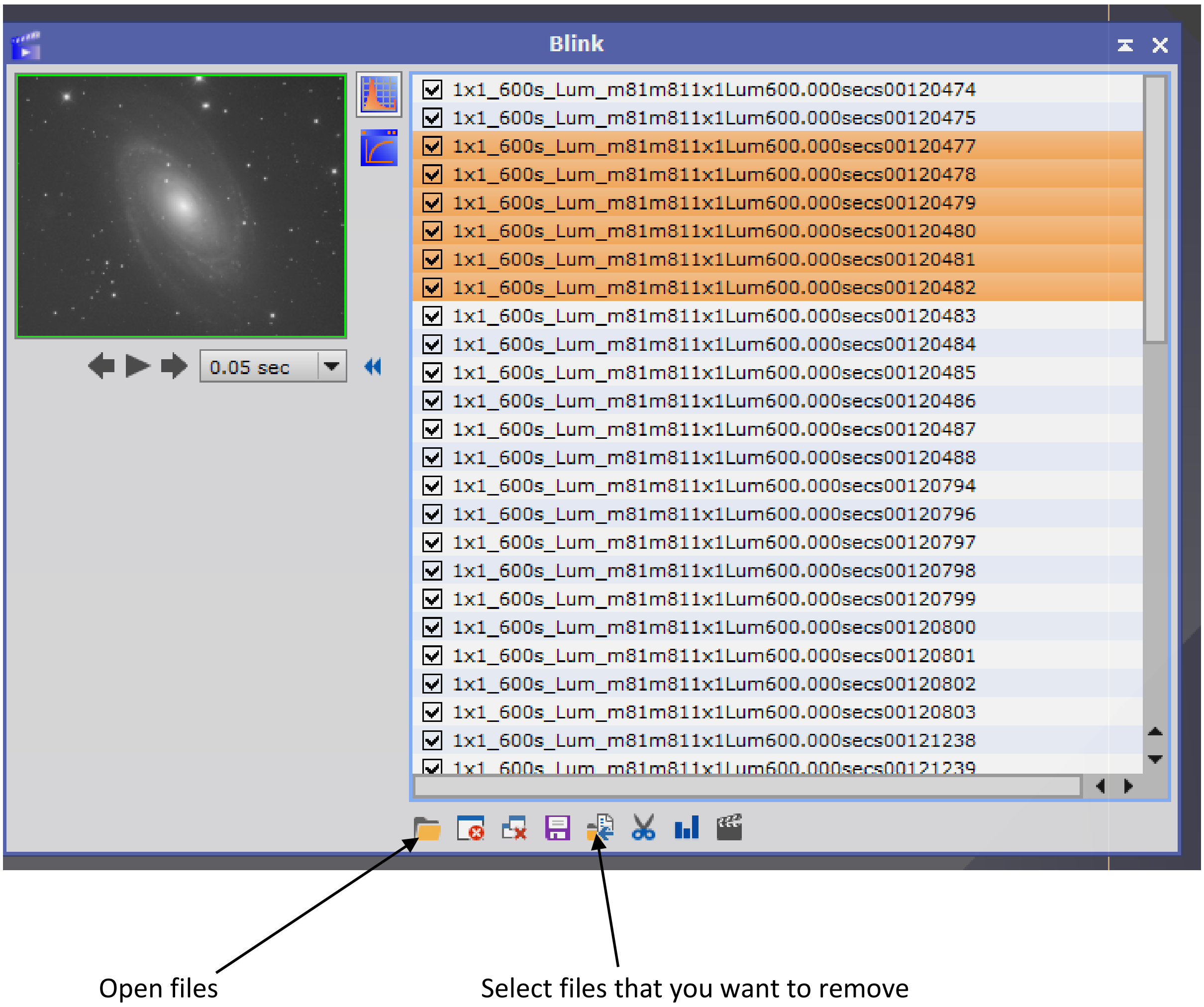
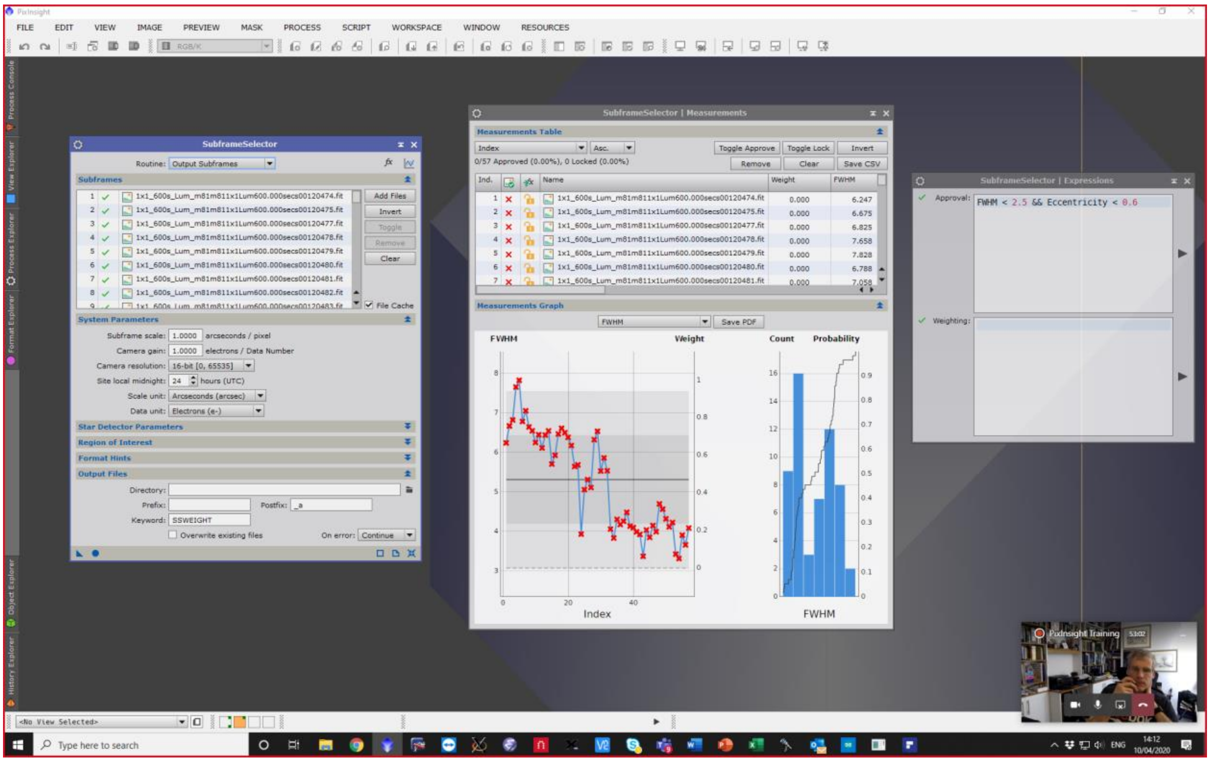
GAS PixInsight Workflow

