

# Sesión especial de PANIC 4K: cómo sacar el mayor partido a tu tiempo asignado de observación



## PANIC Pipeline & Quick-Look Overview

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24-Sep-2025



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# Outline

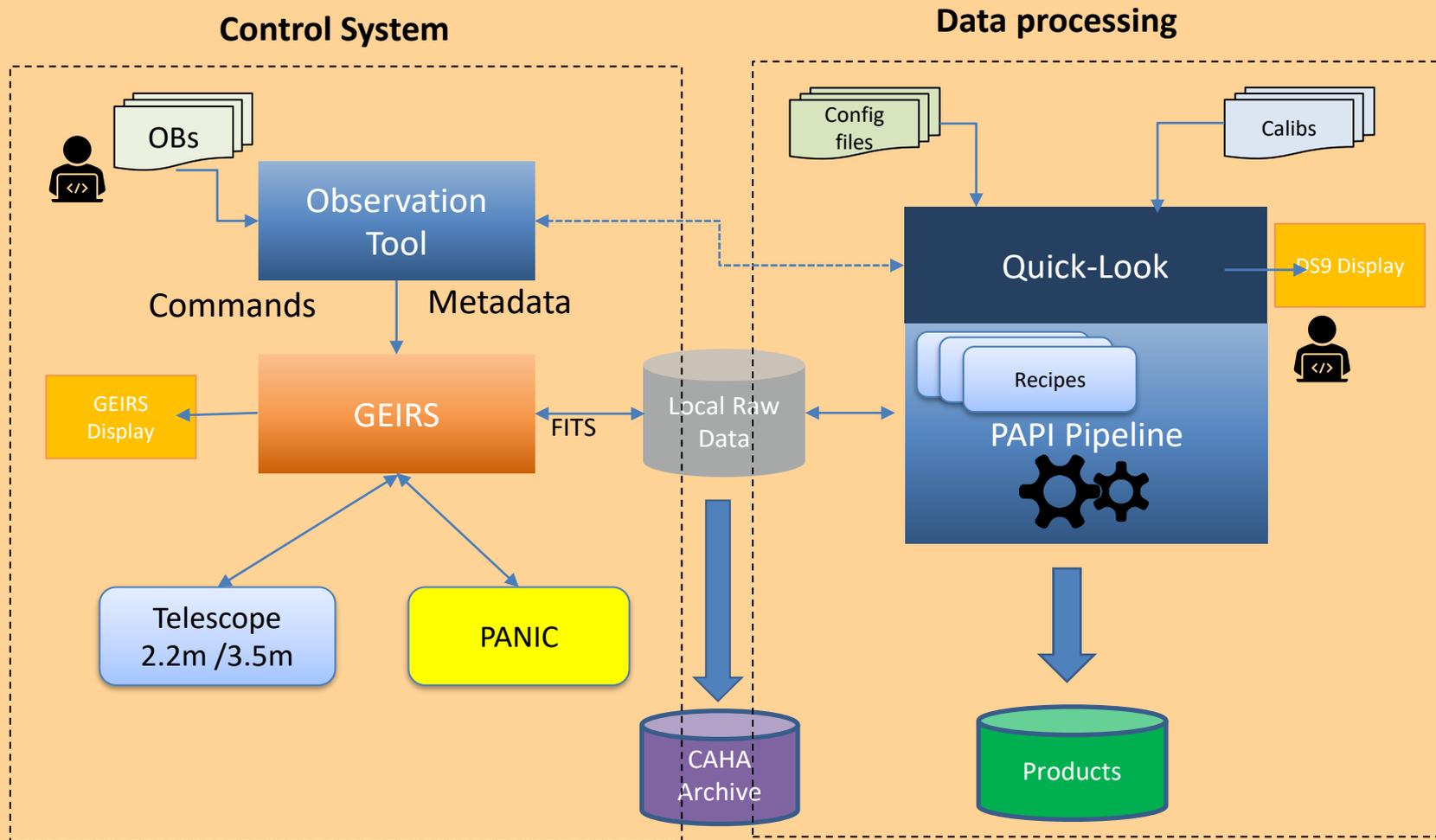
- Part 1: PANIC QL
  - PANIC data flow system
  - Quick-Look overview
- Part 2: PANIC Pipeline (PAPI)
  - Data Handling
  - Pipeline overview and main steps
  - Step-by-step Quick-Guide
  - Doc & Installation & Contribution

# Goal

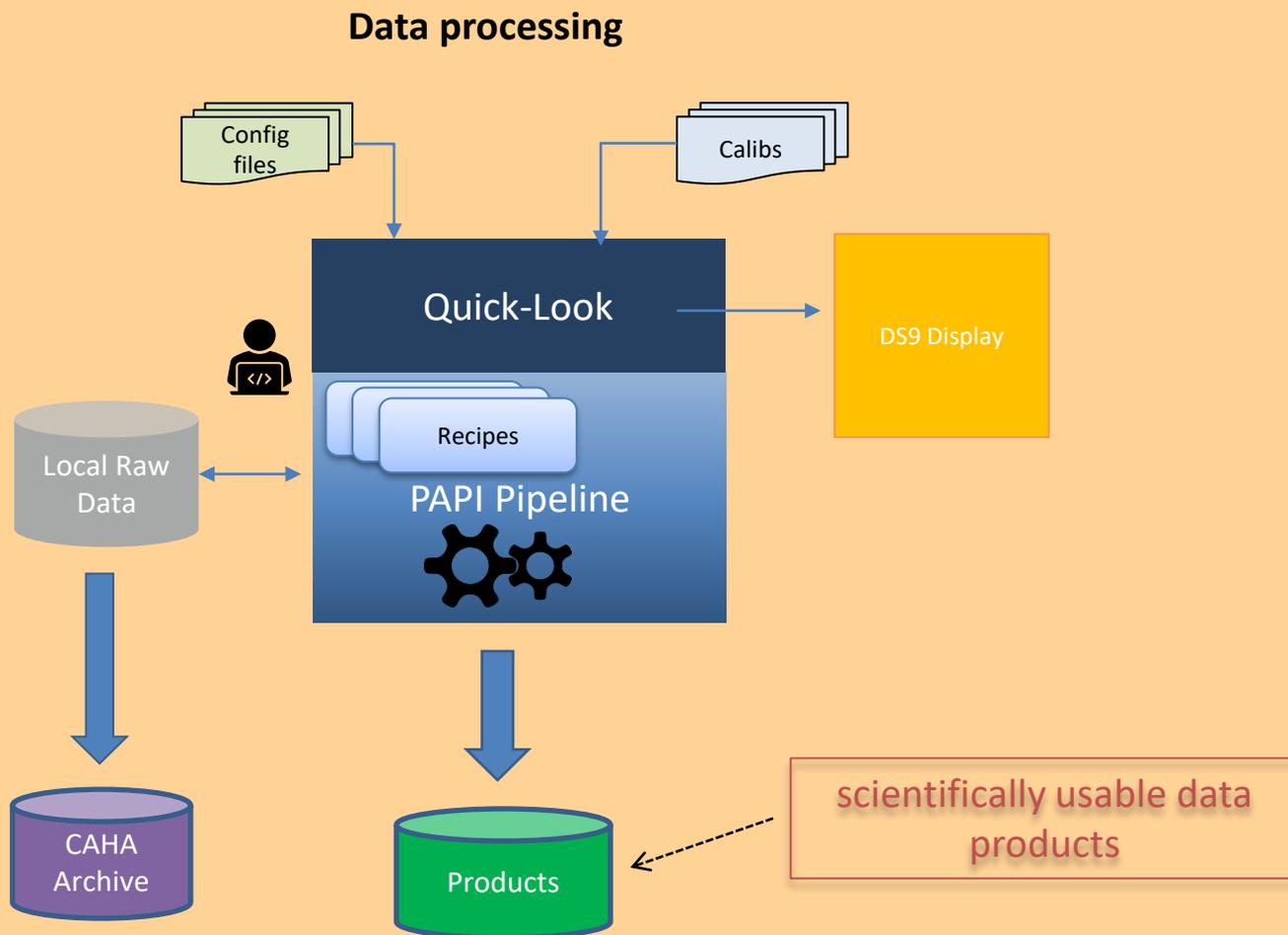
The goal is to demonstrate the package's basic features without getting into too much detail.

# PANIC Quick-Look

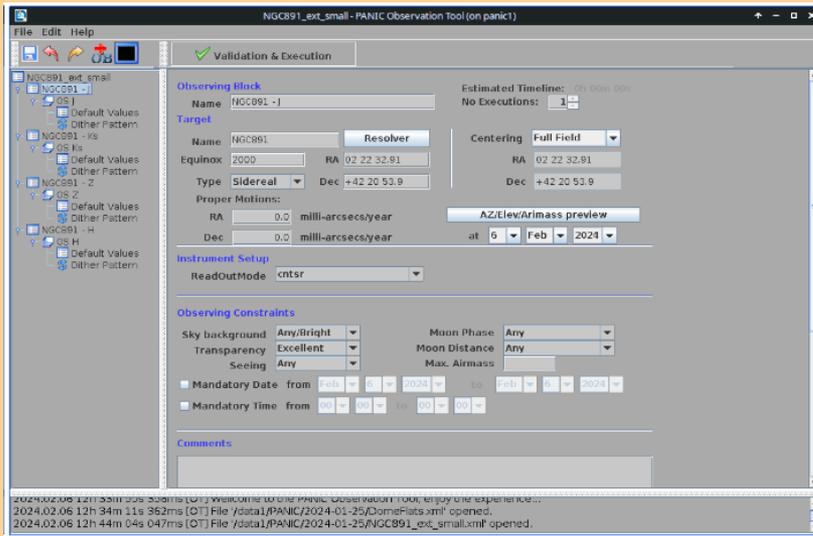
# PANIC Data Flow System Architecture overview



# PQL: GUI Component of PAPI



# PANIC Data Flow System Architecture overview



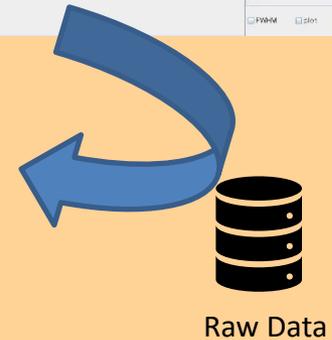
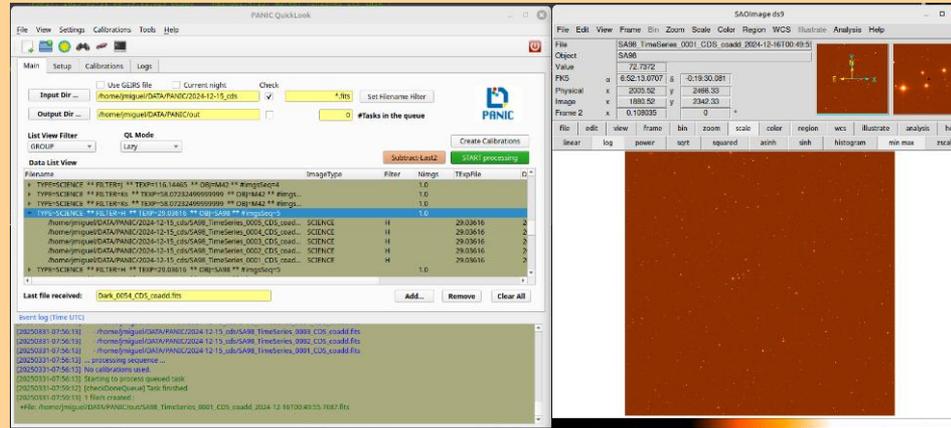
OT



GEIRS



QL



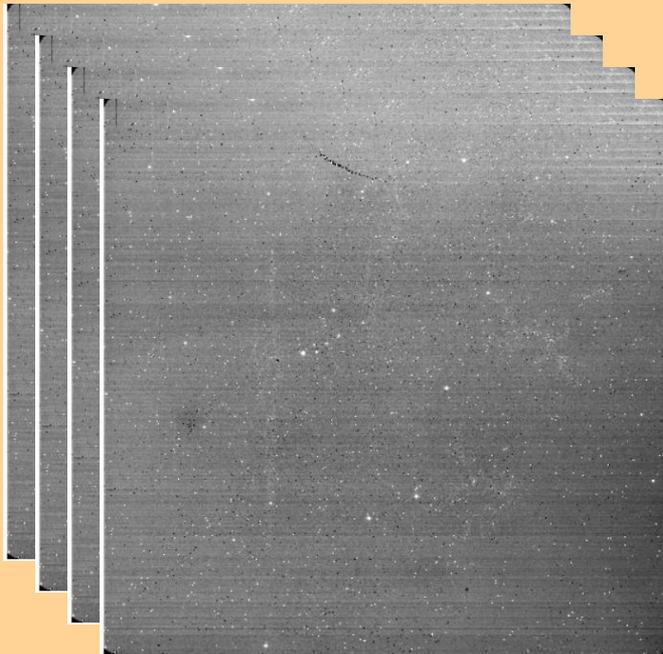
Raw Data

# PANIC Quick-Look (PQL)

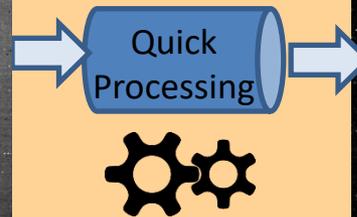
- Why a Quick-Look?
  - Graphical Tool for quick and interactive data processing using PAPI quick-mode
  - Verify whether observations are proceeding as expected
  - On-line / off-line
  - Some functions:
    - PANIC Focus determination
    - Data grouping
    - Astrometric calibration
    - Data visualization
    - Quick reduction
    - ...

# PANIC PAPI/QL Goal

Raw



Processed



H4RG 15um: 4k x 4k  
FOV: 26.3 x 26.3 arcmin  
Pix. Scale: 0.37 arcsec/pix

# PQL - Main GUI

The screenshot shows the PANIC QuickLook interface. The 'Input Dir' is set to '/data3/out/jm\_2024\_12\_13\_cds' and the 'Output Dir' is '/data2/out'. The 'List View Filter' is set to 'INPUTS' and the 'QL Mode' is 'Lazy'. The 'Data List View' table contains the following data:

Filename	ImageType	Filter	Nimgs	TExpFile	DateObs	Object
/data3/out/jm_2024_12_13_cds/Dark_0003_CDS_coadd.fits	DARK	BLANK	1.0	8.710848	2024-12-14::06:50:08.3432	AAOBlar
/data3/out/jm_2024_12_13_cds/Dark_0002_CDS_coadd.fits	DARK	BLANK	1.0	8.710848	2024-12-14::06:49:39.8583	AAOBlar
/data3/out/jm_2024_12_13_cds/Dark_0001_CDS_coadd.fits	DARK	BLANK	1.0	8.710848	2024-12-14::06:49:11.6182	AAOBlar
/data3/out/jm_2024_12_13_cds/SkyFlats_dawn_0005_CDS...	SKY_FLAT	Ks	1.0	23.22893	2024-12-14::06:29:22.7720	AAOBlar
/data3/out/jm_2024_12_13_cds/SkyFlats_dawn_0004_CDS...	SKY_FLAT	Ks	1.0	23.22893	2024-12-14::06:28:01.3978	AAOBlar
/data3/out/jm_2024_12_13_cds/SkyFlats_dawn_0003_CDS...	SKY_FLAT	Ks	1.0	23.22893	2024-12-14::06:26:41.8139	AAOBlar
/data3/out/jm_2024_12_13_cds/SkyFlats_dawn_0002_CDS...	SKY_FLAT	Ks	1.0	23.22893	2024-12-14::06:25:20.5169	AAOBlar
/data3/out/jm_2024_12_13_cds/SkyFlats_dawn_0001_CDS...	SKY_FLAT	Ks	1.0	23.22893	2024-12-14::06:24:01.1335	AAOBlar
/data3/out/jm_2024_12_13_cds/M67_TimeSeries_0100_CD...	SCIENCE	Ks	1.0	29.03616	2024-12-14::06:19:08.6658	M67
/data3/out/jm_2024_12_13_cds/M67_TimeSeries_0099_CD...	SCIENCE	Ks	1.0	29.03616	2024-12-14::06:17:29.2299	M67
/data3/out/jm_2024_12_13_cds/M67_TimeSeries_0098_CD...	SCIENCE	Ks	1.0	29.03616	2024-12-14::06:15:49.7982	M67
/data3/out/jm_2024_12_13_cds/M67_TimeSeries_0097_CD...	SCIENCE	Ks	1.0	29.03616	2024-12-14::06:14:10.3478	M67

The 'Last file received' is 'SkyFlats\_dawn\_0007\_CDS\_coadd.fits'. The event log shows the following messages:

```
[20250618-11:20:27] ... processing sequence ...  
[20250618-11:20:27] No calibrations used.  
[20250618-11:20:27] Starting to process queued task  
[20250618-11:22:57] [checkDoneQueue] Task finished  
[20250618-11:23:01] 1 file/s created :  
+File: /data2/out/SA98_TimeSeries_0001_CDS_coadd_2024-12-14T01:11:43.5264.fits  
[20250618-11:33:07] -----  
[20250618-11:33:07] SEF Filename : /data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0005_CDS_coadd.fits  
[20250618-11:33:07] Image Shape : (4096, 4096)  
[20250618-11:33:07] Filter : Ks  
[20250618-11:33:07] ITIME : 2.903616  
[20250618-11:33:07] NCOARDS : 10
```

# PQL - Main GUI

PANIC QuickLook (on panic22)

File View Settings Calibrations Tools Help

Main Setup Calibrations Logs

Use GEIRS file  Current night Check

Input Dir ... /data1/PANIC/2024-02-20  \*.fits Set Filename Filter

Output Dir ... /data2/out  0 #Tasks in the queue

LIST VIEW FILTER: DARK

QL Mode: Lazy

Create Calibrations Subtract-Last2 START processing

	ImageType	Filter	Nimgs	TExpFile	DateObs	Object	R
INPUTS							
INPUTS							
OUTS	4-02-20/darks_0019.fits	DARK	BLANK	10.0	442.4751	2024-04-23::05:57:55.4884	M101 1
DARK	4-02-20/darks_0018.fits	DARK	BLANK	10.0	359.51102	2024-04-23::05:48:30.8887	M101 1
DOME_FLAT	4-02-20/darks_0017.fits	DARK	BLANK	10.0	304.20162999999997	2024-04-23::05:40:16.7205	M101 1
FOCUS	4-02-20/darks_0016.fits	DARK	BLANK	10.0	221.23755	2024-04-23::05:34:12.9397	M101 1
SKY_FLAT	4-02-20/darks_0015.fits	DARK	BLANK	10.0	165.92816	2024-04-23::05:29:51.1488	M101 1
SCIENCE	4-02-20/darks_0014.fits	DARK	BLANK	10.0	82.96408	2024-04-23::05:27:11.4656	M101 1
MASTERS	4-02-20/darks_0013.fits	DARK	BLANK	10.0	27.65469	2024-04-23::05:25:55.5014	M101 1
REDUCED	4-02-20/darks_0012.fits	DARK	BLANK	10.0	27.65469	2024-04-23::05:24:38.6611	M101 1
GROUP	4-02-20/darks_0011.fits	DARK	BLANK	10.0	27.65469	2024-04-23::05:23:23.5687	M101 1
	/data1/PANIC/2024-02-20/darks_0010.fits	DARK	BLANK	10.0	27.65469	2024-04-23::05:22:07.8952	M101 1
	/data1/PANIC/2024-02-20/darks_0009.fits	DARK	BLANK	10.0	27.65469	2024-04-23::05:20:51.8911	M101 1
	/data1/PANIC/2024-02-20/darks_0008.fits	DARK	BLANK	10.0	27.65469	2024-04-23::05:19:35.6047	M101 1

Last file received: darks\_0019.fits Add... Remove Clear All

Event log (Time UTC)

- [20250910-11:54:10] Detected end of observing sequence [SKY\_FLAT]
- [20250910-11:54:10] Start of observing sequence [SKY\_FLAT]
- [20250910-11:54:10] Start of observing sequence [SKY\_FLAT]
- [20250910-11:54:10] Detected end of observing sequence [SKY\_FLAT]
- [20250910-11:54:10] Start of observing sequence [SKY\_FLAT]
- [20250910-11:54:10] Detected end of observing sequence [SKY\_FLAT]
- [20250910-11:54:10] Start of observing sequence [DARK]
- [20250910-11:54:10] Detected end of observing sequence [DARK]
- [20250910-11:54:10] Start of observing sequence [DARK]
- [20250910-11:54:10] Detected end of observing sequence [DARK]
- [20250910-11:54:10] Start of observing sequence [DARK]
- [20250910-11:54:10] Detected end of observing sequence [DARK]

# PQL - DS9 Display

The image displays two software windows side-by-side. The left window is 'PANIC QuickLook' and the right is 'SAOImage ds9'.

