Ha Imaging with the Lunt LS35THa 35mm f/11.4 Solar Telescope

The following process is how I capture Solar Ha images with my Lunt LS35THa.It may not be directly applicable to other set-ups, but may illustrate some guidelines at least.

1) Equipment

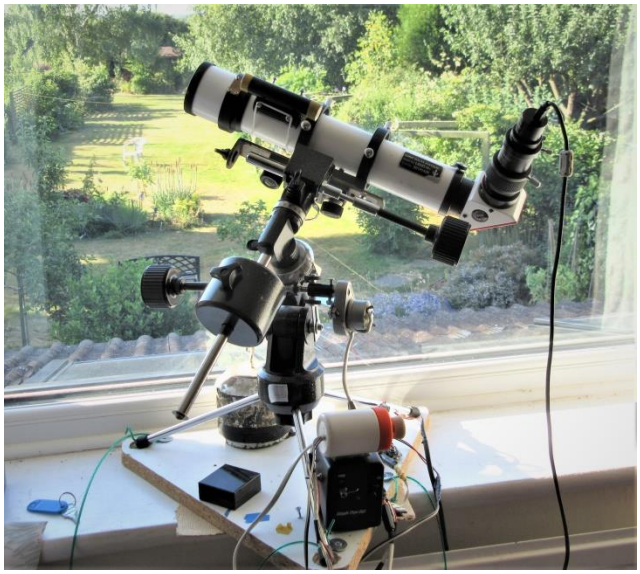


Figure 1 Scope set-up

Figure 1 shows the scope set up on the window-sill. It is mounted on an EQ1 table-top mount equipped with a modified “Simple” motor drive. It also has a home-made solar finder and is shown with a barlow and Bresser Mikrokular full HD camera. If imaging the full solar disc, I use a focal reducer instead of the barlow.

2) Acquisition

I use “Sharpcap” for the data acquisition. In order to optimise the appearance of the solar disc and any prominences, I take2 exposures, I optimised for the disc and one for the prominences.

The prominence exposure has the “gamma” set to be around 0.3, and the disc exposure to be around 0.8. It seems that with the Mikrokular/Sharpcap combination the exposure covers a greater range when set to “auto” than when set to “manuial”, so I normally set the gain to “auto”, move the scope so that solar image moves around on the screen. The auto gain shifts accordingly, and when I get an exposure I like, I click on the “auto” button to revert to “manual”. This freezes the gain at whatever it had got to. Fine adjustment can then be made in “manual”. This normally occurs when in “prominence” mode with only a small part of the disc in-field, whereas the disc fills most of the screen for the disc exposure.

I then take a 200-frame avi at each exposure.

Since prominences appear to the side of the Sun, I sometimes rotate the camera around 90 degrees to accommodate all the visible prominences to one side. That is the case on the following examples.

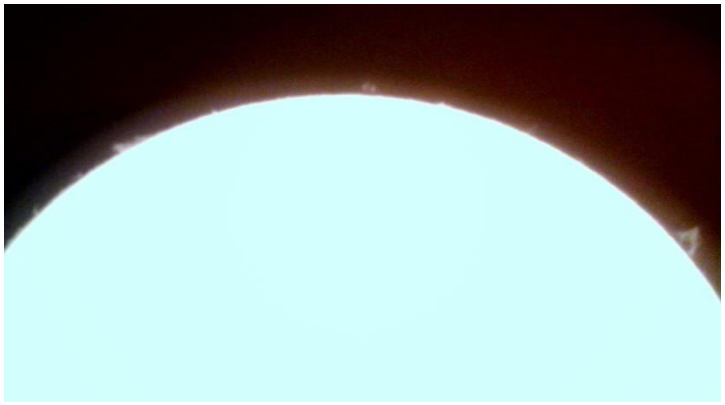


Figure 2 Single "prominence" frame

Figure 3 Single "disc" frame

3) Stacking and initial processing

I use Registax 6 for stacking and initial processing.
For reasonable disc surface images, I use an alignment box size of 50. You can let Registax choose its own alignment points, but usually I do it manually with 20-30 points, scattering them over parts of the image where there is good contrast, especially around the disc edges. Ensure you check the “Show full image” and “Registration graph” boxes. Click on the “Align” box and then select the number of frames you want to stack using the “Registation graph” to help. With good images I use 90% of the images. Then click “Limit” followed by “Stack”.

