The RGB color model is an additive color model based in human color perception where primary colors red, green, and blue are added together to create other colors. A Cartesian coordinate system is used to represent different colors by assigning red to the x-axis, green to the y-axis, and blue to the z-axis as shown in Figure 1.
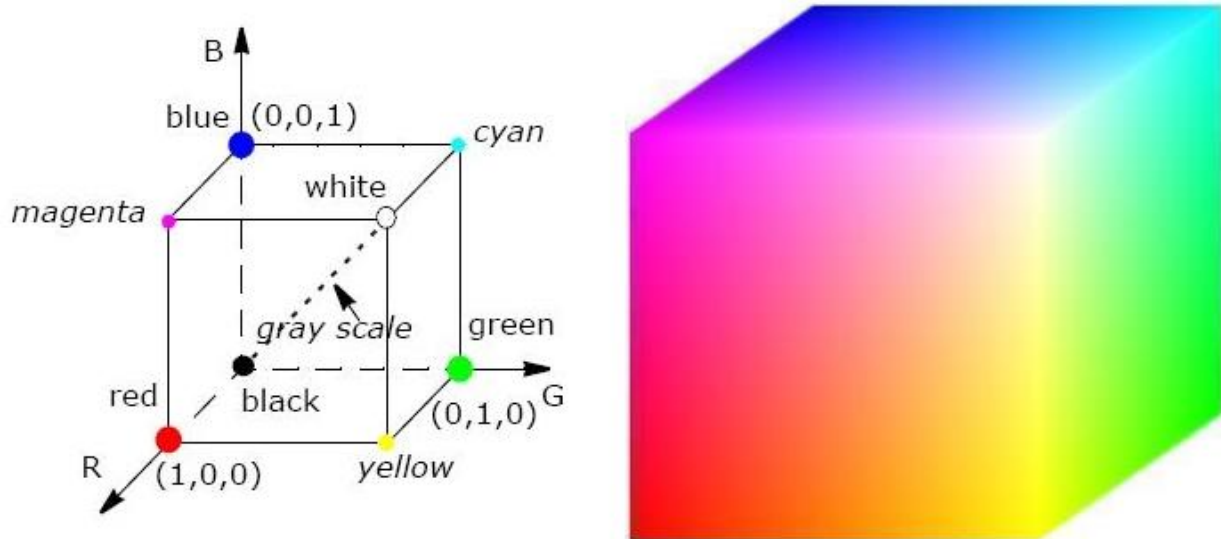

Figure 1 Red, green, and blue assigned to the x, y, and z-axis, respectively, to form the RGB color cube.

The secondary colors cyan, magenta, and yellow are formed by adding equal amounts of the primary colors C = G + B, M = R + B, and Y = R + G. Black is at the origin where (R, G, B) = (0, 0, 0). White is the sum of red, green, and blue all at full strength (R, G, B) = (1, 1, 1). The gray scale is represented by the vector from black to white. Color is represented by the vector (R, G, B) from black at the origin to a point in or on the RGB cube where R, G, and B can be any value from 0.0 to 1.0.

Digital cameras record color by capturing red, green, and blue values independent of each other at each point or pixel of a scene and store the color data using the independent red, green, and blue color planes of the RGB color model. Monochrome CCD cameras capture gray scale luminance by recording all colors at each pixel or just red, green, and blue values at each pixel using different color filter. DSLRS and one shot color CCD cameras use a Bayer RGB filter array to capture color by placing red, green, or blue filters over each pixel of the sensor as shown in Figure 2. Bayer conversion algorithms form a complete (R, G, B) value at each pixel by filling in the missing red, green, and blue values using the measured red, green, and blue values near the pixel. Computers use the RGB color model to display an image by coloring each pixel of the monitor with the corresponding (R, G, B) pixel of the image recorded by a digital camera.

The RGB color model is good at storing a color image from digital cameras and for display of the image on a computer mointor but is not so good for manipulating the color image using a computer algorithm. For example, it is difficult to select and adjust a hue like yellow or blue without shifting color or the brightness of the image because of the independent red, green, and blue planes used to describe each pixel. See Figure 5 below.
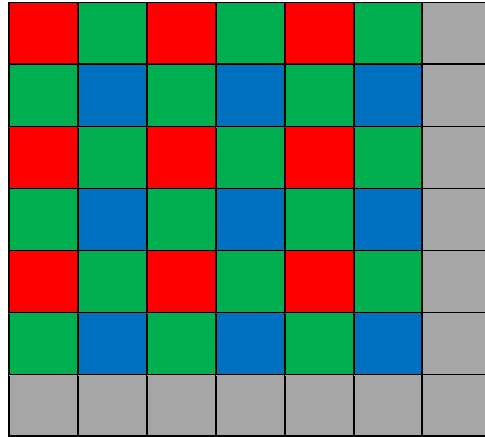
Figure 2 A camera sensor is sensitive to all colors at each pixel shown as gray. The RGB Bayer filter array, used in DSLR and one shot color CCD cameras, covers each pixel and makes the pixel sensitive to only red, green, or blue.

The RGB color model can be transformed to the HSV color model to make manipulating color more intuitive. The HSV color model is a hexagonal cone where hue H defines the color, saturation S defines how a hue differs from gray, and V defines the luminance value of the hue. ***The luminance value V is denoted luminance L in ImagesPlus.*** A saturation S = 0.0 means no color or gray scale and S = 1.0 is the most saturation for a particular hue and luminance. Luminance can range from L = 0.0 for no light or black to L = 1.0 for full luminance or white.
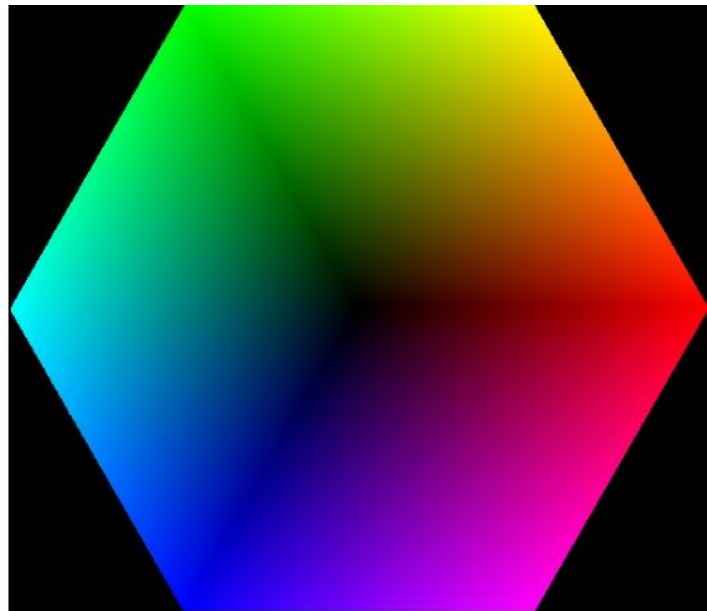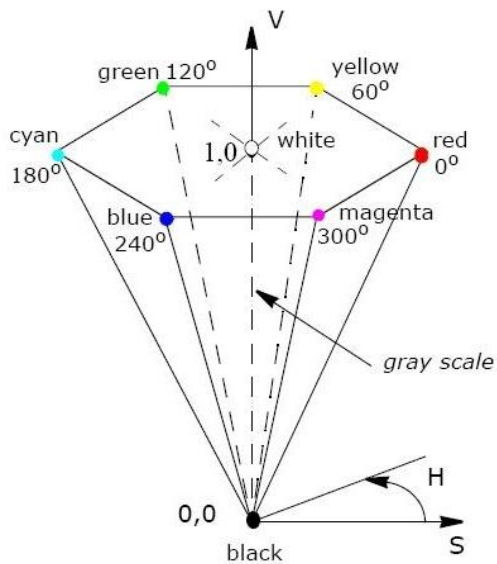

Figure 3 The HSV hexcone has luminance value V denoted by L in ImagesPlus as the vertial axis from black to white. Hue H can range from 0° for red and pass through all colors until you return to red at 360°. Saturation S = 0.0 is along the vertical axis and represents gray scale, Saturation increases as S approaches 1.0 at the boundary of the hex cone for a give hue and lumiance.

The HSV color model makes selection and manipulation of a hue, saturation, and luminance range in an image simple compared to the RGB color model. Luminance, hue, and saturation are decoupled in the HSV color model so adjustment of one will have minimal effect on the other two. See Figure 7 below.

The RGB color model can be transformed into the Lab color model where color is described by luminance L, green-red by a, and blue-yellow by b as shown in Figure 4.
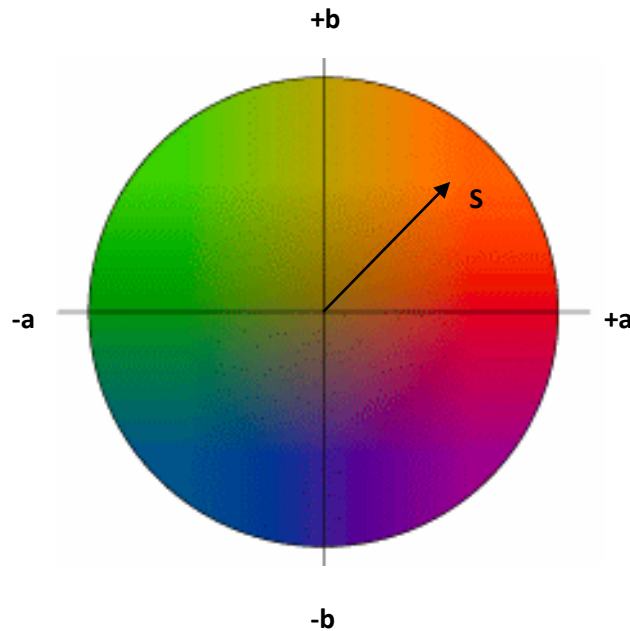

Figure 4 Luminance L in the Lab color model can range from black at 0.0 to white at 100.0. For a given value of L the a-axis represents green-red with green as negative values of a and reds as positive values of a. The b-axis represents blue-yellow with blue as negative values of b and yellows as positive values of b.

Saturation and hue in the Lab model are calculated from a and b where $S = \sqrt{(a^2 + b^2)}$ and $H = \arctan(\frac{b}{a})$. In the Lab color model luminance, green-red, and blue-yellow are decoupled whick makes adjusting luminance with little color shift and manipulating red, gree, blue, or yellow without effecting other colors very simple. See Figure 6 below.

