

Pretty astronomical pictures

Tricolor image composition
Photoshop

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Pretty astronomical images

- ▶ Tricolor image composition
- ▶ The most important things to know from Photoshop

Good references:

- ▶ Adam Block (2013), *Deep sky imaging: workflow 1*
- ▶ Johannes Schedler (2013), *Deep sky imaging: workflow 2*
- ▶ Both in *Lessons from the masters*, ed. Robert Gendler (New York: Springer)



M42 and M43 from lousy data at Mees, L-[SII]-H α -[OIII]; L from February 22, 2020, spectral lines from March 27, 2020. First image has been sharpened/enhanced, while the second is just off-the-shelf.

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LRGB

Thus, ground-based, broadband pretty pictures are almost always LRGB composites.

Even if you wind up without much, or any, L data, it is still worthwhile to generate a pseudo-L frame if possible.

- ▶ For example, if you put all of your time into R, G, and B, you could align the mean R, G, and B images very well, and average them. The result could be used as a substitute for L.
- ▶ Not as good as a lot of 1×1 binned L, but prettier and higher contrast than RGB by itself.



Today's example: M101 from Mees, LRGB, June 14, 2016. This is L. Notice the many artifacts — mostly flat field errors — that were not corrected in calibration.

Usually, the multiple-image-plane and Luminosity features of Photoshop are used to combine L and RGB images, using the RGB as the background, shining through the L image.

- ▶ L acts as a **transmission mask**, suppressing noise in the blank sky in the RGB image, and imposing sharp detail on the bright parts.
- ▶ Enables use of even more subterfuge on RGB, such as coarser binning (which is already part of our recipe) and further blurring within Photoshop to reduce color noise, without changing the resolution of the final product.
- ▶ Penalty: total loss of small-scale color and surface-brightness accuracy.
 - ▶ Colors are smeared over more L PSFs than they deserve to be.
 - ▶ If the L image has been deconvolved too, well... see Lesson 3.
 - ▶ Now, it is more a work of art. Which is, of course, not all bad.

Color composition

CCDStack is a good tool for combining multicolor Mees images into an RGB color composite. Here are the steps.

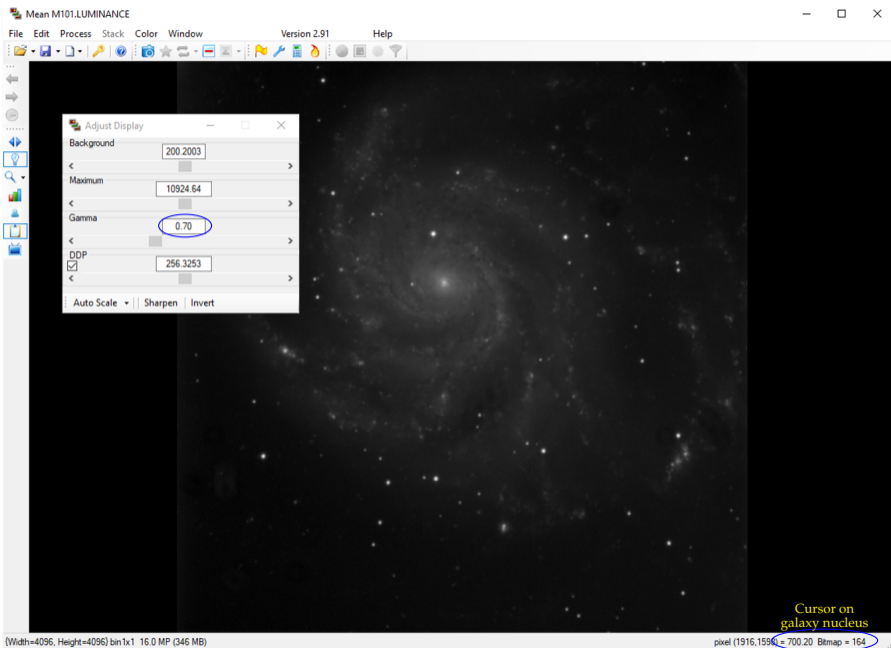
1. If your final L image is binned 1×1 and your colors 2×2 (according to our recommendations in Lesson 2), then load L, and then the colors. With L as the reference image, register (align) the others to it. This will result in an interpolation of the colors to 1×1 binning, as well as lining up all the stars. Then close the L image.
2. Go to Color Combination, specify the images to combine if necessary, and enter the scaling factors.
 - ▶ Choose which images you want represented as R, G, and B.
 - ▶ Choose scale factors by which to multiply the images, according to how the colors bring out the structures you want to emphasize.
 - ▶ “True color” (to make A0V look white in images with the same exposure time): R:G:B = 0.67:0.80:1.0. Or, to make G2V stars look white, R:G:B = 0.50:0.67:1.0.

Color composition

3. Then click **Apply** to get an RGB composite.
4. Reload your L image.
5. Counterintuitively, you will now need to make them both a bit duller, so that Photoshop can change the component brightnesses either up or down:
 - ▶ Stretch the display to a lower gamma and maximum so that nothing important is close to 256 in Bitmap units.
6. Save scaled image to produce 16-bit scaled TIFF images.



M101, RGB, full frame, DDP stretch



LRGB

Now, on to Photoshop (or Photopea).

1. In Photoshop, open (File > Open) the scaled L and RGB TIFF images you want to use.
2. Choose the tab with the L image, select the entire image (Ctrl+A) and copy (Ctrl+C).
3. Choose the tab with RGB and paste (Ctrl+V). This creates a layer containing L above the RGB background.

