Using eXcalibrator With a Color Camera and CCDStack

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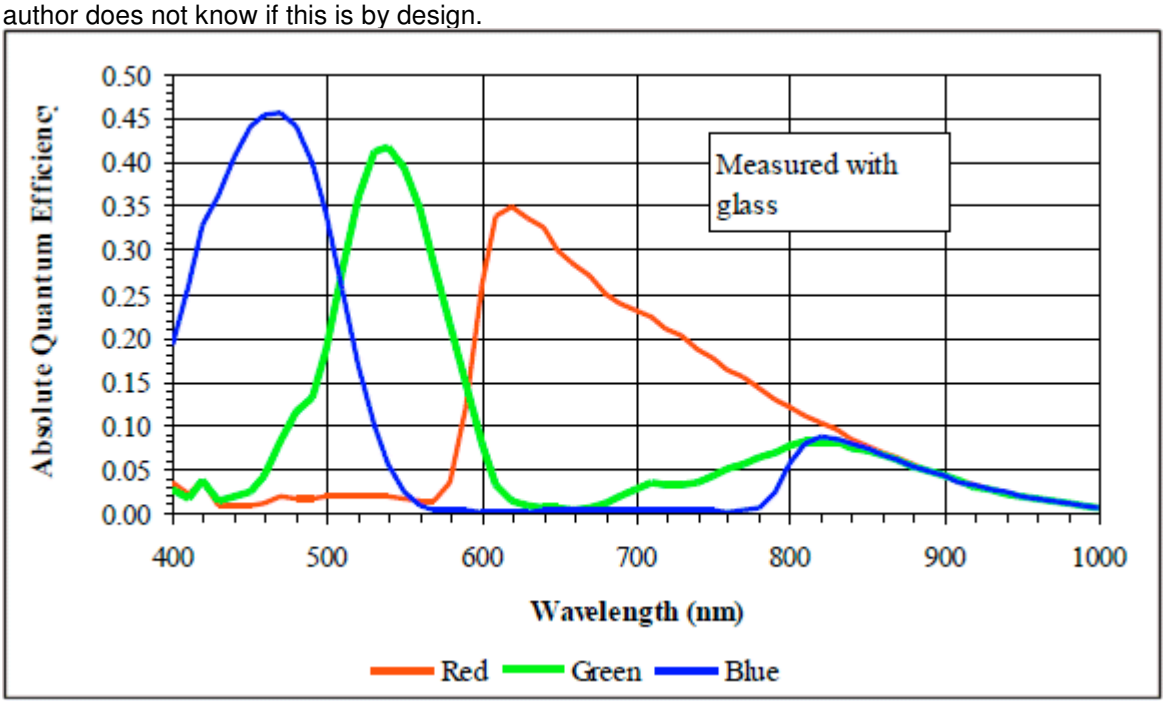
I Introduction

This document shows how to combine several One Shot Color (OSC) camera exposures into separate R, G and B files, suitable for use with eXcalibrator. Finally, the eXcalibrator filter factors are used to create a final color corrected RGB image.

II Why Do I Need To Correct My Camera's Color ?

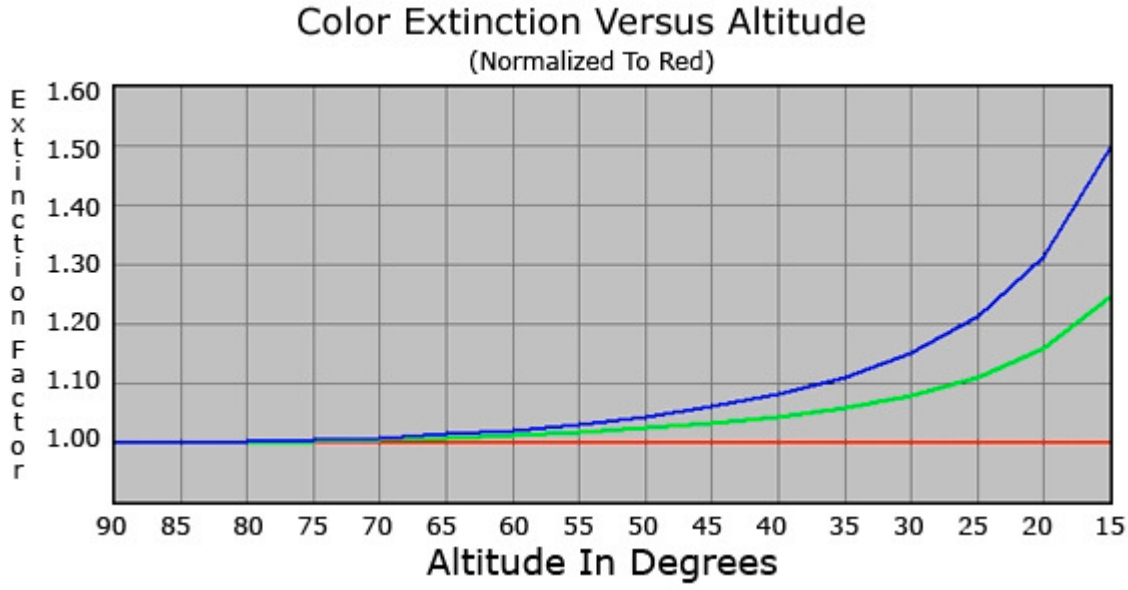
- **CCD Quantum Efficiency**

  All CCD cameras have varying efficiency at different wavelengths. Here is a typical set of quantum efficiency curves. The increased sensitivity, at the blue end of the sprectum, gives a general adjustment for the fact that our atmosphere scatters blue and green light more than red. The author does not know if this is by design.