ImagesPlus represents the RGB, HSV, and Lab color models as 32 bit floating point arrays. The RGB color model is used to read, write, and store image data in 32 bit floating point memory. Color manipulation can be performed in RGB, HSV, or Lab color model depending on the color tool. The HSV and Lab color models are used by the color tools in ImagesPlus to select and modify a hue, saturation, and luminance range with minimal effect to color outside of the selected color range compared to color manipulation in the RGB color model. Figures 5, 6, and 7 below show the same curve applied to the same RGB data using curves in RGB mode, luminance curve L in Lab mode, and the luminance curve L in HSV mode, respectively.
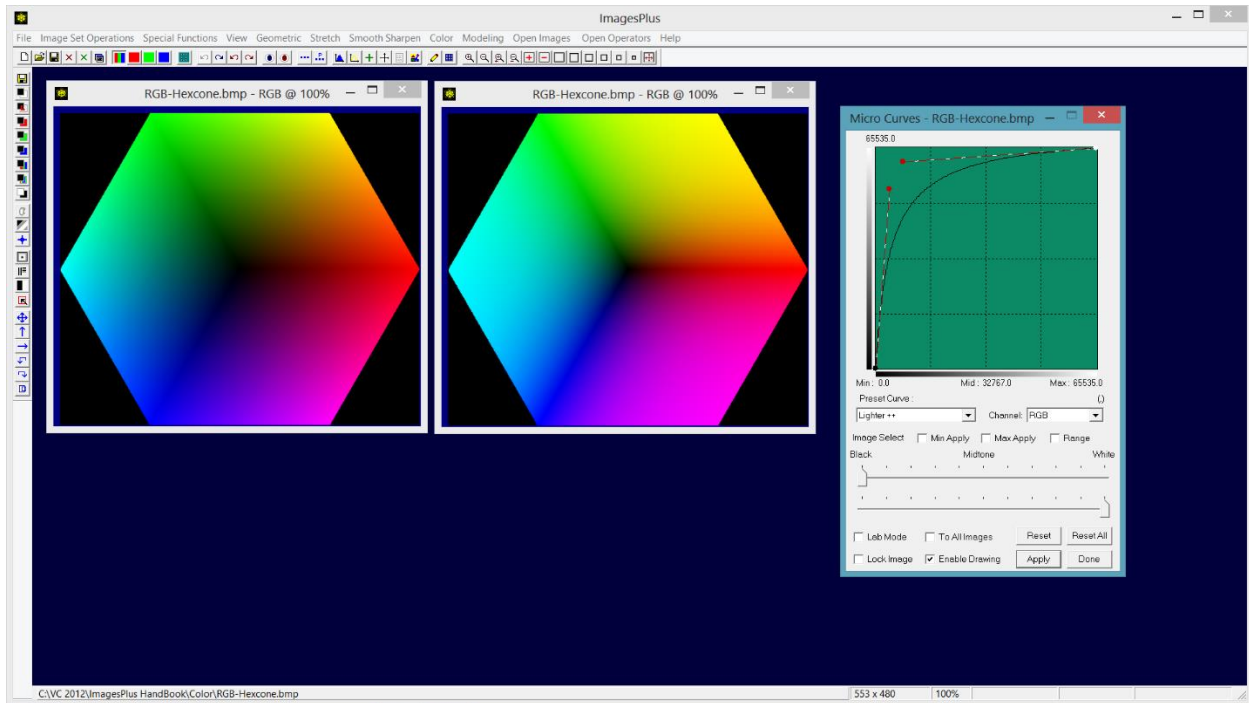
Figure 5 RGB color cone is shown at top left with curves applied in RGB mode at top center. Notice how cyan has expanded into blue and green, magenta into red and blue, and yellow into green and red.
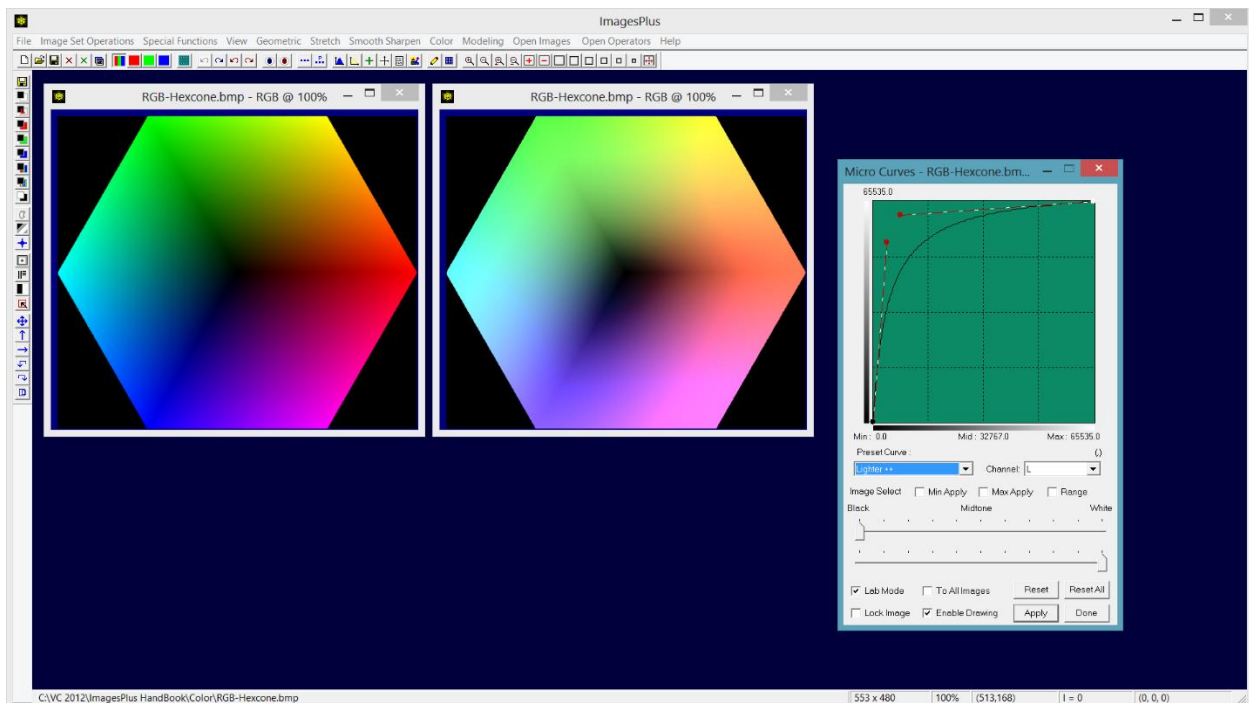

Figure 6 RGB color cone is shown at top left with luminance L curve applied in Lab mode at top center. All colors get brighter when using the L curve in Lab mode with minimal color shift but saturation can change since L is not decoupled from saturation. Lab saturation tools can be used to adjust saturation.
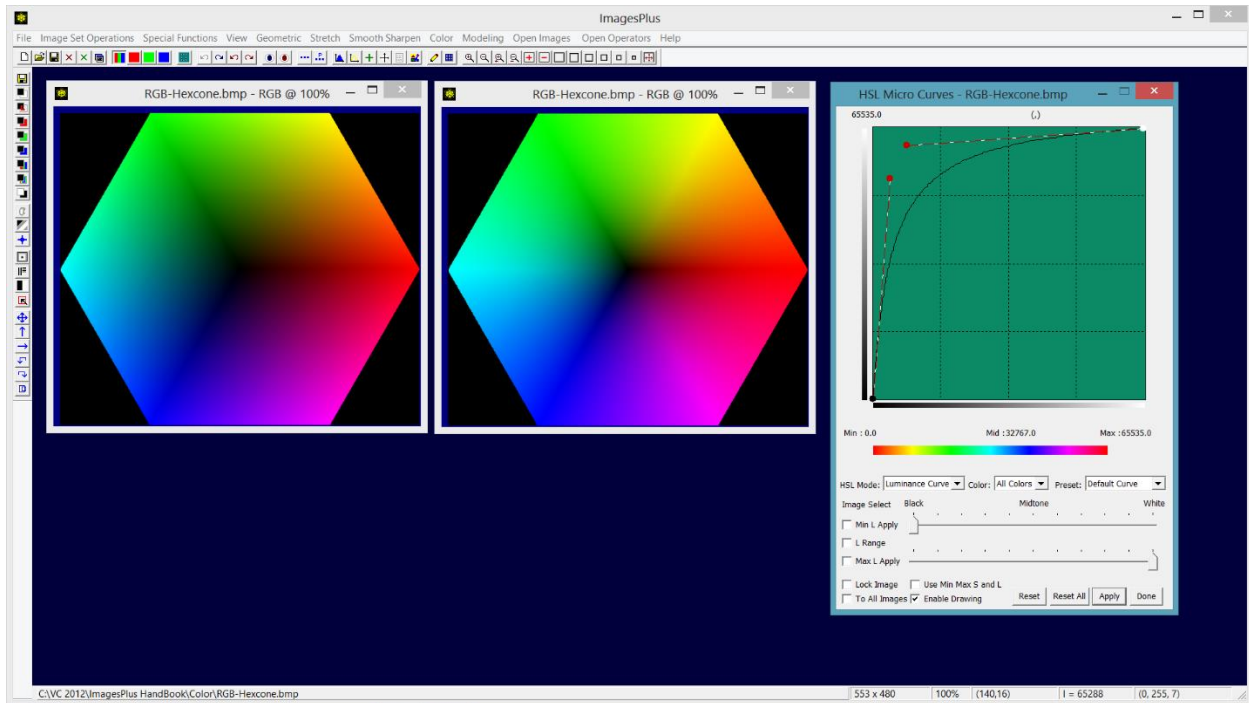
Figure 7 RGB color cone is shown at top left with luminance L curve applied in HSL mode at top center. Note that there is no color shift or saturation change since luminance L is decoupled from hue and saturation in HSV mode.

The mask tools in ImagesPlus use the RGB, HSV, or Lab models when creating gray scale masks. The RGB model is used to create a grayscale mask of the R, G, and B planes or a mixture of the (R, G, B) values at each point of an image as shown by Figure 8. The HSV model is used to create a gray scale mask of a specific hue, saturation, and luminance range as shown by Figure 9. The gray scale mask that represent a hue, saturation, and luminance range can be used to stretch, smooth, sharpen, and adjust color when the mask is assigned to a layer in the Process History window or Combine Images window.

The Cross Hair Statistics window, on the top horizontal toolbar, is used to display 8 and 16 bit RGB, hue, saturation, luminance, and Lab color at an image point under the mouse.
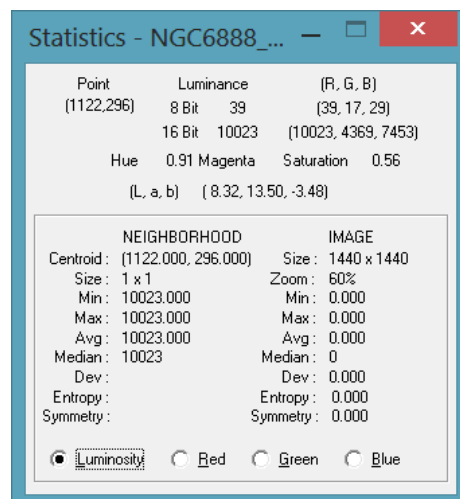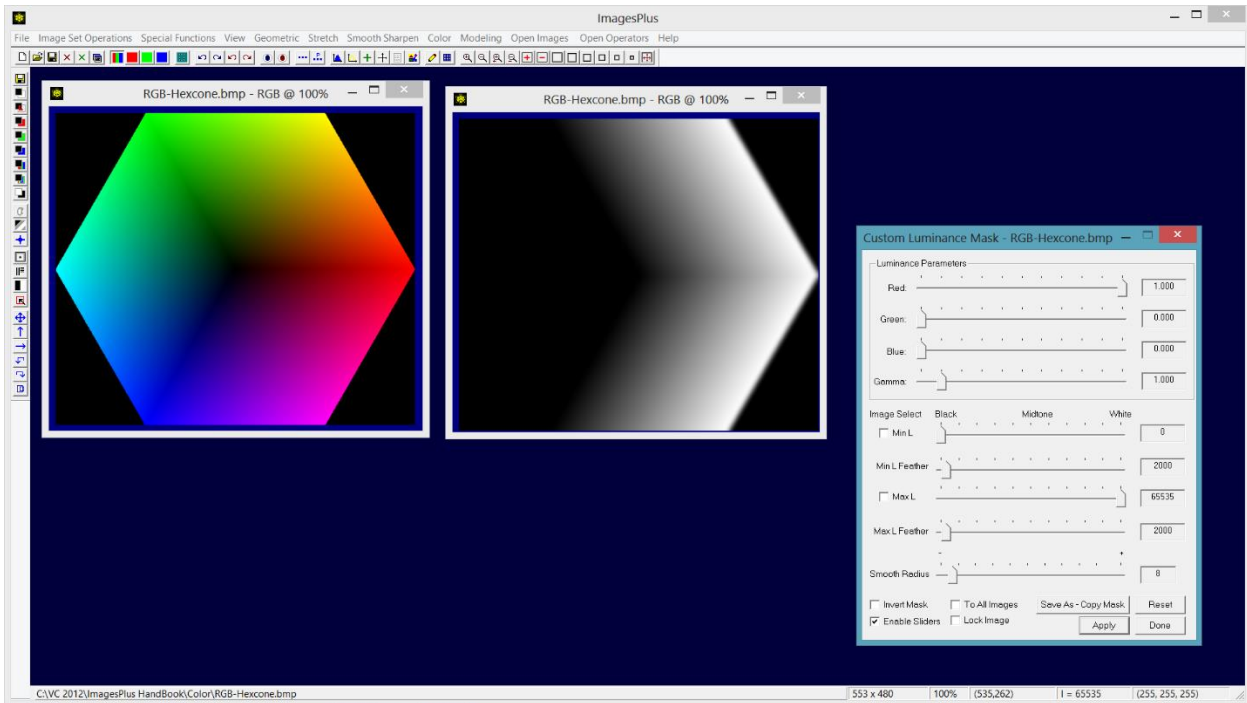
Figure 8 The Custom Luminance Mask tool creates a gray scale mask using the RGB model by mixing R, G, and B values at each point of an image. Only red is used above to create the gray scale mask.
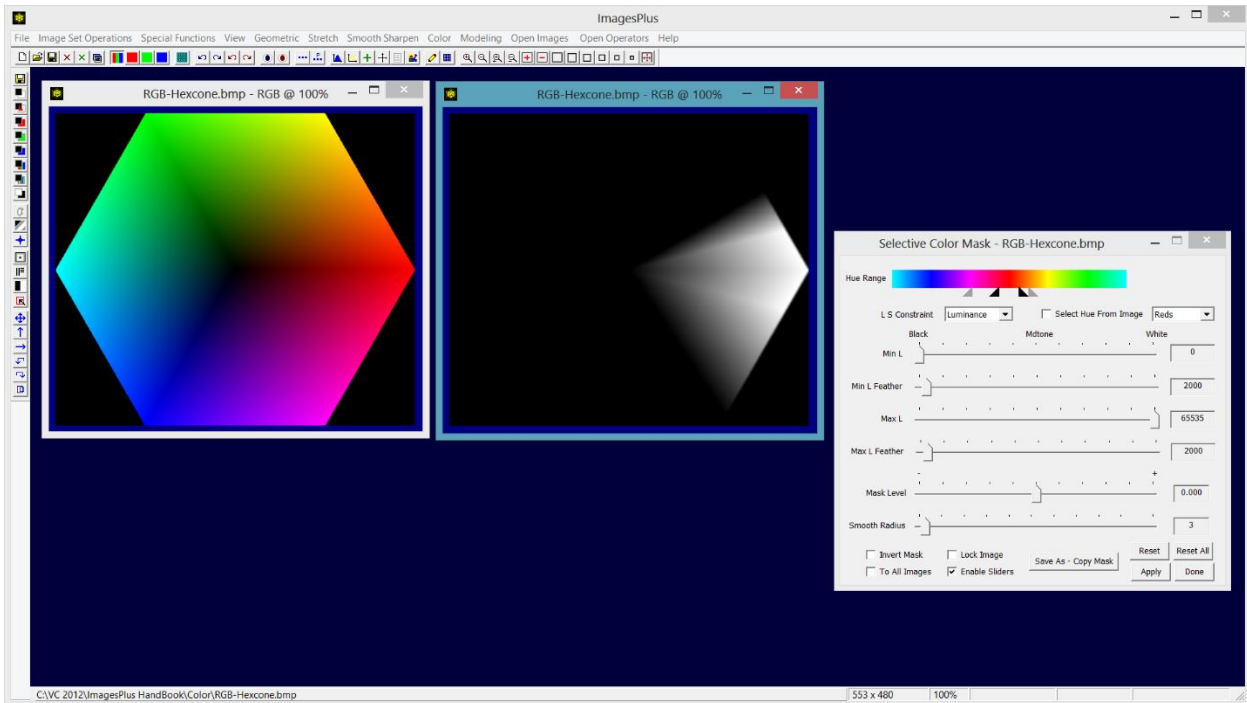

Figure 9 The Selective Color Mask tool uses the HSV model to create a gray scale mask of an image. The Hue Range bar and triangles define the feathered hue range. The L and S sliders can be set to specify a feathered luminance and saturation range. The HSL range is smoothed using the Smooth Radius slider.