Pre-Processing

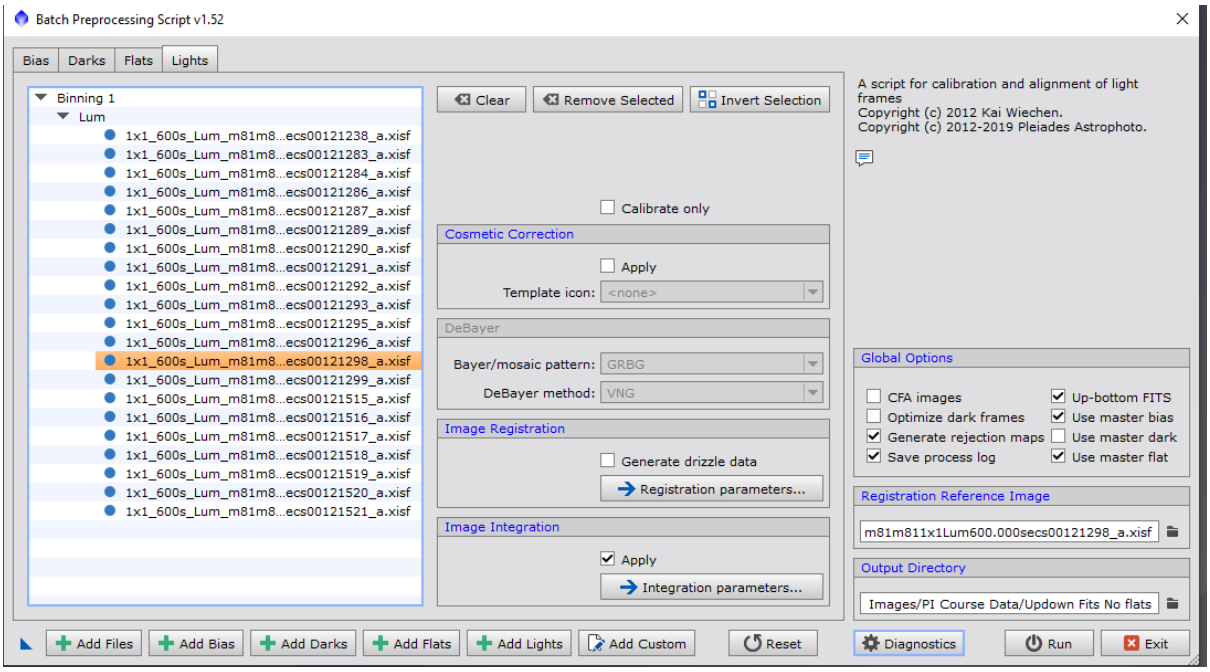
1) Image inspection using **Blink**.



2) **SubframeSelector** to select frames to use for pre-processing.



3) Script: **Batch PreProcessing**



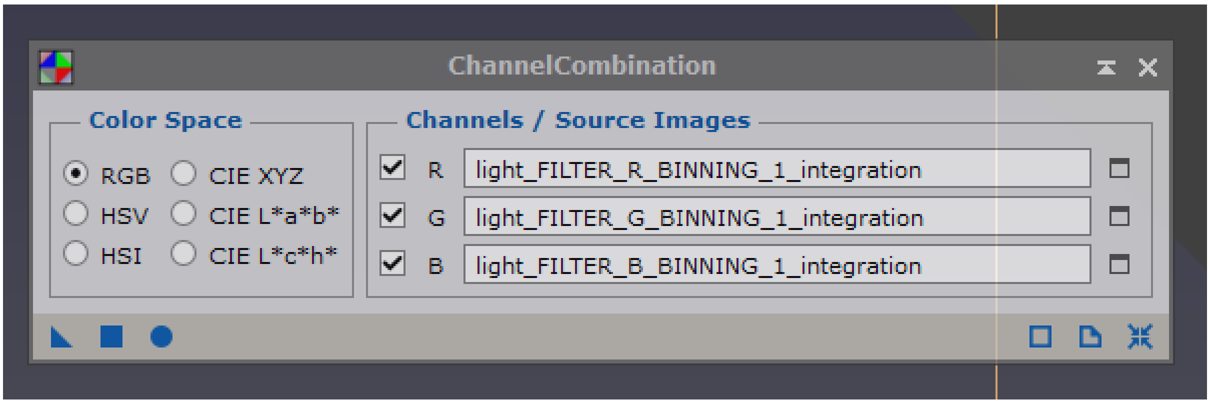
Input selected subs and master flats and bias frames. Be consistent about Up-bottom Fits. Need to select registration document.

3a) Alternatively – use the Weighted Batch Pre-Processing Script

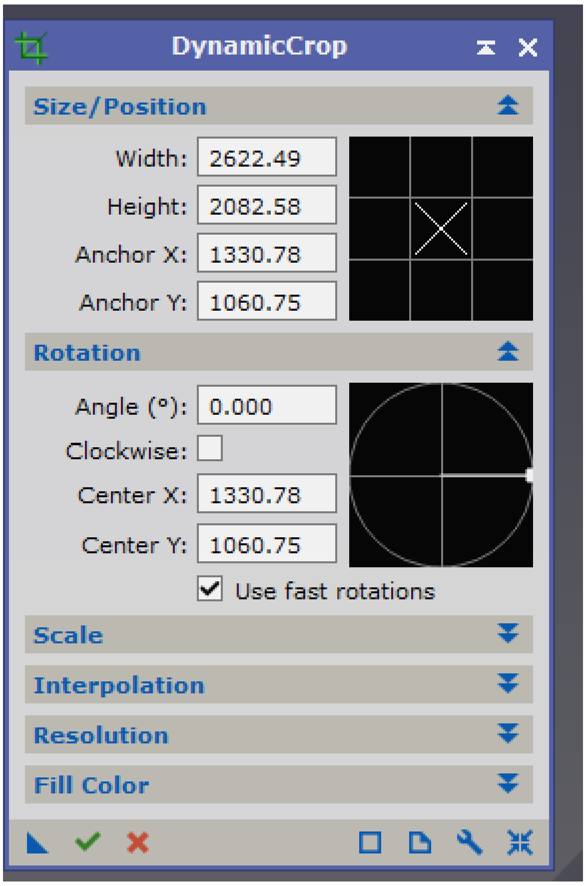
Linear Processing

Getting the right colours

1) **ChannelCombination –** combine R, G, B files.

