DSLR Astrophotography

They say… start with a joke.

DLSR Wide-field Astrophotography
The Advantages

It's Relatively Inexpensive
All you need is a DLSR camera

…and a tripod

You Don't Need This!

Nikon

v.s.

Canon

Most DSLR astrophotographers use Canon cameras.

Canon releases the details of the camera's software.

- This allows the development of third party software, designed specifically for astrophotography.

Nikon does not create a truly raw image

- A simple median blurring filter is always applied... removing many stars, as they are seen as noise.
- This prohibits precise image calibration.
- Some Nikons allow the "Mode 3" work around.

Using Nikon's Mode 3

Simply start the bulb time exposure and terminate it by turning off the camera.

The camera sees this as a low-power warning and immediately saves the image without running the median blurring filter

Testing For Mode 3 Availability

Take a one-minute dark exposure in Mode 1. This is a raw image with "no noise reduction" selected.

Take a one-minute Mode 3 dark exposure.

If Mode 3 is available, that exposure will have noticeably more hot pixels and noise.

For Starters… Keep It Simple

Set the focus to infinity... before it's dark
Mount the camera on a sturdy tripod
Use a wide angle lens (18mm is nice)
Set the lens to its lowest f-stop
Use the RAW image format, at the highest ISO setting
Shoot 20-30 second exposures
Take about five dark exposures (more on this later)

…and you can get an image like this!

Nikon D40X
18mm @ f/4
ISO 1600
Mode 1
4 30-Sec exposures
4 30-Sec darks

After taking several Milky Way shots it may be time to get more adventurous.

Especially at night!

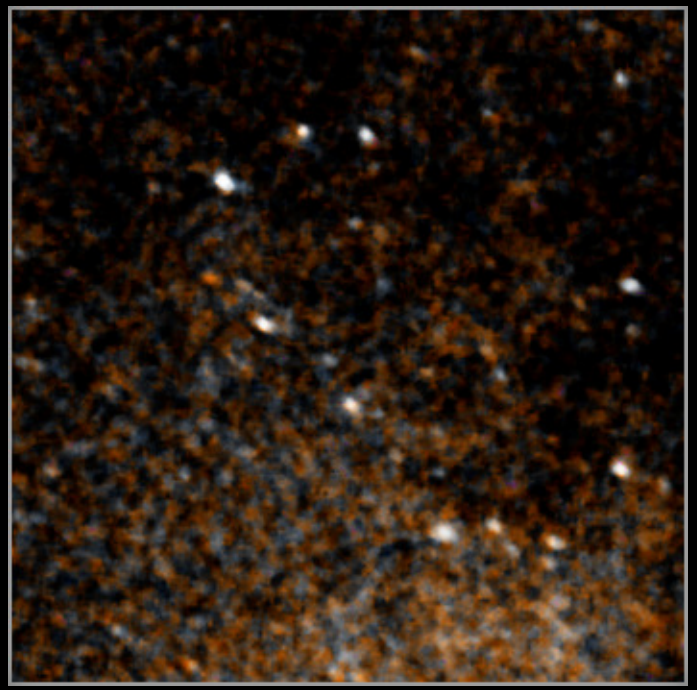
However, the
reward can be great.

The Barn Door Tracker

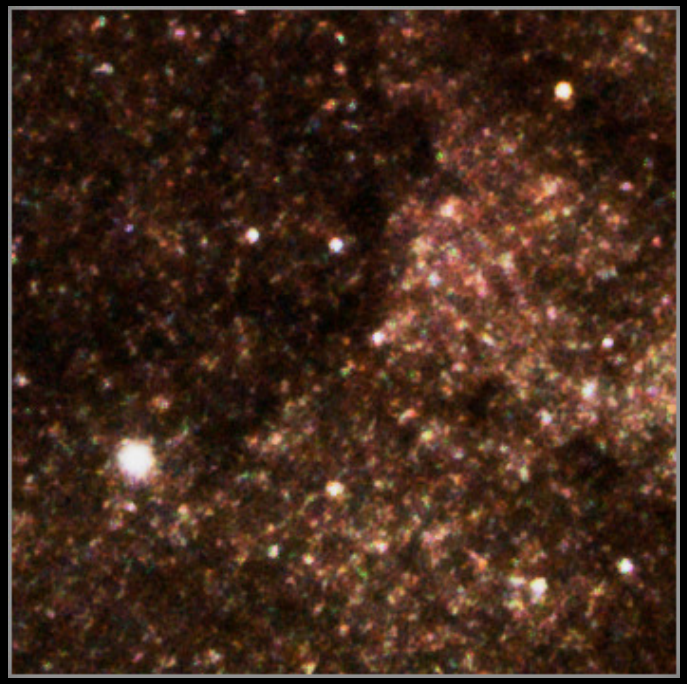
Build cost ~ $200. Just the ball head cost $50.

A polar alignment scope is used for set up. Holding a green laser on the pivot hinge also works, but look out for airplanes.

4 30-second exposures
using a stationary tripod



2 5-minute exposures
with a Barn Door Tracker



2 5-minute exposures
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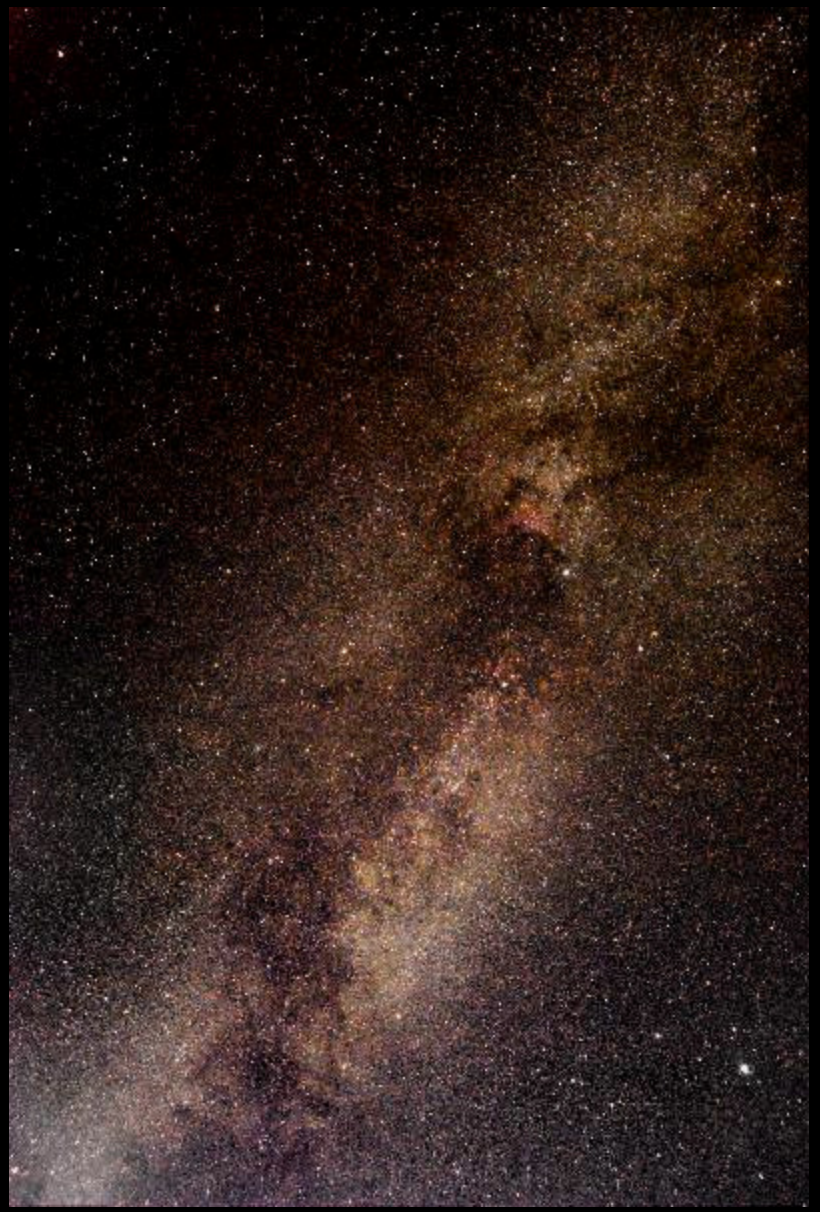


Two one-minute exposures w/ Barn Door Tracker

AstroTrac

This is the ultimate portable camera guider.

Base price is $600, but will be ~ $1000 with accessories.

It tracks for about two hours and takes about 90 seconds to rewind.

AstroTrac Guided

Canon EOS 1000D (ISO 400)
12mm f/5.6
18 5-minute exposures

Shown enlarged to 150%, reveals excellent star shapes and color.

AstroTrac Guided - Canon 200mm f/2.8 7x5 min exposures

Using a Modified Camera

DSLR CCD chips are very sensitive to infrared light. This requires installing an IR filter over the chip.

Unfortunately this also filters out the Ha data that is so important for emission nebula images.

The solution… Remove the filter!

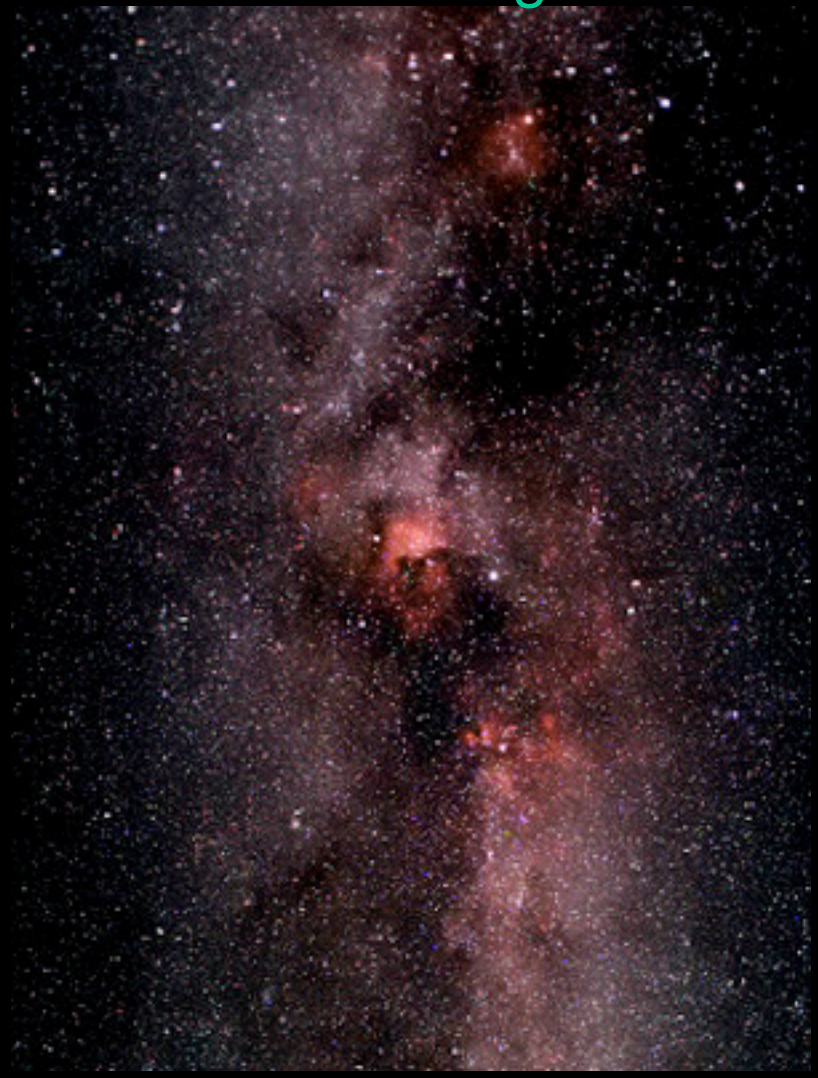
If you are skilled, there are several web sites with instructions to do it yourself.

Astro Hutch is one source for new modified Canon's, starting at $1100… including a 12-month warranty.

Filters are available so the camera can still be used for daylight photography.

Unmodified Canon
© Bernhard Hubl

Modified Canon
© Brian Morganti



Fixed Tripod Wide-Field Images

Use a fast 18-25mm lens. Fixed lenses are still better than zooms… except for maybe Nikon's $1800 14-24mm

Quality wide angle lenses start at about $800 and are worth it if you are going to get serious with starscapes.

For starscapes, use a high ISO, the widest lens opening and a single 30-60 second exposure.

For star fields, use a bit lower ISO, close the lens one f-stop and take multiple 20-30 second exposures.

Barn Door and High Quality Tracker Images

With a DIY tracker, use a maximum FL of 50mm. With a high quality commercial tracker, use up to 200mm lenses.

Close the lens one or two f-stops and use an ISO setting of 400 or 800.

Take multiple two to five minute exposures, depending on the quality of your tracking device.

About Dark Frames

Darks are taken with the lens tightly covered. This produces an image of the camera's noise and hot pixels.

During processing, the dark frame is subtracted from the light frame. This removes the hot pixels and inherent camera noise.

Set the time and ISO to match the light images.

Keep the camera at about the same ambient temperature as the light images.

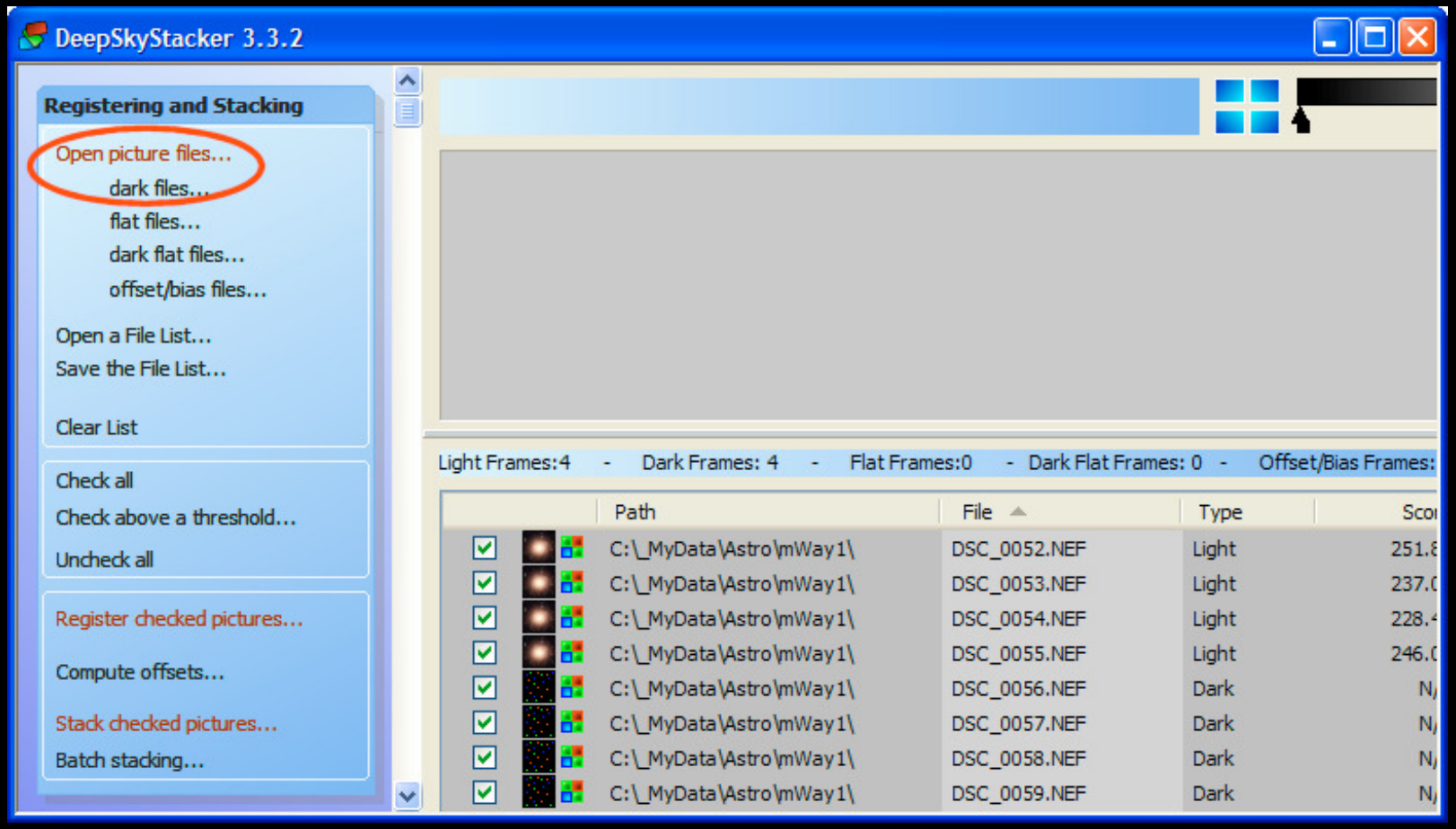
Take at least as many darks as lights, the more... the better.

