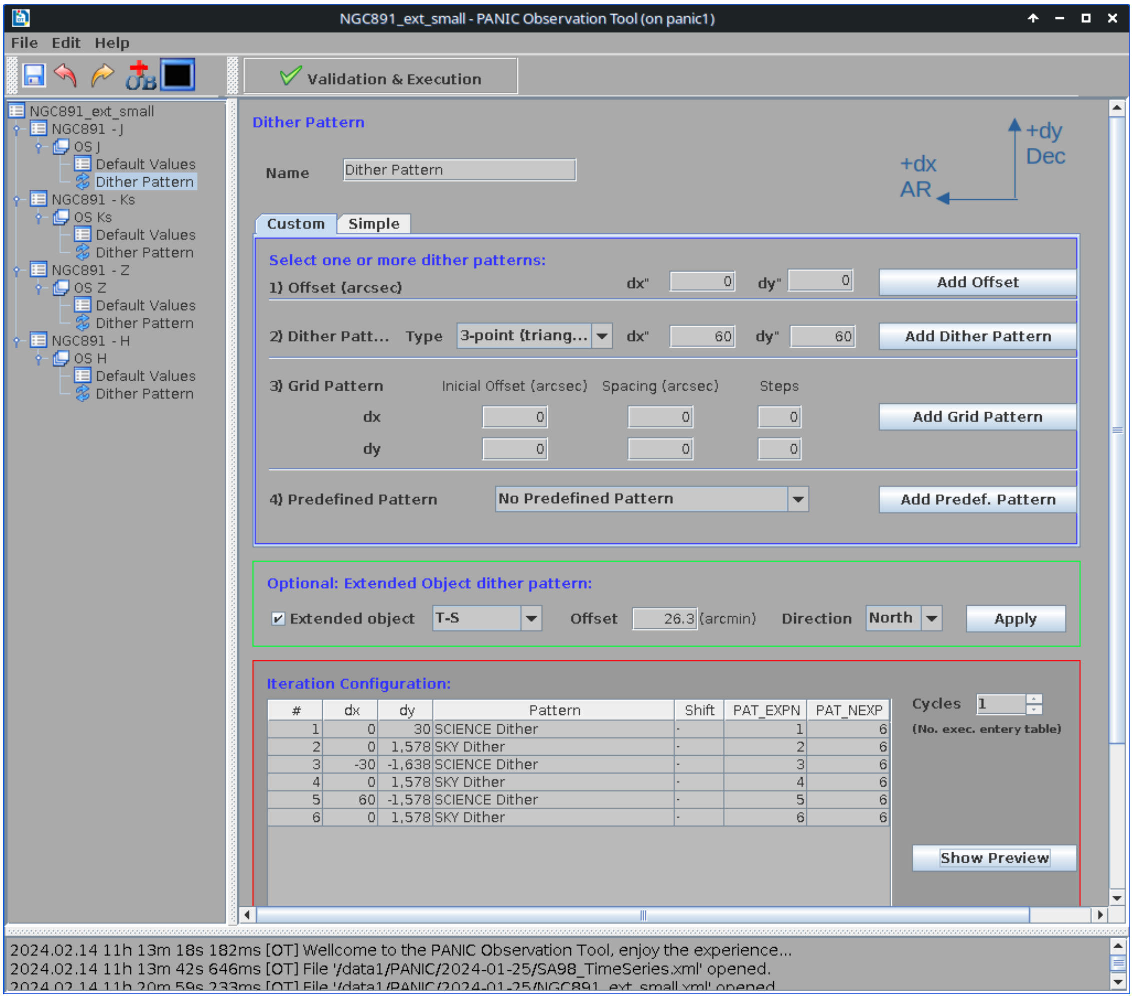

Figure 13: Configuration panel for a science sequence: Dither Pattern (extended object).

Point-like objects

For point-like objects, you can use any pattern from the OT or create your own, ensuring you have enough positions and spacing. At least three different positions are mandatoy: one will be the science image and the other two will be sky images, so that each position serves as the science image once, resulting in all exposures being sky-subtracted. The suggested offset (dx" and dy" boxes) to perform dithering with PANIC is 30". Fig. 12 shows an example of a dithering for a point-like target with 25 positions and an offset of 40", elaborated with the Dither Pattern option.

Extended objects

The dithering for extended objects is more elaborate. First, you have to define a dither pattern for the target with a minimum of two positions, as done for puntual objects. Then, from the 'Extended object' section, select the pattern of science (T) and sky (S) images that you prefer, the offset (in arcminutes), and the direction of the displacement. In this case, the images of the target will serve as the science images, while the offset images will serve as the sky images.

Before you choose the offset and the direction, check that the target object will not appear in sky images, and consider to have a field free of bright and/or saturated stars for the sky images to the extent possible.

In Fig. 13, an example of dithering for an extended object, such as a galaxy, is shown. The basic dithering was introduced using the Dither Pattern option (3 points, 60"), and the offset for sky images was selected using the T-S extended object option, with an offset of 26.3 arcminutes to the north. The OT also has an option to preview the dithering by clicking on 'Show Preview', as shown in Fig. 14.

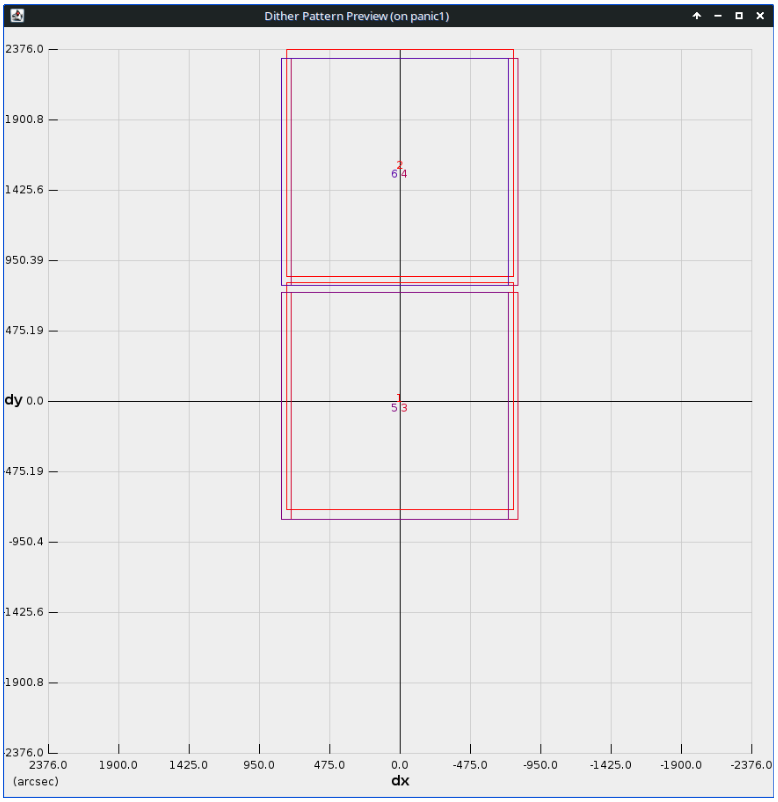

Figure 14: Dither pattern preview (extended object).

3.3.2 Time series

To prepare a time series observation, it is useful to select a dither pattern with several positions. Each position will represent a single observation for the time series, and employing a large dithering will enable better sky subtraction.

Then, if you want to obtain data over an even longer period, configure the OB to take more than one cycle or duplicate the OB as many times as you see fit. These two actions yield the same result: different sequences that PAPI will reduce exposure by exposure, and as a total observation, although this last one is irrelevant for a time series. The main difference between them is that designing the observation with duplicated OBs allows you to restart the observation from the current OB in case of any situation, whereas if you create a single OB with cycles, it is not possible to restart it from a mid-exposure cycle. Fig. 12 shows an example of a time series, where the basis observation consists of

25 exposures with a single cycle, and the OB has been duplicated four times to yield a final observation of 25x4 exposures in the filter Ks.

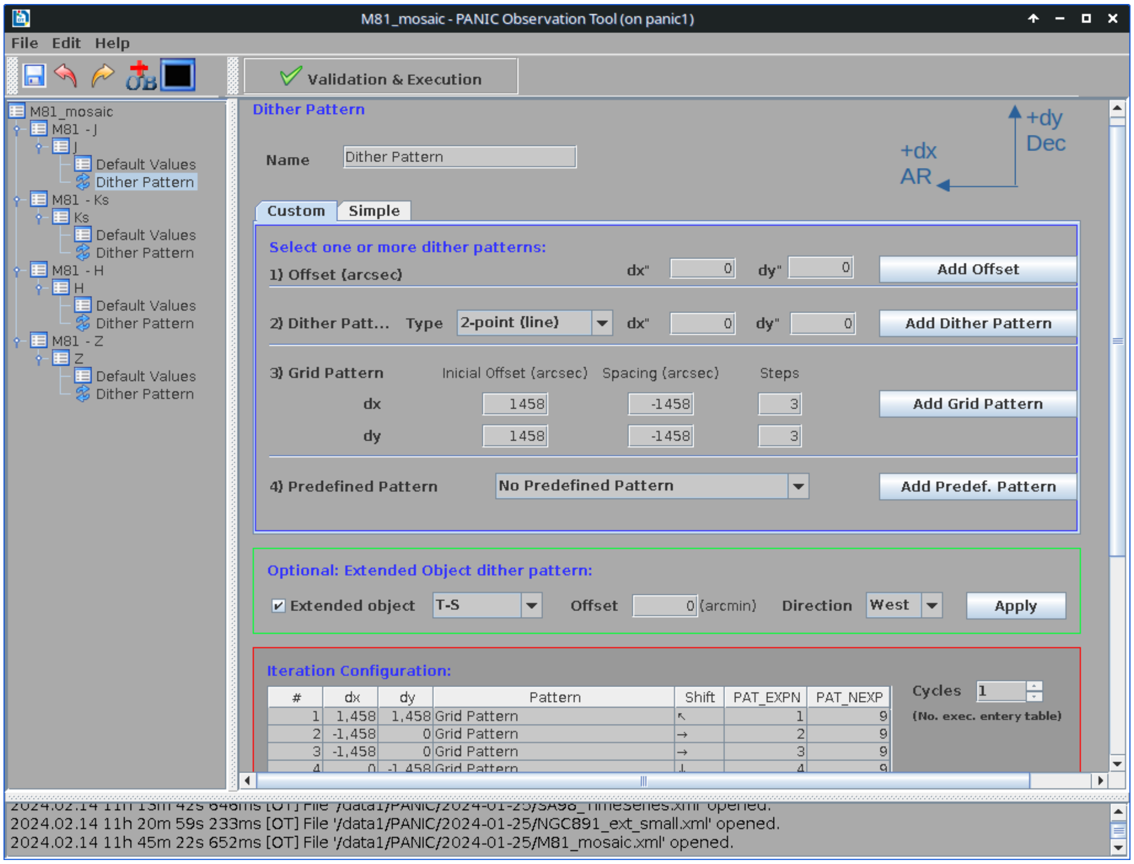

Figure 15: Configuration panel for a science sequence: Grid Pattern (mosaic).

3.3.3 Mosaicing a field

In order to create a mosaic of a field, the consecutive individual observations should have a minimum of 4/5 good stars superimposed. You can use the Grid Pattern option from the Default Values panel to build the iteration configuration. For example, for a mosaic of 9 positions with 1.3' of overlap between images the configuration is shown in Fig. 15, with the respective preview displayed in Fig. 16.

3.3.4 Atmosferic absortion in Ks filter

When observing in the infrared, it is important to consider that for the filter Ks, atmospheric absorption is very high. Therefore, it is recommended that observations conducted with this filter do not exceed 8 minutes if humidity is low (under 60%) and 4 minutes if it is high (above 60%) for a sky subtraction series, this means the corresponding successive images for subtraction, as seen previously. The reduction pipeline, PAPI, takes the closest-in-time sky images to perform the subtraction (2 by default). To change the exposure time to adapt it to this constraint, the simplest way is by adjusting the numer of repetitions of the Ks OB in the default values panel.

