# DSLR & One Shot Color CCD Preprocessing & Basic Enhancement

DSLR & One Shot Color CCD Light, Dark, Flat, Flat Dark, and Bias Preprocessing

The Image Set Operations | Auto Image Set Processing tool on the main ImagesPlus menu is used to process a set of raw images or light frames of an object. The purpose of preprocessing of a set of light frames is to reduce noise, remove hot and problem pixels, and remove vignetting and dust spots to create a single object light frame that is ready to enhance. Preprocessing of a set of light raw object images consists of the following steps in order. DSLR data used in this example provided by Geof Lewis of Frimley, UK.
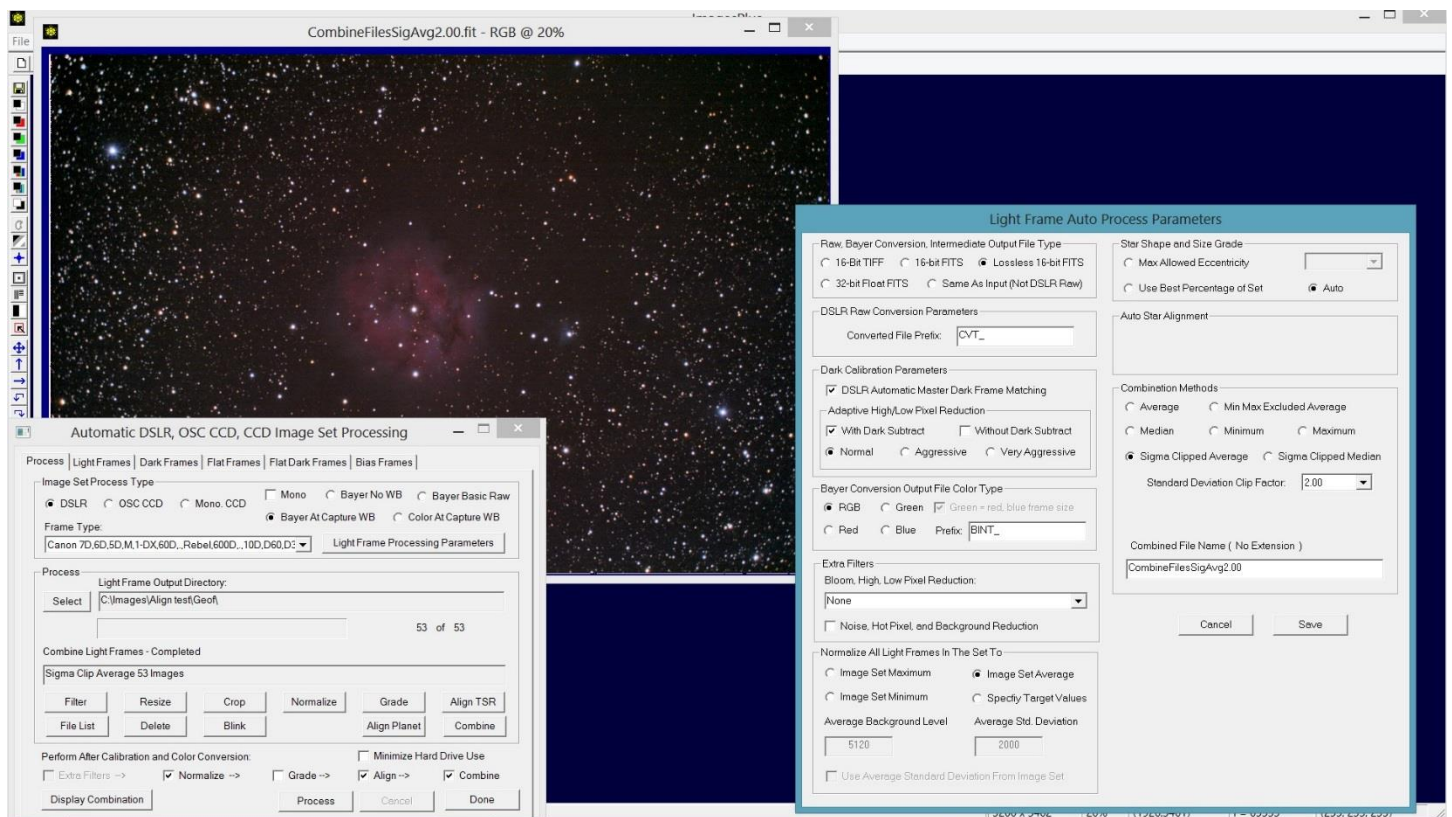
Figure 1. Recommend parameters for processing a set of DSLR light frames with dark, flat, and bias frames. At the top of the Process tab in the Image Set Process Type area select DSLR, Bayer At Capture WB, and Frame Type to match the camera. After light, dark, flat, flat dark, and bias frames are selected on their tabs press the Light Frame Processing Parameters button on the Process tab to display the processing parameters window shown on the right.