Now that we have our light and dark frames, we can process the image.

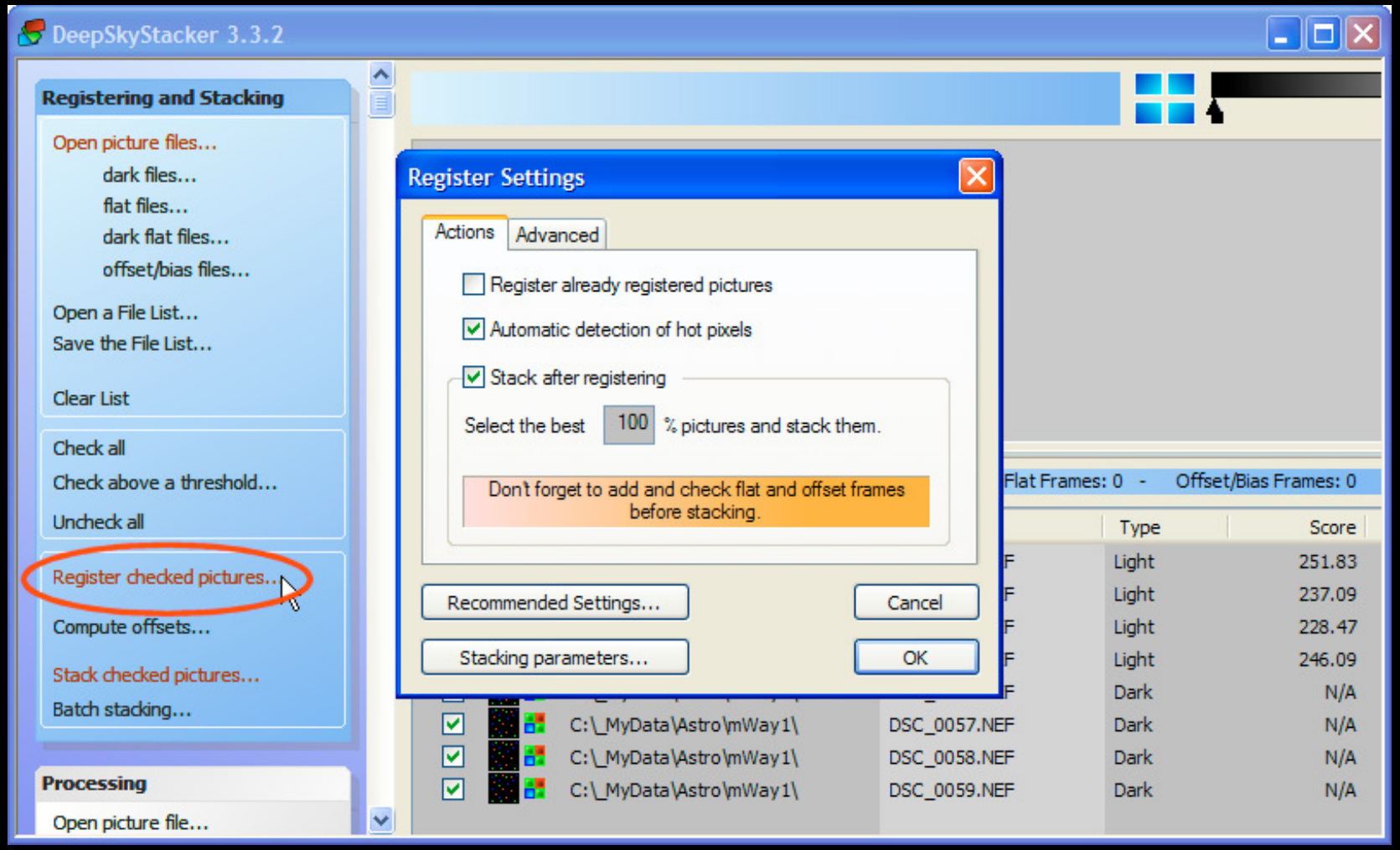
The rest of the presentation shows the processing steps… using three freeware programs.

- Deep Sky Stacker (DSS)
- IRIS
- GIMP

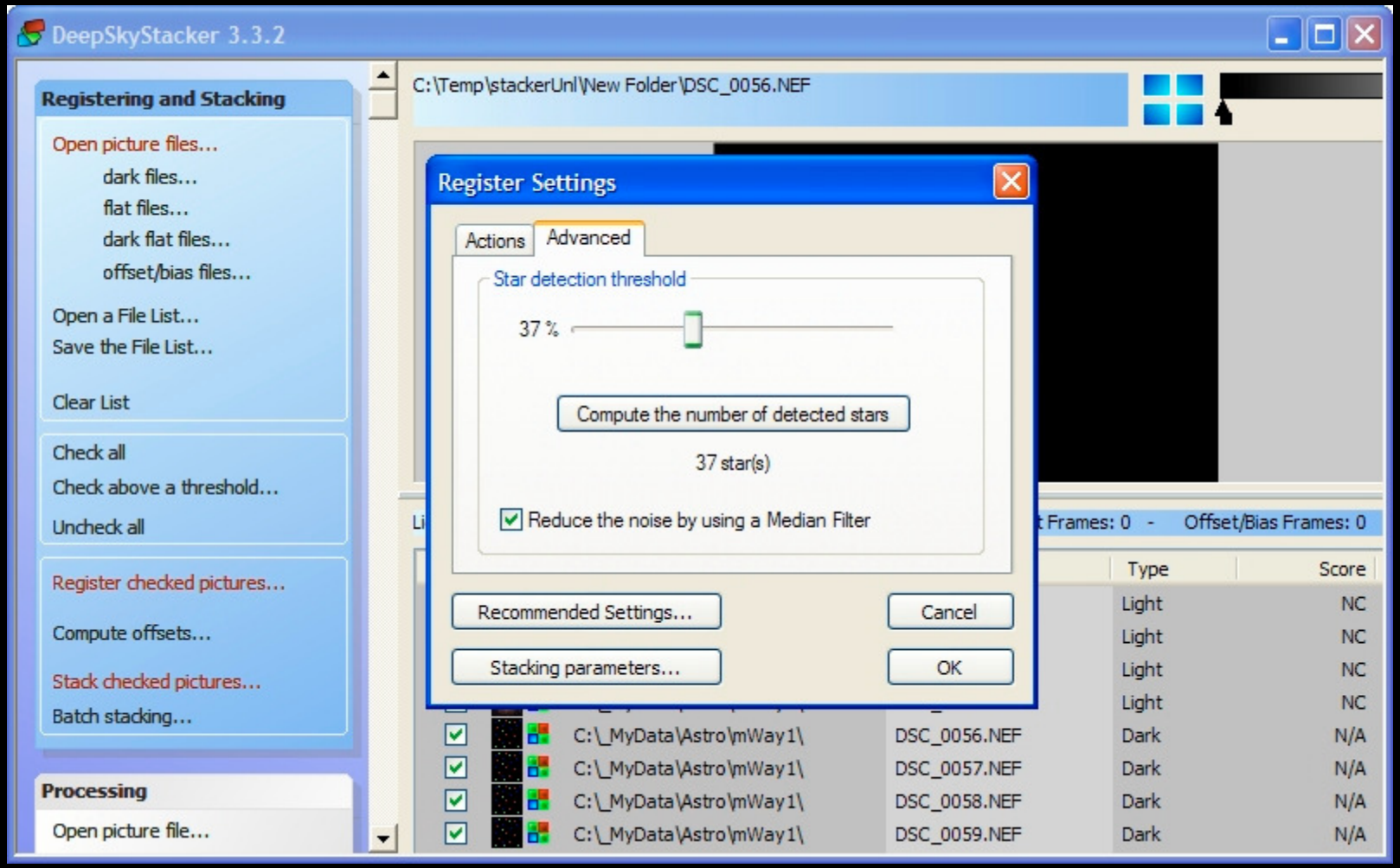
Start DSS and open the picture and dark files.



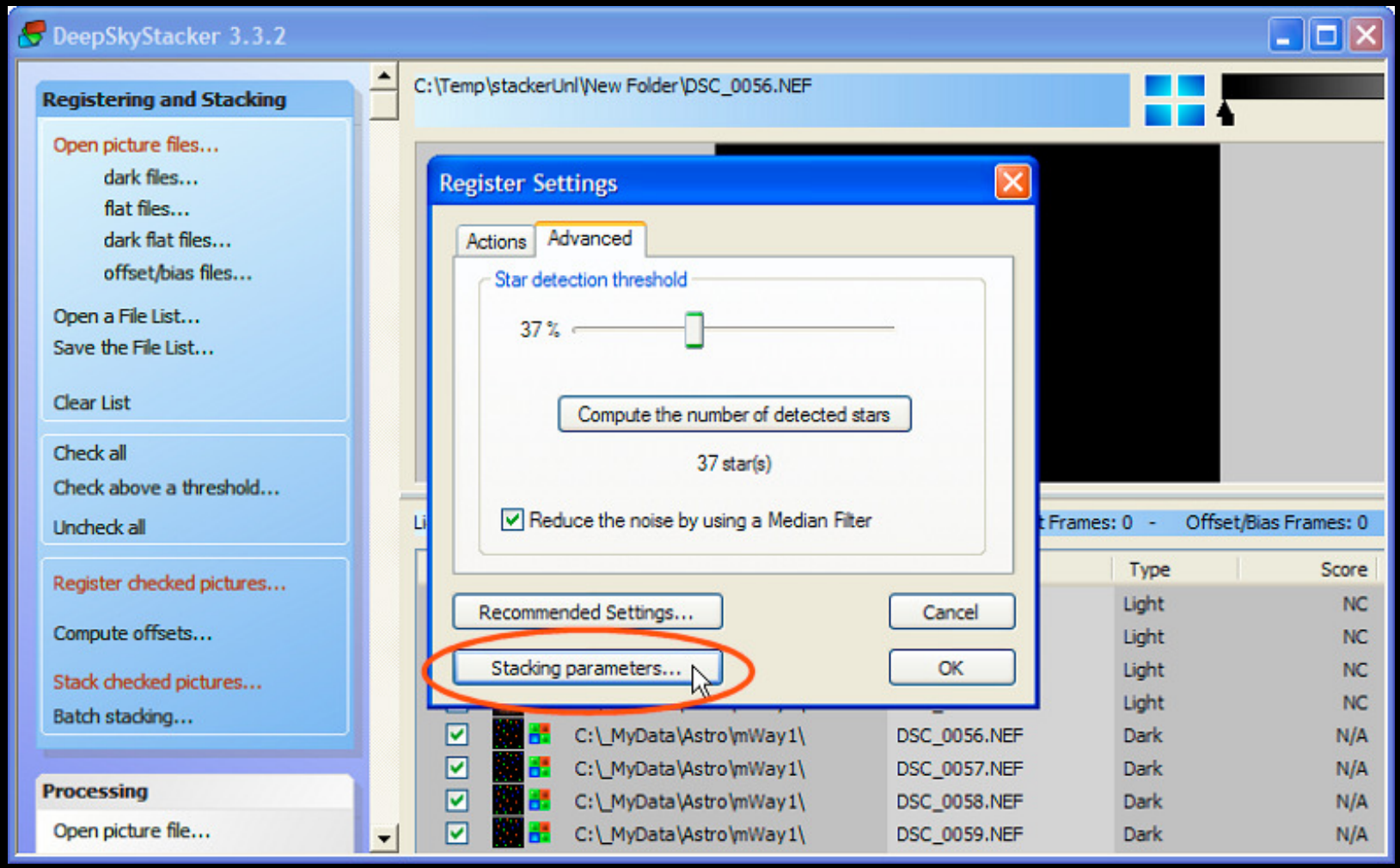
Click *Register checked pictures.*



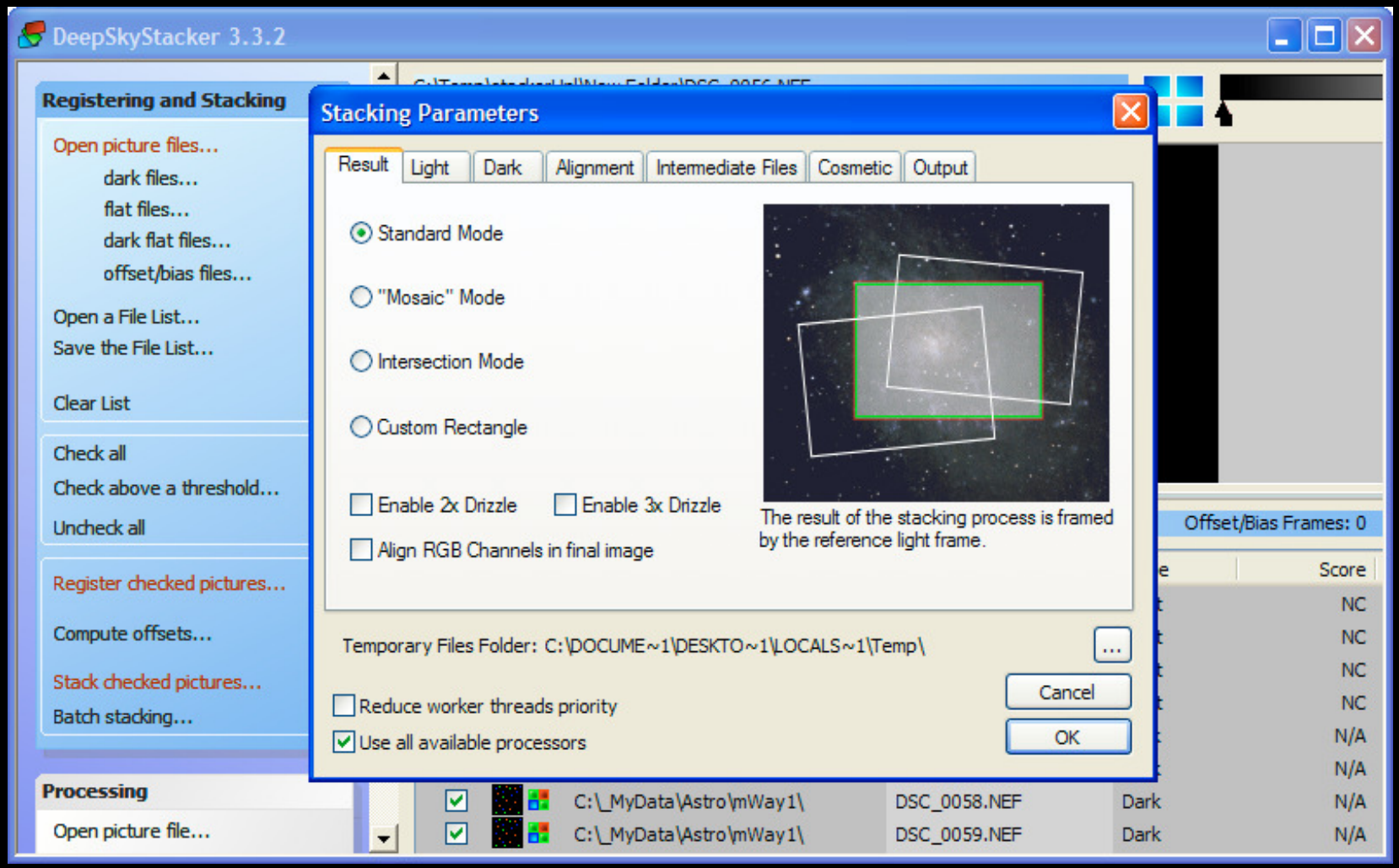
Set the star detection threshold.