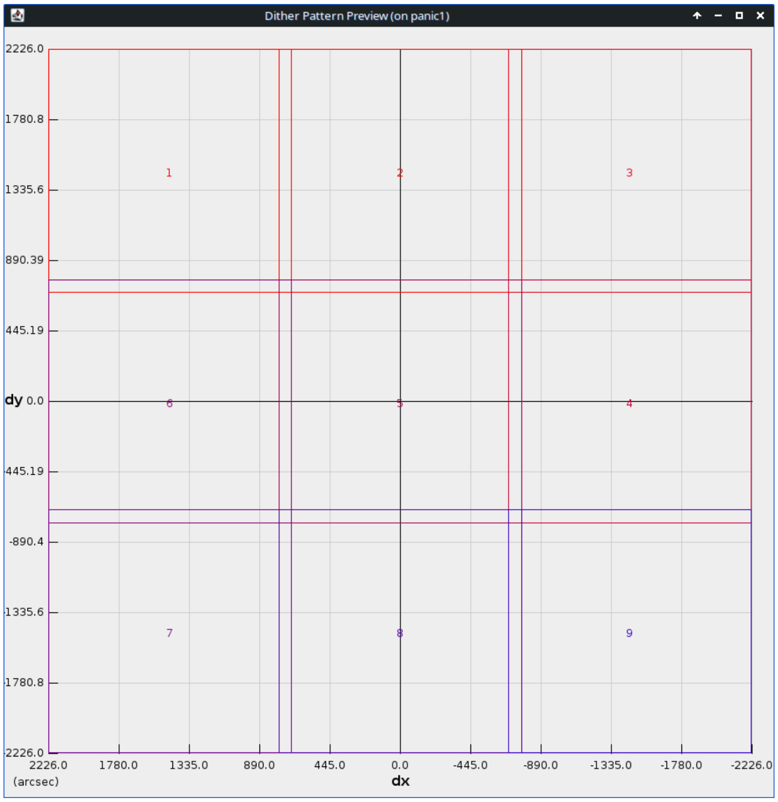

Figure 16: Grid pattern preview (mosaic).

The parameters will depend on the sky subtraction sequence. For example, for a non-extended object with a dither pattern, if the number of sky images to subtract is n, you have to check that n+1 consecutive exposures (one target, n skies) take the corresponding time.

3.3.5 Iterator option

The other panel that can be added to the Default Values is the Iterator option. This panel allows creating an OB with observations configured with different filters, integration times and/or repetitions. It is possible to combine the Iterator with the Dither Pattern (e.g. to take observations with the same dithering in various filters). Before adding the first step, make sure you have marked all the boxes you will want to modify. If not, the OT will take the values defined in the Default Values panel. Fig. 17 shows an example of four steps, with different times and filter, added using this option.

3.3.6 Subwindows implementation

Another possibility located in the Iterator panel is to create subwindows. It is possible to add up to 4 subwindows, configuring the origin and the dimensions in the table below. At the right of the table, there is a schema of the coordinates. In Fig. 18, a rectangular subwindow of 500x300, that start in the coordinates (200, 200), is defined. The integration time will be less than the set, as that is the integration time for the full field of view. To calculate the integration time of the subwindow, follow this equation:

$$\mathrm{IT}_{\mathrm{subwindow}} = 2.77s \cdot \mathrm{X}_{\mathrm{size}}/4096 \tag{1}$$

where $\mathrm{IT}_{\mathrm{subwindow}}$ is the integration time of the subwindow (in seconds) and $\mathrm{X}_{\mathrm{Size}}$ is the dimension of the horizontal axis (in pixels).

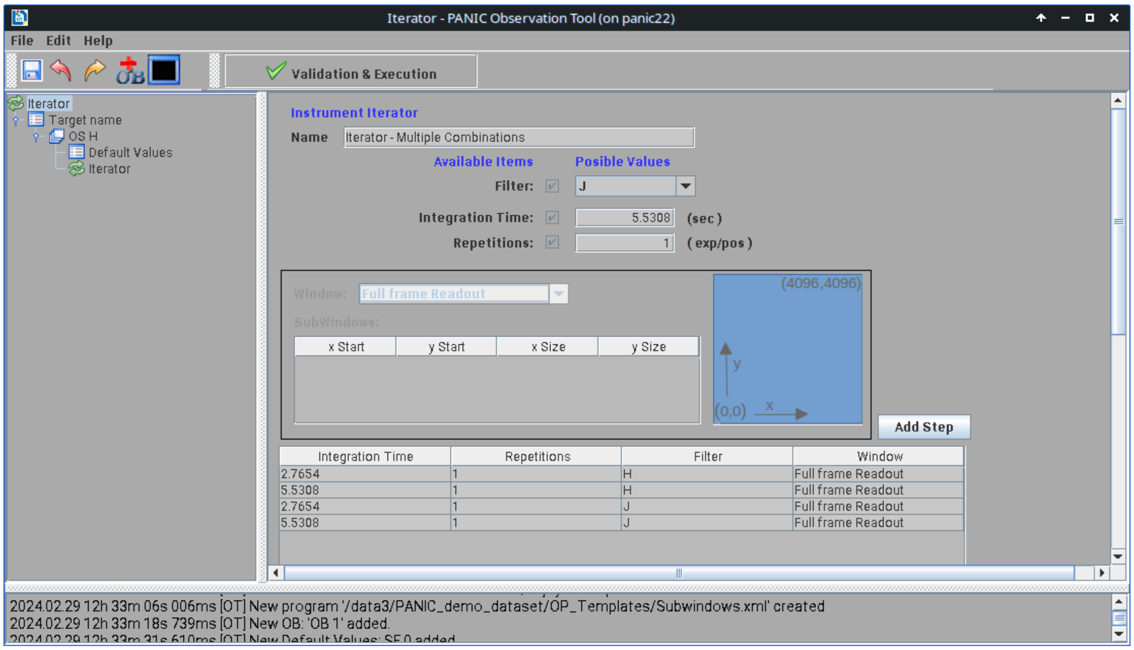

Figure 17: Configuration panel for a science sequence: Iterator.

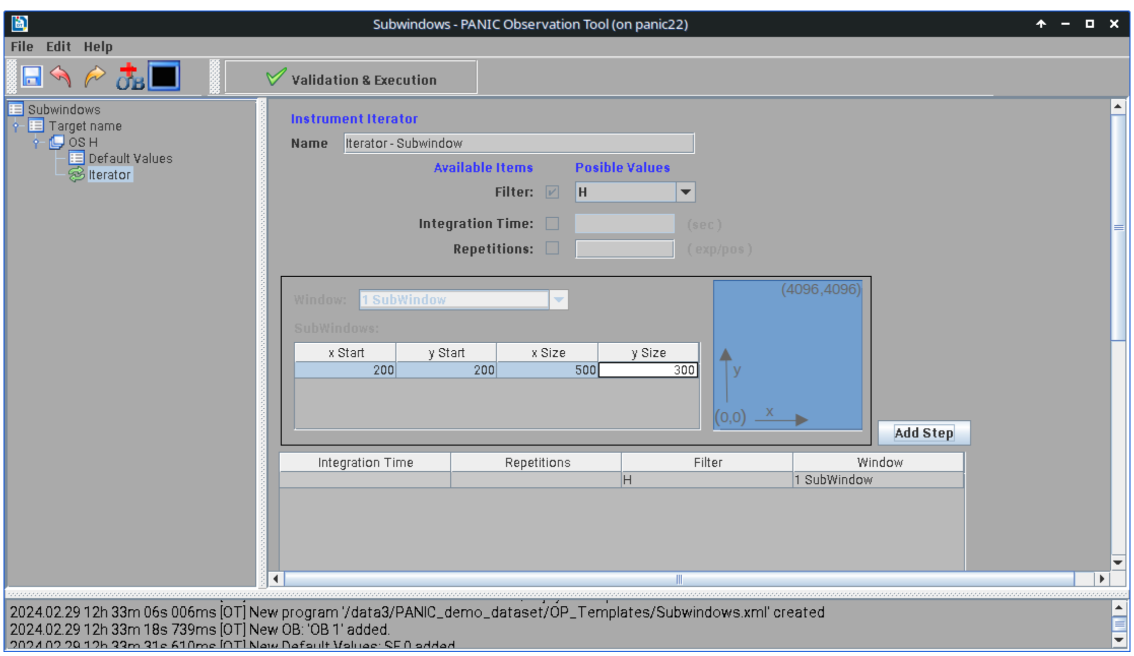

Figure 18: Configuration panel for a science sequence: Iterator (subwindow).

4 Observing with PANIC: step by step

The following description corresponds to observations at the 2.2m. At the beginning of each run, a python program can be run to characterize the run (if it is a commissioning run, galaxy project, calibration, astrometry...). To run the program, open a panic22 terminal on the desktop of XT22, or log in with ssh -X obs22@panic22.caha.es, then write the following commands:

```
source start_papi_env.sh
```

```
cd /home/obs22/bin/
```

```
python .log_mountcycle.py
```

and answer the questions.

4.1 Startup the software

In the remote control room, there are three terminals that will be used to conduct observations with PANIC: tecs22, the computer to communicate with the telescope, XT22, the instrument control terminal and XT20, for monitoring the observations.

To operate PANIC at the 2.2m, the programs DOMEC and GEIRS have to be running. DOMEC can be found on the desktop of the XT22 terminal. It is also possible to start it with the command:

```
start_domec
```

in a terminal previously logged in with `ssh -X obs22@ultra3`. The DOMEC GUI is the one shown in Fig. 19, where, unless observing, 'Hydraulics', 'Drives' and 'Remote' should be off.

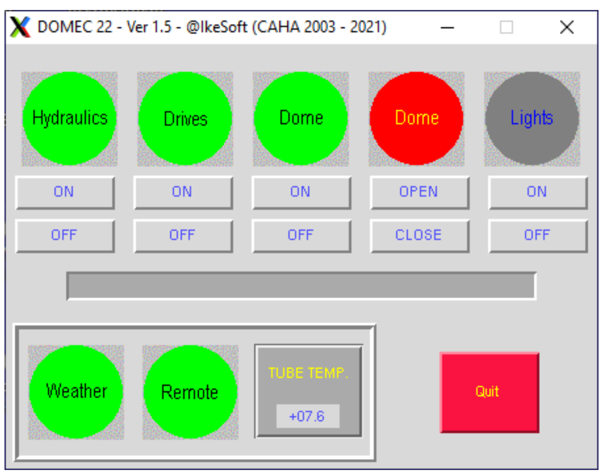

Figure 19: DOMEC graphical user interface.

GEIRS (GEneric InfraRed Software) is the software that implements the instrument control and detectors readout. Information about it can be found in the GEIRS user's manual. To set up GEIRS open panic22 terminal on the desktop of XT22, or log in with `ssh -X obs22@panic22.caha.es`, and start it with the command

```
geirs_start_panic
```

A window like the one shown in Fig. 20 will appear for a few seconds (29 s). Complete the fields as shown, changing the observer name if necessary. It is important to choose the option 'True' in the 'Telescope' field before the time runs out. Then, the main GUI of GEIRS (Fig. 21) will appear, as well as the real time displayer (Fig. 22) and the filter wheel control (Fig. 23). It is advisable to open the interactive shell from GEIRS GUI (*Modules > Interactive Shell*) in order to monitoring the commands that the OT send to GEIRS. The rest of the needed programs and systems are running by default.

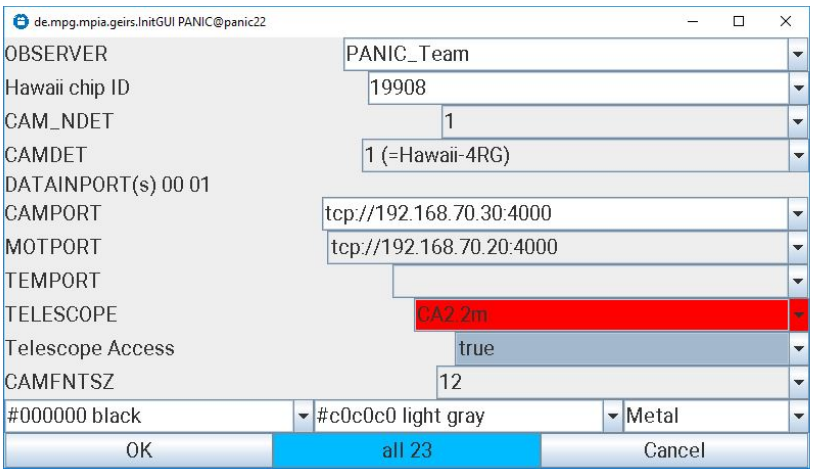

Figure 20: Startup screen to start GEIRS.