- **Altitude Extinction.**

  The below graph shows how green light is darkened more than red and blue more than green. Once the imaging target gets below about 55 degrees, above the horizon, the color extinction starts to noticeably affect color balance.



- **Variable Seeing Conditions**

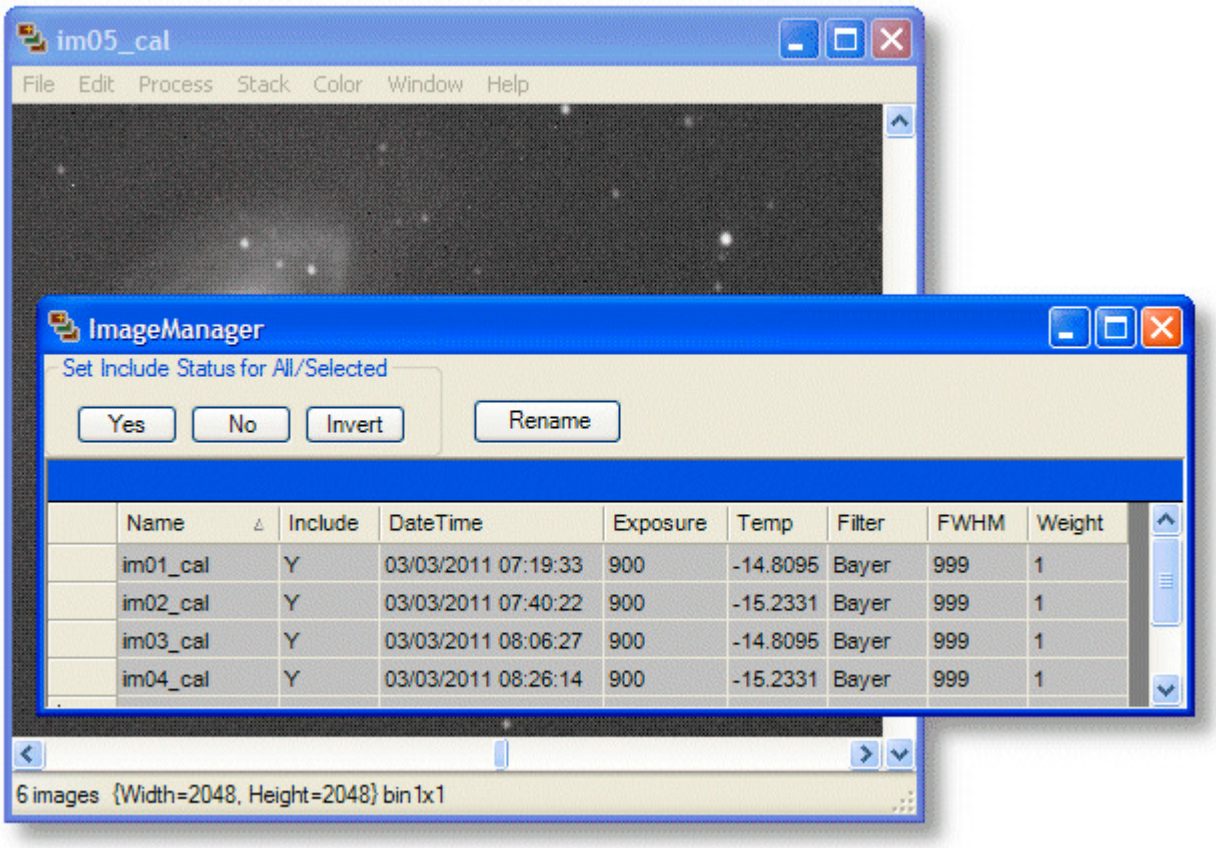
  When data are collected, on multiple nights, the sky transparency will likely vary. Even in a single night, thin clouds may come and go. These varying conditions will affect color balance, in the same way as altitude extinction.

III A Short Description Of The Process

- Load all the color fits image.
- Calibrate the images.
- Create all the R, G and B sub exposures.
- Register the images.
- Create the mean combined R, G and B masters.
- Get the RGB combine ratios from eXcalibrator.
- Create the final combined RGB image.