The Color menu on the main ImagesPlus window contains most of the color tools as shown below in Figure 10. Micro Curves, Levels, and Pixel Math on the main Stretch and Special Functions menus can also be used to manipulate color.
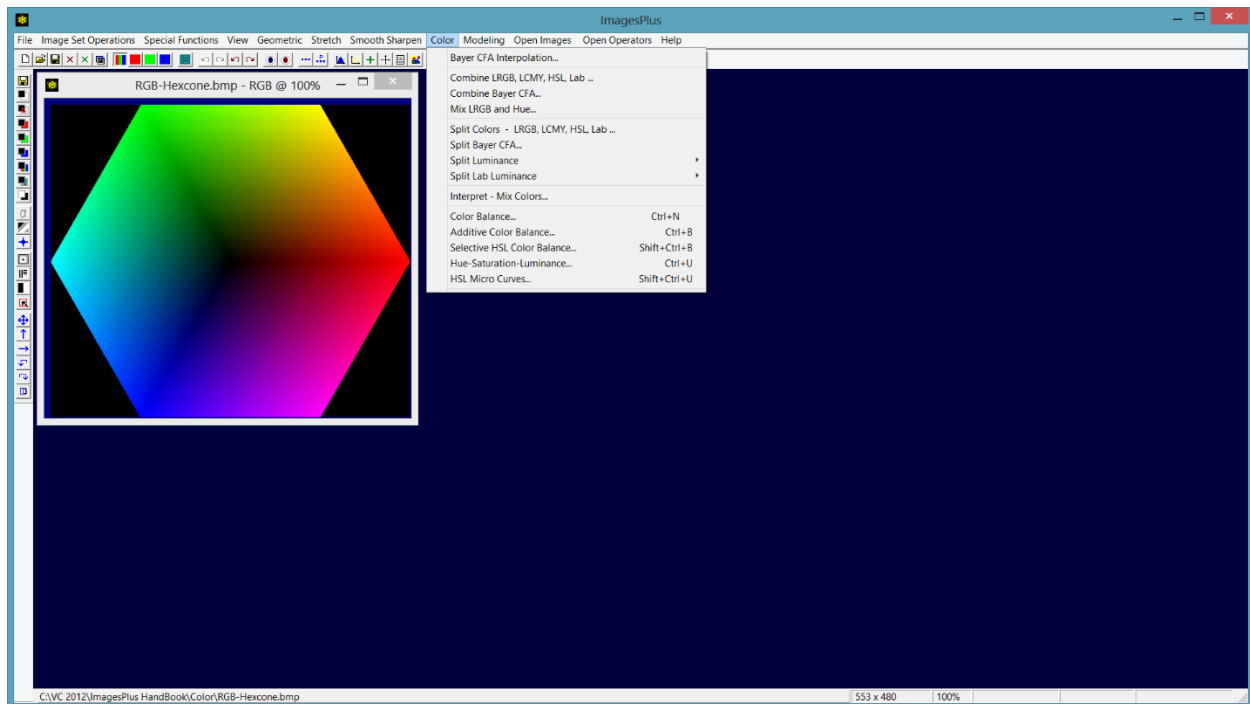

Figure 10 The Color menu on the main ImagesPlus window contains Bayer conversion, split and combine luminance and color component tools, and general color manipulation tools.

Bayer CFA Interpolation

The Digital Camera Raw File Development and Conversion or Automatic DSLR Image Set Processing tools on the main Image Set Operations menu can convert raw DSLR images like CR2 or NEF into Bayer color array format as shown in Figure 2. The Bayer CFA Interpolation tool shown in Figure 11 is used to convert Bayer color array format data into a color image using a gradient driven interpolation. The individual red, green, and blue pixels of an image in Bayer color array format can cause a rectangular grid pattern to be seen when the image is displayed at different zoom factors. It is important to select the correct Bayer CFA type on the Bayer CFA Interpolation tool when converting the image to color otherwise poor color or a rectangular grid pattern will result in the color image. If you are not sure of the Bayer CFA type of your sensor then start at the top of the Input Raw Bayer CFA File Type list with RGB Generic + (0,0) – RG,GB and apply each type to the image until you find the best color without any rectangular pattern.
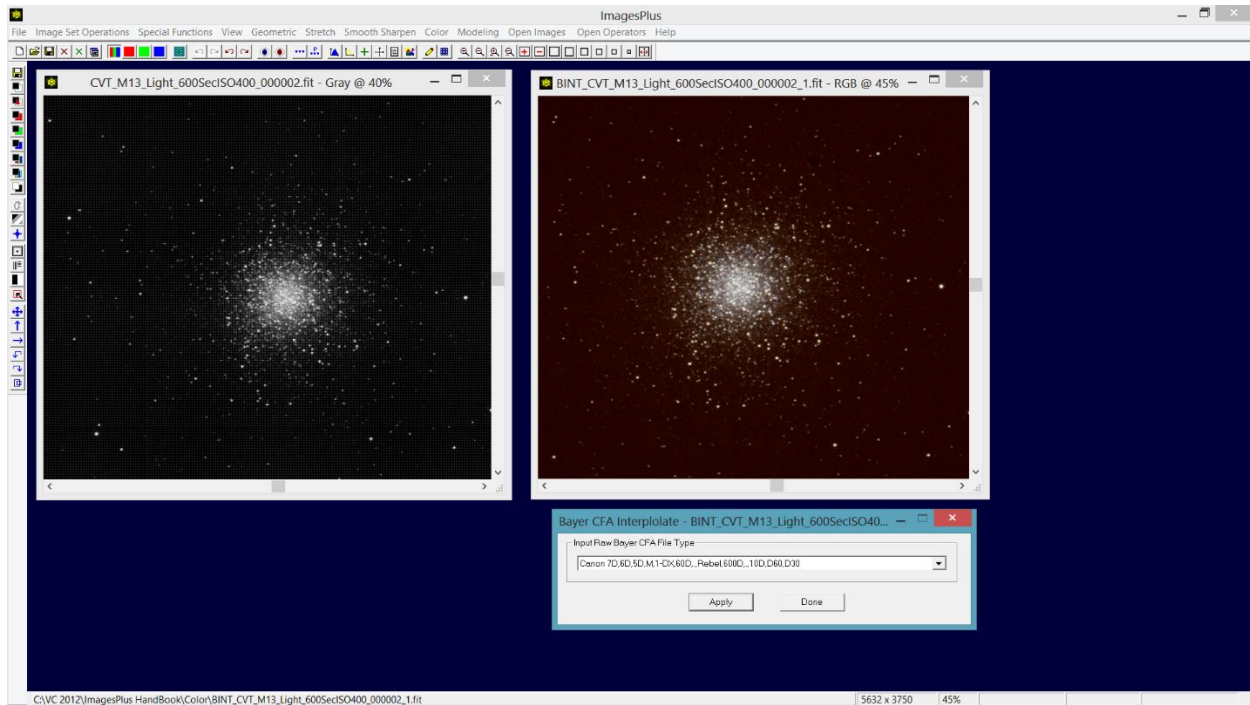
Figure 11 Single channel Bayer color filter array (CFA) format image with individual red, green, and blue pixels is shown on the left with color conversion shown on the right. The red bias of the image is due to red light pollution.

Split Colors - LRGB, LCMY, HSL, Lab

The Split Colors tool is used to separate a color image into its color components based on the color model. Most tools in ImagesPlus allow direct access to the RGB, HSL, and Lab color components of an image directly without splitting the image, but access to the color components of an image can be useful at times. The RGB, R, G, and B buttons on the top horizontal toolbar enable direct access to the selected color component when using an enhancement tool that does not have color selection options such as Pixel Math, smoothing, sharpening, deconvolution, or the geometric transform tools.

The *Link Color Components To* options controls how the color image is split into components. If the *No Image* option is used then the color image is split into separate color component images with no link to rebuild the original color image from the components. If the *New Color Image* option is used to split a color image then the color components are linked by the Combine LRGB, LCMY, HSL, Lab tool to a new version of the color image being split. The component images can be processed and the new combination image updated by pressing the *Apply* button on the Combine LRGB, LCMY, HSL, Lab tool.

The *LRGB* option will spilt a color image into separate luminance, red, green, and blue gray scale images and display them in color. The Interpret – Mix Colors tool can be used to display a red, green, or blue component image as gray scale. Figure 12 shows a color image split into its luminance, red, green, and blue components using the *No Image* option. Figure 13 shows the same image split into luminance, red, green, and blue components and linked to a new color image using the *New Color Image* option.

The *LCMY* option will split a color image into luminance, cyan, magenta, and yellow components shown by Figure 14.
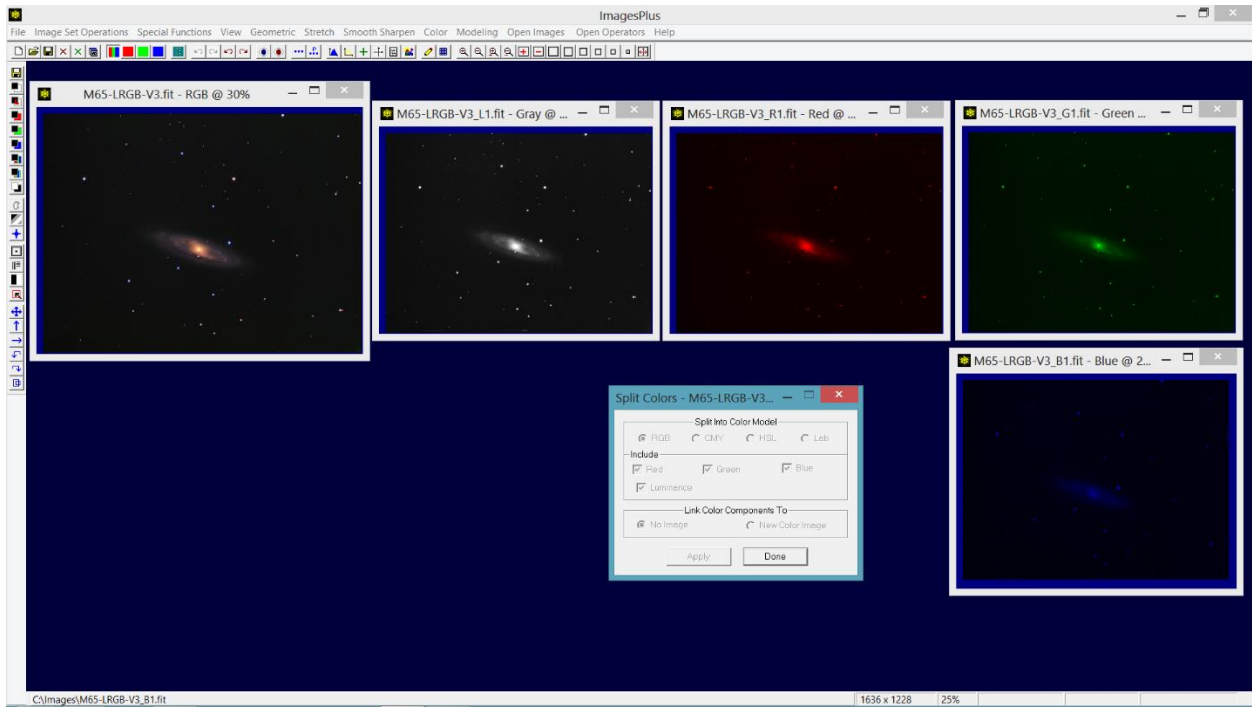
Figure 12 Color image split into L, R, G, B components using the *LRGB* with *No Image* options.
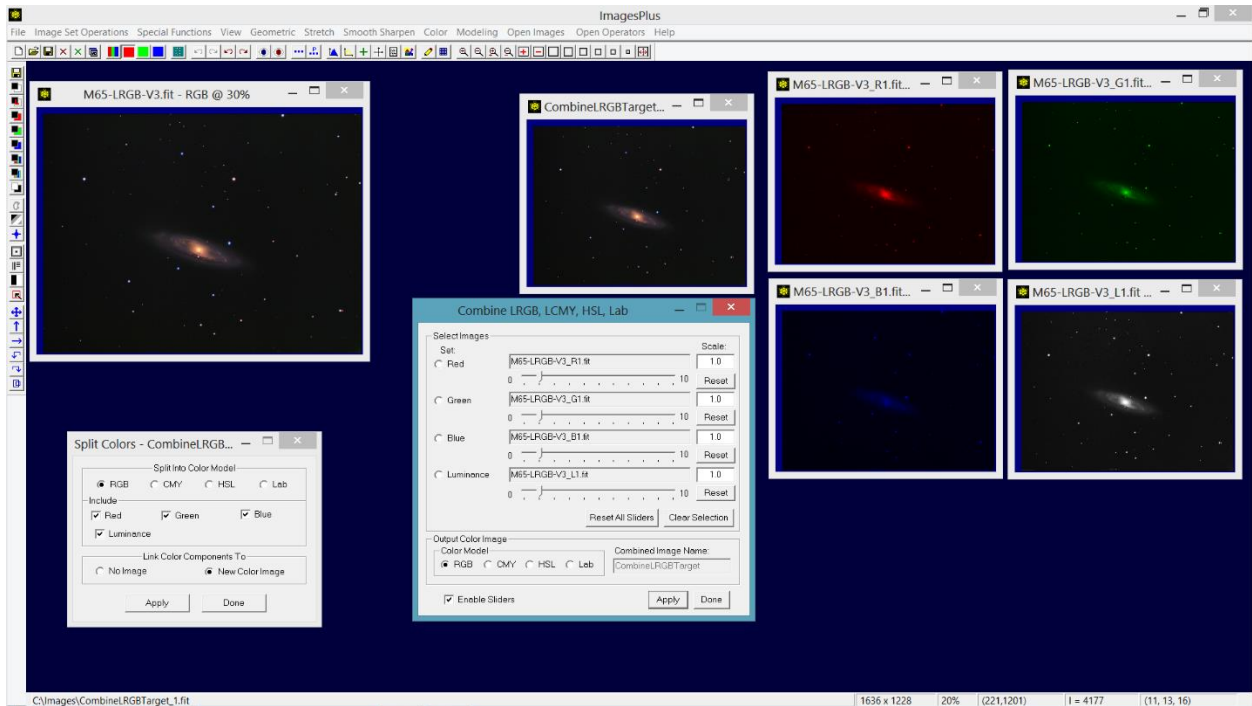