Frame Selection First select DSLR or OSC CCD as the camera type and the camera's Frame Type on the Process tab of Auto Image Set Processing. Next select the light, dark, flat, flat dark, and bias frames on the tabs of Auto Image Set Processing. Raw DSLR formats like Canon CR2, Nikon NEF, Sony ARW, Olympus ORF, and Pentax PEF are preferred input for light, dark, flat, flat dark, and bias images since they contain unprocessed 12 to 14 bit image data compared to 8 bit compressed with data loss JPEG format. If you are using a one shot color CCD then select the raw 16 bit FITS Bayer format images that download from the camera as you are taking the images.

Dark frames have the same exposure time and ISO as the light frames but the optics are covered so that no light reaches the camera sensor. Bias frames are dark frames with the same ISO as light frames but use the shortest camera exposure

possible. Flat frames are taken using a uniform source of illumination such as the daytime sky with low ISO and fast exposure time so that the bell shaped histogram is approximately centered in the middle of the grayscale range. Flat dark frames use the same ISO and exposure time as the flat frames but the optics are covered so light can't reach the sensor. Flat dark frames are used only if the exposure time of the flat frames exceeds a few seconds which should not be necessary if you are using the sky or other bright uniform light source.

Raw DSLR Conversion Raw DSLR light, flat, dark, and bias files are first converted to lossless 16 bit FITS format. The Bayer At Capture WB (white balance) option is used on the Process tab so that raw DSLR files are converted to Bayer color array format since it is best to calibrate Bayer color data before each light frames is converted to color. If single calibration frames are selected on the Dark, Flat, Flat Dark and Bias Frames tabs then the frames are used as master calibration frames.

If you are using a one shot color CCD Bayer At Capture WB is automatically set and raw conversion to Bayer format is not necessary since the camera captures and saves Bayer format FITS files.

Build Master Calibration Frames If multiple dark, flat, flat dark, or bias frames are selected on the Dark Frames, Flat Frames, Flat Dark Frames, or Bias Frames tabs of Auto Image Set Processing then master dark, flat, flat dark and bias images are created by combining the multiple frames using the combination method specified on each tab. *If only a single dark, flat, flat dark, or bias is selected then it is used as the master calibration frame.* For best result at least 10 raw dark, 10 raw flat, and 10 raw bias frames should be used to create master dark, flat, and bias frames.

Calibrate Light Frames Using Master Calibration Frames Light frames are calibrated using the master dark, flat, flat dark, and bias frames. Auto DSLR Dark Frame Matching is used with DSLRs or other cameras with no temperature regulation. This option matches the master dark to each light frame to minimize noise. The Adaptive High/Low Pixel Reduction uses the master dark as a guide to problem high and low pixels so that they can be removed. Both of these options are applied to the Bayer format data before conversion to color so that noise and problem pixels are fixed before they are made large by color conversion. Both of the options are available on the Light Frame Auto Process Parameters window.

Figure 2 below shows the result of auto processing the same set of DSLR light, flat, bias, dark, and flat dark image with all of the same normalize, align, and combine parameters but without Auto DSLR Dark Frame Matching and Adaptive High/Low Pixel Reduction | With Dark Subtract. Note the horizontal streak noise compared to Figure 1 where both calibration options are used.

Convert Calibrated Bayer Format Light Frames to Color Images Conversion of the calibrated light frames to color is performed automatically after calibration using the Bayer type specified by the Frame Type on the Process tab. If you see poor color or a screen pattern in the processed images then the wrong Bayer type is selected in the Frame Type list.

Apply Extra Filters to Color Light Frames If Extra Filters is checked at the bottom of the Process tab of Auto Image Set processing then extra noise reduction filters specified on the Light Frames Auto Process Parameters window are applied to each light frame. Extra noise reduction filters are generally not required if good calibration frames and excluded min-max average or sigma clip average with standard deviation factor ~= 2.0 are used.

Normalize Color Light Frames If Normalize is checked at the bottom of the Process tab then the average brightness of all the light frames is calculated then the brightness of each light frame is set to the average. Normalized light frames respond better to statistical combination methods like excluded min max average and sigma clip average which are used as the final step of preprocessing.

Grade Normalized Color Light Frames If Grade is checked at the bottom of the process tab then the grade option selected on the Light Frame Auto Process Parameters window is used to grade the normalized light frames. Auto grade by star size and shape is the default option and is recommend if the light frames are to be graded before align and combine.

Blink Files can be used as an alternative to automatic grading. Auto image set processing is stopped after normalize by not checking the Grade, Align, and Combine boxes at the bottom of the Process tab. Press the Blink Files button on the

Process tab to examine and exclude any bad frames. Press the Align TSR button on Blink Files to align the remaining normalized light frames using Auto Star.

Align Frames If Align is checked at the bottom of the Process tab then star matching is used automatically to align the light frames.