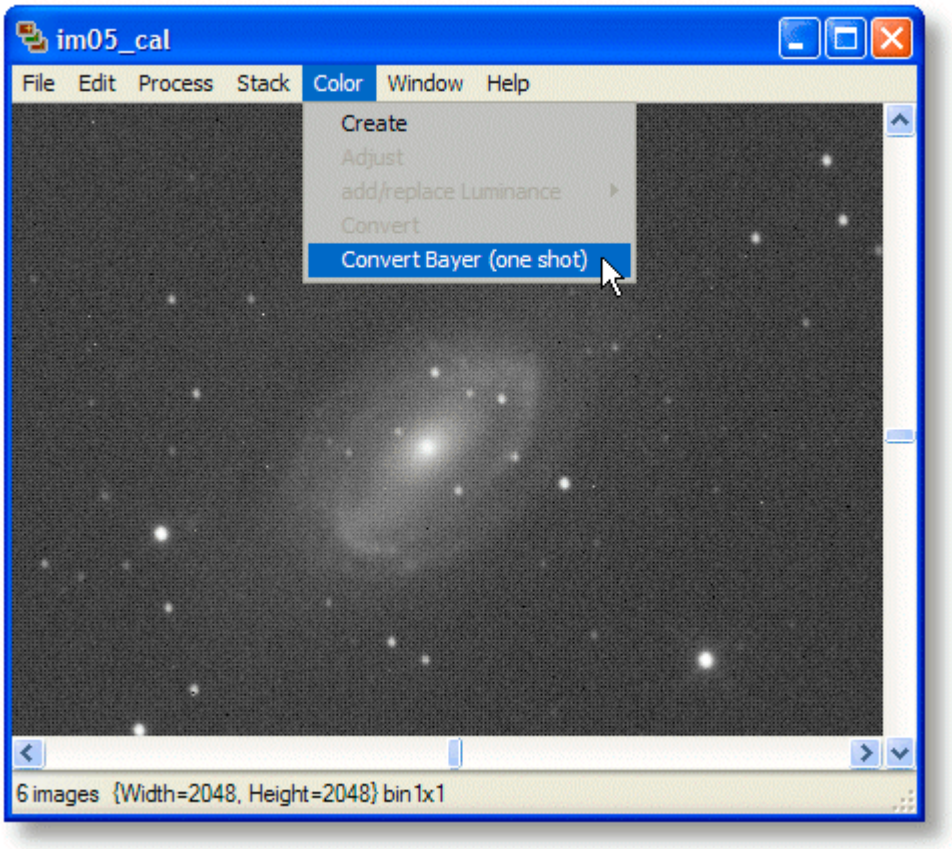
IV The Detailed Work Flow

- Start CCDStack and load all of the color FITS images.
- Apply darks and flats to all images.
- You should get something like this.