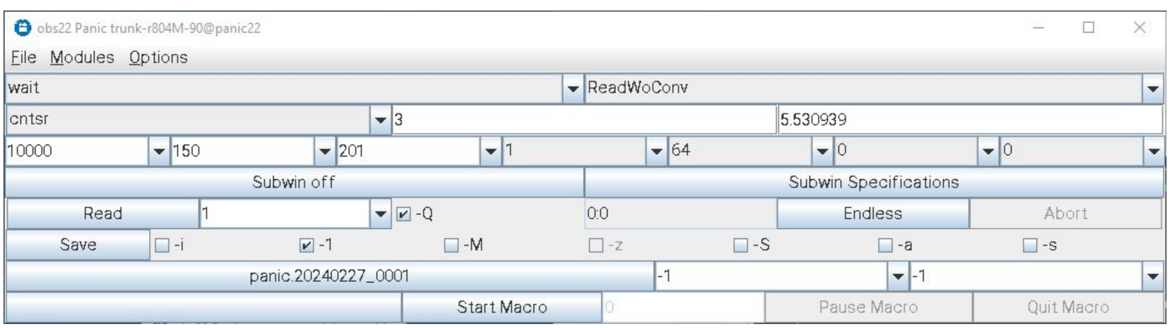

Figure 21: GEIRS camera control window.

Then, start the OT with the command:

```
start_ot.sh
```

on a panic22 terminal, or previously logged in with `ssh -X obs22@panic22.caha.es`. The OT must to be running in the same PANIC computer as GEIRS (XT22). It is possible to have multiple instances of the OT opened simultaneoustly, but do not open the same .xml file, and do not run more than one observing program at a time.

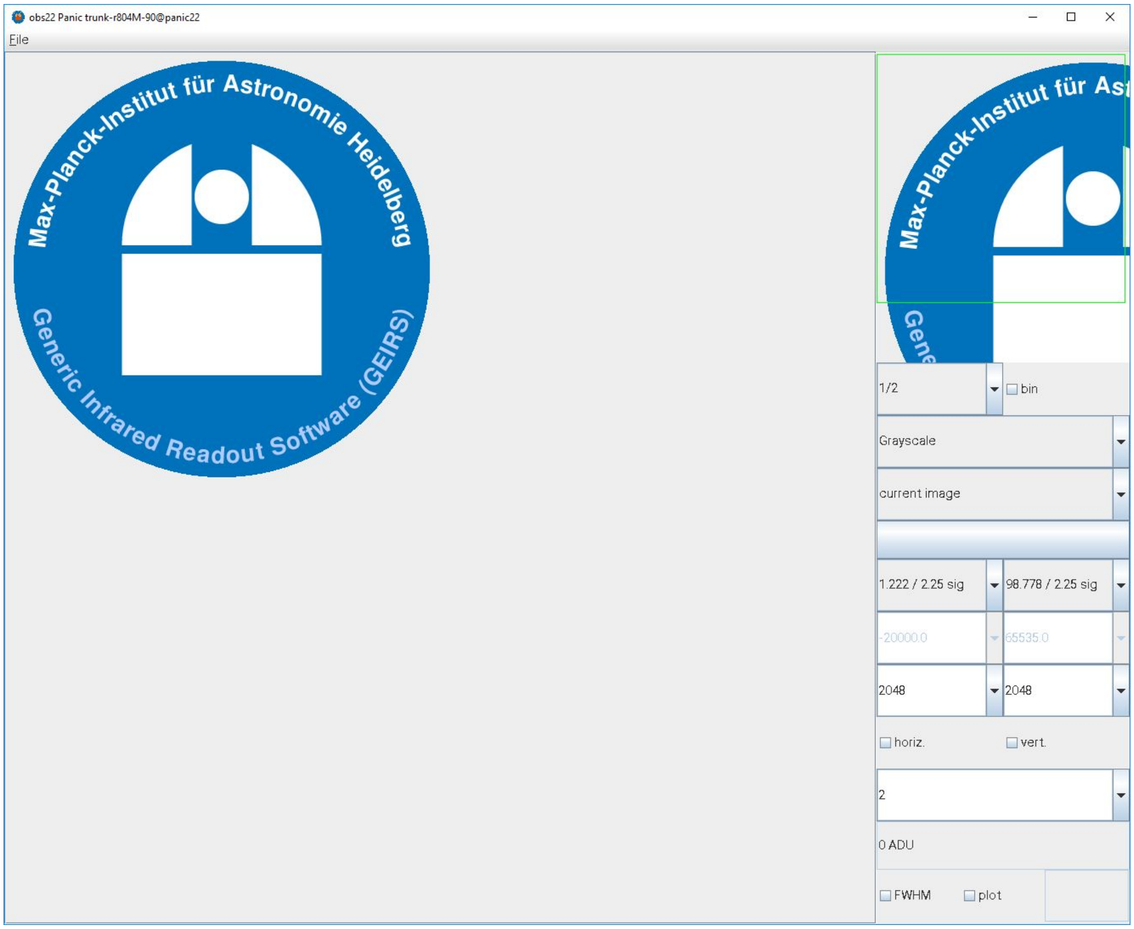

Figure 22: GEIRS real time display.

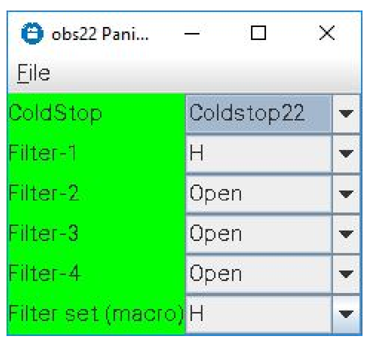

Figure 23: GEIRS filter wheels control.

For monitoring purposes and to determine the best focus, the QL has to be running. It launches by typing:

```
start_ql.sh
```

in a terminal, preferably on XT20. Then, select the input and output directories. The input directory has to be the same as the one in which the observations are saved. All the reductions made with the QL will be saved in the chosen output directory.

More information and troubleshooting are available in the PANIC Software Startup Check document.

4.2 Setup the telescope

Check in DOMEC that the telescope is set in remote mode. From DOMEC, turn on the 'Hydraulics', wait until you see the button turn green, then proceed to turn on the 'Drives'. When required, the dome can be opened from the DOMEC window [3].

From tecs22, in the Telescope GUI open the M1 cover. It may take a few minutes. Wait until the 'Open' box in the M1 cover control appears in green. The telescope will be at zenith, which is the optimal position to prevent PANIC from de-refrigerating. So, whenever the telescope is not being used, park it at zenith. On the other hand, when not taking dome flat observations, activate 'Tracking' and the 'Auto' mode of the dome from the Telescope GUI. GEIRS is unable to move the telescope without tracking.

To verify that there is no miscommunication between GEIRS and the telescope, it is strongly recommended to move the telescope and the focus using the OT at least 1 hour before the first night of an observing run. To do this, there is a prepared OP called 'Checking.xml', located at panic22: /data3/PANIC_demo_dataset/OP_Templates/. This program will perform some telescopes moves at zenith and north, as well as focus changes, both large and small. Everything in this OP is fixed except for the RA coordinates, that must be set to the current sidereal time before executing the OP in both 'Offset Zenith' and 'Offset North' OBs. It is not necessary to open the dome or the mirror cover, but the hydraulics, drives and tracking have to be turned on. How to execute an OP is described in section 4.3.

4.3 Taking observations

Open an OP instance, previusly designed, and click on the 'Validation & Execution' button, then, click on 'Validate'. At this point, it is possible to choose specific OBs, instead of the full OP, by selecting the boxes. To execute the observation click on 'Run'.

The current exposure sequence will be marked in the table below. To pause the sequence, click on 'Pause', then, to continue it, click on 'Resume'. To finish the sequence click on 'Abort'. The pause action will save the current exposure, but when aborting this exposure will not be saved. In both cases, you have to wait for the exposure to finish.

At the start of an OP execution, when the OT sends the command to move the telescope (you will see the message in the Log View, at the bottom of the OT window), pause the execution sequence. Wait until both the telescope and the dome are in the correct position, then click on 'Resume'. This step is necessary to prevent the dome from vignetting the first exposure, as the dome takes longer to reach its position than the telescope.

[3] Do not turn off Dome. In DOMEC you will find two Dome sections, but you only have to modify the one that open and close the dome

4.3.1 Calibrations

Brief instructions for taking calibrations using the OT:

- Dome Flats: Point the telescope to the flat field position in the Telescope GUI (FlatF. Pos) without tracking. Ensure that the dome is closed in DOMEC. Execute the prepared OP for dome flats. A message with instructions for taking these observations will appear. When finished, another message with instructions for ending will be displayed.
- Sky Flats: With the telescope tracking on, and the dome open and on tracking, execute the corresponding OP, depends on the light (east or west, see section 3.1.2). If an image becomes too saturated, you will have to wait 15 minutes before continuing with the observations.
- Darks: At the end of all observations, create the OP for the darks as seen previously. Before executing it, from tecs22, park the telescope at zenith, close the M1 cover, turn off auto and tracking, and, from DOMEC, turn off drivers, hydraulics (in that order and waiting between them), and close the dome.

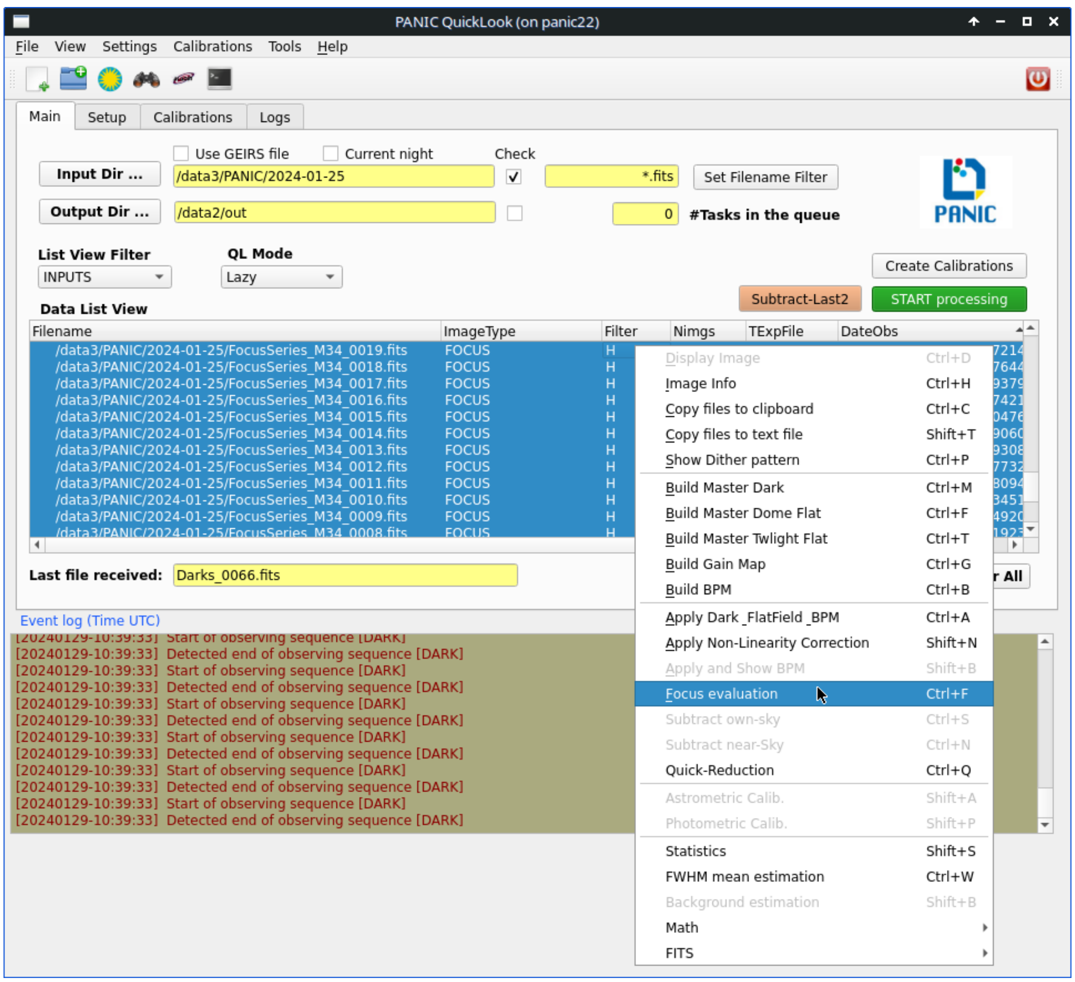

Figure 24: QL window showing how to start the focus evaluation

4.3.2 focusing

To determine the optimal focus, the OP with the prepared focus series should be executed. Once all observations have been taken, select them in the QuickLook, right-click and choose ‘Focus evaluation’, as shown in Fig 24. Subsequently, follow the on-screen instructions to complete the focus evaluation. You may need to have DS9 already running. For added convenience, the steps are detailed bellow.

