

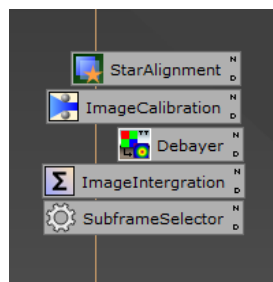
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Calibration Through to Stacking in PixInsight

Preparation

- Before you start, create a series of folders to be used during the calibration process.
 - o Master Calibration Frames
 - o %target% Lights – Put light frames here
 - o %target% Flats – Put flat frames here
 - o %target% Darks – Put dark frames here
 - o Debayer
 - o Calibrated Lights
 - o Calibrated Flats
 - o Aligned
- Set up the workspace as shown below.



Create Master Dark

NB. For the Altair Hypercam, it is suggested that Bias frames are not used. If they are to be used, the master bias is created in exactly the same way as the master dark.

Image Integration

Input Images

- Reset the tool.
- Add all the dark frames.

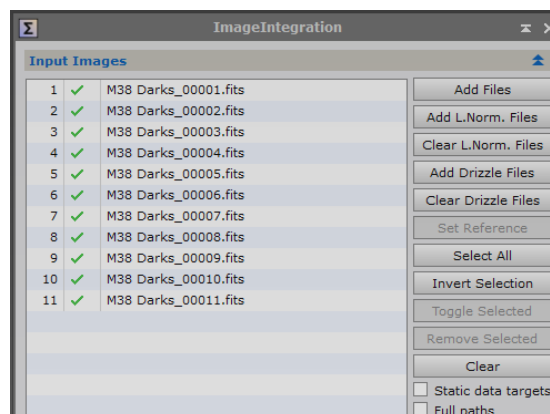
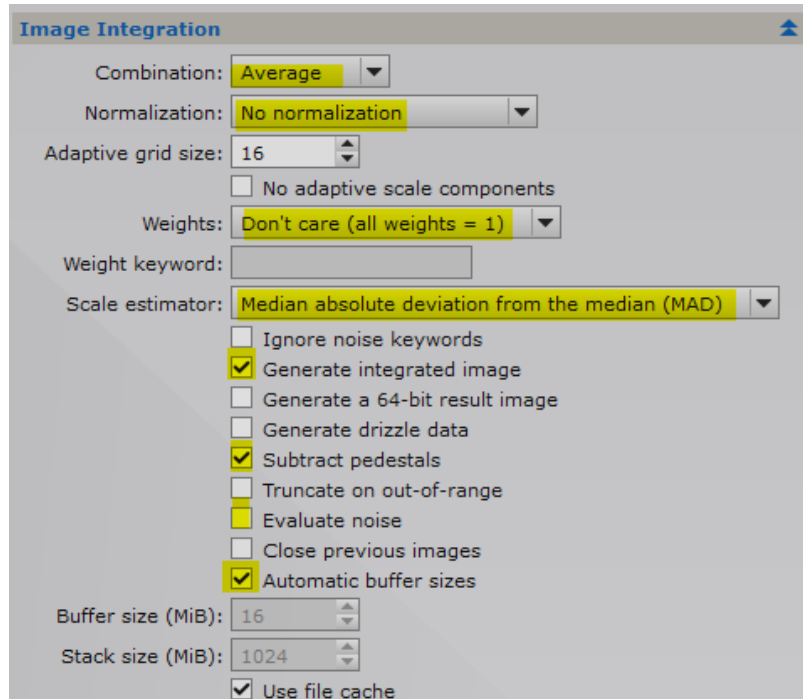


Image Integration

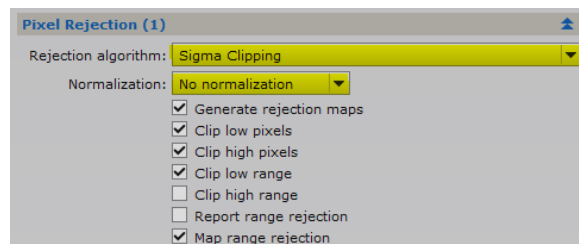
- Select the following:
 - o Combination – Average
 - o Normalization – No Normalization
 - o Weights – Don't Care (all weights = 1)
 - o Scale Estimator – Select the following:

- Median absolute deviation from the median (MAD)
- Generate integrated image - TICK
- Subtract pedestals - TICK
- Automatic buffer sizes - TICK
- Evaluate Noise – UNTICK



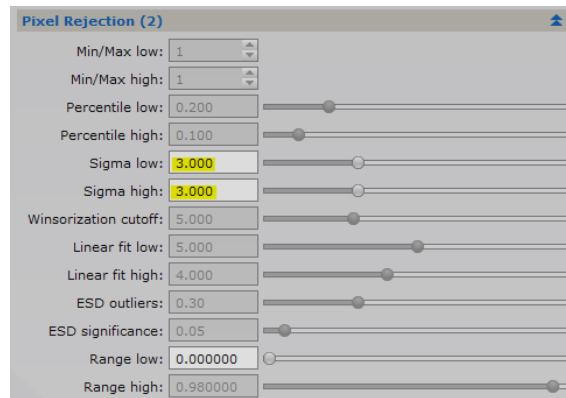
Pixel Rejection (1)