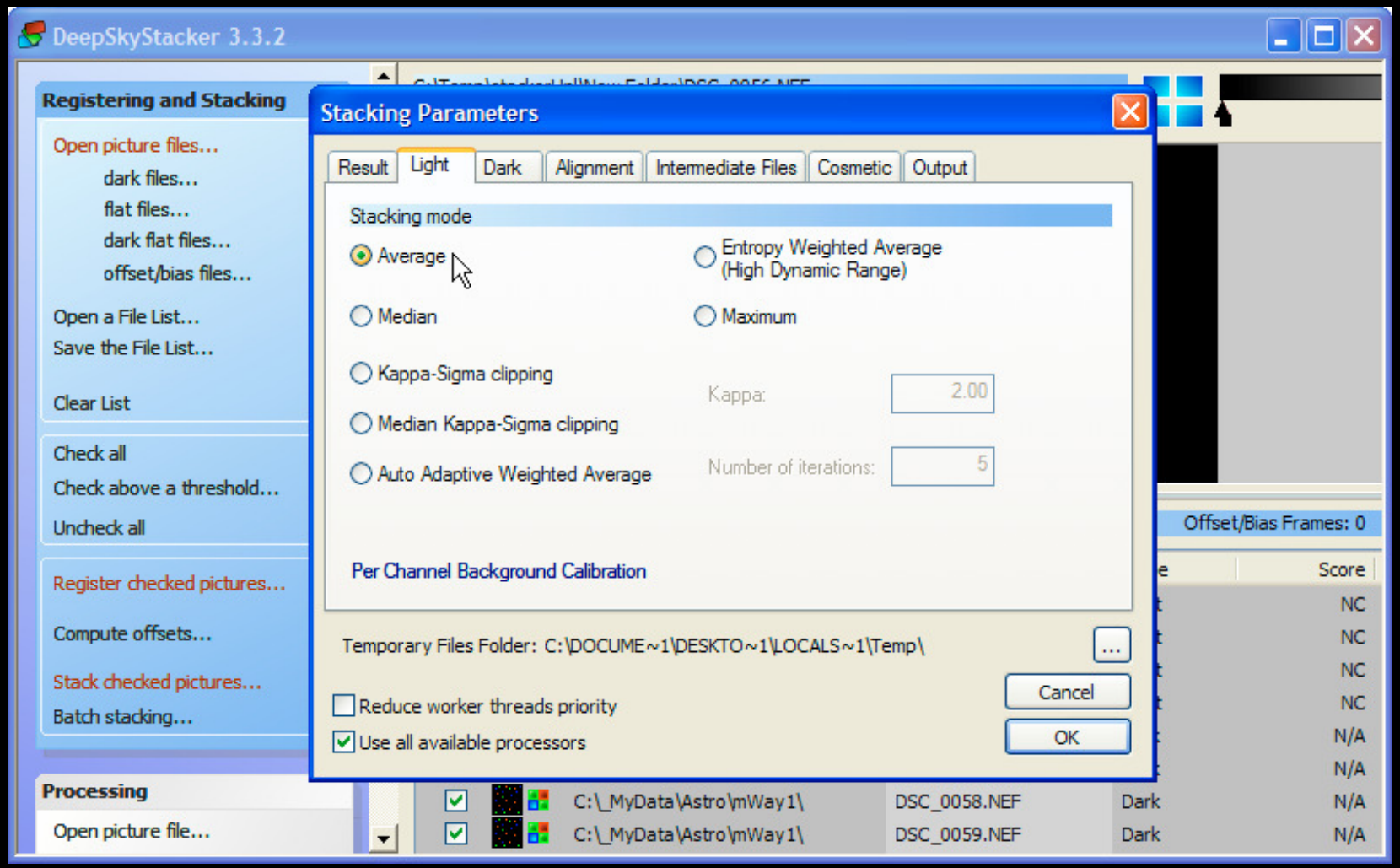
Click on *Stacking parameters*.



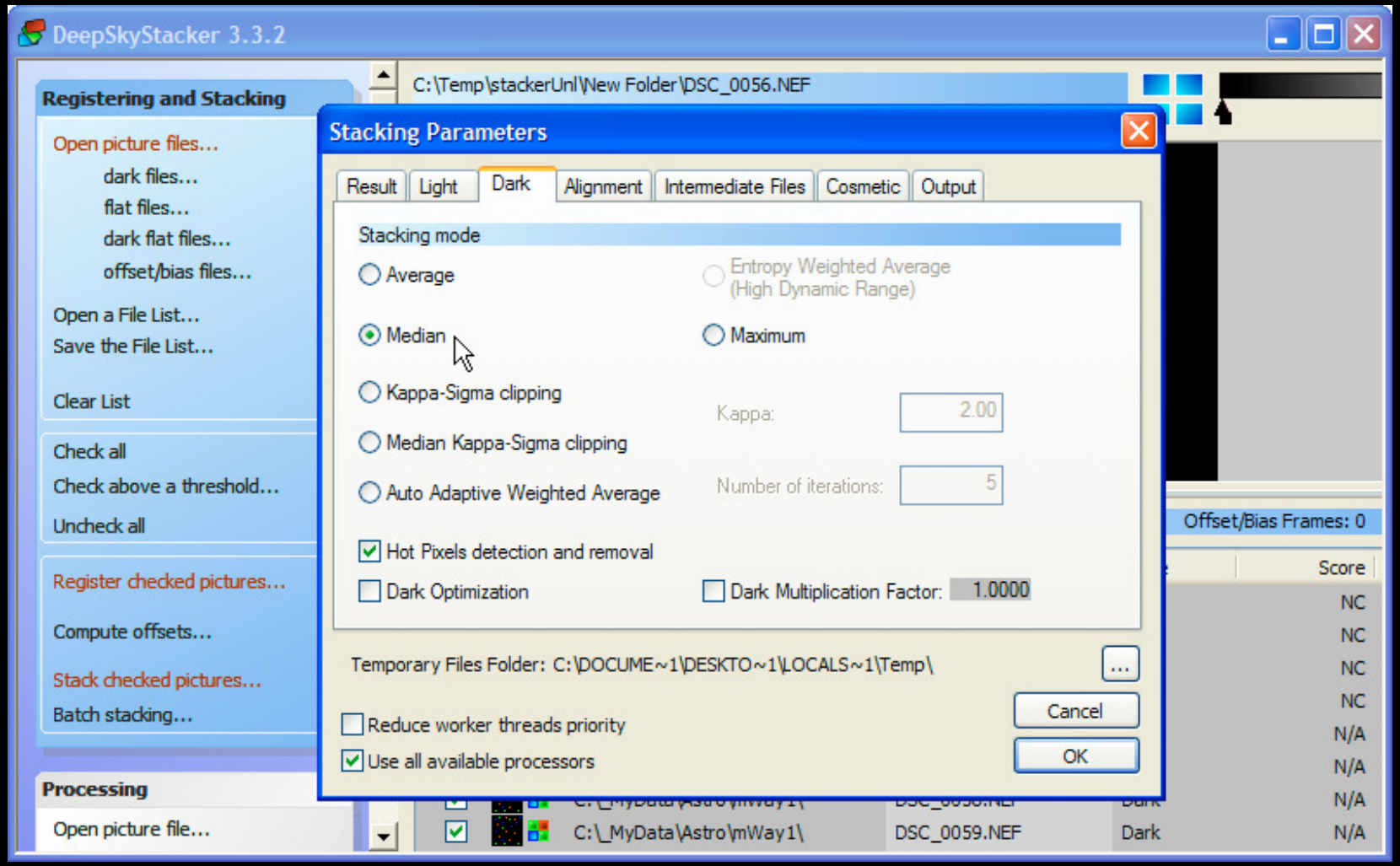
Select the Standard result mode.



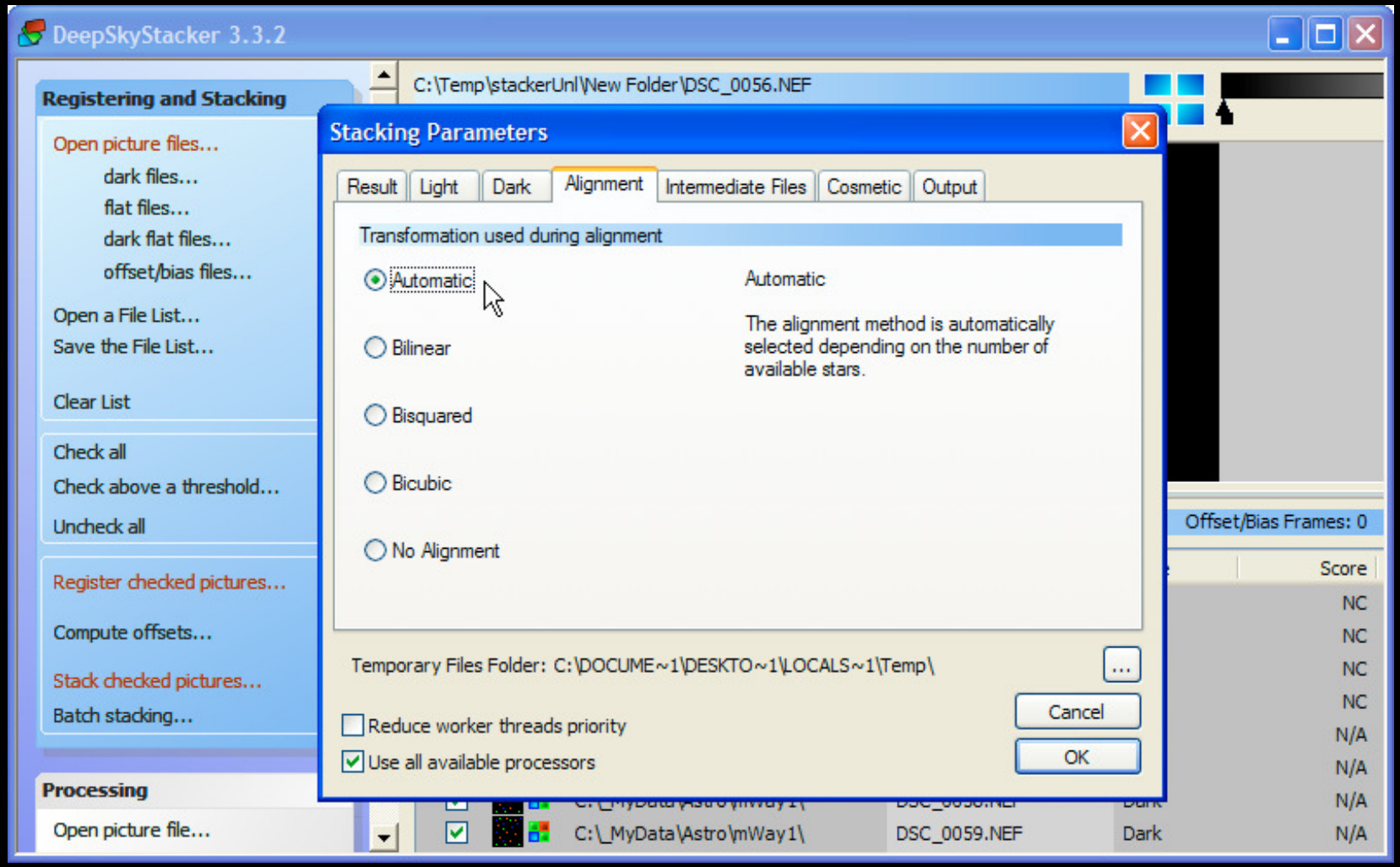
Select the Average stacking mode for lights.



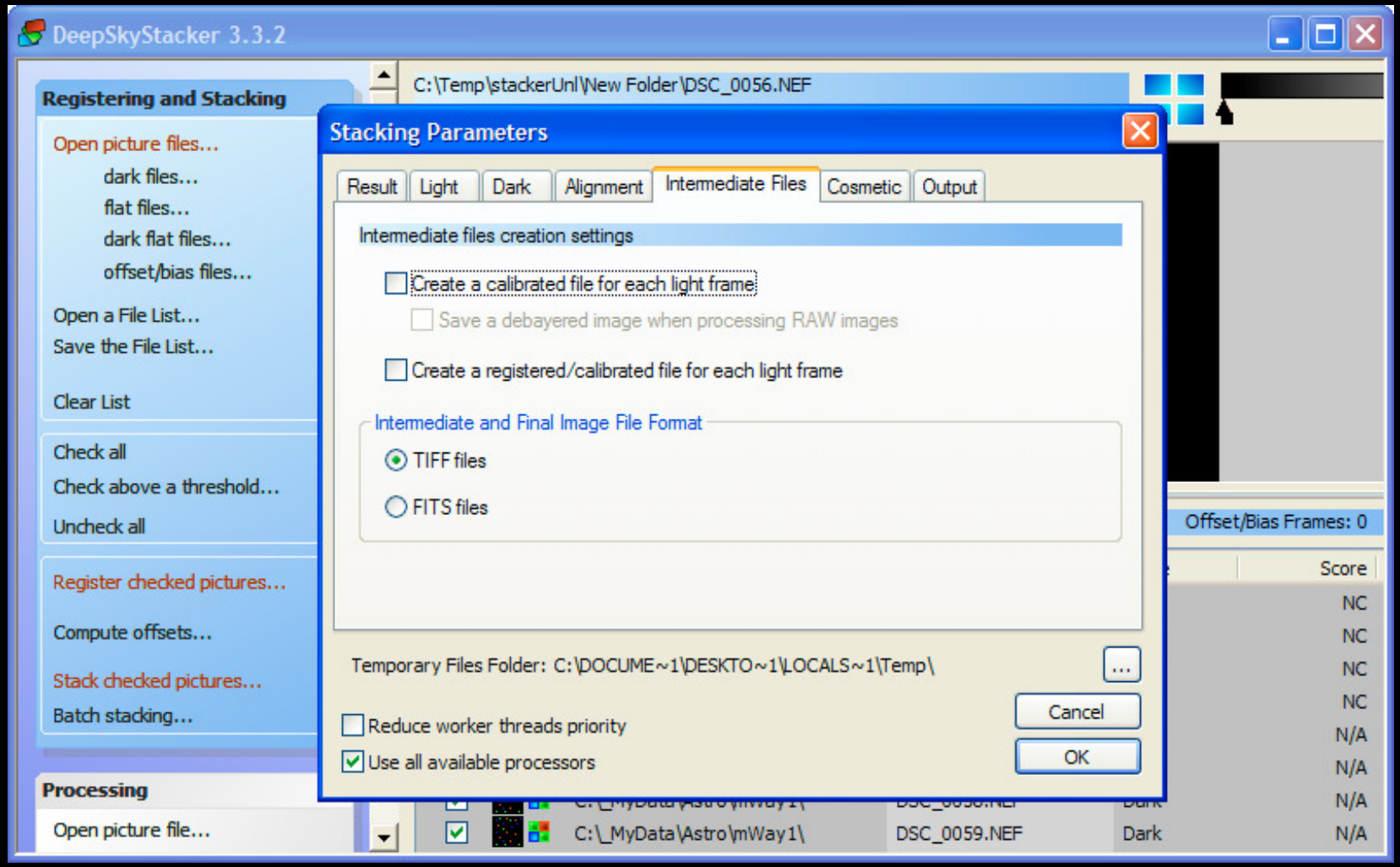
Select the Median stacking mode for darks.



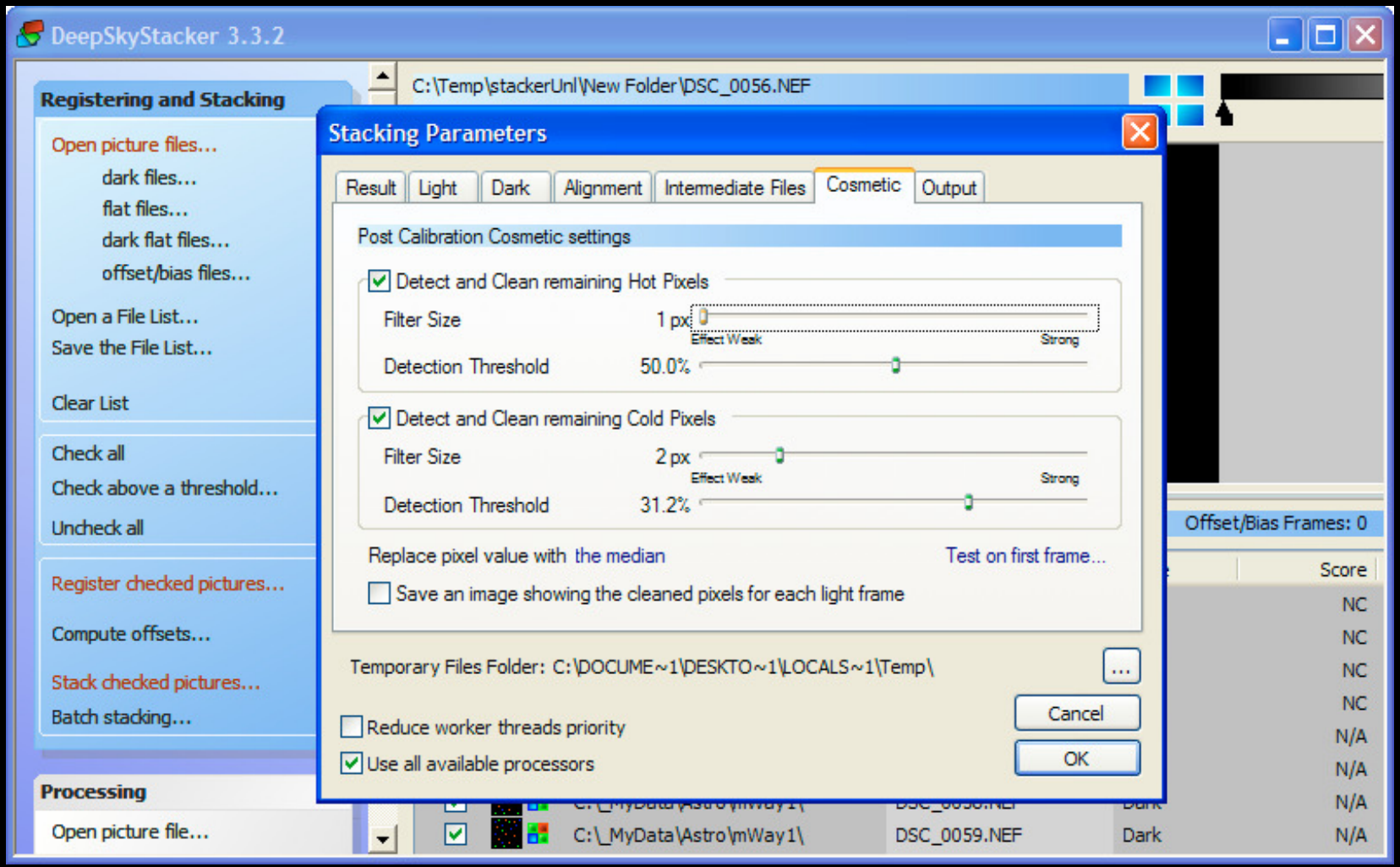
Select Automatic alignment.