After starting the focus evaluation process, a DS9 window with the central observation and an IRAF window with the instructions will appear. Select the stars to measure on DS9 by pressing ‘m’ on the keyboard while the mouse is on the star. Before select the star, you can see the enclosed flux, FWHM and profile vs radius in another IRAF terminal with ‘g’. These screens are presented in Fig 25.

Finish with ‘q’ when you consider that you have selected enough and good stars to perform the focus evaluation. A window displaying the MFWHM and ellipticity versus focus, like in Fig 26, will appear.

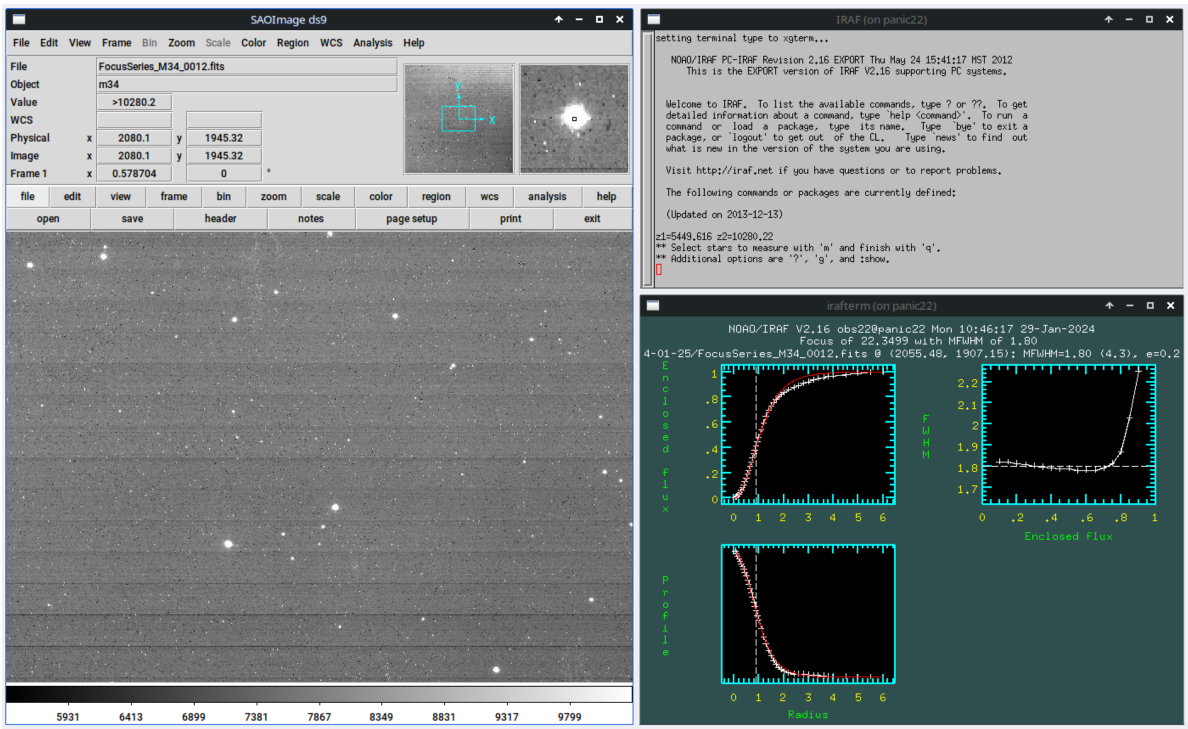

Figure 25: DS9 and IRAF terminals used to select stars for the focus evaluation. The IRAF terminal on top is the one that appears with instructions when starting the focus evaluation process. The IRAF terminal on the bottom has the required info with ‘g’.

Remove the outliers by pressing ‘x’ while the mouse is on them, then press ‘s’ to delete the star or ‘p’ to delete the point. The final MFWHM graph should form a parabola, similar to that in Fig. 27.

Finish with ‘q’, and the optimal focus will be displayed in the IRAF window and in a new image with the focus fit, like the one in Fig 28.

Finally, the OT should record the calculated value, although it can be entered manually if necessary. Forward, the focus is automatically corrected from one filter to another.

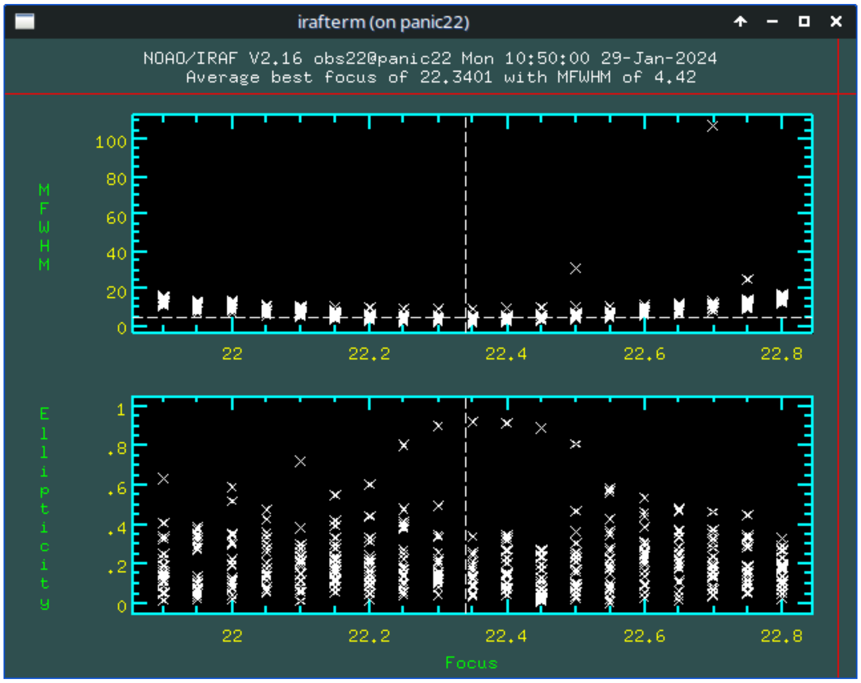

Figure 26: Interactive IRAF terminal displaying the MFWHM and ellipticity versus focus.

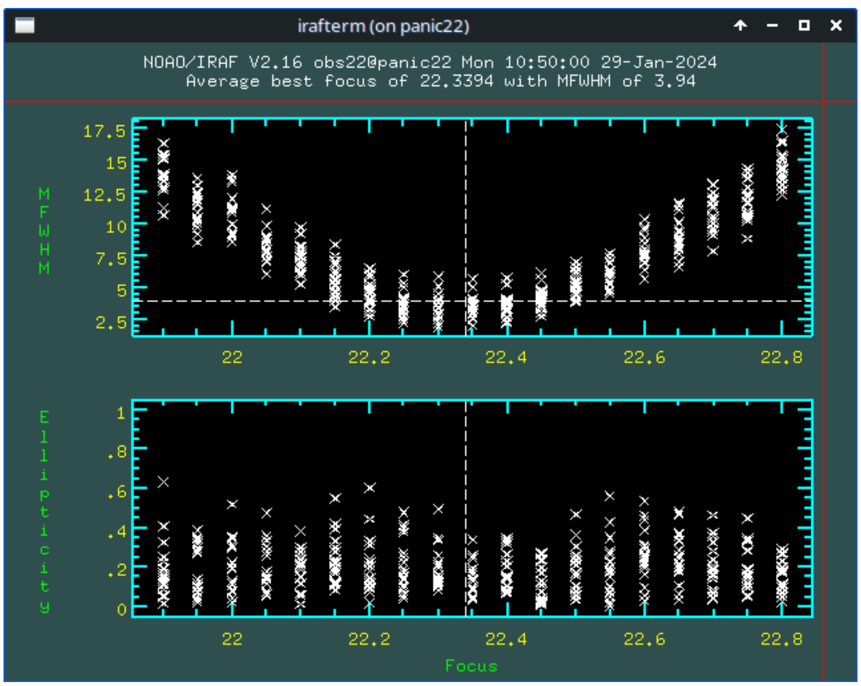

Figure 27: Interactive IRAF terminal displaying the MFWHM and ellipticity versus focus after removing some points.

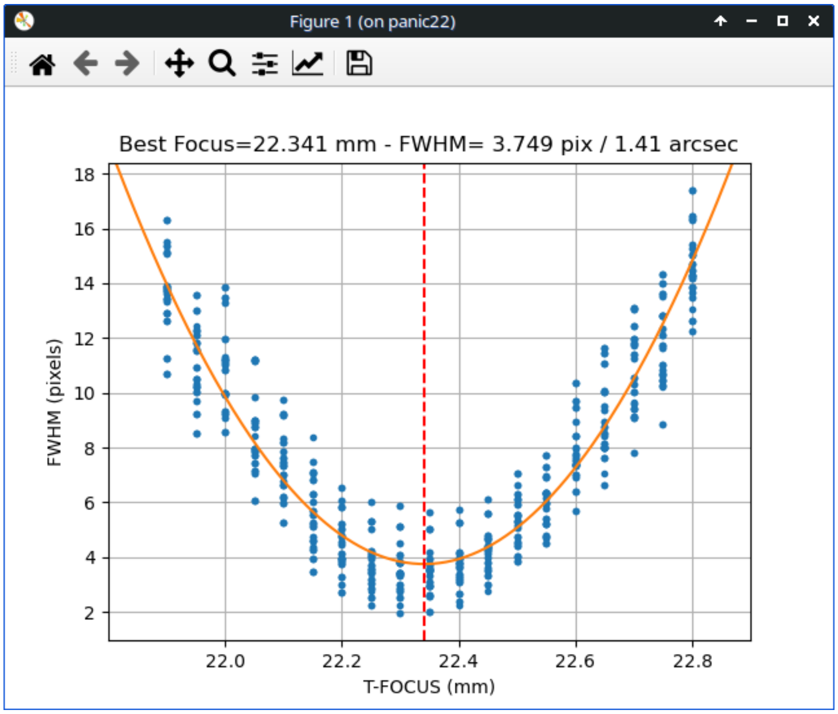

Figure 28: Graph displayed with the determined focus fit in milimeters, the FWHM in pixels and the seeing in arseconds.

The focus changes with the temperature of the tube. The dependency has been determined to be linear, as seen in Fig. 29. For further reference to create a focus series OP, a set of tube temperatures and their respective focus determined during the commissioning of PANIC in H filter are shown in Table 2. If the tube temperature varies significantly during the night, it is advisable to refocus.

Tube temperature (ºC)	H Focus (microns)	Date (MM/YYYY)
+ 0.8	23208	01/2025
+ 1.4	23147	12/2024
+ 2.1	23069	12/2024
+ 6.0	22769	02/2024
+ 6.7	22745	11/2024
+ 7.2	22719	11/2024
+ 7.7	22639	11/2024
+ 8.5	22580	11/2023
+ 9.9	22457	11/2023
+ 10.9	22395	01/2024
+ 11.7	22346	01/2024

Table 2: Different tube temperatures and their respective focus determined during PANIC commisioning in H band.

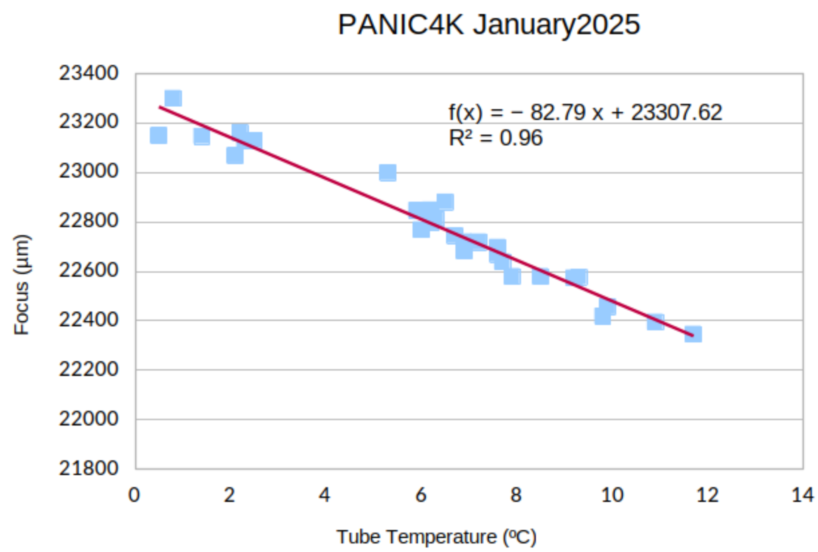

Figure 29: Relation between the focus in H band and the tube temperature.