- Select the following:
 - o Rejection algorithm – Sigma Clipping
 - o Normalization – No normalization



Pixel Rejection (2)

- Select the following:
 - o Sigma low – 3.000
 - o Sigma high – 3.000



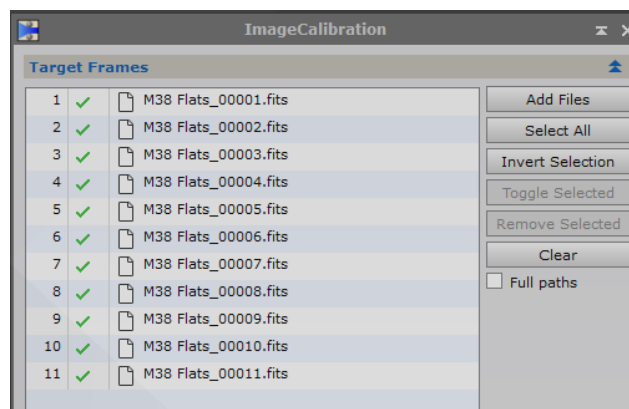
- Click **Apply Global (F6)**.
- Close the **rejection_high** and **rejection_low** rejection frames.
- Save the resulting frame by double clicking on the tab and entering the name **Master_Dark**.
- Click **File > Save As**, and save the frame as a **.xisf** frame in the **Master Calibration Frames** folder.
- Minimise the saved frame to the top left corner of the workspace in case you need to refer to it later.

Calibrate Flats with Master Dark

Image Calibration

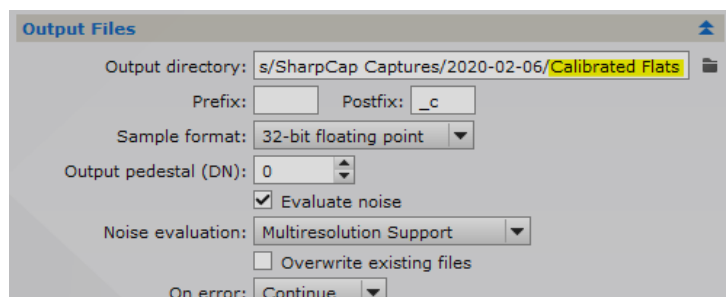
Target Frames

- Reset the tool.
- Add all the flat files.



Output Files

- Browse to the pre-prepared **Calibrated Flats** folder.

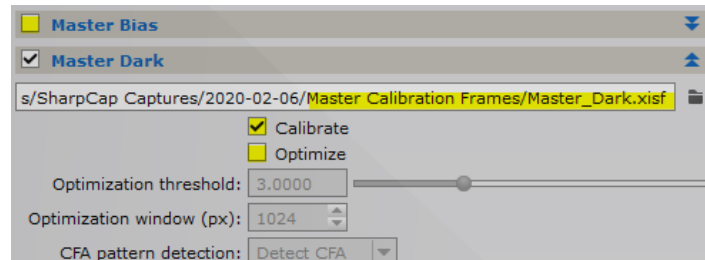


Master Bias

- Deselect this.

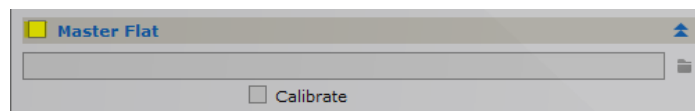
Master Dark

- Browse to the master dark file created in the previous step.
- Calibrate – CHECK
- Optimize – UNCHECK



Master Flat

- Deselect this.



- Click **Apply Global**.
- Minimise the tool.

Create Master Flat

Image Integration

- Reset the tool.

Input Images

- Add the calibrated flat frames from the previous step.