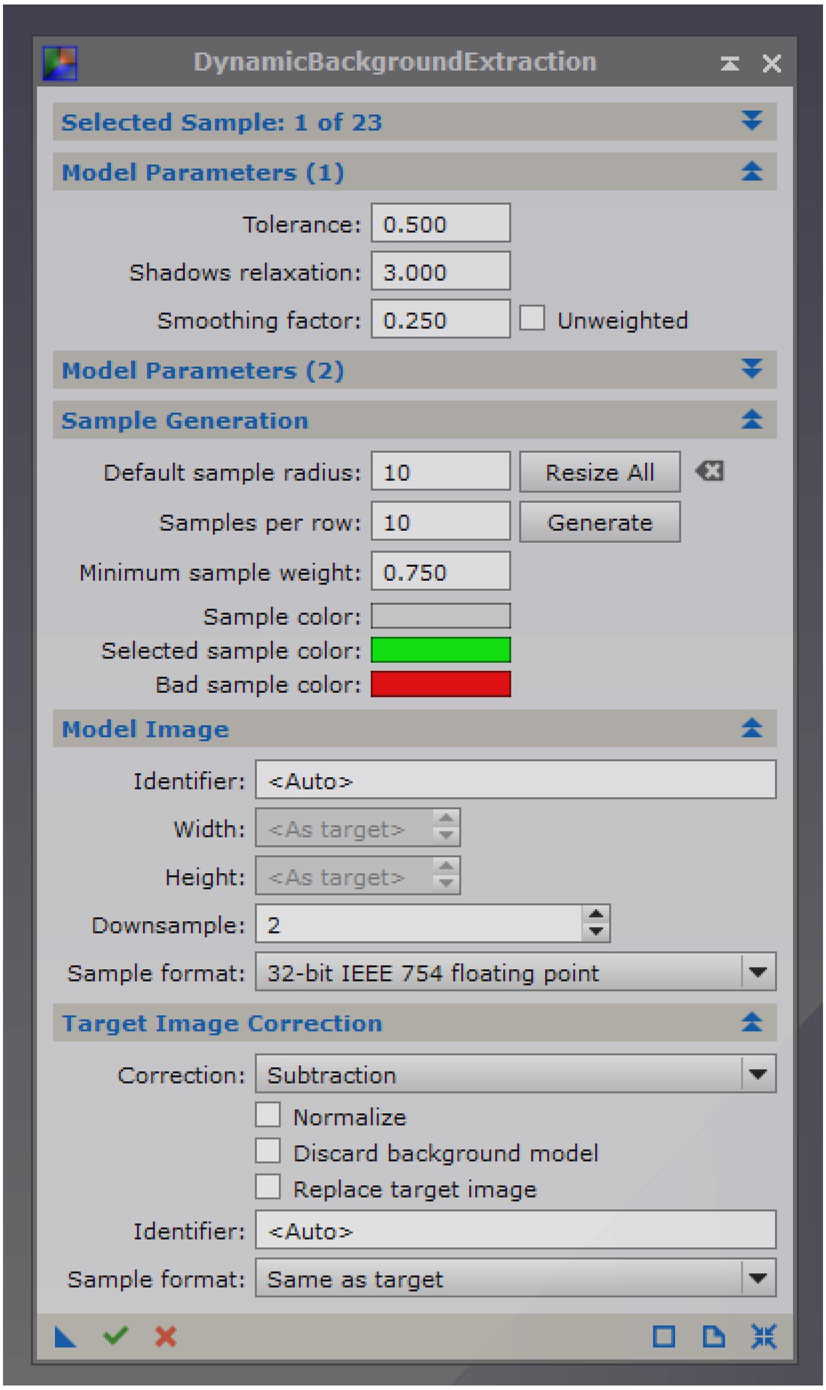


2) **DynamicCrop** – remove ragged edges.



Remember to drag "New Instance" onto desktop to make copy of selected parameters. Can then apply this to other frames (Luminance) to apply the same crop to those too.

3) **DynamicBackgroundExtraction** [if needed]



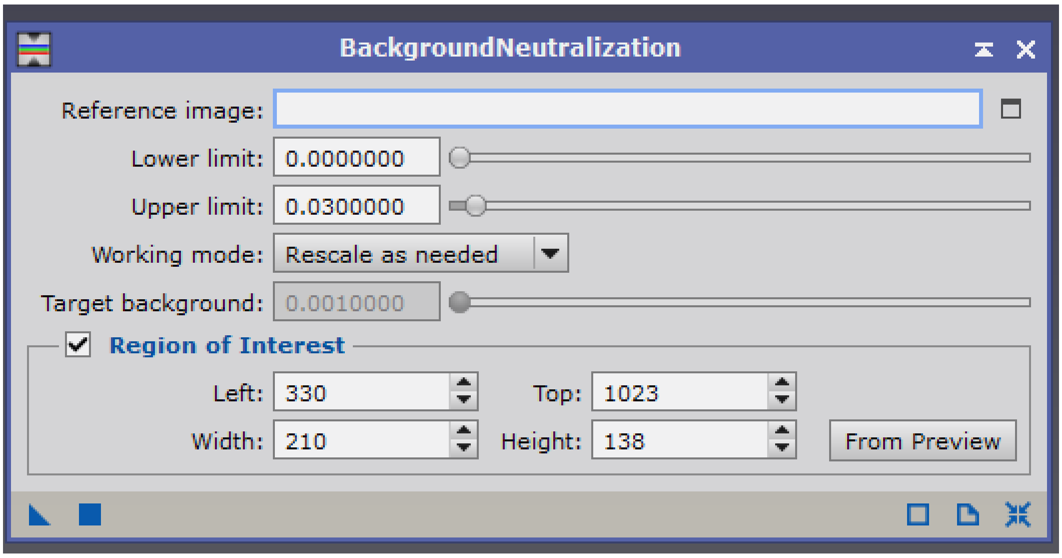
Tolerance often needs to be increased to 1 to avoid samples being rejected.

Set correction to **Subtraction.**

Place samples on the edges and corners of the image where possible.

Save copy of process by dragging new instance icon to desktop to apply to e.g. luminance image. The background model should be relatively smooth – remember, you only want to remove the gradient, not the image details!

4) **BackgroundNeuralization –** to ensure background is grey

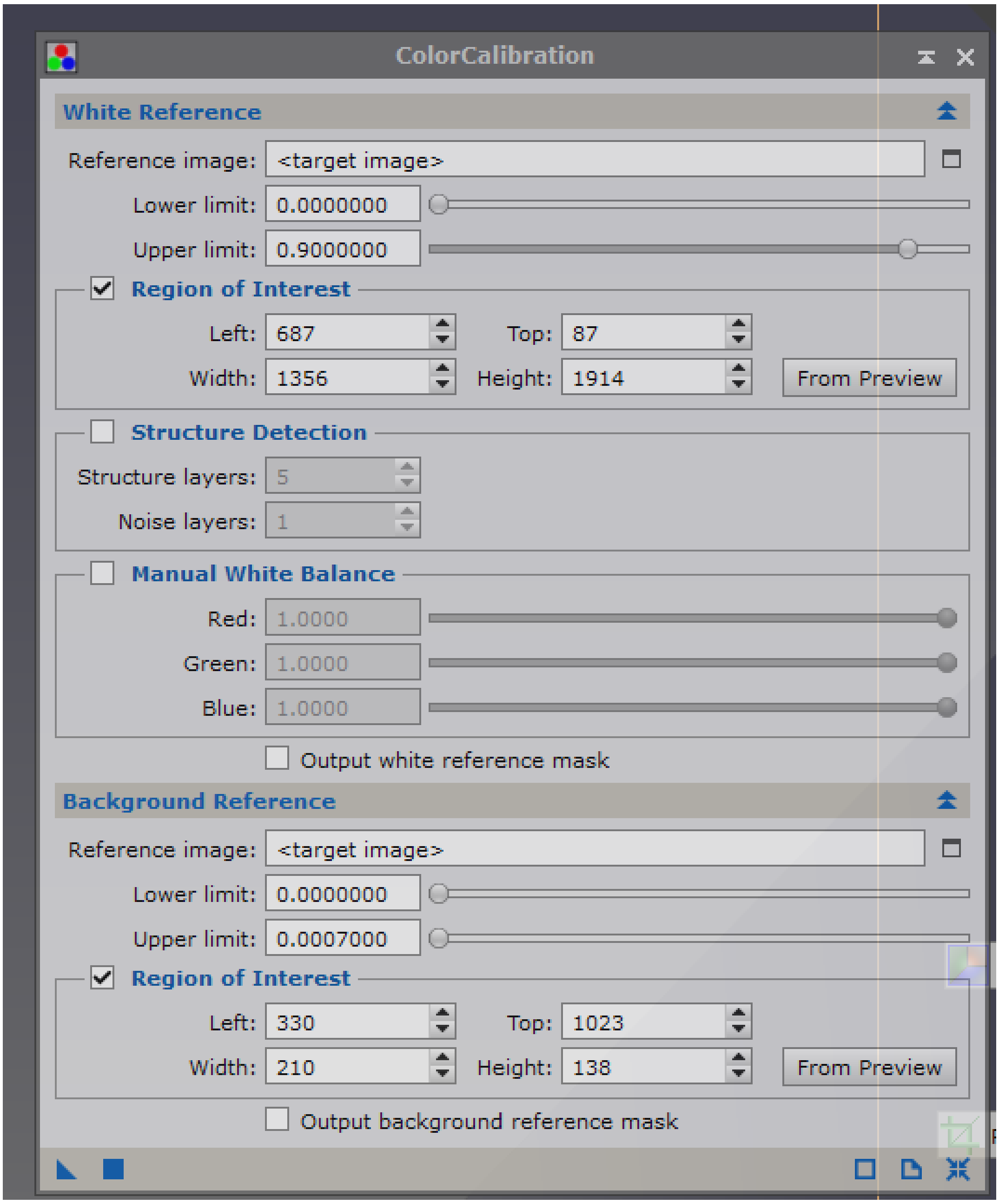


Create a small preview in a dark part of the image.