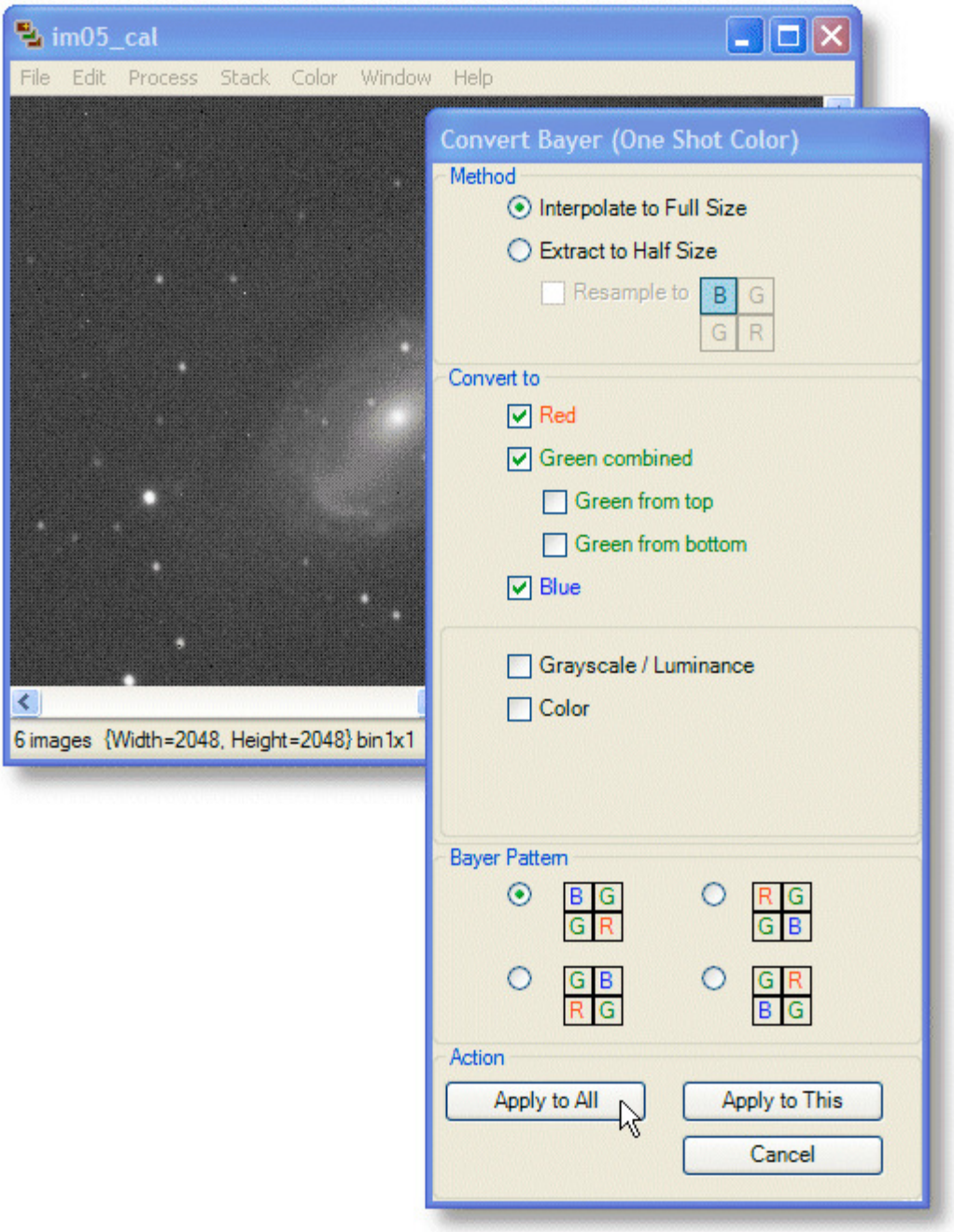


If the Filter column is not filled in with "Bayer", you will have to manually tell CCDStack that the data are from an OSC camera. Use "Edit|Camera Manager" to open the Camera Manager window. Then find your camera and turn on One Shot Color. Close the window and reload the color FITS images.

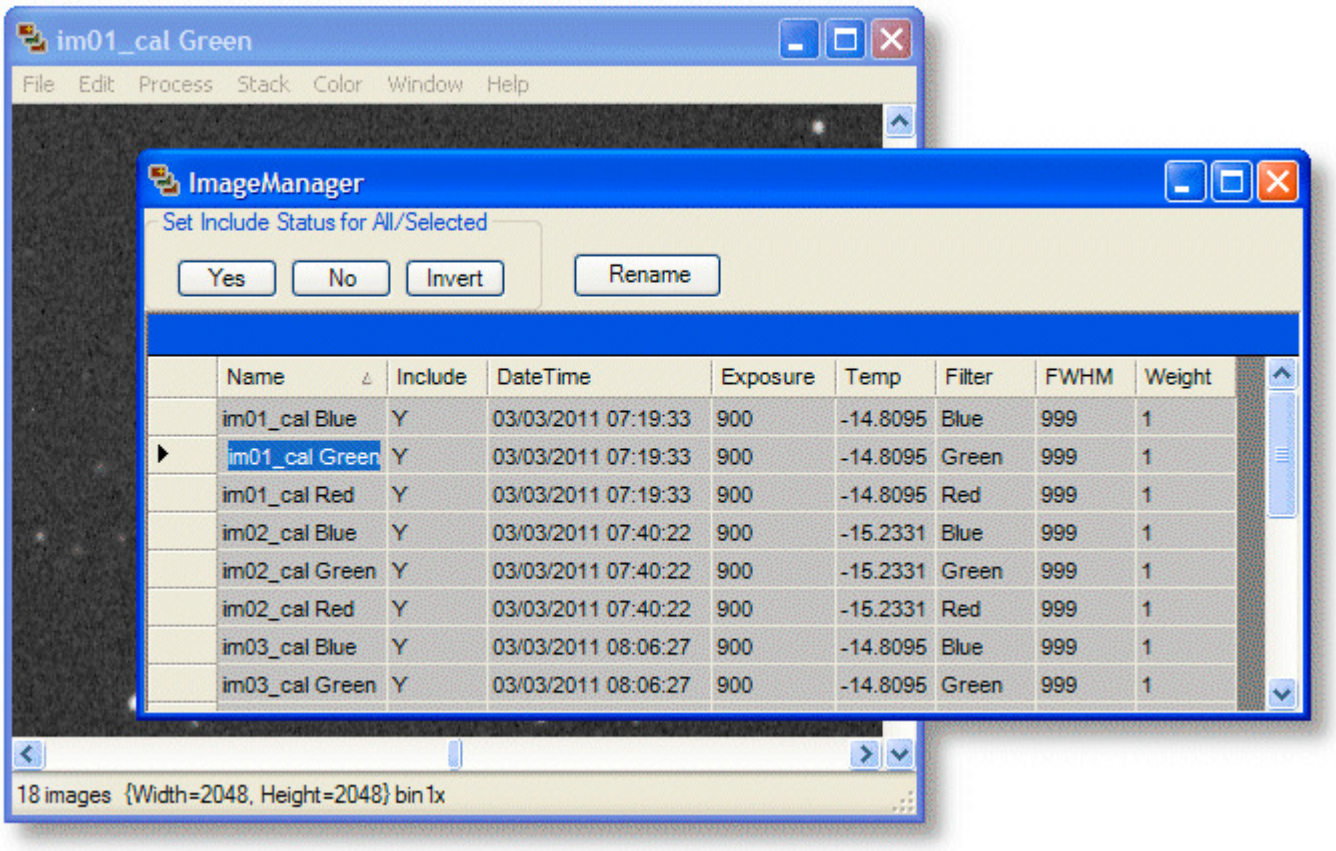
- Use the *Convert Bayer* process to convert the color FITS images into their separate R, G and B components.