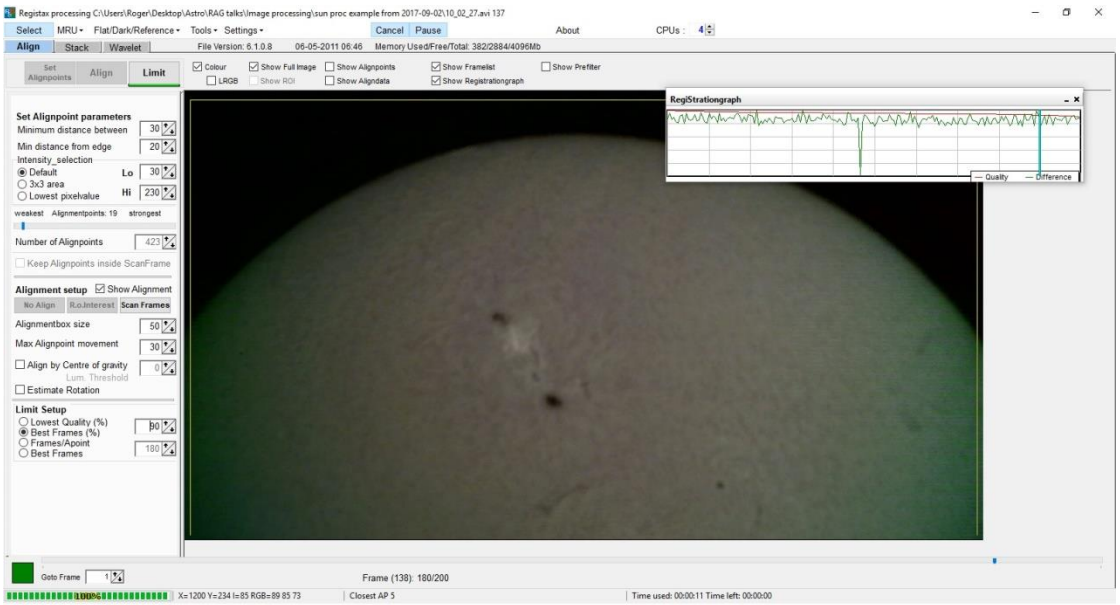


Figure 4 Registax stacking screen

Now for the first magic bit.

After “Stack” is complete, click on the “Wavelet” tab. You now need to select a wavelet sharpening regime. I normally use a bell-shape as in the figure below. The click on “Do all”.

Figure 5 Registax wavelet sharpening

Click on “Save image” and save.

Repeat the exercise for the “prominence” avi, but this time only select alignment points around the disc circumference as there will be no features on the washed-out disc.

We now have 2 sharpened images and can proceed to the next stage of enhancement and combination using GIMP.

4) Enhancement with GIMP

There are many and various ways of optimising images, but the following is what I normally do.

The following is done with GIMP 2.10 which is quite different to GIMP2.8, but the principles are the same. You also need to download and install the G’MIC plug-in for GIMP.

Starting with the disc image, open this in GIMP, and then open “Curves” from the “Colours” drop-down menu.

The histogram on the screen shows the value distribution of the image. The peak is about half-way up the plot. I usually move the transform line so that the peak is at around 0.8-0.9 and add some curvature.

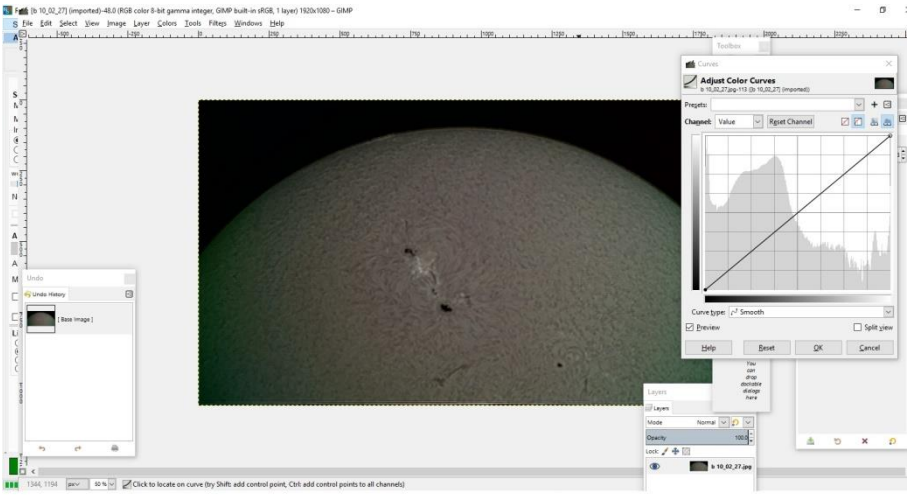


Figure 6 Disc "Curves"

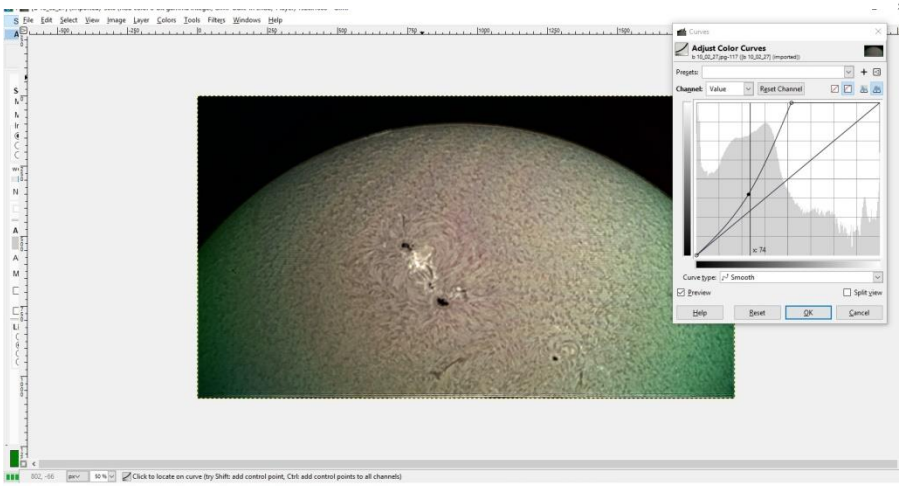


Figure 7 Disc modified “Curves”

At this stage you might also wish to sharpen the image further. If so click on “Filters”, “Enhance”, “Unsharp Mask” or “Filters”, “G’MIC”, “Details”, “Sharpen (Richardson-Lucy)” and adjust the appropriate sliders as you wish. This image is fine without this step.