Place cursor to readout intensity from preview to set upper limit.

Set region of interest to Preview.

5) ColourCalibration – ensures colours are correct in RGB image.



Create a region which contains the galaxy in the White reference.

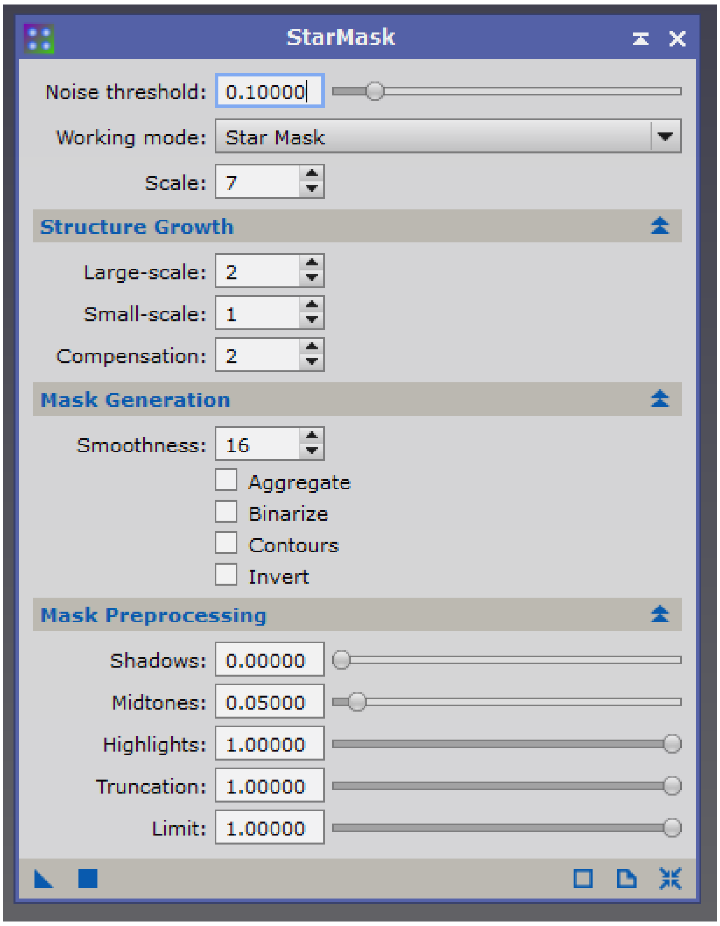
For galaxy, “Structure Detection” should not be ticked, but could be selected if e.g. imaging a red nebula.

Use same region as for BackgroundNeuralization to specify background levels – remember to reset upper limit since BackgroundNeutralization will have changed the background levels.

5a) Alternatively use **PhotometricColourCalibration**.

Mask Creation

1) StarMask



Adjust scale to ensure all stars are captured.

Adjust midtones to capture more stars.

After star_mask is created, you may need to use the CloneStamp or HistogramTransformation to clean up the mask.

2) LumMask

Take clone of luminance

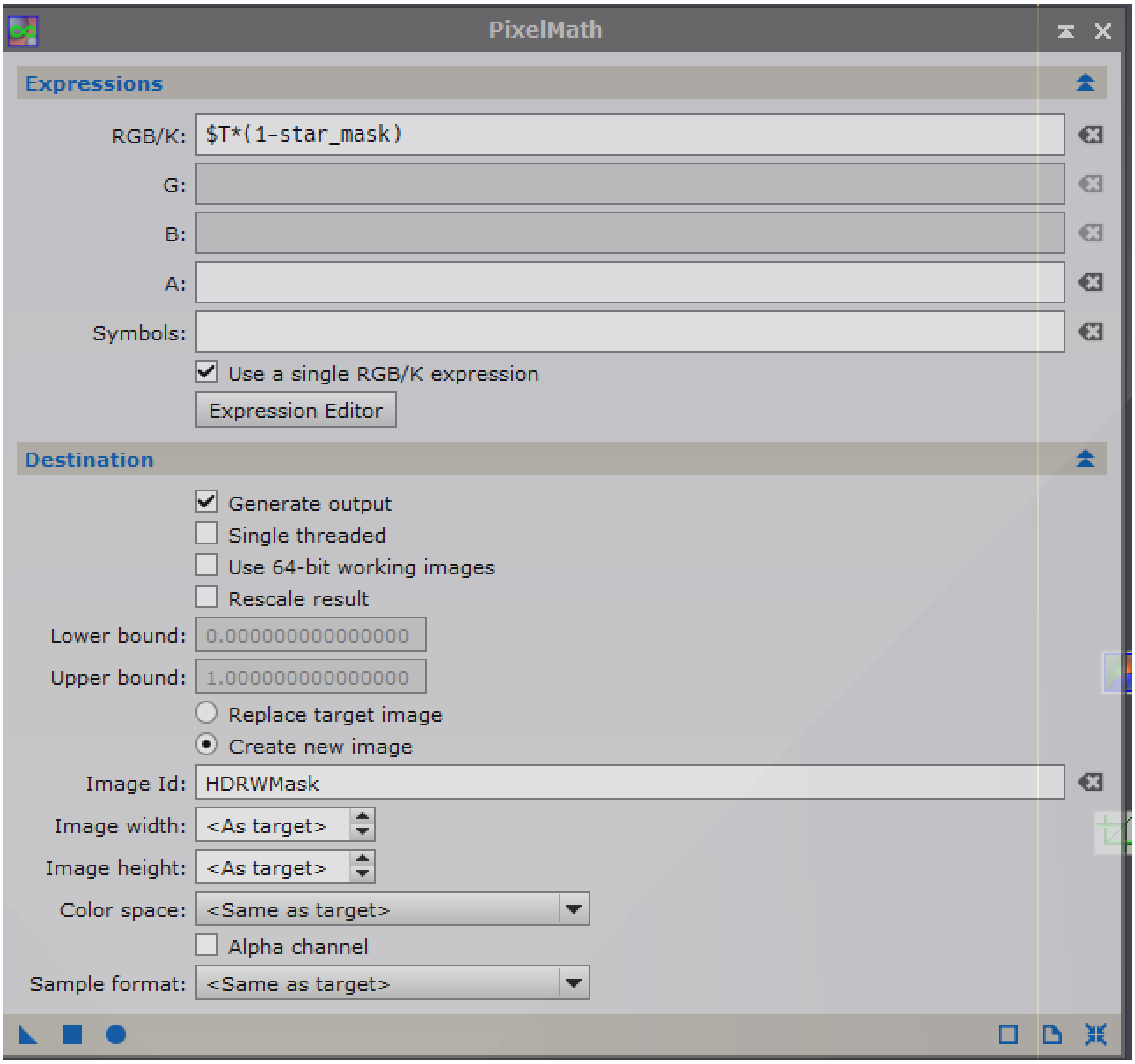
Stretch using HistogramTransformation and ScreenTransferFunction (STF).