**PANIC QuickLook Interface:**

- Menu: File, View, Settings, Calibrations, Tools, Help
- Main Setup: Input Dir: /home/jmiguel/DATA/PANIC/2024-12-15\_cds; Output Dir: /home/jmiguel/DATA/PANIC/out; #Tasks in the queue: 0
- Data List View Table:

Filename	ImageType	Filter	Nimgs	TExpFile	D
TYPE=SCIENCE ** FILTER=J ** TEXP=116.14465 ** OBJ=M42 ** #imgsSeq=4			1.0		
TYPE=SCIENCE ** FILTER=Ks ** TEXP=58.07232499999999 ** OBJ=M42 ** #imgs...			1.0		
TYPE=SCIENCE ** FILTER=Ks ** TEXP=58.07232499999999 ** OBJ=M42 ** #imgs...			1.0		
TYPE=SCIENCE ** FILTER=H ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0		
/home/jmiguel/DATA/PANIC/2024-12-15_cds/SA98_TimeSeries_0005_CDS_coadd...	SCIENCE	H		29.03616	2
/home/jmiguel/DATA/PANIC/2024-12-15_cds/SA98_TimeSeries_0004_CDS_coadd...	SCIENCE	H		29.03616	2
/home/jmiguel/DATA/PANIC/2024-12-15_cds/SA98_TimeSeries_0003_CDS_coadd...	SCIENCE	H		29.03616	2
/home/jmiguel/DATA/PANIC/2024-12-15_cds/SA98_TimeSeries_0002_CDS_coadd...	SCIENCE	H		29.03616	2
/home/jmiguel/DATA/PANIC/2024-12-15_cds/SA98_TimeSeries_0001_CDS_coadd...	SCIENCE	H		29.03616	2
TYPE=SCIENCE ** FILTER=H ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0		

Event log (Time UTC):

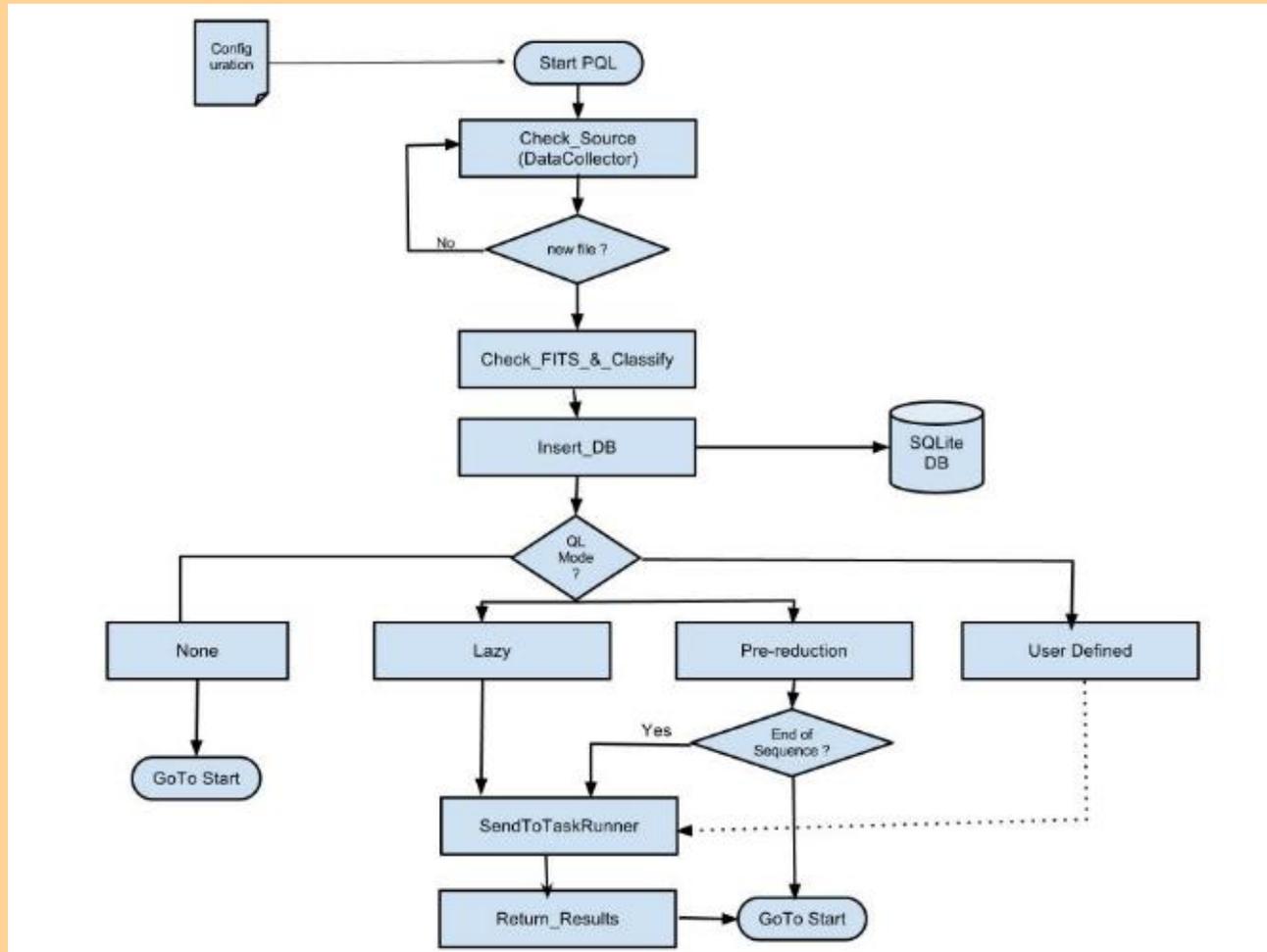
```
[20250331-07:56:13] /home/jmiguel/DATA/PANIC/2024-12-15_cds/SA98_TimeSeries_0003_CDS_coadd.fits  
[20250331-07:56:13] /home/jmiguel/DATA/PANIC/2024-12-15_cds/SA98_TimeSeries_0002_CDS_coadd.fits  
[20250331-07:56:13] /home/jmiguel/DATA/PANIC/2024-12-15_cds/SA98_TimeSeries_0001_CDS_coadd.fits  
[20250331-07:56:13] ... processing sequence ...  
[20250331-07:56:13] No calibrations used.  
[20250331-07:56:13] Starting to process queued task  
[20250331-07:59:12] [checkDoneQueue] Task finished  
[20250331-07:59:13] 1 file/s created:  
+File: /home/jmiguel/DATA/PANIC/out/SA98_TimeSeries_0001_CDS_coadd_2024-12-16T00:49:35.7687.fits
```

**SAOImage ds9 Interface:**

- Menu: File, Edit, View, Frame, Bin, Zoom, Scale, Color, Region, WCS, Illustrate, Analysis, Help
- Object: SA98
- Value: 72.7372
- FK5: RA 6:52:13.0707, Dec -0:19:30.081
- Physical: x 2005.52, y 2486.33
- Image: x 1890.52, y 2342.33
- Frame 2: x 0.108035, y 0

The main window shows a large astronomical image of SA98 with a color scale at the bottom ranging from -6.50e+03 to 2.36e+05.

# Quick-Look Flow Chart



# Data Grouping

**List View Filter** INPUTS **QL Mode** Lazy Create Calibrations

**Data List View** Subtract-Last2 START processing

Filename	ImageType	Filter	Nimgs	TExpFile	DateObs
/data1/PANIC/2024-12-15/M110_ext_small_2_0006.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:27
/data1/PANIC/2024-12-15/M110_ext_small_2_0005.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:23
/data1/PANIC/2024-12-15/M110_ext_small_2_0004.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:20
/data1/PANIC/2024-12-15/M110_ext_small_2_0003.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:16
/data1/PANIC/2024-12-15/M110_ext_small_2_0002.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:13
/data1/PANIC/2024-12-15/M110_ext_small_2_0001.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:09
/data1/PANIC/2024-12-15/M110_ext_small_0016.fits	SCIENCE	Ks	5.0	58.07232499999999	2024-12-15::19:00
/data1/PANIC/2024-12-15/M110_ext_small_0015.fits	SCIENCE	Ks	5.0	58.07232499999999	2024-12-15::18:56
/data1/PANIC/2024-12-15/M110_ext_small_0014.fits	SCIENCE	Ks	5.0	58.07232499999999	2024-12-15::18:56
/data1/PANIC/2024-12-15/M110_ext_small_0013.fits	SCIENCE	Ks	5.0	58.07232499999999	2024-12-15::18:54
/data1/PANIC/2024-12-15/M110_ext_small_0012.fits	SCIENCE	Ks	5.0	58.07232499999999	2024-12-15::18:52
/data1/PANIC/2024-12-15/M110_ext_small_0011.fits	SCIENCE	Ks	5.0	58.07232499999999	2024-12-15::18:50



**List View Filter** GROUP **QL Mode** None Create Calibrations

**Data List View** Subtract-Last2 START processing

Filename	ImageType	Filter	Nimgs	TExpFile
/data1/PANIC/2024-12-15/FocusSeries_NGC752_0022.fits	FOCUS	H		8.7100
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=4			10.0	
/data1/PANIC/2024-12-15/M110_ext_small_0004.fits	SCIENCE	J		116.14464999999998
/data1/PANIC/2024-12-15/M110_ext_small_0003.fits	SCIENCE	J		116.14464999999998
/data1/PANIC/2024-12-15/M110_ext_small_0002.fits	SCIENCE	J		116.14464999999998
/data1/PANIC/2024-12-15/M110_ext_small_0001.fits	SCIENCE	J		116.14464999999998
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=4			10.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=4			5.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=4			5.0	
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=3			10.0	
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=3			10.0	
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=3			10.0	

Last file received: Dark\_0054.fits Add... Remove Clear All

# Data Grouping

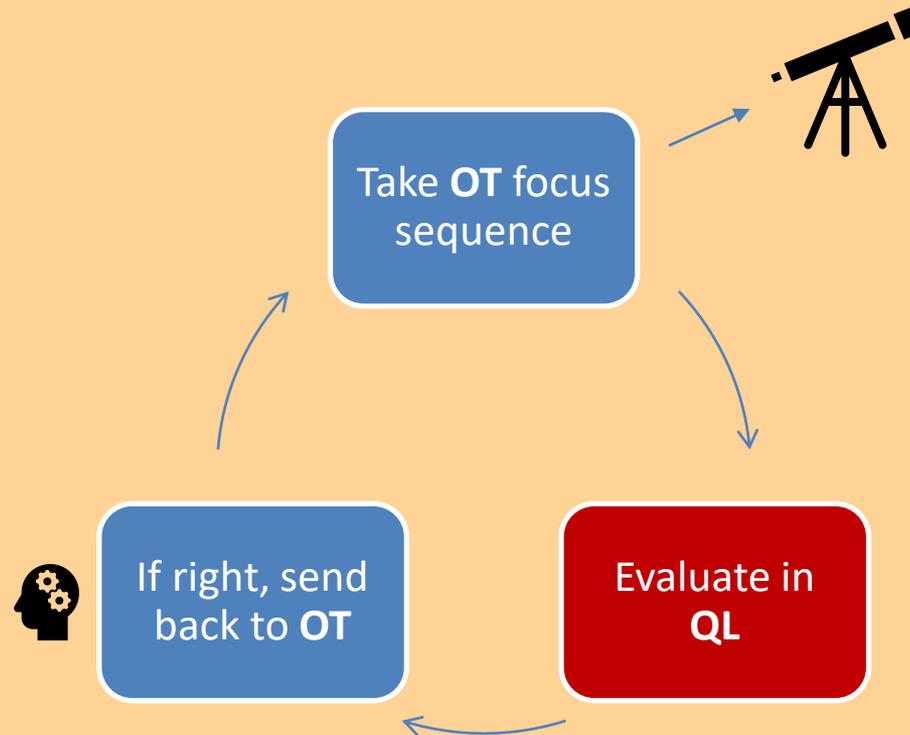
The screenshot shows the PANIC QuickLook@panic22 software interface. The main window has a menu bar (File, View, Settings, Calibrations, Tools, Help) and a toolbar with various icons. The main area is divided into several sections:

- Input/Output:** Input Dir is set to /data1/PANIC/2024-12-15, and Output Dir is /data2/out. There are checkboxes for "Use GEIRS file", "Current night", and "Check". A "Set Filename Filter" button is present.
- Queue:** A "#Tasks in the queue" field shows 0.
- Filters:** "List View Filter" is set to "GROUP" (highlighted with a red oval). "QL Mode" is set to "None".
- Buttons:** "Create Calibrations", "Subtract-Last2", and "START processing" buttons are visible.
- Data List View:** A table with columns: Filename, ImageType, Filter, Nimgs, and TExpFi. It lists various observation files with their parameters.
- Last file received:** Dark\_0054.fits
- Event log (Time UTC):** A log of events showing "Start of observing sequence [DARK]" and "Detected end of observing sequence [DARK]" for the date 20250324-11:14:03.

Filename	ImageType	Filter	Nimgs	TExpFi
TYPE=SKY_FLAT ** FILTER=Z ** TEXP=2.903616 ** OBJ=CABlank7 ** #imgsSeq=1			1.0	
TYPE=SKY_FLAT ** FILTER=Z ** TEXP=2.903616 ** OBJ=CABlank7 ** #imgsSeq=1			1.0	
TYPE=SKY_FLAT ** FILTER=Z ** TEXP=2.903616 ** OBJ=CABlank7 ** #imgsSeq=1			1.0	
TYPE=SKY_FLAT ** FILTER=Z ** TEXP=2.903616 ** OBJ=CABlank7 ** #imgsSeq=4			1.0	
TYPE=SKY_FLAT ** FILTER=J ** TEXP=2.903616 ** OBJ=CABlank7 ** #imgsSeq=4			1.0	
TYPE=SKY_FLAT ** FILTER=H ** TEXP=2.903616 ** OBJ=Blank4 ** #imgsSeq=5			1.0	
TYPE=SKY_FLAT ** FILTER=Ks ** TEXP=8.710849 ** OBJ=Blank4 ** #imgsSeq=5			2.0	
TYPE=FOCUS ** FILTER=J ** TEXP=8.710849 ** OBJ=NGC752 ** #imgsSeq=21			1	
TYPE=FOCUS ** FILTER=H ** TEXP=8.710849 ** OBJ=NGC752 ** #imgsSeq=13			1	
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=4			10.0	
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=4			10.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=4			5.0	

# Instrument focusing: PQL Focus Evaluation

## ➤ Telescope focusing



# Instrument focusing: PQL Focus Evaluation

## ➤ Telescope focusing

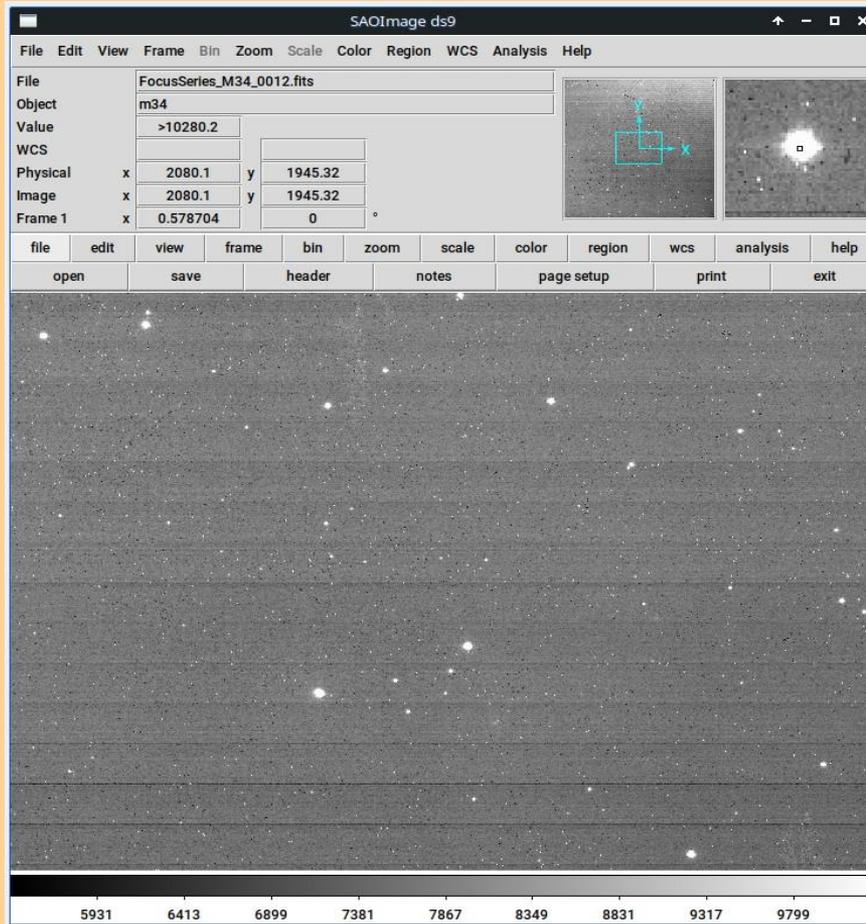
The screenshot shows the PANIC QuickLook software interface. The main window displays a list of files in the 'Data List View' section, with columns for Filename, ImageType, Filter, Nimgs, TExpFile, and DateObs. The files listed are FocusSeries\_M34\_0019.fits through FocusSeries\_M34\_0008.fits, all of type FOCUS. A context menu is open over the selected files, listing various actions such as 'Display Image', 'Image Info', 'Copy files to clipboard', 'Build Master Dark', 'Apply Dark\_FlatField\_BPM', and 'Focus evaluation'. The 'Focus evaluation' option is highlighted. Below the file list, there is an event log showing a series of 'Start of observing sequence [DARK]' and 'Detected end of observing sequence [DARK]' events.