Ha light is highly monochromatic, so at this stage I usually desaturate the image. Click on “Colours”, “Desaturate”, “Desaturate”, and choose one of the desaturation regimes that are presented.

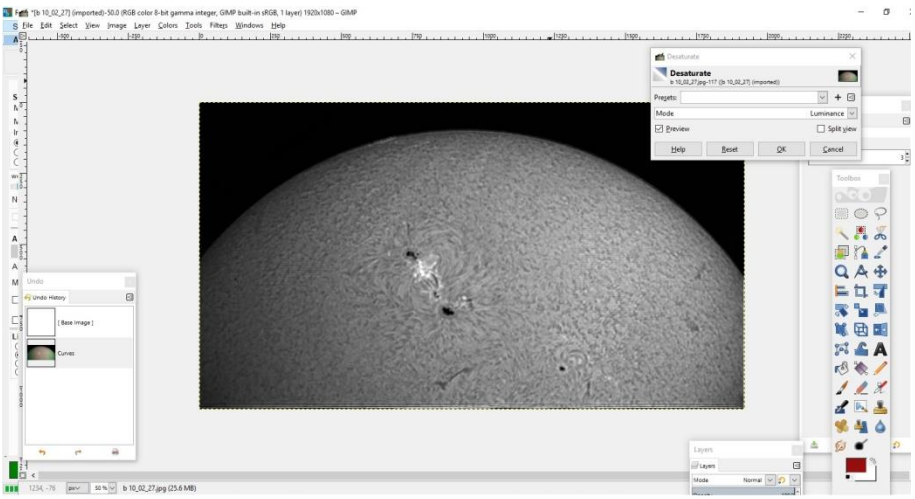


Figure 8 Disc desaturated image

Although monochromatic, sometimes we like to see the Ha images in (false) colour. To do this, click on “Colours”, “Colorize”, and select a hue. I like a hue of 0.13 in GIMP 2.10 (042 in GIMP 2.8)

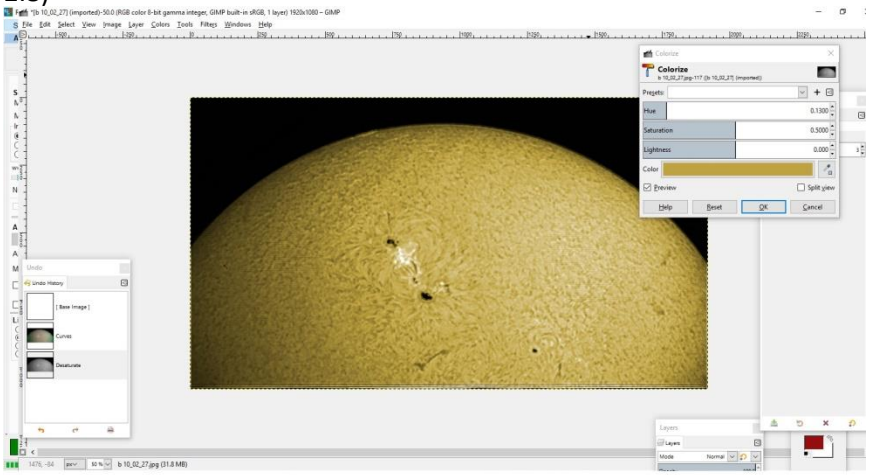


Figure 9 Disc colorized image

Now save this image with an appropriate name by clicking on “File”, “Export as”, “Export”, “Export”.

We now need to do something similar with the prominence image. I used an S-shaped “Curves” transform this time to optimise the prominences.