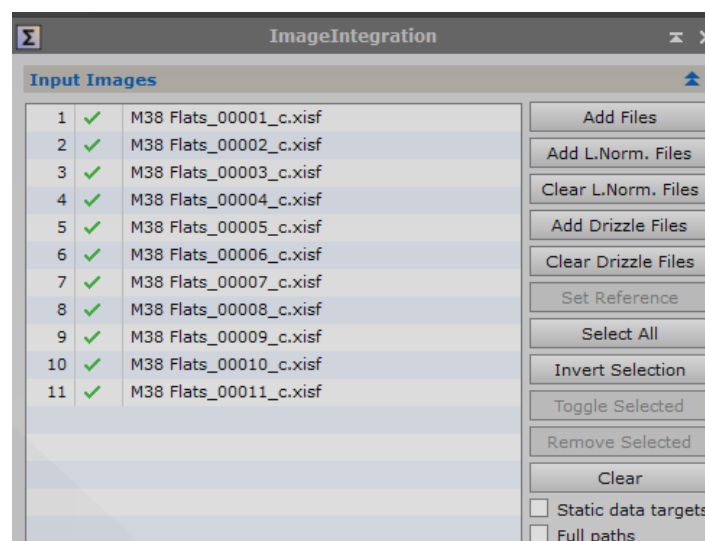
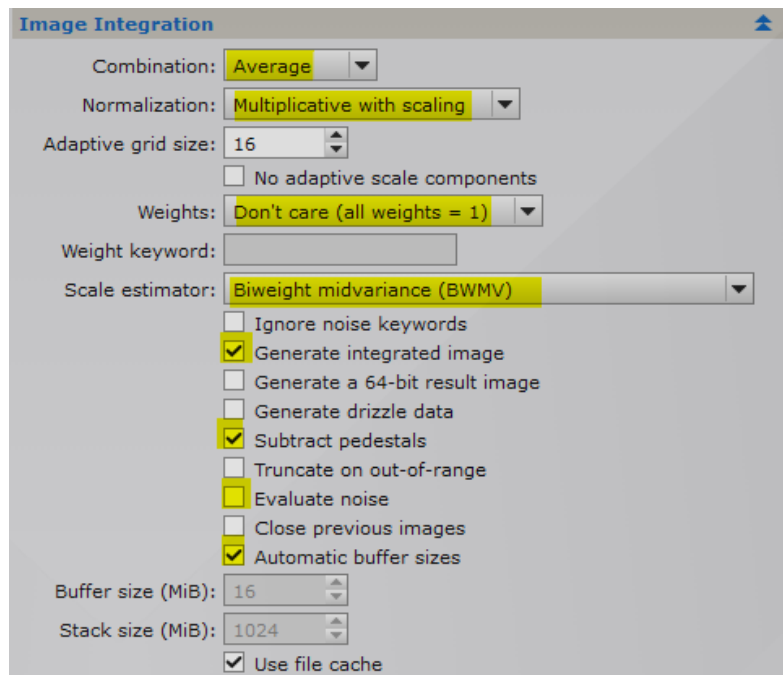


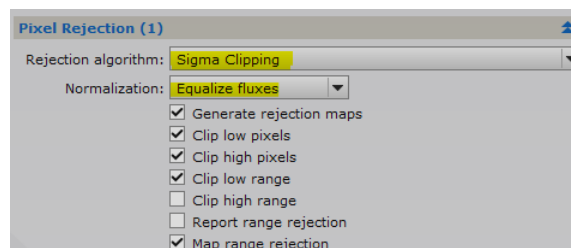
Image Integration

- Select the following.
 - o Combination – Average
 - o Normalization – Multiplicative with scaling
 - o Weights – Don't Care (all weights = 1)
 - o Scale estimator – Biweight midvariance (BWMV)
 - o Evaluate noise – UNTICK
 - o Leave **Subtract pedestals** ticked and leave **Automatic buffer sizes** ticked.



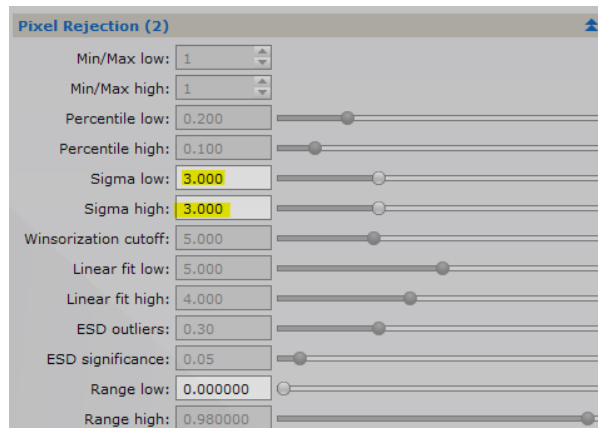
Pixel Rejection (1)

- Select the following.
 - o Rejection algorithm – Sigma Clipping (can change depending on number of frames)
 - o Normalization – Equalize fluxes



Pixel Rejection (2)

- Select the following.
 - o Sigma low – 3.000
 - o Sigma high – 3.000



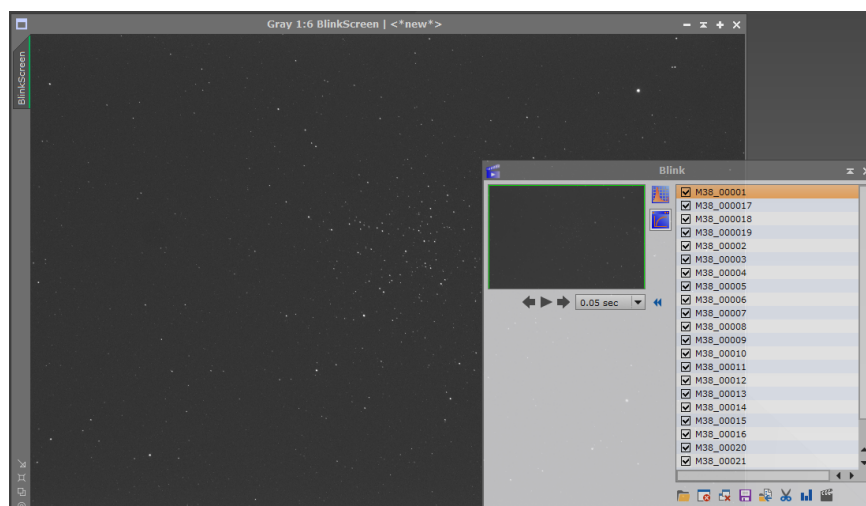
- Click **Apply Global**.
- Close the **rejection_high** and **rejection_low** rejection frames.
- Save the resulting frame by double clicking on the tab and entering the name **Master_Flat**.
- Click **Save As**, and save the .xisf frame in the **Master Calibration Frames** folder.
- Minimise the save frame to the top left corner of the workspace in case you need to refer to it later.
- Close the tool.