- Leave *Gray Scale/Luminance* and *Color* unchecked. These images are not needed.
- Select Green combined. This creates a green file with a better S/N ratio, providing a smoother final image. eXcalibrator will compensate for the increased signal in the green data.

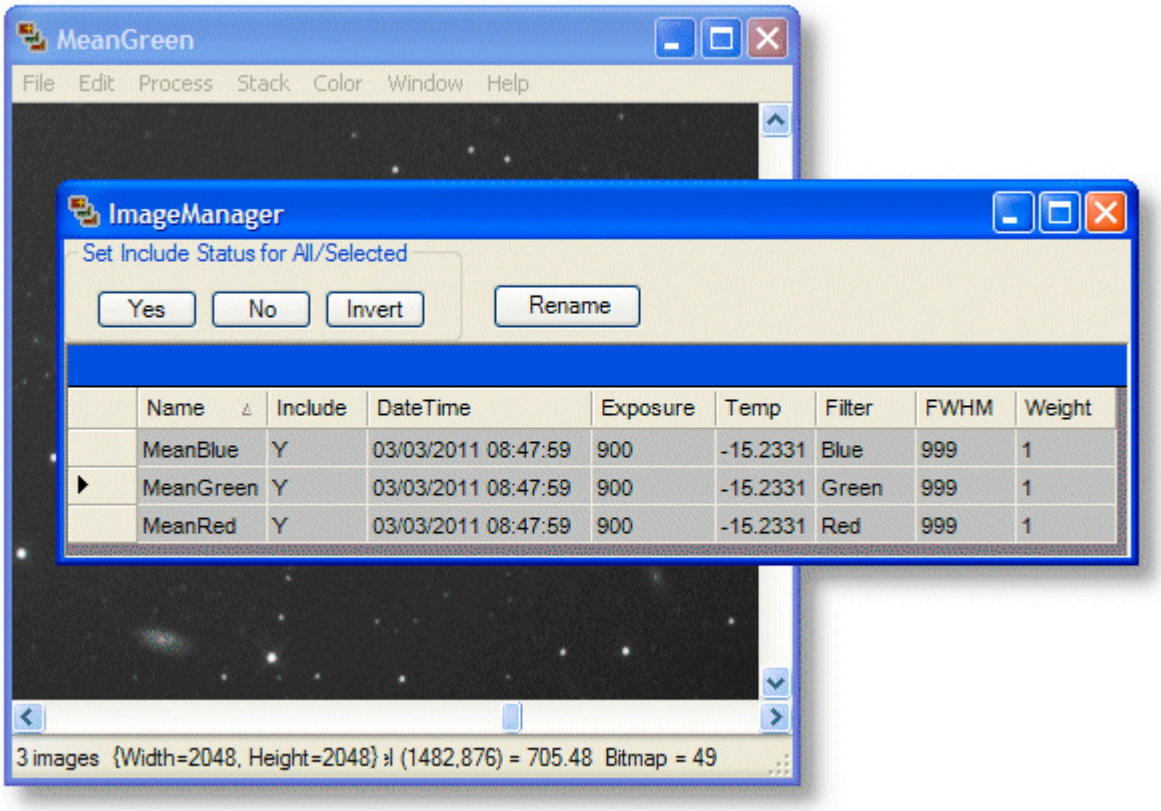


- Here is the result.