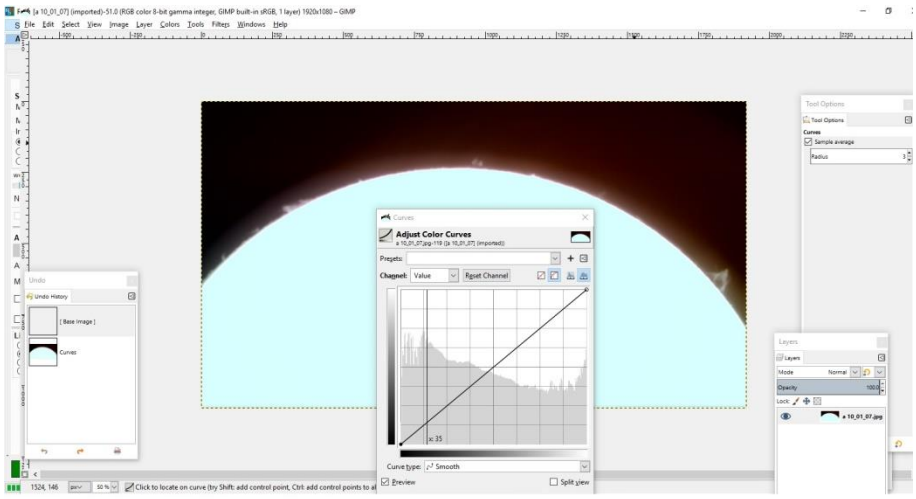


Figure 10 Prominence base image

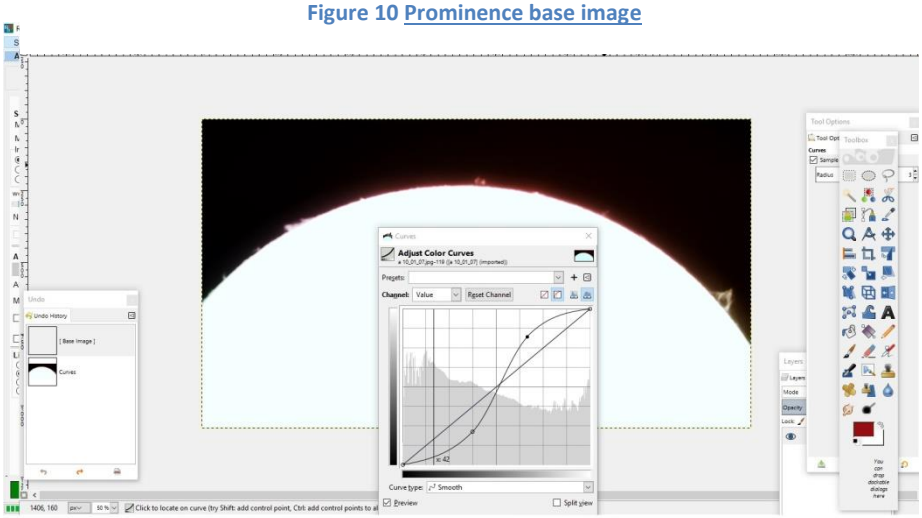


Figure 11 Prominence image modified "Curves"

For the prominence image, there seems to be some value in a further enhancement using the “Unsharp Mask”. Click on “Filters”, “Enhance”, “Unsharp Mask”.

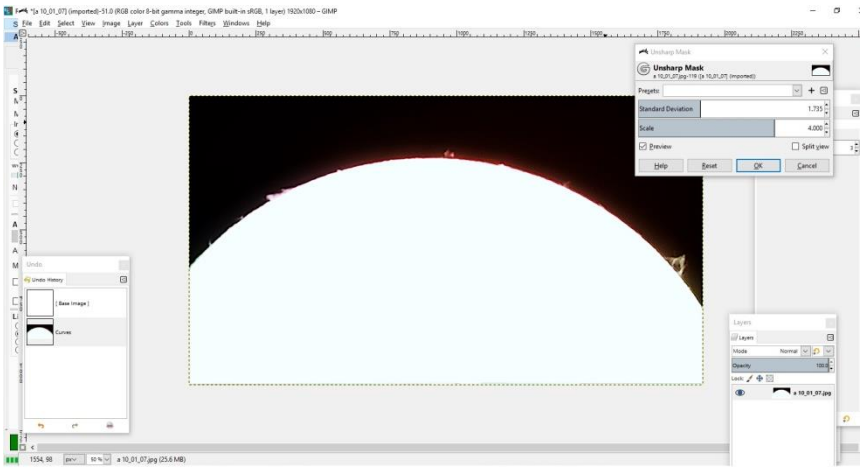


Figure 12 Prominence image Unsharp Mask enhanced

For “Colorization” I like to see the prominences in red, so I use the following “Colorization” regime:

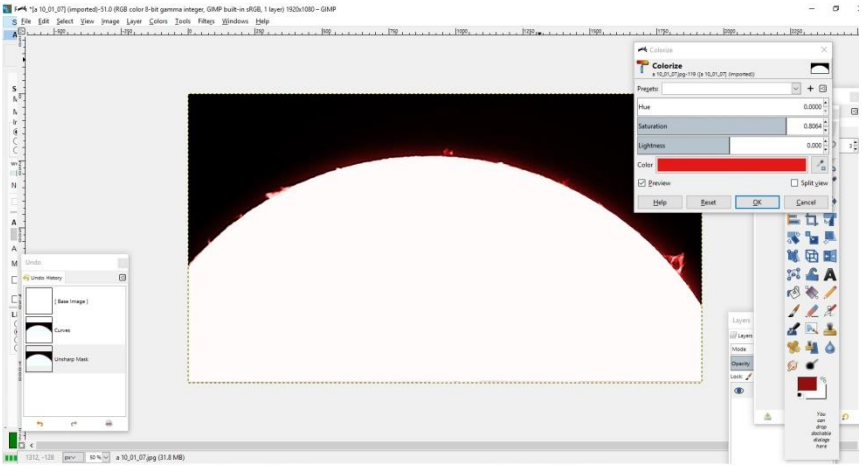


Figure 13 Prominence image colorized

As before, now export this image with an appropriate name.

We now have our disc and prominence images. We now need to combine them and make the final adjustments.

5) Combination of the images

To do this we make use of the “Layers” method.

In GIMP, click on “File” and “Open as Layers”. Highlight the 2 images and click “Open”.

Ensure you can see the “Layers” drop down by clicking on “Windows”, “Dockable dialogs”, “Layers”. Ensure the prominence image is on top. If it isn’t, highlight it, hold down the left mouse button and move the layer up.

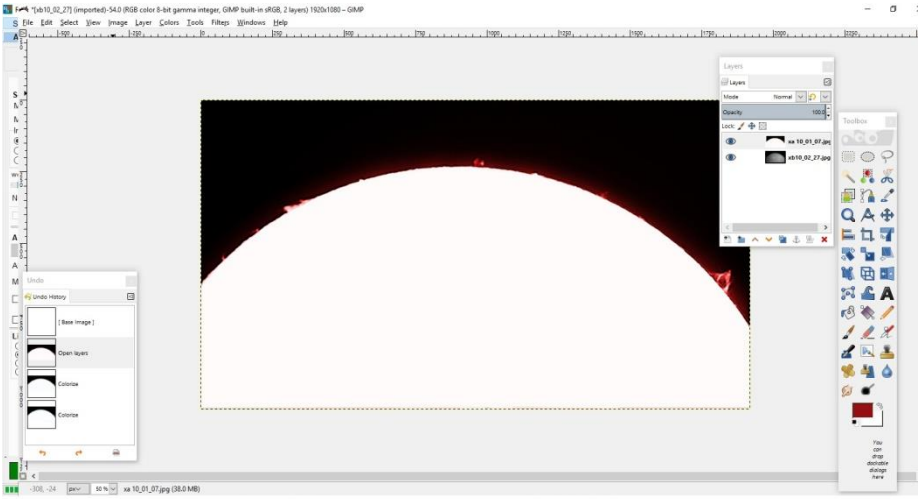


Figure 14 The 2 layers

We now need to align the 2 layers. One way of doing this is to highlight the prominence layer and set its mode (at the top of the “Layers” box) to “Difference”.