Figure 13 Color image at top left is split into L, R, G, and B components using Split Colors with the *New Image* option. As a result the split L, R, G, and B components are linked to a new color image called CombineRGBTarget by the Combine LRGB tool. The components images can be enhanced and the new color image updated by pressing *Apply* on Combine LRGB.
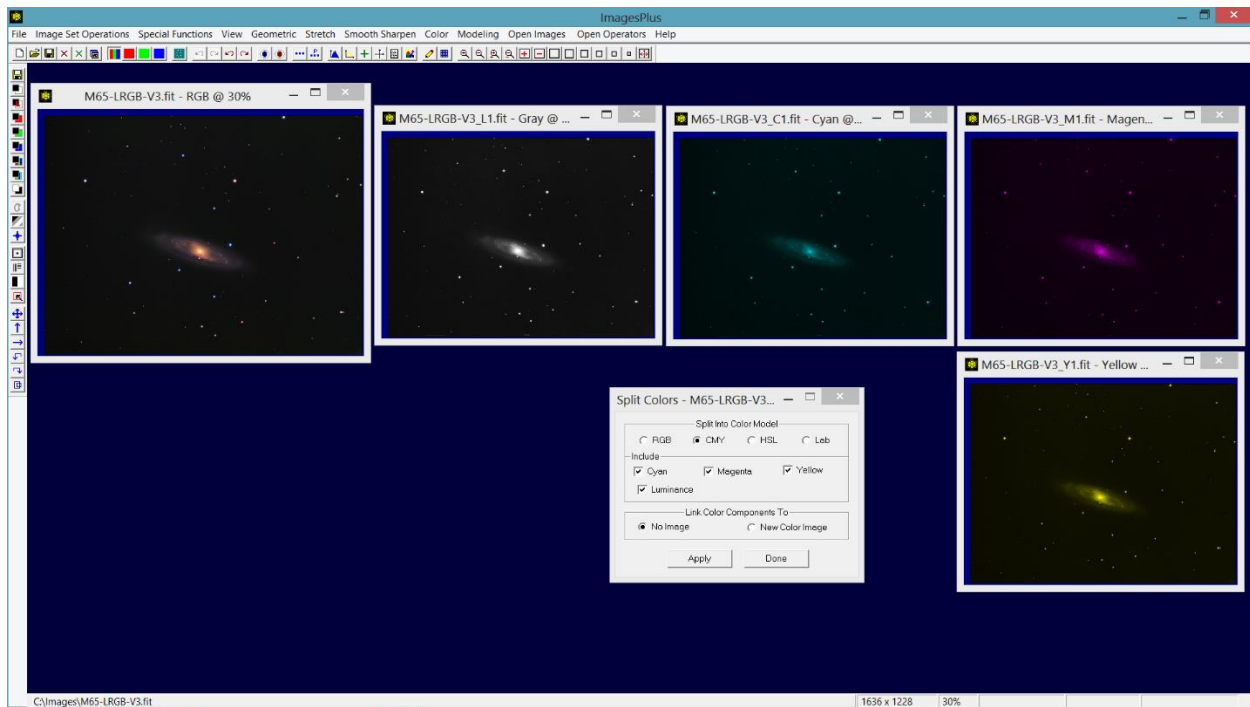
Figure 14 Color image split into luminance, cyan = blue + green, magenta = red + blue, and yellow = red + green components.

The *HSL* option splits a color image into hue, saturation, and luminance components. The hue hexcone shown by Figure 3 is mapped from red at 0° through magenta at 300° back to red to the gray scale [black, white] = [0.0, 65535.0]. The saturation component maps 0.0 saturation to black at 0 and 1.0 or full saturation to white at 65535.0 in a 32 bit floating point gray scale image [0.0, 65535.0]. Luminance is the gray scale image calculated by finding the maximum value of red, green, blue at each pixel. The hue and saturation components can be used to modify hue and saturation by applying a tool to a specific gray scale range but it is simpler to use tools with HSL built in. For example, Micro Curves could be applied to the darker areas of the saturation image to increase saturation but the operation is much more direct if you use the saturation curve of HSL Micro Curves. Figure 15 shows a color image split into H, S, and L components.

The *Lab* option splits a color image into its Lab L, a, and b components. The Lab luminance component is usually darker and smoother than the HSL luminance component since Lab luminance is not the maximum of R, G, and B at each pixel. The Lab a (green-red) component represent green by negative values and red by positive values of a. The split a(G-R) image has green mapped from black to medium gray in the range [0.0, 32765.5] and red mapped from medium gray to white in the range [32765.7, 65535.0]. The Lab b (blue-yellow) component represent blue as negative values and yellow as positive values of b. The split b(B-Y) image has blue mapped from black to medium gray in the range [0.0, 32765.5] and yellow mapped from medium gray to white in the range [32765.7, 65535.0]. It is possible to modify color by applying a smooth, sharpen, deconvolution, or stretch tool to the component a and b images but it is simpler to use a tool with Lab mode built in. For example, you could use Micro Curves in RGB mode and apply a curve to the black to medium gray range of the b(B-Y) image to modify blue. The

Micro Curves, Selective HSL Color Balance, and Hue-Saturation-Luminance tools in Lab mode allows much easier access to Lab color data. Figure 16 shows a color image split into L, a, and b components.
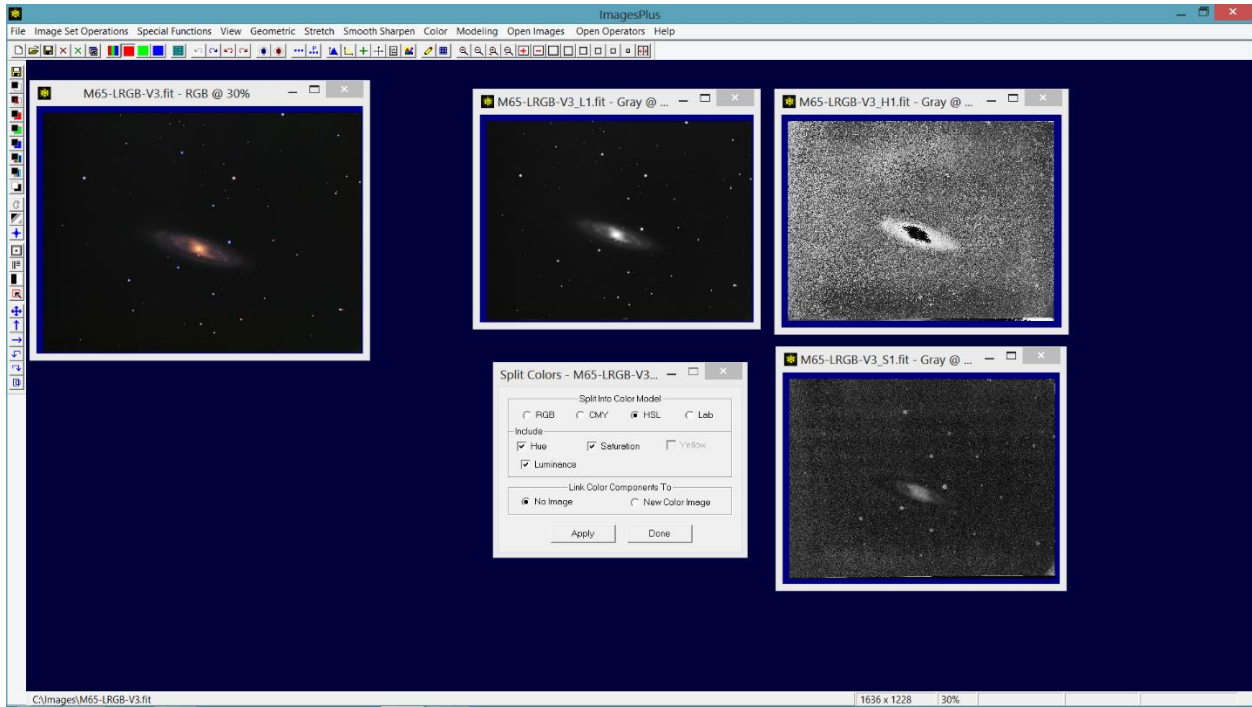

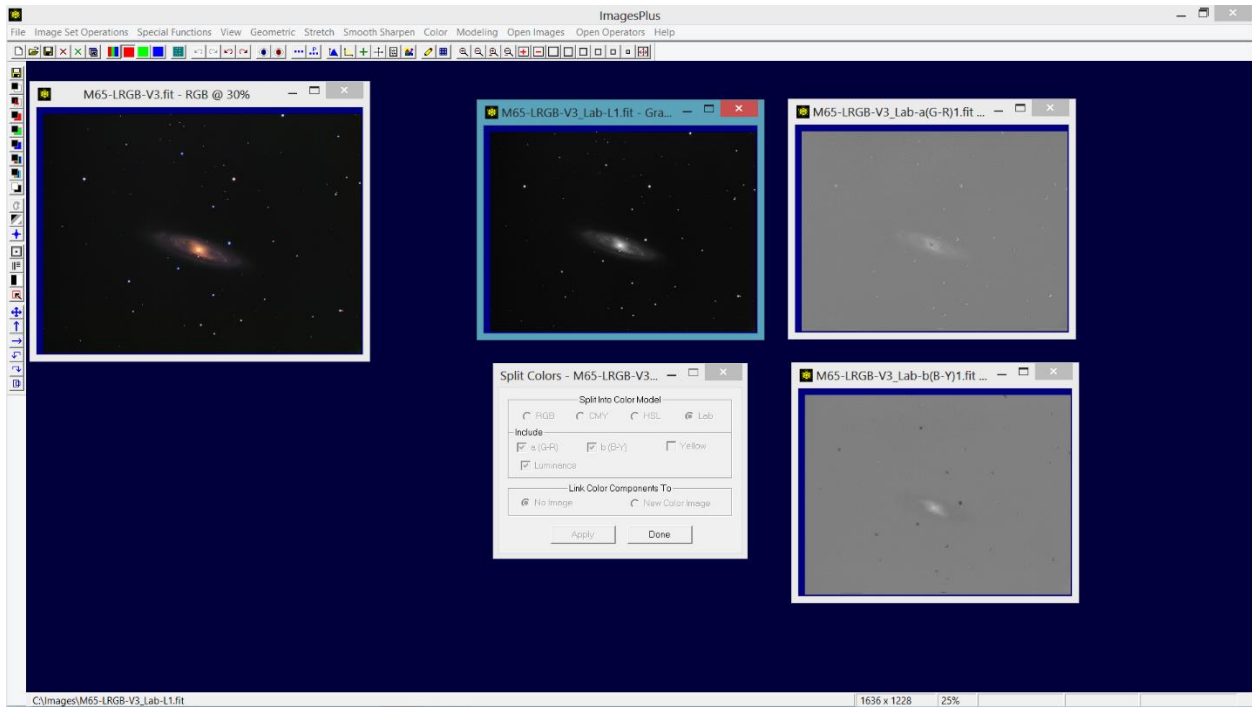**Figure 15** Color image split into hue, saturation, and luminance components.