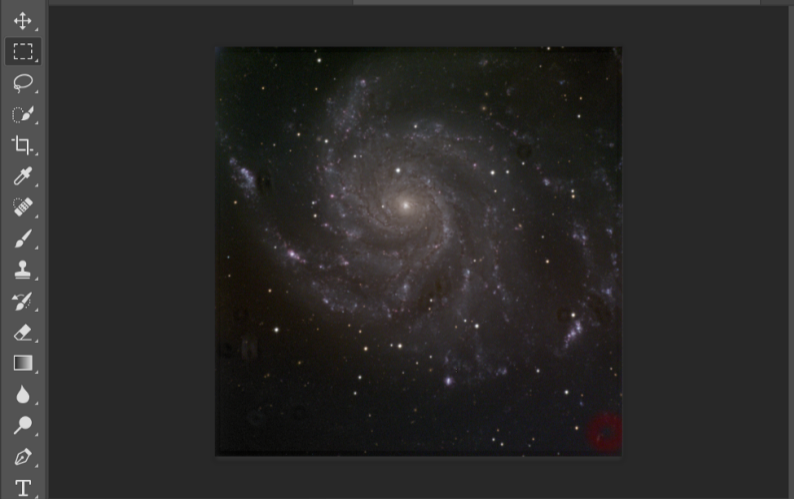


LRGB

4. You will see this superposition indicated on the Layers tab at the lower right of the Photoshop window.
 - ▶ If you want, rename the layers by double-clicking the name and typing a new one.
5. Select the upper layer (L, Layer 1 if you did not rename it), click on the dropdown box immediately above it, which starts off saying Normal, and choose Luminosity (last choice in the list).
6. Now, the colors are shining through the L image, and you are ready to start tuning the image to look nice.

Tip

Take note of the menu items Edit > Undo, Edit > Step Backward, and Edit > Step Forward, by which you may recover from almost any misstep in Photoshop, or toggle between two steps in the process.



Color Swatches

Libraries Adjustments Styles

Layers Channels Paths

Kind

Luminosity Opacity: 100%

Lock: Fill: 100%

Layer 1

Background

fx

Turning up the LRGB image

As long as L and RGB are two separate layers, you can — and should — operate on them separately. Make sure to always look through L onto RGB with the Luminosity overlay, as shown on the previous page.

Here are the tools to use, and *roughly* the order in which to use them:

1. View > Zoom In, View > Zoom Out, and View > Fit on Screen, invoked with keyboard shortcuts Ctrl++, Ctrl+-, and Ctrl+0, respectively. You will use these a lot.
2. Select RGB (background) layer and do Filter > Blur > Gaussian Blur. This essentially convolves the RGB layer with a Gaussian, which smooths out the noise in this layer; it also blurs the layer, but not the final image, as the L layer determines the detail.
 - ▶ Do this to suppress “color noise” in the Highlights parts of the image: those parts where L is bright.

Turning up the LRGB image

3. Several tools under Image > Adjustments, still just on the RGB layer:

Shadows/Highlights Favorite of Adam Block's; I cannot make it work as well as he does, but it is a versatile tool for adjusting the signal and color of background and highlights with respect to each other. For example: taking color out of the background without affecting the color of the highlights very much.

Levels Can adjust the black level (left slider), white level (right), or midtone (middle) of RGB all at once or one color at a time.

- ▶ Note especially that raising the black level of RGB — basically, cutting off all of the signals below the level indicated by the left slider — dramatically increases the color saturation of the highlights.

Curves Enhance or suppress some ranges of brightness with respect to others in a smooth and nonlinear fashion.

Turning up the LRGB image

Vibrance Brightness of color, which is somewhat different from color saturation. Often turned up way too far in APOD images; careful of what it does around stars and compact parts of the highlights. Also has a Saturation slider.

Hue/Saturation Allows tweaking of colors in mixed ways, like CYM instead of RGB. Adjusting M (magenta) is often useful in making HII regions in galaxies look a bit more like the real thing.

Color balance Some of the same features as **Hue**, but allows adjustment separately for shadows, midtones, and highlights, and does so in energy-conserving fashion.

Brightness/contrast Like **Levels** but more crude. Might not help much if you did all of the others first.

4. After RGB, select the L layer and revisit **Levels** and **Curves**.
5. Important: **Raise the L black level last.**

Tuned-up LRGB image



Flattening and retouching

6. When you are happy with the tuned-up image superposition, combine the two layers into one by using `Layer > Flatten Image`.
 - ▶ Now it is back to being a three-plane RGB image, but it still bears the L image's transmission, hence LRGB.
7. Retouching: Necessary to get rid of any remaining flat-field or deconvolution artifacts. This gets into some of the real magic of Photoshop.
 - Lasso** tool, and `Edit > Fill > Content-Aware`. Best thing for dust donuts and other flat-fielding flaws. Enclose them with the lasso and “erase” them with the menu command.
 - Brush** tool is a versatile way to click away tiny blemishes such as deconvolution artifacts. I still find myself using Lasso and content-aware fill for this, but the brush can be quicker.

Final steps

1. Save as . . . , of course. Do not overwrite your original TIFF files.
2. Save the full frame before you crop, as a 16-bit TIFF image.
3. Use the Crop tool to prepare a trimmed version of the image for posting on the internet (PNG) or printing and framing (TIFF).
 - ▶ Note that the Crop banner has some useful ways to set the cropping frame's aspect ratio precisely.
 - ▶ Picture frames frequently have ratios 4:3, 5:4, or square.
 - ▶ [Fracture](#) is a good printing service to use, which prints images directly on glass and adds a stiff backing, for nice frameless hangings in many sizes and 4:3 or square aspect ratio.
 - ▶ Printing takes practice: things look different on the screen and on paper.