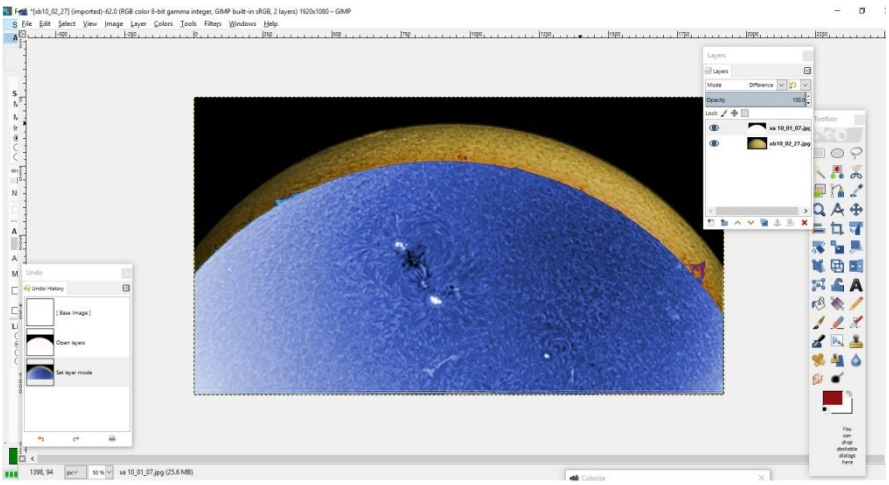


Figure 15 Prominence layer difference mode

You can now see the 2 layers to facilitate the alignment.

Highlight the prominence layer, click on “Tools”, Transform tools”, and “Move”.

Hold down the LH mouse button and move the layer until both layers are aligned.

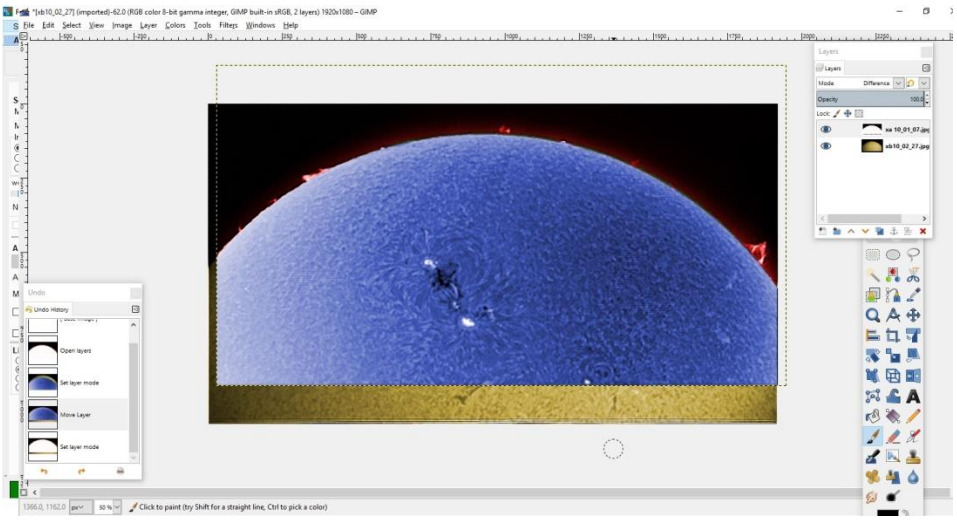


Figure 16 Aligned layers

Now reset its mode to “Normal”

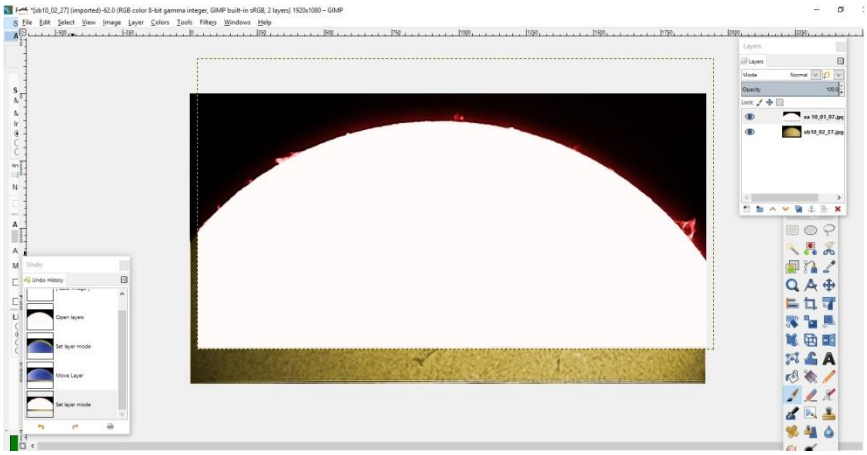


Figure 17 Top layer back to "Normal"

We now need to create a “Layer Mask” so that only the parts of the images we want are combined. To do this, highlight the top layer, right click, click “Add layer mask” and from the resultant menu check “Grayscale copy of original”.