4.3.3 Science observations

Taking observations with PANIC using the OT is truly simple. With tracking on, the dome opened, and in auto mode, execute the OP, or individual OBs. The OT will send all the commands needed to GEIRS, so the only thing to do at this point is to supervise that everything is working well.

It is possible to monitor the observation trough the Log View of the OT (at the bottom of the OT window). All communication between GEIRS and the OT is displayed there. The warning and error messages will also be displayed in this view: warning messages are printed in blue color, and error messages in red color.

To take a test observation (e.g., to check saturation, adjust the integration time, determine the needed repetitions, etc.), you can design a single simple OB and execute it. When saved, open the image with DS9 to inspect it. You can do it through the QuickLook (QL).

If during the execution of a sequence it is necessary to change the dome segment,'Pause' the observation in the OT, wait until the processes in GEIRS ends, and then, in tecs22 terminal, click on 'eXec' buttom, which will appear in red. After the segment is adjusted, 'Resume' the observation.

Situations that may occur during the observations are described in the troubleshooting section (sec. 7).

4.4 QuickLook: monitoring

The QL and the OT are configured to communicate through the headers of the FITS images, so all the information and characteristics of the observations set during the creation of the OPs will be read and processed by the QL.

While the QL is running and if the input directory is properly selected, all the observations will appear in the Data List View when saved. There are nine colums of information about each file: Filename,

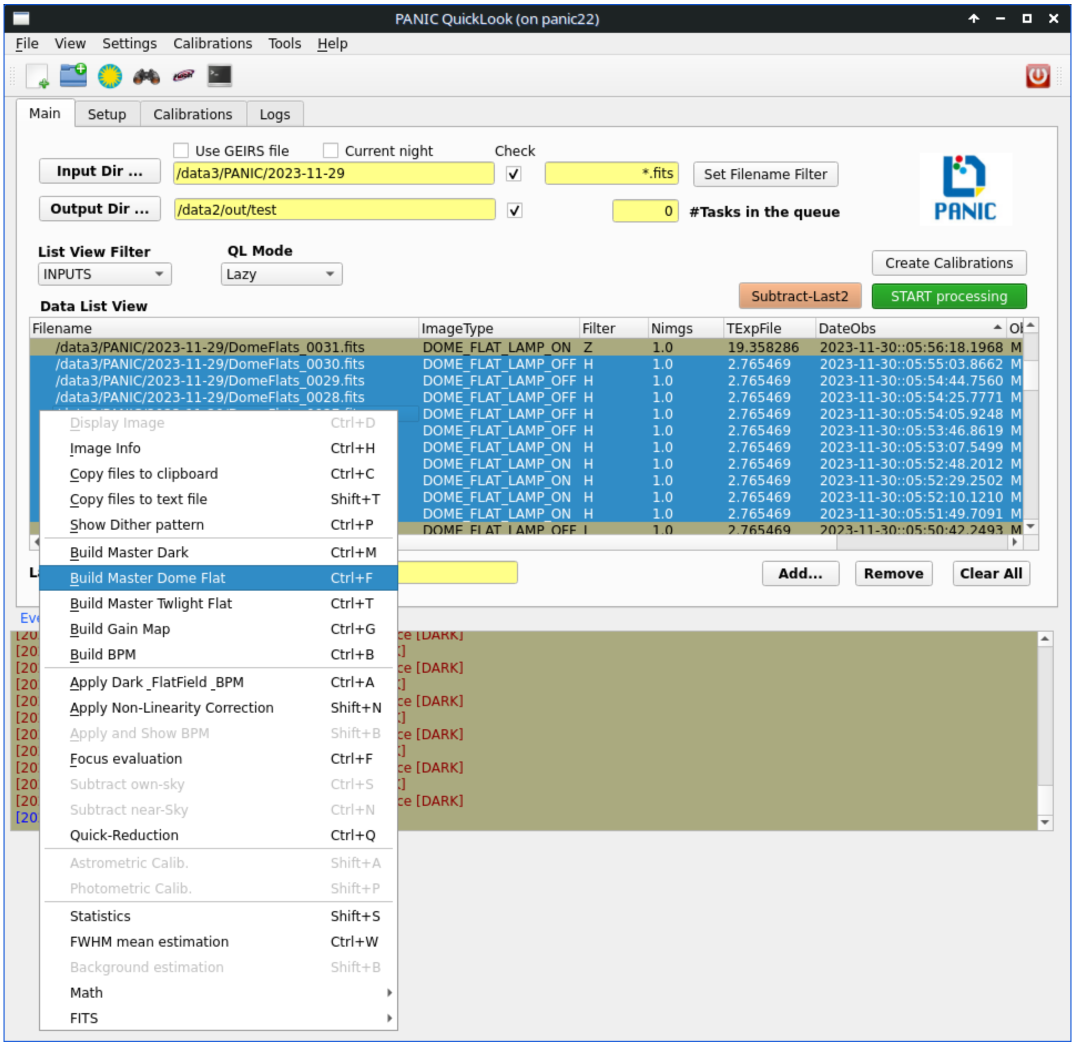

Figure 30: QL window showing how to create a master dome flat.

ImageType, Filter, Nimgs, TExpFile, DateObs, Object, RA and Dec. This tool allows for on-site data reduction to monitor the observations. Some of the available options are:

- Create calibration masters. Select the observations from which to create the master, right-click, and choose the corresponding option 'Build Master...', as shown in Fig 30. The final file will be saved in the output directory.
- Collapse a cube. Right-click on the file to collapse, select 'FITS', and then choose 'Collapse Cube'.
- Subtract sky. With the QL, it is possible to subtract the own-sky or near-sky by right-clicking and selecting the respective option. If the target is an extended object and you have SCIENCE and SKY files for it, you can subtract the sky by selecting both images, right-clicking, and then selecting 'Math' and 'Subtract Images'.
- Create sequences. It is possible to create a sequence from specific files using the QL. To do this, select the files, right-click, choose 'FITS', and then 'Create DataSeq'. This option is useful if an OB is aborted before completion because the corresponding exposures may not be save as a sequence.

More information about the facilities of this tool is shown in the QL documentation online.

4.5 Shutdown

To finish the night you have to shutdown the telescope. From tecs22, park the telescope at zenith, close the M1 cover, turn off auto (dome) and tracking. From DOMEC, turn off drivers, hydraulics (in that order and waiting between them), and close the dome. To shutdown PANIC there is nothing to do.

4.6 Some simple GEIRS commands

Although all the observations can be performed using the OT, here you will find some useful commands to take a simple observation with GEIRS. These commands have to be executed in the interactive shell of GEIRS, previously launched as shown in section 4.1.

filter. To change the filter. For example: filter J

crep. To adjust the number of repetitions. For example: crep 3

itime. To set the integration time. This number will be automatically changed to the closest multiple of 2.90 sec. For example: itime 13 (that will be 14.52)

read. To take the previously configured observation.

save. To save the file. You can add '-i' to sum the repetitions, '-1' to save it as a cube, or write at the end the desired filename followed by '.fits'. For example: save -i observation.fits

sync read. To check if the reading is done and to know when it is finished.

5 A demo observation and data reduction

In this section, an observation of an extended object is presented: from preparing the OPs, followed by the description of the conditions of the observation, to performing the data reduction with PAPI. The target is NGC891, a galaxy with an apparent size of approximately 13 arcminutes, visible in the infrared, with coordinates 02h 22m 33s +42° 20' 57".

5.1 Observing Programs

The calibration OPs for flat fields (dome and twilight) were created following the instructions in section 3.1 for all filters, although in the actual observation, only Ks, H, J, and Z filters were used. Additionally, dark calibrations were automatically taken at the end of the night, as previously explained.

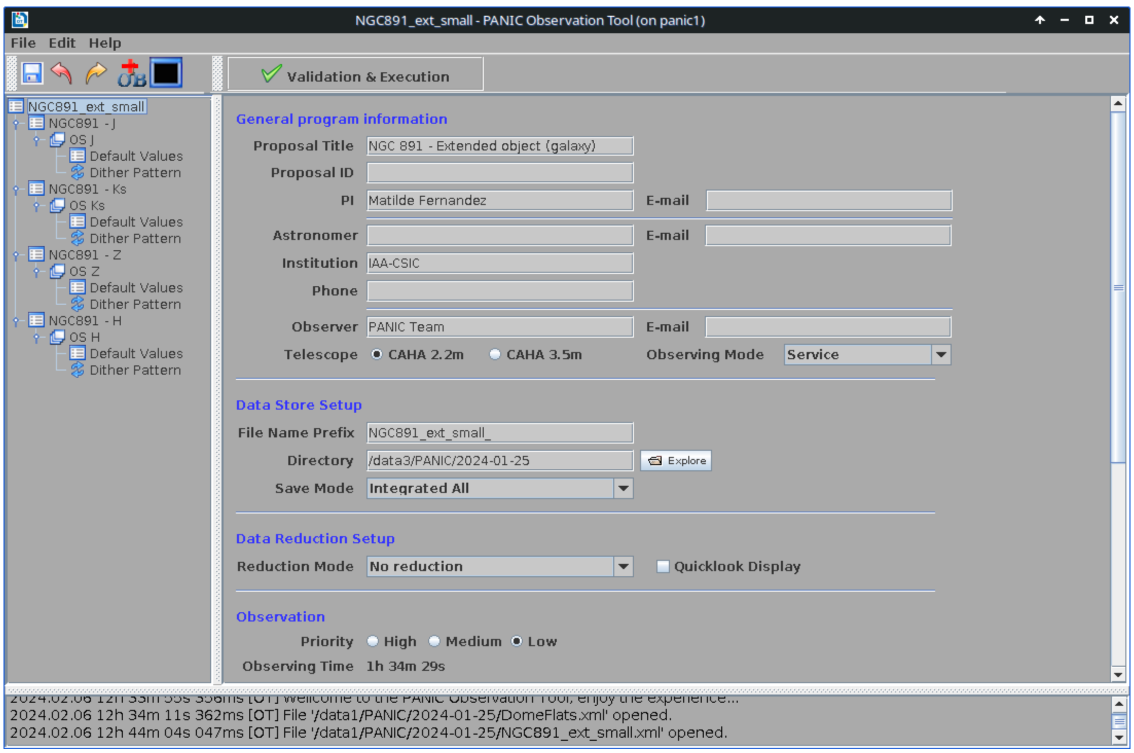

Figure 31: OT: OP panel for NGC891 observation.

For the science OP, all the necessary information from the panel and some additional fields were filled in, as shown in Fig. 31. Then, after creating an OB for each filter, the coordinates were resolved using only the target's name, and the readout mode was selected (Fig. 32). More information can be added, but this is the bare minimum for an OB.

Subsequently, in the Default Values panel (Fig. 33) of each OB, we set the filter, the integration time (which will be a multiple of 2.90), and the number of repetitions. There is no need to fill in the cycle field because it will be completed in the next panel. All filters had the same configuration in this panel; however, under different weather conditions (e.g., high humidity), the repetition number for the Ks filter may need to be lower.