Combine Aligned Light Frames to a Single Image Excluded min max average is the default combination method and is recommend because of its high and low pixel rejection at each pixel of the combination image. Sigma clip average can be tuned to reject more or less high and low pixels by adjusting the standard deviation factor. At each pixel of the combination image a smaller standard deviation factor will reject more high and low pixels from the average of the corresponding light frame pixels. *It is important to either dither or have a small amount of shift from polar misalignment while capturing the light frames so that high, low, and problem pixels are in different locations of the light frame so they can be rejected by excluded min max average or sigma clip average.*
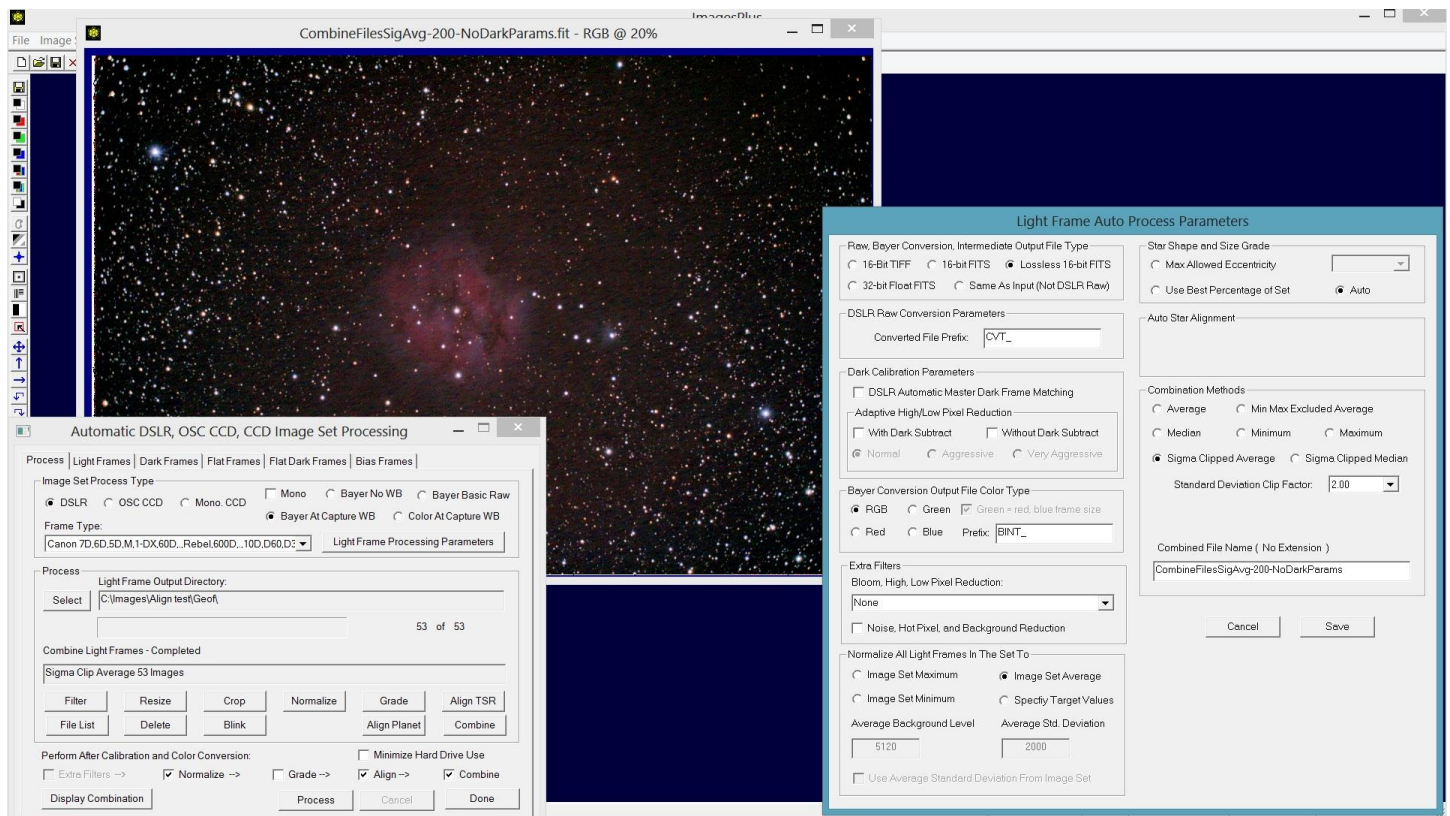