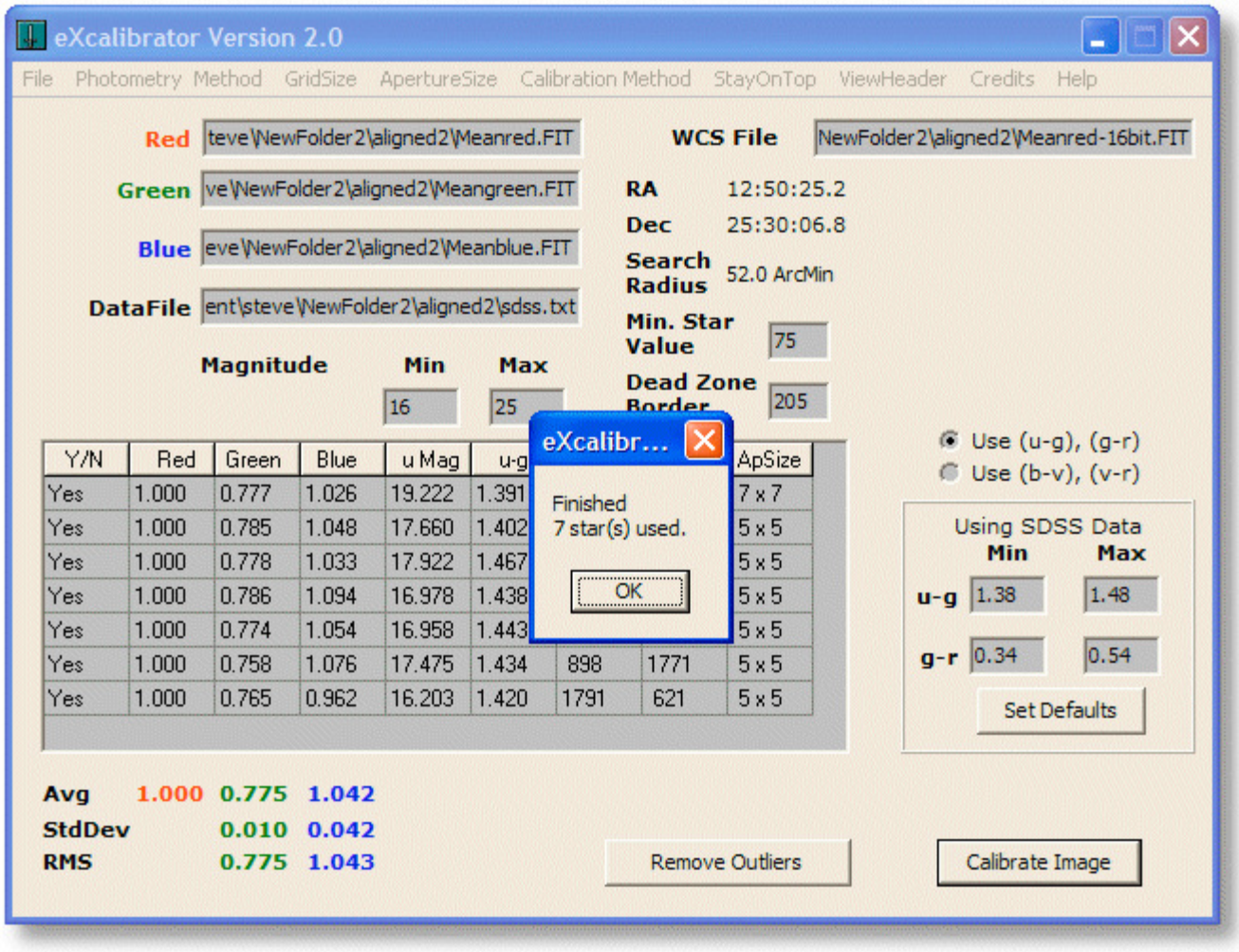
- Create the R, G and B masters.
  1. Register all the images, save them as FITS 32-bit Float and clear all.
  2. Reload only the red images.
  3. Normalize
  4. Run data rejection.
  5. Mean combine the sub exposures.
  6. Rename the combined image to MeanRed.
  7. Close all, except the just combined image.
  8. Repeat steps 2 - 7 for the green and blue sub exposures.
  9. Save the R, G and B masters as FITS 32-bit Float.

  Here is the result.



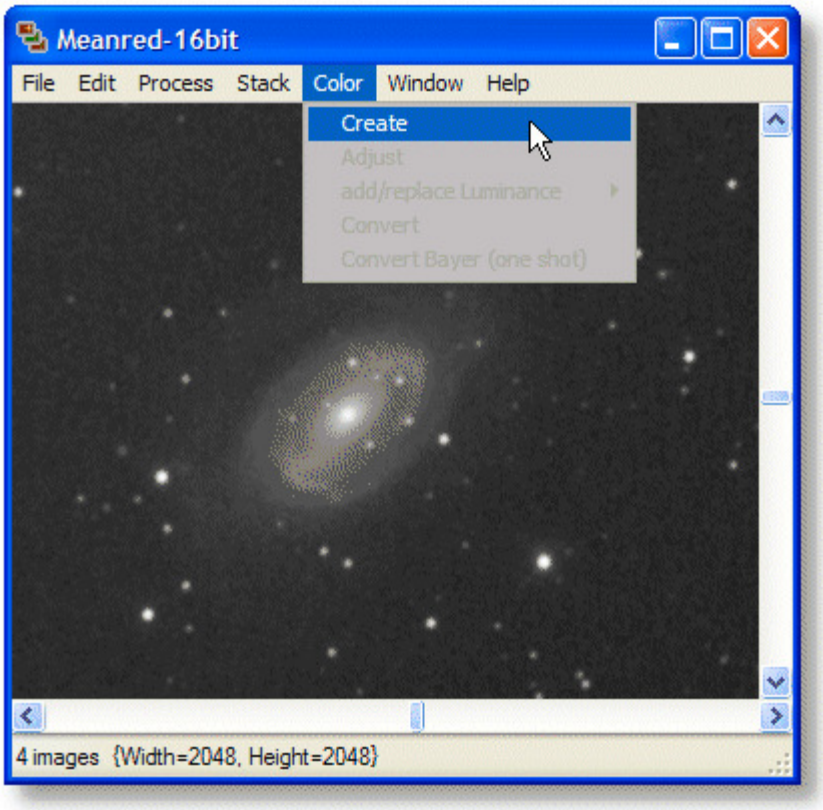
V Run eXcalibrator

- eXcalibrator computes the color ratios for combining the RGB image. See program's the documentation for complete details.
- First it is necessary to plate solve one of the color files. It may be useful to save an additional copy of one file as 16-bit unsigned. Sometimes 16-bit files are easier to plate solve. Also, the red file often works best.
- If you still can not get a good plate solve, combine the files into an RGB image. Then convert it to a B&W Luminance image and save it as a 16-bit unsigned FITS. After plate solving, load this file into eXcalibrator's WCS File text box. This way, eXcalibrator will use the luminance image to find the stars in the R, G and B images.
- Here is the result from eXcalibrator.