Check Light Frames for Trash

Blink

This step will allow you to quickly flick through the light frames, and discard any obvious rubbish, such as captures of planes, clouds or satellites.

- Add all the light frames into the module.
- A window will open up and display the frame.
- Use the left and right arrows to get a preview of each frame.
- Make a note of any frames to be discarded.



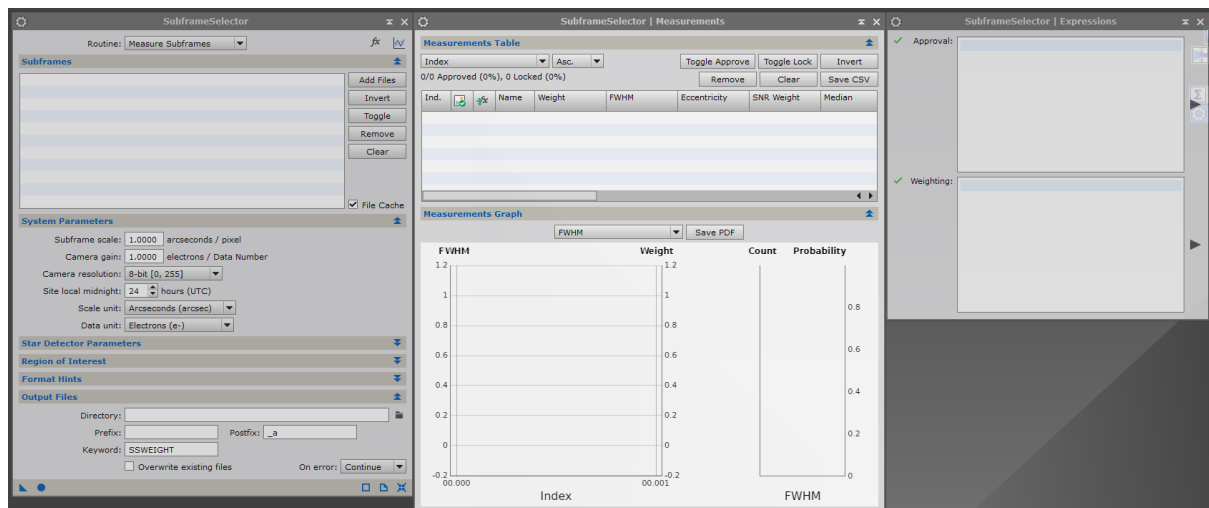
- Close the tool.
- Open file explorer and locate the files you want to omit from the rest of the stacking process. Rename/prepend the file names with **trash**.

Light Frame Quality Check

This section allows you to identify the best quality light frame in terms of focus. This can be used as a reference frame for later steps. If desired, this tool can also be used to reject any light frames that are widely out of focus when compared to the rest of the light frame data set.

SubframeSelector

- Open the tool and reset it.
- SubframeSelector opens 3 windows as part of the tool.

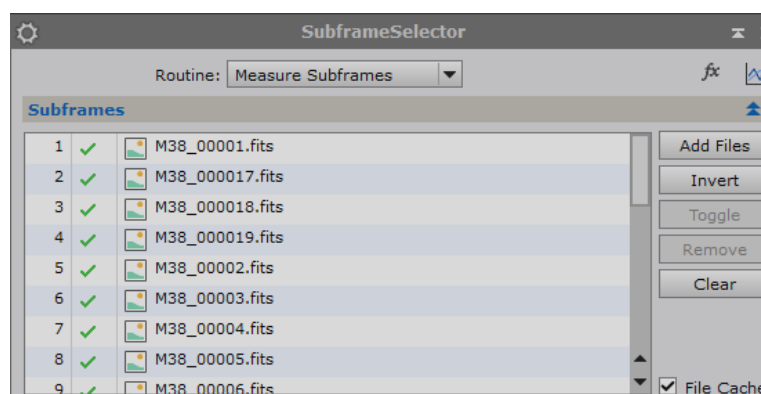


- The first part of the work is carried out in the **SubframeSelector** window.

SubframeSelector window

Subframes

- Add the remaining subframes not rejected in the previous step.



System Parameters

- Select the following.
 - o Subframe scale – 0.892 (*this is specific to the 183c Hypercam*)
 - o Camera resolution – 16 bit
 - o Scale unit – Pixels (pixel)
 - o Data unit – Data Numbers (DN)

System Parameters

Subframe scale: 0.8920 arcseconds / pixel

Camera gain: 1.0000 electrons / Data Number

Camera resolution: 16-bit [0, 65535]

Site local midnight: 24 hours (UTC)

Scale unit: Pixels (pixel)

Data unit: Data Numbers (DN)

- Click **Apply Global**. The tool will now look at each frames and measure different metrics such as FWHM etc.