Figure 2. The same light, flat, darks, and bias frames processed with the same normalize, align, and combine options but without Auto DSLR Dark Matching and Adaptive High/Low Pixel Reduction | With Dark Subtract checked. Note the horizontal streak noise compared to Figure 1 where both calibration options are used.
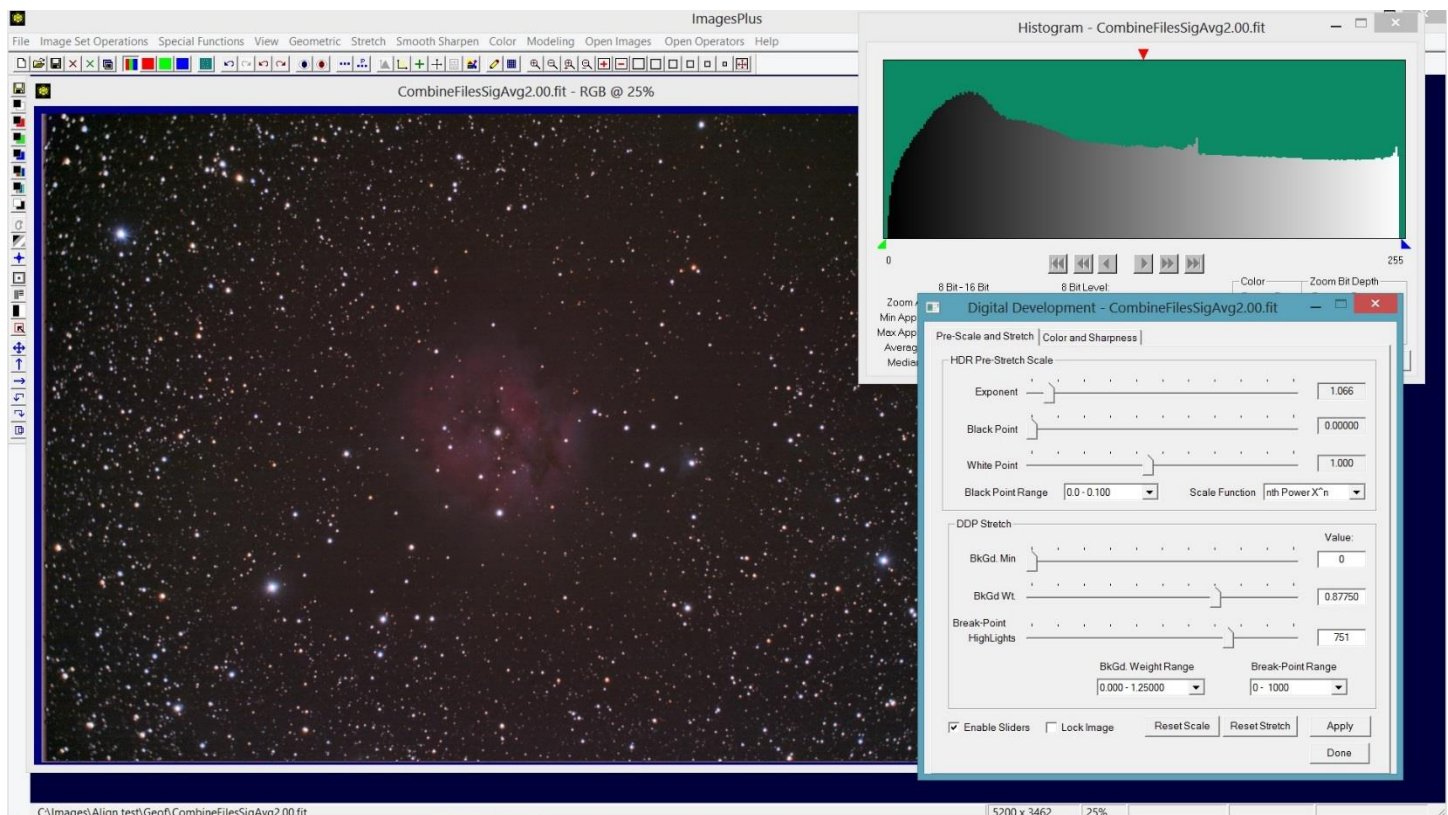
Basic Enhancement