Filename	ImageType	Filter	Nimgs	TExpFile	DateObs
/data3/PANIC/2024-01-25/FocusSeries_M34_0019.fits	FOCUS	H			7214
/data3/PANIC/2024-01-25/FocusSeries_M34_0018.fits	FOCUS	H			7644
/data3/PANIC/2024-01-25/FocusSeries_M34_0017.fits	FOCUS	H			9375
/data3/PANIC/2024-01-25/FocusSeries_M34_0016.fits	FOCUS	H			7421
/data3/PANIC/2024-01-25/FocusSeries_M34_0015.fits	FOCUS	H			0476
/data3/PANIC/2024-01-25/FocusSeries_M34_0014.fits	FOCUS	H			9060
/data3/PANIC/2024-01-25/FocusSeries_M34_0013.fits	FOCUS	H			9308
/data3/PANIC/2024-01-25/FocusSeries_M34_0012.fits	FOCUS	H			7732
/data3/PANIC/2024-01-25/FocusSeries_M34_0011.fits	FOCUS	H			8094
/data3/PANIC/2024-01-25/FocusSeries_M34_0010.fits	FOCUS	H			3451
/data3/PANIC/2024-01-25/FocusSeries_M34_0009.fits	FOCUS	H			4926
/data3/PANIC/2024-01-25/FocusSeries_M34_0008.fits	FOCUS	H			1927

Event log (Time UTC)

```
[20240129-10:39:33] Start of observing sequence [DARK]
[20240129-10:39:33] Detected end of observing sequence [DARK]
[20240129-10:39:33] Start of observing sequence [DARK]
[20240129-10:39:33] Detected end of observing sequence [DARK]
[20240129-10:39:33] Start of observing sequence [DARK]
[20240129-10:39:33] Detected end of observing sequence [DARK]
[20240129-10:39:33] Start of observing sequence [DARK]
[20240129-10:39:33] Detected end of observing sequence [DARK]
[20240129-10:39:33] Start of observing sequence [DARK]
[20240129-10:39:33] Detected end of observing sequence [DARK]
[20240129-10:39:33] Start of observing sequence [DARK]
[20240129-10:39:33] Detected end of observing sequence [DARK]
[20240129-10:39:33] Start of observing sequence [DARK]
[20240129-10:39:33] Detected end of observing sequence [DARK]
[20240129-10:39:33] Start of observing sequence [DARK]
[20240129-10:39:33] Detected end of observing sequence [DARK]
```

# Focus\_evaluation: focus star selection



```
IRAF (on panic22)
setting terminal type to xterm...

NOAO/IRAF PC-IRAF Revision 2.16 EXPORT Thu May 24 15:41:17 MST 2012
This is the EXPORT version of IRAF V2.16 supporting PC systems.

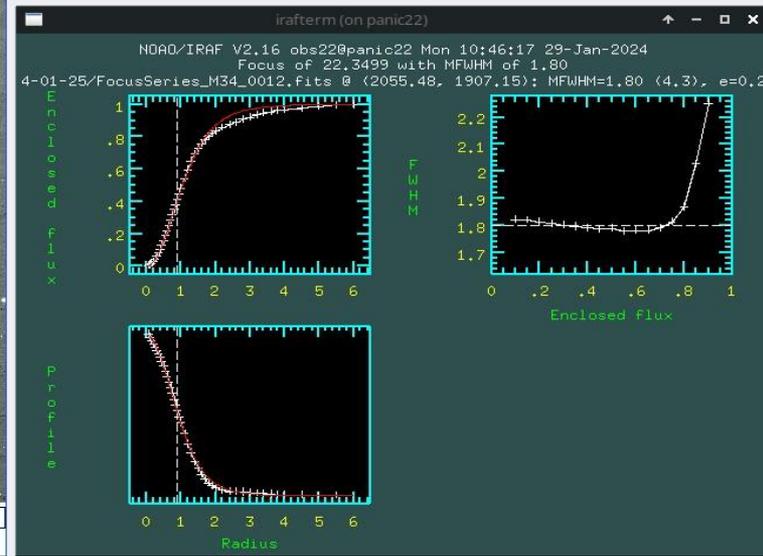
Welcome to IRAF. To list the available commands, type ? or ?? . To get
detailed information about a command, type 'help <command>' . To run a
command or load a package, type its name. Type 'bye' to exit a
package, or 'logout' to get out of the CL. Type 'news' to find out
what is new in the version of the system you are using.

Visit http://iraf.net if you have questions or to report problems.

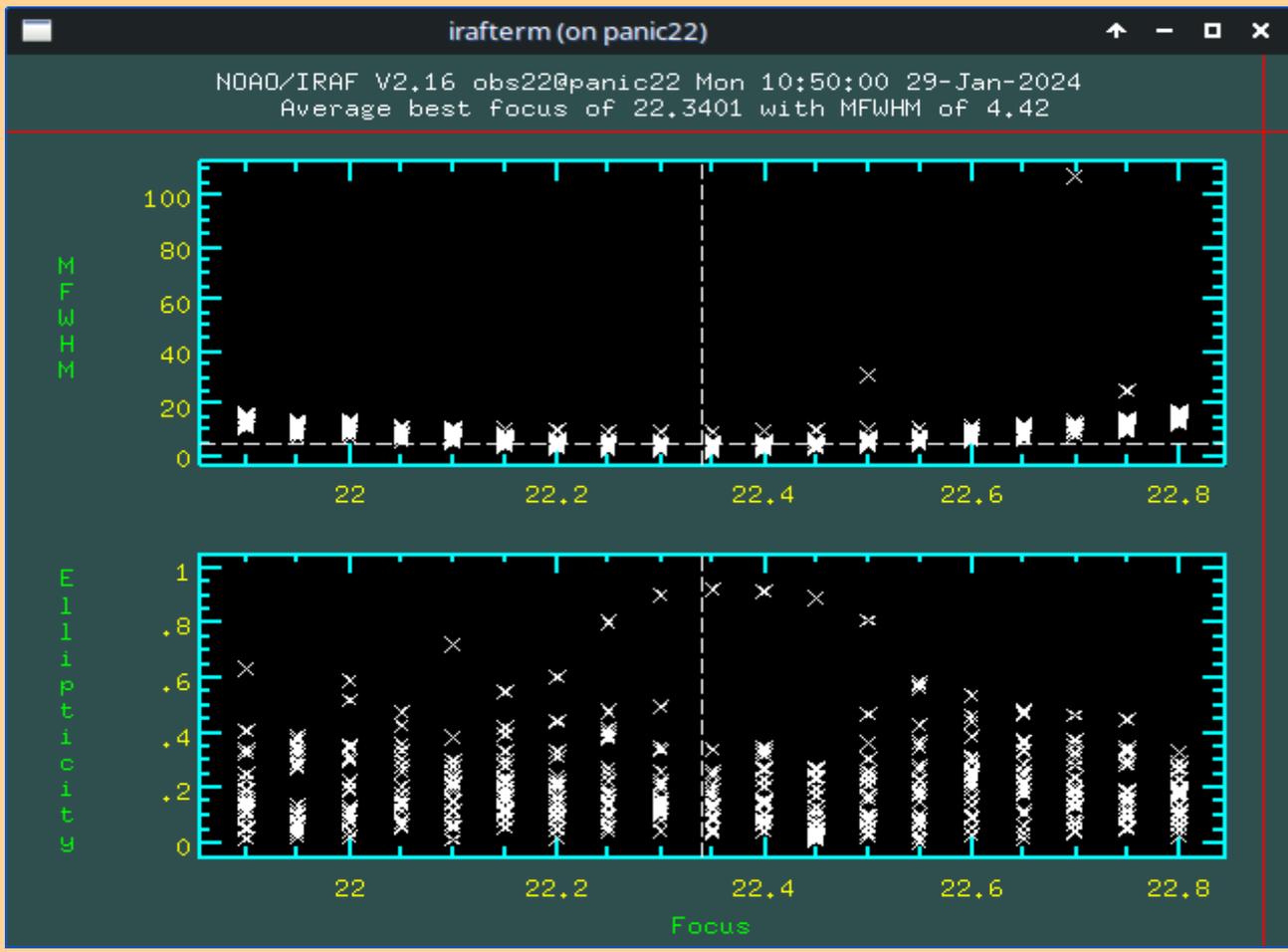
The following commands or packages are currently defined:

(Updated on 2013-12-13)

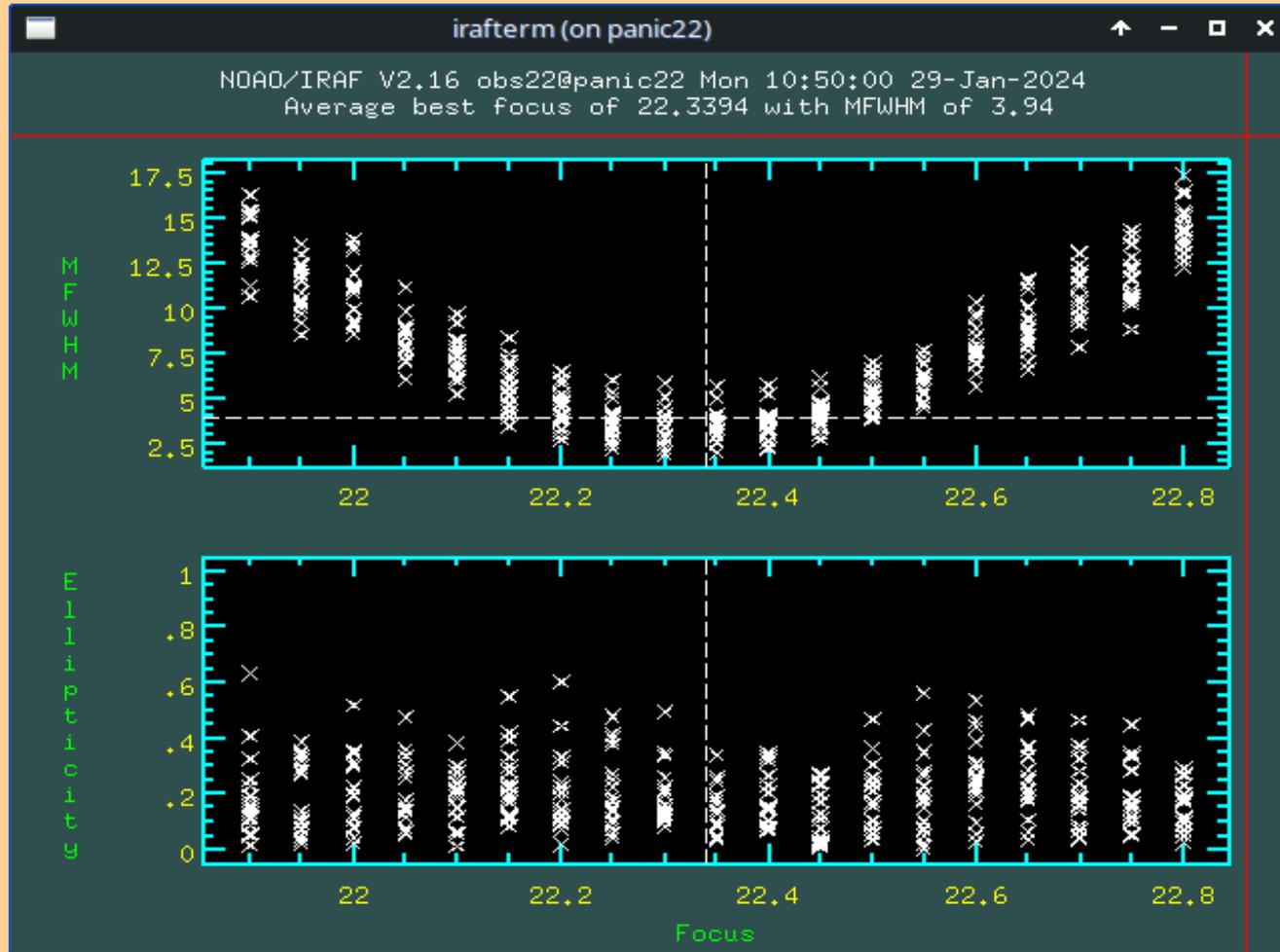
z1=5449.616 z2=10280.22
** Select stars to measure with 'm' and finish with 'q'.
** Additional options are '?', 'g', and ;show.
```



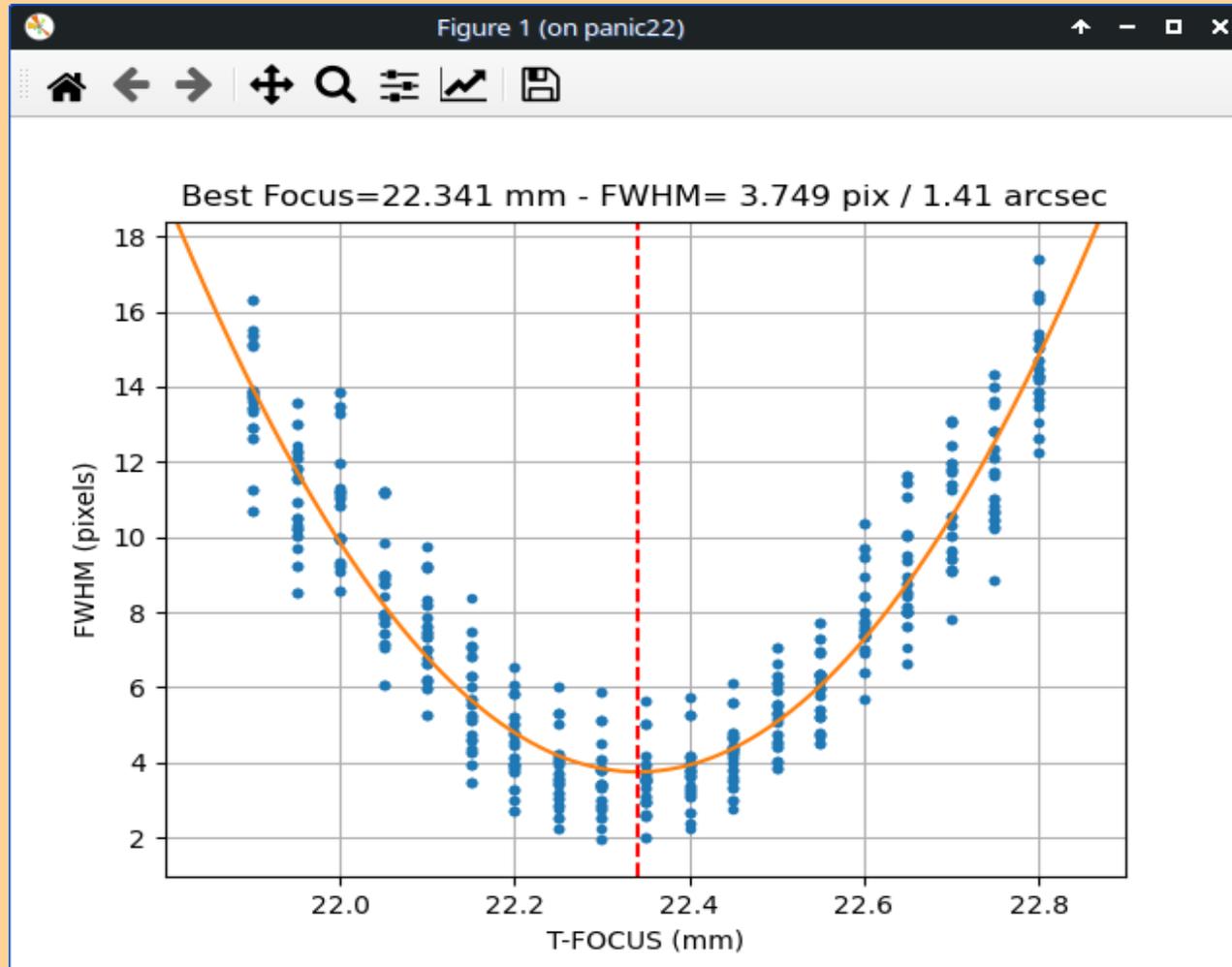
# Focus Evaluation: cleaning focus set of measurements