Once the tool has completed it's measurements, the **SubframeSelector | Measurements** window will populate.

SubframeSelector | Measurements window

Measurements Table

- In the first dropdown menu, select **FWHM**.
- The table order will change showing the FWHM values in ascending order. Lower FWHM values are considered the frames in best focus.
- Identify the best frame, make a note of the file name.

SubframeSelector | Measurements

Measurements Table

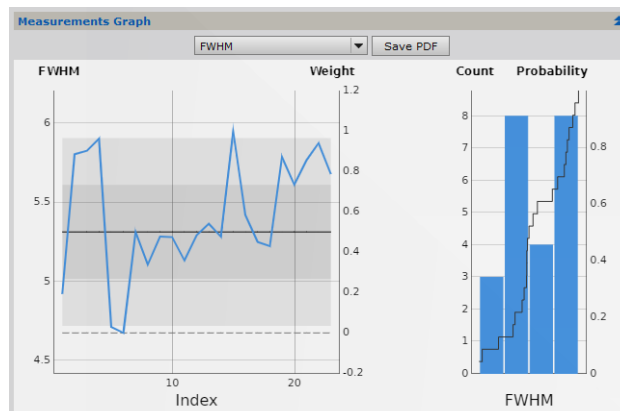
FWHM Asc. 23/23 Approved (100.00%), 0 Locked (0.00%)

Toggle Approve Toggle Lock Invert Remove Clear Save CSV

Ind.		Name	Weight	FWHM	Eccentricity	SNR Weight
6	✓	M38_00003.fits	0.000	4.676	0.472	0.8918
5	✓	M38_00002.fits	0.000	4.713	0.493	0.8927
1	✓	M38_00001.fits	0.000	4.923	0.440	0.8939
8	✓	M38_00005.fits	0.000	5.109	0.388	0.8896
11	✓	M38_00008.fits	0.000	5.135	0.520	0.8894

Measurements Graph

- The graph will show the value allocated to each frame. The worst frames can be identified here, or in the table, and removed from the whole calibration process if desired.



- Use Windows explorer to locate the best file identified from the Table section. Pre-pend the file name with **ref** to identify it as the reference file for later in the calibration process.

- Close each of the windows that make up the tool.

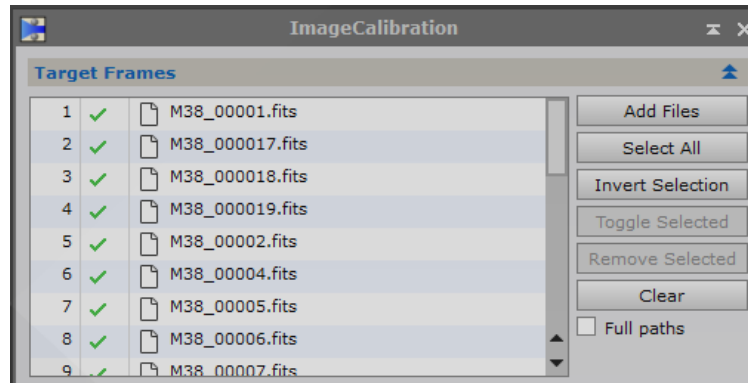
Calibrate Light Frames

Image Calibration

- Open the tool and reset it.

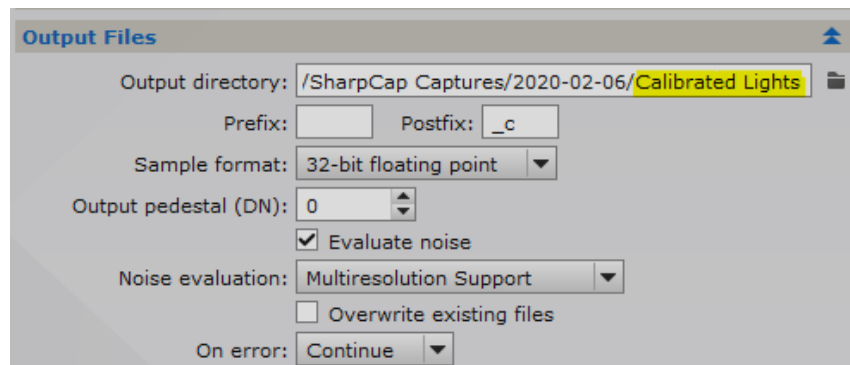
Target Frames

- Add all the light frames taken of the target.



Output Files

- Browse to the pre-prepared **Calibrated Lights** folder.