Step 1) Initial Brightness Increase or Stretch
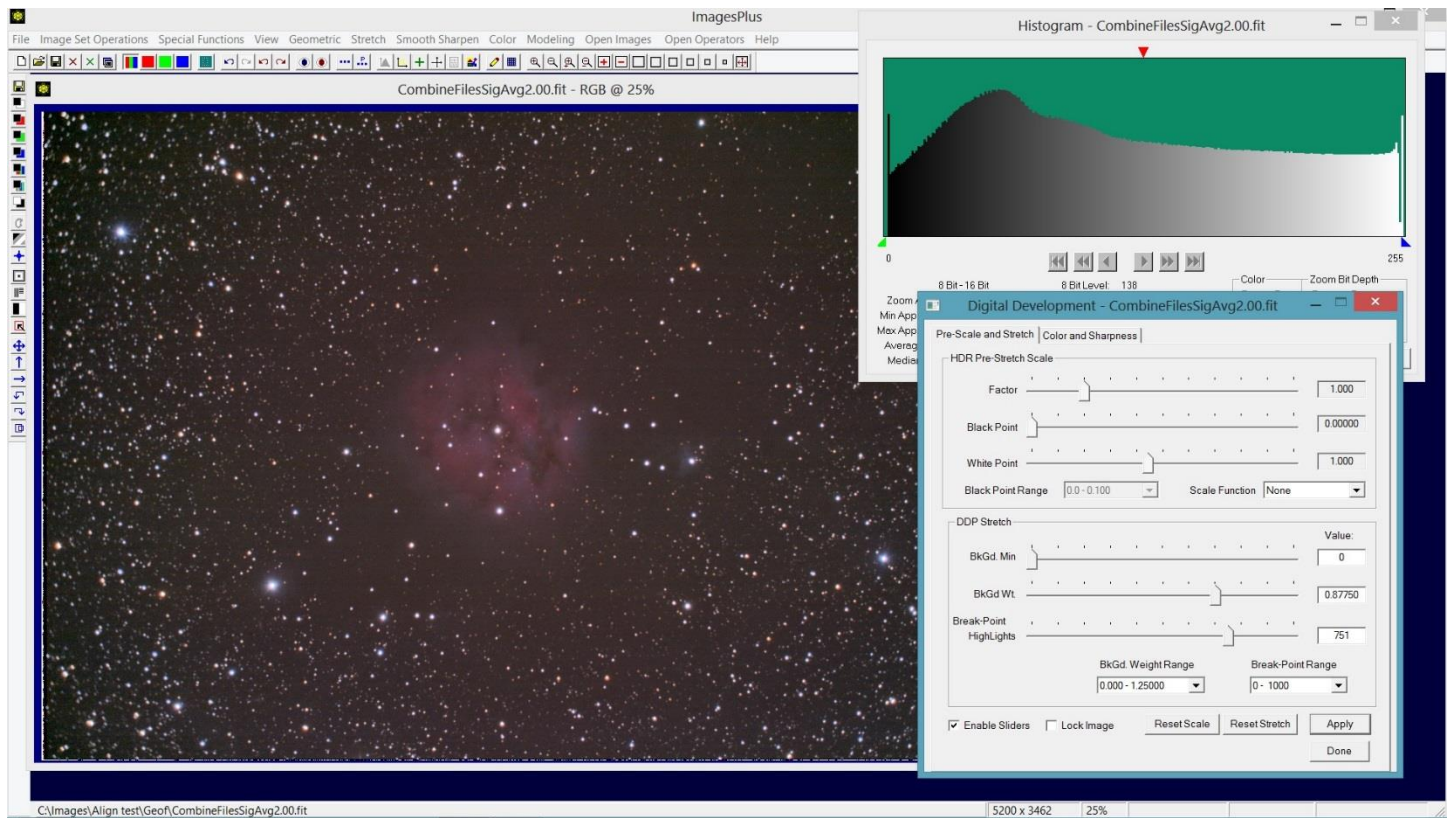
First the break-point and background weight sliders of Stretch | Digital Development are adjusted to the left to brighten the image. I leave the background brighter at this point so that there is no clipping.


After break-point and background weight are adjusted as shown above select the nth Power X^n pre stretch scale option at the top of Digital Development then move the exponent solider towards the right to dark the background and shape the histogram so that there is no clipping.