# Focus Evaluation: final focus set of measurements

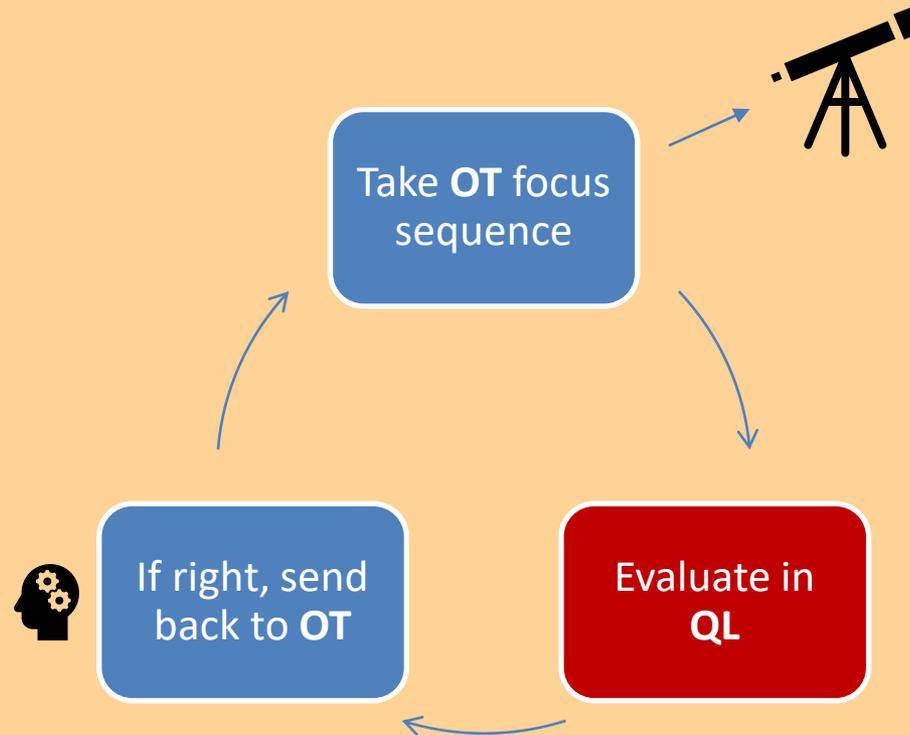


# Focus Evaluation: focus fitted parable



# Instrument focusing: PQL Focus Evaluation

## ➤ Telescope focusing



# PQL: Build Master calibrations

The screenshot shows the PANIC QuickLook software interface. The main window has a menu bar (File, View, Settings, Calibrations, Tools, Help) and a toolbar. The 'Calibrations' tab is active, showing options for 'Use GEIRS file', 'Current night', and 'Check'. The 'Input Dir' is set to '/data3/PANIC/2023-11-29' and the 'Output Dir' is '/data2/out/test'. The 'List View Filter' is set to 'INPUTS' and the 'QL Mode' is 'Lazy'. The 'Data List View' table contains the following data:

Filename	ImageType	Filter	Nimfs	TExpFile	DateObs	
/data3/PANIC/2023-11-29/DomeFlats_0031.fits	DOME_FLAT_LAMP_ON	Z	1.0	19.358286	2023-11-30::05:56:18.1968	M
/data3/PANIC/2023-11-29/DomeFlats_0030.fits	DOME_FLAT_LAMP_OFF	H	1.0	2.765469	2023-11-30::05:55:03.8662	M
/data3/PANIC/2023-11-29/DomeFlats_0029.fits	DOME_FLAT_LAMP_OFF	H	1.0	2.765469	2023-11-30::05:54:44.7560	M
/data3/PANIC/2023-11-29/DomeFlats_0028.fits	DOME_FLAT_LAMP_OFF	H	1.0	2.765469	2023-11-30::05:54:25.7771	M
	DOME_FLAT_LAMP_OFF	H	1.0	2.765469	2023-11-30::05:54:05.9248	M
	DOME_FLAT_LAMP_OFF	H	1.0	2.765469	2023-11-30::05:54:46.8619	M
	DOME_FLAT_LAMP_ON	H	1.0	2.765469	2023-11-30::05:53:07.5499	M
	DOME_FLAT_LAMP_ON	H	1.0	2.765469	2023-11-30::05:52:48.2012	M
	DOME_FLAT_LAMP_ON	H	1.0	2.765469	2023-11-30::05:52:29.2502	M
	DOME_FLAT_LAMP_ON	H	1.0	2.765469	2023-11-30::05:52:10.1210	M
	DOME_FLAT_LAMP_ON	H	1.0	2.765469	2023-11-30::05:51:49.7091	M
	DOME_FLAT_LAMP_OFF	I	1.0	2.765469	2023-11-30::05:50:42.2493	M

A context menu is open over the table, listing various actions such as 'Display image', 'Image Info', 'Copy files to clipboard', 'Build Master Dark', 'Build Master Dome Flat', 'Build Master Twilight Flat', 'Build Gain Map', 'Build BPM', 'Apply Dark\_FlatField\_BPM', 'Apply Non-Linearity Correction', 'Apply and Show BPM', 'Focus evaluation', 'Subtract own-sky', 'Subtract near-Sky', 'Quick-Reduction', 'Astrometric Calib.', 'Photometric Calib.', 'Statistics', 'FWHM mean estimation', 'Background estimation', 'Math', and 'FITS'. The 'Build Master Dome Flat' option is highlighted.

# PQL: Apply Master calibrations

The screenshot shows the PANIC QuickLook application window. The main interface includes a menu bar (File, View, Settings, Calibrations, Tools, Help), a toolbar with icons for file operations, and a main control area. The control area has tabs for Main, Setup, Calibrations, and Logs. Under the Main tab, there are input and output directory fields, checkboxes for 'Use GEIRS file' and 'Current night', a 'Check' checkbox, and a '#Tasks in the queue' indicator. Below this are 'List View Filter' and 'QL Mode' dropdowns. A 'Data List View' table is visible, listing files with columns for Filename, ImageType, Filter, Nimgs, TExpFile, and DateObs. A context menu is open over the table, listing various actions like 'Display Image', 'Image Info', 'Copy files to clipboard', 'Copy files to text file', 'Show Dither pattern', 'Build Master Dark', 'Build Master Dome Flat', 'Build Master Twilight Flat', 'Build Gain Map', 'Build BPM', 'Apply Dark FlatField\_BPM', 'Apply Non-Linearity Correction', 'Apply and Show BPM', 'Focus evaluation', 'Subtract own-sky', 'Subtract near-Sky', 'Quick-Reduction', 'Astrometric Calib.', 'Photometric Calib.', 'Statistics', 'FWHM mean estimation', 'Background estimation', 'Math', and 'FITS'. The 'Event log (Time UTC)' at the bottom left shows a series of 'Start of' and 'Detect' events.

Filename	ImageType	Filter	Nimgs	TExpFile	DateObs
/data1/PANIC/2024-12-15/M110_ext_small_2_0006.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:27
/data1/PANIC/2024-12-15/M110_ext_small_2_0005.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:27
/data1/PANIC/2024-12-15/M110_ext_small_2_0004.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:26
/data1/PANIC/2024-12-15/M110_ext_small_2_0003.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:14
/data1/PANIC/2024-12-15/M110_ext_small_2_0002.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:13
/data1/PANIC/2024-12-15/M110_ext_small_2_0001.fits	SCIENCE	J	10.0	116.14464999999998	2024-12-15::19:00



# QL: FWHM estimation

The screenshot shows the PANIC QuickLook software interface. The main window displays the 'Data List View' with a list of files. A context menu is open over the list, with 'FWHM mean estimation' highlighted. The event log at the bottom shows the results of the FWHM estimation for a specific file.

**Input Dir ...** /data3/out/jm\_2024\_12\_13\_cds  
**Output Dir ...** /data2/out

**List View Filter** GROUP  
**QL Mode** Lazy

**Data List View**

Filename
TYPE=DOME_FLAT ** FILTER=Z ** TEXP=17.421698 ** OBJ=...
TYPE=DOME_FLAT ** FILTER=Y ** TEXP=5.807233 ** OBJ=...
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA...
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0005_C
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0004_C
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0003_C
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0002_C
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0001_C
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA...
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA...
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA...
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA...

**Last file received:** SkyFlats\_dawn\_0007\_CDS\_coadd.fits

**FWHM mean estimation** Ctrl+W

**Event log (Time UTC)**

```
[20250919-10:11:05] Start of observing sequence [SKY_FLAT]
[20250919-10:11:05] Detected end of observing sequence [SKY_FLAT]
[20250919-10:11:05] Start of observing sequence [DARK]
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [DARK]
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [DARK]
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [DARK]
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [SKY_FLAT]
[20250919-10:15:58] SA98_TimeSeries_0001_CDS_coadd.fits FWHM = 5.48 (pixels) std= 1.8234161581844088 detector= all
```

# PQL: Astrometric Calibration

Main Setup Calibrations Logs

Use GEIRS file  Current night  Check

Input Dir ... /data1/PANIC/2024-12-15  \*.fits Set Filename Filter

Output Dir ... /data2/out  0 #Tasks in the queue

LIST VIEW FILTER: GROUP QL Mode: None

Create Calibrations Subtract-Last2 START processing

Filename	ImageType	Filter	Nimgs	TExpFi
/data1/PANIC/2024-12-15/FocusSeries_NGC752_0022.fits	FOCUS	H		8.710
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110 ** #imgsSeq=4			10.0	
/data1/PANIC/2024-12-15/M110_ext_small_0004.fits	SCIENCE	J		116.1
/data1/PANIC/2024-12-15/M110_ext_small_0003.fits	ICE	J		116.1
/data1/PANIC/2024-12-15/M110_ext_small_0002.fits	ICE	J		116.1
/data1/PANIC/2024-12-15/M110_ext_small_0001.fits	ICE	J		116.1
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110			10.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=11.614465 ** OBJ=M110			5.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=11.614465 ** OBJ=M110			5.0	
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110			10.0	
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110			10.0	
TYPE=SCIENCE ** FILTER=J ** TEXP=11.614465 ** OBJ=M110			10.0	

Last file received: Dark\_0054.fits

- Display Image Ctrl+D
- Image Info Ctrl+H
- Copy files to clipboard Ctrl+C
- Copy files to text file Shift+T
- Show Dither pattern Ctrl+P
- Build Master Dark Ctrl+M
- Build Master Dome Flat Ctrl+F
- Build Master Twilight Flat Ctrl+T
- Build Gain Map Ctrl+G
- Build BPM Ctrl+B
- Apply Dark\_FlatField\_BPM Ctrl+A
- Apply Non-Linearity Correction Shift+N
- Apply and Show BPM Shift+B
- Focus evaluation Ctrl+F
- Subtract own-sky Ctrl+S
- Subtract near-Sky Ctrl+N
- Quick-Reduction Ctrl+Q
- Astrometric Calib. Shift+A
- Photometric Calib. Shift+P
- Statistics Shift+S
- FWHM mean estimation Ctrl+W
- Background estimation Shift+B
- Math
- FITS

# PQL: Astrometric Calibration

## ➤ Using Astrometry.net + GAIA-DR3

The image displays two software interfaces used for astronomical data processing. The left window is PANIC QuickLook, and the right window is SAOImage ds9.

**PANIC QuickLook Interface:**

- Menu: File, View, Settings, Calibrations, Tools, Help
- Buttons: Main, Setup, Calibrations, Logs
- Input Dir: /home/jmiguel/DATA/PANIC/m\_2024\_12\_13\_cds
- Output Dir: /home/jmiguel/DATA/PANIC/out
- QL Mode: Lazy
- Data List View table:

Filename	ImageType	Filter	Nimgs	TExpFile	DateObs
/home/jmiguel/DATA/PANIC/m_2024_12_13_cds/SA98_TimeSeries_0061	CDS_coadd.fits	SCIENCE	1.0	29.03616	2024-12-14:00
/home/jmiguel/DATA/PANIC/m_2024_12_13_cds/SA98_TimeSeries_0060	CDS_coadd.fits	SCIENCE	1.0	29.03616	2024-12-14:00
/home/jmiguel/DATA/PANIC/m_2024_12_13_cds/SA98_TimeSeries_0059	CDS_coadd.fits	SCIENCE	1.0	29.03616	2024-12-14:00
/home/jmiguel/DATA/PANIC/m_2024_12_13_cds/SA98_TimeSeries_005					

Event log (Time UTC):

- [20250325-08:40:28] Detected end of observing sequence [SCIENCE]
- [20250325-08:40:28] Start of observing sequence [SCIENCE]
- [20250325-08:40:28] Detected end of observing sequence [SCIENCE]
- [20250325-08:40:28] Start of observing sequence [SCIENCE]
- [20250325-08:41:05] File to calib: /home/jmiguel/DATA/PANIC/m\_2024\_12\_13\_cds/SA98\_TimeSeries\_005
- [20250325-08:41:05] Starting Astrometric calibration (2MASS)
- [20250325-08:41:05] +Engine: Astrometry.net
- [20250325-08:41:19] Task finished
- [20250325-08:41:19] Process successfully finished !
- [20250325-08:41:19] New file /home/jmiguel/DATA/PANIC/out/SA98\_TimeSeries\_005

**SAOImage ds9 Interface:**

- Menu: File, Edit, View, Frame, Bin, Zoom, Scale, Color, Region, WCS, Illustrate, Analysis, Help
- Object: SA98
- Value: SA98
- WCS: x, y, x, y, x, y
- Frame 3: x: 0.117159, y: 0
- Buttons: open, save, header, notes, same, page setup, print, exit
- Color bar: 2.4e+04 to 3.5e+04



# QL: Quick-Reduction

File View Settings Calibrations Tools Help

Main Setup Calibrations Logs

Use GEIRS file Current night Check

Input Dir ... /data3/out/jm\_2024\_12\_13\_cds \*.fits Set Filename Filter

Output Dir ... /data2/out 0 #Tasks in the queue

List View Filter GROUP QL Mode Lazy

Create Calibrations

Subtract-Last2 START processing

Filename	ImageType	Filter	Nimgs	TExpFile
TYPE=DOME_FLAT ** FILTER=Z ** TEXP=17.421698 ** OBJ=J223957-300000 ** #i...			1.0	
TYPE=DOME_FLAT ** FILTER=Y ** TEXP=5.807233 ** OBJ=J224919-300000 ** #i...			1.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** ORI=SA98 ** #imgsSeq=5			1.0	
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0001_CDS_coadd.fits	SCIENCE	Ks	29.03616	
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0002_CDS_coadd.fits	SCIENCE	Ks	29.03616	
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0003_CDS_coadd.fits	SCIENCE	Ks	29.03616	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** ORI=SA98 ** #imgsSeq=5			1.0	

Last file received: SkyFlats\_dawn\_0007\_CDS\_coadd.fits Add... Remove Clear All

Event log (Time UTC)

```
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [DARK]
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [DARK]
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [DARK]
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [DARK]
[20250919-10:11:05] Detected end of observing sequence [DARK]
[20250919-10:11:05] Start of observing sequence [SKY_FLAT]
[20250919-10:15:58] SA98_TimeSeries_0001_CDS_coadd.fits FWHM = 5.48 (pixels) std= 1.8234161581844088 detector= all
[20250919-10:23:56] SA98_TimeSeries_0003_CDS_coadd.fits FWHM = 5.19 (pixels) std= 1.955413762886145 detector= all
[20250919-10:24:08] FILE MEAN MODE STDDEV MIN MAX
[20250919-10:24:11] /data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0003_CDS_coadd.fits 31233.32 30401.4 8281.589 -54061. 517886.
```

View Frame Bin Zoom Scale Color Region WCS Illustrate Analysis Help

SA98\_TimeSeries\_0001\_CDS\_coadd.fits

SA98

x y

x y

x 0.112277 y 0

zoom out zoom fit zoom 1/4 zoom 1/2 zoom 1 zoom 2 zoom 4

# QL: Quick-Reduction(2)

PNIC QuickLook@panic22

File View Settings Calibrations Tools Help

Main Setup Calibrations Logs

Use GEIRS file  Current night  Check

Input Dir ... /data3/out/jm\_2024\_12\_13\_cds  \*.fits Set Filename Filter

Output Dir ... /data2/out  0 #Tasks in the queue

List View Filter: GROUP QL Mode: Lazy

Create Calibrations Subtract-Last2 START processing

Filename	ImageType	Filter	Nimgs	TExpFile
TYPE=DOME_FLAT ** FILTER=Z ** TEXP=17.421698 ** OBJ=J223957-300000 ** #i...			1.0	
TYPE=DOME_FLAT ** FILTER=Y ** TEXP=5.807233 ** OBJ=J224919-300000 ** #i...			1.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0	
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0005_CDS_coadd.fits	SCIENCE	Ks	29.03616	
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0004_CDS_coadd.fits	SCIENCE	Ks	29.03616	
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0003_CDS_coadd.fits	SCIENCE	Ks	29.03616	
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0002_CDS_coadd.fits	SCIENCE	Ks	29.03616	
/data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0001_CDS_coadd.fits	SCIENCE	Ks	29.03616	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0	
TYPE=SCIENCE ** FILTER=Ks ** TEXP=29.03616 ** OBJ=SA98 ** #imgsSeq=5			1.0	

Last file received: SkyFlats\_dawn\_0007\_CDS\_coadd.fits Add... Remove Clear All

Event log (Time UTC)

```
[20250919-10:34:55] ++ Starting to process next [5] files :
[20250919-10:34:55] - /data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0005_CDS_coadd.fits
[20250919-10:34:55] - /data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0004_CDS_coadd.fits
[20250919-10:34:55] - /data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0003_CDS_coadd.fits
[20250919-10:34:55] - /data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0002_CDS_coadd.fits
[20250919-10:34:55] - /data3/out/jm_2024_12_13_cds/SA98_TimeSeries_0001_CDS_coadd.fits
[20250919-10:34:55] ... processing sequence ...
[20250919-10:34:55] No calibrations used.
[20250919-10:34:56] Starting to process queued task
[20250919-10:37:46] [checkDoneQueue] Task finished
[20250919-10:37:58] 1 file/s created :
+File: /data2/out/SA98_TimeSeries_0001_CDS_coadd_2024-12-14T01:11:43.5264.fits
```

image ds9

View Frame Bin Zoom Scale Color Region WCS Illustrate Analysis Help

SA98\_TimeSeries\_0001\_CDS\_coadd\_2024-12-14T01:11:43.5264.fits

SA98

x y x y x y

0.10358 0

zoom out zoom fit zoom 1/4 zoom 1/2 zoom 1 zoom 2 zoom 4

-1.8e+02 -1e+02 -78 46 1.2e+02 1.9e+02 2.7e+02 3.4e+02 4.2e+02

# QL: IRAF console

The image displays two software windows. The left window is the IRAF console, showing a terminal window with the following text:

```
NOAO/IRAF PC-IRAF Revision 2.16 EXPORT Thu May 24 15:41:17 MST 2012
This is the EXPORT version of IRAF V2.16 supporting PC systems.
```

The terminal window also shows the execution of a task:

```
NOAO/IRAF V2.16 obs22@panic22 Fri 10:46:53 19-Sep-2025
43.5264.Fits: Radial profile at 1990.90 2608.32
SA98
```

The plot shows a radial profile with the following data points:

Radius	Pixel Value
17.52	7.06
1.506E7	162.3
337588	0.06
-25	4.25
5.60	5.97
5.84	

The right window is SAOImage ds9, showing the following parameters:

Parameter	Value
Object	SA98
Value	28864.4
FK5 $\alpha$	6:52:10.5066
FK5 $\delta$	-0:17:44.891
Physical x	2098.64
Physical y	2732.17
Image x	1974.64
Image y	2607.17
Frame 2 x	0.10358
Frame 2 y	0

The SAOImage ds9 window also shows a zoomed-in view of the astronomical image, with a color bar at the bottom ranging from  $-1.8e+02$  to  $4.2e+02$ .