Master Bias

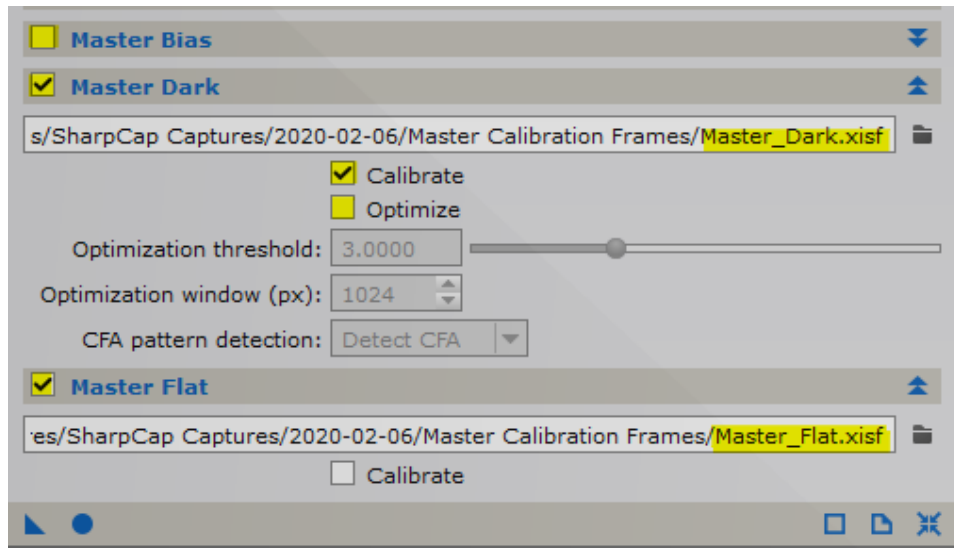
- Deselect this.

Master Dark

- Browse to the master dark file created in the previous step.
- Calibrate – TICK
- Optimise - UNTICK

Master Flat

- Browse to the master flat file created in the previous step
- Calibrate – UNTICK

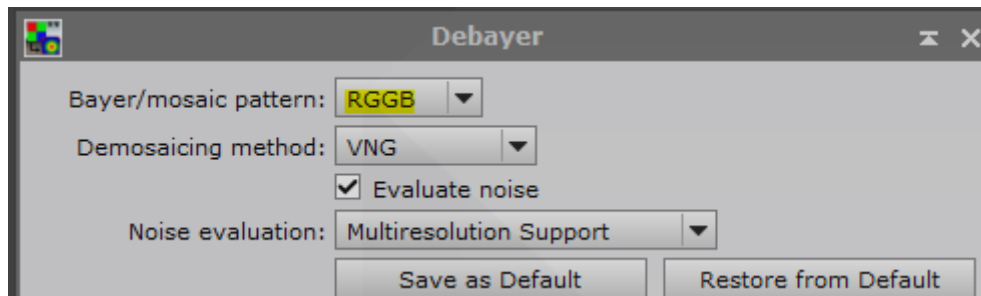


- Click **Apply Global**.
- Once complete, close the tool.
- If required, open and stretch a calibrated light frame to ensure the process has worked.

Debayer Calibrated Light Frames

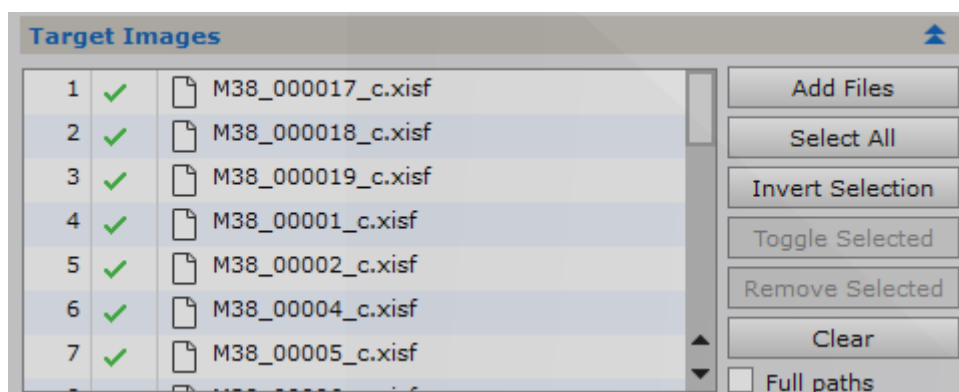
Debayer

- Open the tool and reset it.
- Select **RGGB** from the drop down menu for the Bayer/mosaic pattern.



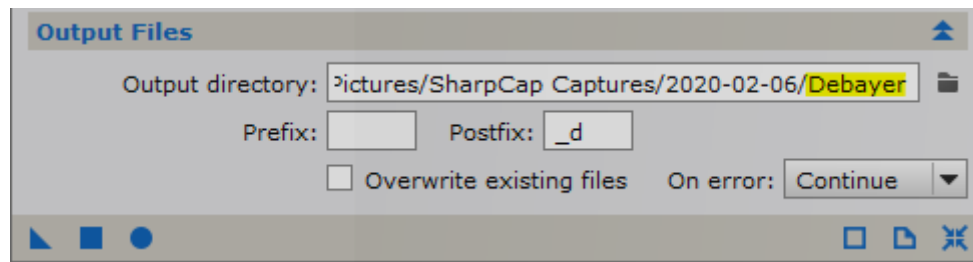
Target Images

- Add all the **Calibrated Light** frames from the previous step.



