



Image Processing Tutorial

Basic Concepts

CCDware

CCDWare Publishing
<http://www.ccdware.com>

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Introduction

The following tutorial is meant to give you a basic understanding of how CCDStack works as well as a suggested workflow for CCD image processing.

There are many advanced features of CCDStack not covered in this tutorial. Please see the help file included with CCDStack to learn more about the power of this image processing program.

We hope you find this tutorial helpful and it gets you started creating fantastic CCD images.

For more information and support, please visit the CCDWare website at:

<http://www.ccdware.com>

Copyright Notice:

All sample images are copyright 2005 by Richard A. Bennion of the Ewell Observatory.

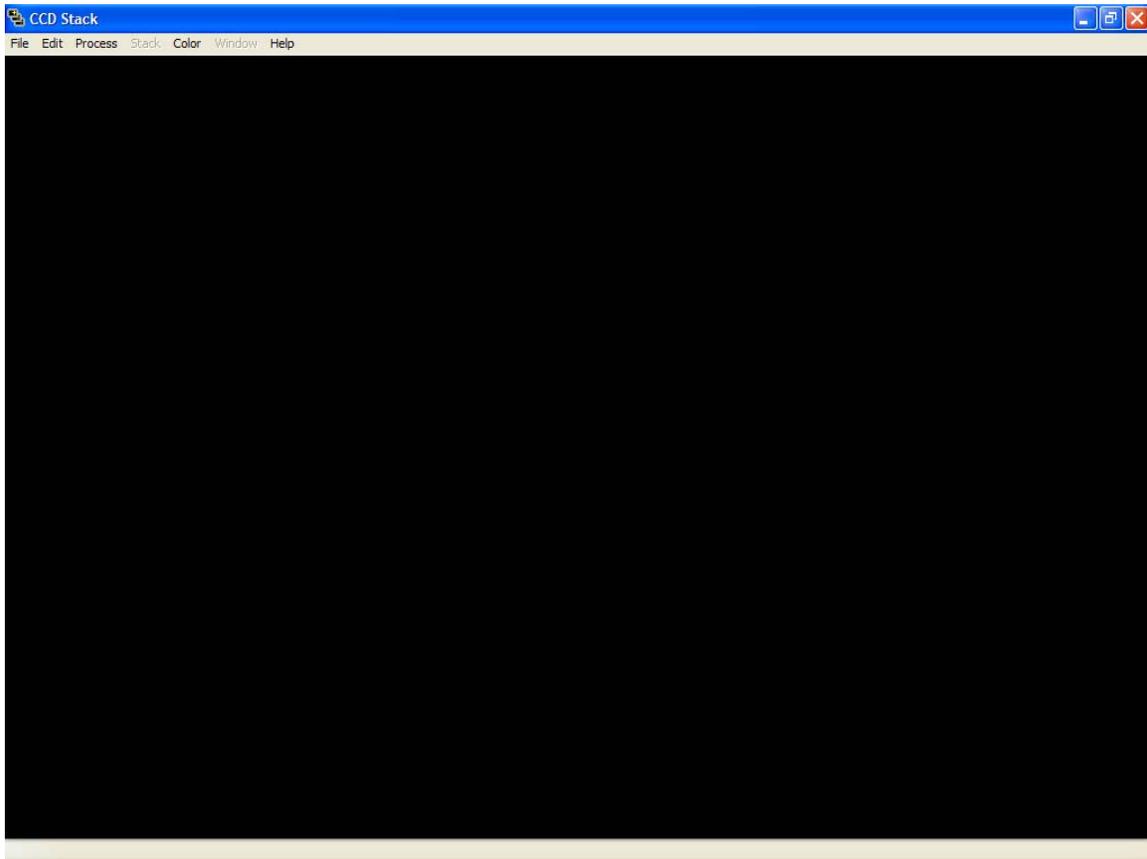
The sample images contained in the tutorial are a small subset of a much longer exposure of M101. To keep file size down, only 10 of the 100 exposures are included for this tutorial.

To see the final results of this image processed with CCDStack, please see:

<http://www.ewellobservatory.com/gallery/viewer.cfm?ID=58>

Starting CCDStack

Click on the CCDStack icon on your desktop. This will bring up an empty CCDStack application window:

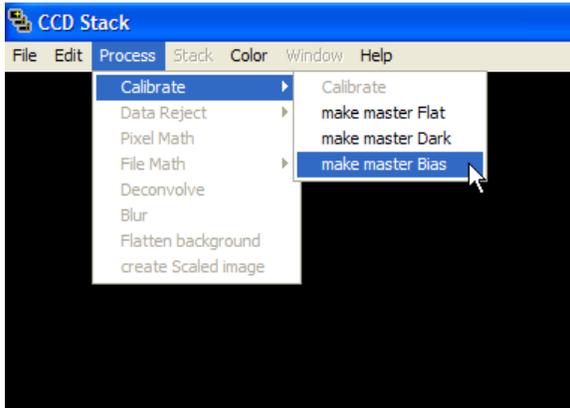


Creating Calibration Frames

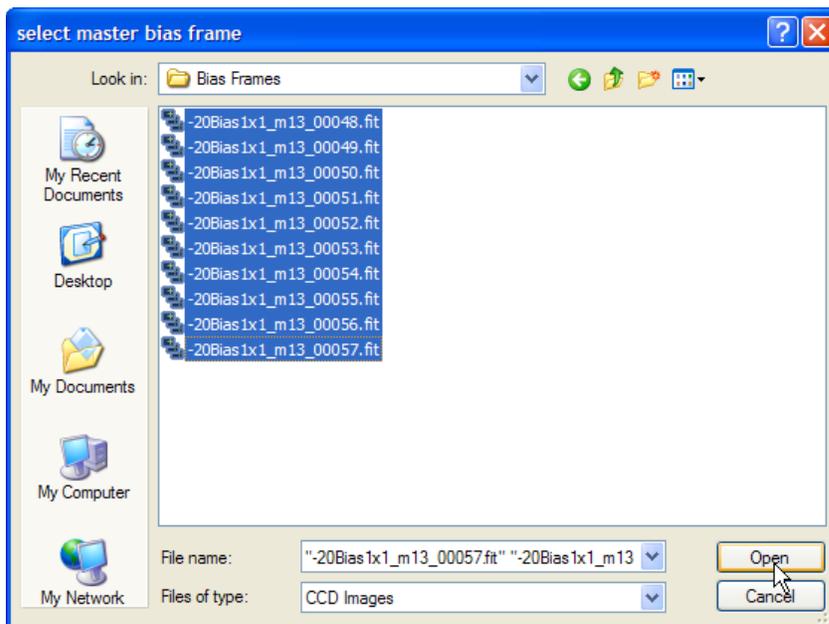
The first step in processing your images is to create your master calibration frames.

Create your Master Bias Frame

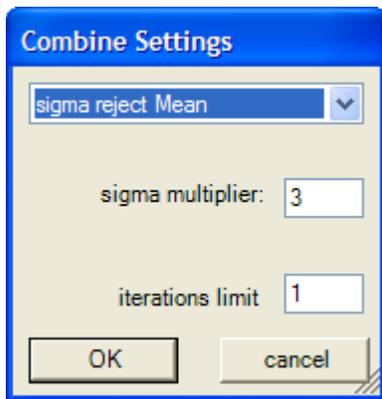
From the main menu, select PROCESS > CALIBRATE > MAKE MASTER BIAS



From the CCDStack Sample Files, navigate to the Bias Frames directory and select all the bias frames. Note: Use the CTRL-A keyboard shortcut to select all files quickly.

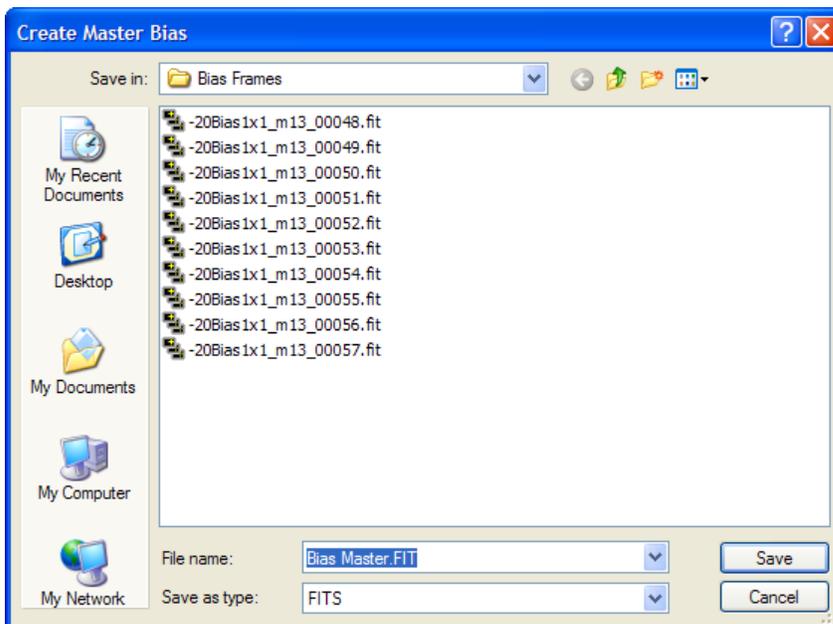


Once you click the Open button on the above dialog box, you will be presented with the bias frame **Combine Settings** dialog box:

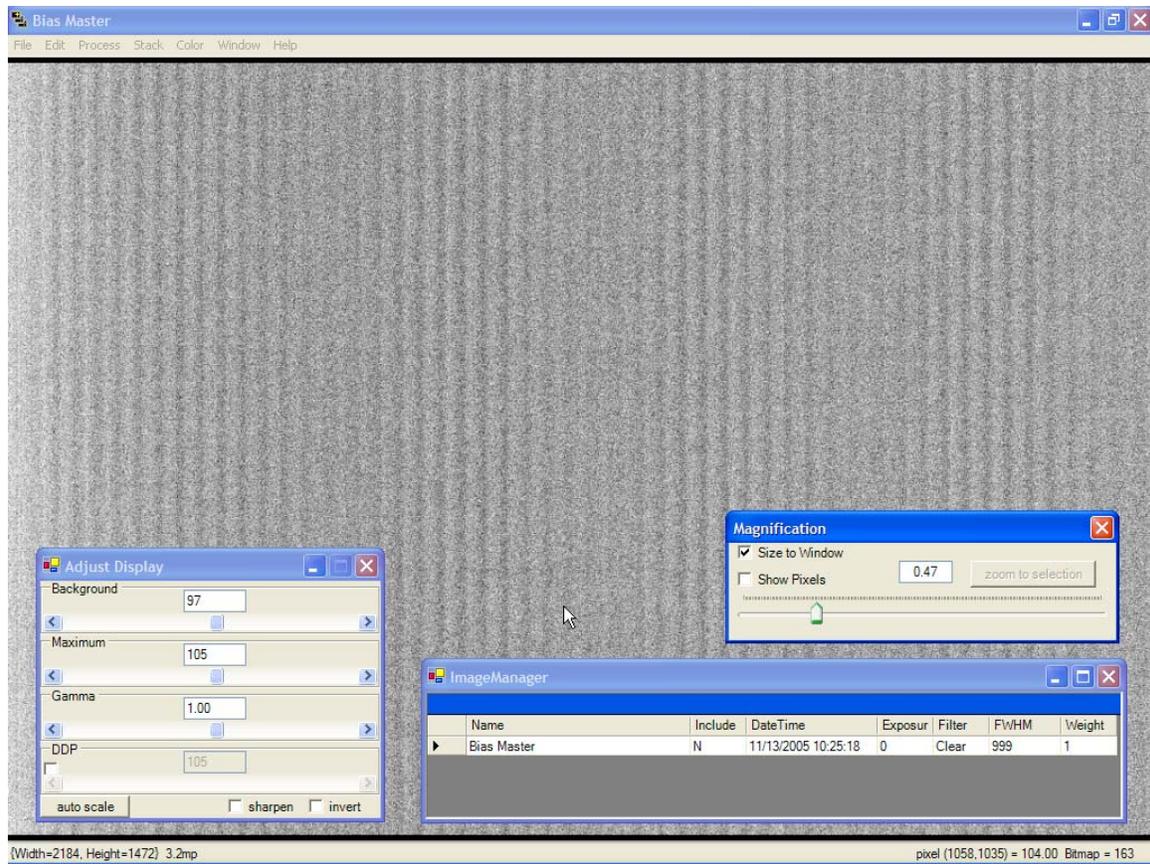


Use the above settings, and click the OK button.

You will then be asked where you would like to save the master bias frame. Select the Calibration Masters directory in the CCDStack Sample Files and click **Save**.

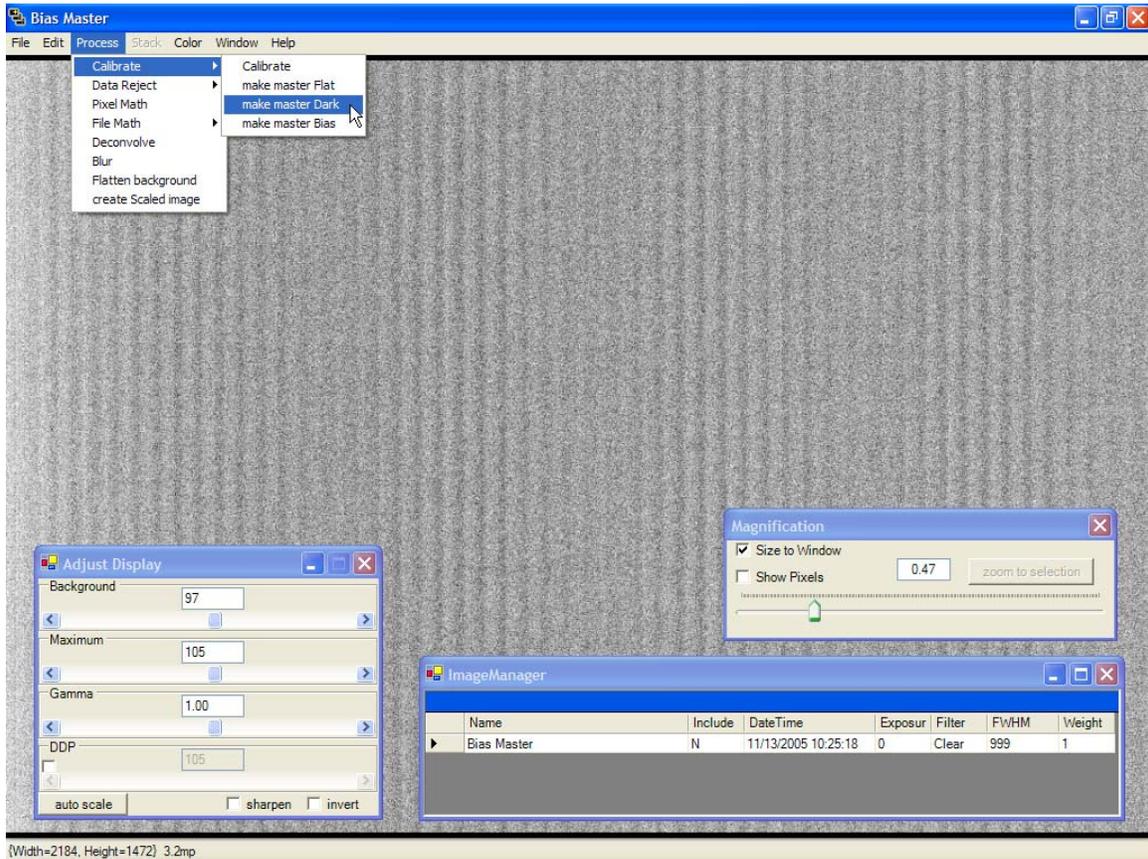


After a few moments, you will be presented with your master bias frame.

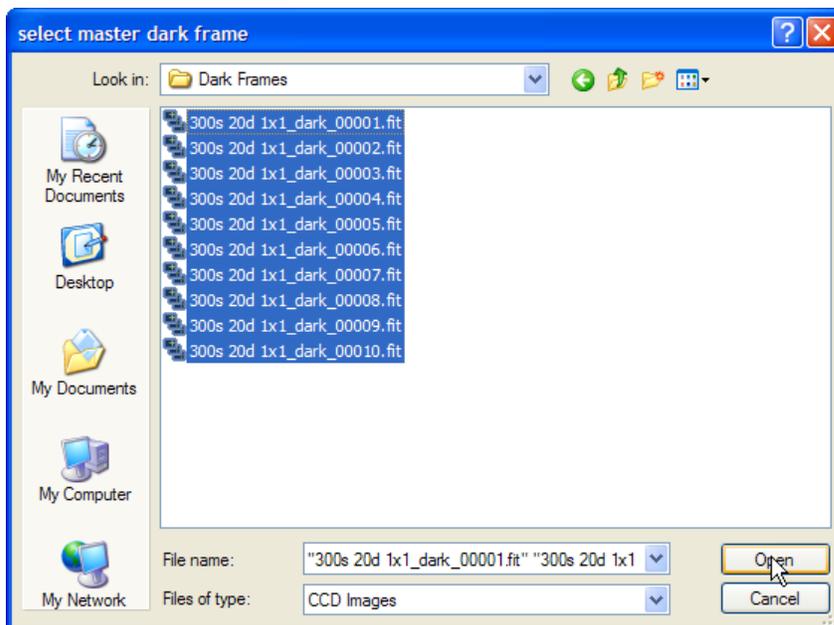


Create your Master Dark Frame

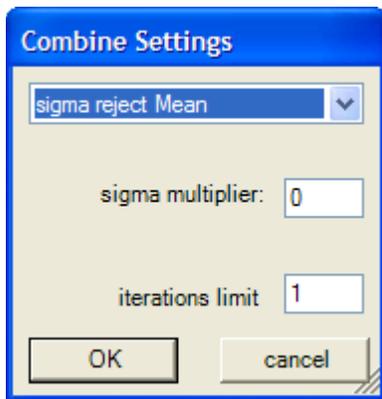
From the main menu, select PROCESS > CALIBRATE > MAKE MASTER DARK.



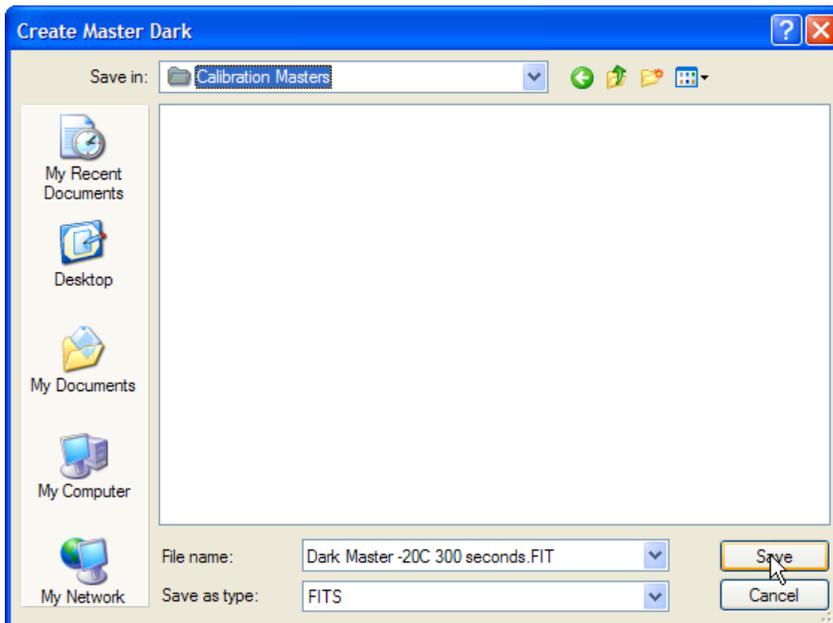
From the CCDStack Sample Files, navigate to the Dark Frames directory and select all the dark frames.