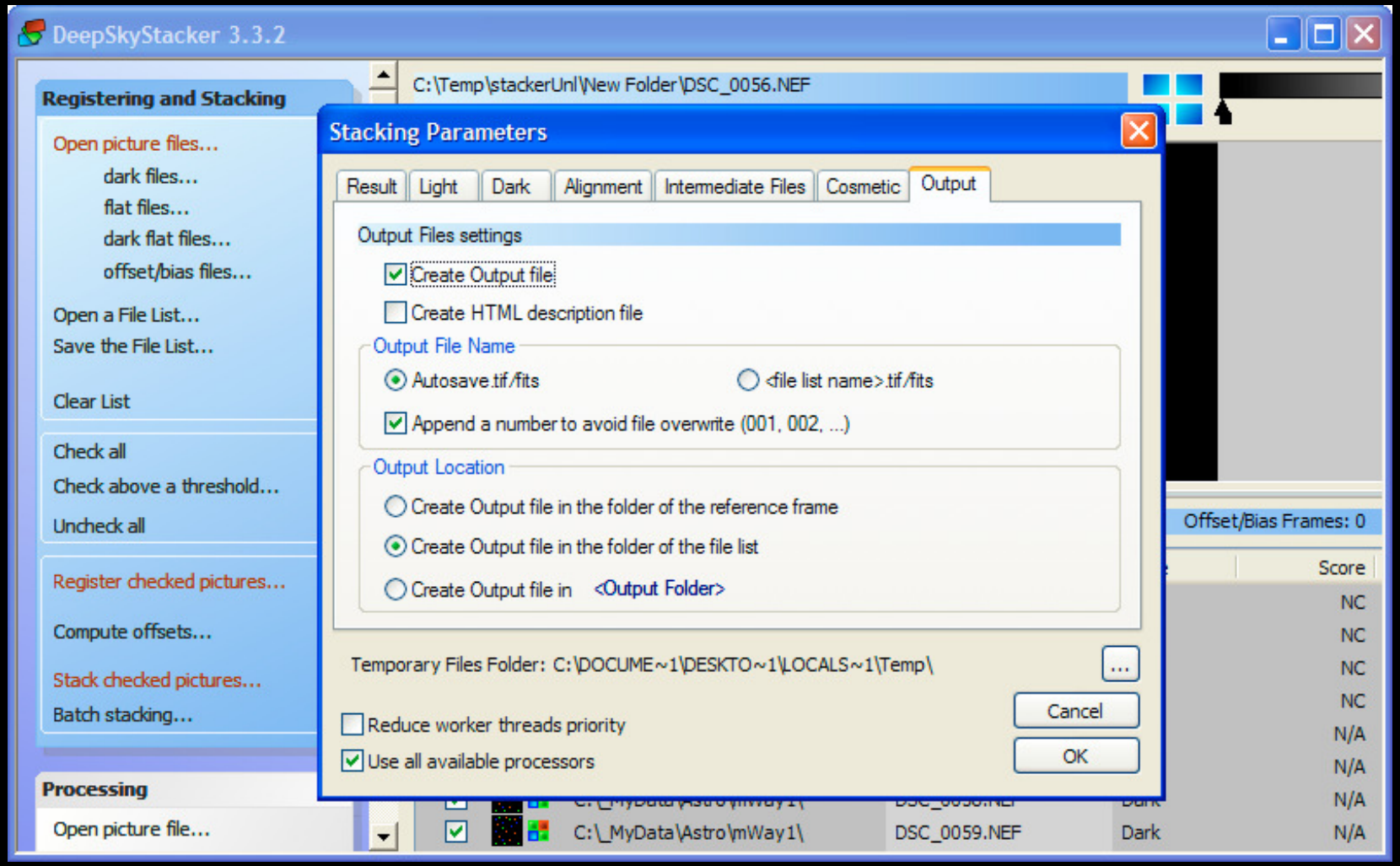
There is usually no need to keep temp files.



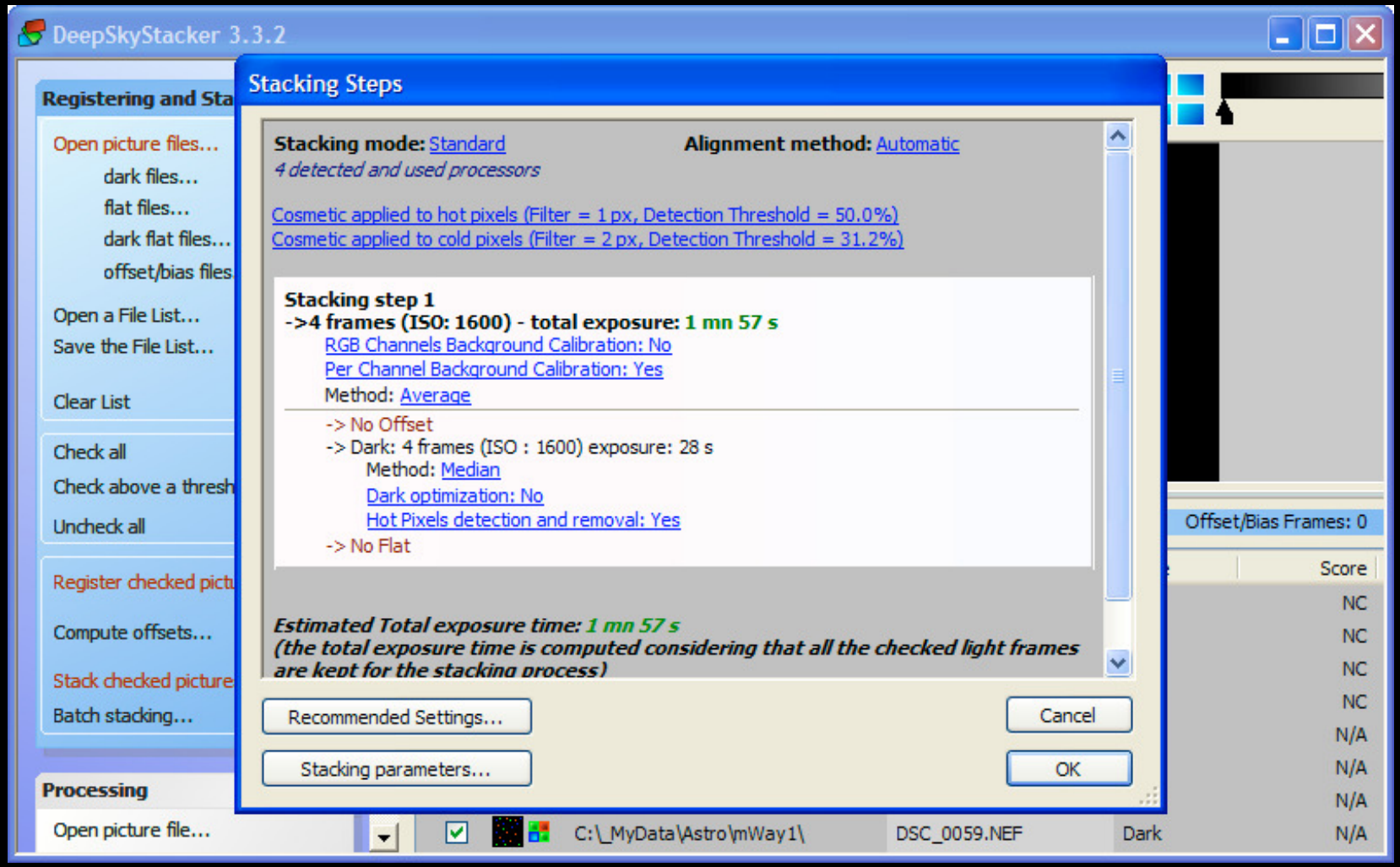
This tab will take a bit of experimenting. These settings seem to be working OK.



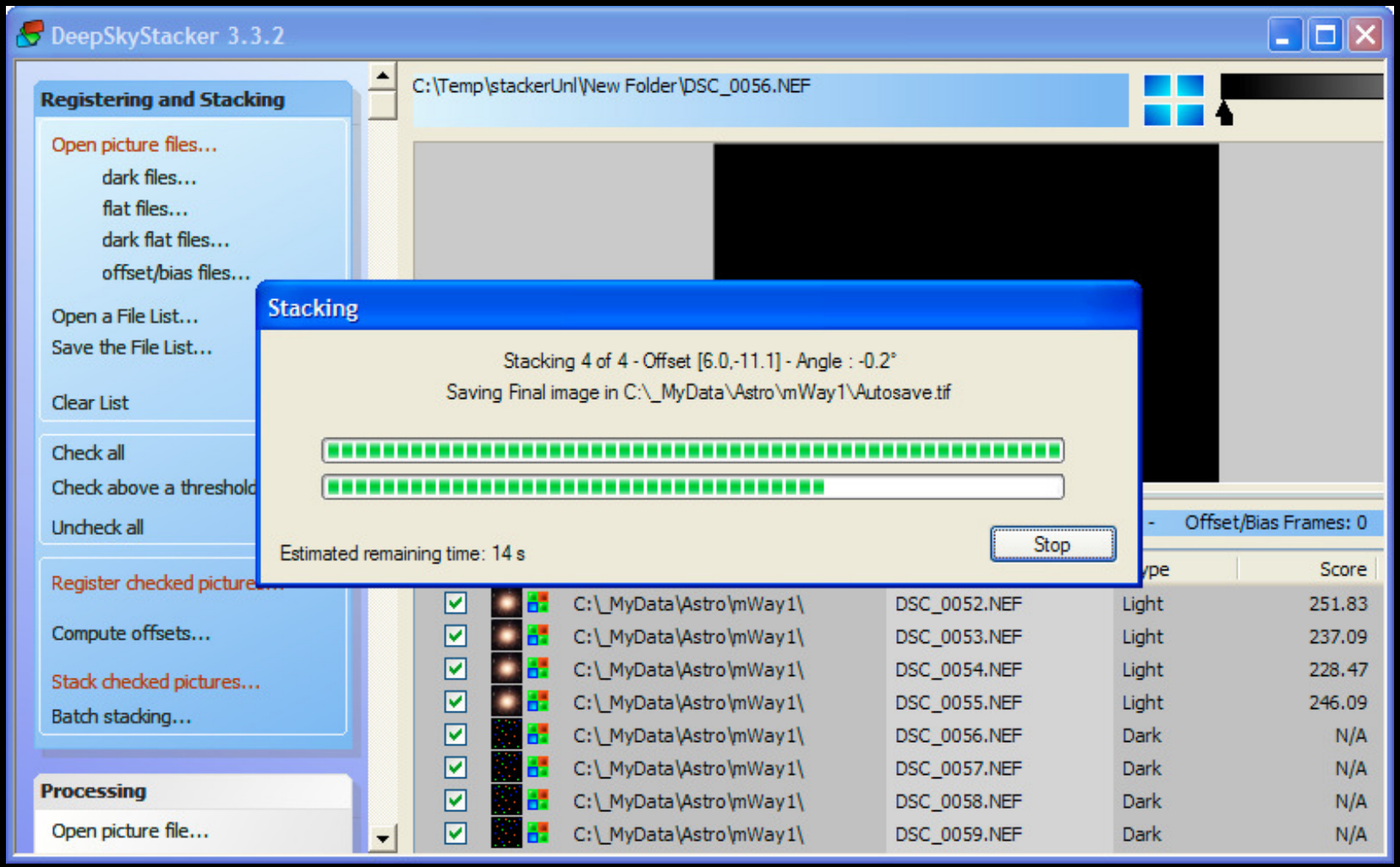
Finally, set the data for the output files.



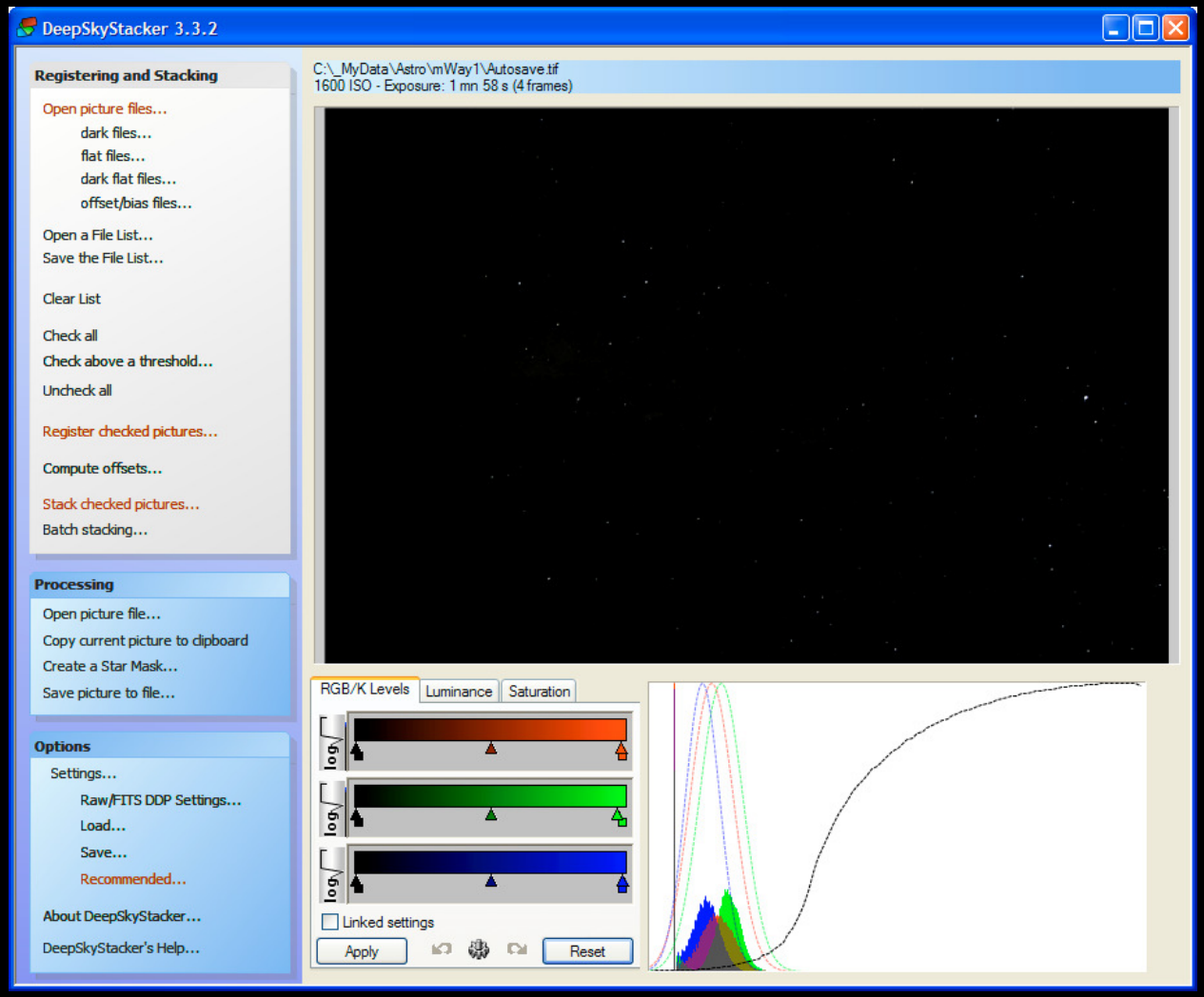
Click *OK*, until you get to this screen.