Output Files

- Browse to the pre-prepared **Debayer** folder.

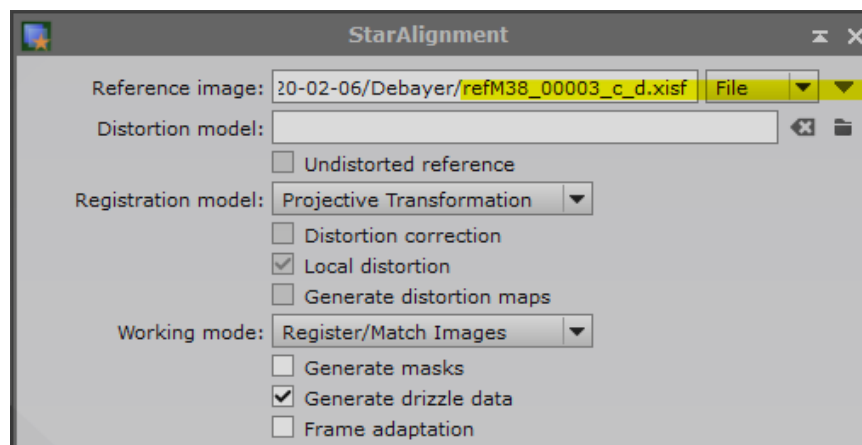


- Click **Apply Global** and when finished, close the tool.

Align the Debayered Frames

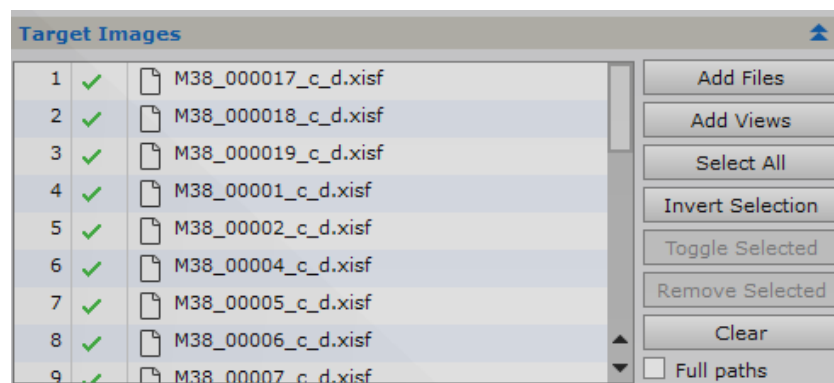
Star Alignment

- Open the tool and reset it.
- **Reference image** – Change the dropdown to **File** and browse to the reference file created earlier from the **Debayer** folder.



Target Images

- Add all the debayered light frames created in the previous step.



Output Files

- Browse to the pre-prepared **Aligned** folder.

Output Images

Output directory:

Prefix: Postfix: Mask: D.Map:

Sample format:

☐ Overwrite existing files On error:

Star Detection

- Select the following.
 - o Detection scales – 6
 - o Noise scales – 1
 - o Hot pixel removal – 2
 - o Noise reduction – 1
 - o Log (sensitivity) - -0.90

Star Detection

Detection scales:

Noise scales:

Minimum structure size:

Hot pixel removal:

Noise reduction:

Log(sensitivity):

Peak response:

Maximum distortion:

Upper limit:

Compute PSF fits:

☐ Inverted image

Star Matching

- Select the following.
 - o RANSAC tolerance – 3.5
 - o RANSAC iterations – 4000
 - o Descriptors per star – 60

Star Matching

RANSAC tolerance:

RANSAC iterations:

Maximum stars:

Descriptor type:

Descriptors per star:

Compute intersections:

☒ Restrict to previews

☐ Use brightness relations

☐ Use scale differences

Scale tolerance:

- Click **Apply Global**.
- When the tool finished, close it.

Stacking

Image Integration

- Open the tool and reset it.

Input Images

- Add all the Aligned frame created in the previous step.