Drag triangle from STF to HT tool to copy parameters.

Once stretched, use “Convolution” to blur mask.

Then finish by using HistogramTransformation to adjust black point (left hand slider) and possibly increase values in core of the object (mid slider).

3) Create HDRWMask – luminance mask with stars removed using PixelMath



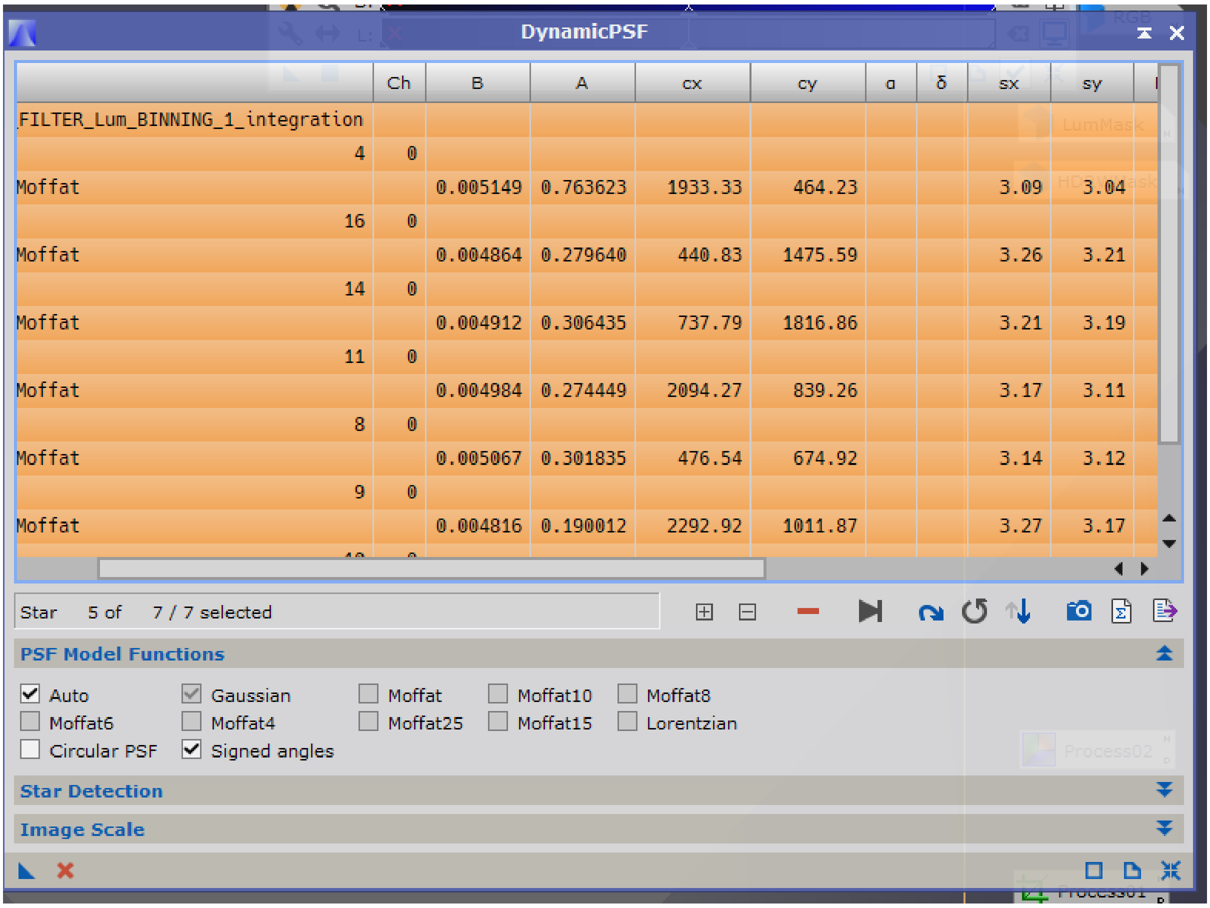
Set expression to $T*(1-star_mask)

Create new image – set Image id.

Can use Expression Editor to make the expression – and the Parse button in there to test the syntax of the expression.

Sharpening – Deconvolution

1) Create Point Spread Function - PSF



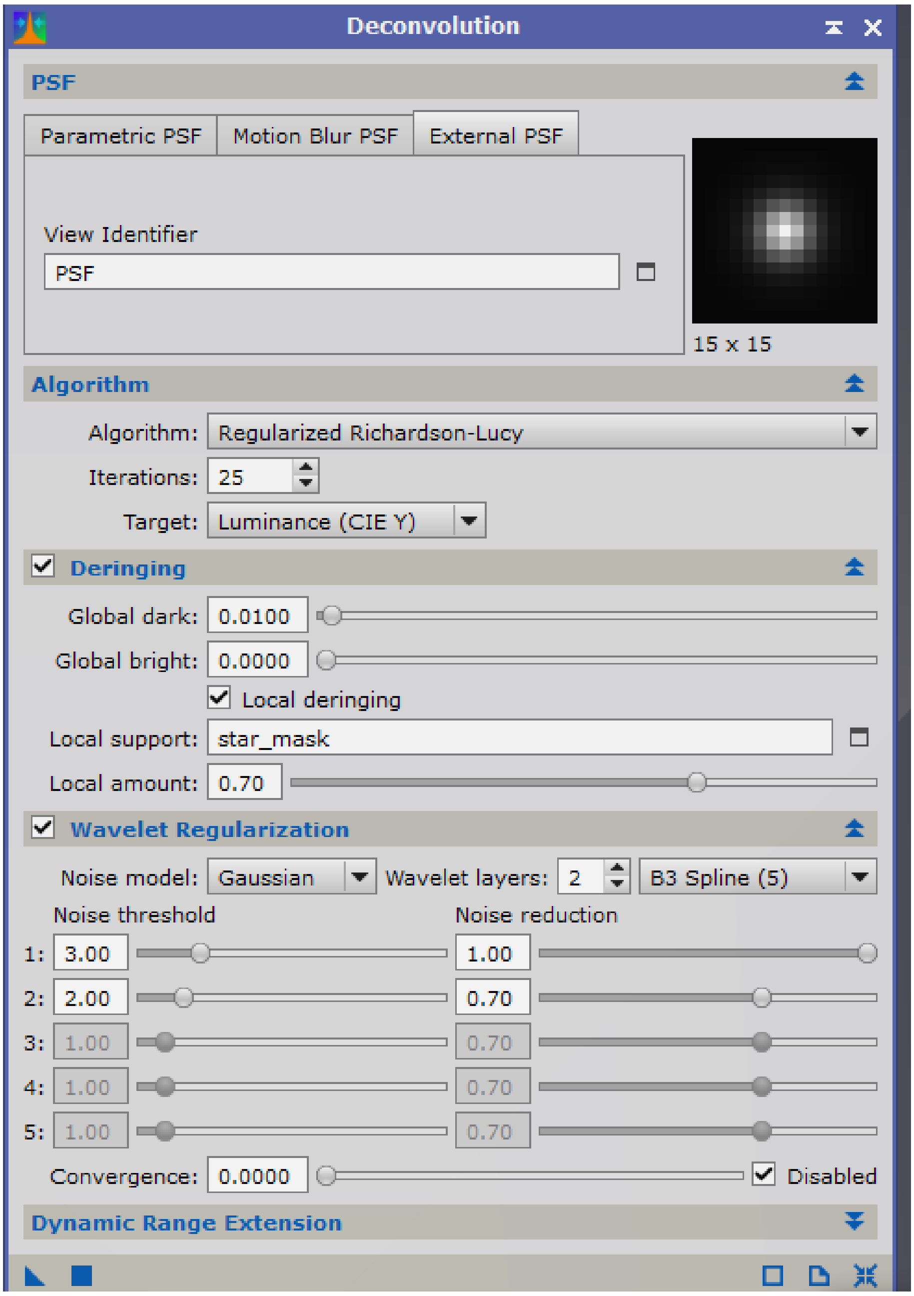
Select a group of bright but not saturated stars.