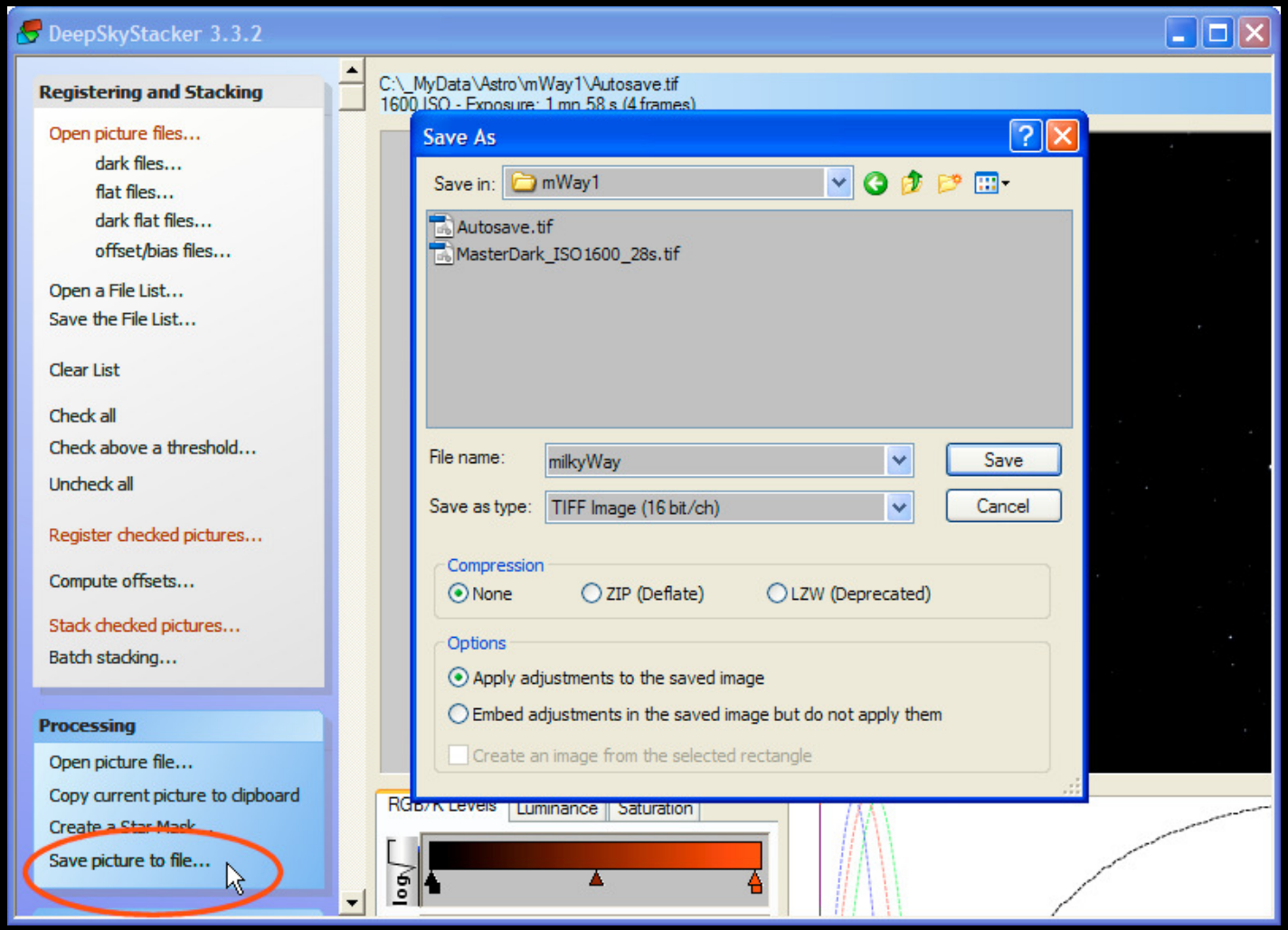
Click *OK* to start stacking. For this example DSS thrashes around for about two minutes.



The Final Stacked Image



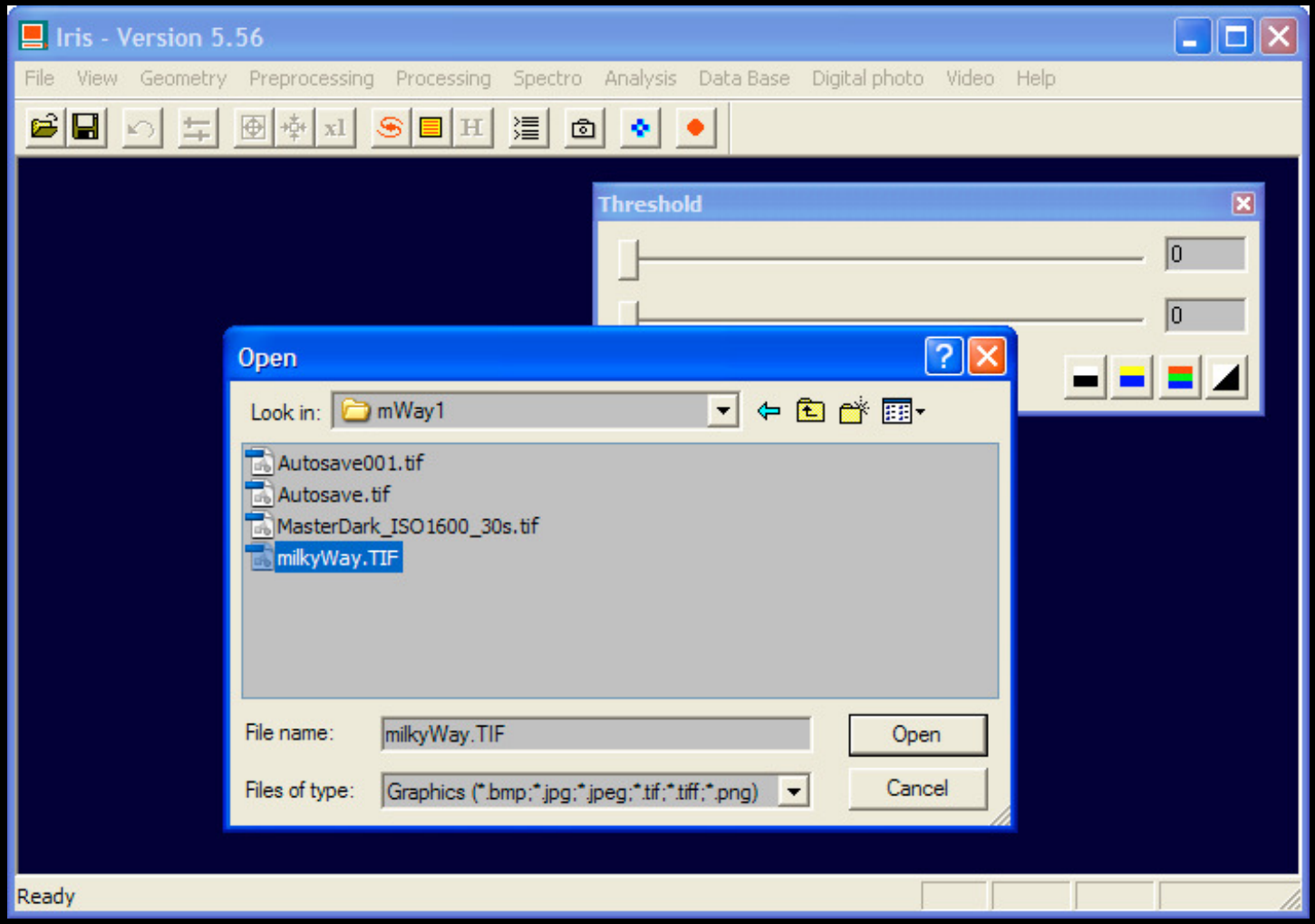
Save the picture as a 16-bit TIFF for loading into IRIS.



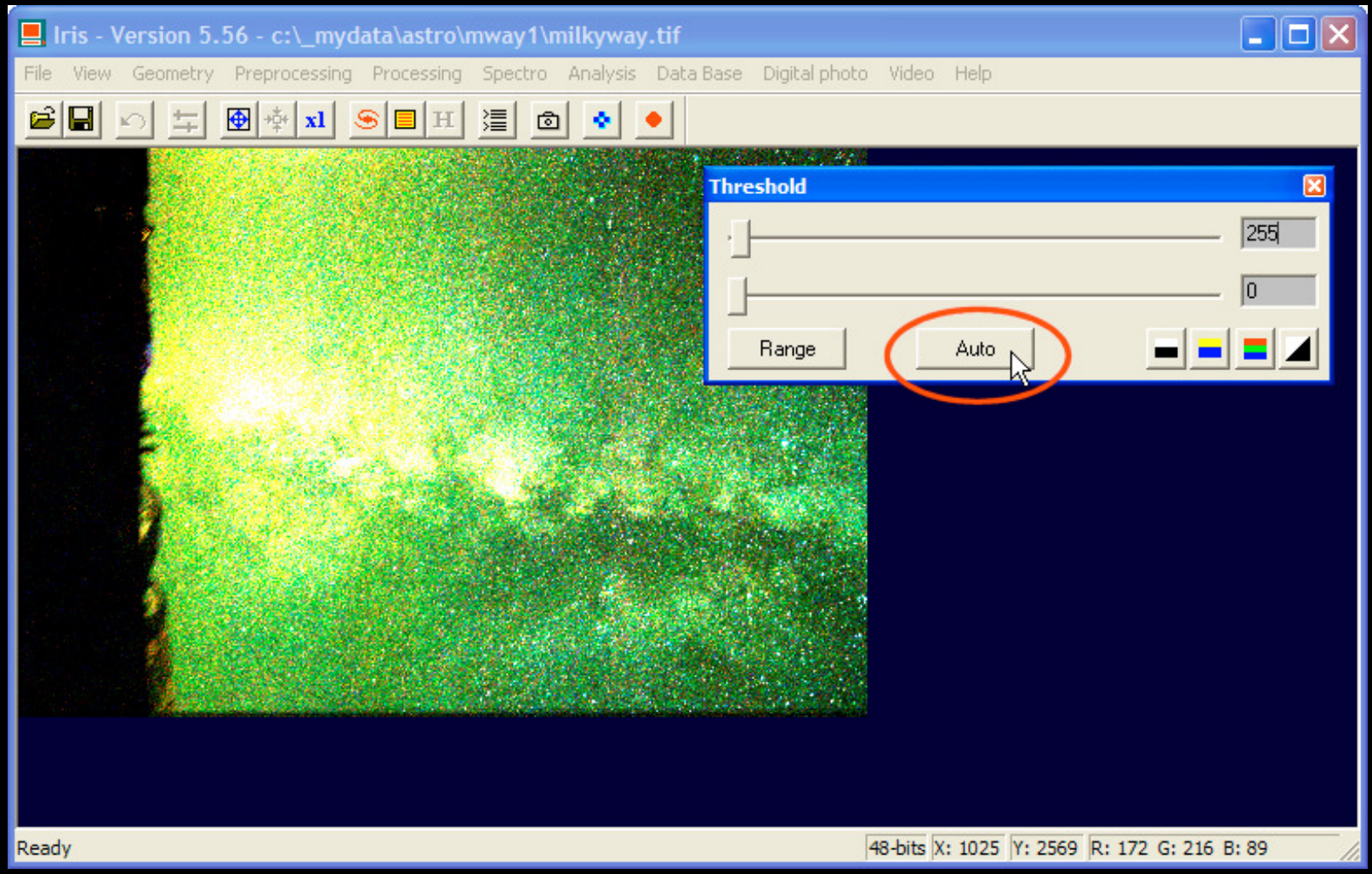
Deep Sky Stacker does good job of stacking, but its image processing features are limited and difficult to use.

In the next step we with use IRIS to do a DDP stretch and save the image as 8-bit, for loading into GIMP.

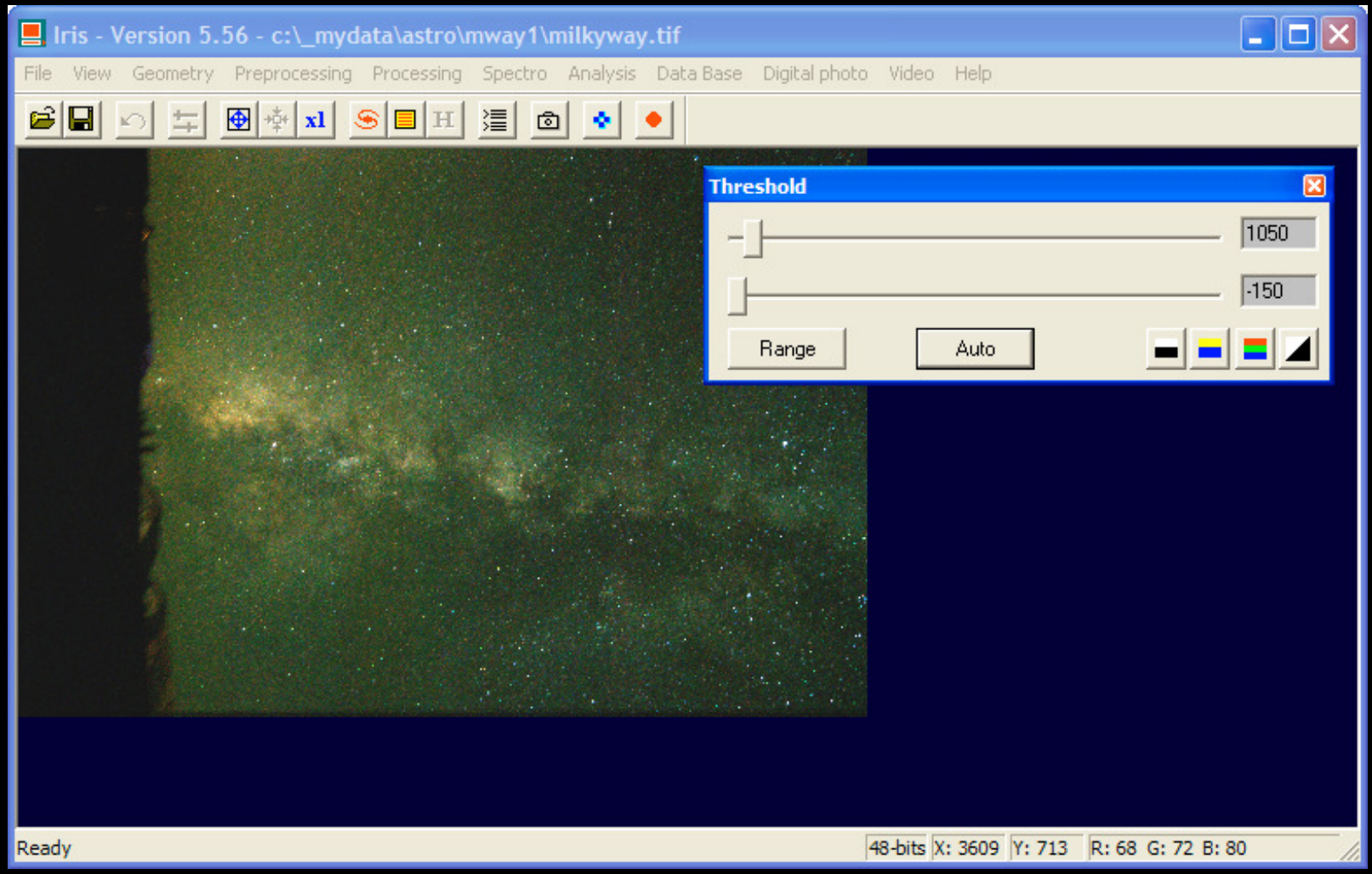
Open IRIS and load the 16-bit TIFF image