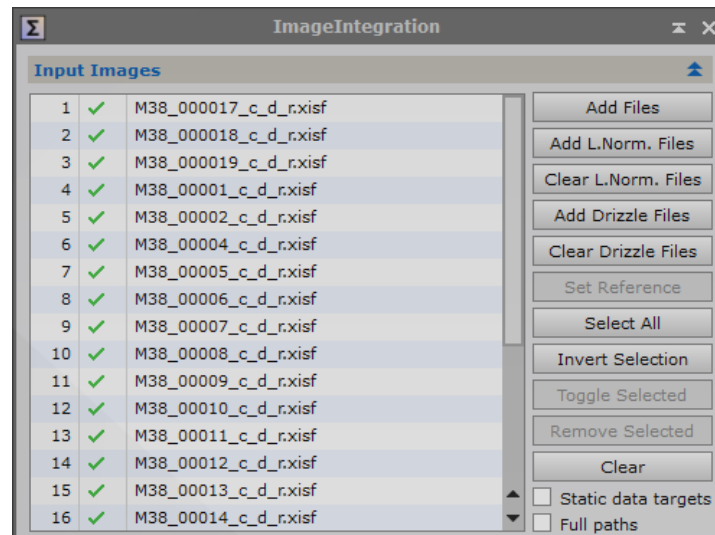
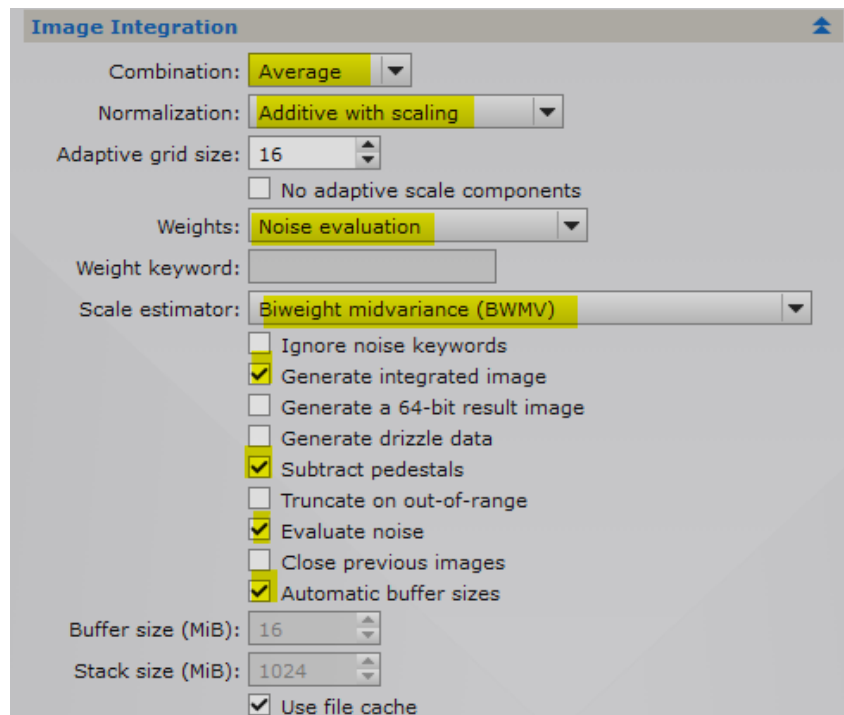


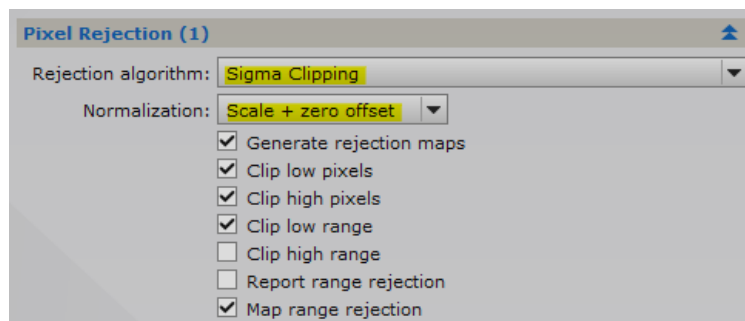
Image Integration

- Select the following if not already selected.
 - o Combination – Average
 - o Normalization – Additive with scaling
 - o Weights – Noise evaluation
 - o Scale estimator – Biweight midvariance
 - o Evaluate noise – TICK
 - o Subtract pedestals – TICK
 - o Automatic buffer sizes – TICK



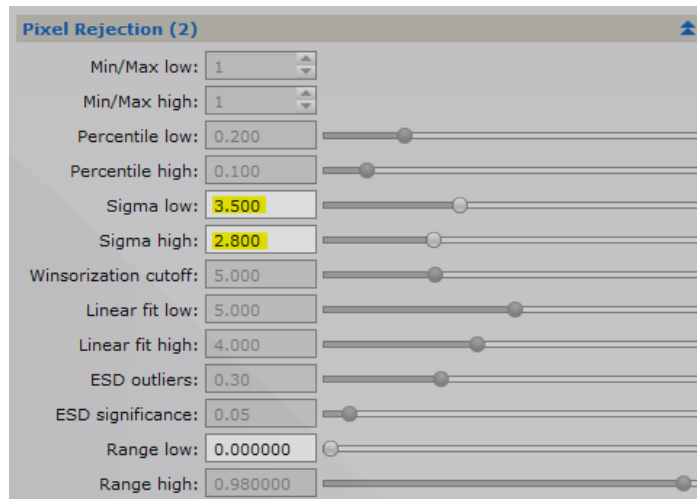
Pixel Rejection (1)

- Select the following.
 - o Rejection algorithm – Sigma Clipping
 - o Normalization – Scale + zero offset



Pixel Rejection (2)

- Select the following.
 - o Sigma low – 3.500
 - o Sigma high – 2.800



- Click **Apply Global**.
- Once the stacking process has completed, close the tool.
- Three frames will open. Close the **rejection_high** and **rejection_low** frames. They are not needed.
- Save the **integration** .xisf image as **%targetname%integration**.
- Save a copy of the **integration** .xisf image should the first be changed and saved accidentally.
- The **integration** image which will be used for the processing stage. Stretching the image will give an impression of what data there is to be processed.