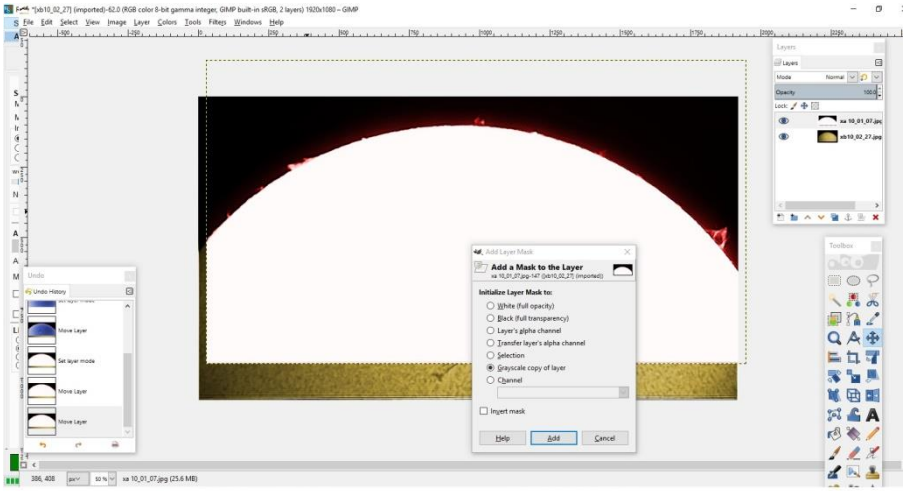


Figure 18 Add layer mask

The mask will then appear in the “Layers” box

We now need to edit the mask so that it is a “clean” black-and-white disc. The first stage is to right click on the mask and then click “Show layer mask”

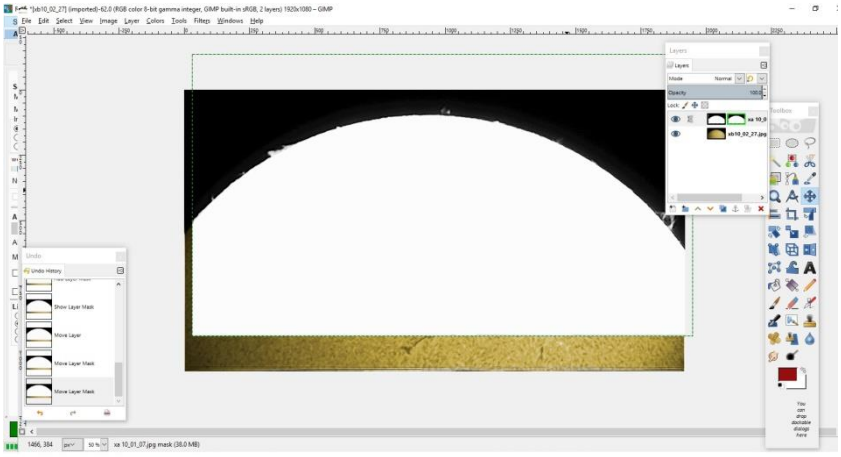


Figure 19 Show layer mask

With the mask now visible, we want to remove the prominences from the mask. The first stage is to go to the “Colors” tab, then “Curves” and try to remove the prominences by using a very sharp transform.

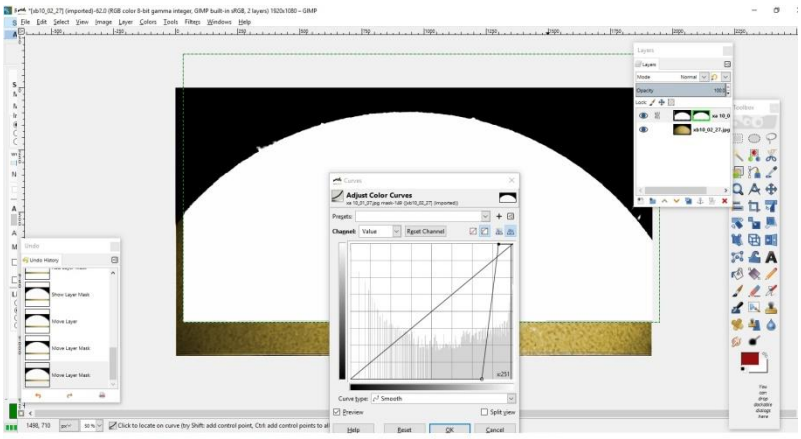


Figure 10 Mask "Curves" transform

This has removed most of the prominences from the mask, but not quite all. I remove the rest manually by using the “Paintbrush” tool from the “Toolbox”. If the “Toolbox” has disappeared for any reason, go to “Windows”, then “Toolbox” from the drop-down menu.

For the mask to have the desired effect it needs to be black for the disc and white elsewhere. To do this go to the “Colours” tab and then “Invert” from the drop-down.