Figure 16 Color image split into Lab luminance, a(G-R), and b(B-Y) components.

Split Bayer CFA

A Bayer color filter area (CFA) image, see Figure 2, is created by the Auto DSLR Image Set Processing tool, Digital Camera Raw Conversion and Development tool, or captured by a one shot color CCD camera. Split Bayer CFA, which operates like the Split LRGB tool, is used to split a Bayer CFA image into separate images that contain only the red, green, or blue data before conversion to a color image. The split color components allow the application of stretch, smooth, sharpen, deconvolution, or pixel math tools to the separated data before red, green, and blue are merged back into a Bayer color filter array image and converted to an RGB color image.

The *Link Color Components To* options controls how the Bayer CFA image is split into components. If the *No Image* option is used then the color image is split into separate color component images with no link to rebuild the original Bayer CFA image from the components. If the *New Monochrome Image* option is used to split a Bayer CFA image then the color components are link by the Combine Bayer CFA tool to a new version of the Bayer CFA image being split. The component images can be processed and the new combination image updated by pressing the *Apply* button on the Combine Bayer CFA tool. Figure 17 shows a Bayer CFA image split into R, G, and B components. The G component has twice the height as the R and B components since every row of the Bayer CFA image has green pixels but every row does not contain a red or blue pixel as shown by Figure 2.
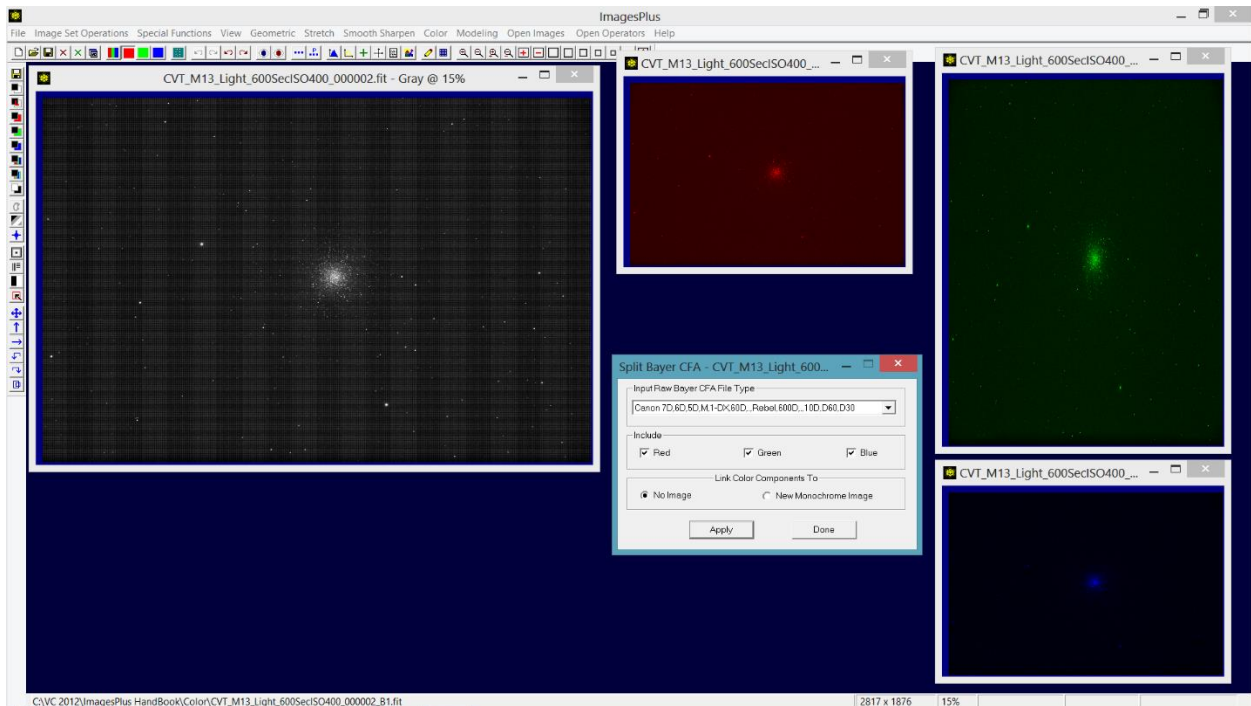

Figure 17 Bayer CFA format image on left is split into separate R, G, and B pixel images for processing before the components are merged back into a Bayer CFA image using Combine Bayer CFA and converted to a color RGB image with the Bayer CFA Interpolation tool.

Split Luminance

The Split Luminance menu option is used to quickly create a luminance image by splitting the current active color image into its luminance component using the HSV model. Split Luminance is also available on the left vertical toolbar.

Split Lab Luminance

The Split Lab Luminance menu option is used to quickly create a Lab luminance image by splitting the current active color image into its Lab luminance component using the Lab model. Split Lab Luminance is also available on the left vertical toolbar. The Lab luminance image is usually darker and smoother than a HSL luminance image from the same color image since Lab luminance is not the maximum of R, G, and B at each pixel.

Combine LRGB, LCMY, HSL, Lab

The Combine LRGB, LCMY, HSL, Lab tool is used to combine split LRGB, LCMY, HSL, and Lab components created by the Split LRGB, LCMY, HSL, Lab tool into a color image. LRGB components can also be created by a digital camera using different color and luminance filters. To combine components first open the components using File | Open then open the Combine LRGB, LCMY, HSL, Lab tool from the Color menu. Select the type of component on the Combine tool then left click on the component image inside its window to add the component image to the Combine tool. Each component assigned to the Combine tool has a scale slider that is used to scale the component when building the color image. Component scale is used to balance the sensor and color filter sensitivity difference between colors. Modern color filters are already balanced and a scale factor of 1.0 is used with all components.

This combination tool is good at combining RGB components into a color image. A luminance L image could also be combined with the RGB components but it is better to layer a luminance component on top of the RGB image since the luminance image and RGB image are usually stretched and processed differently. The Combine Images tool on the Special Functions menu is used to layer a luminance image L on top of an RGB image using blend modes, opacity, and masks. Figure 18 shows the combination of R, G, and B components from a monochrome CCD camera.

Combine Bayer CFA

The Combine Bayer CFA tool is used to combine red, green, and blue pixel images that were split from a Bayer CFA format image. The red, green, and blue components can be processed before they are merged back into a Bayer CFA format image using Combine Bayer CFA. To combine components first open the components using File | Open then open the Combine Bayer CFA tool from the Color menu. Select the type of component on the Combine tool then left click on the component image inside its window to add the component image to the Combine tool. Each component assigned to the Combine Bayer CFA tool has a scale slider that is used to scale the component when building the Bayer CFA format image. Normally a scale factor of 1.0 is used with all components. The *Display Color Image* button can be used to convert the Bayer CFA combination into an RGB color image. Figure 19 shows the combination of R, G, and B components that were split from a Bayer CFA format image and smoothed before they are merged and converted to a color RGB image.
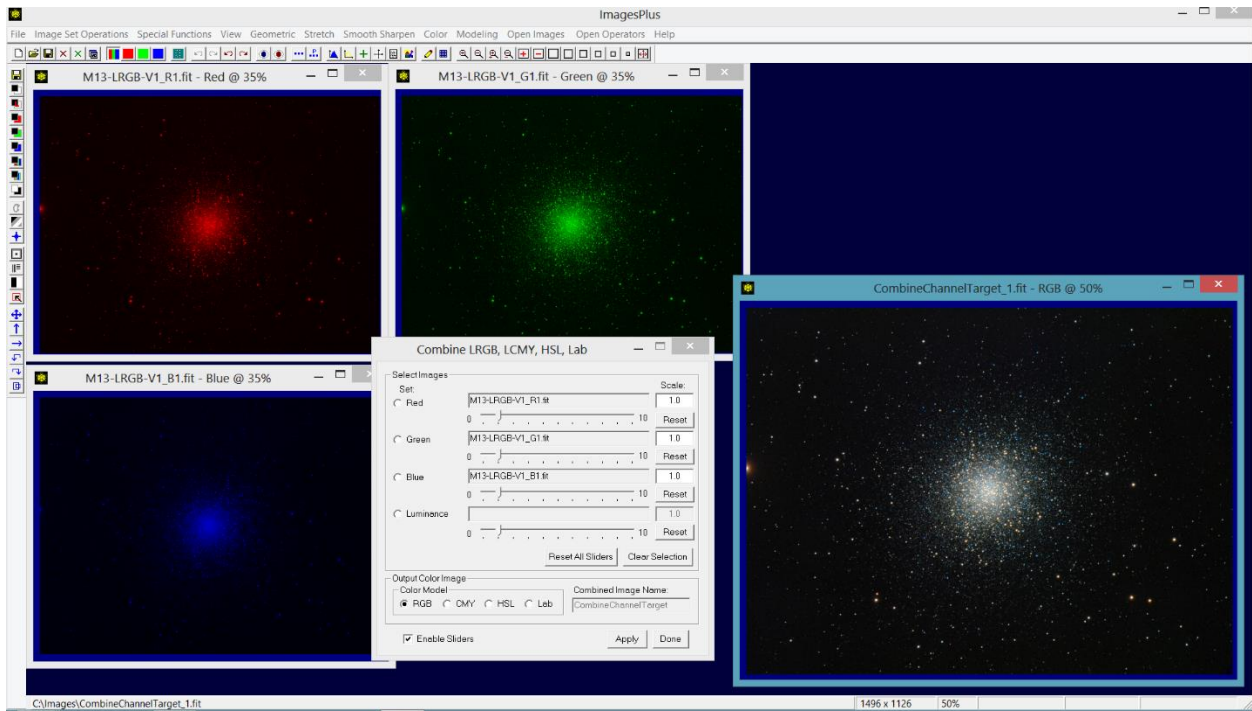
Figure 18 Color RGB image on right created using the Combine LRGB tool with red, green, and blue components each with a scale factor of 1.0. The component images can be modified and the combination image updated by pressing the *Apply* button on Combine LRGB.
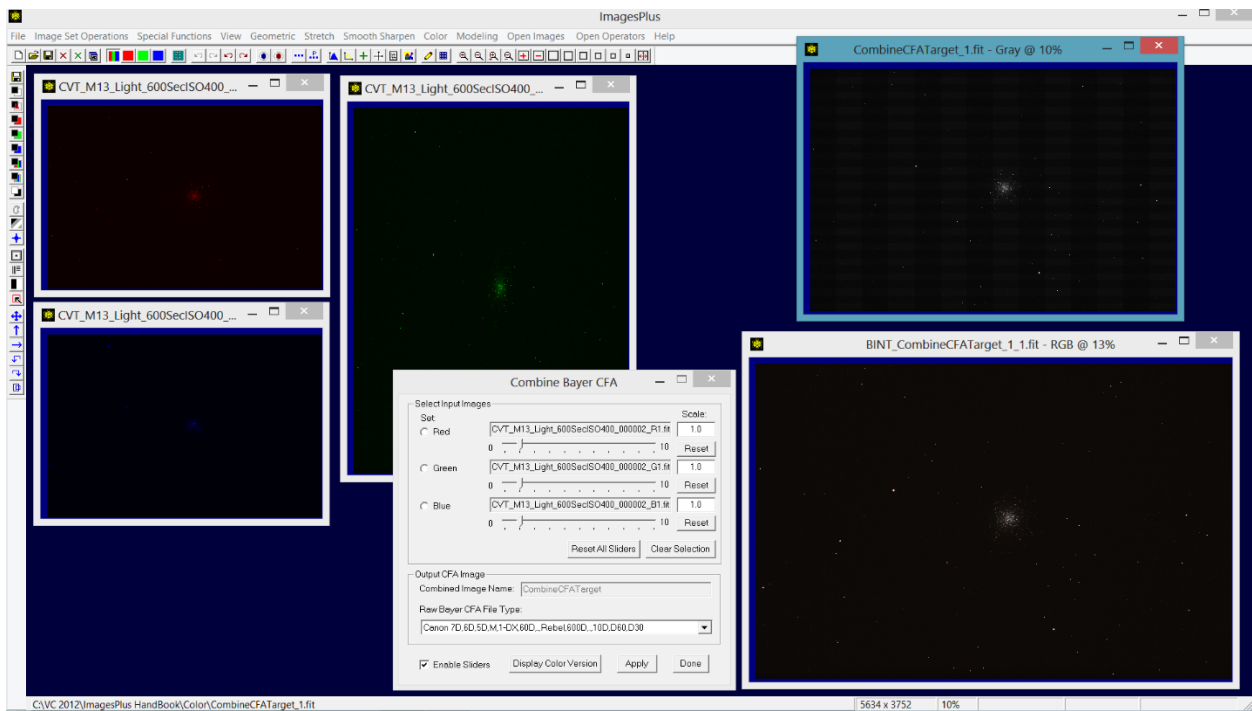

Figure 19 The R, G, and B pixel data images can be processed before conversion into a Bayer CFA image using the *Apply* button or into a color RGB image using the *Display Color Image* button.