Use the arrow icon to arrange by amplitude – remove stars with A values less than 0.2 and above 0.8.

Sort again by Mean Absolute Difference – remove stars with anomalously high values of MAD.

Create the PSF using the camera icon.

2) Deconvolution – if needed. No point if undersampled stars (FWHM < 3 pixels).



Set External PSF to PSF image generated by Dynamic PSF process.

Set Deringing Global Dark – default value of 0.1 is generally too high (try 0.01).

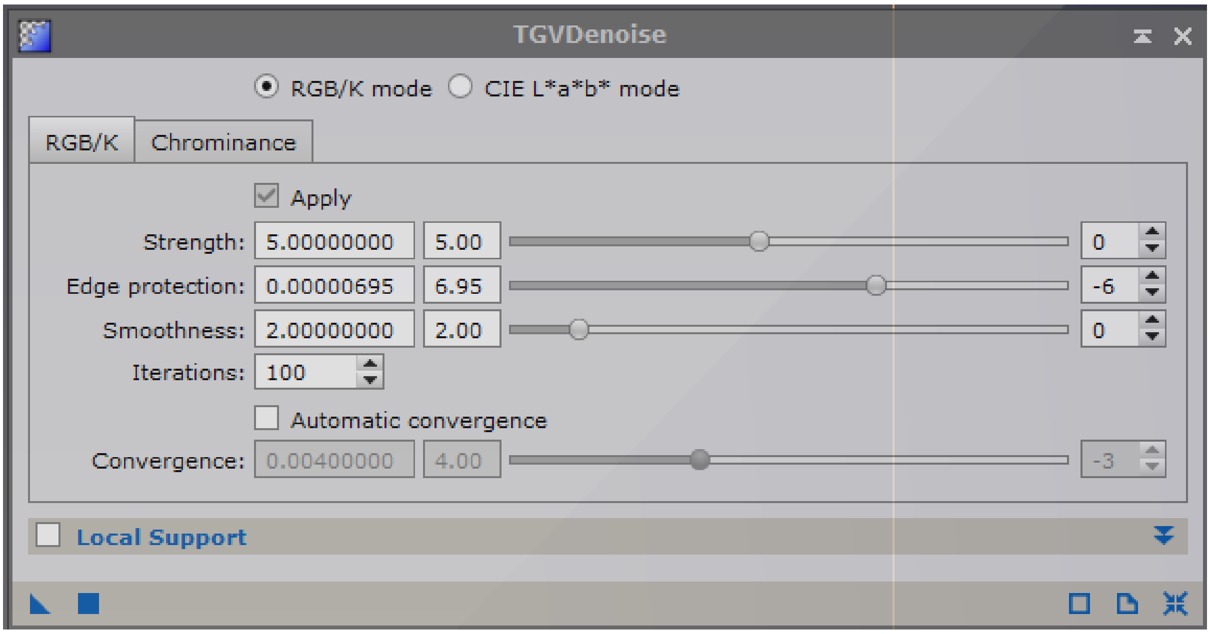
Set local support to star mask.

Select a preview containing a bright part of the object and background to experiment on (include some stars)

Experiment with number of iterations – 10-50 is the right range typically.

Apply HDRWmask.

Smoothing



TGVDenoise: The key parameter is "Edge Protection". Measure the natural variability of the image using the **Statistics** process. Choose a small preview in a blank part of the image, select that in Statistics and note the value of the "AvgDev". Set the value of edge protection to be 10 times smaller than that.

Choose a preview that contains part of the object and part of the backgound.

Apply the LumMask but make it inverted – you only want to smooth the dim areas.

Experiment with the Edge protection parameter to get smoothing of the background, but stop **TGVDenoise** from removing small stars or other small interesting features. Apply it to the preview selected above. Remember that using "Ctrl+Shift+Z" will toggle the process on and off to allow you to see the impact.

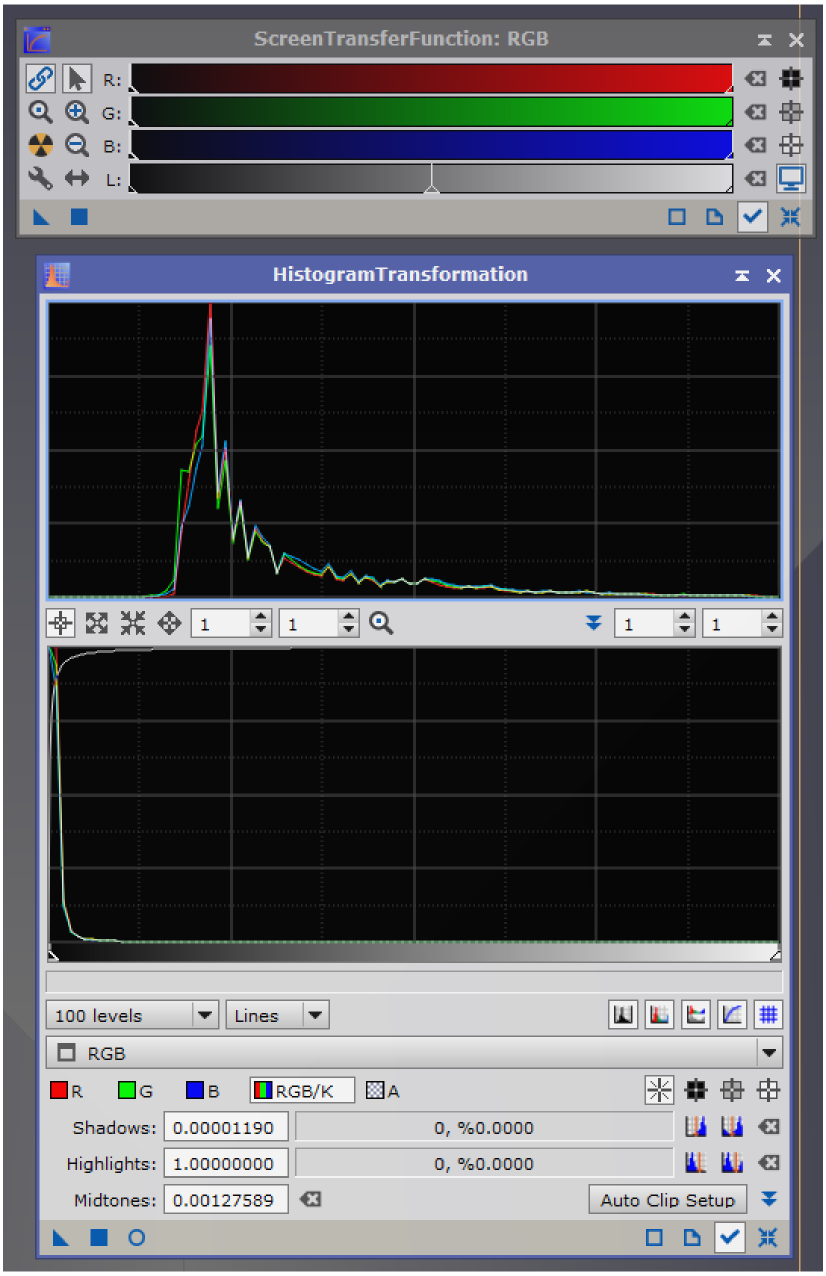
Once happy, apply to the main image rather than the preview.