Step 2) Background Color Balance
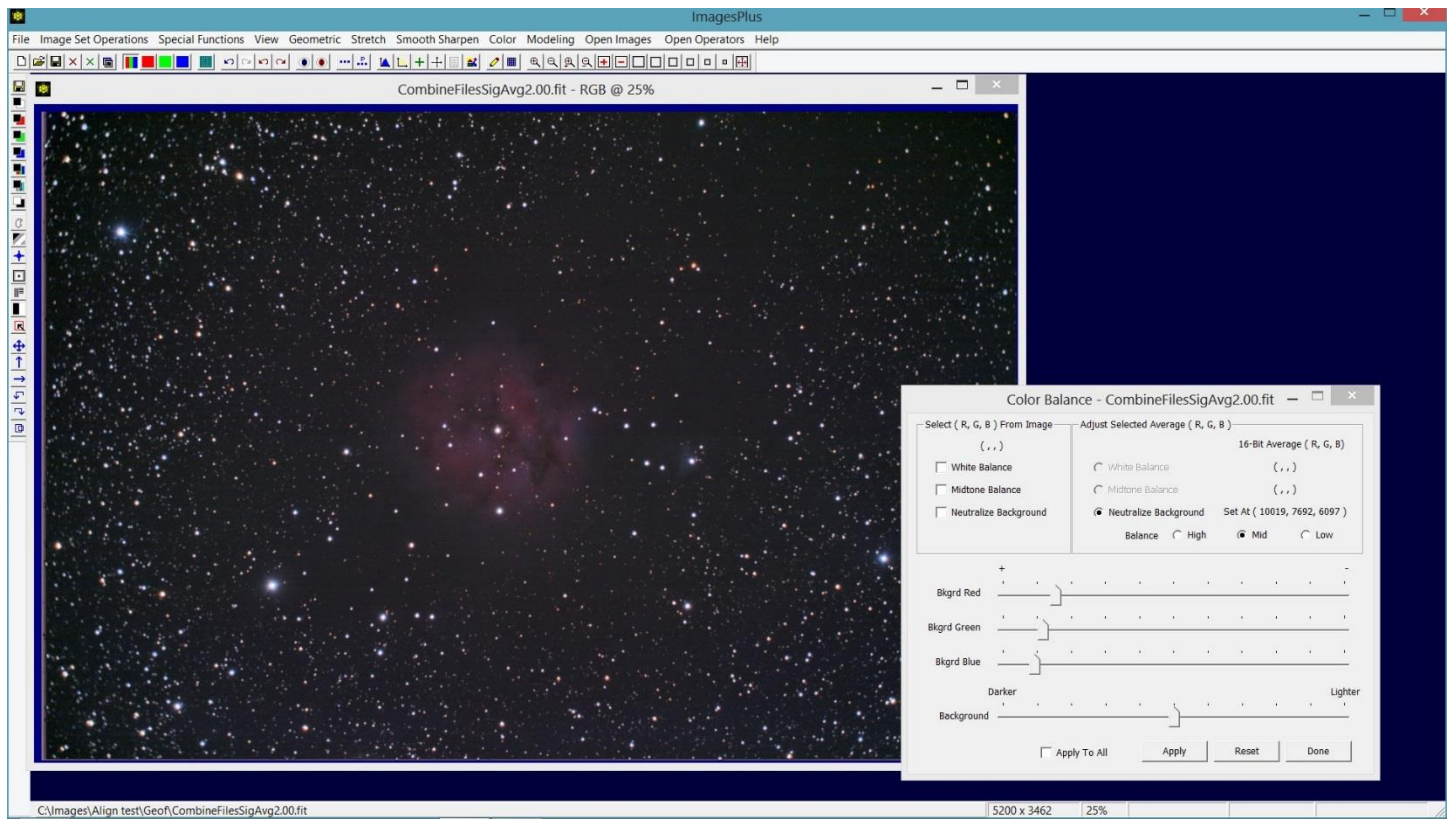
Check the neutralize background box on Color | Color Balance then left click at the center of the top edge of the image to set the background level and remove the red bias.
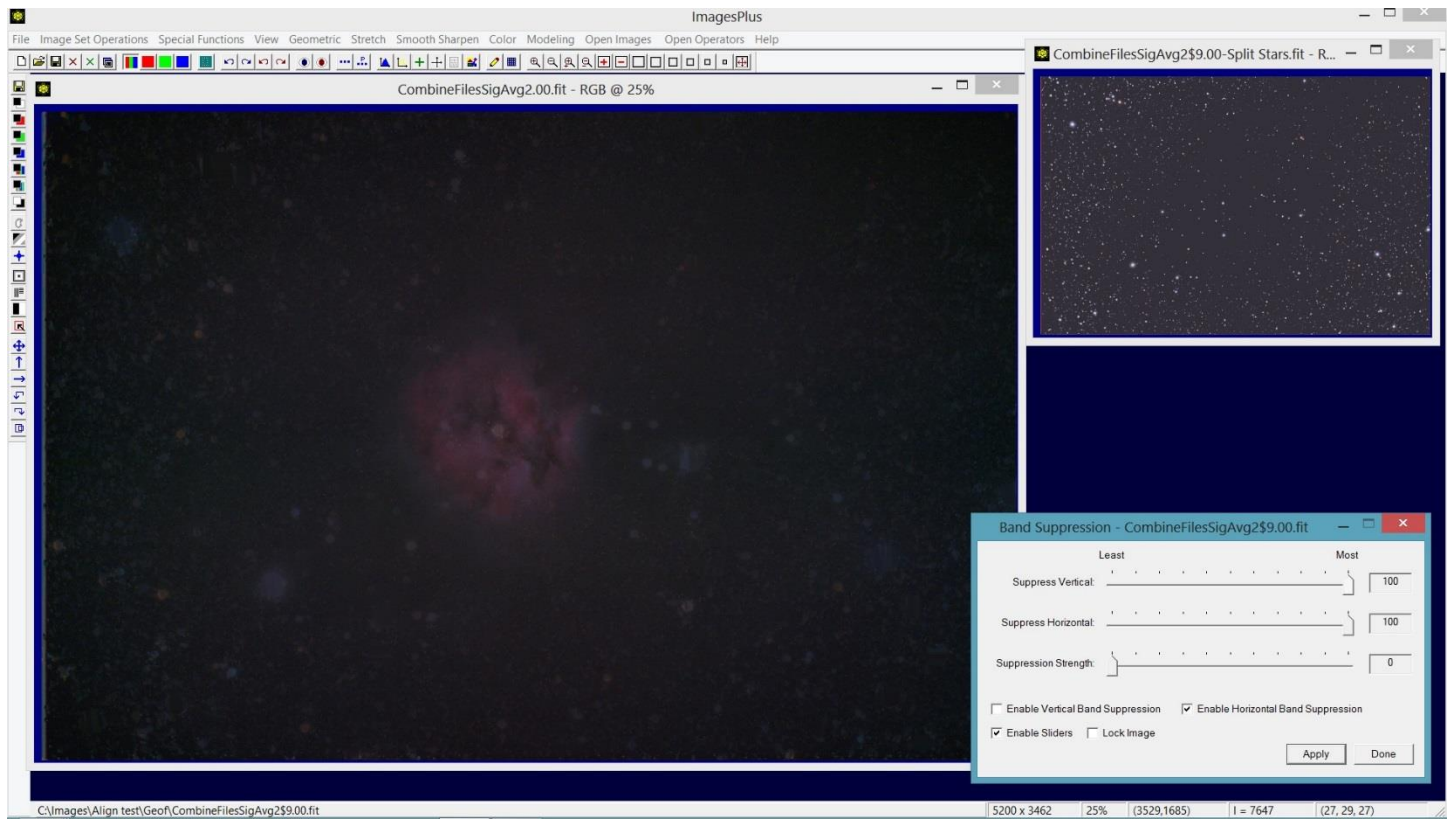
Step 3) Band Suppression