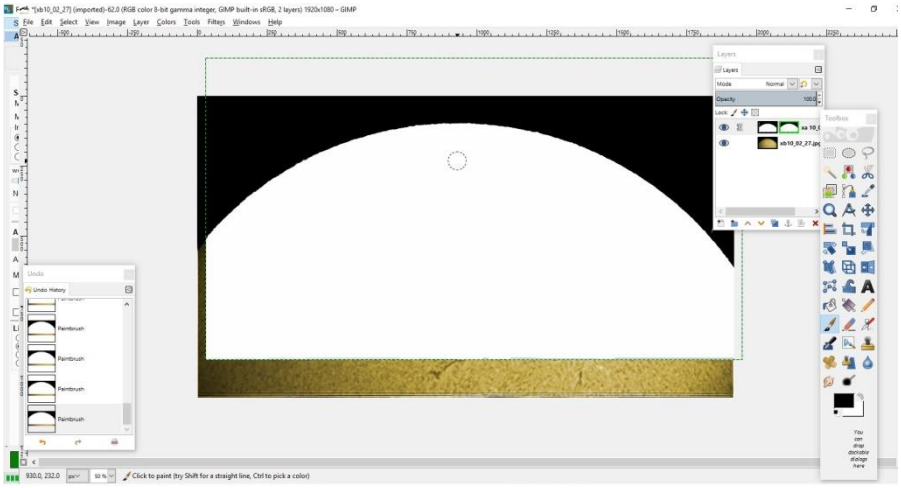


Figure 21 Mask Paintbrush edit

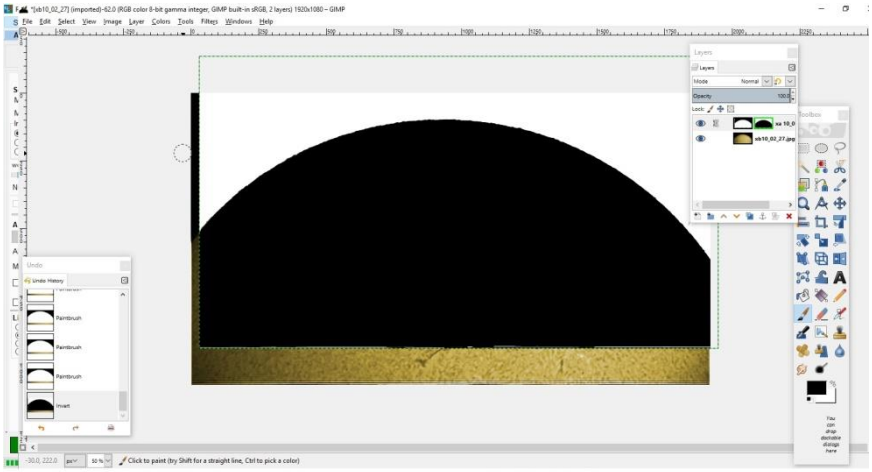


Figure 22 Mask inverted

Now to see the final combination, we right click on the Layer mask and un-check “Show layer mask”.

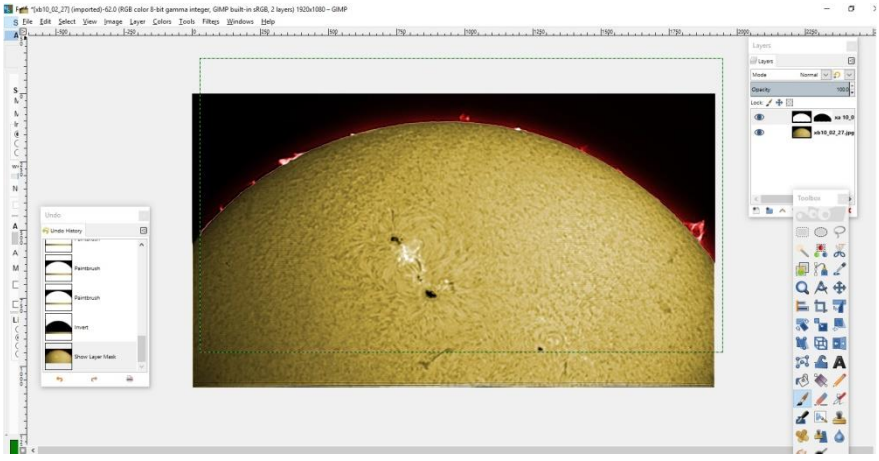


Figure 23 Layer mask "unshown"

Now we are almost there! Go to the “Layers” tab and click “Merge down” from the drop-down. This consolidates the layers into 1 image. The telescope/camera optics produced a vertically flipped image, so we need to flip this back. Go to the “Tools” tab, and from the drop-down, “Transform tools”, “Flip” to flip the image. (Hold down Ctrl to flip it vertically).

To ensure we see all the available image, go to the “Image” tab and click “Fit canvas to layers” from the drop-down.

Don’t forget we rotated the camera 90 degrees to accommodate the prominences, so again we need to rotate it back. Got to “Tools”, “Transform tools”, “Rotate”, and then “Rotate” again from the Rotate box to do this. Again, go to “Image” and “Fit canvas to layers” to see all the image.