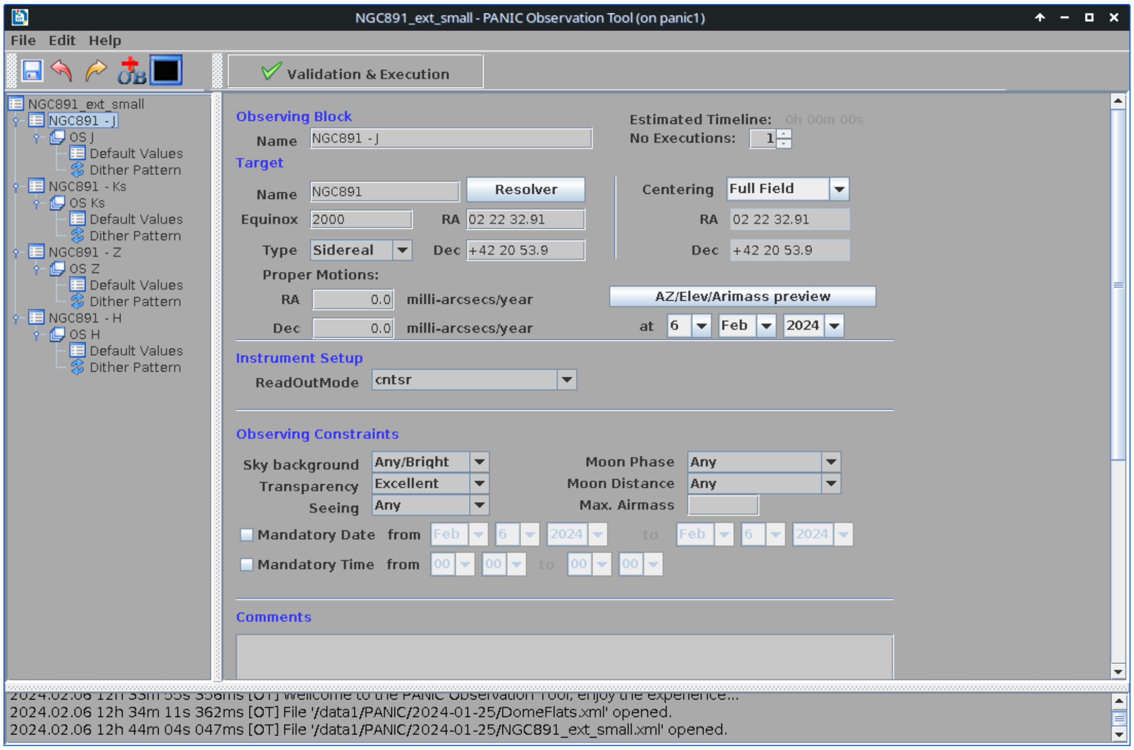

Figure 32: OT: OB panel for NGC891 observation.

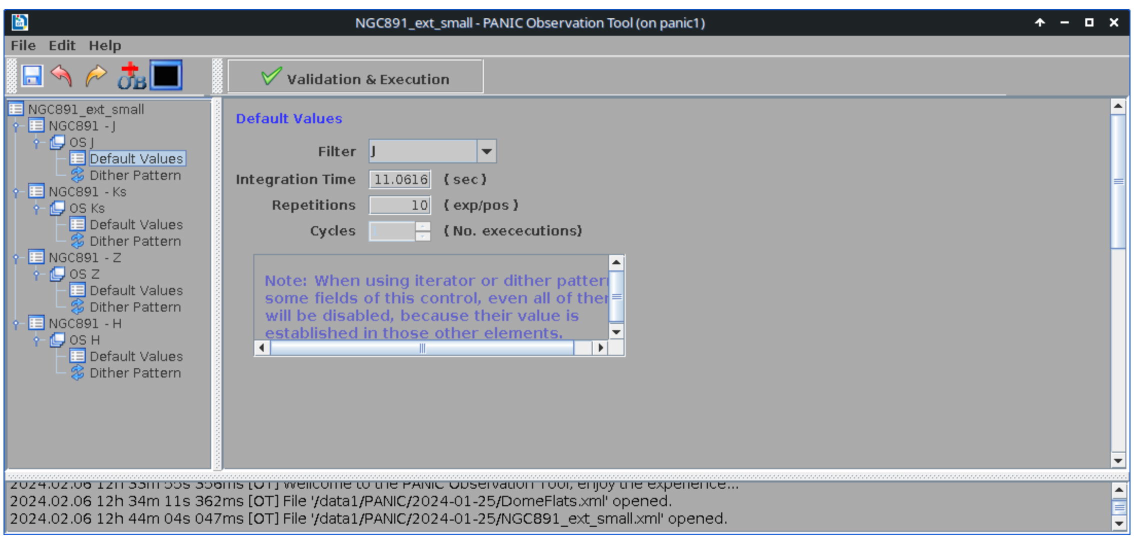

Figure 33: OT: Default Values for NGC891 observation.

Finally, in the Dither Pattern panel (Fig. 34) we designed the iteration configuration for the observation. Firstly, a dithering of 3 points was added using the second option of the custom dithering (blue square), selecting the 3-point type with dx" = 60 and dy" = 60. Then, since the object is extended, it is necessary to add an offset for the sky images large enough to not include the galaxy in them, so we aplied the T-S extended object dither pattern option (green square), with an offset of 26.3 arcminutes in the north direction. The final configuration is shown above in the panel (red square), and a graph preview can be shown by click on the buttom 'Show Preview'.

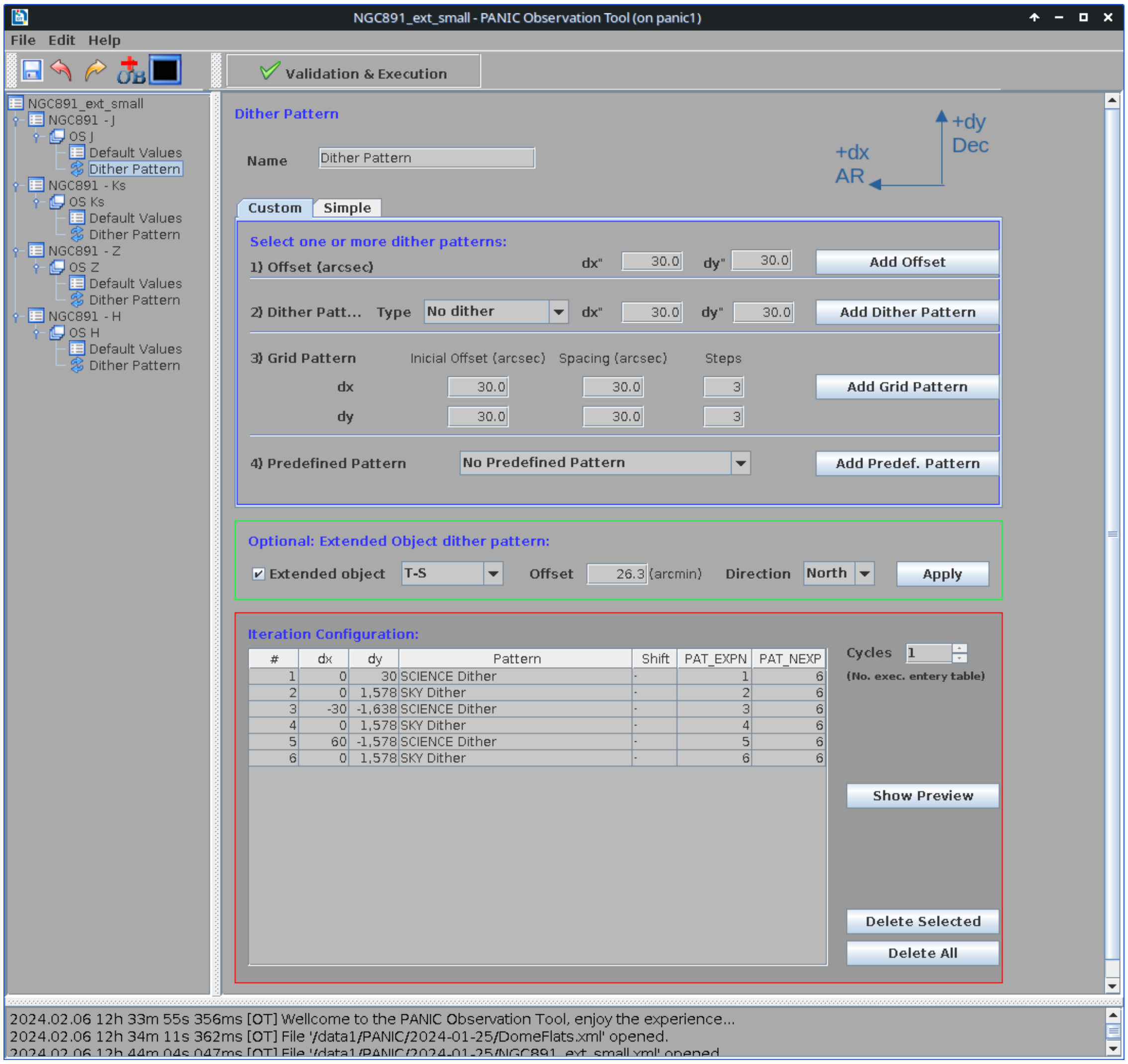

Figure 34: OT: Dither pattern for NGC891 observation.

In summary, we have created an OP with four OBs, one per filter, that will send to GEIRS the command corresponding to taking six exposures, tree of the target and the other tree of sky, consisted in 10 repetitions of 11.06 sec.

5.2 Observation conditions

The observation took place on January 25, 2024. The weather was clear, with low humidity oscillating between 22% and 40%, and a nearly constant temperature around +11ºC. The recorded humidity and temperature over time are shown in Fig. 35 and Fig. 36 respectively.

We took calibration observations for the H2, Ks, H, J, Z, and Y filters, including both dome and twilight

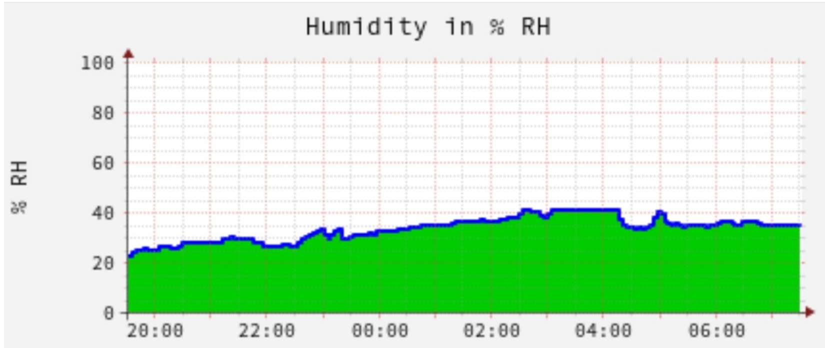

Figure 35: Humidity registred on January 25, 2024.

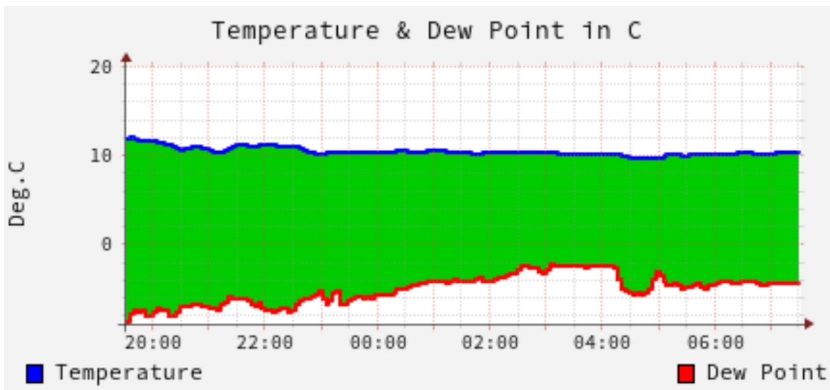

Figure 36: Temperature and dew point as shown in the Weather CAHA Website registred on January 25, 2024.

flats, distributed in dusk and dawn (5 cycles). The dark calibrations were taken at the end of all the observations (3 cycles).

The science observation (NGC891) started at 18:30 UT and ended at 20:15 UT. At that moment, the target was at its culmination and descending, from approximately 85º to 68º in altitude. It was at a distance of 76-77 degrees from the moon. Humidity changed between 22% and 25%, and the tube temperature ranged from +11.7ºC to +11.5ºC during the observation. We took two sequences for Ks: one with 10 repetitions and the other with 5, in order compare them and ensure that the changes in humidity did not affect the observation. The different focus values are shown in Table 3.

Filter	Focus (microns)
Ks	22332
H	22346
J	22343
Z	22385

Table 3: Focus values for each filter with +11.7 tube temperature.

5.3 Data reduction with PAPI

The reduction of this observation using the PANIC reduction pipeline is described below. We separate it into two steps: calibrations and science reduction, although it is possible to do it all at once. PAPI will reduce data obtained through the OT, as the FITS files generated by the OT contain the necessary information in their headers to communicate with PAPI for performing the reductions. Further information about the PANIC reduction pipeline can be found online in the PAPI documentation.