# PQL: Other functions

<u>D</u> isplay Image	Ctrl+D
<u>I</u> mage Info	Ctrl+H
<u>C</u> opy files to clipboard	Ctrl+C
<u>C</u> opy files to text file	Shift+T
<u>S</u> how Dither pattern	Ctrl+P
<hr/>	
<u>B</u> uild Master Dark	Ctrl+M
<u>B</u> uild Master Dome Flat	Ctrl+F
<u>B</u> uild Master Twilight Flat	Ctrl+T
<u>B</u> uild Gain Map	Ctrl+G
<u>B</u> uild BPM	Ctrl+B
<b>A</b> pply Dark _FlatField _BPM	Ctrl+A
<u>A</u> pply Non-Linearity Correction	Shift+N
<u>A</u> pply and Show BPM	Shift+B
<u>F</u> ocus evaluation	Ctrl+F
S <u>ub</u> tract own-sky	Ctrl+S
S <u>ub</u> tract near-Sky	Ctrl+N
Q <u>u</u> ick-Reduction	Ctrl+Q
<hr/>	
A <u>s</u> trometric Calib.	Shift+A
P <u>h</u> otometric Calib.	Shift+P
<hr/>	
S <u>t</u> atistics	Shift+S
F <u>W</u> HM mean estimation	Ctrl+W
B <u>a</u> ckground estimation	Shift+B
M <u>a</u> th	▶
F <u>I</u> T <u>S</u>	▶

# PANIC Pipeline (PAPI)

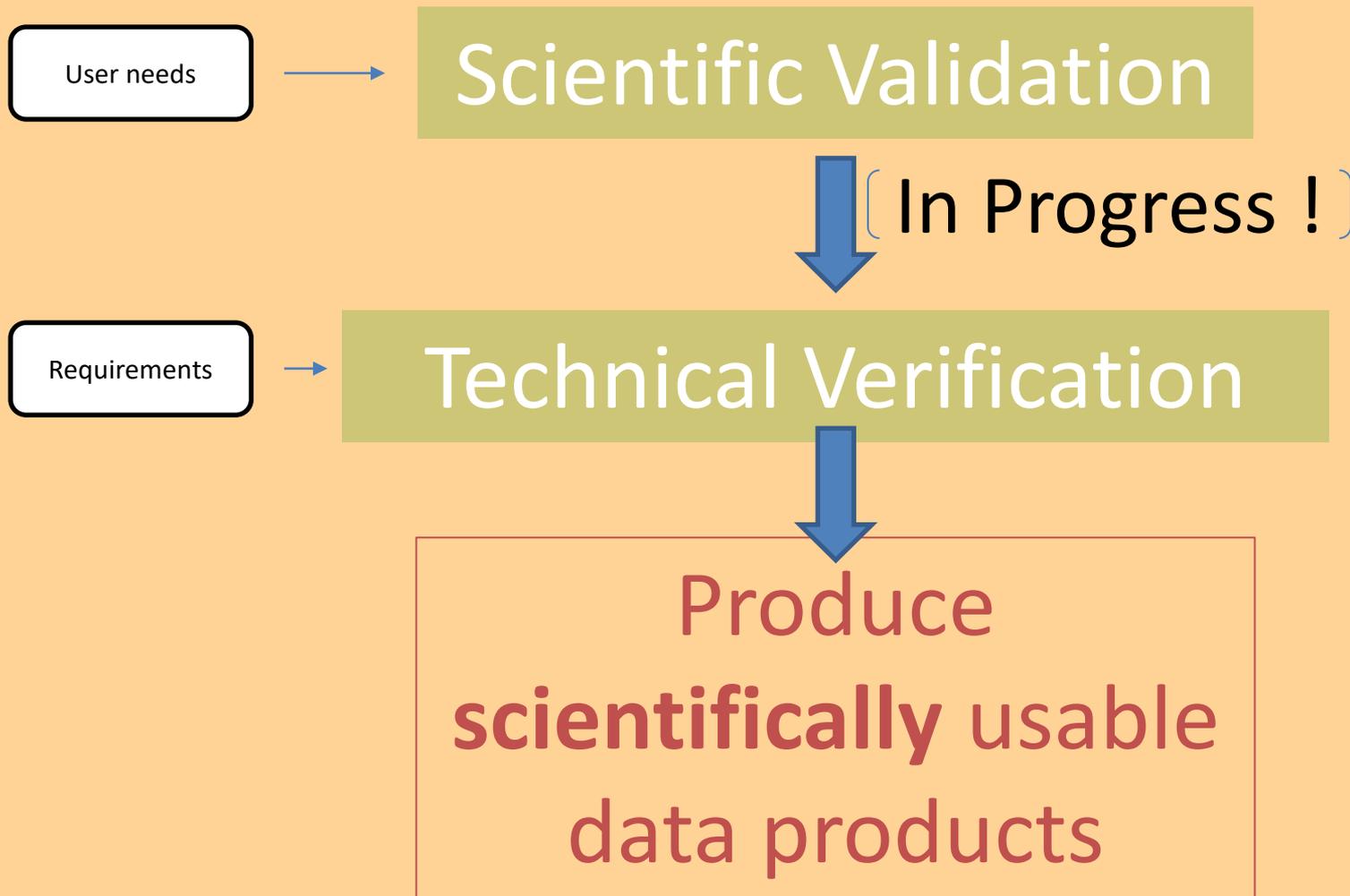


## PANIC Pipeline (PAPI)

- PANIC Pipeline

- Why a Data Reduction Pipeline?
  - Instrument Requirement !
  - Data volume (40-50 GB/night)
  - Complex detector characteristics (non-linearity, cross-talk)
  - Sky subtraction & Dither patterns
  - Automate reduction, improve data quality, enable quick-look (**on-line**) and science-ready outputs (**off-line**)
  - **Commissioning** support !

- PANIC Pipeline Goal



- PAPI preliminaries

# Data Handling

# PANIC data production rate, storage and retrieval

- The **PANIC** features a **4k x 4k detector**, generating astronomical data in **FITS format**. Data acquisition operates in two main saving modes:



- **Integrated Mode** (**Integrated All in the OT**): Produces a single **32-bit coadded image** per exposure (**BITPIX = 32**) → **64 MB per file**



- **Cube Mode** (**FITS Cube in the OT**): Captures a sequence of **N non-integrated images**, stored as a **FITS cube**, with each slice representing a **32-bit image** → **N x 64 MB per file**



- **Raw mode** (**Single Frame Cube**): all the frames of **CNTSR** (large data files!) → `convRaw2CDS.py`

# PANIC data production rate, storage and retrieval

- Data is initially stored on the **PANIC computer's local storage**, where it remains for at least **one month** for local processing and archiving. Additionally, at the end of each observing night, all data is transferred to the **global CAHA archive system** for long-term storage. Observers can later retrieve their data using the **secure file transfer protocol (SFTP)** over the observatory's **high-speed network infrastructure** for transfer to their local systems.



# PAPI constraints

- FITS metadata → OT Keywords
- Readout Mode → CNTSR
- Save Mode →
  - Integrated (**preferred**), mandatory for Focusing Evaluation
  - Cube Mode
  - Raw Mode



# OT Keywords

For general purpose, such as viewing and simple analysis, only minimal headers keywords are required. However, and in order to group and reduce observing sequences, the following header keywords are also required:

```
OBS_TOOL= 'OT_V1.1 '           / PANIC Observing Tool Software version
PROG_ID = ' '                   / PANIC Observing Program ID
OB_ID   = '6 '                  / PANIC Observing Block ID
OB_NAME = 'OB CU Cnc Ks 2'     / PANIC Observing Block Name
OB_PAT  = '5-point '          / PANIC Observing Block Pattern Type
PAT_NAME= 'OS Ks 2 '          / PANIC Observing Sequence Pattern Name
PAT_EXPN=                       1 / PANIC Pattern exposition number
PAT_NEXP=                       5 / PANIC Pattern total number of expositions
IMAGETYP= 'SCIENCE '          / PANIC Image type
```

These keywords are automatically added to the FITS header by the PANIC Observation Tool, as each file is created. If these are not saved, PQL will not work correctly.

# Other important Keywords

$$\text{EXPTIME} = \text{NEXP} * \text{ITIME}$$

```
SAVEMODE= 'continuous.sampling.read ' / save cycle-type
NEXP = 10 / cycle repeat count
CPAR1 = 2 / cycle type parameter
ITIME = 2.903616 / [s] scheduled integration time
CTIME = 5.807233 / [s] read-mode cycle time
EMSAMP = 1 / [ct] electronic multi-sampling
NCOADDS = 10 / [ct] coadds (total)
EXPTIME = 29.03616 / [s] total integ. time
FRAMENUM= 1 / contains 1 .. 20
```

$$\text{EXPTIME} = (\text{NEXP} * \text{ITIME}) * \text{N\_DitherPos}$$

## Other important Keywords (2)

### Saved as a cube:

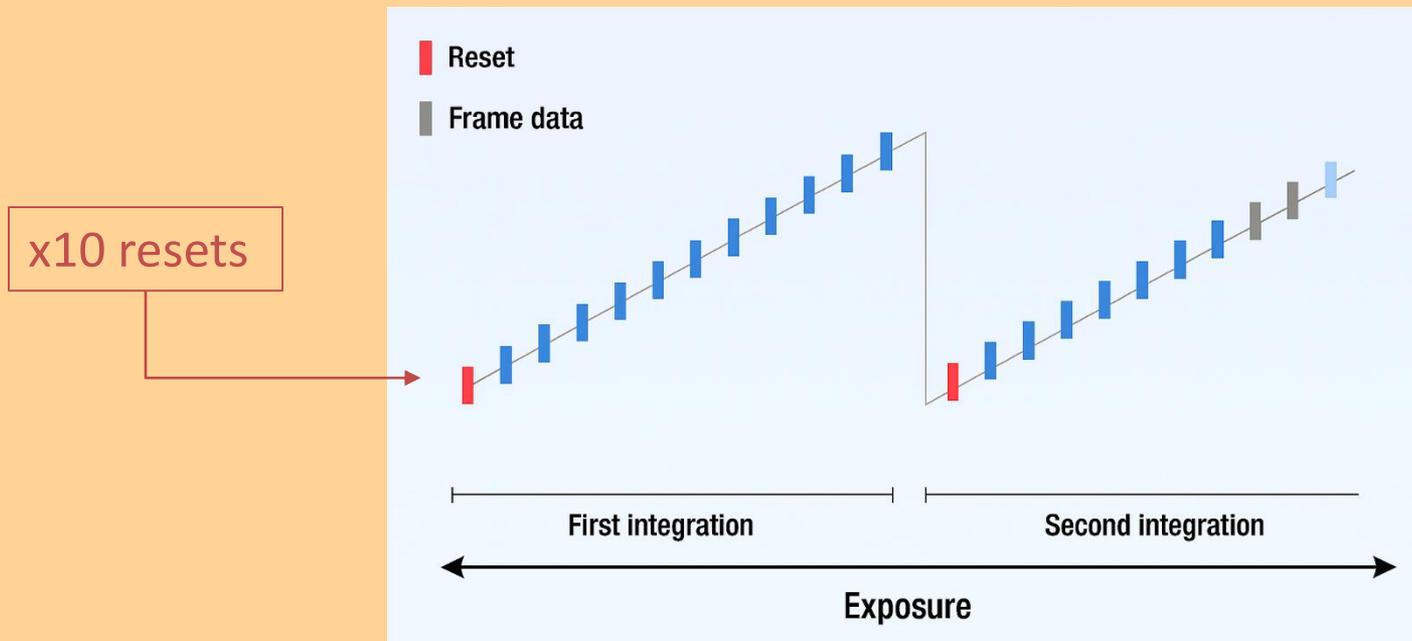
```
SAVEMODE= 'single.frame.read' / save cycle-type  
NEXP = 10 / cycle repeat count  
CPAR1 = 2 / cycle type parameter  
ITIME = 2.903616 / [s] scheduled integration time  
CTIME = 5.807233 / [s] read-mode cycle time  
EMSAMP = 1 / [ct] electronic multi-sampling  
NCOADDS = 1 / [ct] coadds (total)  
EXPTIME = 2.903616 / [s] total integ. time  
FRAMENUM= 1 / contains 1 .. 20
```

# Other important Keywords (3)

```
SAVEMODE= 'continuous.sampling.read' / save cycle-type
NEXP = 3 / cycle repeat count
CPAR1 = 2 / cycle type parameter
ITIME = 2.903616 / [s] scheduled integration time
CTIME = 5.807233 / [s] read-mode cycle time
EMSAMP = 1 / [ct] electronic multi-sampling
NCOADDS = 3 / [ct] coadds (total)
EXPTIME = 8.710849 / [s] total integ. time
FRAMENUM= 1 / sum of 3 image(s)
```

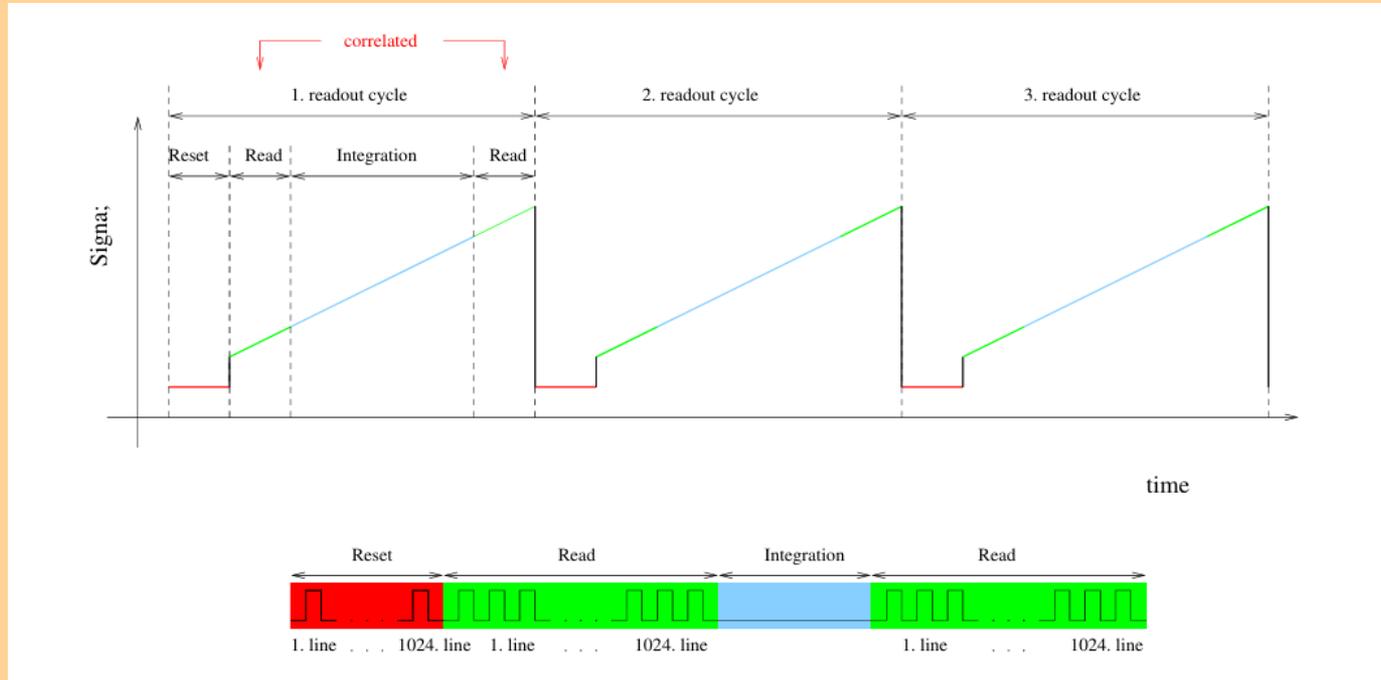
# PANIC raw data & readout mode

- PANIC **CNTR** (continuous sampling read) raw data is generated as CDS image subtracting the first frame from the last frame, ignoring all the other frames on the ramp.