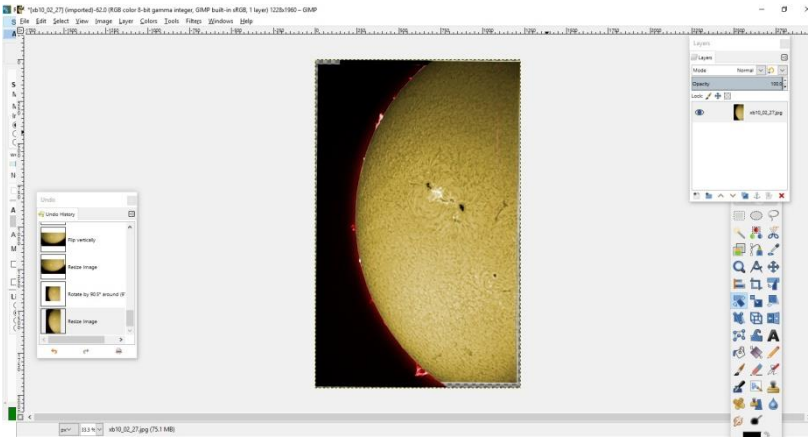


Figure 24 Image flipped and rotated

We can now crop the image to taste. Go to “Tools”, “Transform tools”, “Crop”, then select your crop area and hit “Return”

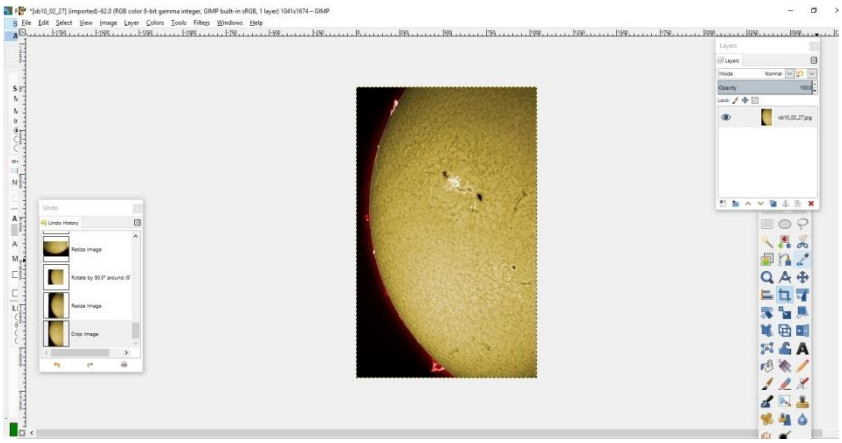
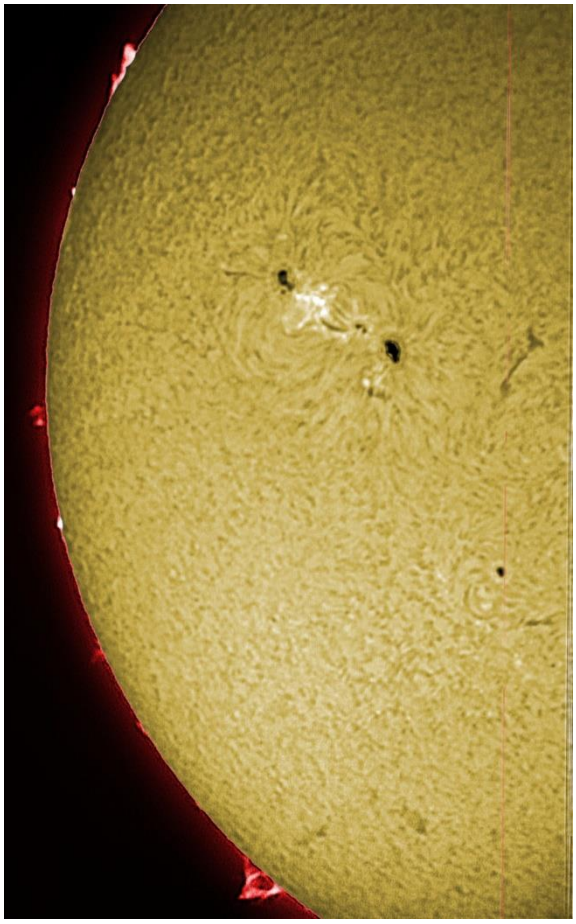


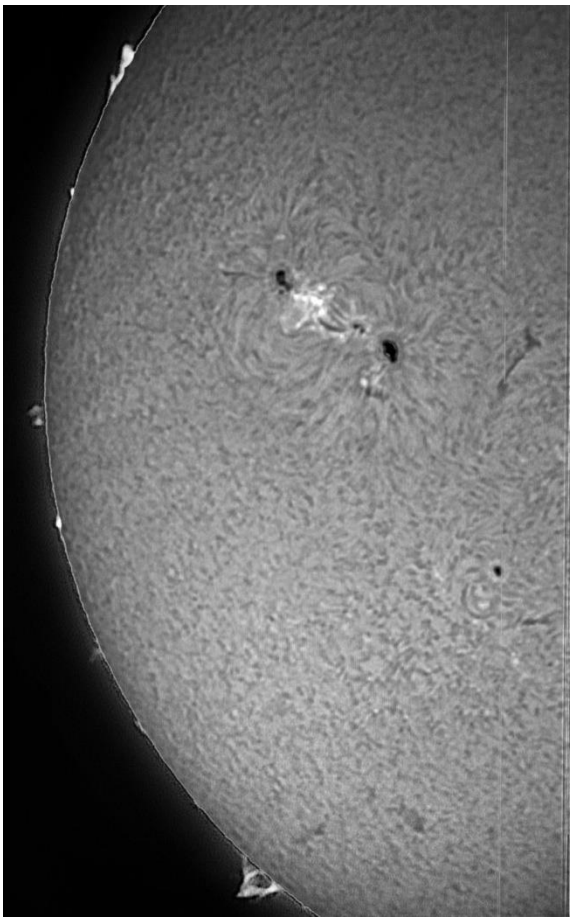
Figure 25 Cropped image

Don’t forget to “Export as” the final image!

Finally, If you prefer the images in black-and-white, (generally, I do), Go to “Colours” and “Desaturate”, or desaturate in any editing software

Final images:





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10/07/2018