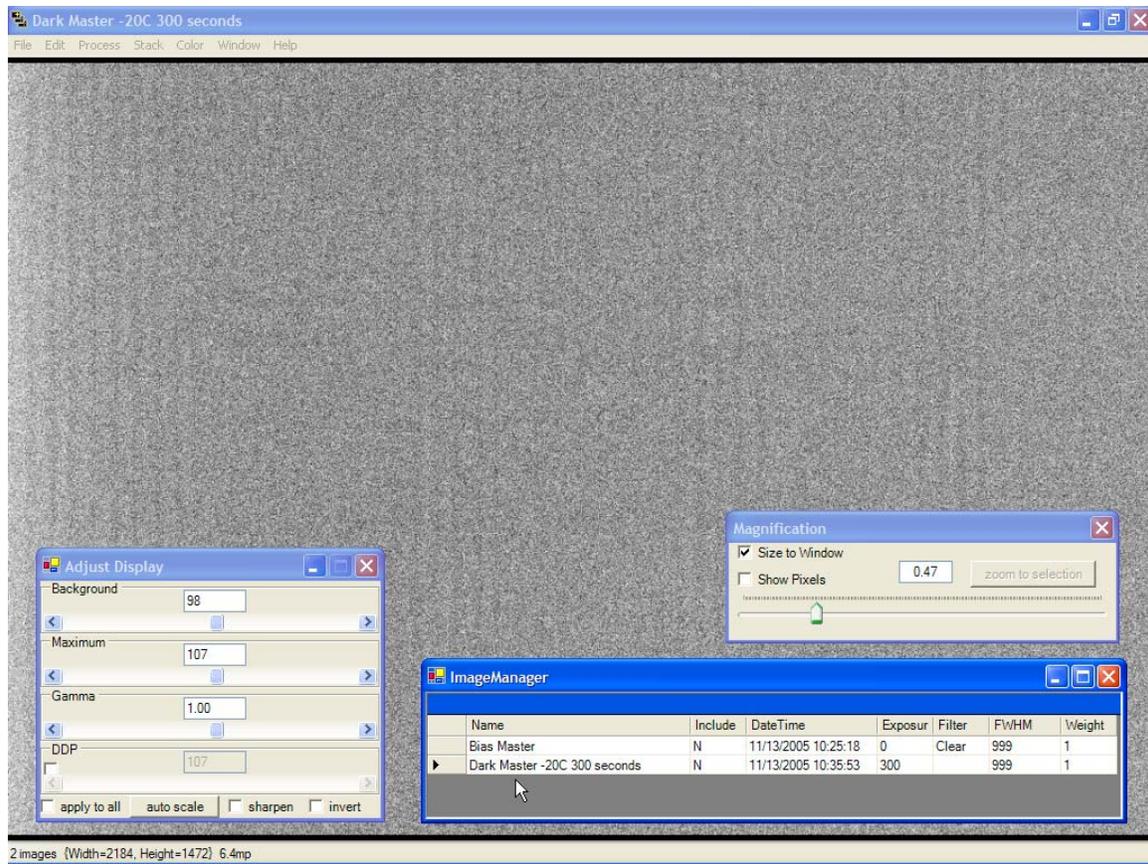
Once you click the **Open** button on the above dialog box, you will be presented with the dark frame **Combine Settings** dialog box:



Use the above settings, and click the **OK** button. You will then be asked where you would like to save the master dark frame. Select the Calibration Masters directory in the CCDStack Sample Files and click **Save**.



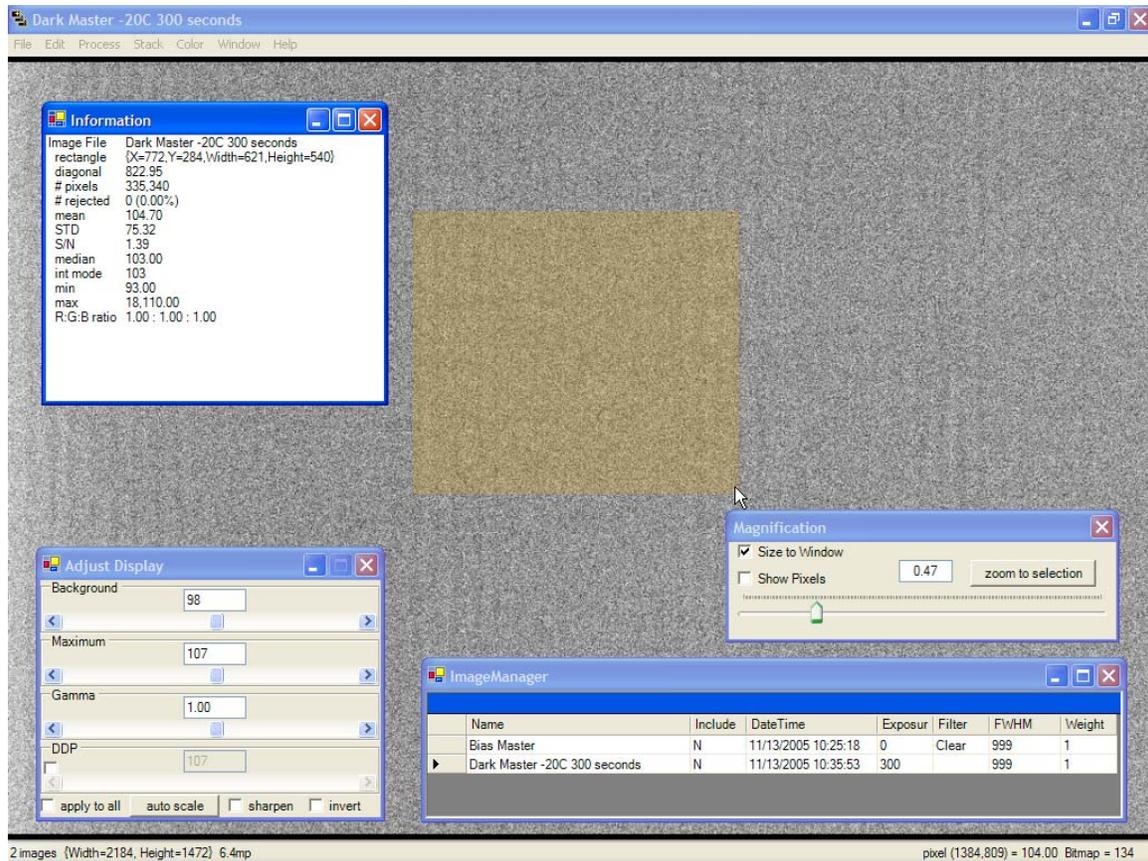
After a few moments, you will be presented with your master bias frame.



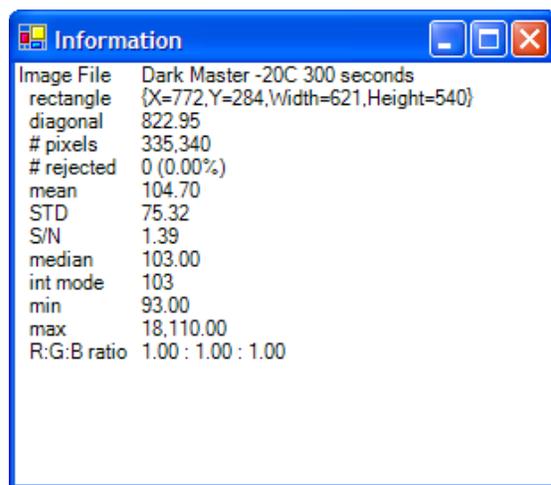
You will notice that you now have two images in your stack. You can click on either file to view it and use the **Adjust Display** dialog box to change the screen display of the bias and dark frames.

Another useful piece of information is statistics about your calibration frames.

Select the Dark Master from the **ImageManager** dialog box so that it is displayed on screen. Using your mouse, draw a rectangle at some point on your dark frame. This will bring up the **Information** window:



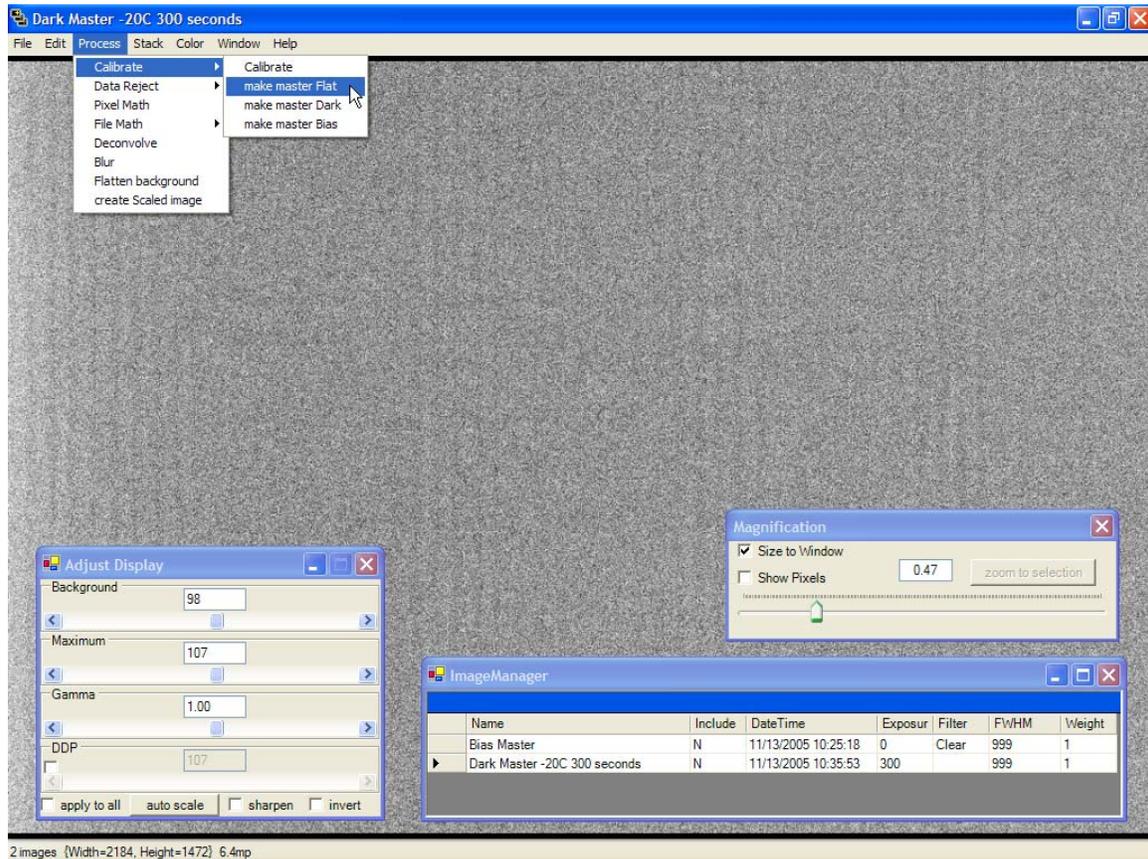
The **Information** window displays important information and statistics about your data:



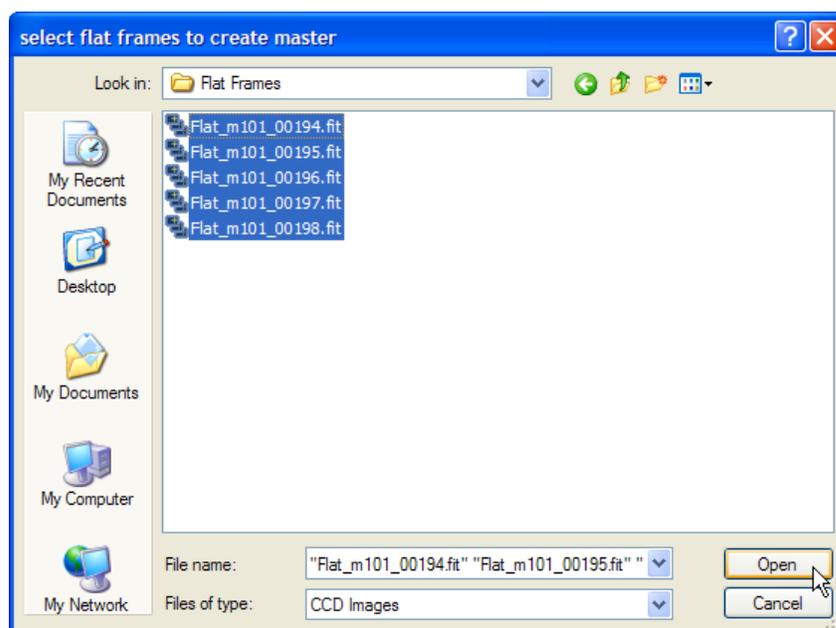
Close the Information window.

Create your Master Flat Frame

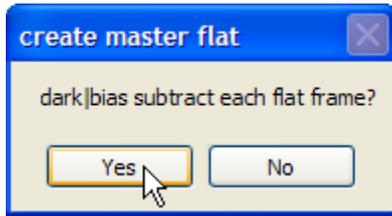
Now we are going to create our final calibration master, our flat frame. From the main menu, select PROCESS > CALIBRATE > MAKE MASTER FLAT.



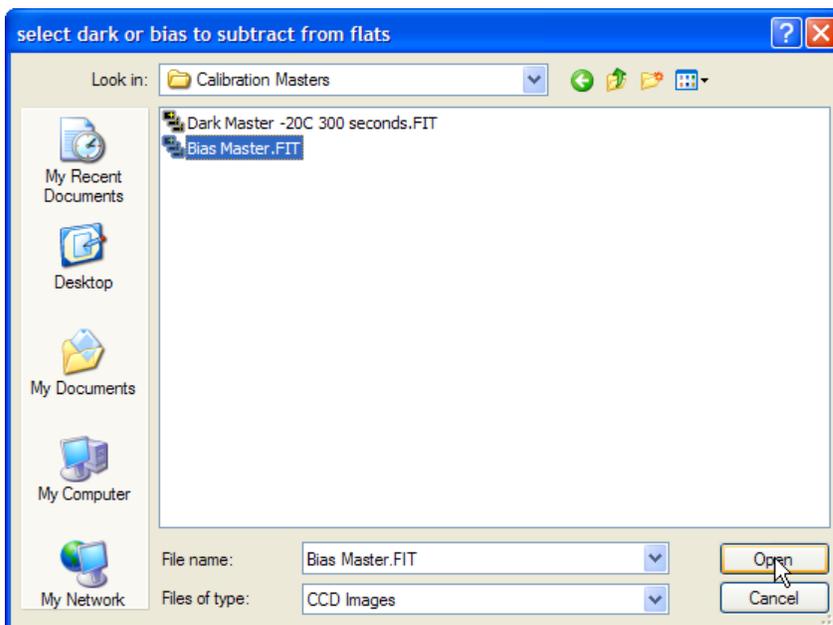
From the CCDStack Sample Files, navigate to the Flat Frames directory and select all the flat frames.



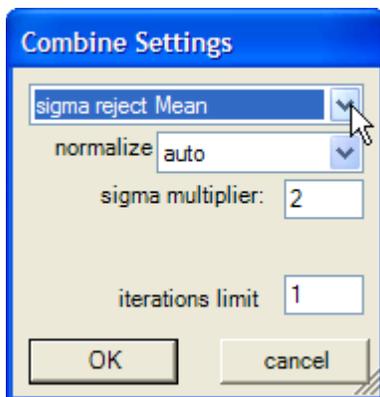
You will then be presented the option to Dark or Bias subtract your flat frames. Select **Yes** at the following dialog box:



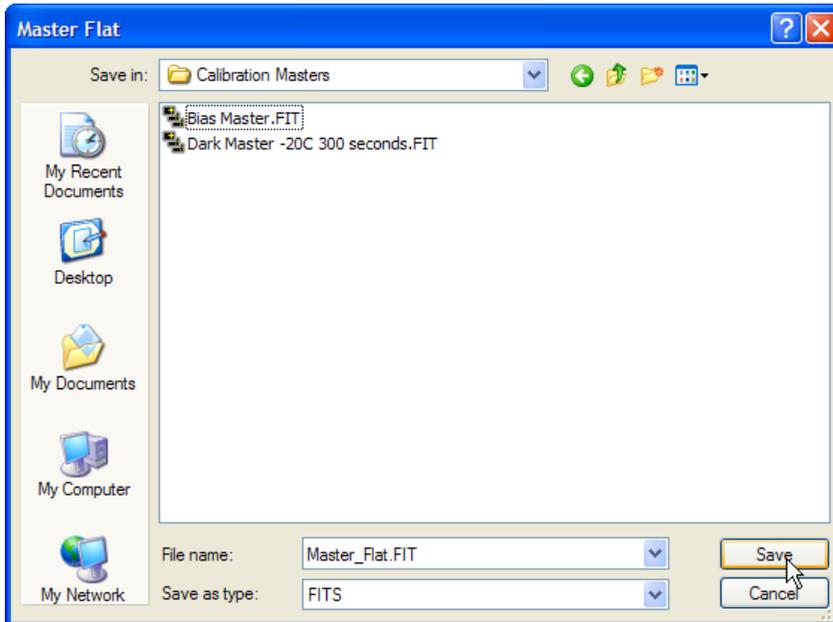
You are now asked to select the Dark or Bias master you would like to use to calibrate your flat frames. Navigate to the Calibration Masters directory and select the **Bias_Master.FIT** file.



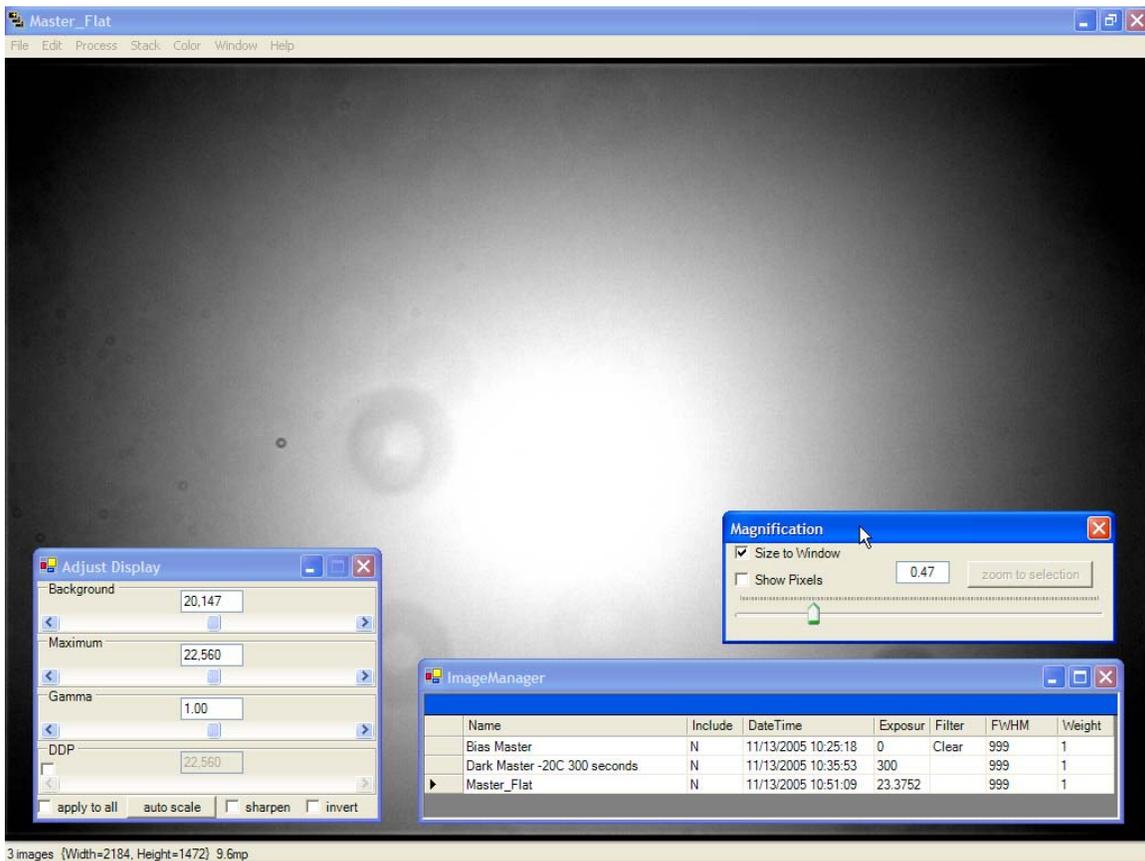
Once you click the **Open** button on the above dialog box, you will be presented with the flat frame **combine settings** dialog box:



Use the above settings, and click the **OK** button. You will then be asked where you would like to save the master flat frame. Select the Calibration Masters directory in the CCDStack Sample Files and click **Save**.