Normally, the directory for raw data in panic22 is /data1/PANIC/, the output directory for reduced data with PAPI or the QL is /data2/PANIC/, and the directory to save the calibrations is /data2/PANIC/Calibs/. For this demo observation, the directories where the data can be found,with the respective names of 'input', 'output' and 'calibs', are in:

```
panic22.caha.es:  /data3/PANIC_demo_dataset/
```

To start using the pipeline, it is required to initiate PAPI envioremen. To do so on panic22, write:

```
source bin/start_papi_env.sh
```

5.3.1 Create master calibrations

Once the PAPI environment is started, the first step is to build the master calibrations. This is done with the run_papi.py module, where the argument '-s' is added to specify the directory where the raw data is located, '-d' to indicate the output directory where the reductions will be saved, '-T' to specify the type of data that the command is going to to reduce, and '-C' to force the pipeline to use the calibrations from that directory. Therefore, the commands to perform the master calibrations are as follows:

```
./run_papi.py -s /data3/PANIC_demo_dataset/input/ -d /data3/PANIC_demo_dataset/calibs/ -T
DARK
```

```
./run_papi.py -s /data3/PANIC_demo_dataset/input/ -d /data3/PANIC_demo_dataset/calibs/ -T
DOME_FLAT
```

```
./run_papi.py -s /data3/PANIC_demo_dataset/input/ -d /data3/PANIC_demo_dataset/calibs/ -T
SKY_FLAT -C /data3/PANIC_demo_dataset/calibs/
```

It is important to create the dark calibrations first, as the sky flats rely on them by the '-C' argument. In this example, we have used the directories from the demo dataset.

5.3.2 Reduce a sequence

It is posible to reduce all the sequences of the night concurrently, but as the calibrations are already created, we are going to reduce only the science sequences of NGC891. To identify the corresponding sequences, write the following command in the PAPI environment:

```
./run_papi.py -s /data3/PANIC_demo_dataset/input/ -p
```

The argument '-p' prints all detected sequences in the input directory, as shown in Fig. 37. Once identify, select the sequences with '-S', writting the initial and final subsequent sequence to reduce, like this:

```
./run_papi.py -s /data3/PANIC_demo_dataset/input/ -d /data3/PANIC_demo_dataset/output/ -S
7 11 -C /data3/PANIC_demo_dataset/output/
```

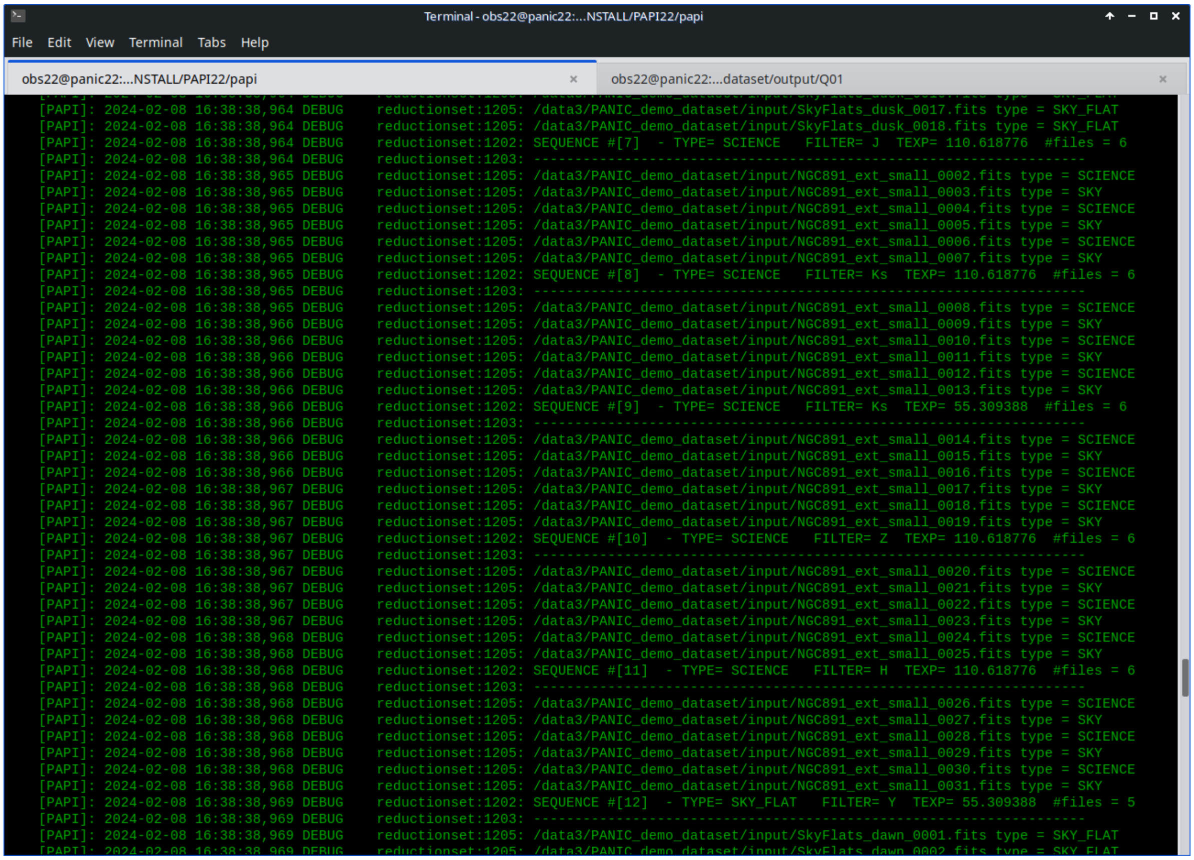

Figure 37: Displayed sequences.

Consider setting the calibration directory with '-C'. If not, the pipeline may search for calibrations in its default directory.

More available options for reducing data are displayed with the following command:

```
./run_papi.py -h
```

When finished, you will find the reduced sequences in the output directory, and all the reduced exposures, both science and sky, in the pipeline-created subdirectory /data3/PANIC_demo_dataset/output/Q01/, as shown in Fig. 38 and Fig. 39

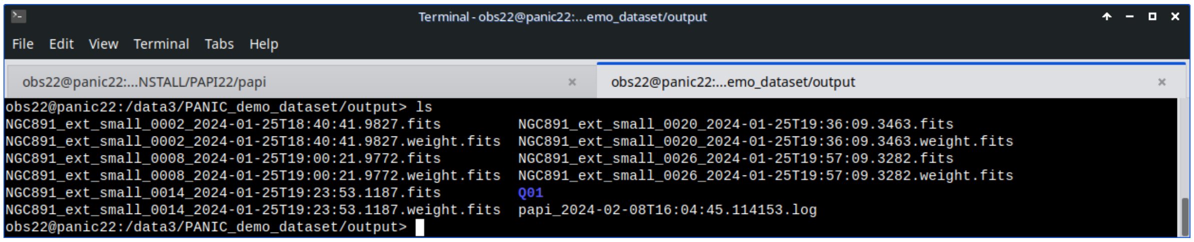

Figure 38: Created files of reduced sequences.

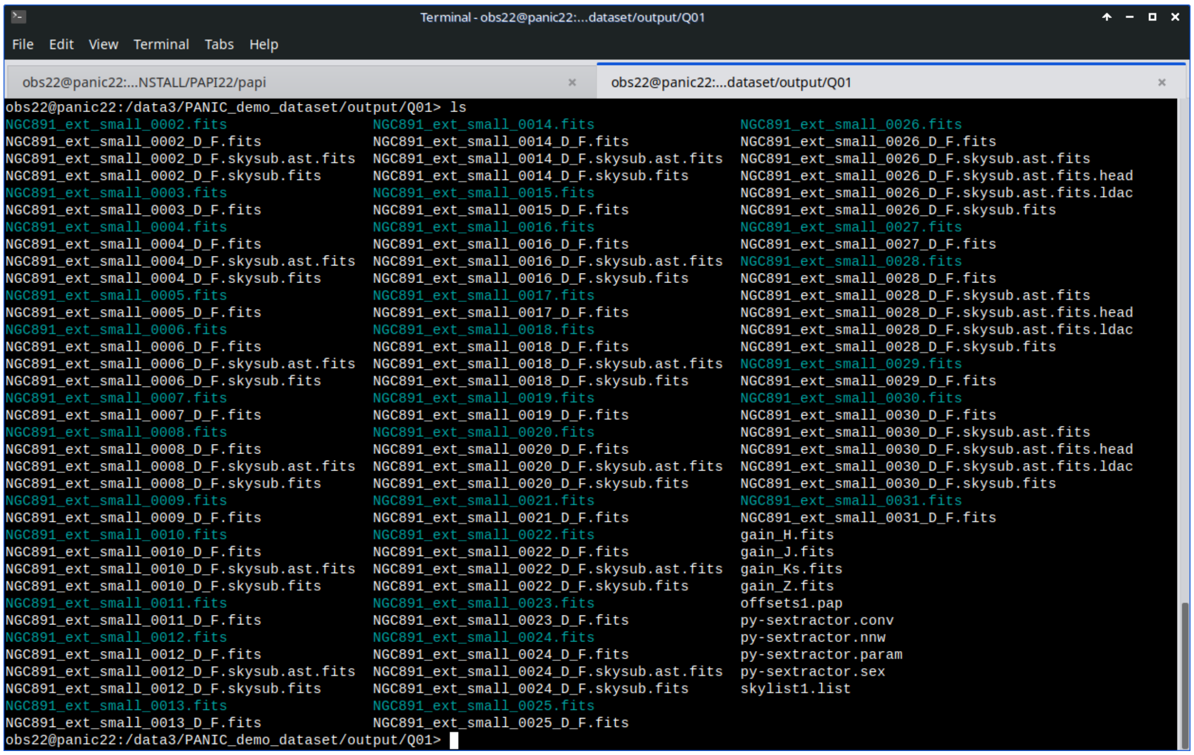

Figure 39: Created files of reduced exposures.

5.3.3 Handling incomplete Observation Blocks

If an Observation Block (OB) is aborted before the data sequence is completed, it is still possible to create a custom sequence using the available data. The following command can be used to achieve this:

```
papi/misc/createDataSeq.py [options]
```

This script modifies the headers of a set of FITS files to generate a Data Sequence compliant with PAPI.

Options:

-h, –help

Display this help message and exit.

-s SOURCE_FILE, –source=SOURCE_FILE
Specify an input text file containing the list of FITS files to process.

-t SEQ_TYPE, –seq_type=SEQ_TYPE
Define the type of Data Sequence. Available options: DARK, SKY_FLAT, DOME_FLAT_LAMP_ON, DOME_FLAT_LAMP_OFF, FOCUS, SCIENCE

-o OUTPUT_DIR, –output_dir=OUTPUT_DIR
Specify the output directory where the new FITS files will be stored.

-O, –overwrite
Overwrite input files (default: False).

Example Usage:

```
(papi):~/DEVELOP/papi/misc$ python createDataSeq.py -s /tmp/new_dataset.txt -t SCIENCE
-o /data/tmp/
```

In this example, /tmp/new_dataset.txt contains the paths to the FITS files of a broken sequence.

After running the script, the newly generated files in /data/tmp/ will have updated values for the following FITS header keywords:

PAT_EXPN: Sequential numbering (1, 2, 3, 4)
PAT_NEXP: Total number of exposures (=4)
IMAGETYP: Set to the specified sequence type (e.g., SCIENCE)

This procedure can also be used to create custom sequences of different lengths, whether shorter or longer than the original, for example, splitting or joining the original.

5.3.4 Modify configuration parameters

To modify configuration parameters, such as the minimum number of frames required to build a master calibration, *min_frames*, the half width of sky filter window in frames, *hwidth*, or the default directories, you have to edit the PAPI configuration file. First, find the path of the file by typing:

```
echo $PAPI_CONFIG
```

since this is how the environmental variable is defined. Then, access to the file and change the desired parameter using a text editor (e.g.: kate).

6 Operational details

In this section, some important usage information while using PANIC is listed.

Readout mode: cntsr

GEIRS has different readout modes available, but the one designed for taking observations with PANIC, and for which the instrument is calibrated, is the 'cntsr' mode.