Apply to the Luminance image first. Then test the same set of parameters on the RGB image. I generally find that the same values work well for both images, but if not, adjust as described above.

TGVDenoise can also be applied in the non-linear phase if needed.

Stretching

We are now finished with the linear phase of image processing. We need to apply a permanent stretch to the image. Here, we use the STF and HistogramTransformation tool.



Apply the STF to the image using the black and yellow icon. If needed, “Ctrl click” the same icon to bring up the input parameters for the stretch. Try increasing or decreasing the target background to get brighter or dimmer images as you prefer.

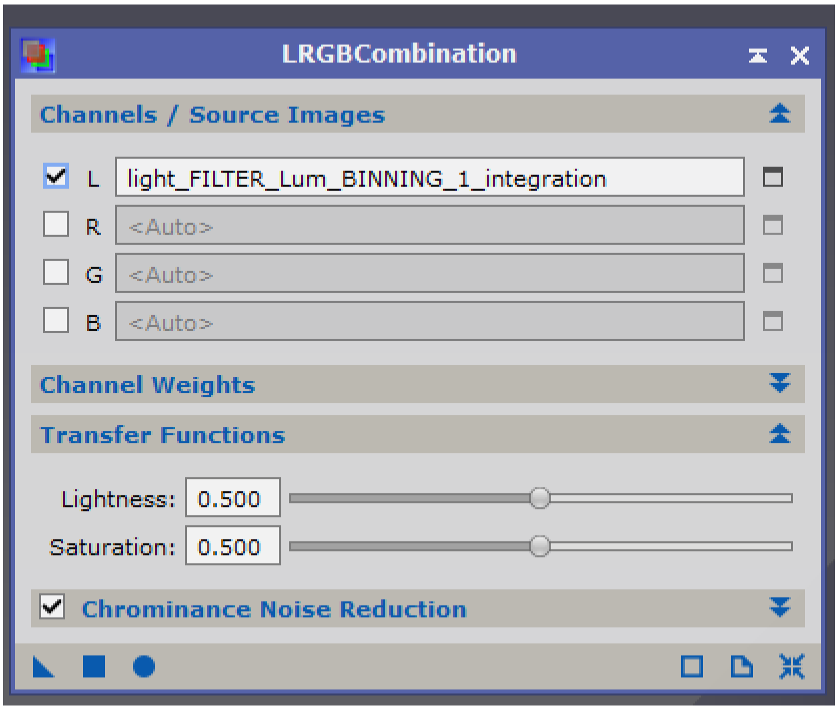
Once OK, drag the new instance triangle from the STF to the bottom bar of the HistogramTransformation tool. Select the green tick to track the view and you should see the input and final histogram of values in the tool.

Click the Apply button (blue square) or drag the triangle to the unstretched image. Don’t worry if the image goes white – simply cancel the STF on the image and all will be well.

NonLinear Processing.

Combine colour and Luminance Image

Having stretched both the luminance and the RGB images, now is the time to combine these.

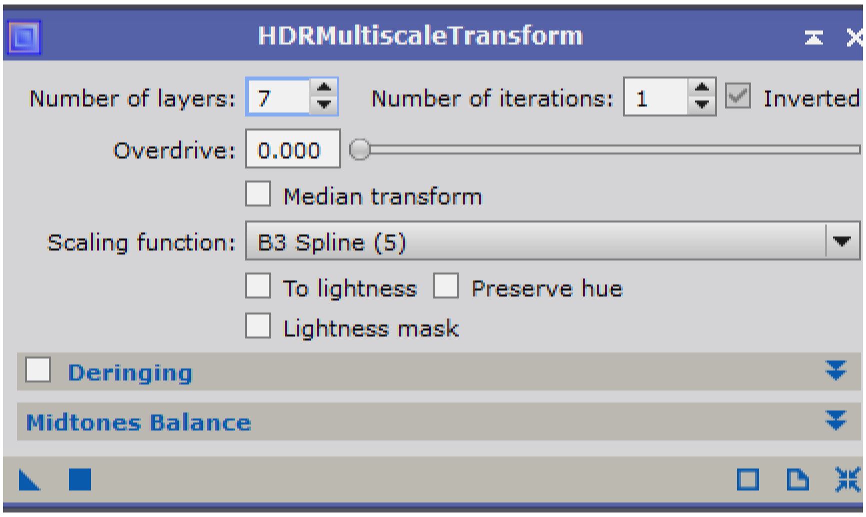


In the **LRGBCombination** tool, untick the R, G and B boxes (you are going to apply this to an existing RGB image).

Select the luminance image for the L image and tick the Chrominance Noise Reduction box.

Apply to the RGB image. This should keep the colours, but add more detail from the Luminance image.

Revealing more detail



The **HDRMultiscaleTransform** tool is one of the jewels in the PI crown. It locally compresses the dynamic range of an image to bring out more of the hidden details in a galaxy or nebula – but it does take some experimentation to get the right parameters.

Create three previews of the entire image and apply the **HDRWMask**. This process can create ringing and this helps prevent that.

The key parameter is the number of layers selected – this controls the scale of the image features to be enhanced. I typically find that 5, 6 or 7 is the right number. Choose 5 and apply to the top preview, 6 to the middle preview and 7 to the bottom preview.

Choose which one you prefer – and extend to e.g. 8 if needed.