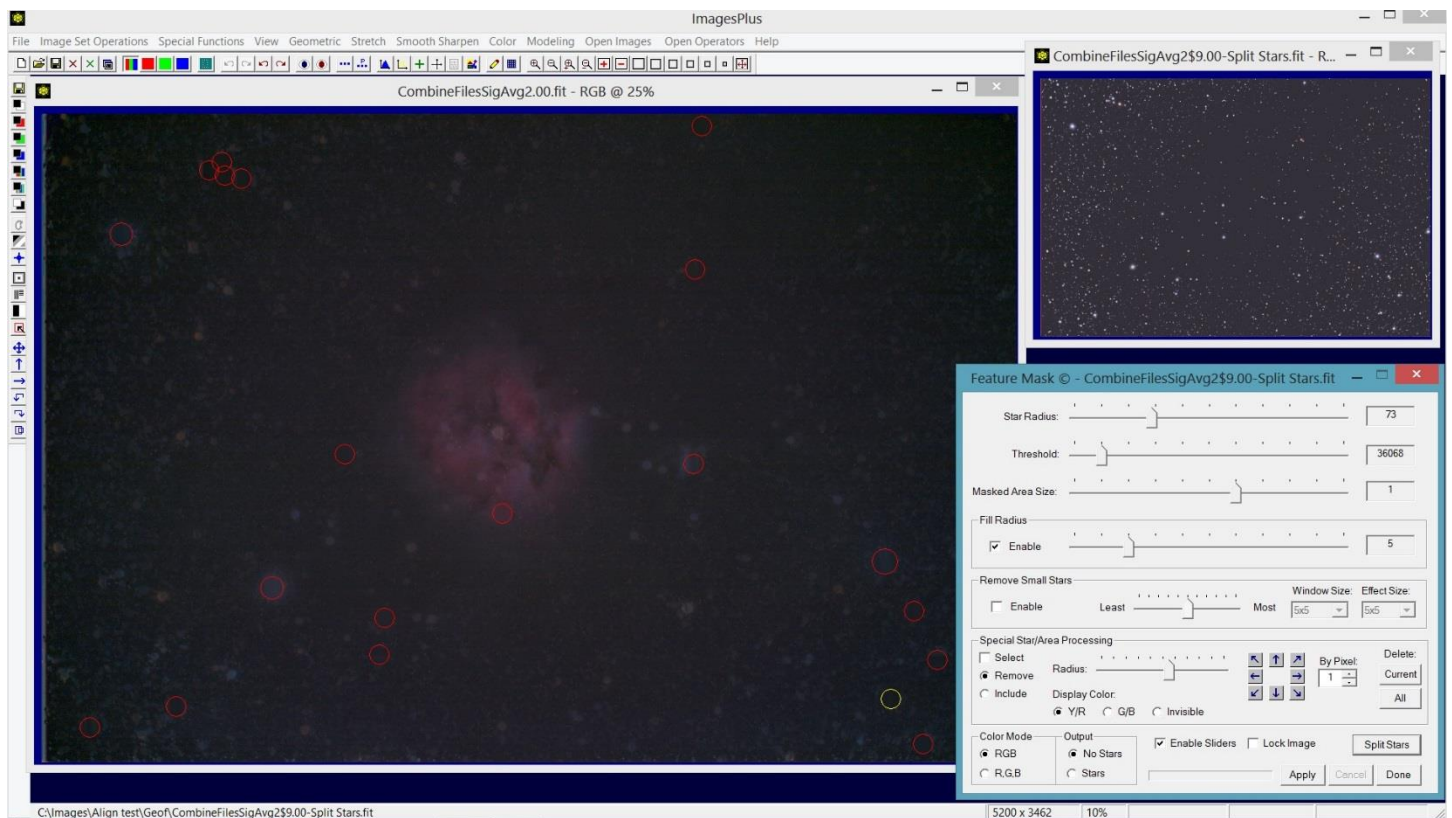
The horizontal bands can now be seen so use the Feature Mask tool to reduce and remove bright stars from the image and create the matching split star image.
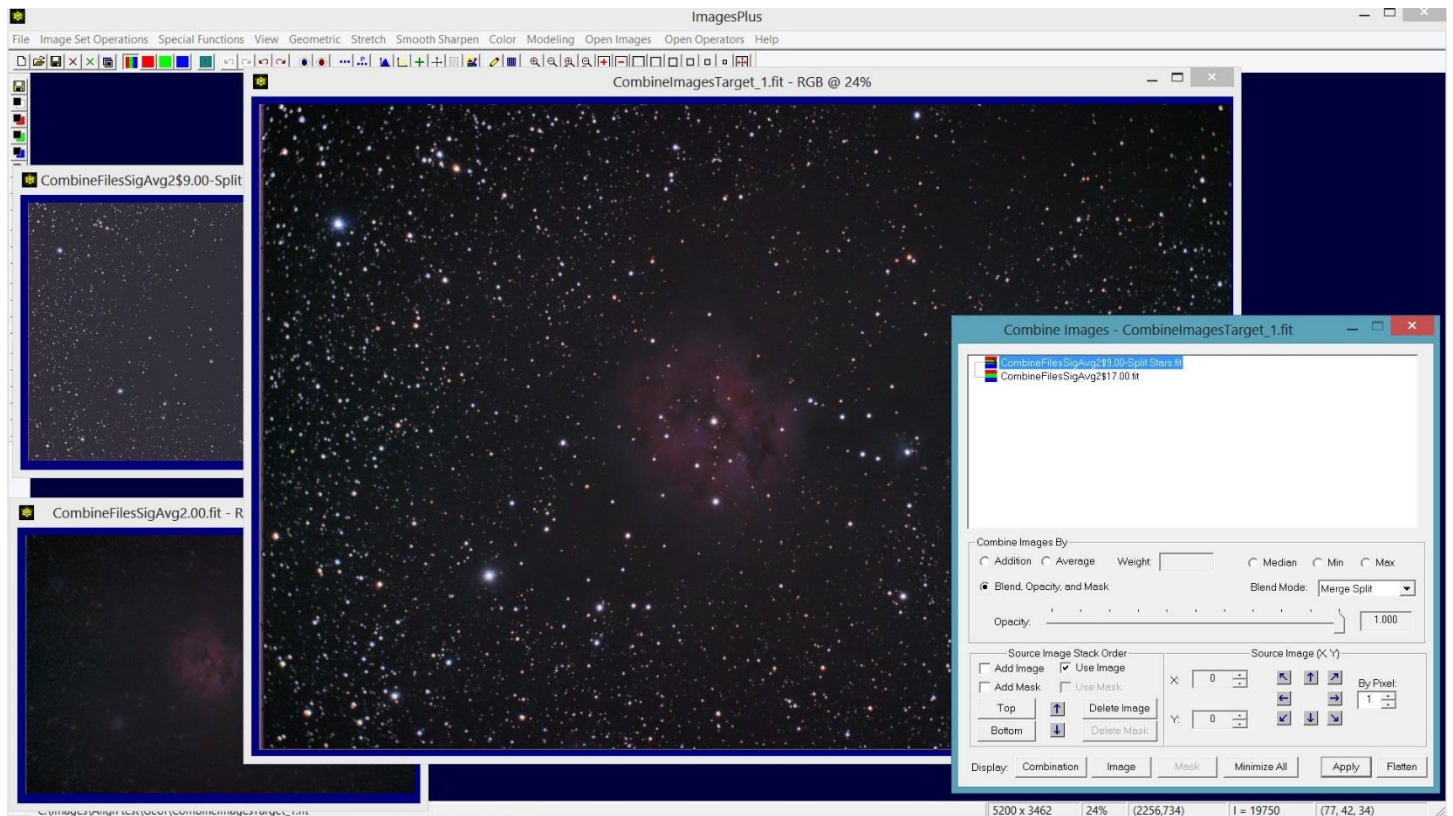
Step 4) Suppress Horizontal Color Bands

Apply the Band Suppression tool with only Suppress Horizontal checked to the object image with reduced stars from step 3 and not the split star image.

Step 5) Merge band corrected object image with Split Star Image

Merge the band corrected image and split star image using Combine Images Layers with the split star image on top and merge split blend mode set.

Final image with horizontal bands removed.