The minimum exposure time with the cntsr readout mode is 2.90 s. This time corresponds to the time used to perform 10 resets per line (of ∼70 µs) at the start of the exposure. After these resets, each line begins to receive light, completing the 4096 lines in ∼2.90 s. The exposure time must therefore be a multiple of 2.90 s, so that the 10 initial resets are only performed the first time. In addition, the final image is calculated by subtracting the first 2.90 s frame from the last frame.

This gives us very good data at the cost of high overhead. This overhead is directly related to the integration time selected, but also to the intrinsic clocking scheme of the detector, varying between 2 to 4 times of the selected integration time. You also have to take into account the pointing of the telescope and the time it takes to save the images. For timing/observing purposes, it is recommended to consider 4 times the selected integration time.

Skyflats filter order

A study on the variation in the number of counts in each filter during dusk and dawn has been conducted to determine an appropriate order for taking sky flats for all filters. The orders for both times of the day are as follows in Table 4.

Dusk	H2, Ks, H, J, Z, Y
Dawn	Y, Z, J, H, Ks, H2

Table 4: Determined sky flats filter order at dusk and at dawn.

Not following this order may result in losing calibrations for one or more filters, as the count number exceeds the limits set in the OB at the moment of the exposure.

Image quality

The PSF of the objects may not be uniform across the full field of view (FoV). We have observed a distorsion of the PSF in the corners of the FoV, which is typically more pronounced in the northeast corner (top left). This phenomenon is more noticeable under good seeing conditions. The irregularities form a diagonal pattern across the FoV, as depicted in Fig. 40. This graph displays the PSF FWHM in the reduced sequence corresponding to the J filter of the demo observation (Section 5). This pattern is not constant: the diagonal may be shifted.

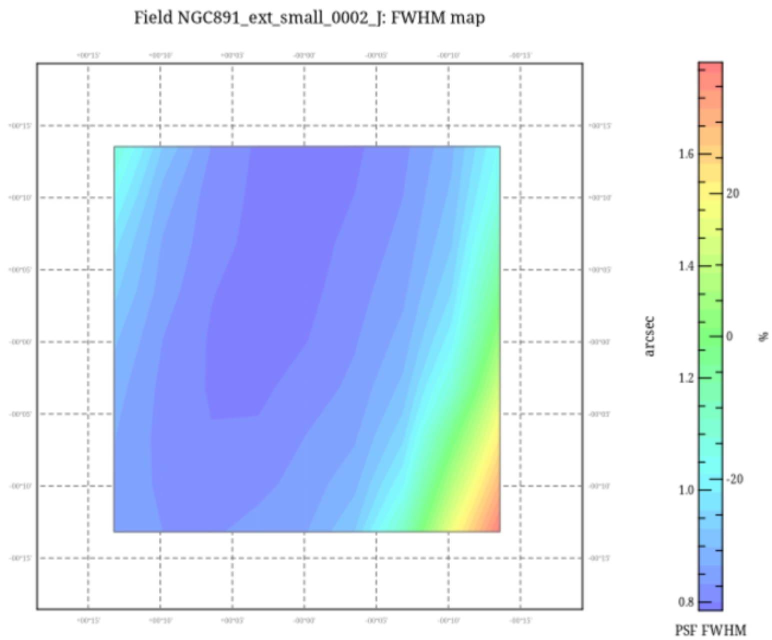

Figure 40: PSF FWHM of the reduced sequence in the J filter for the demo observation of NGC891. The legend displays the FWHM from blue for the smallest values to red for the maximum FWHM value.

Optical ghosts

The optical ghosts in all filters, except for Z band, have a relative intensity (image/ghost ratio) lower than 10^{-4} (this means that for a point source at the detector and at the limit of saturation any single ghost structure contributes less than 6 counts). Additionally, the diameter of any individual ghost is larger than 10 arcsec (27 px, 15µm/px), which avoids star confusion in case the relative intensity is bigger than 10^{-4}.

In the Z band, there is a Narcissus ghost that appears for saturated starts. This ghost has a relativity intensity of $\sim 6 \cdot 10^{-4}$ with 37 arcsec diameter ($\sim$ 100 px, 15µm/px)

Vertical bands

We have found an anomalous behavior in some images in form of darker vertical bands, although it has been observed that the difference in counts is not significant. This phenomenon has not occurred since February 2024.

Subwindows

Using subwindows mode makes that the itime in OT and GEIRS is automatically reduced proportionally to the new size of the window.

7 Trouble-shooting

Error: mov_sync

During the execution of an OB, mainly at the beginning of it, a warning error like Fig. 41 may appear in the OT:

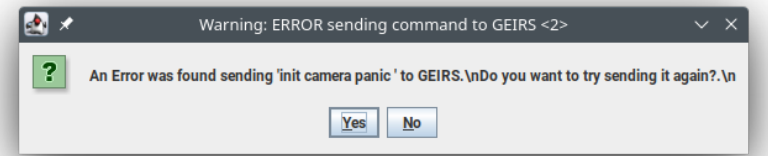

Figure 41: Error message from OT.

This is due to a miscommunication with the telescope while pointing, offsetting or changing the focus. The first time in the same movement, just click on 'Yes'. If the error persists, you will see the message shown on Fig. 42. Then, follow the instructions listed in it to solve the problem.

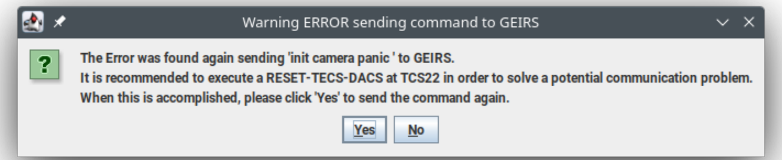

Figure 42: Error message from OT.

If the issue persists, please contact the operator in case a PEP restart is necessary.

Errors while using the QL

The DS9 window may take a long time to appear. If DS9 has already been initiated and IRAF is not, it may be necessary to click again on 'focus evaluation' to launch the IRAF terminal. Therefore, although the QL starts DS9, it is recommended to open it before clicking on 'focus evaluation'.

If the focus evaluation routine crashed or displayed any warning or error message, close the IRAF terminal (not DS9) and restart the process. This may occur if the selected stars are not suitable due to invalid flux (e.g., saturated stars, stars too close to each other, or stars too faint).

GEIRS/OT is not responding

If something go wrong with GEIRS you may type the command

`geirs_cleanup`

to close all the current process in GEIRS. Then, restart GEIRS with the command `geirs_start_panic`.

If the problem is with the OT, use the command

`ot_cleanup`

and launch the OT again.

Error with sounds

If GEIRS does not show sounds when finishing a command (e.g., save, read, move...) there may be a problem with the XT20 computer. Check if there are sounds by typing in a terminal in XT20 the following command:

`pruebasonido`

If nothing sounds, then you need to type:

```
pulseaudio --kill
pulseaudio --start
```

If it still doesn't work, the next thing (for now) is to reboot XT20.

Disable and enable subwindows

When using subwindows, make sure the 'Subwin off/on' button in the GEIRS GUI (see Fig. 43) is correctly set. It will turn red when the subwindow is activated. You can enable or disable the subwindow option by clicking the button or by typing the command `subwin off` or `subwin on` in the interactive shell terminal.

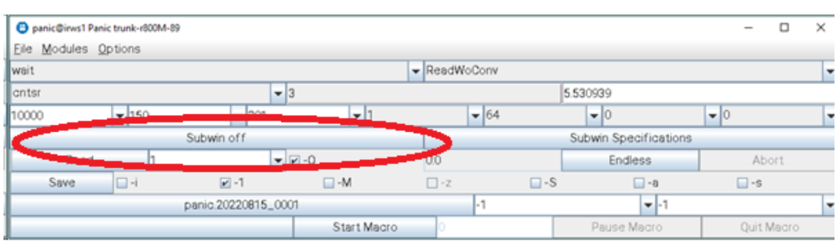

Figure 43: Subwindow button in the GEIRS camera control panel.

8 Appendix

8.1 Fields for focusing

In this appendix there are some fields selected for evaluating the focus. Some of them are inherited from the Omega2000 User's Manual. The finding charts are from DSS-2-red with a FoV equal to the PANIC FoV (25.6'x25.6').

Focus at 1h. $\alpha(\text{J200}) = 00^{\text{h}}\ 55^{\text{m}}\ 12.33^{\text{s}}$ $\delta(\text{J2000}) = +24^{o}\ 55'\ 05.00''$

M34. $\alpha(\text{J200}) = 02^{\text{h}}\ 42^{\text{m}}\ 07.44^{\text{s}}$ $\delta(\text{J2000}) = +42^{\text{o}}\ 43'\ 19.20$

M67. $\alpha(\text{J200}) = 08^{\text{h}}\ 51^{\text{m}}\ 23.04^{\text{s}}$ $\delta(\text{J2000}) = +11^{\text{o}}\ 48'\ 50.40$

Focus at 12h. $\alpha(\text{J200}) = 12^{\text{h}}\ 24^{\text{m}}\ 15.00^{\text{s}}$ $\delta(\text{J2000}) = +36^{\text{o}}\ 58'\ 40.00$

Focus at 17h. $\alpha(\text{J200}) = 17^{\text{h}}\ 03^{\text{m}}\ 37.00^{\text{s}}$ $\delta(\text{J2000}) = +26^{\text{o}}\ 59'\ 50.00$

Focus at 22h. $\alpha(\text{J200}) = 21^{\text{h}}\ 58^{\text{m}}\ 27.00^{\text{s}}$ $\delta(\text{J2000}) = +20^{\text{o}}\ 17'\ 50.00$

Other suitable fields for focus are shown in Table 5.

	α(J200) (hh mm ss)	δ(J2000) ($\pm$ dd mm ss)
NGC188	00 47 11.52	+85 14 38.40
NGC752	01 56 53.52	+37 47 38.40
NGC1647	04 45 55.44	+19 04 44.40
M36	05 36 20.16	+34 08 06.00
M35	06 09 05.28	+24 20 09.60
Focus at 10h	09 58 51.00	+69 19 47.00

Table 5: Additional focus fields and their RA and DEC coordinates (J2000).

8.2 OP templates

In panic22:/data3/PANIC_demo_dataset/OP_Templates/ there are some OP templates for different observation cases. These are:

- **DomeFlats.xml**. Average parameter values used for dome flats observations for H2, Ks, H, J, Z and Y filters. No target coordinates need to be defined.

- **SkyFlats_dusk.xml**. Tipical configuration for sky flats at dusk. The OBs are arranged in the specified order: H2, Ks, H, J, Z, Y.

- **SkyFlats_dawn.xml**. Tipical configuration for sky flats at dawn. The OBs are arranged in the specified order: Y, Z, J, H, Ks, H2.

- **FocusSeries.xml**. Predefined OP for focusing in H filter.

- **Point_Object.xml**. An example of an observation with a dithering of 25 exposures (positions) of 2.90 seconds and 10 repetitions in the H filter.

- **Extended_Object.xml**. A six positions observation, 3 sciente (target) images and 3 sky images, with a dithering of 3-point 60"x60" and an sky offset of 26.6', in the H filter (11.06 sec, 10 repetitions).

- **Mosaic.xml**. A mosaic of 9 positions with an overlap of 1.3' between them, in the H filter (11.06 sec, 10 repetitions).

Do not delete them from the current directory. Copy and edit them in another directory.

9 References

References

[1] A. Segura, Observation Tool User Manual (22 Jun 2015).
URL: https://home.iaa.csic.es/ agsegura/PANIC_OT/PANIC_OT_User_Manual.pdf

[2] Sky Flatfield Procedure

[3] R. J. Mathar, Generic Infrared Software - Installation and User's Manual (19 Feb 2024).
URL: https://www2.mpia-hd.mpg.de/%7Emathar/public/PANIC-SW-DCS-01.pdf

[4] B. Dorner, Software startup check (17 Jul 2015).
URL: https://panic.iaa.es/sites/default/files/PANIC-SW-MN-02_1_1_Startup_check.pdf

[5] J. M. Ibañez, PANIC Quick-Look Tool.
URL: https://home.iaa.csic.es/ jmiguel/PANIC/PAPI/html/quick_look.html

[6] J. M. Ibañez, PANIC Pipeline documentation.
URL: https://home.iaa.csic.es/ jmiguel/PANIC/PAPI/html/index.html

[7] H. J. Röser, Omega2000 User's Manual (Nov 2008).
URL: http://www.caha.es/CAHA/Instruments/O2000/OMEGA2000_manual.pdf