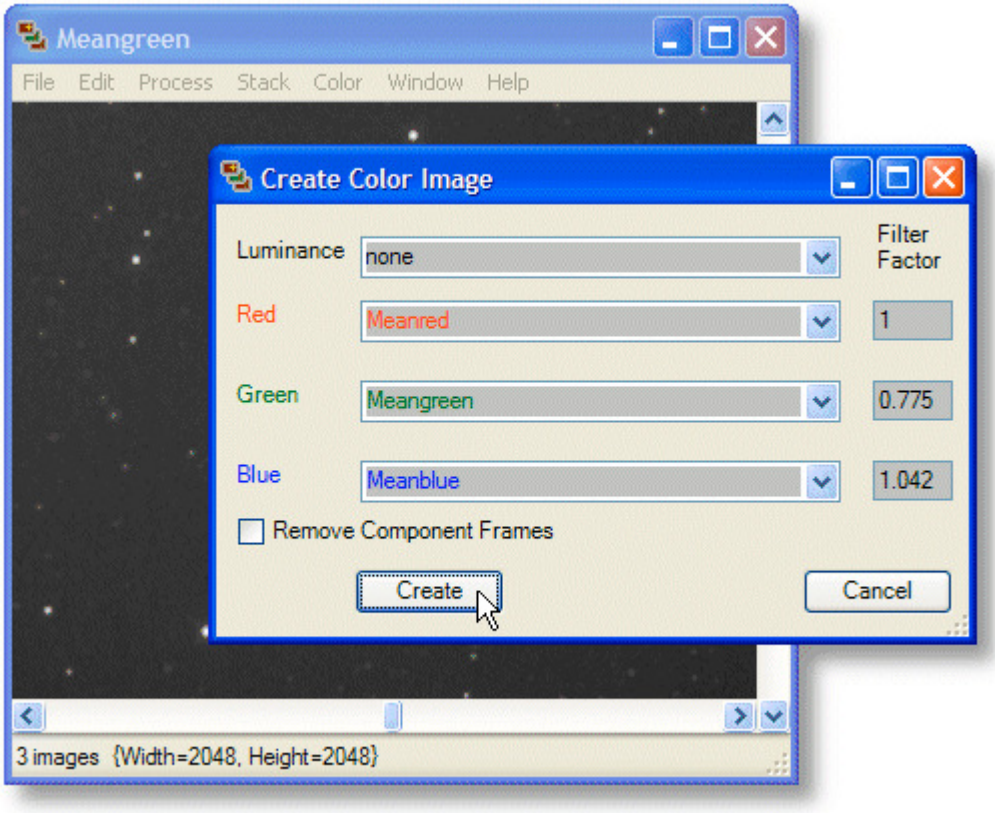


VI Create The RGB Image In CCDStack

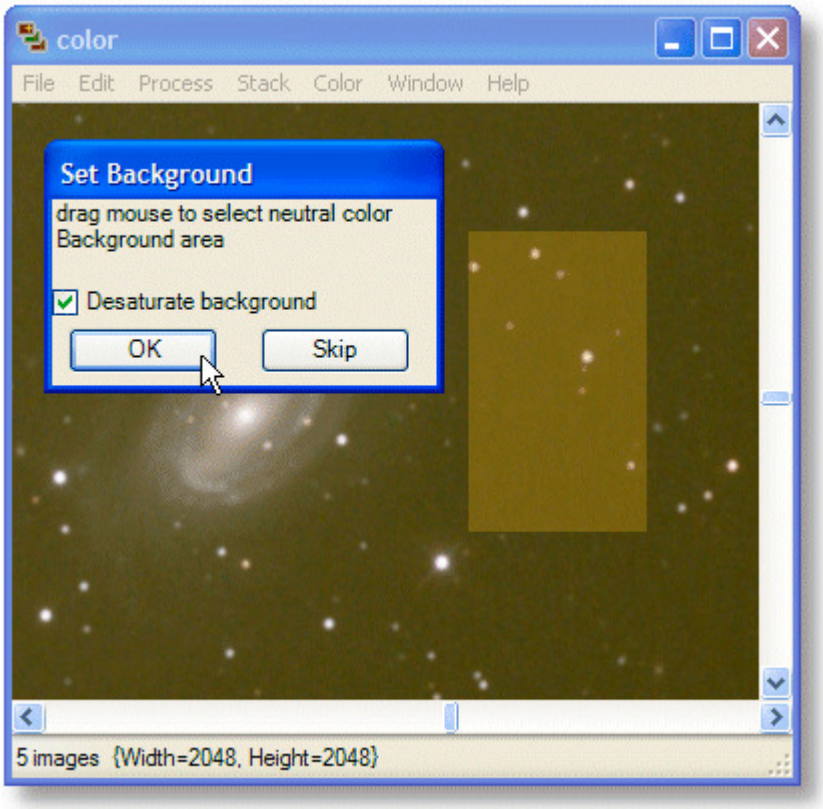
- With the three R, G and B mean combined masters loaded, click *Color*|*Create*.