Mix LRGB & Hue

The Mix LRGB & Hue tool is used to build a color RGB image by assigning different amounts of luminance, red, green, blue, narrow band, and RGB component data from a color image to the luminance, red, green, blue, or custom hue data of the combination color image under construction. In order to build a color image from component images follow these steps.

1) Open the component images using File | Open then open the Mix LRGB & Hue tool on the Color menu.
2) Use the *Select All Open* button on Mix LRGB &Hue to insert all open images in the component tree of Mix LRGB & Hue. To insert a single image into the component tree check the *Select Source Image* box the left click on the image inside its window.
3) Each monochrome image in the component tree must be assign to HSL L, Lab L, red, green, blue, or a custom hue to be added to the combination image. To assign a monochrome image to a color first select the image in the component tree then in the *Map Color* To group select L, Lab L, R, G, B, or a custom hue from the hue table. Press the *Add* button to assign the monochrome image to the selected color. Use the Scale slider to assign 100% or a different percent of the monochrome image to the color selection.
     A color RGB image can also be used in the component tree and is inserted in the tree in the same way as a monochrome image. If the RGB color image is selected in the component tree then the *Split LRGB* button can be used to assign its L, R, G, and B components at 100% automatically. The L, R, G, and B components of the color image can also be assigned by selecting the *Map Color From* and *Map Color To* options then press the *Add* button and set the *Scale* slider to the desired percent.
4) To edit a color assignment select the assignment under the image component entry in the component tree and change color or scale then press the *Edit* button.
5) Use the *Apply* button to build the color image using the component assignment set in the component tree. If you want to apply some processing to the combination image then duplicate the combination image using the … toolbar button or press the *Release Combination* button.
6) The order or position of a component in the tree is not important since each component is assign to a color and a percentage of the component data is added to the color.

Example 1) Building a color image from L, R, G, and B components from a monochrome camera should be performed by first combining the R, G, and B components into a color RGB image since the initial stretch or brightening tools like Digital Development and ArcSinH are designed to brighten a color image and preserve good color without compressing color. Figure 20 shows the setup of Mix LRGB & Hue when building a color image from R, G, and B component images.

The L component is stretched and processed separate then assigned to luminance of the stretched and processed RGB image. Assign the processed L component using Lab luminance to get the best color. Figures 21, 22, and 23 show the combination of the processed L component with the processed RGB color image.
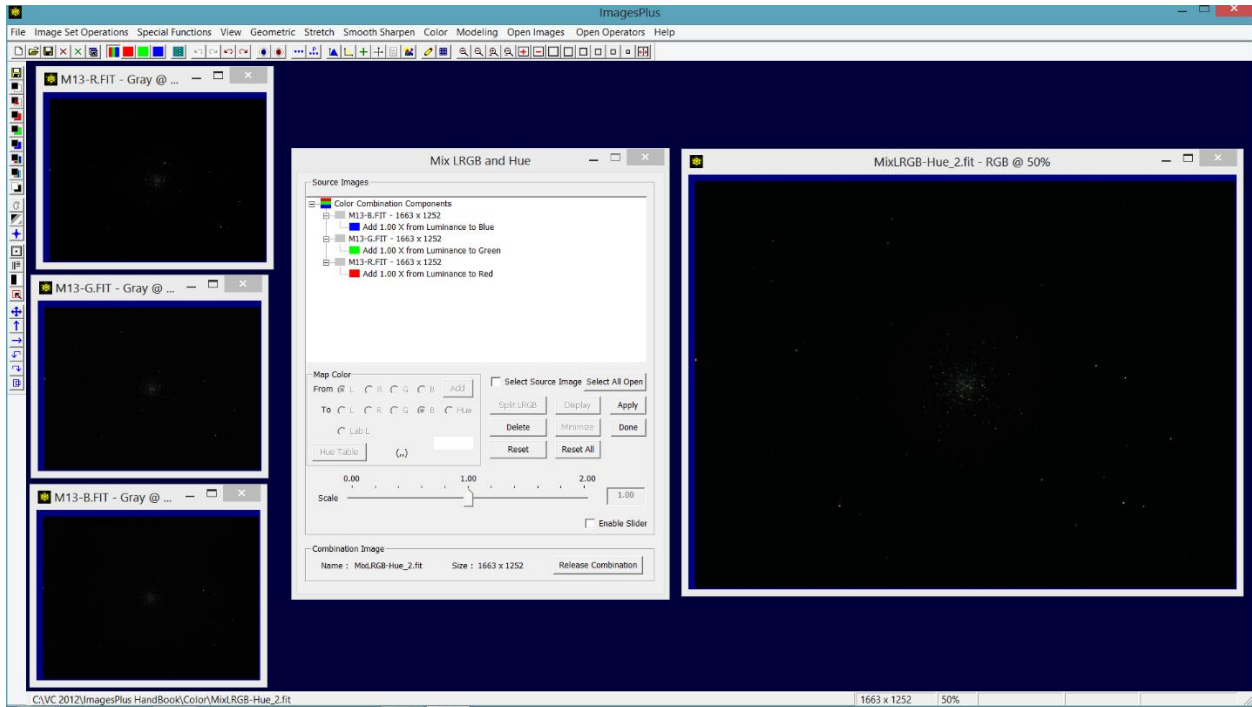
Figure 20 The calibrated, aligned, and stacked with no further processing R, G, and B components are shown at left with the Mix LRGB & Hue combination image on the right. Note the excellent color in the combination image. The Mix LRGB and Hue image is saved as M13-RGB.fits for later use.
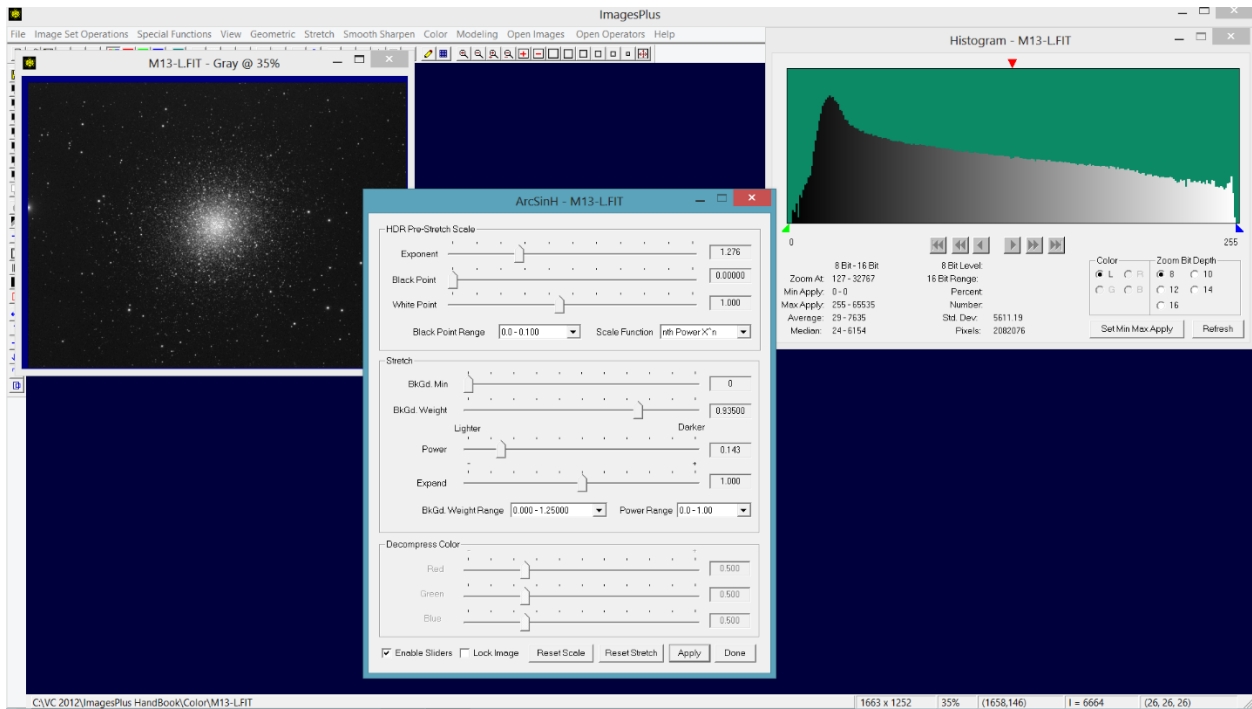

Figure 21 Open and process the calibrated, aligned, and stacked luminance L image.
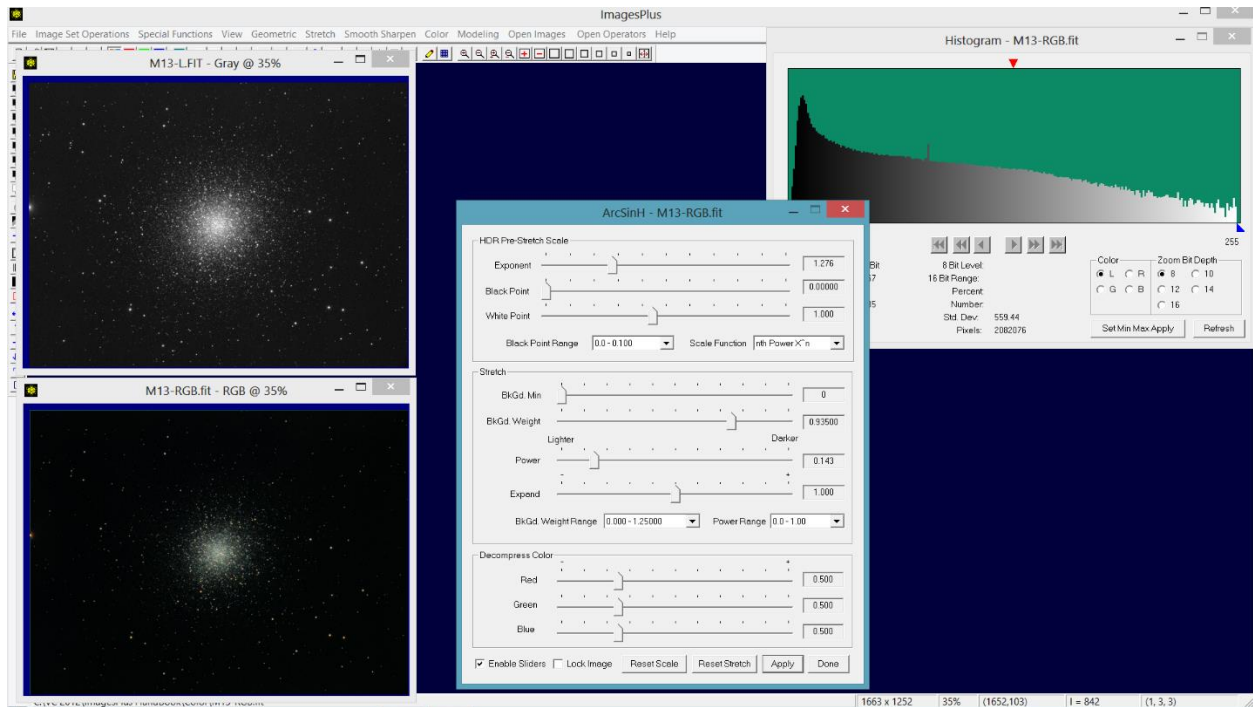
Figure 22 Open and process the RGB combination image M13-RGB.fits created as shown in Figure 20.
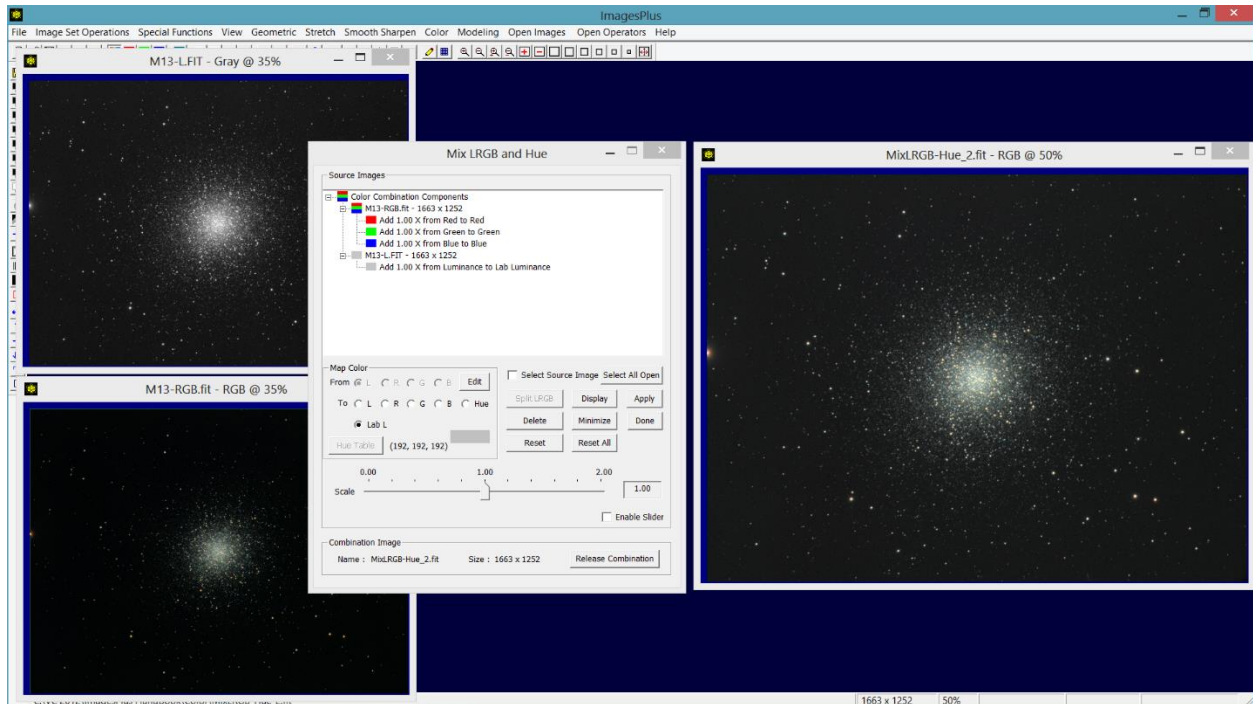

Figure 23 Processed L and RGB images are shown on the left with the Mix LRGB and Hue combination image on the right. The luminance L component is assigned to Lab L luminance for better and smoother color. The color M13-RGB image has its R, G, and B data assigned at 100% to the R, G, and B data of the combination image. Note the excellent color of the blue and yellow stars.