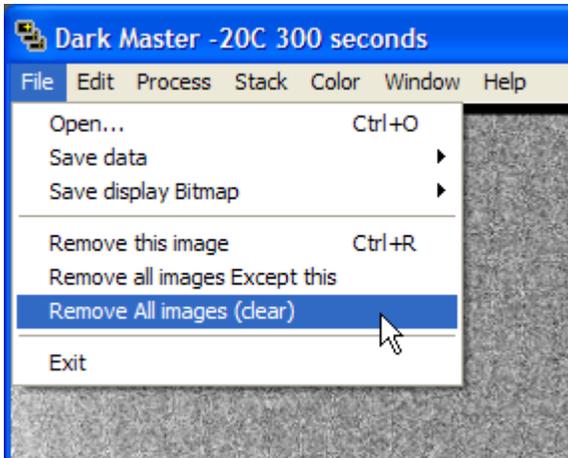


After a few moments, you will be presented with your master flat frame.



You will now see all three of your master calibration frames in the **ImageManager**. Feel free to look at the different files and get a feel for the **Magnification** dialog box as well as the **Adjust Display** dialog box.

Before moving on to the next section of this tutorial, please select **FILE > REMOVE ALL IMAGES (CLEAR)** to remove all the calibration frames from the **ImageManager**.

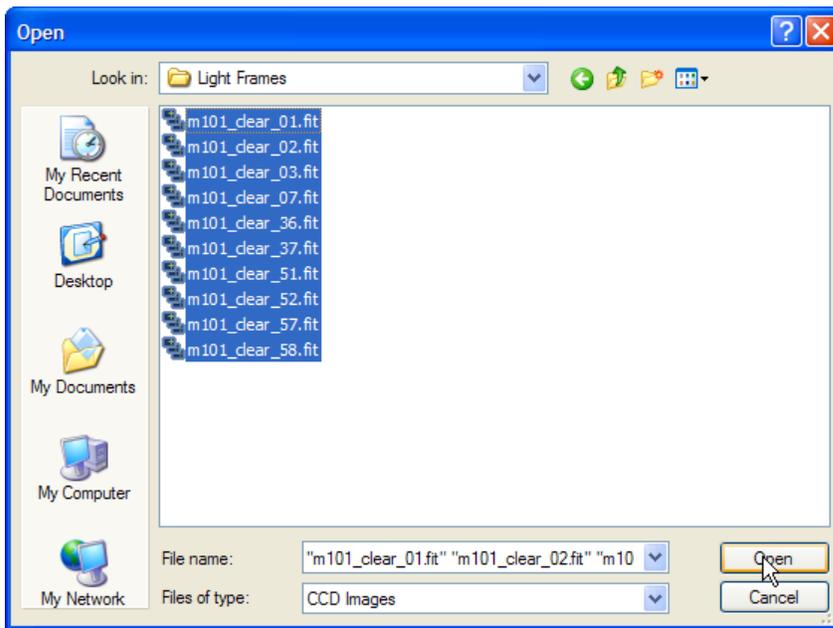


Creating a Master Light Frame

Load Light Exposures

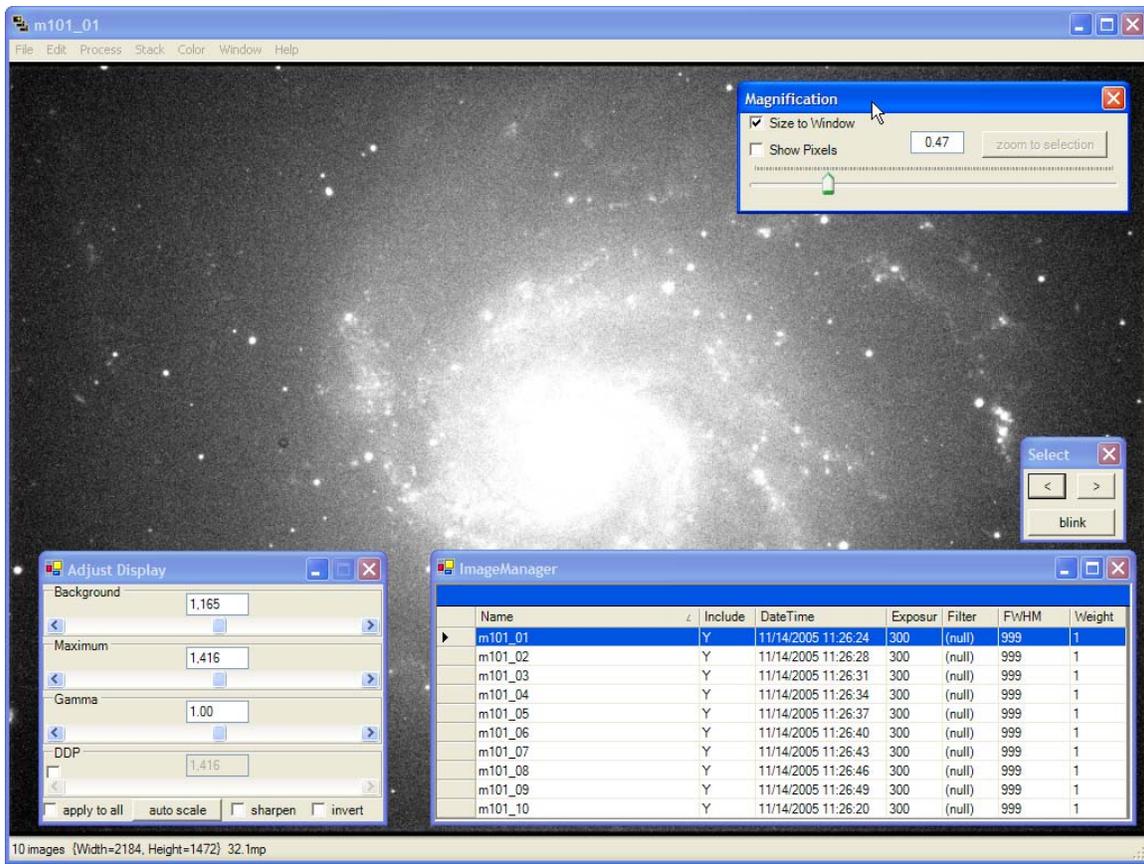
Now that we have created all of our master calibration frames, it is time to create a master light frame. The process is the same for any series of exposures taken with a particular filter and bin mode.

First we need to open our raw exposures. From the main menu select FILE > OPEN and navigate to the Light Frames directory in the CCDStack Sample Files.



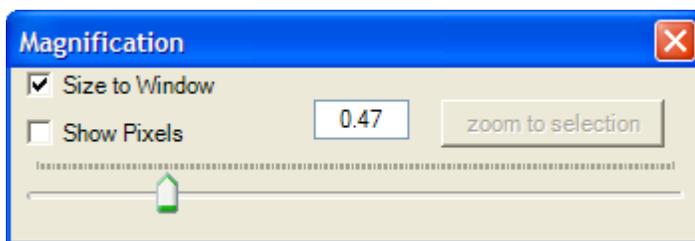
Notes: You can use the CTRL-O keyboard shortcut to bring up the open dialog box. In addition you can drag and drop files into the CCDStack application to add them to the ImageManager.

Once our images are loaded, our screen should look something like this:



Let's take a few moments to explore some key features of the CCDStack interface before we move forward with our processing workflow:

The Magnification window



- The **Magnification** window allows you to zoom in and out the entire stack of images contained in the **ImageManager**.
- Explore how the **Show Pixels** check box changes the operation of the magnification slider.
- Using your mouse, select an area of the image and click the **Zoom to Selection** button on the **Magnification** window.
- When you are done exploring, check the **Size to window** option to return the image back to the above state.

The Select window



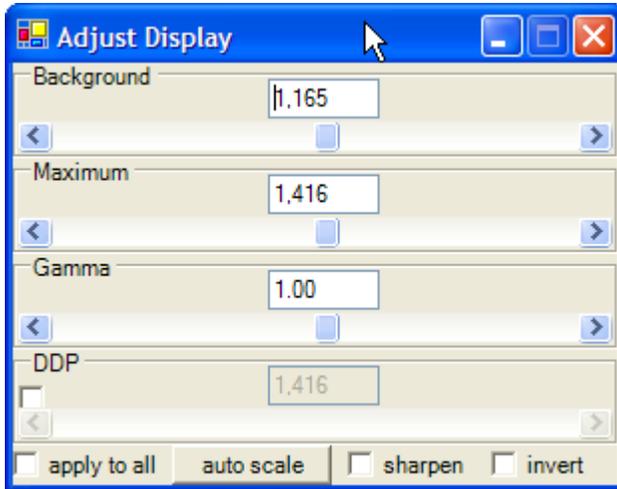
- The **Select** window allows us to step back and forth between our images.
- Click the forward and back arrows to cycle through your stack.
- Notice how the **ImageManager** window indicates what image of the stack is currently being displayed.
- Click the **Blink** button to automatically cycle through your images in an animated fashion.
- While in **Blink** mode, the forward and backward buttons, turn into options to speed up or slow down the blink sequence.
- While Blinking your stack of images, the **Blink** button will turn into a **Pause** button.
- Click the **Pause** button to stop the animation.

The ImageManager window

Name	Include	DateTime	Exposur	Filter	FWHM	Weight
m101_01	Y	11/14/2005 11:26:24	300	(null)	999	1
m101_02	Y	11/14/2005 11:26:28	300	(null)	999	1
m101_03	Y	11/14/2005 11:26:31	300	(null)	999	1
m101_04	Y	11/14/2005 11:26:34	300	(null)	999	1
m101_05	Y	11/14/2005 11:26:37	300	(null)	999	1
m101_06	Y	11/14/2005 11:26:40	300	(null)	999	1
m101_07	Y	11/14/2005 11:26:43	300	(null)	999	1
m101_08	Y	11/14/2005 11:26:46	300	(null)	999	1
m101_09	Y	11/14/2005 11:26:49	300	(null)	999	1
m101_10	Y	11/14/2005 11:26:20	300	(null)	999	1

- The **ImageManager** window shows us all the exposures we have loaded into our stack.
- By clicking on the left hand side of the window, we can select what exposure is displayed on the screen.
- Using the up and down arrows, we can also navigate through the stack.
- The **ImageManager** contains useful information that we will explore later in this tutorial.

The Adjust Display window



- One of CCDStacks more powerful features is the ability for you to adjust the display of the image you are looking at on the screen separate from the 32 bit data stored in CCDStacks memory. Any changes we make to the display have no permanent effect on the actual data we are processing.
- Dynamic DDP is a very powerful feature for seeing more information in your raw images. Check the **DDP** checkbox and the **apply to all** checkbox and click the **auto scale** button. Even though we have not calibrated our image yet, we still see a much more realistic view of our data.
- Try moving the DDP slider back and forth. This determines how much we are stitching our data.
- Explore the **Background**, **Maximum** and **Gamma** sliders in conjunction with the **DDP** adjustment to see how these affect your images.
- If you get lost, click the **auto scale** button to reset the current image you are viewing or check **apply to all** and then click the **auto scale** button to reset all images in the stack.
- We will explore **sharpen** and **invert** later in this tutorial.

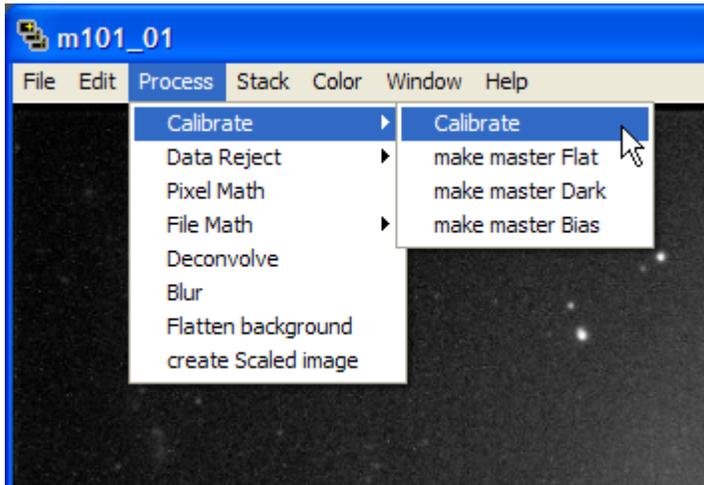
Now that we are familiar with the basic operation of the CCDStack interface, let's continue our processing.

Make sure to reset your magnification to **Size to window** and **auto scale** the entire stack before moving on to the next step.

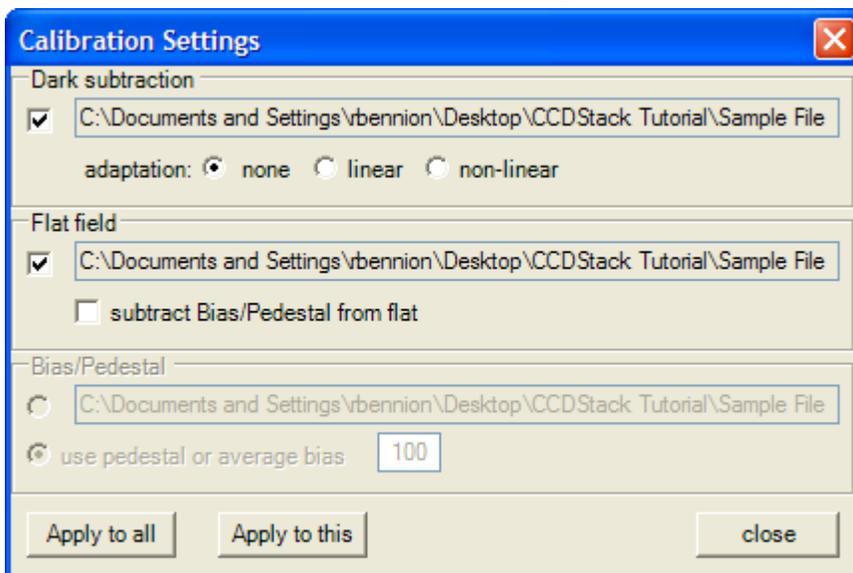
If you have made changes that you are uncomfortable with, clear all images from the application and reload them.

Calibrate Images

From the Main Menu, select PROCESS > CALIBRATE > CALIBRATE.



You will then be presented with the **Calibration Settings** dialog box.



Make sure that **Dark subtraction** and **Flat field** checkboxes are checked.

The last calibration frames that were created with CCDStack are automatically chosen for you. If you would like to select another calibration file, just click on the **path info box** and you will be presented with a dialog box asking for the location of the calibration master.

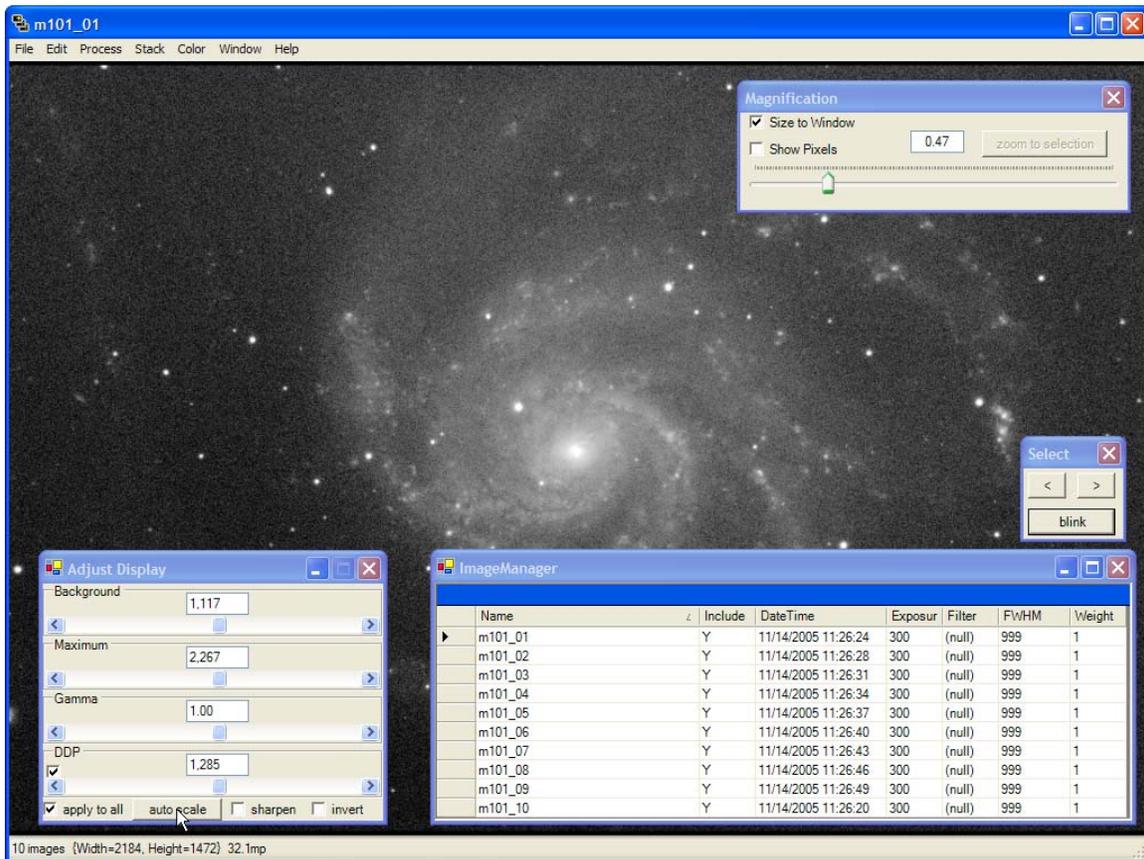
CCDStack has very powerful **Dark Subtraction Adaptation** methods. These are covered in more detail in the on-line help file. For now we will stick with the option 'none' as our darks frames were acquired at the same temperature and duration as our light frames.

We do not need to subtract a Bias frame or a specific pedestal value as we have already handled that process when we create the flat master.

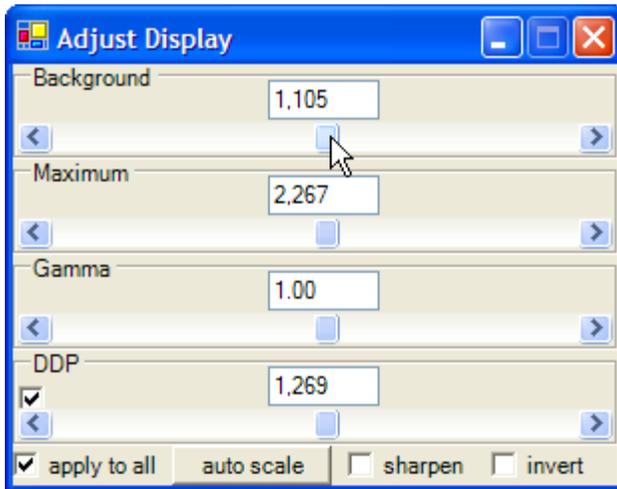
Select the **apply to all** button to calibrate all the light exposures in the stack.