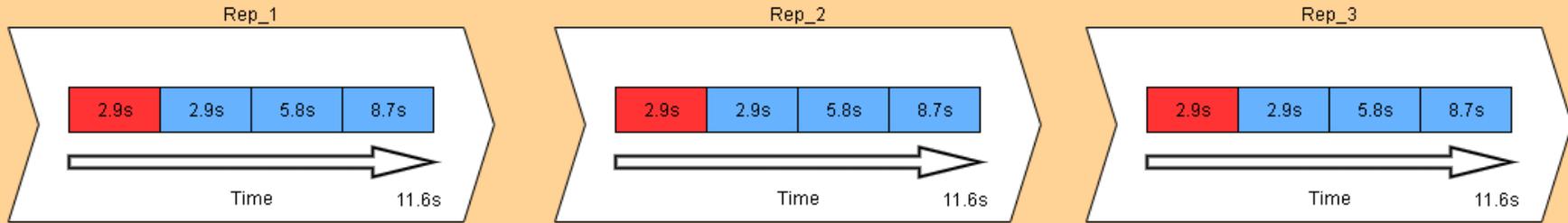
# PANIC raw data & readout mode (2)

## ➤ CDS (Correlated double sampling)



Image= Last Frame – Reset Frame

# Saving Modes



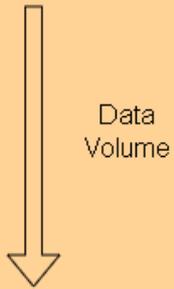
ltime=8.7s  
 NReps=3  
 EXPTIME=26.1

Saving Modes

**Integrated:** (Frame#3\_1 - ResetFrame\_1) + (Frame#3\_2 - ResetFrame\_2) + Frame#3\_3 - ResetFrame\_3)

**Cube:** (Frame#3\_1 - ResetFrame\_1) , (Frame#3\_2 - ResetFrame\_2) , Frame#3\_3 - ResetFrame\_3)

**Raw:** [ResetFrame\_1, Frame#1\_1, Frame#1\_2, Frame#1\_3], [ResetFrame\_2, Frame#2\_1, Frame#2\_2, Frame#2\_3], [ResetFrame\_3, Frame#3\_1, Frame#3\_2, Frame#3\_3]



# Common NIR detector Artifacts

- Non-Linearity
- Bad Pixels
- Persistence
- Pixel/channel cross-talk
- *Reset anomaly*

- Bright and strongly variable sky



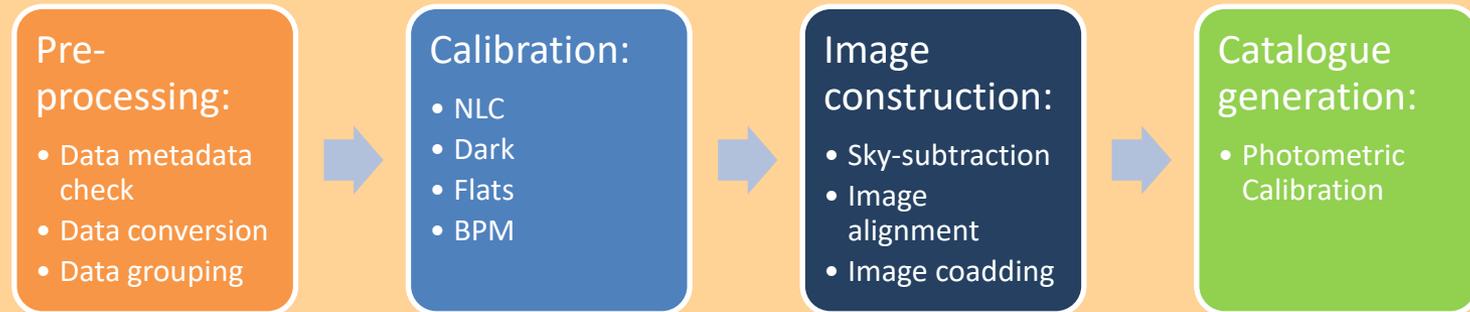
**Dithering strategy**

$$\text{EXPTIME} = (\text{NEXP} * \text{ITIME}) * \text{N\_DitherPos}$$

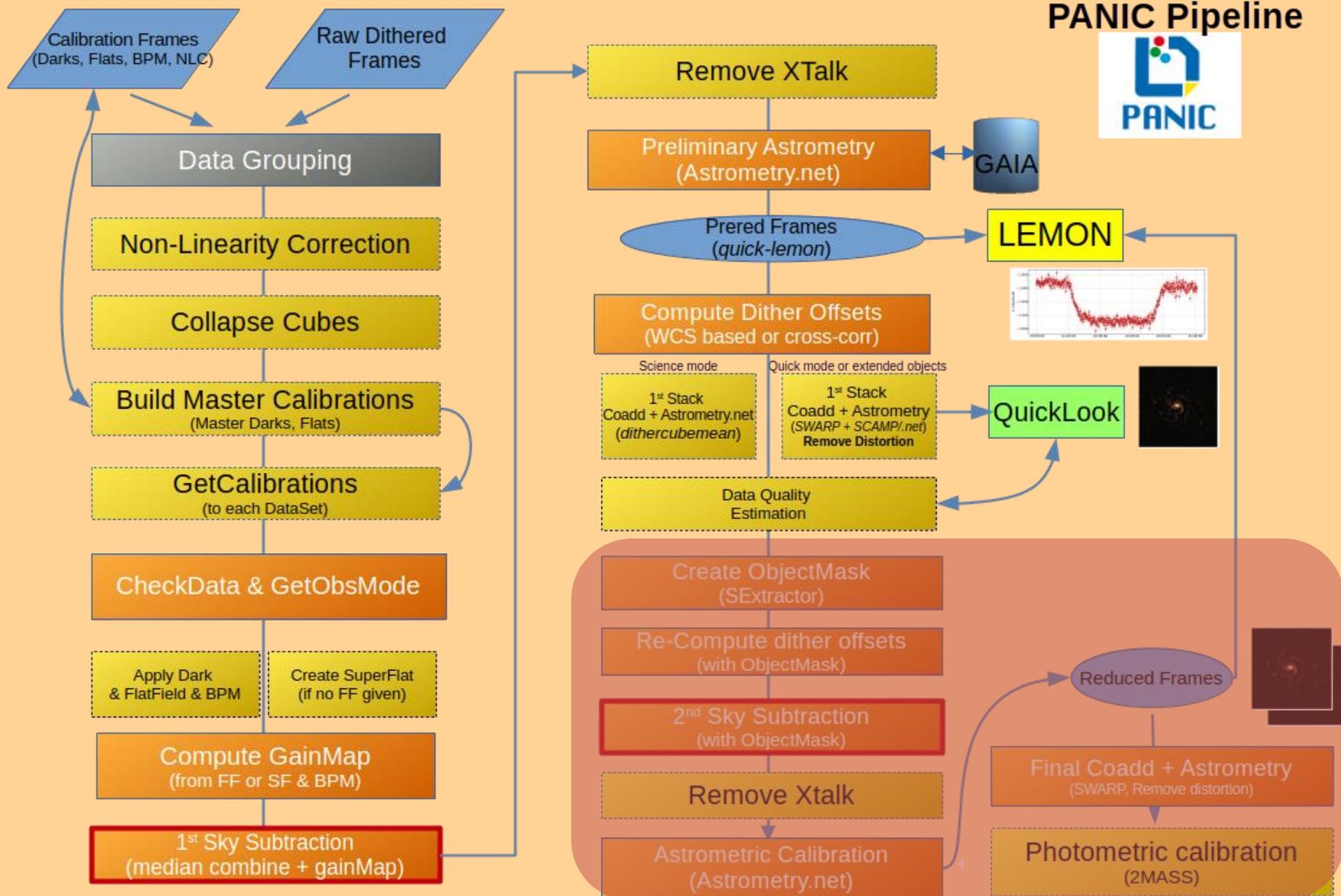
- PAPI Processing

# Processing: Main Steps

# PAPI: main stages



# PAPI: main steps



# Non-Linearity Correction

- Constraints:
  - To be applied to **all** raw frames saved as integrated.
  - Only for CNTSR readout mode
- What:
  - CDS offset subtraction
  - NLC correction (polynomial fit)  $\rightarrow S_{\text{lin}} = P(S_{\text{raw}}) = \sum_{i=1}^7 c_i S^i$
- How:
  - Enabling **First step** in the pipeline.

```
[nonlinearity]
# Non-linearity correction configuration
apply = True
suffix = "NL"
# FITS file containing the NL model for correction
model_cntsr = /data/Calibs2/BD_NLC/NLCORR_2025-04-09.fits
# FITS file containing the reference offset (bias) to be used for correction
cds_offset_cntsr = /data/Calibs2/BD_NLC/CDS-OFFSET_2025-03-27.fits
```

- Manually

```
> python reduce/correctNonLinearity.py \
-m /data1/Calibs2/BD_NLC/NLCORR_2025-04-09.fits \
-r /data1/Calibs2/BD_NLC/CDS-OFFSET_2025-03-27.fits \
-i /data3/out/2024-12-15_cds/Dark_0001_CDS_coadd.fits
```

QL

Display Image	Ctrl+D
Image info	Ctrl+H
Copy files to clipboard	Ctrl+C
Copy files to text file	Shift+T
Show Dither pattern	Ctrl+P
Build Master Dark	Ctrl+M
Build Master Dome Flat	Ctrl+F
Build Master Twilight Flat	Ctrl+T
Build Gain Map	Ctrl+G
Build BPM	Ctrl+B
Apply Dark_FlatField_BPM	Ctrl+A
Apply Non-Linearity Correction	Shift+N
Apply and Show BPM	Shift+B
Excess evaluation	Ctrl+E
Subtract own-sky	Ctrl+S
Subtract near-sky	Ctrl+N
Quick-Reduction	Ctrl+Q
Astrometric Calib.	Shift+A
Photometric Calib.	Shift+P
Statistics	Shift+S
FWHM mean estimation	Ctrl+W
Background estimation	Shift+B
Math	
FITS	

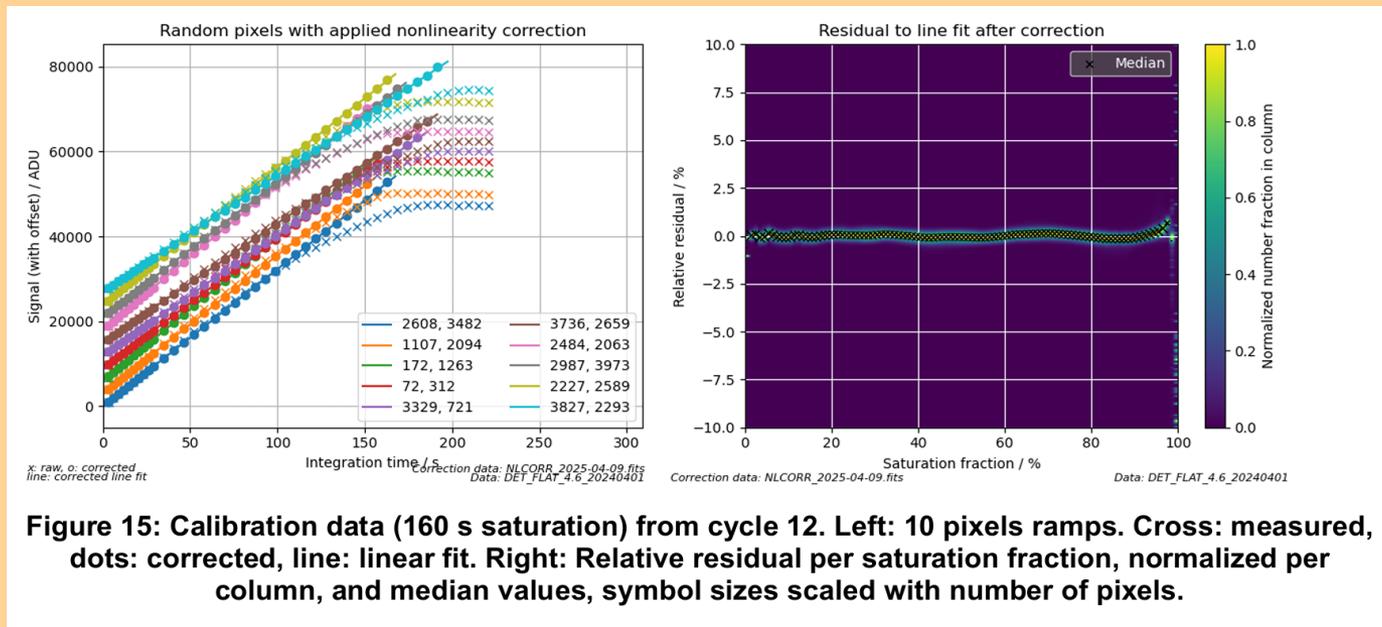
# Non-Linearity Correction (2)

## Special Handling

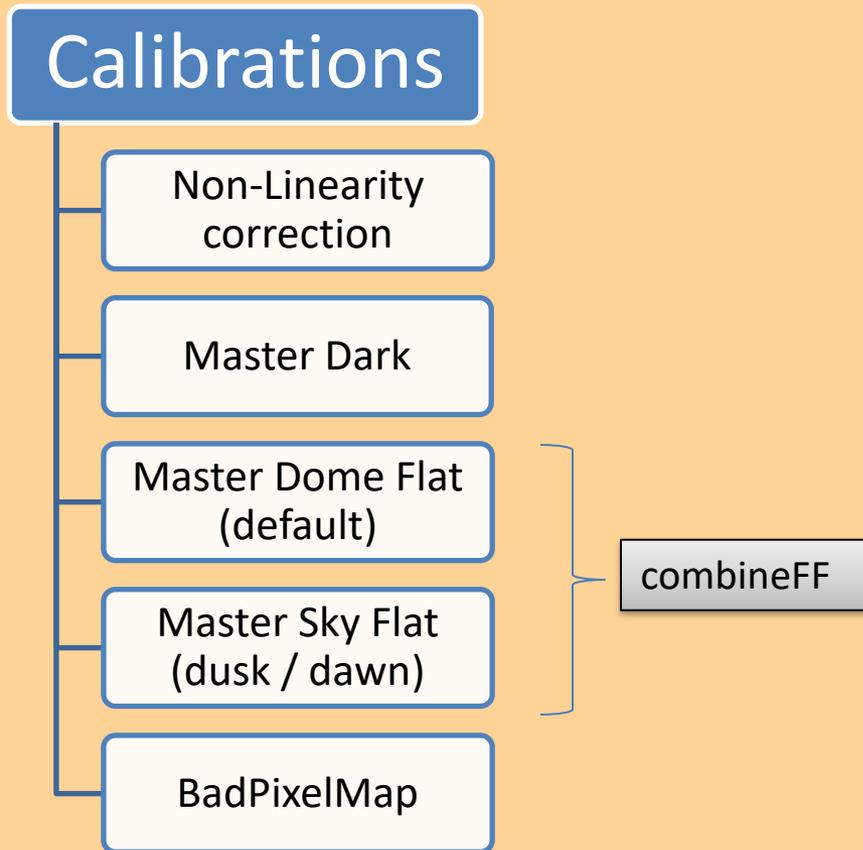
- The non-linearity correction is **applied only to the pixels** that have a value between the **minimum** and **maximum** values defined in the reference file. If a pixel value is below the minimum or above the maximum, it will not be corrected. This is done to avoid applying the correction to pixels that are not within the valid range of the non-linearity model.
- Pixels having a **NaN** value will not have the linearity correction applied.
- **Integrated images** (i.e., images with **NCOADD** > 1) are also corrected for non-linearity. The non-linearity correction is applied to the integrated image divided by NCOADD, and then the result is multiplied by NCOADD. This is done to ensure that the non-linearity correction is applied to the average pixel value of the integrated image, rather than to the sum of the pixel values.
- The **CDS reference offset** (bias) to be subtracted previously to apply the model will also be scaled by NCOADD.
- **Sub-windows/Sub-arrays** are supported, applying the non-linearity correction only to the pixels contained in the sub-window. The sub-window is defined by the keyword DETSEC. If this keyword are not present, the whole image is considered as the sub-window.

# NLC results

- Typical residuals  $<0.5\%$ , although some datasets show systematic errors up to  $1.5\%$ .
- The correction is robust across the entire useful range, though less accurate at very low signal levels due to offset uncertainties.

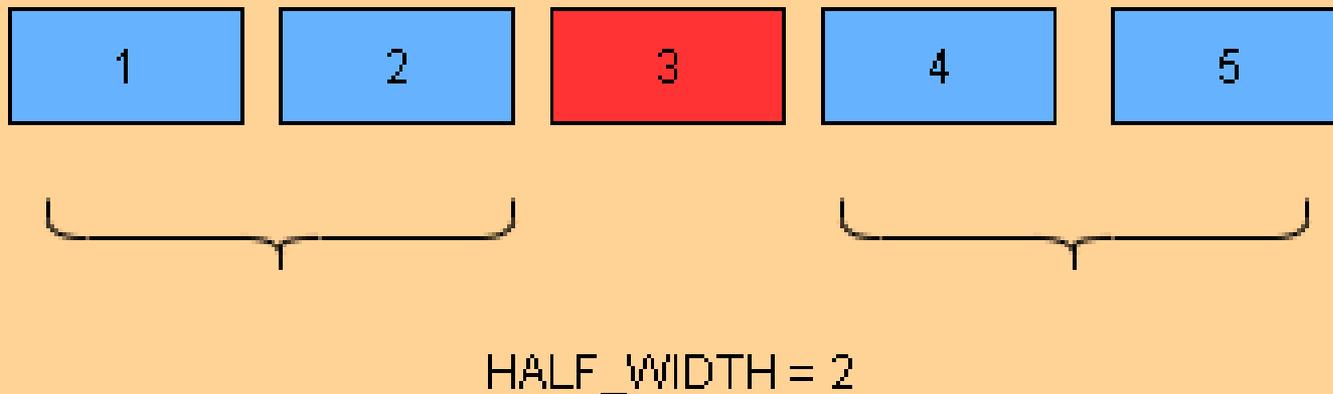


# Calibrations



# Sky Subtration

- Based on Sliding-Window



- **Config parameter !**

- →the temporal spacing should not exceed 10 min on either side

# Sliding-window for sky subtraction

- Sequence of  $N$  images: for image  $i$ , use  $W$  previous and  $W$  subsequent frames ( $W=3, i=7$ ).