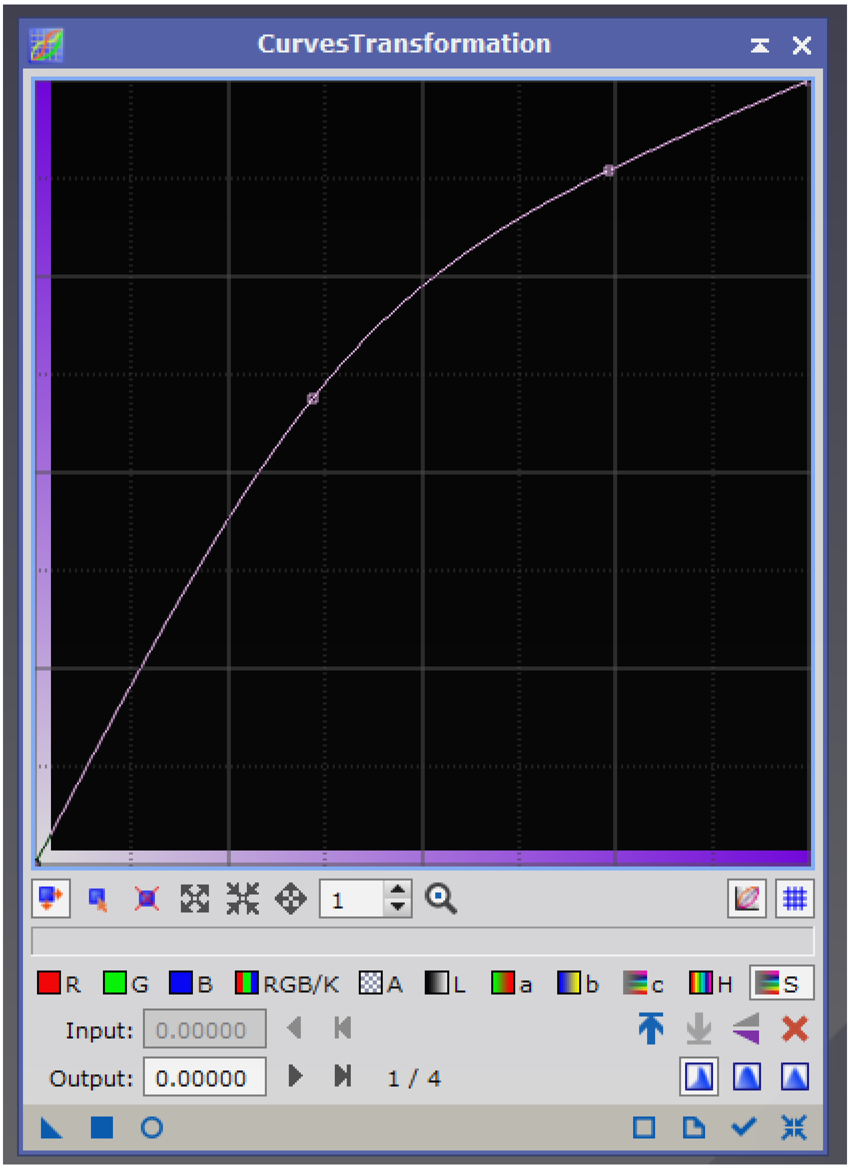
I also frequently find that this tool overdoes it. If you find that for an object, you can scale back the impact by playing with the mask.

Use **PixelMath –** set the expression to $T*0.75 (or whatever factor you like) and apply to HDRWMask to create a new mask. Apply this mask and try again.

When you get the strength you like, apply the tool with final mask to the main image.

Boosting the Colour Saturation

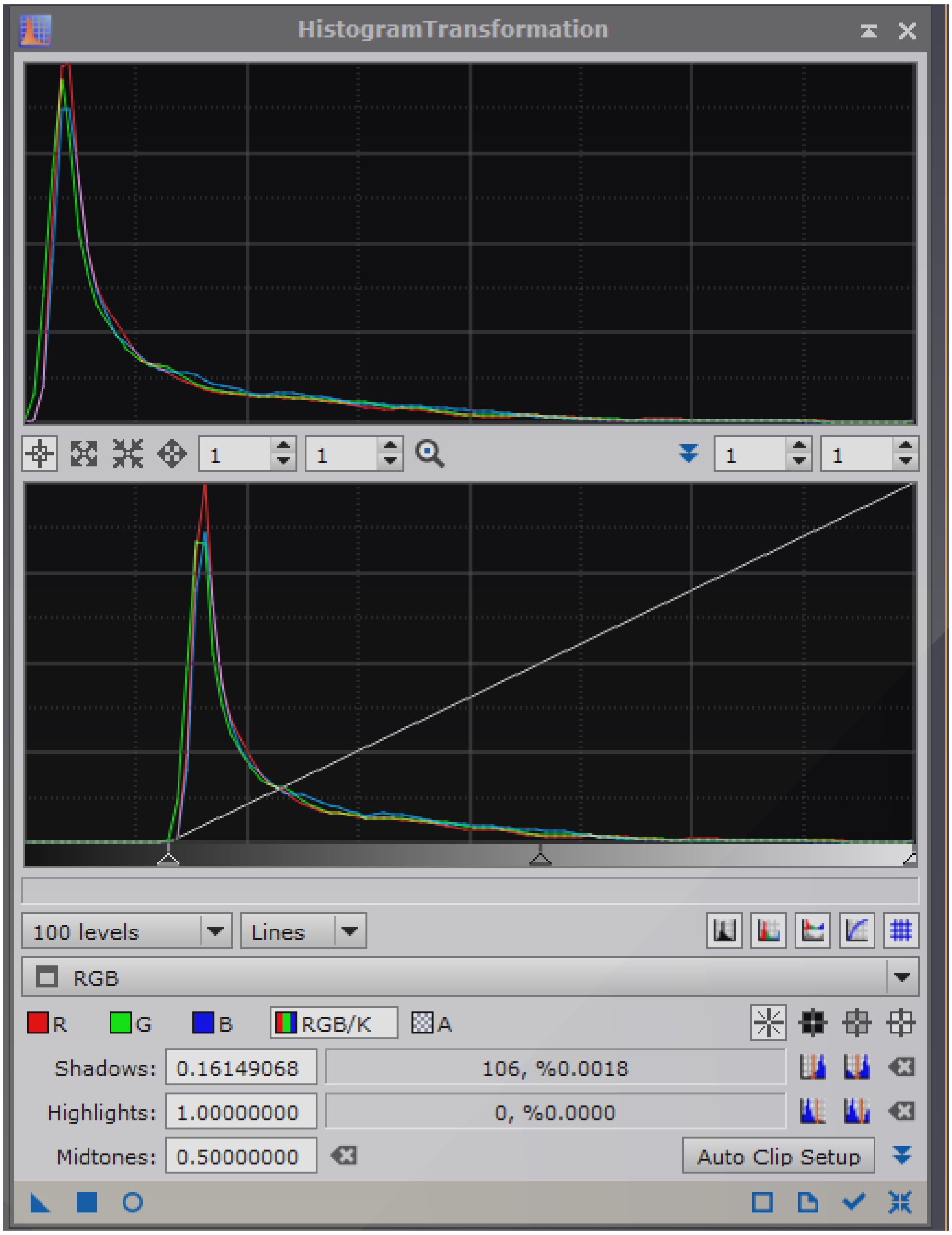
At this stage, the colours typically look bland. Now is the time to increase the saturation to make these pop. To do this, we use the **CurvesTransformation** tool.



Click on the “S” button for saturation and add a couple of points on the curve to increase the saturation as shown.

Select the LumMask for your RGB image and apply **CurvesTransformation** one or more times to your image to get the colours you like. If you find you want to apply the tool more than say twice, but three times looks too far, then apply twice, reset the tool, and choose a less aggressive curve (closer to the original curve line). This will allow you finer control.

Adjusting the Black Point



The final step is to reduce the intensity of the background using the HistogramTransformation tool again. Looking at the original histogram (lower graph), you can see that there are no small values. Roughly 20% of the available intensity distribution is not being used!

To correct this, drag the black point slider (the left hand triangle) to the base of the histogram as shown. In this case, only a tiny number of pixels are clipped (106 out of 6 million) and produces the much nicer histogram shown in the top.

Apply to your image – your object should now standout much more! You can also experiement with applying an inverted LumMask – this will further preserve the higher luminance values and can result in improved images in some cases.

Final Images

Well done – you have now finished the key steps in the process and hopefully have a beautiful image like the M81 from the GAS PI class.

If you would like to save this, click on "File->Save As" and choose the appropriate format – XISF to bring back into PI, TIFF to export to Photoshop, jpg for a web image.

Don't forget – once you have done, save all your work as a project "File->Save Project". You can also add notes here to remind yourself of any special steps you took during the processing. I keep a physical book with the processing details, but many do use this instead.

Enjoy PI – it is a great tool, and with a little practice it becomes second nature.