Dynamic DDP Scaling

Now that all of our frames are calibrated, this is a good time to use CCDStacks dynamic DDP scaling display to see more detail in our individual exposures.



Check the DDP and **apply to all** options on the **Adjust Display** window and click the **auto scale** button. We can also lower our background slightly to get a bit more contrast in our image.

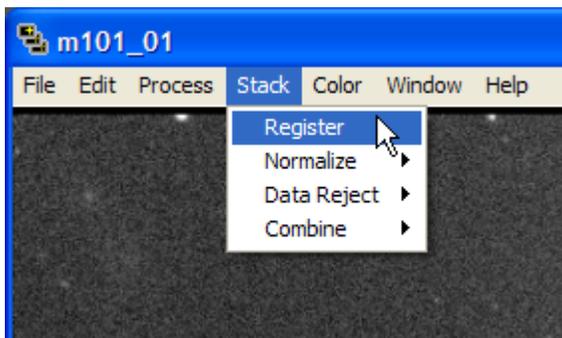


Once you are satisfied with the display of the images, move on to the next step.

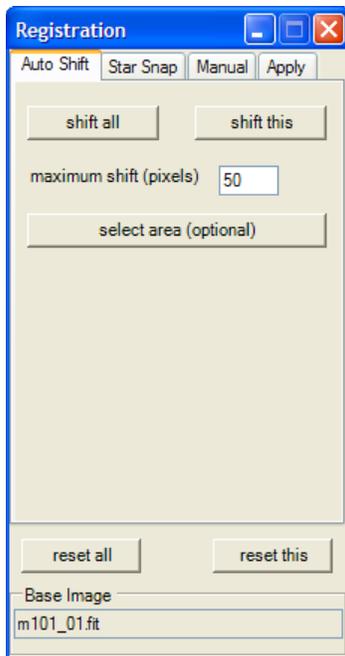
Align Images

Now that our images are calibrated, we need to align our light frames. The images contained with the sample files have been dithered to reduce signal to noise and eliminate hot and cold pixels. They require a very accurate alignment.

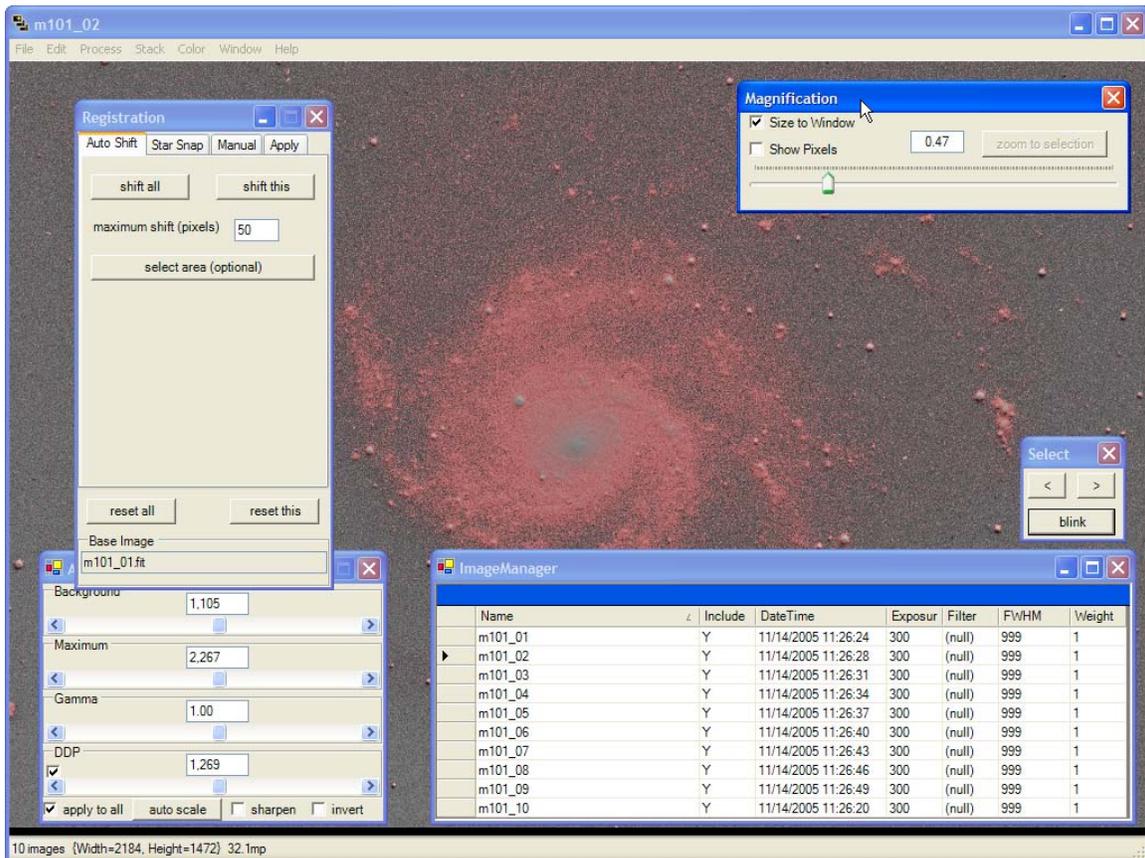
From the Main Menu select STACK > REGISTER



This will present you with CCDStacks **Registration** dialog box:

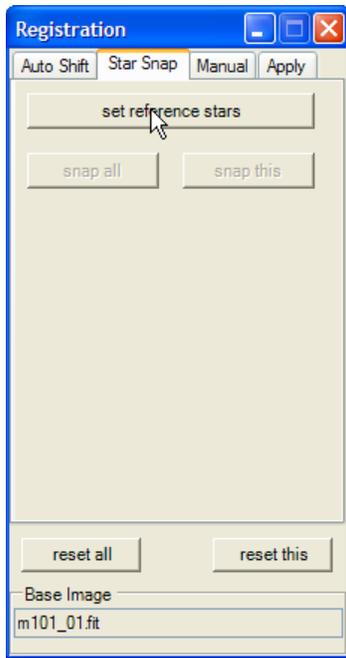


In addition, the image display will turn a slightly red color and show us a view of our base image overlaid on the other images in our stack.

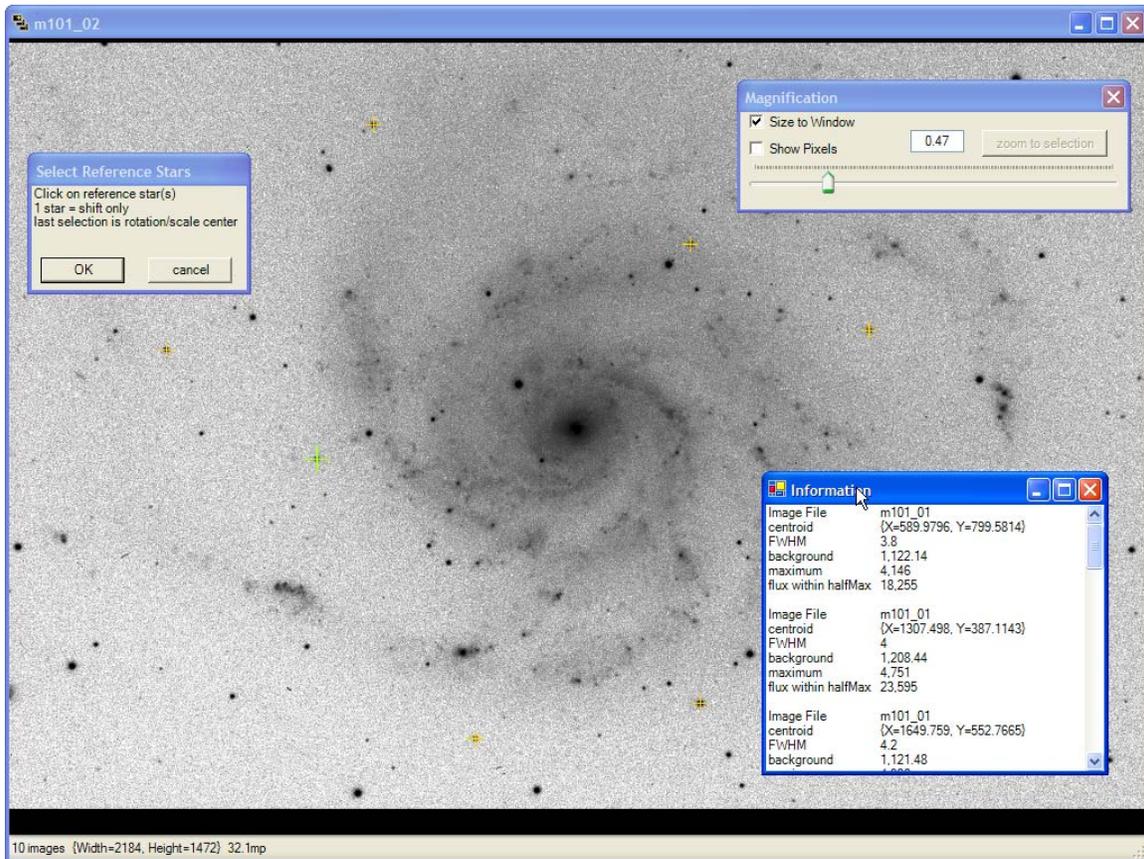


There are many ways to align your images with CCDStack. This is covered in the on-line help file. For this tutorial, we are going to do a simple star-snap.

Select the **Star Snap** tab on the **Registration** dialog box and click the **Set Reference Stars** button:



At this point you will be presented with an inverted view of your image so you can more clearly see the stars in the exposure.



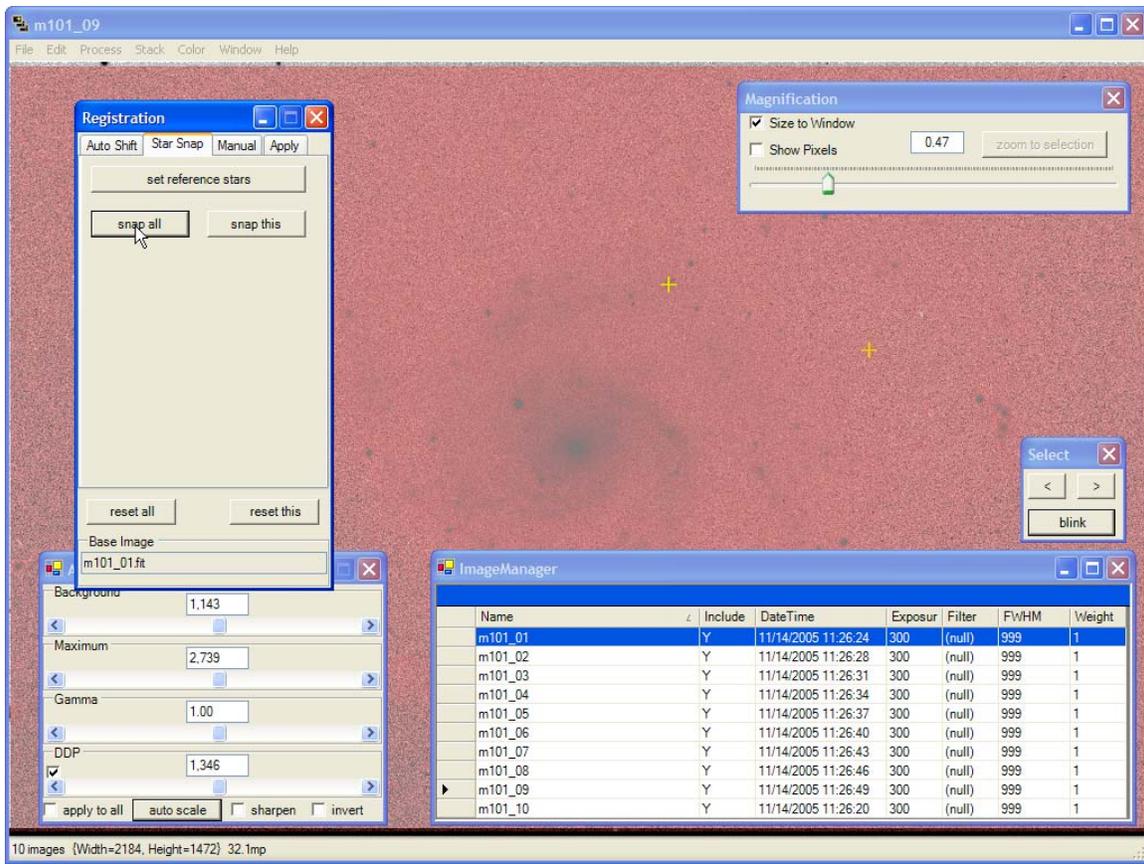
Click on five or six stars around the image. Don't worry about clicking the exact center of the star. CCDStack will find the star, compute the centroid, and snap a crosshair on the star.

As soon as you click on a star, the **Information** window will appear to show you information about the star you selected. Ideally you would click on stars that have a brightness range between 10,000 and 30,000 ADU. Avoid saturated stars and stars that are too dim to be distinguished from the background.

Feel free to use the **Magnification** window to zoom in and out of the image for easy star selection in star rich fields.

Once you have selected your alignment stars, click the **OK** button on the **Select Reference Stars** dialog box.

You will then be switched back to normal view and the **Registration** dialog box.

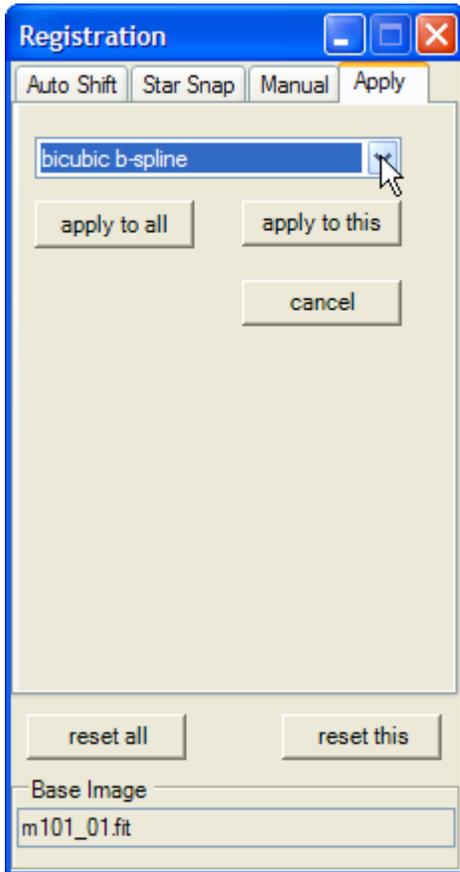


Click the **Snap All** button on the **Registration** dialog box to align all the images in your stack. Each image in the stack has now been shifted, rotated and scaled to match the base image.

Don't close the **Registration** dialog box yet, as we still need to resample all of our aligned images.

Resample Images

Select the **Apply** tab on the **Registration** dialog box.



Select the **Bicubic b-Spline** resampling method from the drop down box and click **apply to all**. There are more advanced methods of re-sampling covered in the on-line help file.

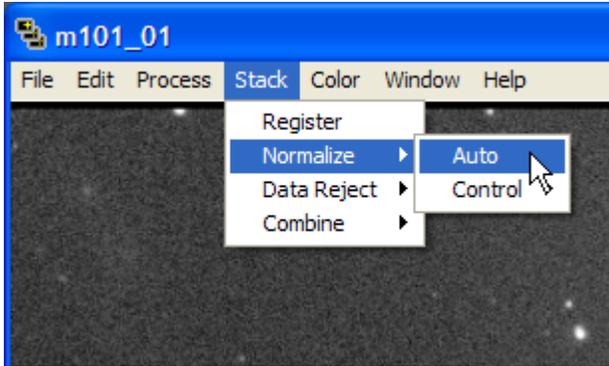
In a few moments all our images will be resampled permanently in CCDStacks image buffer and we are ready to move to the next process.

Feel free to use the **Blink** tool and the **ImageManager** to assess the registration of your images.

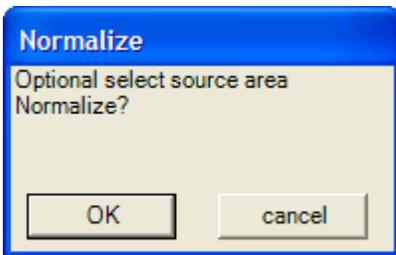
Normalize Images

In order to perform data rejection properly to our stack, we must first normalize all the images to a common value.

From the Main Menu, select **STACK > NORMALIZE > AUTO**.

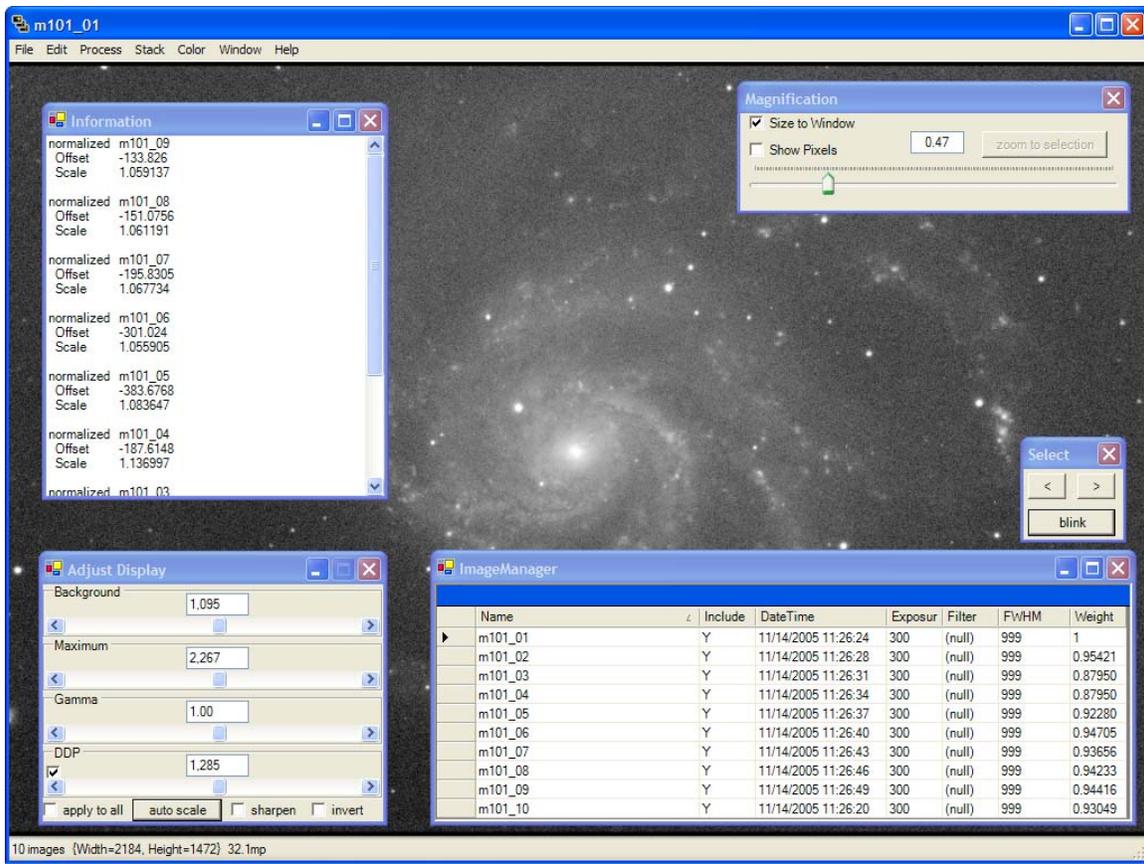


The **Normalize** dialog box will appear presenting you with the option of selecting an area of your image to normalize.



For this tutorial, we are just going to click **OK** and let CCDStack select the best area of the image to normalize.