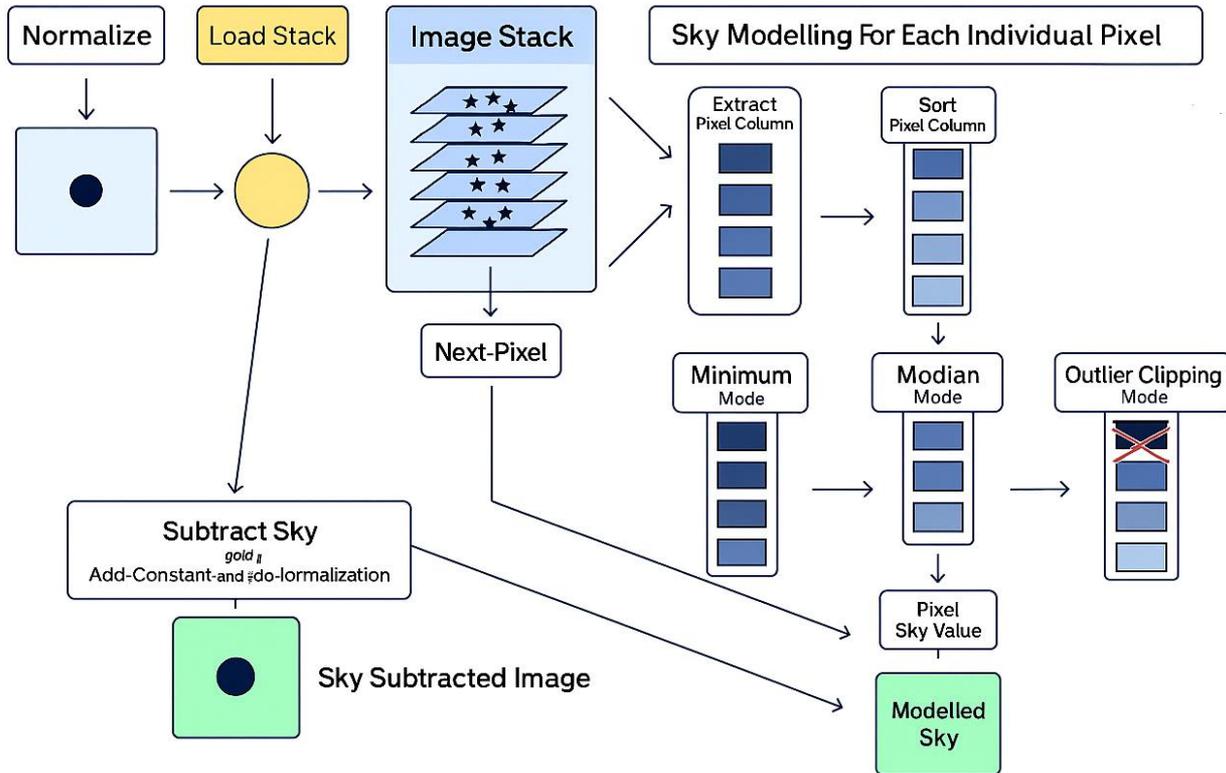


$Sky(i) = \text{combine}(\{ I_{\{i-w\}}, \dots, I_{\{i-1\}}, I_{\{i+1\}}, \dots, I_{\{i+w\}} \})$   
combine = median / mean with sigma-clipping (excludes image  $i$ ).

- At the edges ( $i$  near 1 or  $N$ ), use an asymmetric window!

# Sky modeling

## Sky Modelling



# Sliding-window for sky subtraction (Extended objects)

Sequence of N images: for image i, use W previous and W subsequent frames (w=3, i=7).



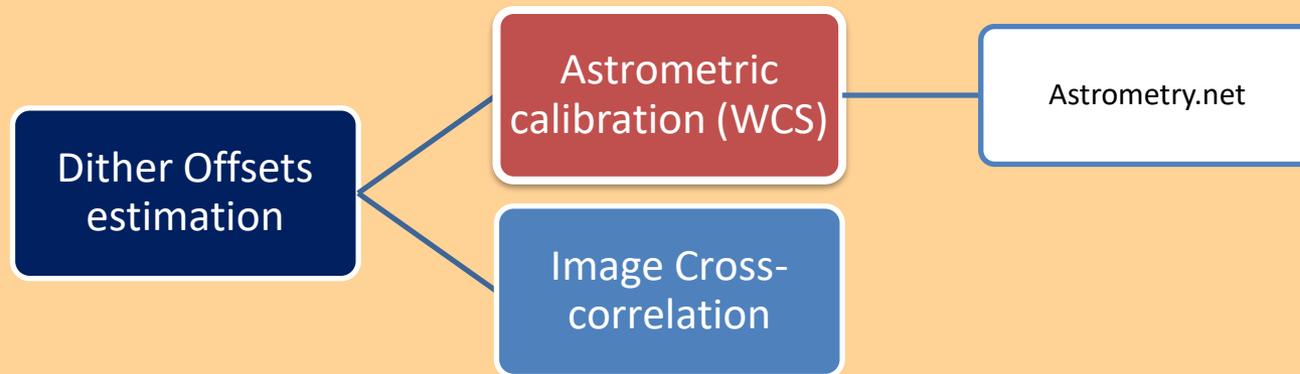
$Sky(i) = combine(\{ I_{\{i-w\}}, \dots, I_{\{i-1\}}, I_{\{i+1\}}, \dots, I_{\{i+w\}} \})$   
combine = median / mean with sigma-clipping (excludes image i).

At the edges (i near 1 or N), use an asymmetric window!

- dither (T-T-T-T-T- ....)
- dither\_on\_off (T-S-T-S-T-S-T-S-T-....)
- dither\_off\_on (S-T-S-T-S-T-S-T-S-....)
- other (non defined sequence, unknown)  
(e.g, T-S-T-T-S-T-T-S-T-....)

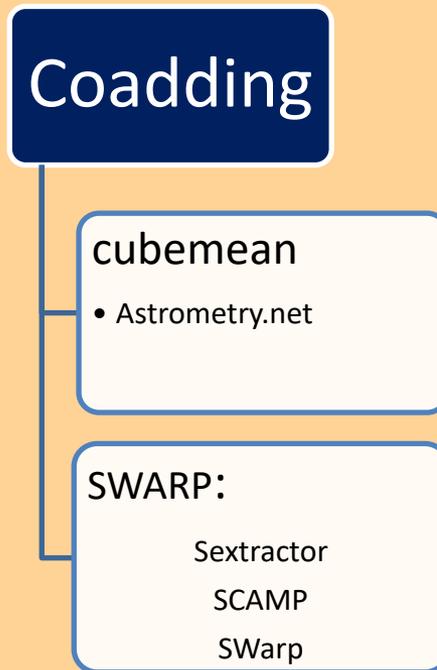
# Dither offsets estimation

- 1) Given a set of sky subtracted dithered images:
  - 1) Based on astrometric calibration (wcs)
  - 2) Using cross-correlation: no astrometric calibration required; cross-reference offset algorithm. For big offsets and sparse/poor fields, it not recommended.



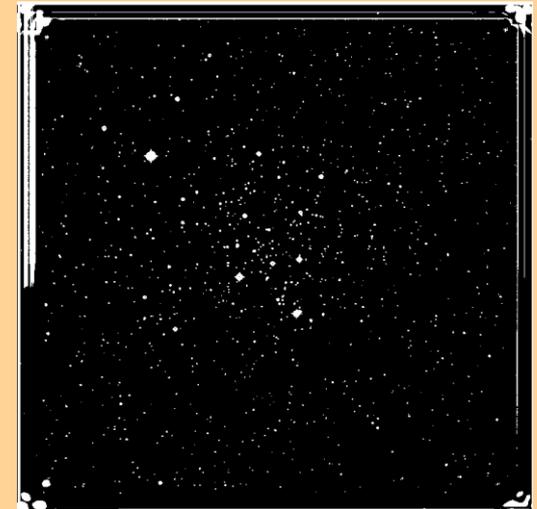
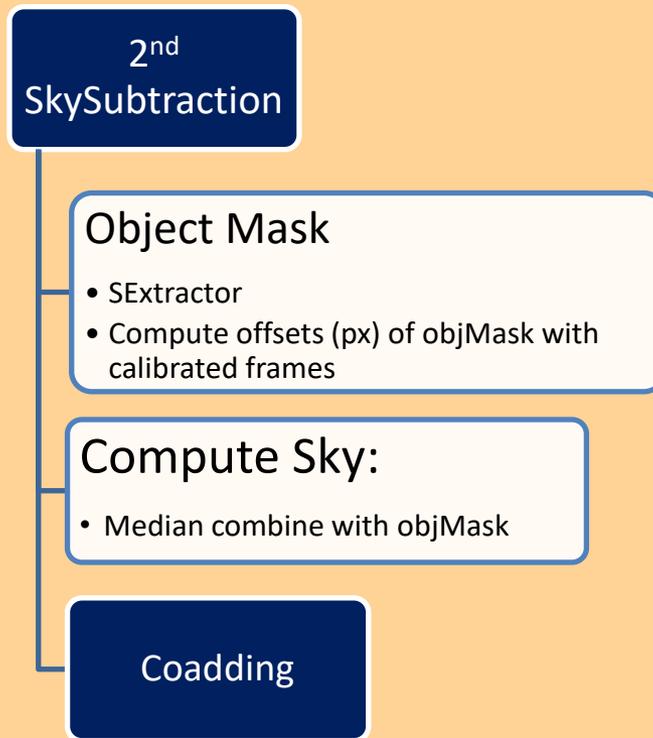
# Coadding

- 1) Given a set of sky subtracted dithered images and dither offsets, two options:
  - 1) Compute cube mean
  - 2) Swarp based: Sextractor + SCAMP + SWarp

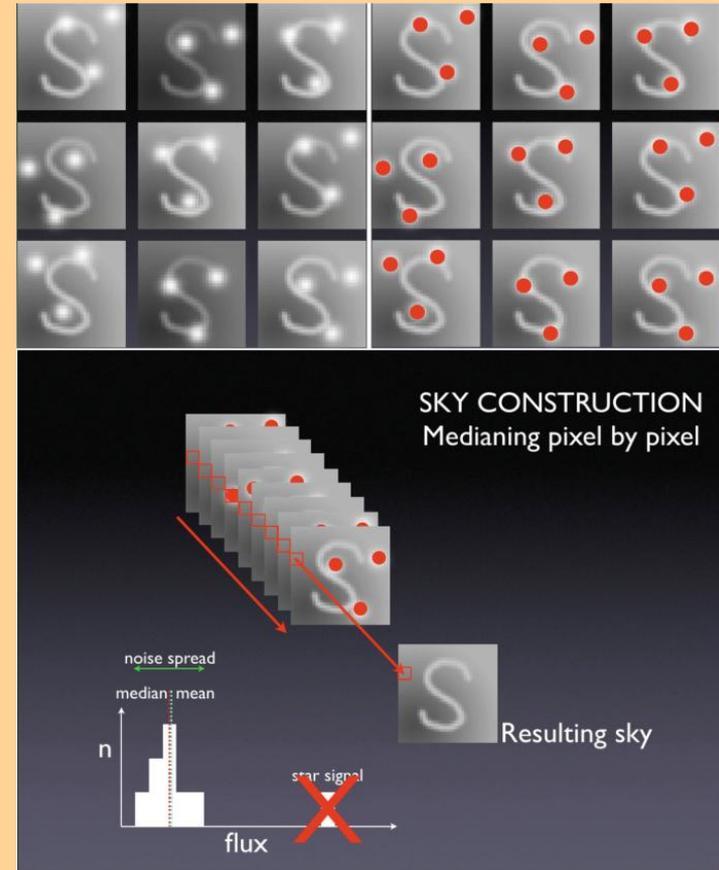
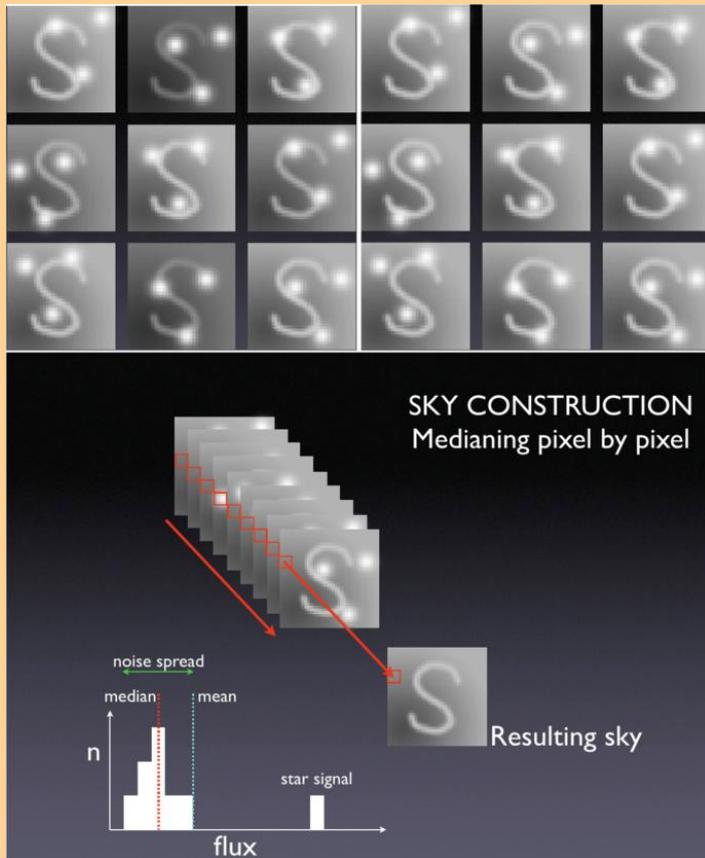


# Second Sky-Subtraction

- 1) Given a set of sky subtracted dithered images and dither offsets: 1) Compute object mask (SExtractor) of first coadd → **mask out fainter objects**  
2) Compute sky background model based using object mask

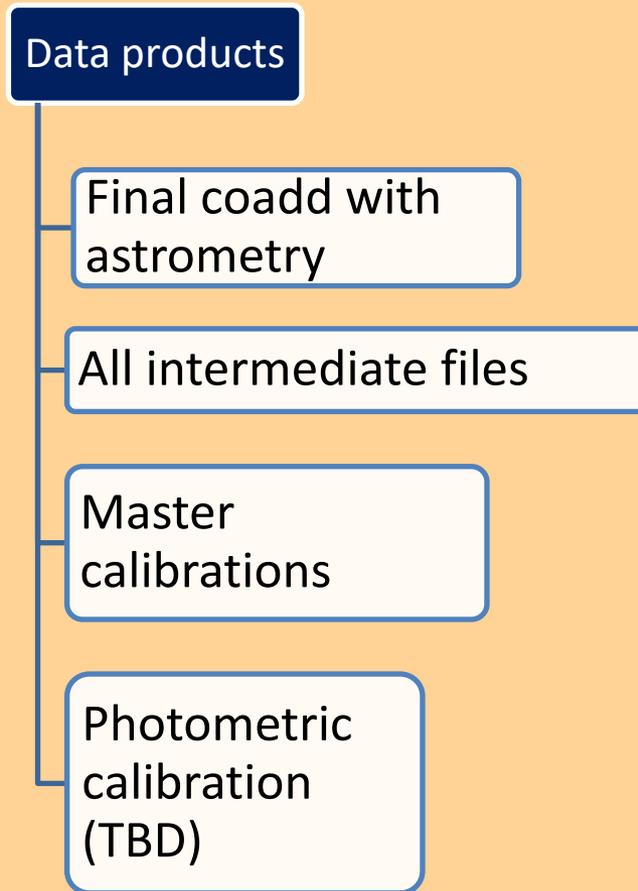


# Object masking



Courtesy of L ic Albert

# PAPI Data products



- PAPI Processing

# Running PAPI: Quick Guide

# PAPI step-by-step Guide (1)

- Directories:

- source directory → /data3/out/2025\_01\_19\_cds/
- output directory → /data2/out/2025\_01\_19\_out/
- calibration directory → /data2/out/2025\_01\_19\_cal/

- Show the sequences in your dataset:

```
> python run_papi.py -s /data3/out/2025_01_19_cds/ -p
```