Example 2) Narrow band components can be mixed into a color RGB image using a wide range of color schemes. The components can be processed separately before mixing into the color RGB image. Additional processing is normally applied to the color RGB image created by the Mix LRGB & Hue tool.
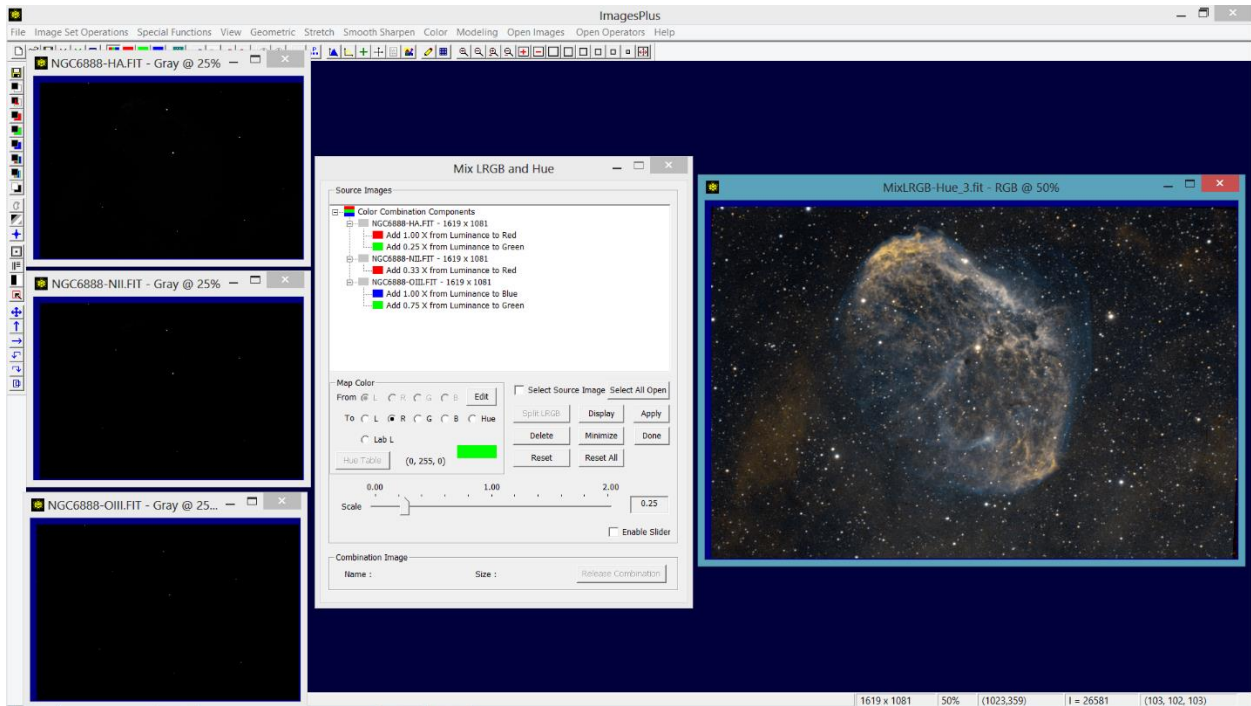

Figure 24 Component Ha, NII, and OIII images are mixed into a color image using the color assignments shown in the tree. The mixed color RGB image is then processed as shown on the right.

Interpret – Mix Colors

The main use of the Interpret – Mix Colors tool is to assign a monochrome single channel image to a color for use with the Combine Images layering tool. For example, a monochrome gray scale image taken with an H-alpha filter will appear as a gray scale image when opened in ImagesPlus using File | Open. If the gray scale H-alpha is to be layered with the red data of a color image using the Combine Images layering tool then the gray scale H-alpha image needs to be interpreted as red data. So the Interpret – Mix Colors tool is used to assign the gray scale H-alpha image to red as shown in Figure 25.

The most often used interpret color types are luminance, red, green, and blue followed by cyan, magenta, and yellow. The other interpret as types are rarely used and refer to gray scale image types created by the Split HSL and Lab tool.

The controls of the *Mix Channels of Multi-Channel Image* are used to swap and mix the red, green, and blue channels of a color image.
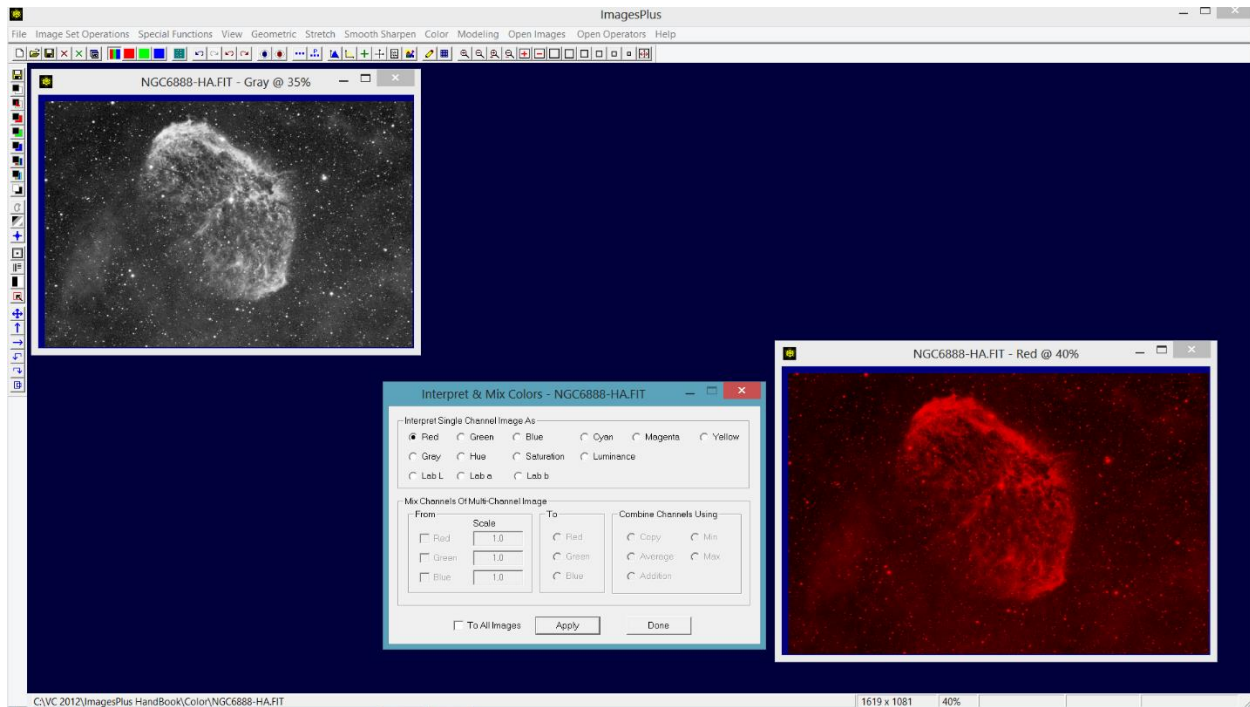
Figure 25 The gray scale H-alpha image shown at top right is interpreted as red data for use with the Combine Images layering tool on the Special Functions menu.

Color Balance

The Color Balance tool is used to neutralize or set to gray the background of an image using a click of the mouse. Mid-tone gray and white points can also be set. For a selected background, mid-tone, or white point expressed as (R, G, B) the R, G, and B values are set equal to the Max{R, G, B}, Median{R, G, B}, or Min{R, G, B} if the *Balance High, Mid,* or *Low* control is set, respectively. The red, green, and blue sliders can be used to adjust the color balance at a selected background, mid-tone, or white point. In order to neutralize the color of the background of an image to dark gray follow these steps.

1) Check the Neutralize Background box on Color Balance then left click on the background of an image away from any stars, nebula, or galaxy.
2) If needed adjust the background color using the red, green, or blue sliders.
3) Use the Background Darker – Lighter slider to set the overall background brightness to dark gray or near the value (20, 20, 20) on an 8 bit scale or (5120, 5120, 5120) on a 16 bit scale as measured by the Cross-Hair tool.

Figure 26 shows the application of the N*eutralize Background* option to an image with a red background.
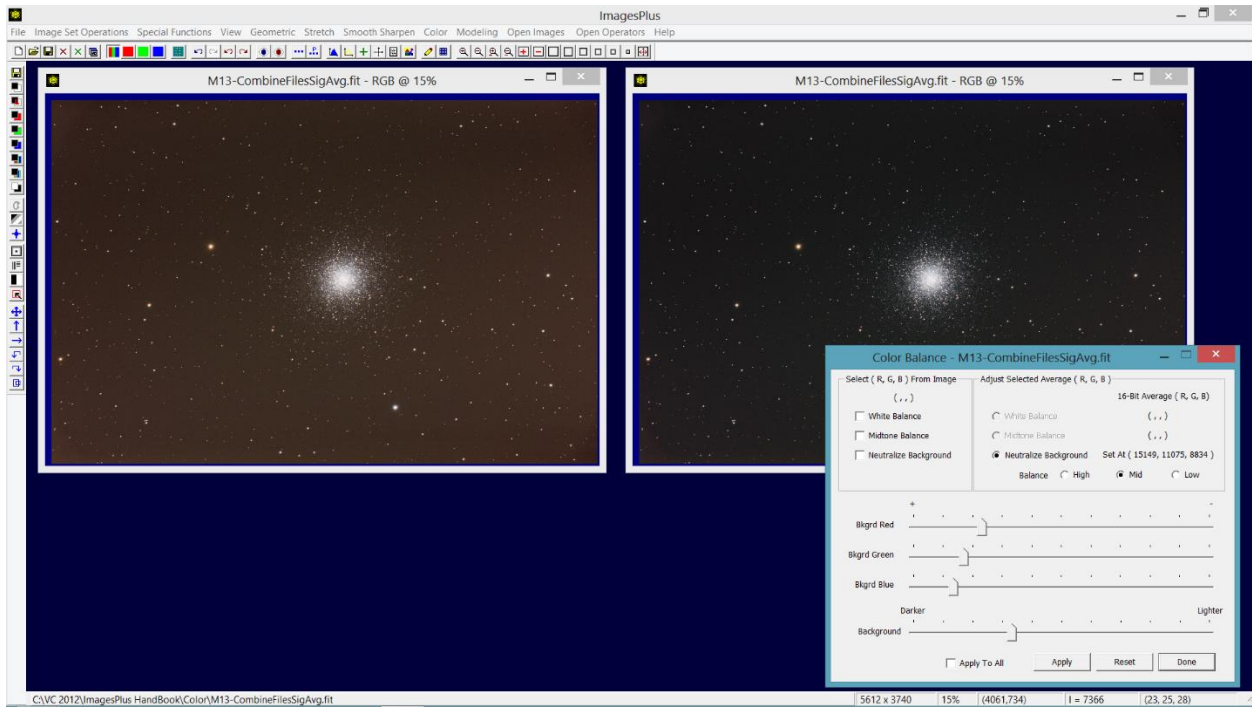
Figure 26 The red background of the image on the left is set to dark gray using the *Neutralize Background* option of the Color Balance tool. After the background point is selected the background is made darker or lighter using the *Background* slider.