In a few moments, CCDStack will complete normalizing your images.

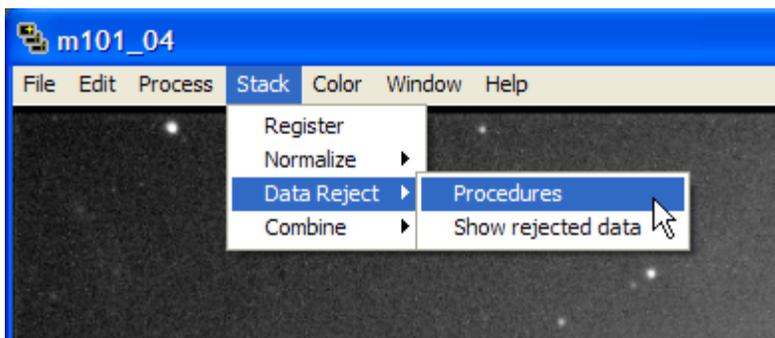


While all your exposures are being normalized, the **Information** window will appear showing the normalization parameters used on each image and the **ImageManager** will show how much each image has been normalized.

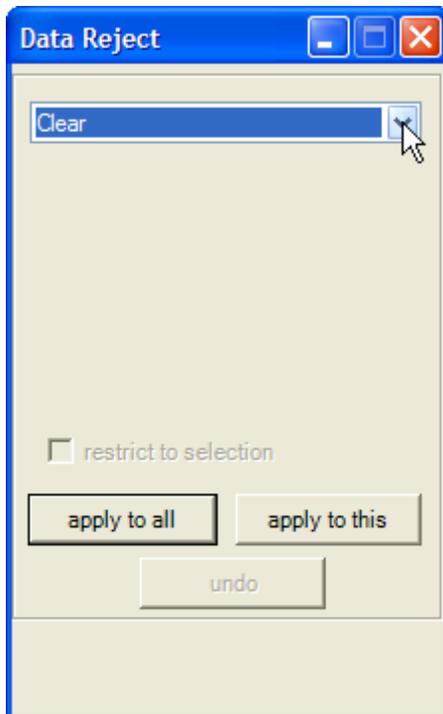
Data Rejection

Now that our images are calibrated, aligned, re-sampled and normalized, its time to get rid of unwanted data such as hot and cold pixels and cosmic ray hits. We achieve this with data rejection.

From the Main Menu, select **STACK > DATA REJECT > PROCEDURES**.

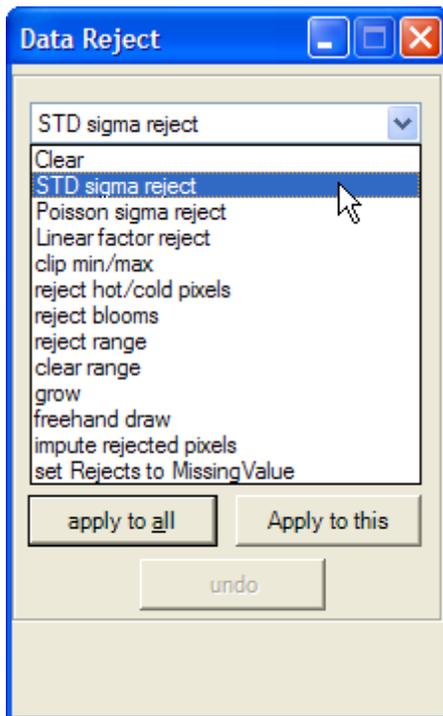


You will now be presented with the **Data Reject** dialog box:

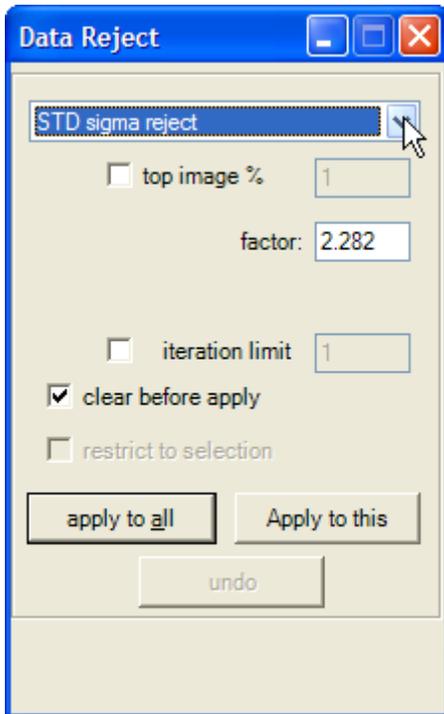


This is a very powerful feature of CCDStack with many options and capabilities. We will not cover them here in this tutorial. More information can be found in the on-line help file. We are going to perform a simple Sigma rejection to our stack of images.

From the **Data Reject** pull down menu, select **STD Sigma Reject**:

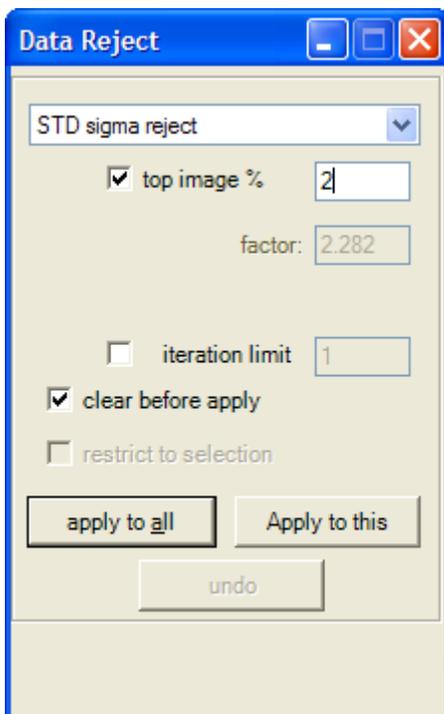


You will now be presented with the options that are relative to the **STD sigma reject** procedure:



You will see in the above dialog box we have the option to enter the STD (Standard Deviation) **factor** to reject pixels or we can select the check box called **top image %** and specify what percent of pixels we want rejected from each image.

For this image, we are going to check the **top image %** option and enter a value of **2**.



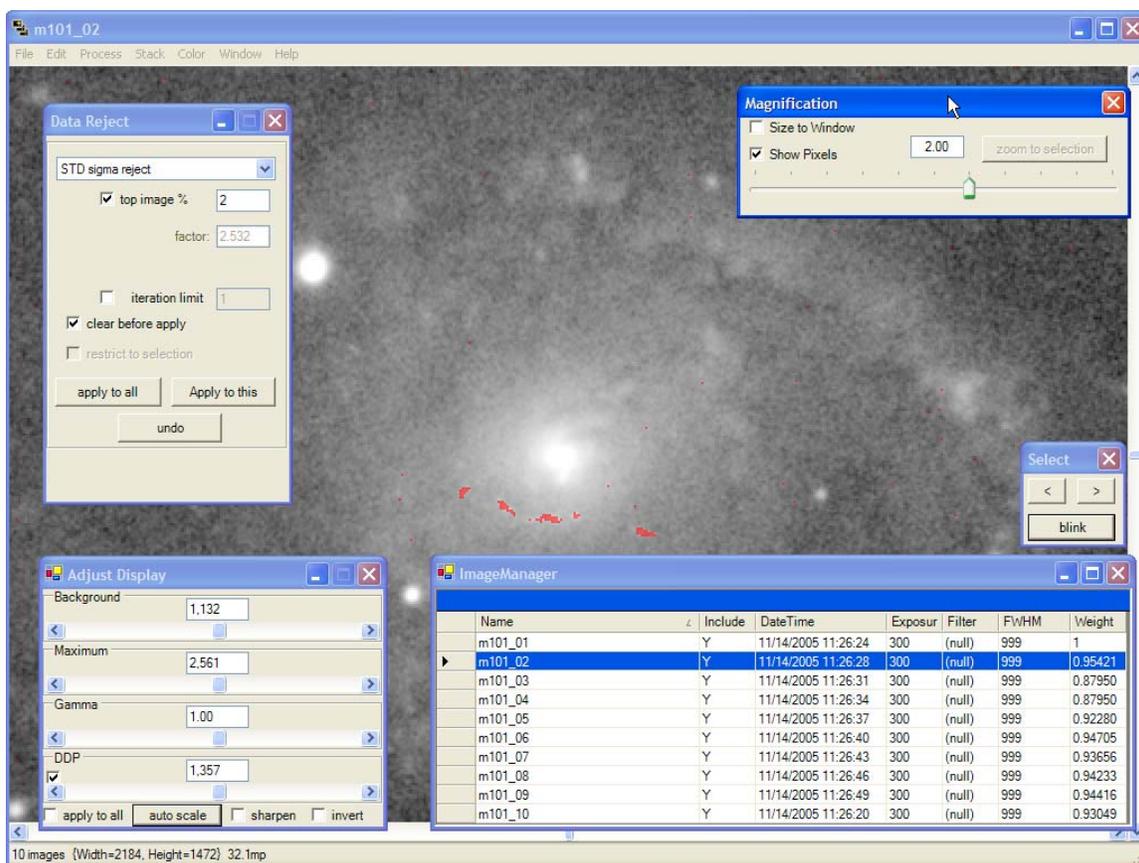
Now click the **apply to all** button. CCDStack will now compute what Standard Deviation **factor** to use to ensure that a maximum of 2% of the total pixels are rejected in each one of our images.

After a few moments, the **factor** will be computed and CCDStack will go through each image and mark the rejected pixels.

In the **Magnification** window, check the **Show Pixels** option and zoom to **2.00**.

In the **Adjust Display** window make sure the **DDP** option is checked, check **apply to all**, and click the **auto scale** button.

In the **ImageManager** window, select **m101_02**. You should see something that looks like this:



CCDStack has marked all the rejected pixels in red so you know exactly what has been rejected in each image.

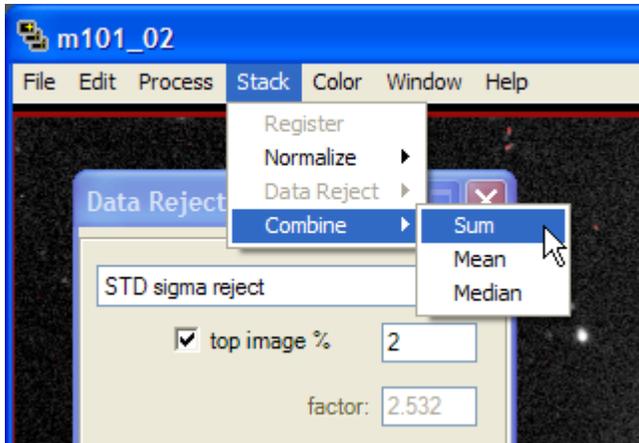
Blink through your stack of images at different zoom levels to see the rejected pixels in each image.

Don't close the **Data Reject** dialog at this point.

Combining Images

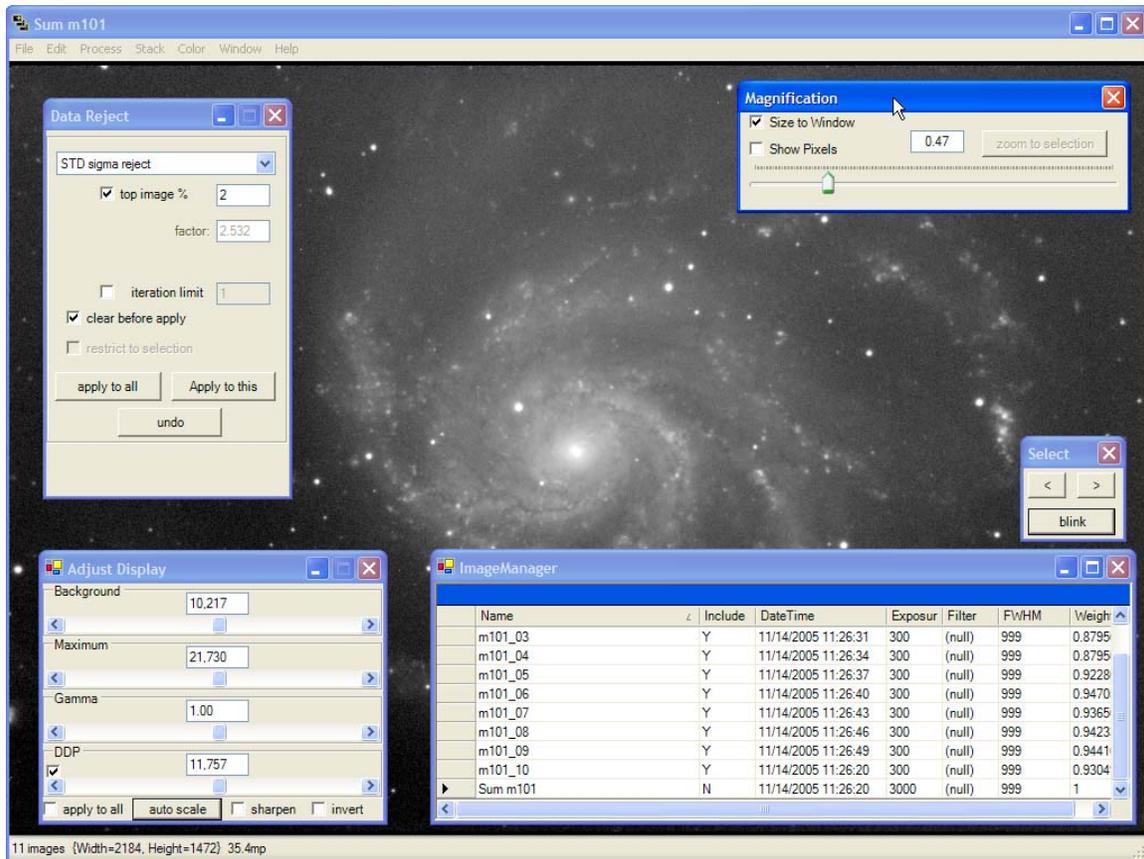
Now that we have rejected our unwanted pixels, we are ready to combine our stack of images.

From the Main Menu, select STACK > COMBINE > SUM:



After a few moments, our stack of images are summed together, ignoring the rejected pixels.

The resulting screen should look like thing:



Notice that we have a new image in our **ImageManager** called **Sum m101**. This is the resultant image created from our stack of exposures.

Note that the total exposure time for the image now indicates 3000 seconds. This is because we added 10 x 300 second exposures of M101 to create the summed image.

Also note in the **Include** column, the image is set to **N**. This indicates that if we perform any additional combine operations, this image will not be included in these operations.

This would be a good time to explore the **Adjust Display** window to get a deeper feel for how the image can be stretched in real time until you have a satisfactory result displayed.

Saving our Images

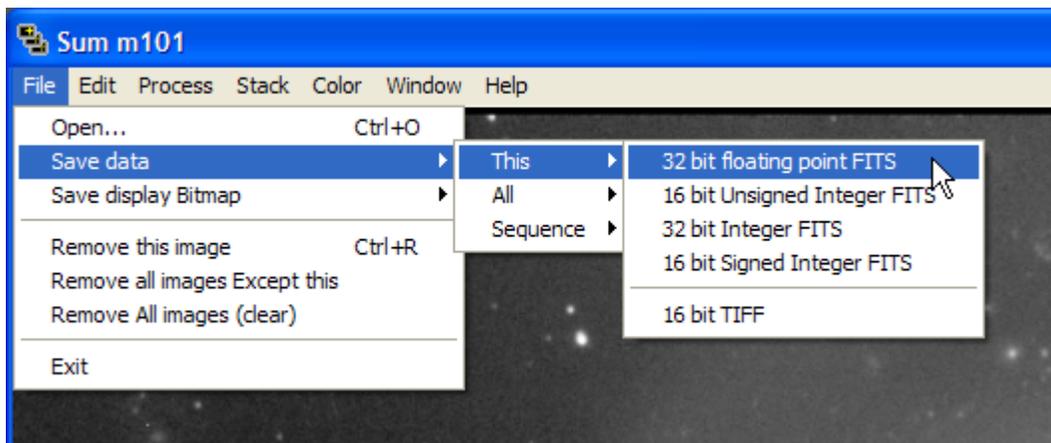
With CCDStack, we have many options to save our images. The following section gives a brief overview of some common save operations.

Saving FITS files

Now is a good time for us to save our combined image. The first thing we should do is save it as a 32 bit FITS file so we can adjust the image at a later time. Remember, the display is just a visual representation of the data. The saved FITS file will not include our current display settings, just the raw FITS data.

Make sure that **Sum m101** is selected in the **ImageManager**.

From the Main Menu, select FILE > SAVE DATA > THIS > 32 BIT FLOATING POINT FITS



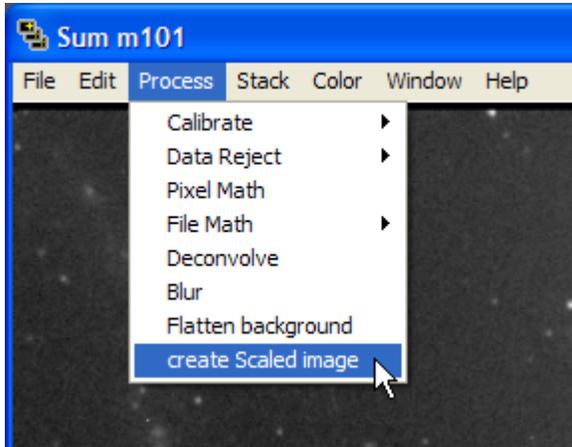
Now we have our raw data saved for later manipulation and archive purposes.

Rescaling Images

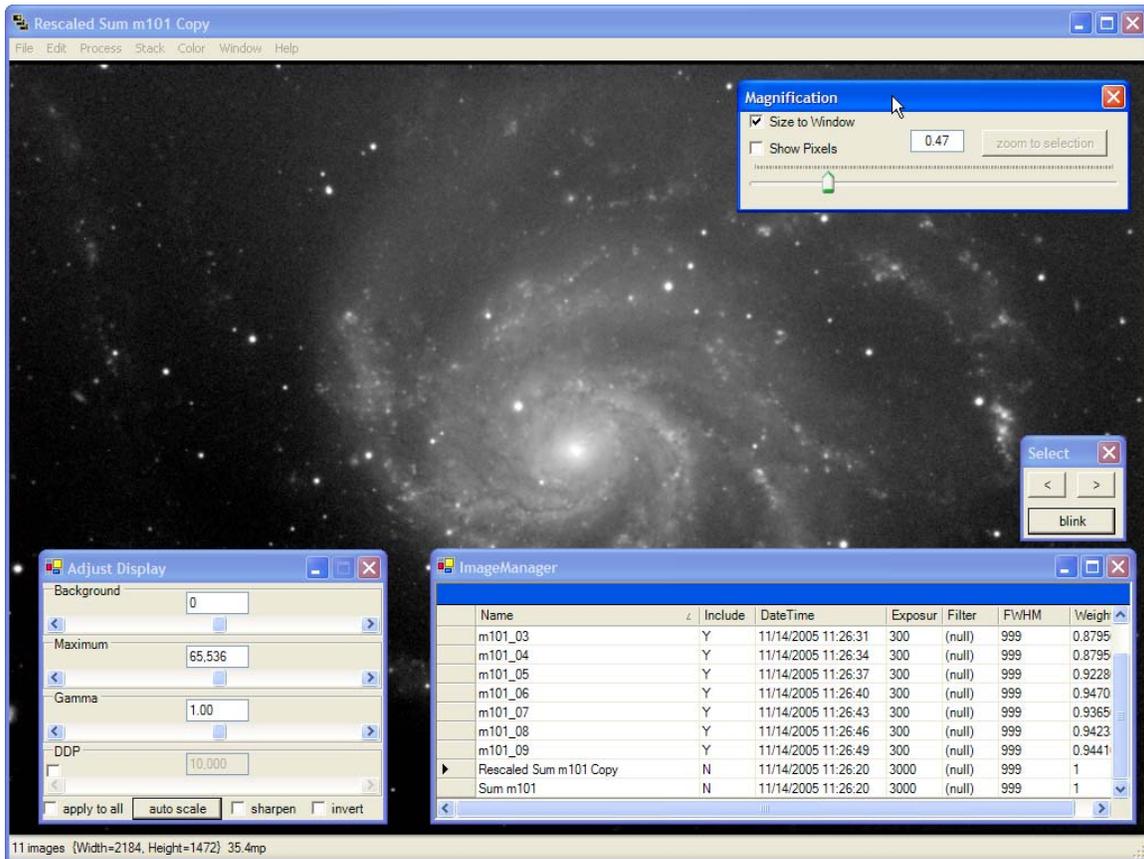
After we have adjusted the image to our liking and want to preserve our settings, we will want to rescale our image to match the display.