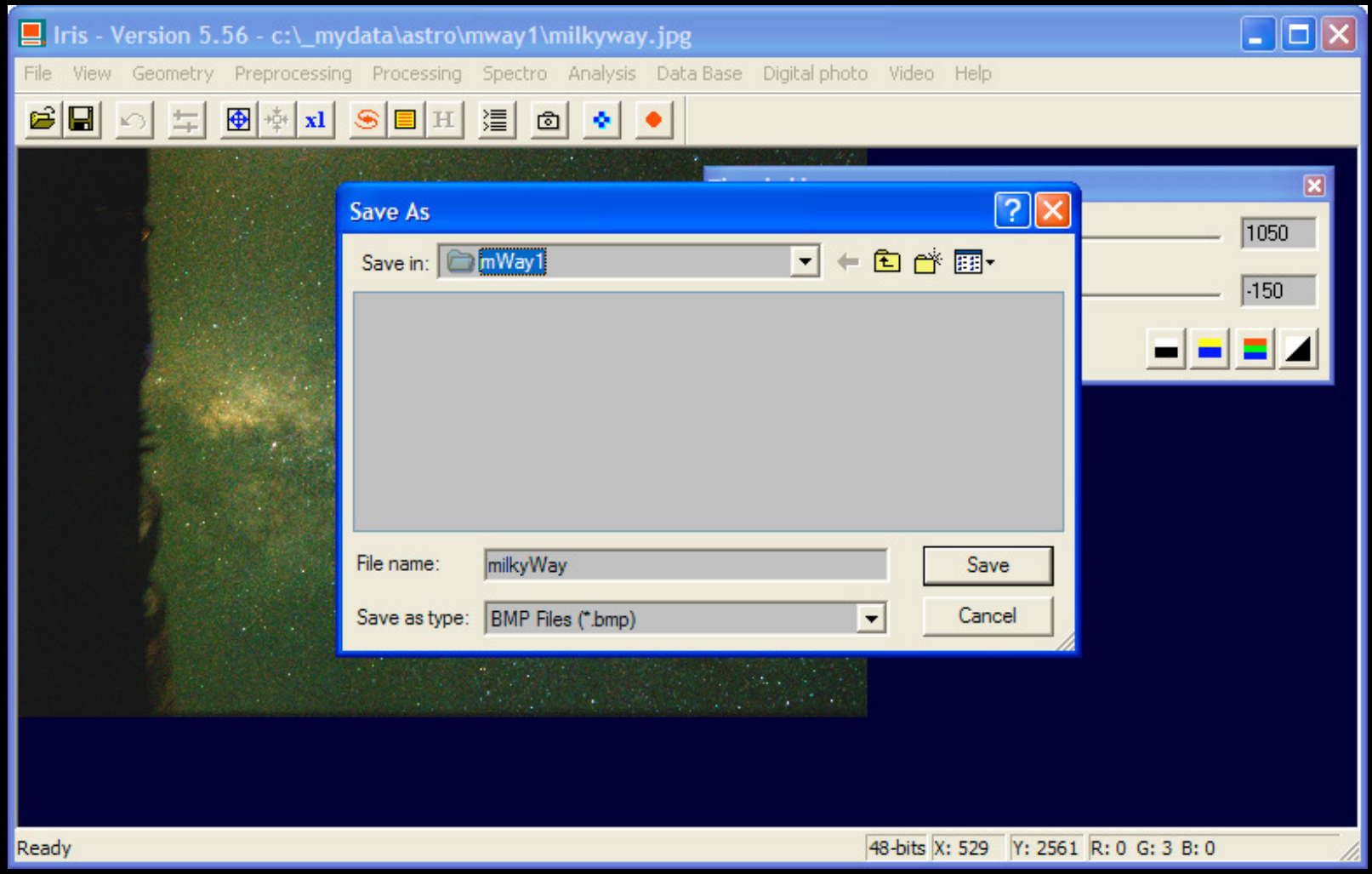
and we get this. Now click *Auto*, in the Threshold window.



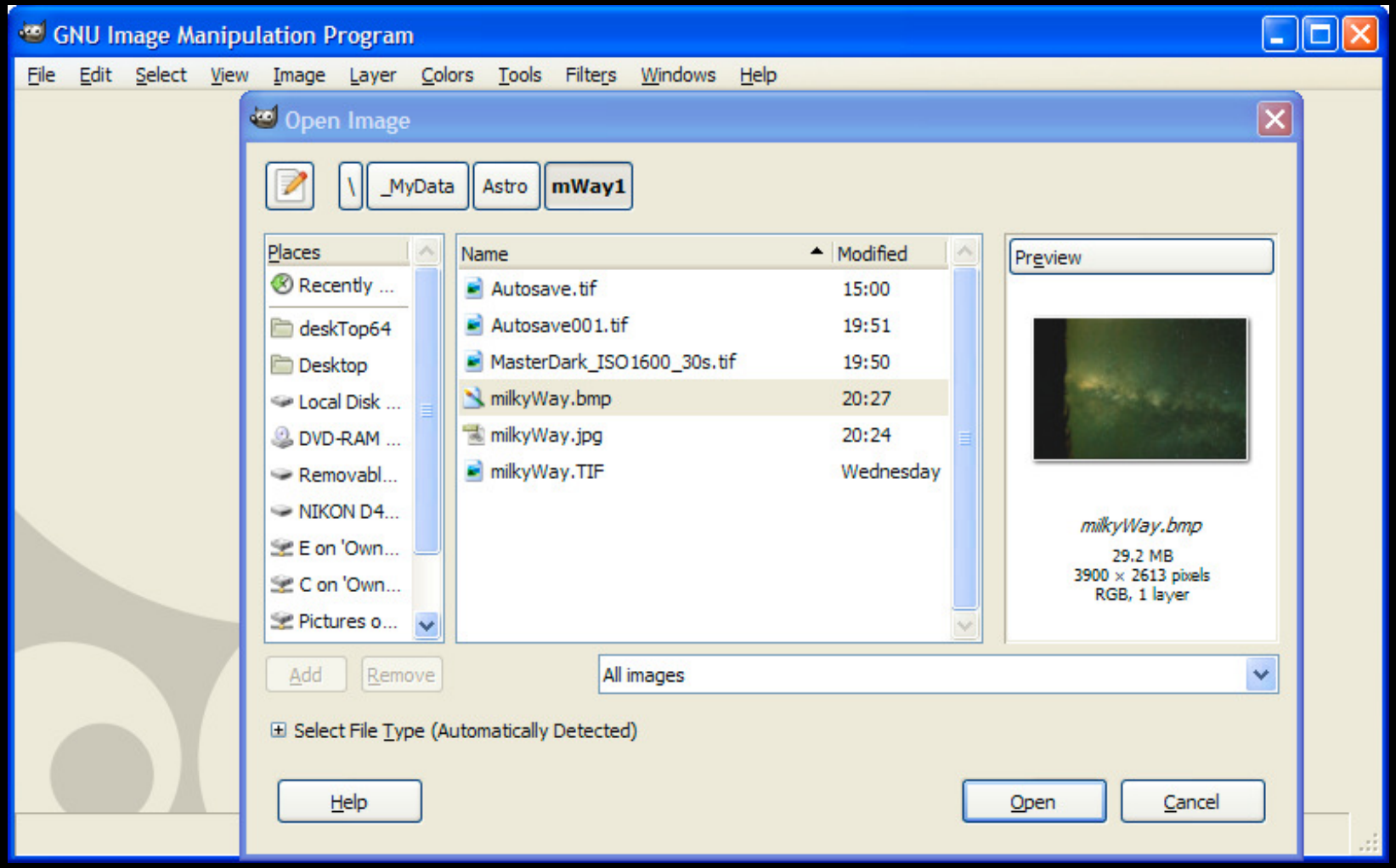
and we get this.



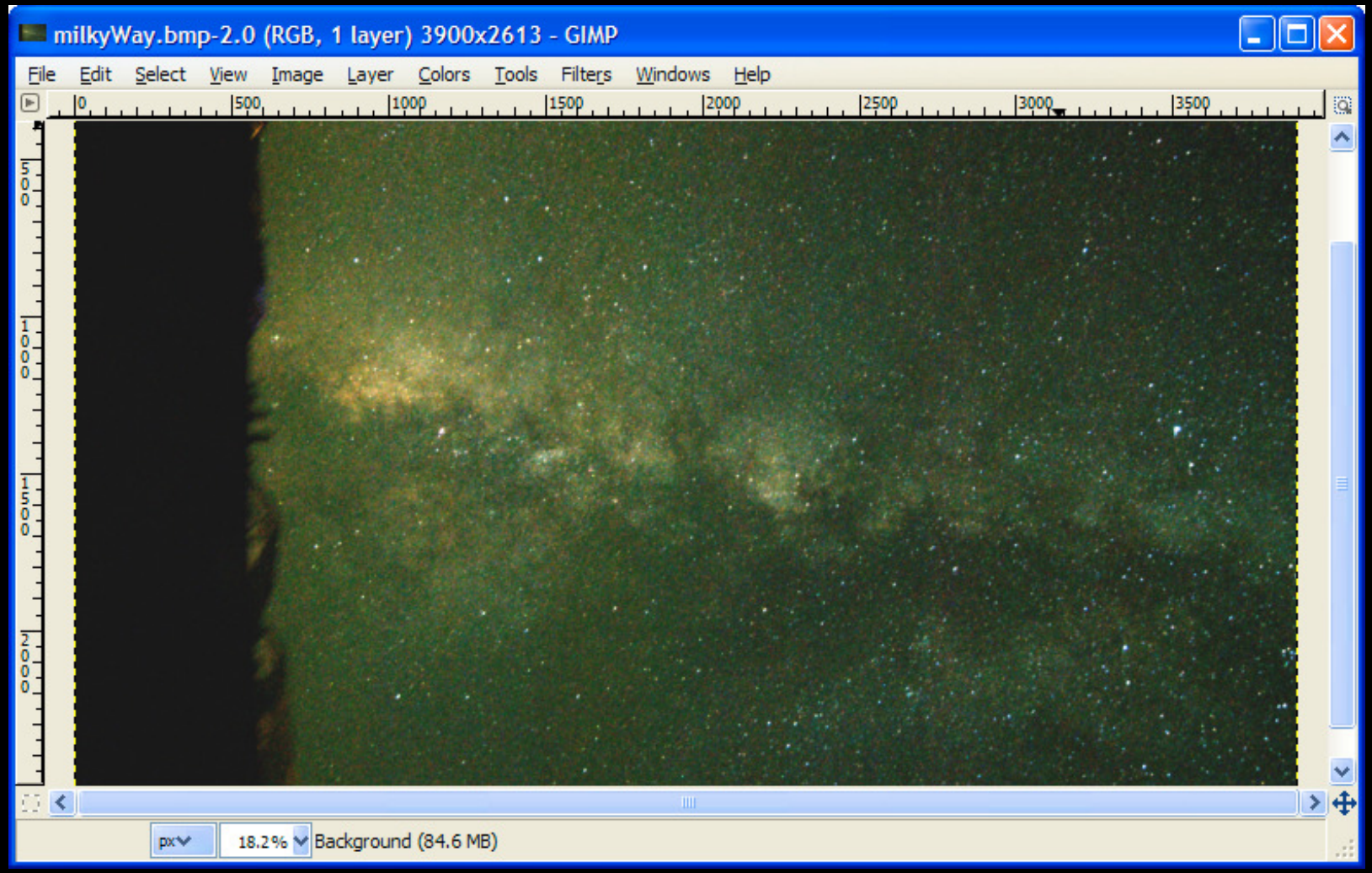
Save the image as a BMP for loading into GIMP.