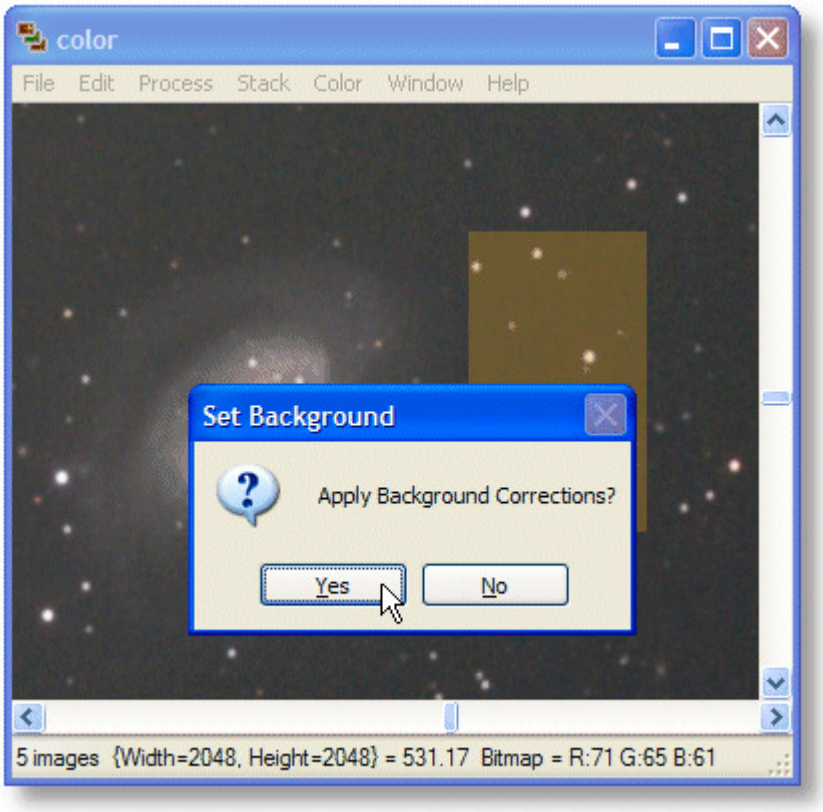
- Enter the filter factors, as calculated by eXcalibrator, and click *Create*.



Select an area of the image with the brightest background level, select *Desaturate background* and click *OK*.

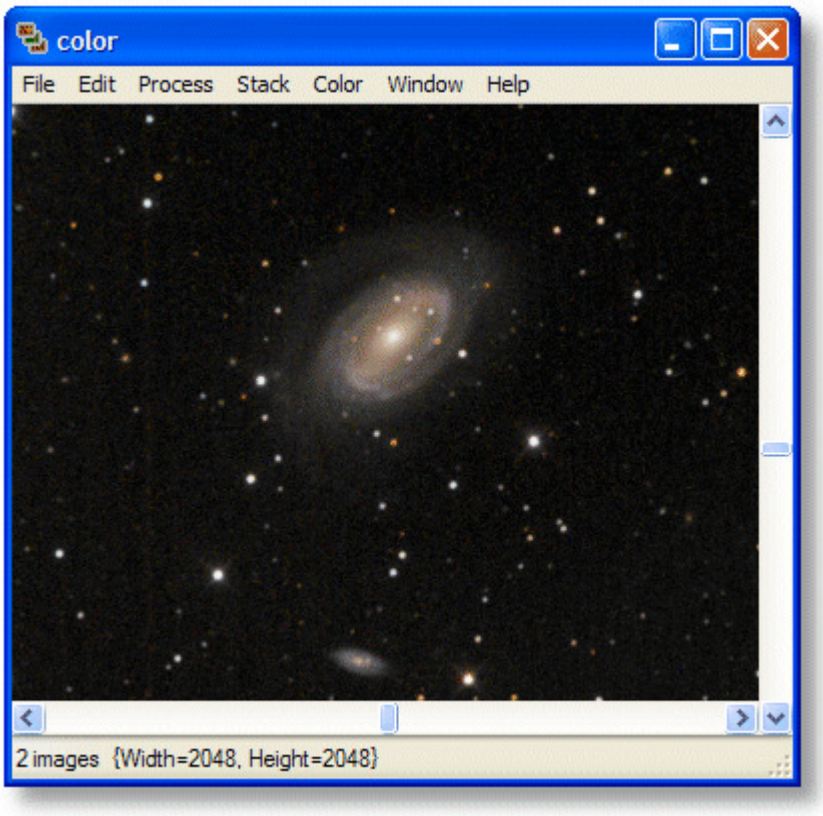


- Click *YES*. Note that the background color has changed to a neutral gray.



- Adjust the saturation as desired and click *Apply to this*.

- The final color corrected RGB image.



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