Make sure that **Sum m101** is selected in the **ImageManager**.

From the Main Menu, select PROCESS > CREATE SCALED IMAGE.



You will now notice we have a new image in our **ImageManager** named **Rescaled Sum m101 Copy**.



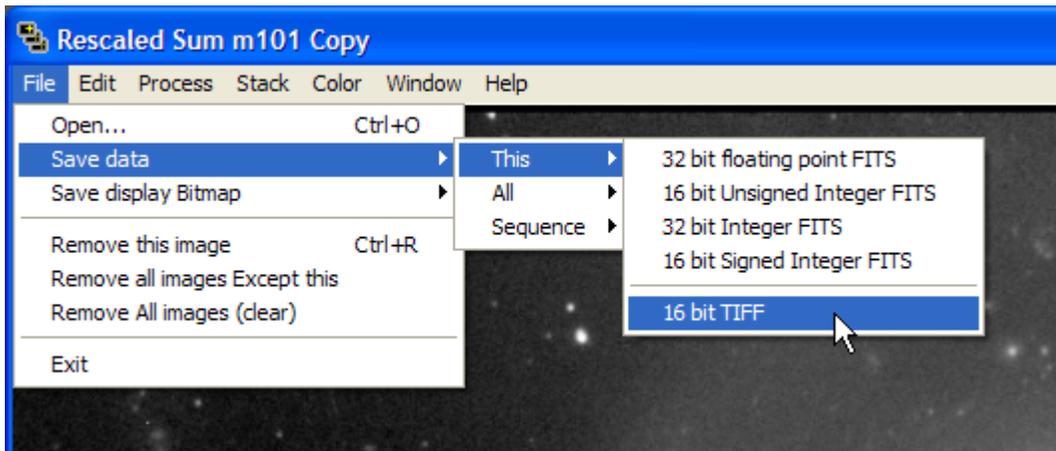
The display image from **Sum m101** was scaled to a new 16-bit image. Notice in the **Adjust Display** window that the **Background** is set to **0** and the **Maximum** is set to **65,536**.

Saving TIFF files

Now that we have rescaled our image to a 16-bit format, we are now ready to save out the image for editing in other programs.

Select **Rescaled Sum m101 Copy** in the **ImageManager**.

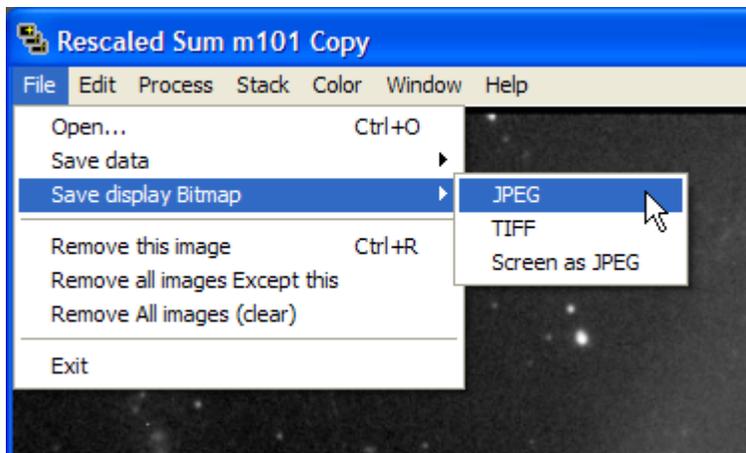
From the Main Menu, select **SAVE DATA > THIS > 16 BIT TIFF**.



Now we have a fully scaled 16-bit TIFF file that we can import into a program like Photoshop.

Saving the Screen Display

Another option is to just save what ever is currently being display by CCDStack. For instance, you want to save a JPEG file and post it on the Web.



Here we have three options:

Save the entire display (even those areas that may be off screen depending on your magnification level) as a JPEG.

Save the entire display as a scaled TIFF.

Save what ever is being displayed on the screen as a JPEG. You might want to zoom to one half actual size and save a small copy of the image

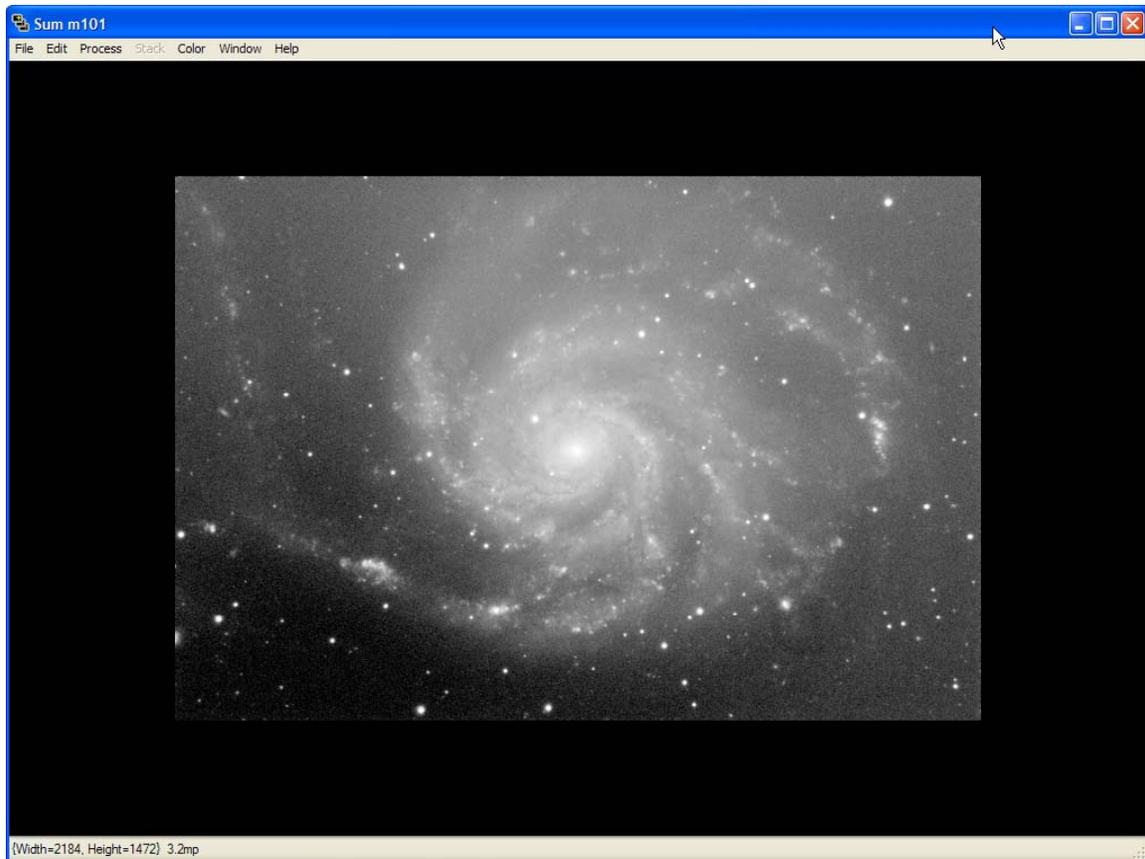
Gradient Removal

CCDStack has the ability to remove linear and non-linear gradients with a very easy to use interface.

Flatten Background

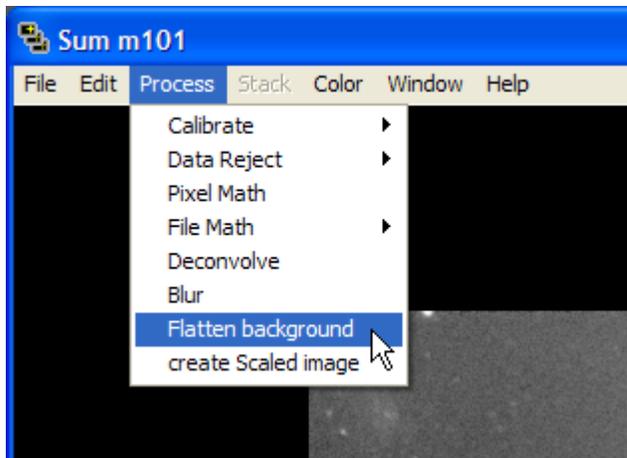
You might have noticed while experimenting with our final summed image that we have a few gradients in our image due to light pollution in the North.

A strong stretch of the image will reveal this gradient with more clarity:

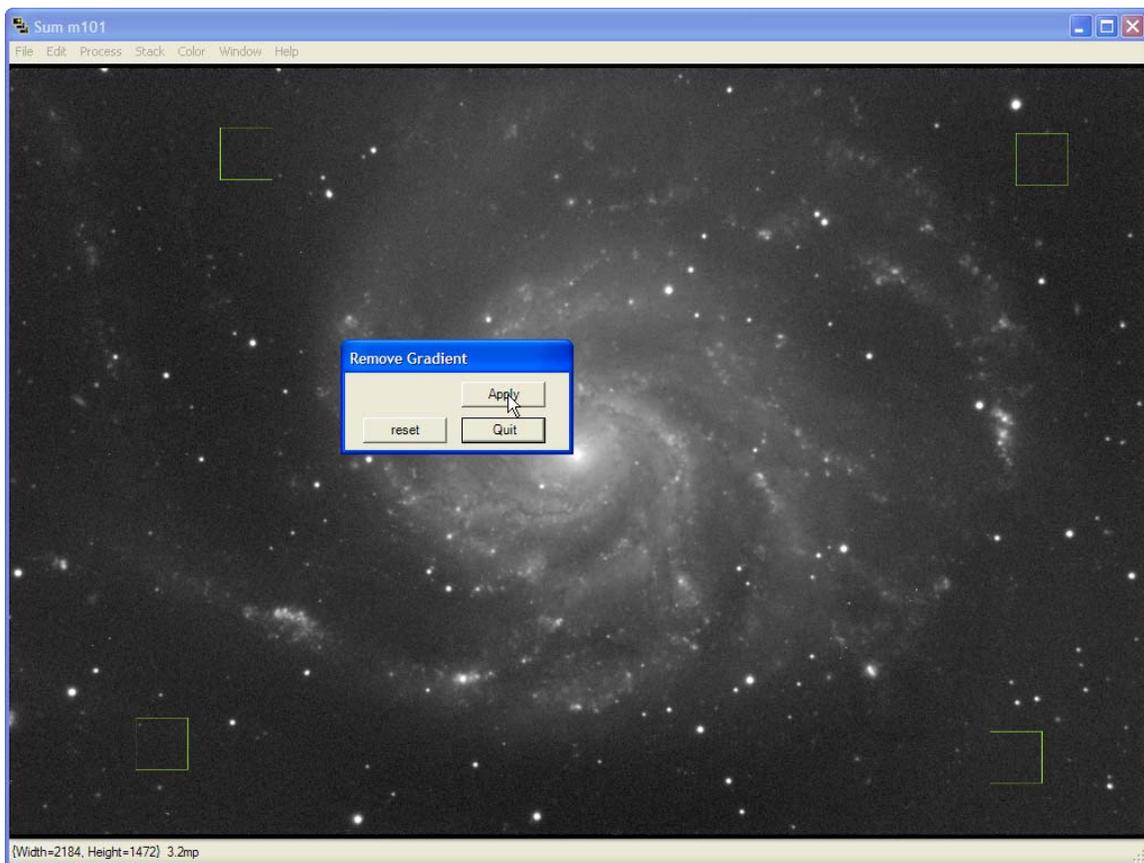


To remove this gradient we are going to use the **Flatten Background** command.

From the Main Menu, select PROCESS > FLATTEN BACKGROUND:



Now we will use the **Flatten Background** tool to get rid of our gradients.

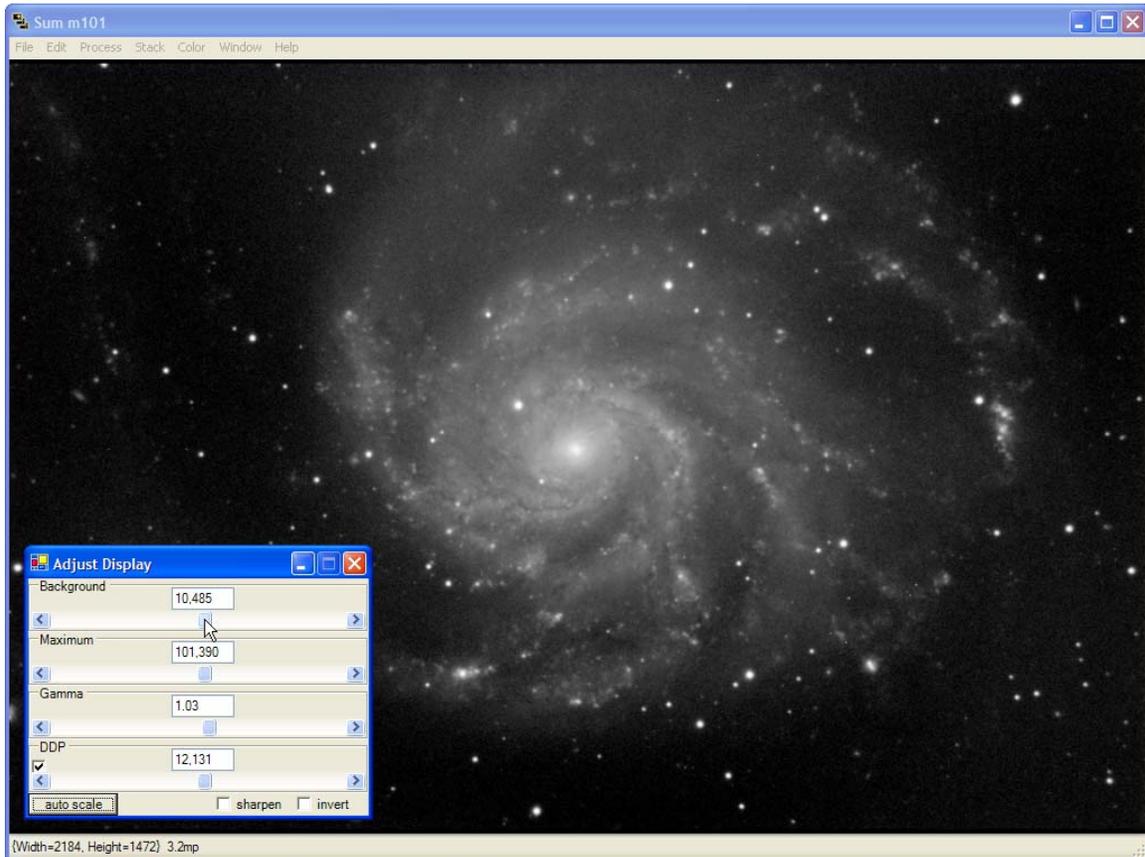


Using the mouse, select several areas that represent background area devoid of galaxy structure as shown in the above image.

Once we have selected our points and are happy with the results, click the **Apply** button to apply those changes permanently to our image.

This process can be repeated several times until you have removed all traces of the original gradients.

Now bring back up the **Adjust Display** window (CTRL-A) and click on the **auto scale** button.



As you can see, we easily corrected our gradient while preserving the integrity of the image.

We can fine tune out display settings, rescale our image and save a TIFF file of our finished light frame.

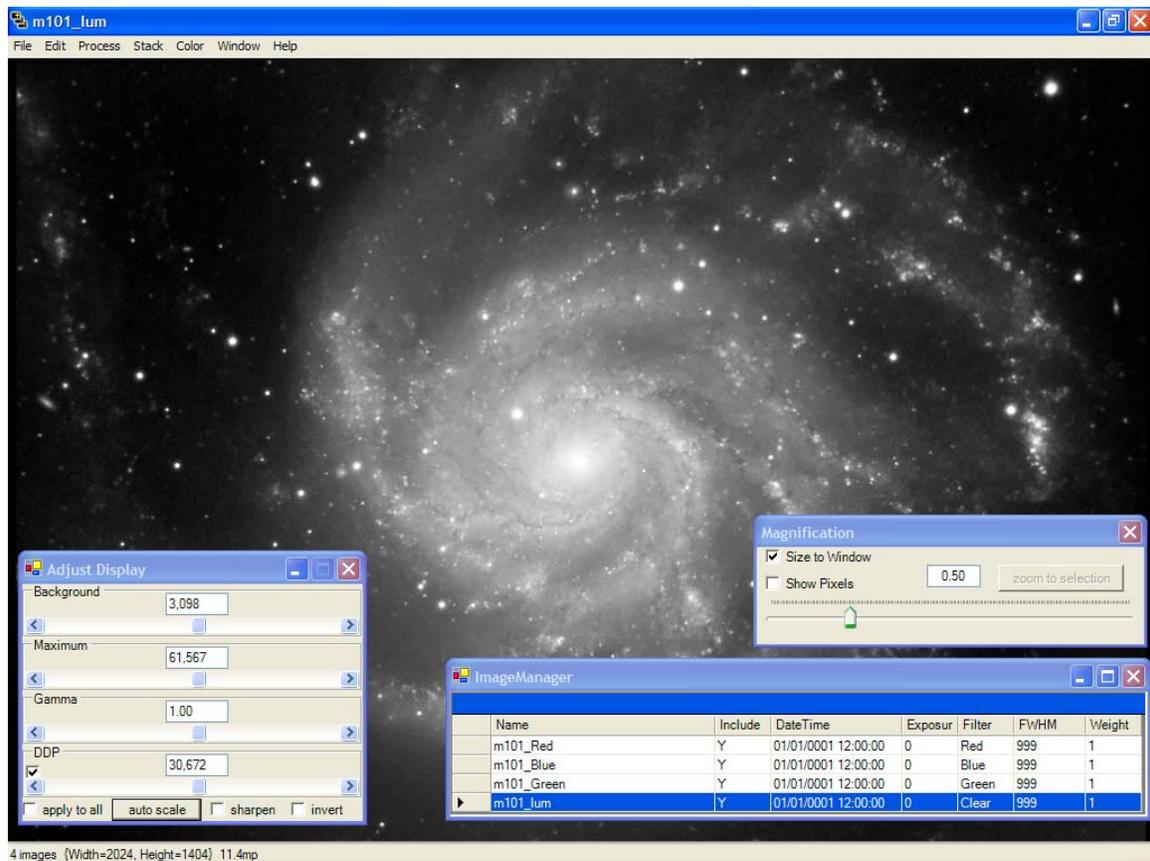
LRGB Color

CCDStack has very powerful color capabilities that will allow you to fine tune your color settings in real-time.

Loading LRGB Masters

To start this process in the tutorial, clear all open images in CCDStack or restart the application.