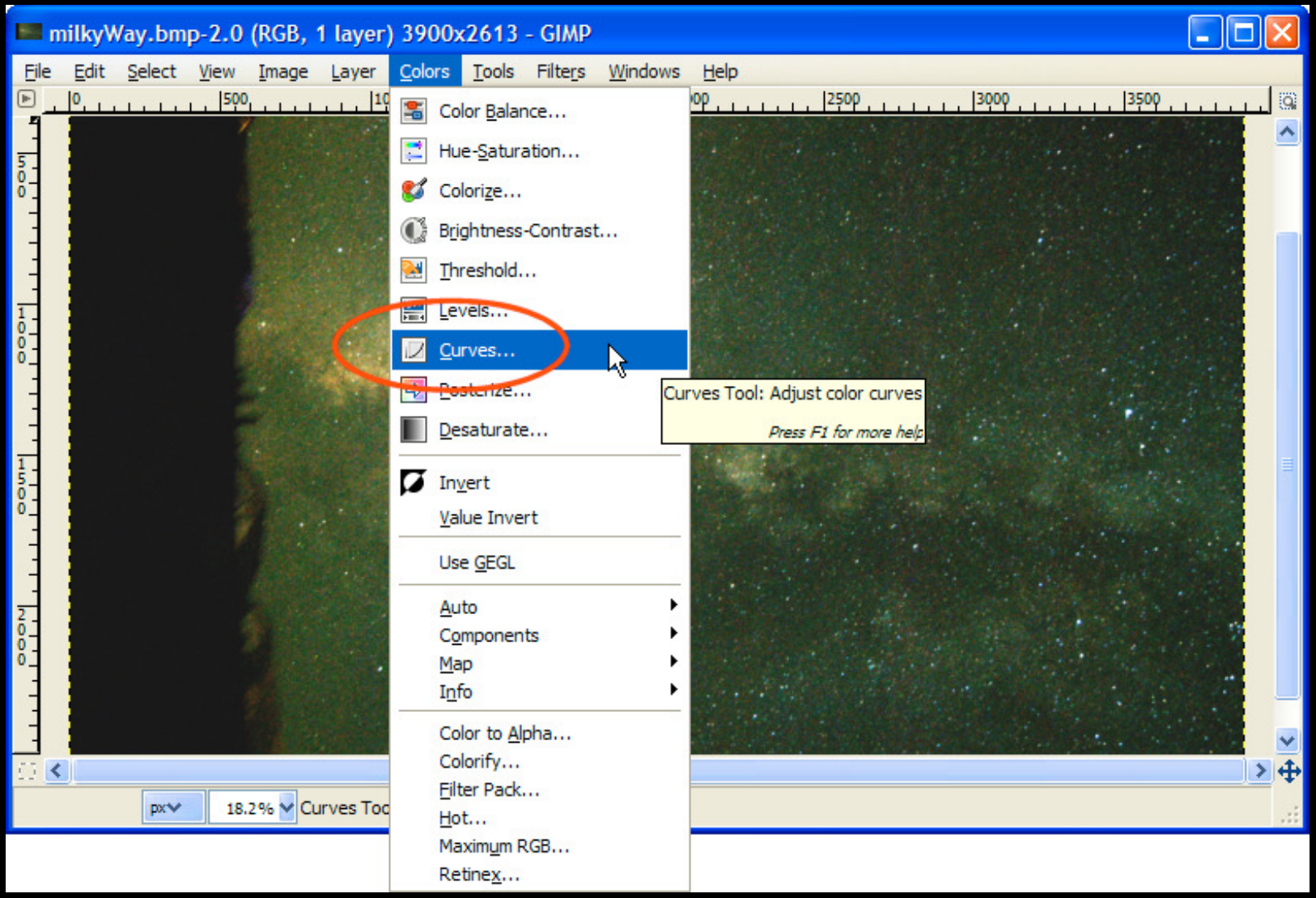
Open GIMP and load the 8-bit BMP image



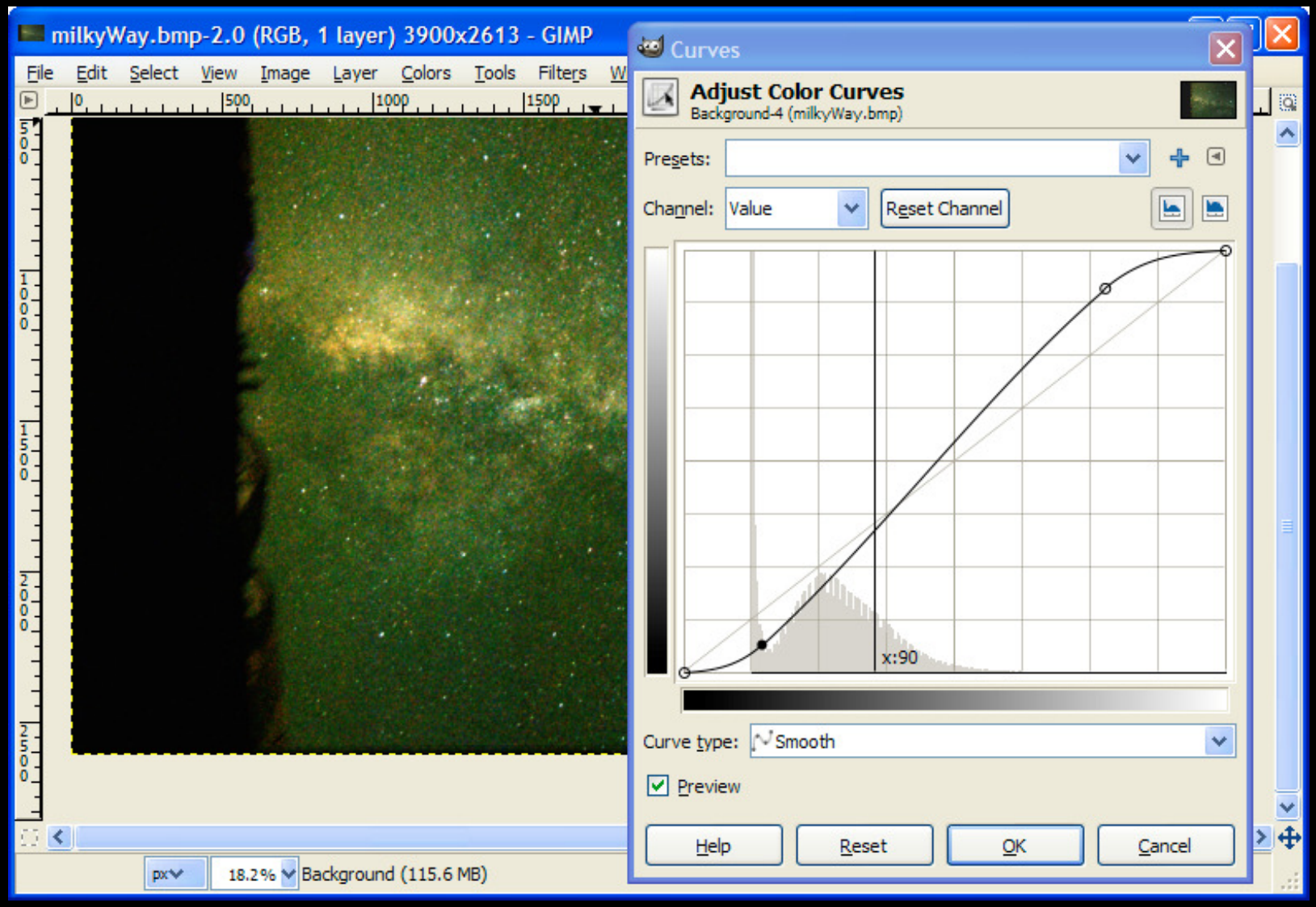
GIMP's initial screen with our image



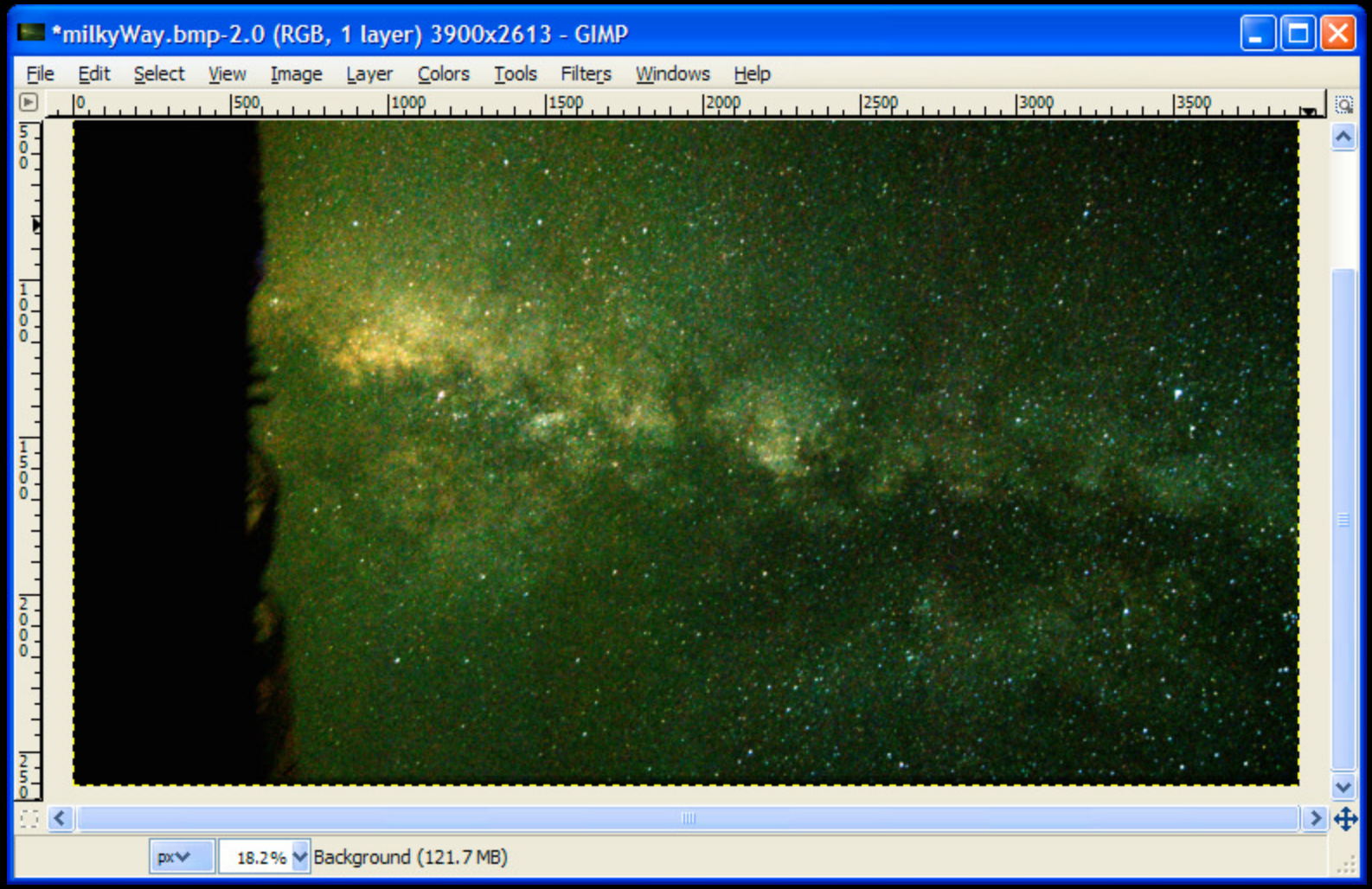
Select *Curves*, to make a contrast adjustment.



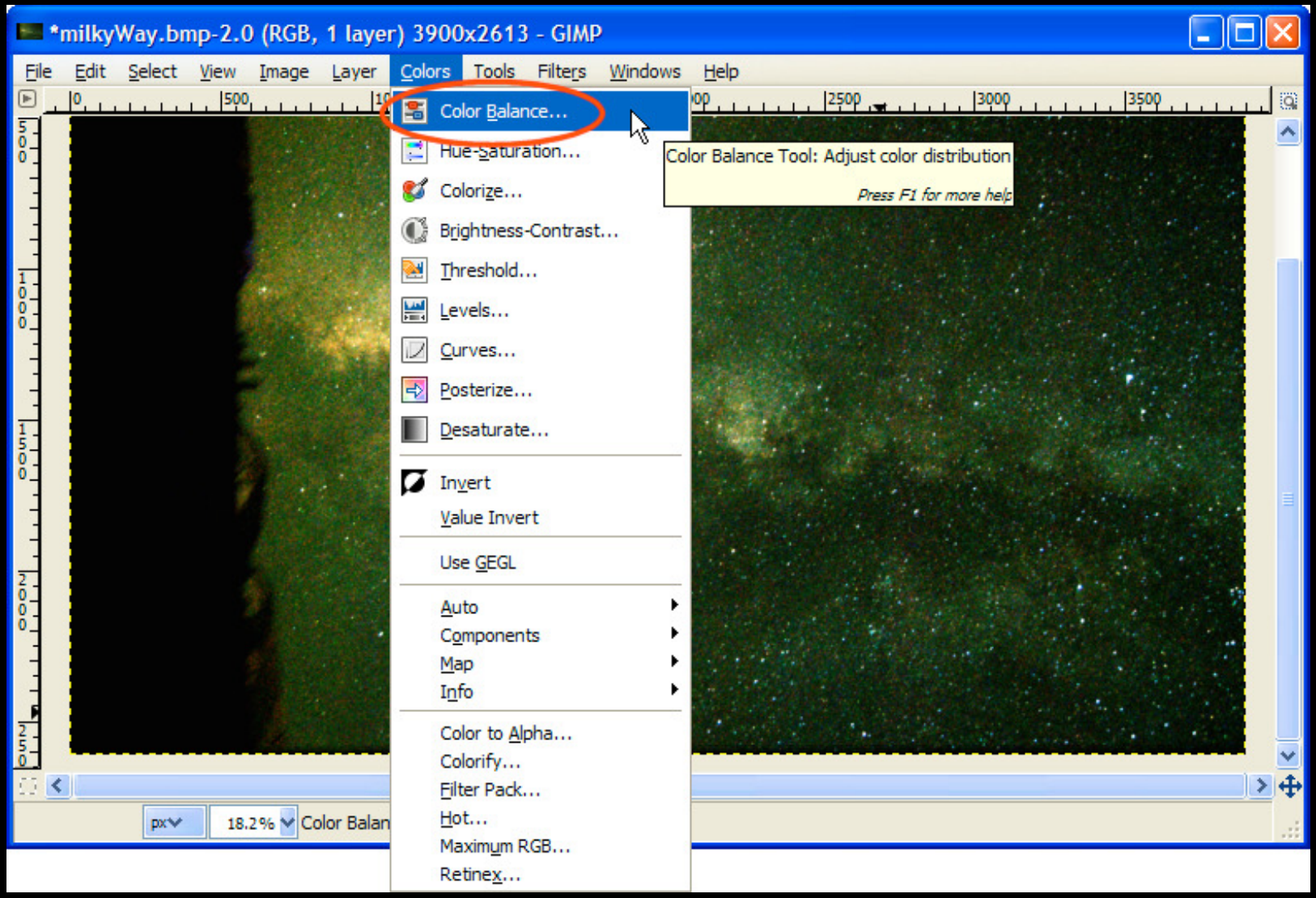
A curve like this increases the contrast.



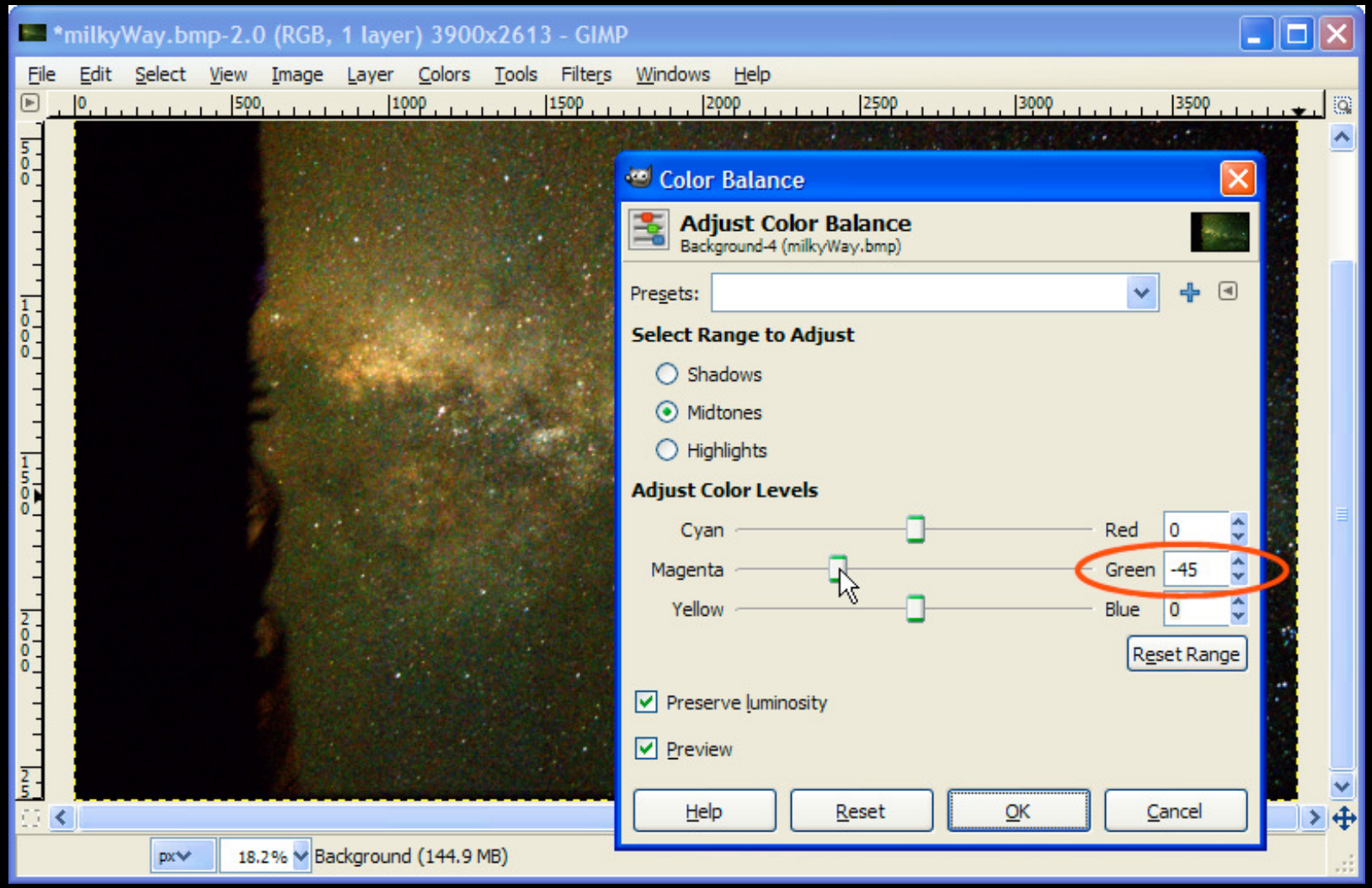
This looks good for contrast, but it's a bit green. Checking the background color shows that the green is about 45% too high.