# PAPI Command Line

> ./run\_papi.py -s /data/jm\_2024\_12\_13\_cds/ -p

```
jmiguel@jmiguel-Precision-T3610:~/DEVELOP/PANIC/PAPI22/papi
File Edit View Search Terminal Tabs Help

jmiguel@jmiguel-Precision-T3610:~/DEVELOP/PANIC/PAPI22/papi
(papi) jmiguel@jmiguel-Precision-T3610:~/DEVELOP/PANIC/PAPI22/papi python run_papi.py -h
WARNING: AstropyDeprecationWarning: block_reduce was moved to the astropy.nddata.blocks module. Please update your import statement. [astropy.nddata.blocks]
WARNING: AstropyDeprecationWarning: block_replicate was moved to the astropy.nddata.blocks module. Please update your import statement. [astropy.nddata.blocks]
usage: run_papi.py [-h] [--version] [-c CONFIG_FILE] [-s SOURCE]
                  [-d OUTPUT_DIR] [-o OUTPUT_FILE] [-t TEMP_DIR]
                  [-r ROWS ROWS] [-R] [-L] [-M REDUCTION_MODE] [=m OBS_MODE]
                  [-S SEQ_TO_REDUCE SEQ_TO_REDUCE]
                  [-W {01,02,03,04,0123,all}] [-p]
                  [-T {DARK,FLAT,DOE,FLAT,SKY,FLAT,FOCUS,SCIENCE,CAL,all}]
                  [-b] [-A] [-C EXT CALIBRATION_DB] [-D MASTER DARK]
                  [-F MASTER_FLAT] [-B BPM_FILE] [-g GROUP_BY] [-e]

This is PAPI, the PANIC Pipeline data reduction system - IAA-CSIC - Version
2.2.20250324104713

optional arguments:
  -h, --help            show this help message and exit
  --version            show program's version number and exit
  -c CONFIG_FILE, --config CONFIG_FILE
                        Config file for the PANIC Pipeline application.If not
                        specified, './config_files/papi.cfg' is used.
  -s SOURCE, --source SOURCE
                        Source file list of data frames. It can be a file or
                        directory name.
  -d OUTPUT_DIR, --out_dir OUTPUT_DIR
                        Output dir for product files
  -o OUTPUT_FILE, --output_file OUTPUT_FILE
                        Final reduced output image
  -t TEMP_DIR, --temp_dir TEMP_DIR
                        Directory for temporal files
  -r ROWS ROWS, --rows ROWS ROWS
                        Use only files of the source file-list in the
                        range of rows specified (0 to N, both included)
  -R, --recursive       Does recursive search for files in source directory
  -l, --list            Generate a list with all the source files read from the
                        source and sorted by MJD
  -M REDUCTION_MODE, --red_mode REDUCTION_MODE
                        Mode of data reduction to do
                        (quick|science|lab|lemon|quick-lemon).
  -m OBS_MODE, --obs_mode OBS_MODE
                        Observing mode (dither|ext_dither|other)
  -S SEQ_TO_REDUCE SEQ_TO_REDUCE, --seq-to_reduce SEQ_TO_REDUCE SEQ_TO_REDUCE
                        Sequence number to reduce. By default, all sequences
                        found will be reduced.
  -W {01,02,03,04,0123,all}, --window_detector {01,02,03,04,0123,all}
                        Specify which detector to process:01(SG1), 02(SG2),
                        03(SG3), 04(SG4), 0123(all except SG4), all (default:
                        all)
  -p, --print           Print all detected sequences in the Data Set
  -T {DARK,FLAT,DOE,FLAT,SKY,FLAT,FOCUS,SCIENCE,CAL,all}, --sequences_type {DARK,FLAT,DOE,FLAT,SKY,FLAT,FOCUS,SCIENCE,CAL,all}
                        Specify the type of sequences to show: DARK,
                        FLAT(all), DOE,FLAT, SKY,FLAT, FOCUS, SCIENCE, CAL,
                        all (default: all)
  -b, --build_calibrations
                        Build all the master calibrations files
  -A, --apply_dark_flat
                        Apply dark and flat calibration to source files
                        [default: False]
  -C EXT_CALIBRATION_DB, --ext_calibration_db EXT_CALIBRATION_DB
                        External calibration directory (Library of Dark & Flat
                        calibrations)
  -D MASTER_DARK, --master_dark MASTER_DARK
                        Master dark to subtract
  -F MASTER_FLAT, --master_flat MASTER_FLAT
                        Master flat to divide by
  -B BPM_FILE, --bpm_file BPM_FILE
                        Bad pixel mask file
  -g GROUP_BY, --group_by GROUP_BY
                        kind of data grouping (based on) to do with the dataset
                        files (ot |filter)
  -e, --check          Check if versions of PAPI modules are right.
(papi) jmiguel@jmiguel-Precision-T3610:~/DEVELOP/PANIC/PAPI22/papi
```

```
jmiguel@jmiguel-Precision-T3610:~/DEVELOP/PANIC/PAPI22/papi
File Edit View Search Terminal Tabs Help

jmiguel@jmiguel-Precision-T3610:~/DEVELOP/PANIC/PAPI22/papi
[PAPI]: 2025-03-25 10:58:48,751 INFO reductionset:1199: ===== SEQUENCES (by ot) =====
[PAPI]: 2025-03-25 10:58:48,751 INFO reductionset:1200: ===== GROUPED SEQUENCES (by ot) =====
[PAPI]: 2025-03-25 10:58:48,751 INFO reductionset:1201:
[PAPI]: 2025-03-25 10:58:48,751 INFO reductionset:1209: SEQUENCE #0] - TYPE= SCIENCE FILTER= Ks TEXP= 29.036160 #files = 5
[PAPI]: 2025-03-25 10:58:48,751 INFO reductionset:1210: -----
[PAPI]: 2025-03-25 10:58:48,751 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0001 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,751 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0002 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0003 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0004 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0005 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1211:
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1209: SEQUENCE #1] - TYPE= SCIENCE FILTER= Ks TEXP= 29.036160 #files = 5
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1210: -----
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0006 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0007 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0008 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0009 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,752 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0010 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1211:
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1209: SEQUENCE #2] - TYPE= SCIENCE FILTER= Ks TEXP= 29.036160 #files = 5
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1210: -----
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0011 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0012 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0013 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0014 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0015 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1211:
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1209: SEQUENCE #3] - TYPE= SCIENCE FILTER= Ks TEXP= 29.036160 #files = 5
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1210: -----
[PAPI]: 2025-03-25 10:58:48,753 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0016 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0017 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0018 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0019 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0020 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1211:
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1209: SEQUENCE #4] - TYPE= SCIENCE FILTER= Ks TEXP= 29.036160 #files = 5
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1210: -----
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0021 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0022 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0023 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,754 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0024 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0025 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1211:
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1209: SEQUENCE #5] - TYPE= SCIENCE FILTER= Ks TEXP= 29.036160 #files = 5
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1210: -----
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0026 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0027 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0028 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0029 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0030 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1211:
[PAPI]: 2025-03-25 10:58:48,755 INFO reductionset:1209: SEQUENCE #6] - TYPE= SCIENCE FILTER= Ks TEXP= 29.036160 #files = 5
[PAPI]: 2025-03-25 10:58:48,756 INFO reductionset:1210: -----
[PAPI]: 2025-03-25 10:58:48,756 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0031 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,756 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0032 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,756 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0033 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,756 INFO reductionset:1211: /data/jm_2024_12_13_cds/S98 TimeSeries 0034 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,756 INFO reductionset:1212: /data/jm_2024_12_13_cds/S98 TimeSeries 0035 CDS coadd.fits type = SCIENCE
[PAPI]: 2025-03-25 10:58:48,756 INFO reductionset:1211:
[PAPI]: 2025-03-25 10:58:48,756 INFO reductionset:1209: SEQUENCE #7] - TYPE= SCIENCE FILTER= Ks TEXP= 29.036160 #files = 5
```



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MAX PLANCK INSTITUTE FOR ASTRONOMY



Infraestructuras Científicas y Técnicas Singulares



MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

CAHA15-CE-3902 por valor de 1.1MC

# PAPI step-by-step Guide (2)

- Directories:
  - source directory → /data3/out/2025\_01\_19\_cds/
  - output directory → /data2/out/2025\_01\_19\_out/
  - calibration directory → /data2/out/2025\_01\_19\_cal/

- Create the master calibrations:

## 1.DARKs:

```
>python run_papi.py -s /data3/out/2025_01_19_cds/ -d /data2/out/2025_01_19_cal/ -T DARK
```

## 2.DOME\_FLATs

```
>python run_papi.py -s /data3/out/2025_01_19_cds/ -d /data2/out/2025_01_19_cal/ -T DOME_FLAT
```

## 3.SKY\_FLATs

```
>python run_papi.py -s /data3/out/2025_01_19_cds/ -d /data2/out/2025_01_19_cal/ -C /data2/out/2025_01_19_cal/ -T SKY_FLAT
```



# PAPI Command Line

```
> run_papi.py -s /data/2024-12-15_cds/ -C /data/2024-12-15_cds/calibs/ -d /data/2024-12-15_cds/out/ -S 54 54
```

```
Terminal - obs22@panic22:...dataset/output/Q01
File Edit View Terminal Tabs Help

obs22@panic22:...NSTALL/PAPI22/papi
obs22@panic22:...dataset/output/Q01

obs22@panic22:/data3/PANIC_demo_dataset/output/Q01> ls
NGC891_ext_small_0002.fits          NGC891_ext_small_0014.fits          NGC891_ext_small_0026.fits
NGC891_ext_small_0002_D_F.fits      NGC891_ext_small_0014_D_F.fits      NGC891_ext_small_0026_D_F.fits
NGC891_ext_small_0002_D_F.skysub.ast.fits  NGC891_ext_small_0014_D_F.skysub.ast.fits  NGC891_ext_small_0026_D_F.skysub.ast.fits
NGC891_ext_small_0002_D_F.skysub.fits  NGC891_ext_small_0014_D_F.skysub.fits  NGC891_ext_small_0026_D_F.skysub.ast.fits.head
NGC891_ext_small_0003.fits          NGC891_ext_small_0015.fits          NGC891_ext_small_0026_D_F.skysub.ast.fits.ldac
NGC891_ext_small_0003_D_F.fits      NGC891_ext_small_0015_D_F.fits      NGC891_ext_small_0026_D_F.skysub.fits
NGC891_ext_small_0004.fits          NGC891_ext_small_0016.fits          NGC891_ext_small_0027.fits
NGC891_ext_small_0004_D_F.fits      NGC891_ext_small_0016_D_F.fits      NGC891_ext_small_0027_D_F.fits
NGC891_ext_small_0004_D_F.skysub.ast.fits  NGC891_ext_small_0016_D_F.skysub.ast.fits  NGC891_ext_small_0028.fits
NGC891_ext_small_0004_D_F.skysub.fits  NGC891_ext_small_0016_D_F.skysub.fits  NGC891_ext_small_0028_D_F.fits
NGC891_ext_small_0005.fits          NGC891_ext_small_0017.fits          NGC891_ext_small_0028_D_F.skysub.ast.fits
NGC891_ext_small_0005_D_F.fits      NGC891_ext_small_0017_D_F.fits      NGC891_ext_small_0028_D_F.skysub.ast.fits.head
NGC891_ext_small_0006.fits          NGC891_ext_small_0018.fits          NGC891_ext_small_0028_D_F.skysub.ast.fits.ldac
NGC891_ext_small_0006_D_F.fits      NGC891_ext_small_0018_D_F.fits      NGC891_ext_small_0028_D_F.skysub.ast.fits
NGC891_ext_small_0006_D_F.skysub.ast.fits  NGC891_ext_small_0018_D_F.skysub.ast.fits  NGC891_ext_small_0029.fits
NGC891_ext_small_0006_D_F.skysub.fits  NGC891_ext_small_0018_D_F.skysub.fits  NGC891_ext_small_0029_D_F.fits
NGC891_ext_small_0007.fits          NGC891_ext_small_0019.fits          NGC891_ext_small_0030.fits
NGC891_ext_small_0007_D_F.fits      NGC891_ext_small_0019_D_F.fits      NGC891_ext_small_0030_D_F.fits
NGC891_ext_small_0008_D_F.fits      NGC891_ext_small_0020.fits          NGC891_ext_small_0030_D_F.skysub.ast.fits
NGC891_ext_small_0008_D_F.fits      NGC891_ext_small_0020_D_F.fits      NGC891_ext_small_0030_D_F.skysub.ast.fits.head
NGC891_ext_small_0008_D_F.skysub.ast.fits  NGC891_ext_small_0020_D_F.skysub.ast.fits  NGC891_ext_small_0030_D_F.skysub.ast.fits.ldac
NGC891_ext_small_0008_D_F.skysub.ast.fits  NGC891_ext_small_0020_D_F.skysub.ast.fits  NGC891_ext_small_0030_D_F.skysub.ast.fits
NGC891_ext_small_0009.fits          NGC891_ext_small_0021.fits          NGC891_ext_small_0031.fits
NGC891_ext_small_0009_D_F.fits      NGC891_ext_small_0021_D_F.fits      NGC891_ext_small_0031_D_F.fits
NGC891_ext_small_0010.fits          NGC891_ext_small_0022.fits          gain_H.fits
NGC891_ext_small_0010_D_F.fits      NGC891_ext_small_0022_D_F.fits      gain_J.fits
NGC891_ext_small_0010_D_F.skysub.ast.fits  NGC891_ext_small_0022_D_F.skysub.ast.fits  gain_Ks.fits
NGC891_ext_small_0010_D_F.skysub.fits  NGC891_ext_small_0022_D_F.skysub.fits  gain_Z.fits
NGC891_ext_small_0011.fits          NGC891_ext_small_0023.fits          offsets1.pap
NGC891_ext_small_0011_D_F.fits      NGC891_ext_small_0023_D_F.fits      py-sextractor.conv
NGC891_ext_small_0012.fits          NGC891_ext_small_0024.fits          py-sextractor.nnw
NGC891_ext_small_0012_D_F.fits      NGC891_ext_small_0024_D_F.fits      py-sextractor.param
NGC891_ext_small_0012_D_F.skysub.ast.fits  NGC891_ext_small_0024_D_F.skysub.ast.fits  py-sextractor.sex
NGC891_ext_small_0012_D_F.skysub.fits  NGC891_ext_small_0024_D_F.skysub.fits  skylist1.list
NGC891_ext_small_0013.fits          NGC891_ext_small_0025.fits
NGC891_ext_small_0013_D_F.fits      NGC891_ext_small_0025_D_F.fits
obs22@panic22:/data3/PANIC_demo_dataset/output/Q01>
```

# PAPI Config file

- PAPI has a set of configuration files required to run properly. They are the next ones:

- **papi.cfg**: main configuration file

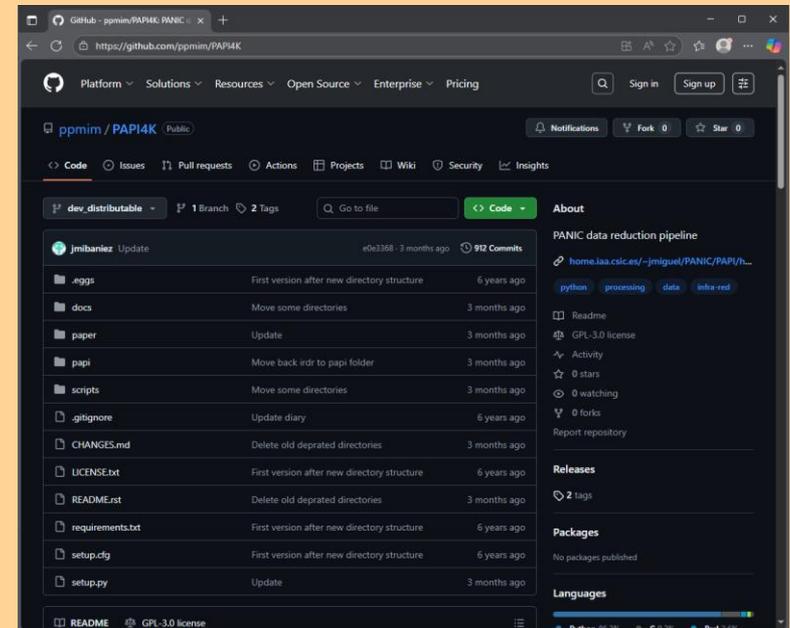
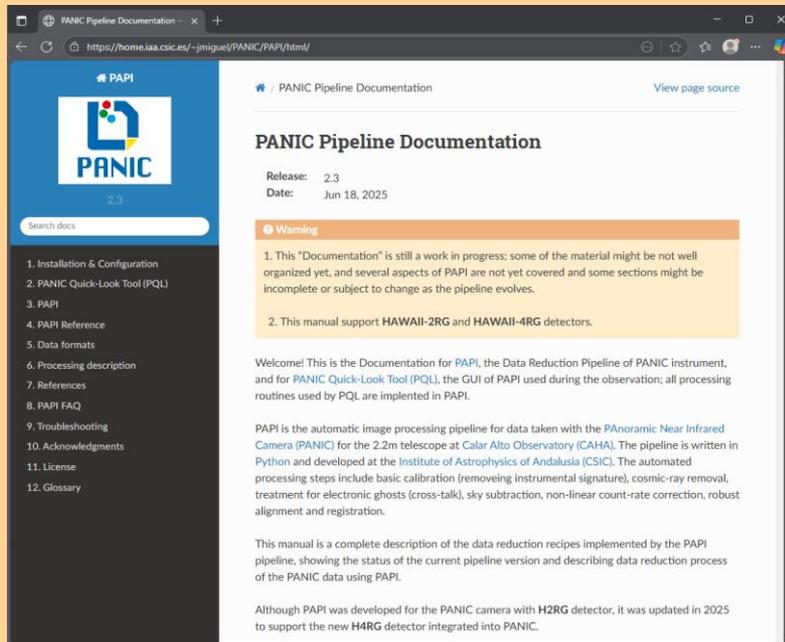
In addition to the command line options, PAPI has a configuration file in which the user can set both the command line options and a wider set of additional ones. This config file can be specified with the -c option, but by default it is looked for it in the config\_files directory defined by PAPI\_CONFIG environment variable.

- scamp.cfg: SCAMP configuration file
- swarp.conf: SWARP configuration file
- sextractor.sex : SExtractor configuration file
- sextractor.conf:
- sextractor.cong:
- sextractor.nnw:
- sextractor.param:

Many data products can be improved for specific science cases by using non-default settings!

# Documentation

- Main documentation sites:
  - [PANIC User's Manual](#)
  - [PAPI & QL manual](#)
  - Github:
    - <https://github.com/ppmim/PAPI4K>



# PAPI Installation

➤ <https://github.com/ppmim/PAPI4K>



Package	Version stable/next
openSUSE	15.5
Anaconda	2022.05 / 2024.10
IRAF - PyRAF	2.16 - 2.1.15
Python	3.7.13 / 3.7.16
PyQt	5.15.7
Astropy	4.3.1
SExtractor	2.25 / 2.28.2
SCAMP	2.10 / 2.13
SWarp	2.41.5

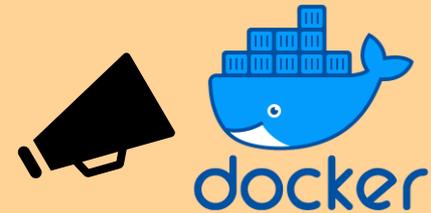


# PAPI Installation

- From Git clone  
<https://github.com/ppmim/PAPI4K>



- Very soon: Docker container with all software installed



# PAPI: Caveats



- The PANIC pipeline will **never automate everything** for everybody, but it should be capable of doing most things for most people.
- Currently, PAPI can process data acquired using the **Observing Tool** (OT) by defining the necessary Observing Blocks (OB), or alternatively through manual reduction using **GEIRS scripts**. However, PAPI is not intended to handle all types of observations performed with PANIC.
- Furthermore, PAPI has **not yet been fully validated** with scientific data, as no datasets reduced with it have been used in published scientific papers. Validation efforts are ongoing to ensure its reliability and suitability for scientific analysis.

# PAPI Citation

- [ASCL.net](https://www.ascl.net)
- JOSS – Journal Of Open Source Software
- [Zenodo](https://zenodo.org):
  - José Miguel Ibáñez. (2025). ppmim/PAPI4K: Release candidate for PAPI4K (papi4k.v1). Zenodo.  
<https://doi.org/10.5281/zenodo.15676577>

# Questions, problems, or want to contribute?

- Staying up to date on the latest news:
  - Subscribe to Github notifications at <https://github.com/ppmim/PAPI4K>
- Questions about your data or the PANIC pipeline?
  - Contact CAHA Astronomy group
  - Contact [jmiguel@iaa.es](mailto:jmiguel@iaa.es)
- Got a suggestion?
  - The PANIC pipeline is open-source, pull requests welcome at <https://github.com/ppmim/PAPI4K>
  - File an Issue or Discussion on GitHub

# PAPI: Next

- Next
  - Complete Scientific Validation !
  - Docker container
  - Migration to Python 3.11 and remove IRAF dependences
  - Containerisation (Docker)
  - Reproducibility & OpenScience
  - CI/CD
  - Publish a paper

# Questions ?

## Thanks for your attendance !

## Questions ?



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