Open all the sample files in the LRGB Files directory. You should be presented with a screen that looks something like this:

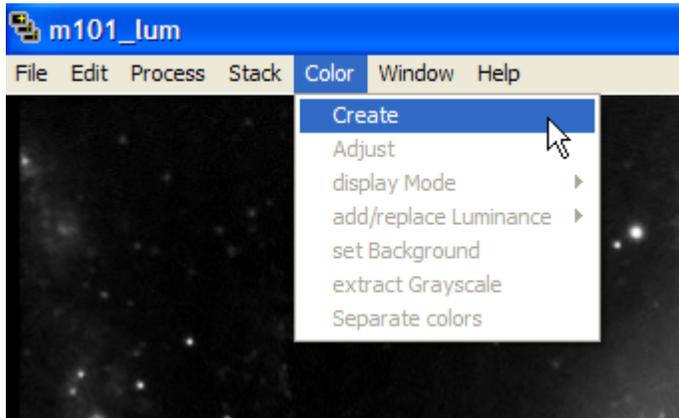


Feel free to view any of the images in the **ImageManager** to see the differences in the color channels.

The sample M101 LRGB files have already been registered. If your LRGB images are not registered, then you would want to use the **PROCESS > REGISTER** process described earlier. The key to registering LRGB images is to make sure to select the luminance file in the **ImageManager** as the base image for image registration.

Creating a LRGB Color Image

To create a new LRGB image from the images in our stack, select COLOR > CREATE from the Main Menu:



Once selected, you will be presented with the **ColorCreate** dialog box:



Select which images in your stack correspond to the correct color channel as shown above. CCDStack will look at filter names as indicated in the **ImageManager**, so the correct files should be already selected.

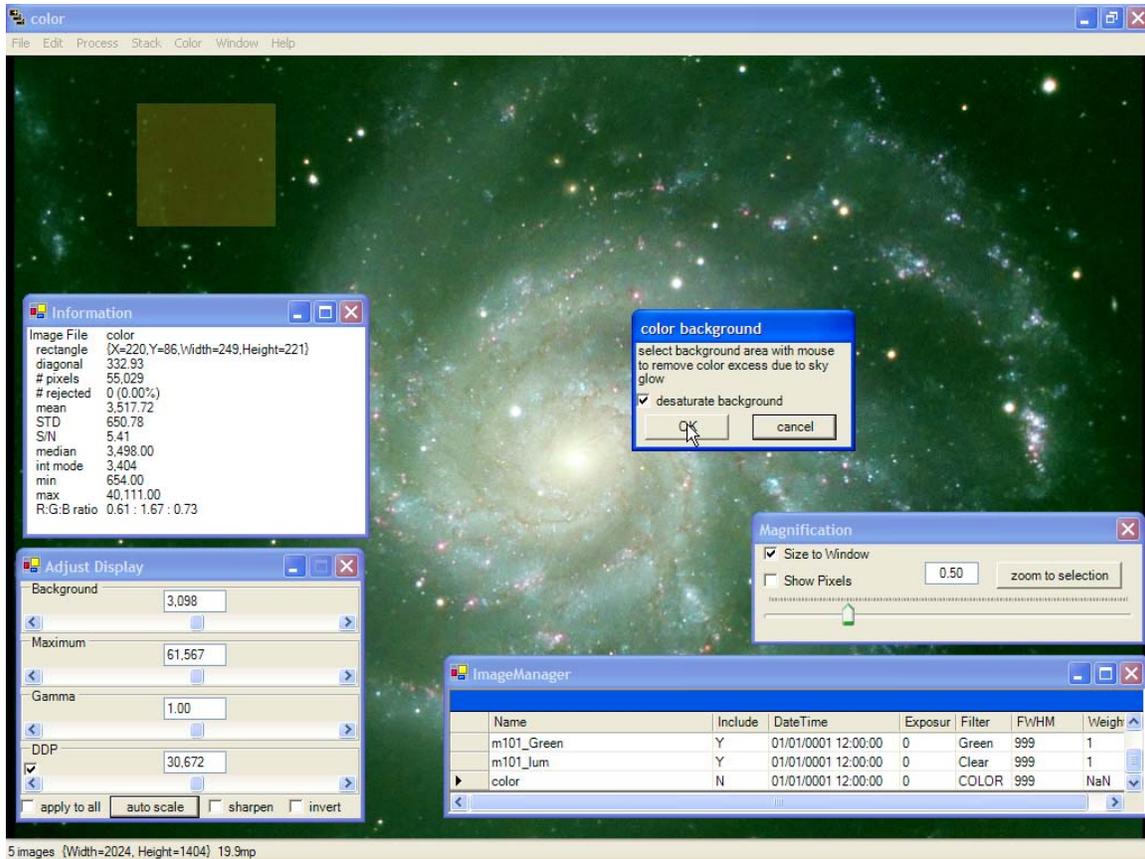
Next, set your **initial filter factor** or RGB color ratio as indicated by your filter manufacturer. The sample files were taken with AstroDon filters so we will use a RGB color ration of 1:1:1.

Now click the **Create** button to apply your settings and create your LRGB image.

Notice in the **ImageManager** we have a new image in our stack called **color**.

Background Normalization

In most cases, our background value will not be the same for our RGB images. After you click the **Create** button on the **ColorCreate** dialog box, you are presented with the option to normalize your RGB values by selecting an area of the background that contains no structure from our target.



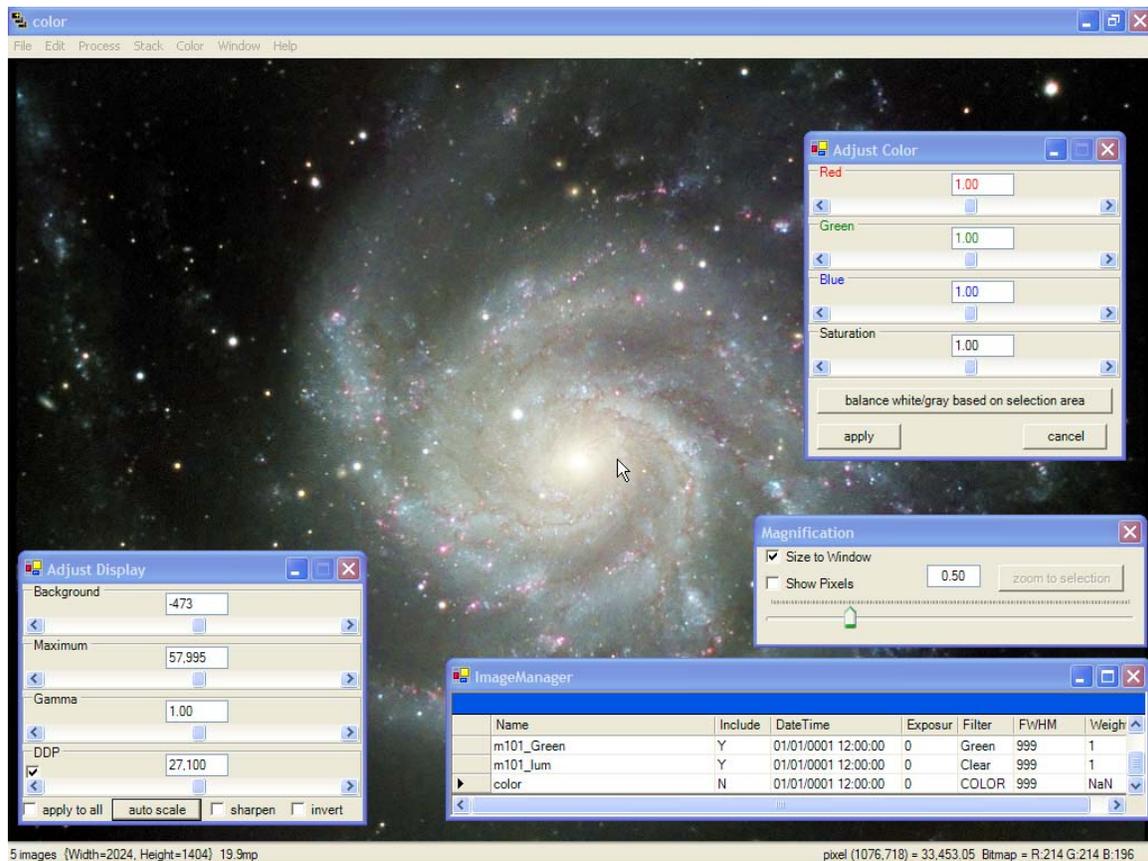
With your mouse, create a rectangle selecting the background of our image as show above. Don't worry about a few stars in the area you select as CCDStack will ignore those stars when computing the background value.

Once you select a background region with your mouse, CCDStack will open the **Information** window showing statistics about the selected region. Notice now that we have a R:G:B ratio value in addition to other statistics about the selected region. In this case we can see that the green channel dominates the background.

CCDStack will optionally de-saturate the computed background to remove any faint color gradients in our image. Leave this option checked.

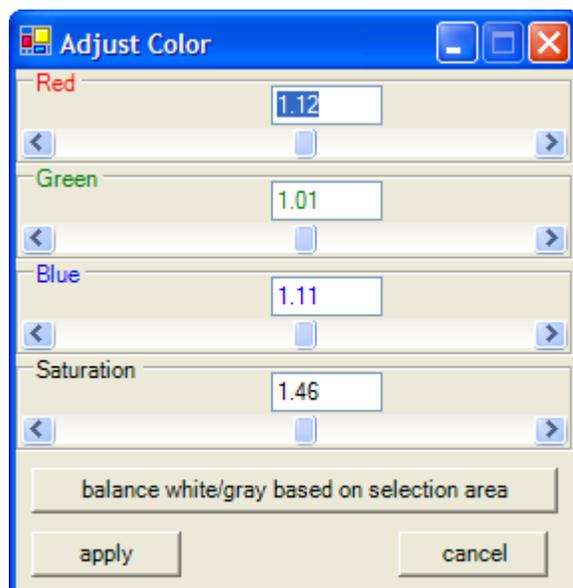
Once you have selected a region of the background, click OK on the **color background** dialog box.

You will now be presented with a normalized RGB version of your image with the background desaturated:



Making Color Adjustments

Now that we have a normalized LRGB color image in our stack, we are presented with the **Adjust Color** dialog box.



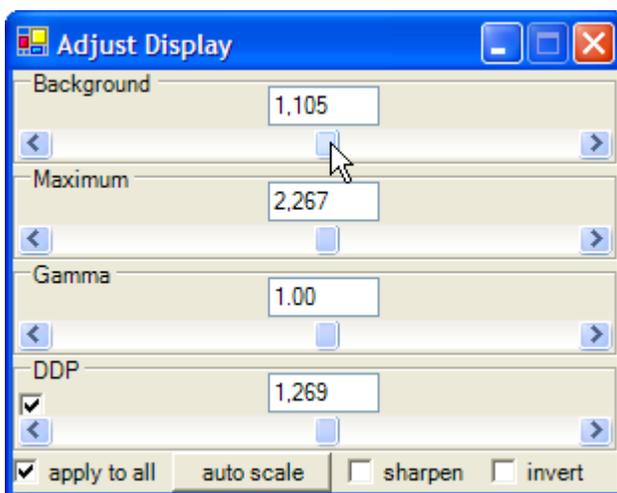
This is a very powerful feature that allows you to make color adjustments in real-time.

Using the **Red**, **Green** and **Blue** sliders, we can adjust the color balance of our image to our liking. In addition, we can boost the saturation of our image with the **Saturation** slider.

Remember that CCDStack is not altering the raw 96-bit color data contained in your image. Any adjustments you make are only being represented on the display and can be reset or changed at any time.

This is a good time to experiment with the RGB and Saturation sliders to see how they affect your image.

It is also important to note that the **Adjust Display** window is also still active:



Using the **Adjust Color** and **Adjust Display** windows at the same time allows you powerful flexibility in manipulating your image to achieve the exact result you desire.

Try experimenting with the **DDP**, **Gamma**, **Maximum** and **Background** sliders in conjunction with changing the **RGB** and **Saturation** of your image.

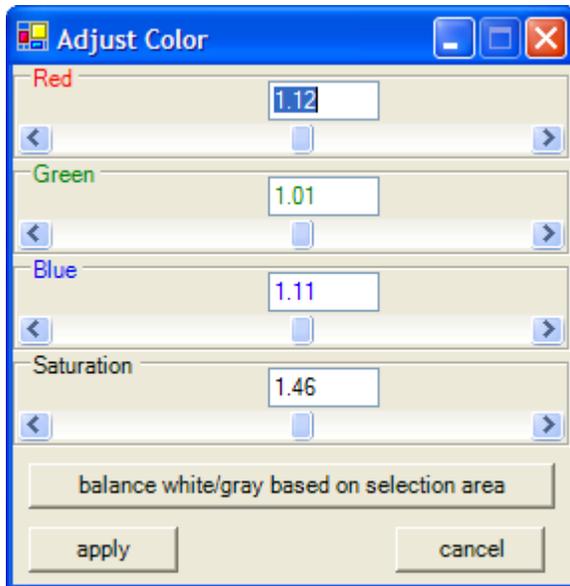
If at any time you can reset the display to default by selecting **auto scale** from the **Adjust Display** window.

Balancing White Points

One of the most powerful features of CCDStacks color capabilities is the ability to balance your image based on a known white point in your image.

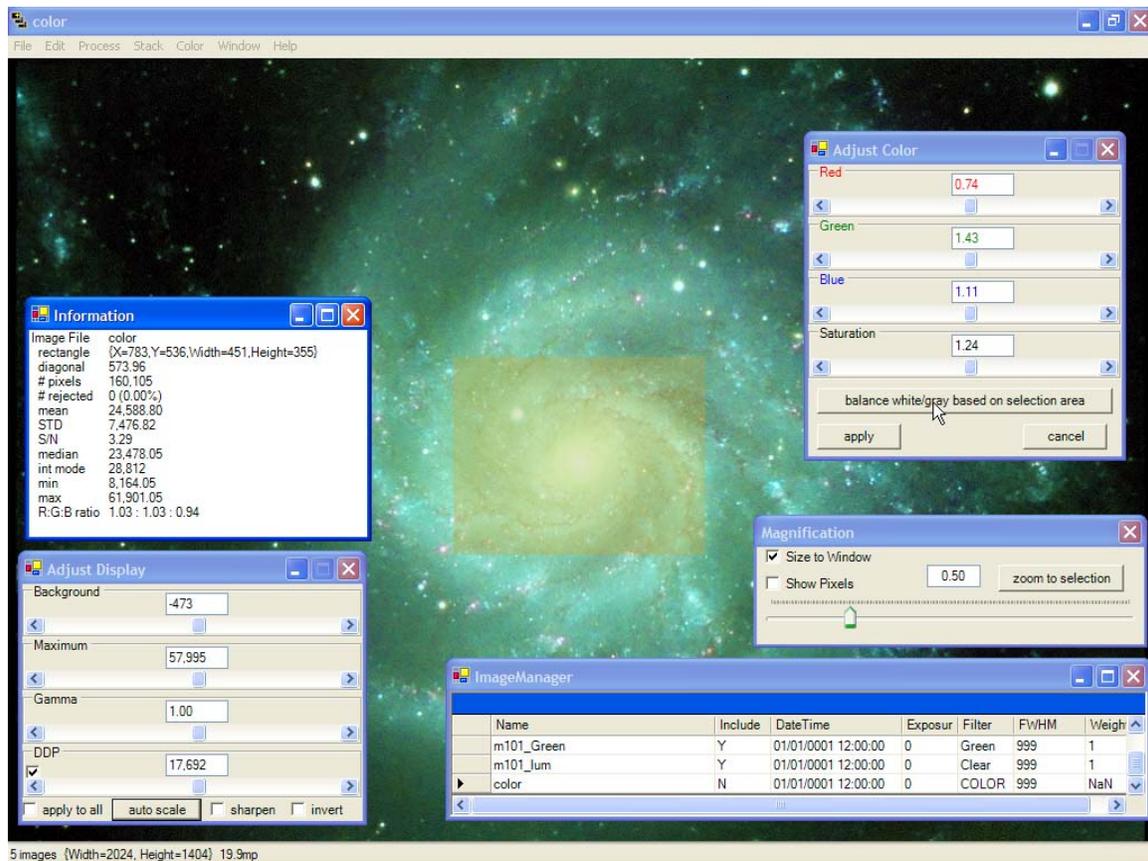
Before you start this step, click **auto scale** in the **Adjust Display** window.

On the **Adjust Color** dialog box make some major changes to your Red, Green and Blue channels to create an unbalanced image. Make sure to do your best to ruin the image as best as possible.



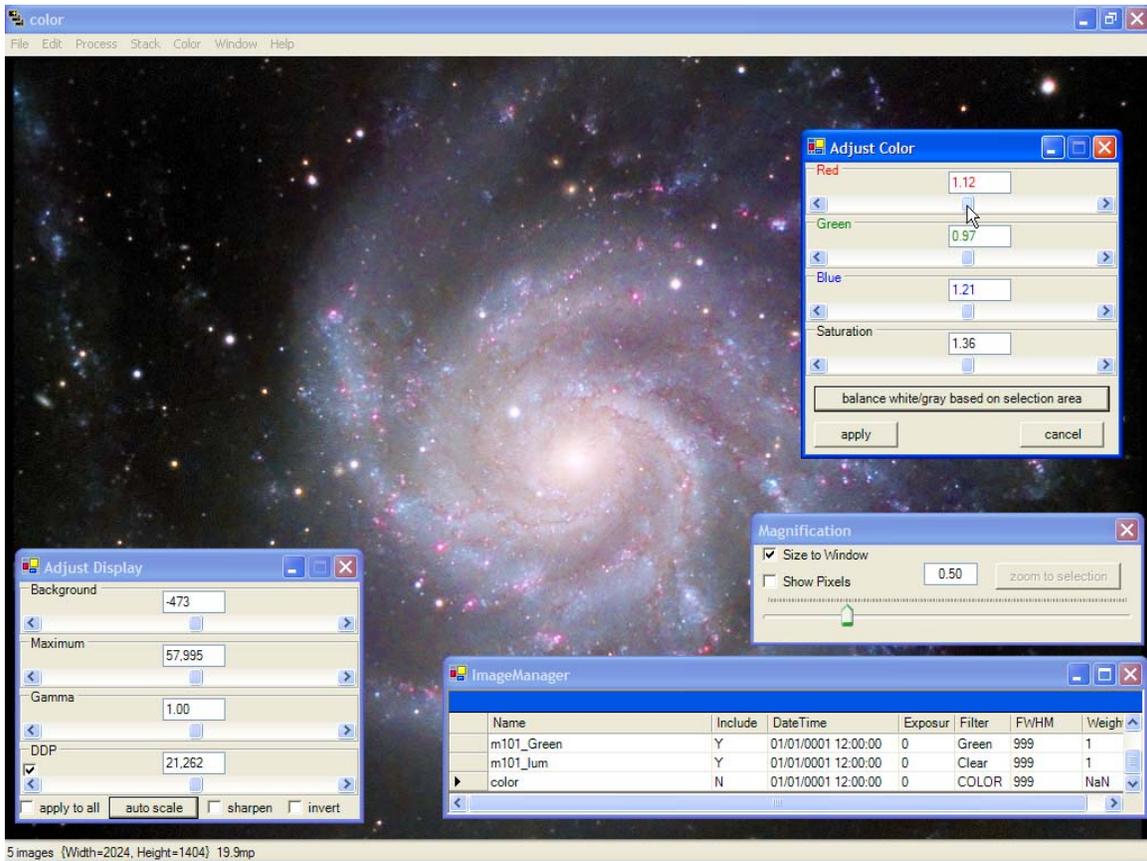
Once your image is significantly destroyed, click on the **balance white/gray based on selection area** button on the **Adjust Color** window.

You will now be prompted to select an area of your image in which to balance the white points of each channel:



Select a region in the core of our galaxy as indicated above with your mouse.

After selecting the region, CCDStack will automatically calculate the RGB ratio required to balance your image:



This technique can also be used to calibrate an image to a G2V star located in the field of view.