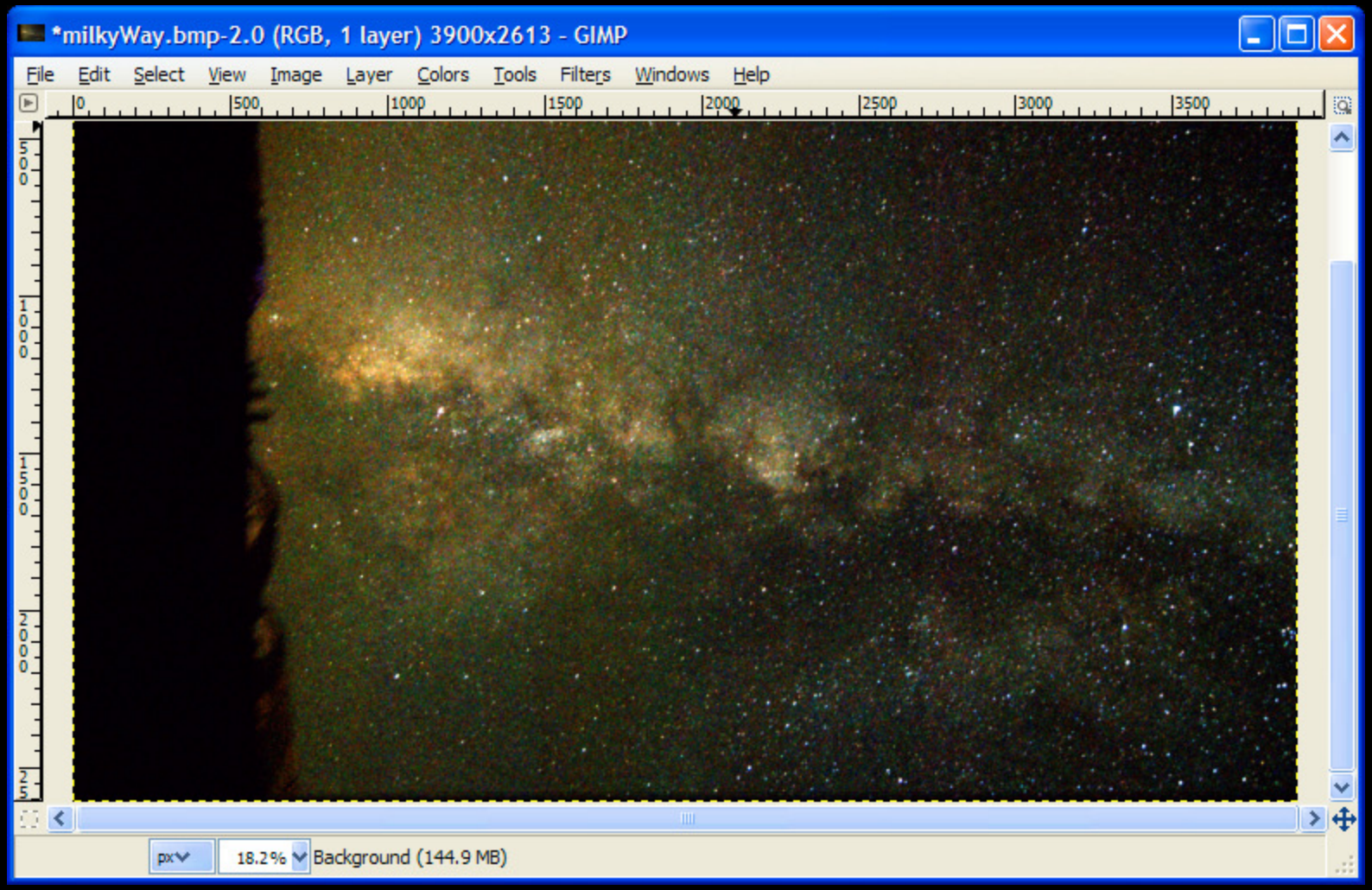
Select *Color Balance....*



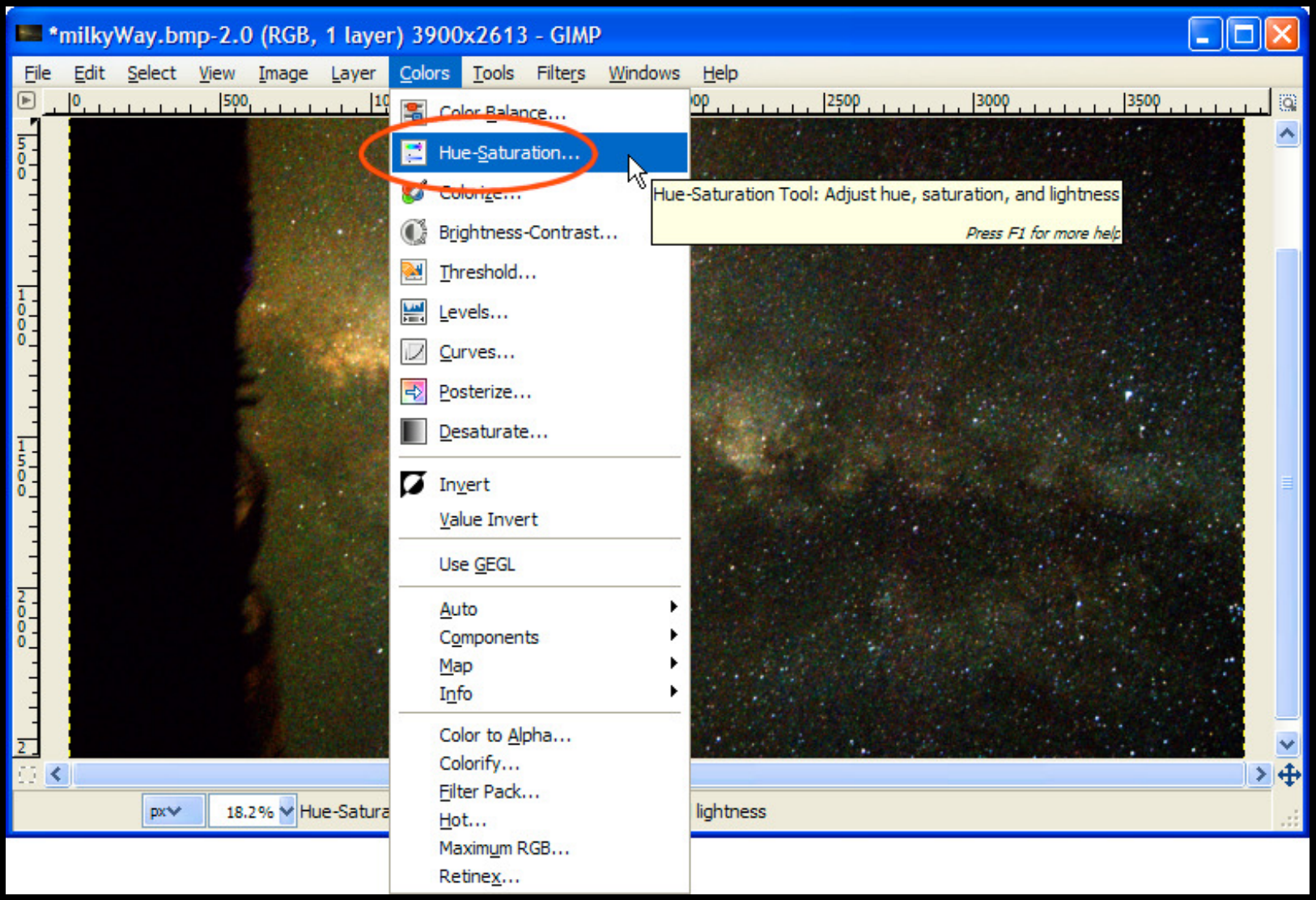
Set the green to -45 and click *OK*



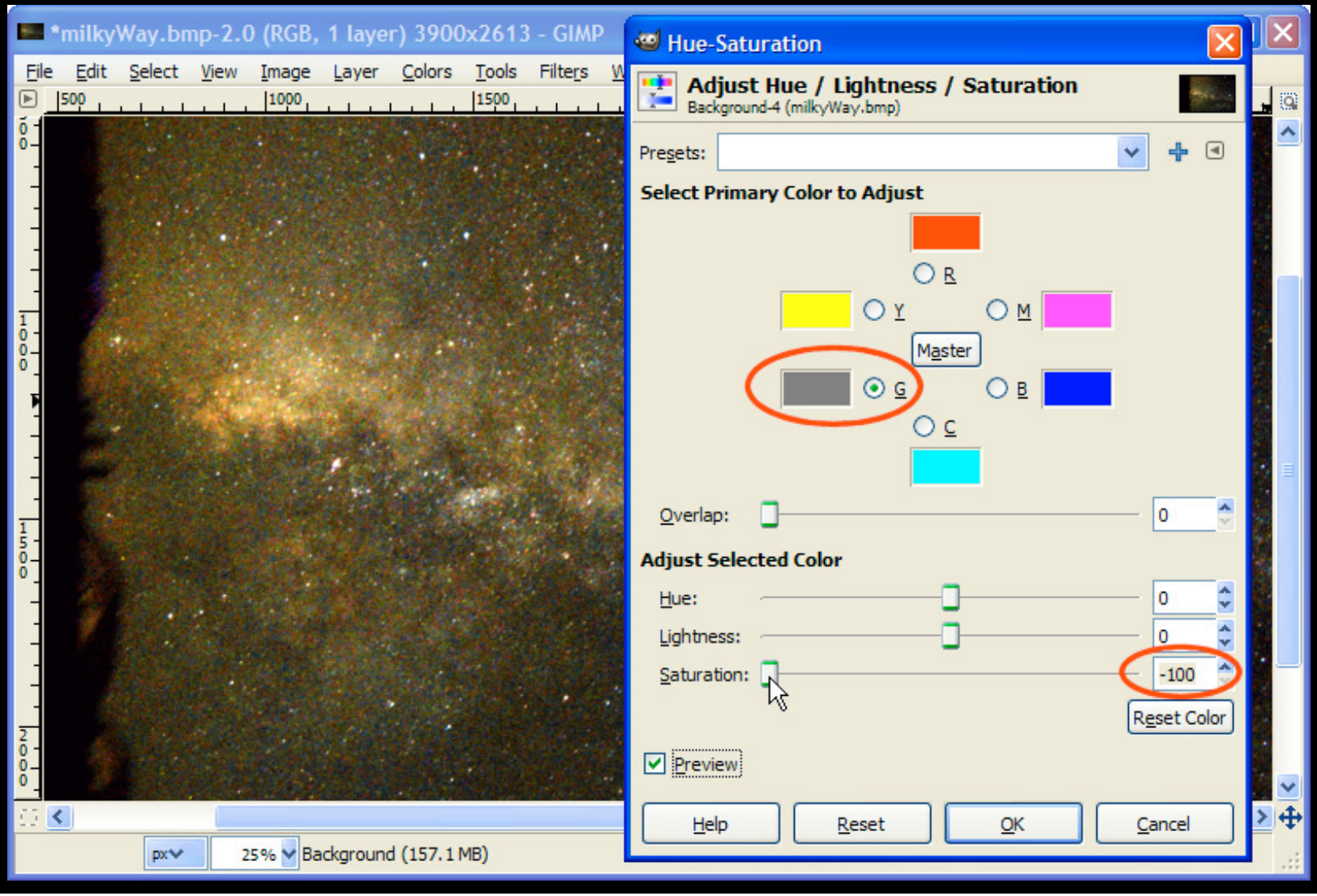
This looks pretty good, but still a bit green.



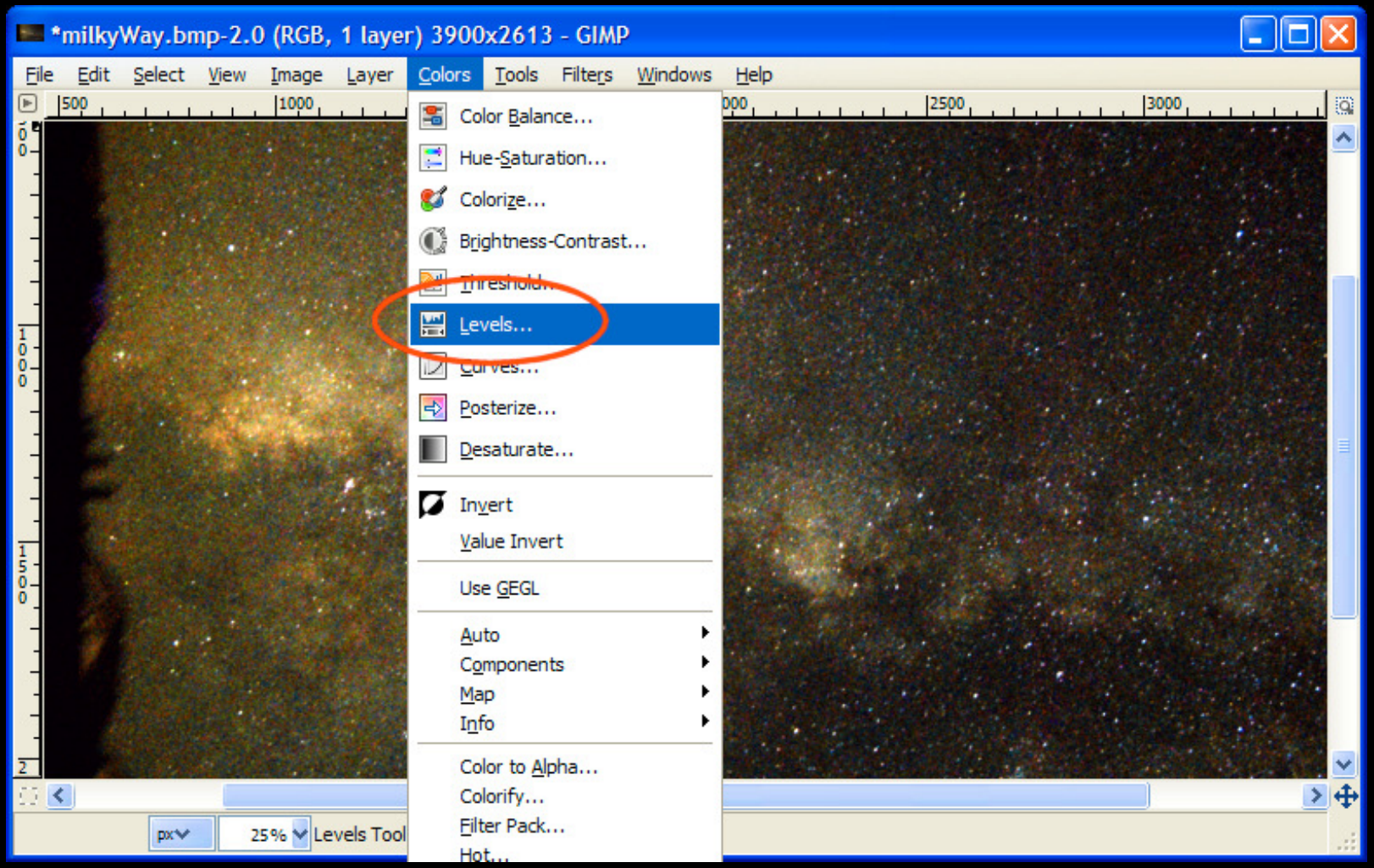
Let's try a *Hue-Saturation* adjustment.



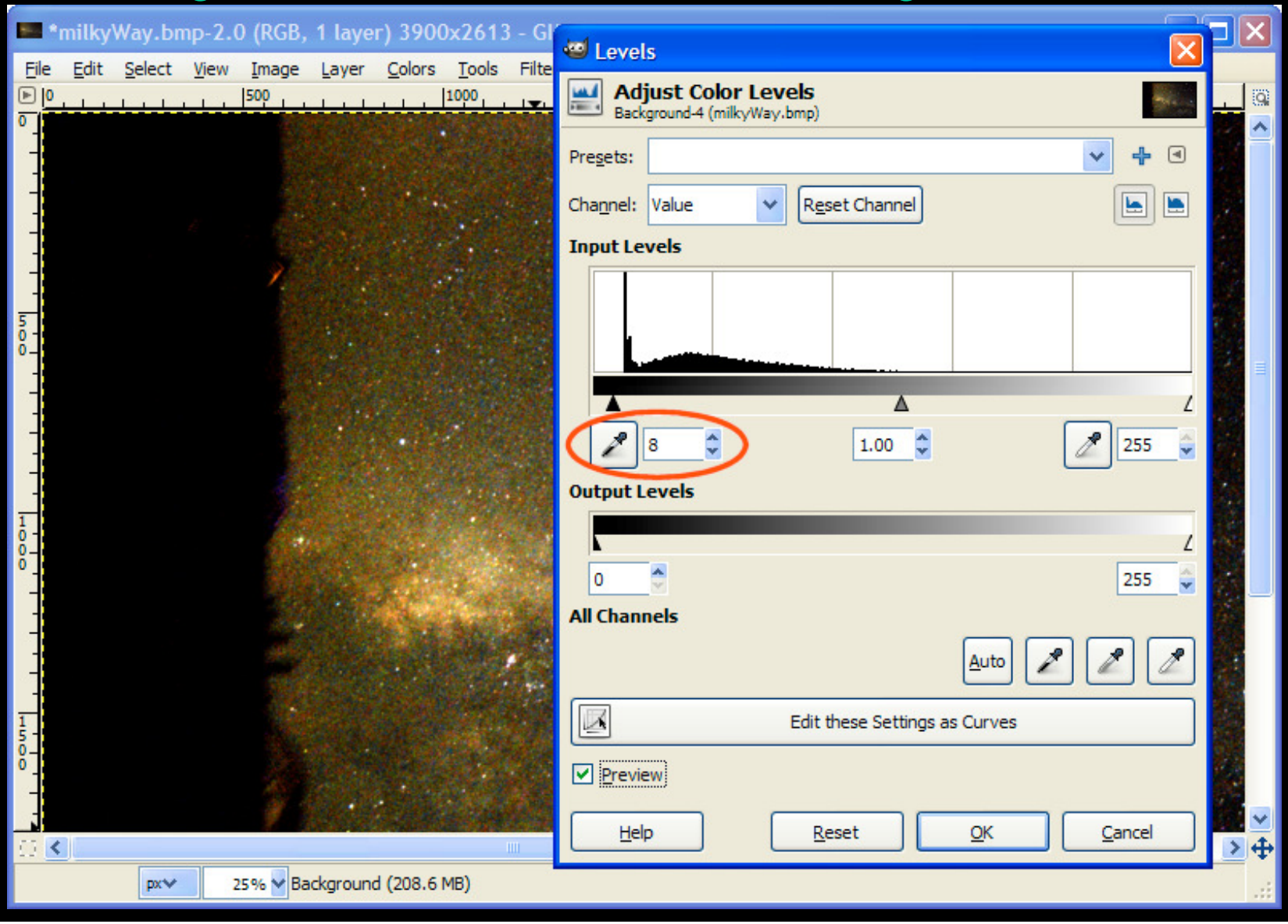
Generally, we don't want any green in an astro image. Select the Green button, set the saturation to -100 and click OK.



Lowering the black point adds more ”pop” to the image. Select *Levels.*



Setting the left slider to about 8 looks good, click *OK.*



Finished

Best web site for DSLR astrophotography
http://www.astropix.com/

Camera Lenses for Astrophotography
http://www.astropix.com/HTML/I_ASTROP/LENSES.HTM

Deep Sky Stacker
http://deepskystacker.free.fr/english/index.html

IRIS
http://www.astrosurf.com/buil/us/iris/iris.htm

GIMP
http://www.gimp.org/

This PowerPoint is available at
http://www.bf-astro.com

DSLR Astrophotography