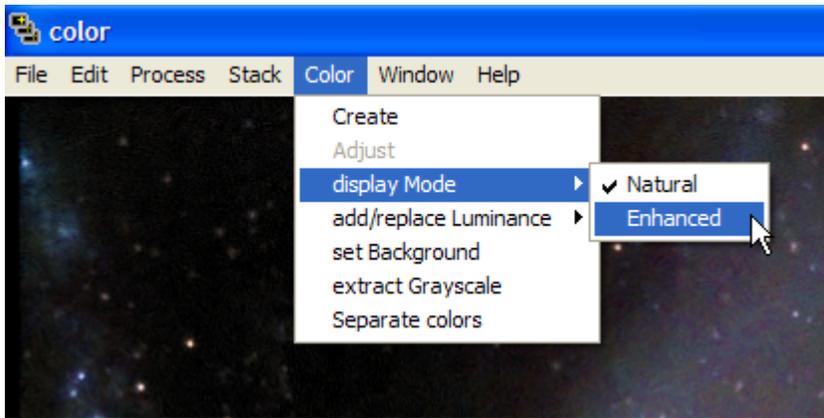
In many cases you will find that balancing your white points in this fashion with a quick click of the **auto scale** button on the **Adjust Display** window will create a very pleasing image.

Enhanced Color

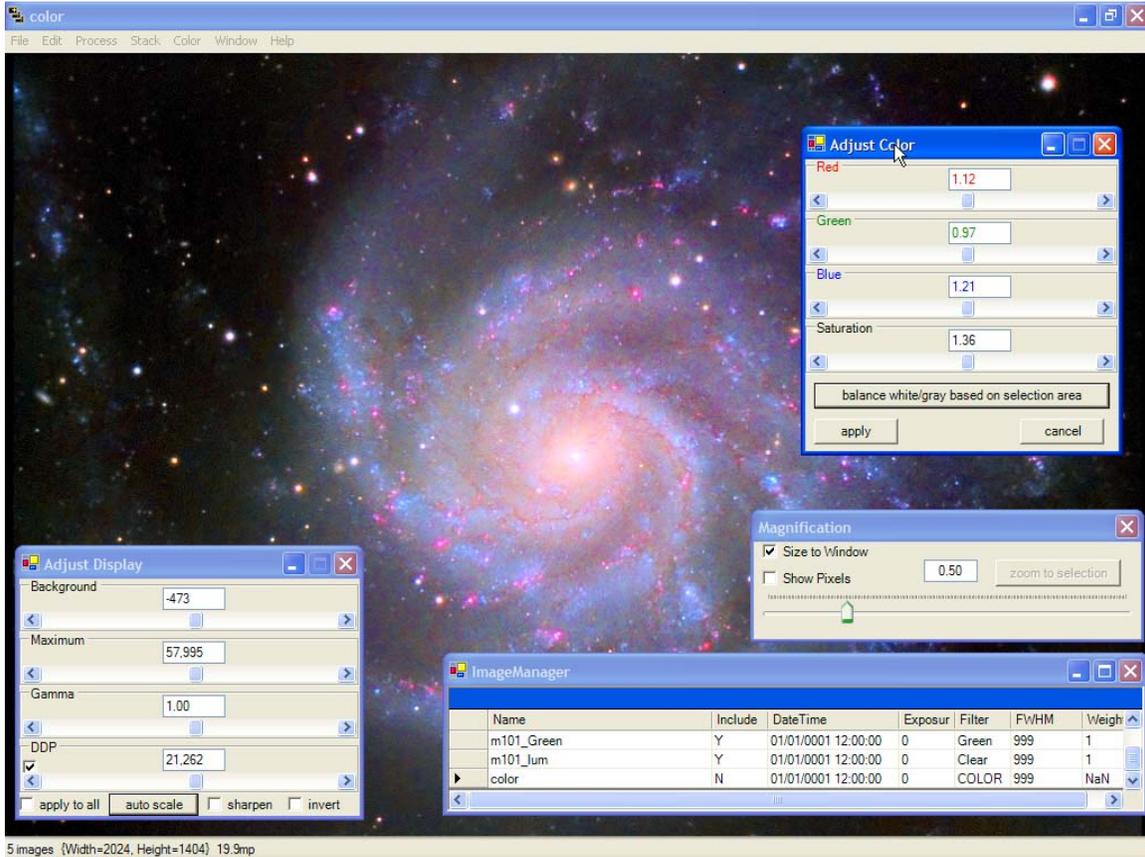
In the previous steps of the LRGB tutorial, we have been working in **Natural Color** mode.

CCDStack has a special mode to work in color that may in certain cases create a more pleasing result.

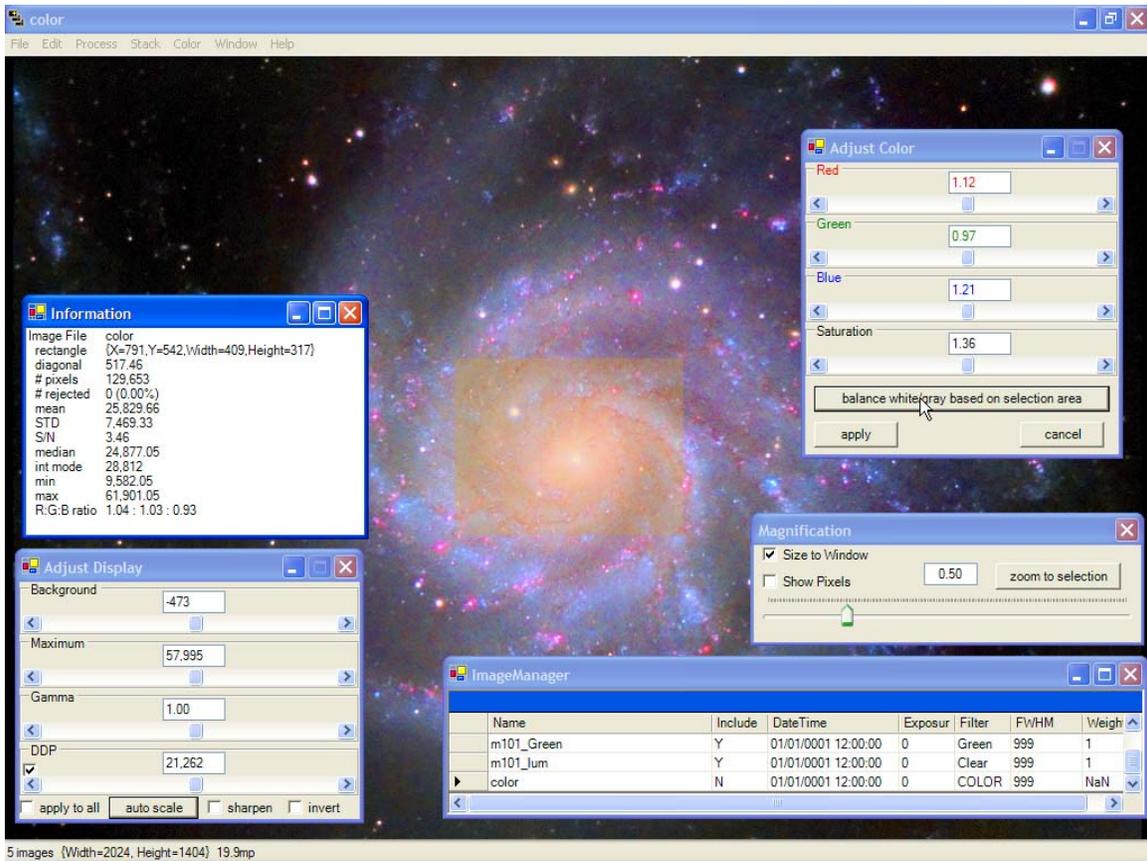
To use this mode, select COLOR > DISPLAY MODE > ENHANCED from the Main Menu:



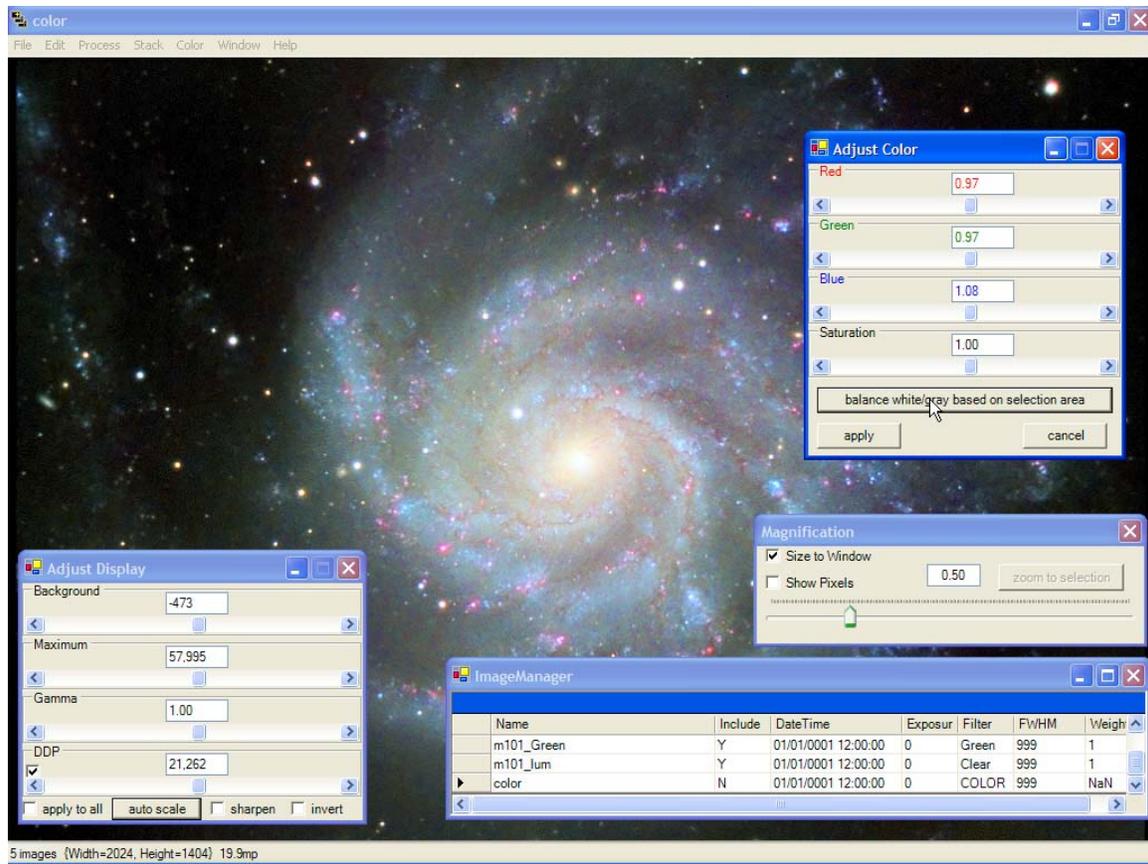
At first, this mode may look very odd due to the fact that our image was balanced using the **Natural** color mode.



To correct for this, use the **balance white/gray based on selection area** button on the **Adjust Color** window to reset and balance our RGB and Saturation levels.



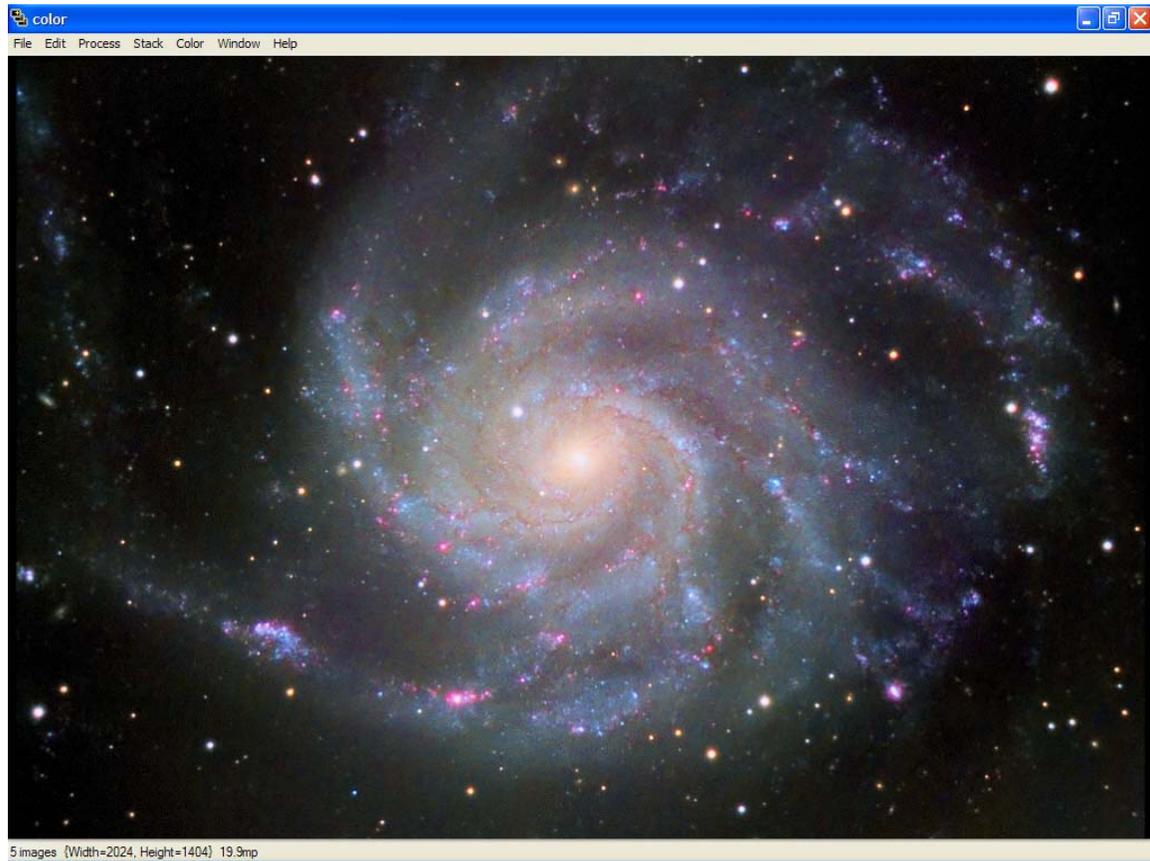
Once balanced, you should be presented with an image that looks something like this:



Notice how the RGB and Saturation sliders behave differently in Enhanced color mode. In many cases you will find that you will create a result more pleasing using **Enhanced** color mode vs. **Natural** color mode.

Creating Our Final Image

Now using the Adjust Color and Adjust Display windows, let's focus on creating our final image.



As you can see, working with color in CCDStack is a very dynamic process. There are limitless options to how you choose to display your image and you get to see them in real-time without making permanent changes to the data that resides in memory.

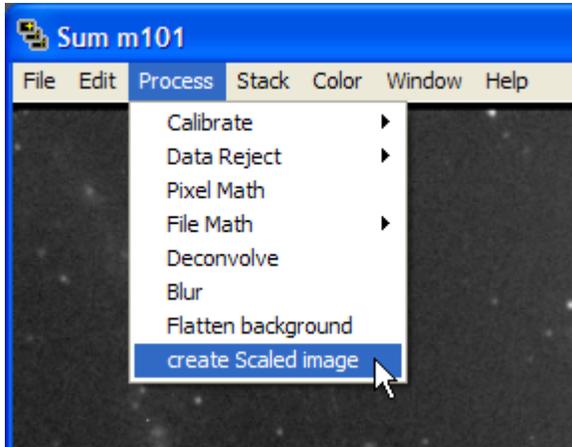
Exporting our Image Final Image

Once we have an image that we are pleased with, its time to save the image for display or for exporting into another graphics program such as Photoshop.

After we have adjusted the image to our liking and want to preserve our settings, we will want to rescale our image to match the display.

Make sure that **color** is selected in the **ImageManager**.

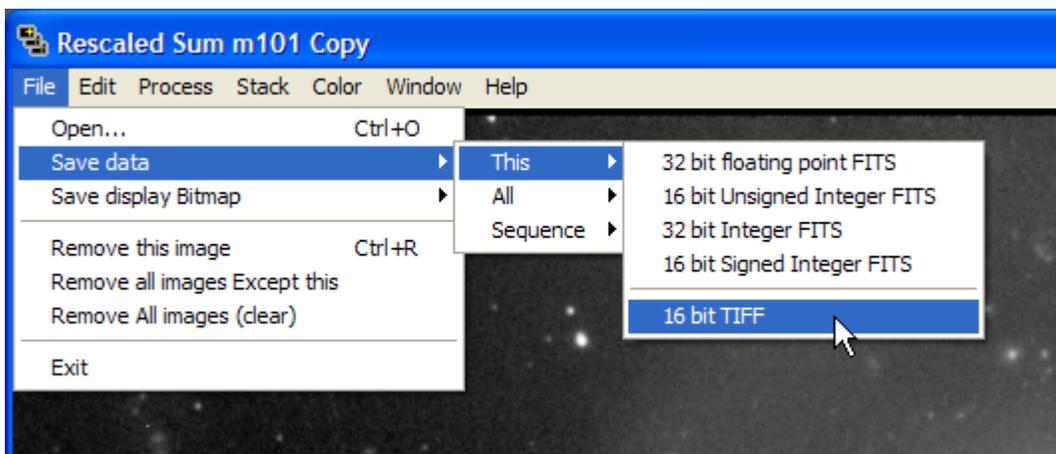
From the Main Menu, select PROCESS > CREATE SCALED IMAGE.



You will now notice we have a new image in our **ImageManager** named **Rescaled color Copy**.

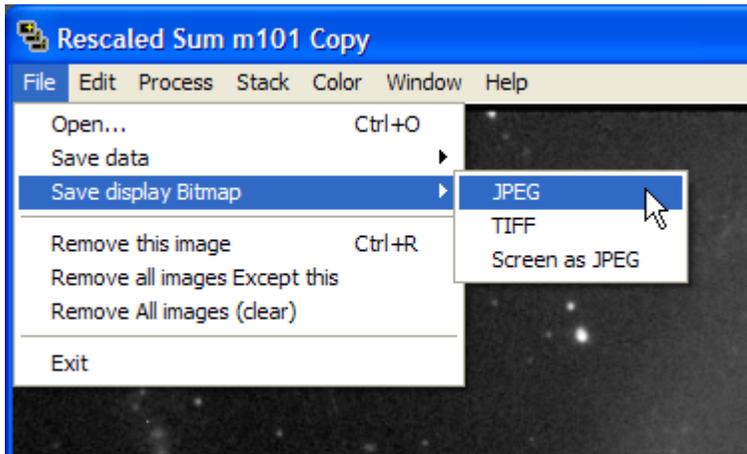
Select **Rescaled color Copy** in the **ImageManager**.

From the Main Menu, select SAVE DATA > THIS > 16 BIT TIFF.



Now we have a fully scaled 16-bit TIFF file that we can import into our favorite graphics program.

Another option is to just save what ever is currently being display by CCDStack. For instance, you want to save a JPEG file and post it on the Web.



Here we have three options:

Save the entire display (even those areas that may be off screen depending on your magnification level) as a JPEG.

Save the entire display as a scaled TIFF.

Save what ever is being displayed on the screen as a JPEG. You might want to zoom to one half actual size and save a small copy of the image.

Conclusion

We hope you have found this tutorial to be helpful in getting you started using CCDStack.

CCDStack has many, many more powerful features including:

- Pixel Math
- File Math
- Deconvolution
- Blurring
- Sharpening

CCDStack even contains a full 32-bit compiler so you can create your own procedures for image processing.

We appreciate the time you have taken to explore CCDStack and look forward to seeing your images!

Support Options

General Questions

Please visit the CCDWare website at <http://www.ccdware.com> for more information on CCDStack and our other products for astrophotography.

Technical Support

CCDWare has a dedicated support forum for CCDStack users. This can be found at: <http://ccdware.infopop.cc/groupee>