Additive Color Balance

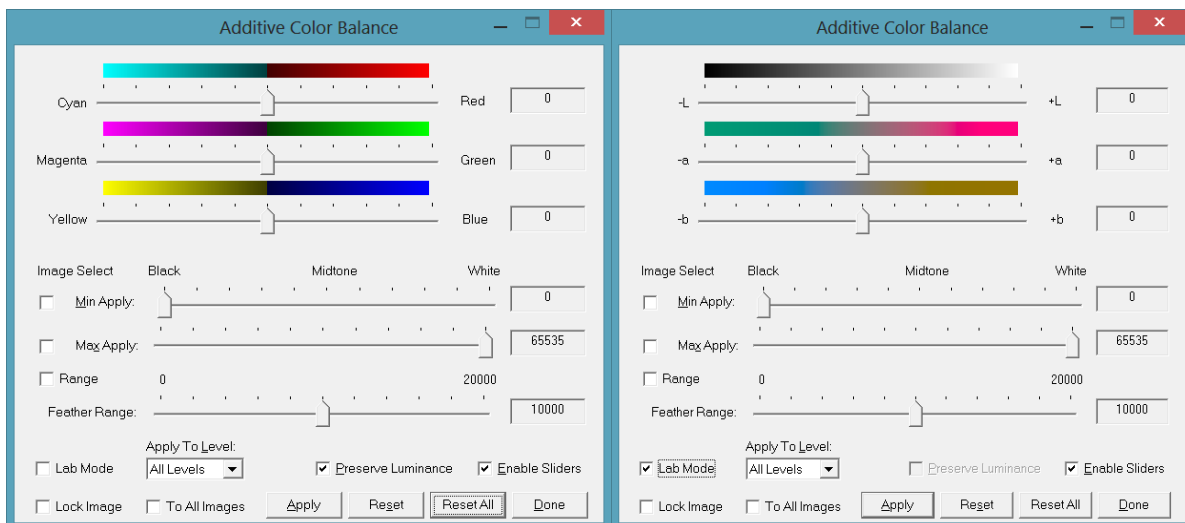The Additive Color Balance tool is used to add or subtract color in RGB mode or Lab color mode.

Figure 27 If *Lab Mode* is not checked then Additive Color Balance is in RGB mode shown on the left. If *Lab Mode* is checked then the red, green, and blue sliders are set to Lab L, a(G-R), and b(B-Y) shown on the right.

A luminance range with feather radius can be used to select pixels where Additive Color Balance is applied. The *Min Apply* and *Max Apply* sliders are used to define the luminance range [min apply value, max apply value] where Additive color balance is applied at 100% opacity. The *Feather Range* slider is used to define the feather radius for pixel values less than the min apply value and greater than the max apply value. For example, suppose min apply is set to 7500 and max apply is set to 32000 with a feather radius of 1500 then Additive Color Balance is applied at 100% in the luminance range [7500, 32000]. Additive Color Balance is not applied at pixel values less than 6000 = 7500 – 1500 or greater than 33500 = 32000 + 1500. Additive Color Balance is applied from 0% to 100% as pixel values increase from 6000 to 7500 and as pixel value decrease from 33500 to 32000.

The *Min Apply* and *Max Apply* values can be set by a left click on an image. To select *Min Apply* or *Max Apply* using the mouse check the box to the left of *Min Apply* or *Max Apply* then click on the image.

The *Apply To Level* list box is used to set the luminance range controls to preset *All Levels, Dark, Midtone,* or *Light*. The preset luminance range can then be modified by moving the *Min Apply, Max Apply,* or *Feather Range* sliders.

Preserve Luminance is available in RGB Mode only and automatically moves the other two colors in the opposite direct as the color slider being adjusted. Lab mode is best used for adjusting color with minimal shift in luminance.

Additive Color Balance does not have hue and saturation range selection built in but a mask can be used to select a hue, saturation, and luminance range. Follow these steps to create and use a hue, saturation, and luminance range mask with Additive Color Balance.
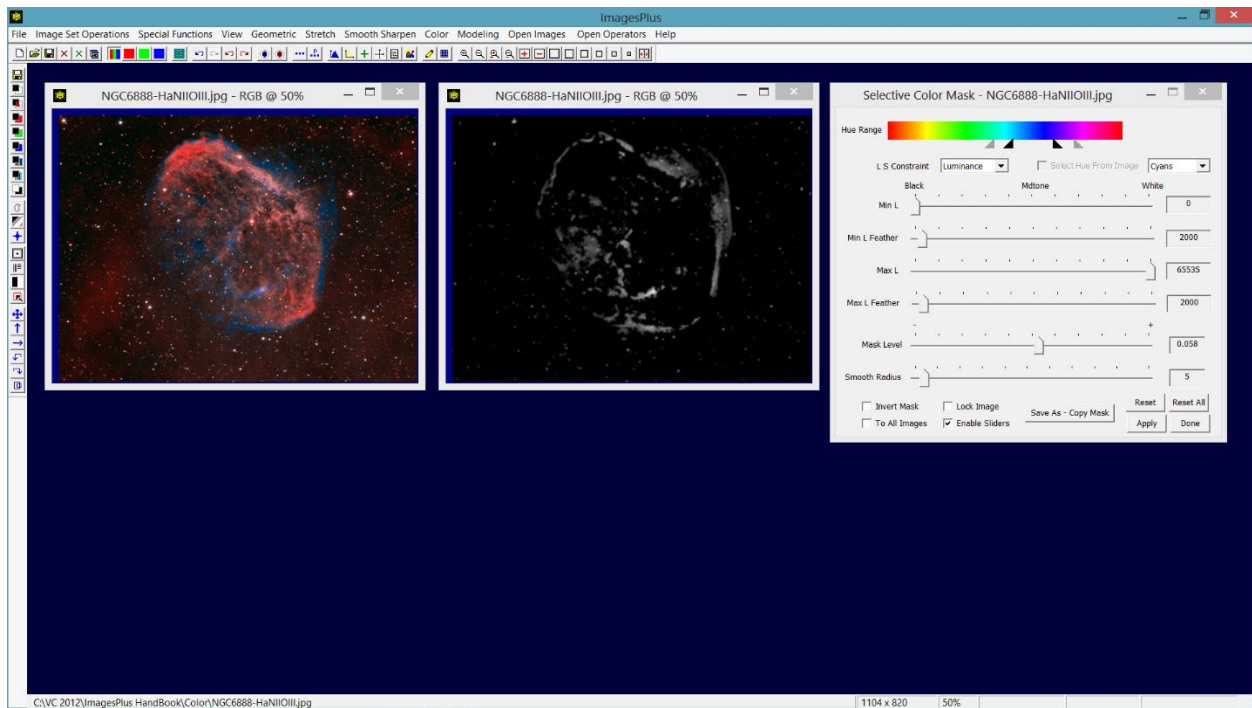

Figure 28 Use the Selective Color Mask tool on the left vertical tool bar is used to create a smoothed hue, saturation, and luminance range mask. Press the Save As – Copy Mask button on the Selective Color Mask tool to name and save the color mask as the current mask.
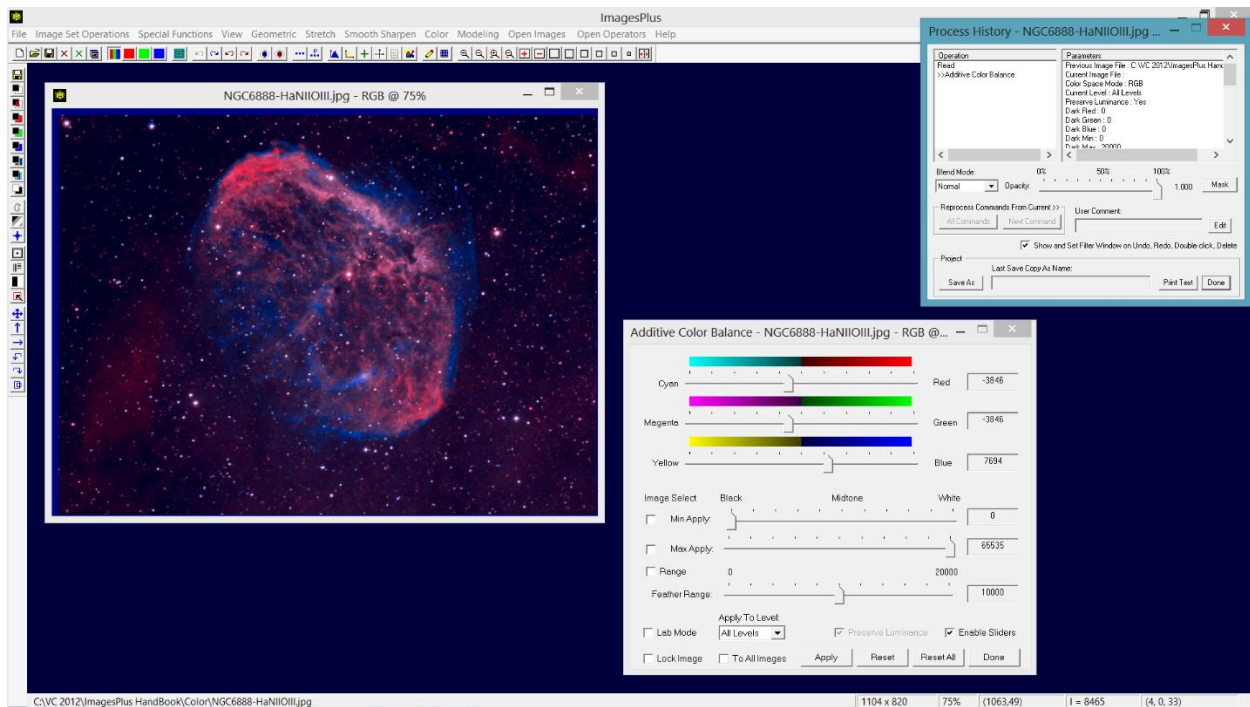
Figure 29 Apply Additive Color Balance to a color image to create the new adjustment layer in the Process History window that tracks adjustment layers. Without a mask Additive Color Balance is applied to every pixel of the image in the luminance range as shown above. To assign the mask open the Process History window using the top horizontal toolbar.
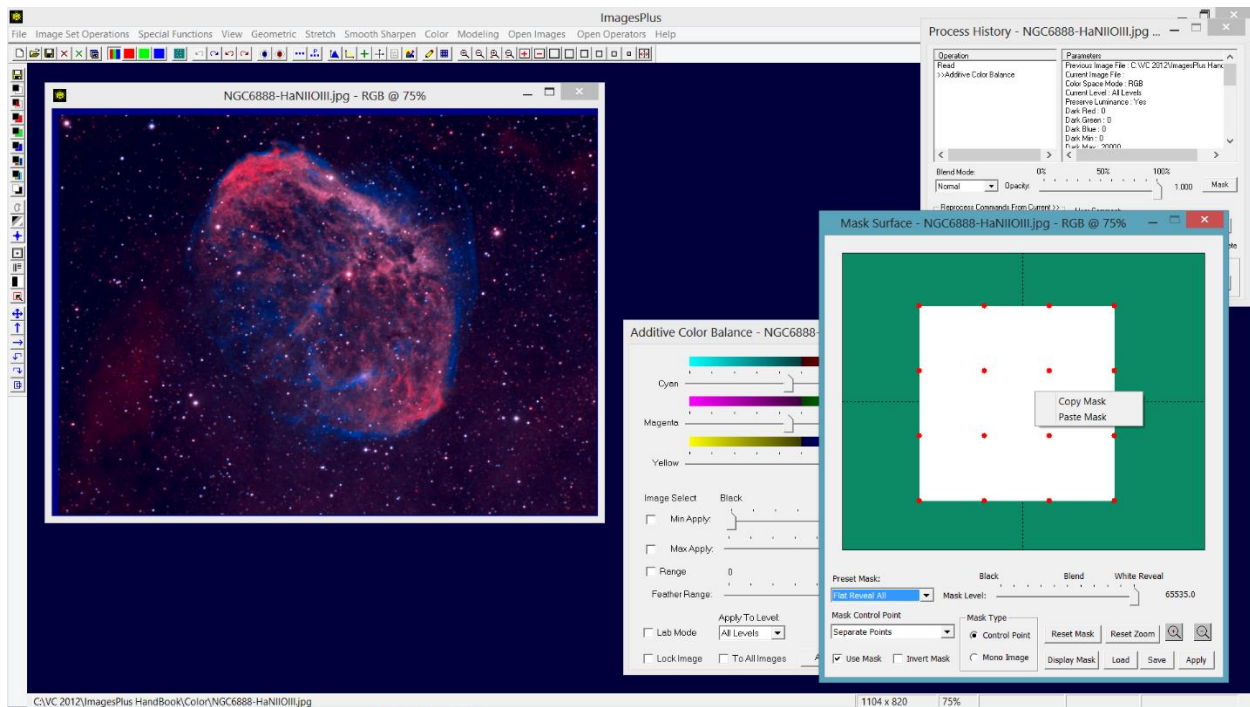
Figure 30 Press the Mask button on Process History to open the Mask Surface window. Right-click on the white rectangle in the Mask Surface window and select Paste Mask to assign the blue mask created and saved using the Selective Color Mask tool to the Additive Color Balance adjustment layer.
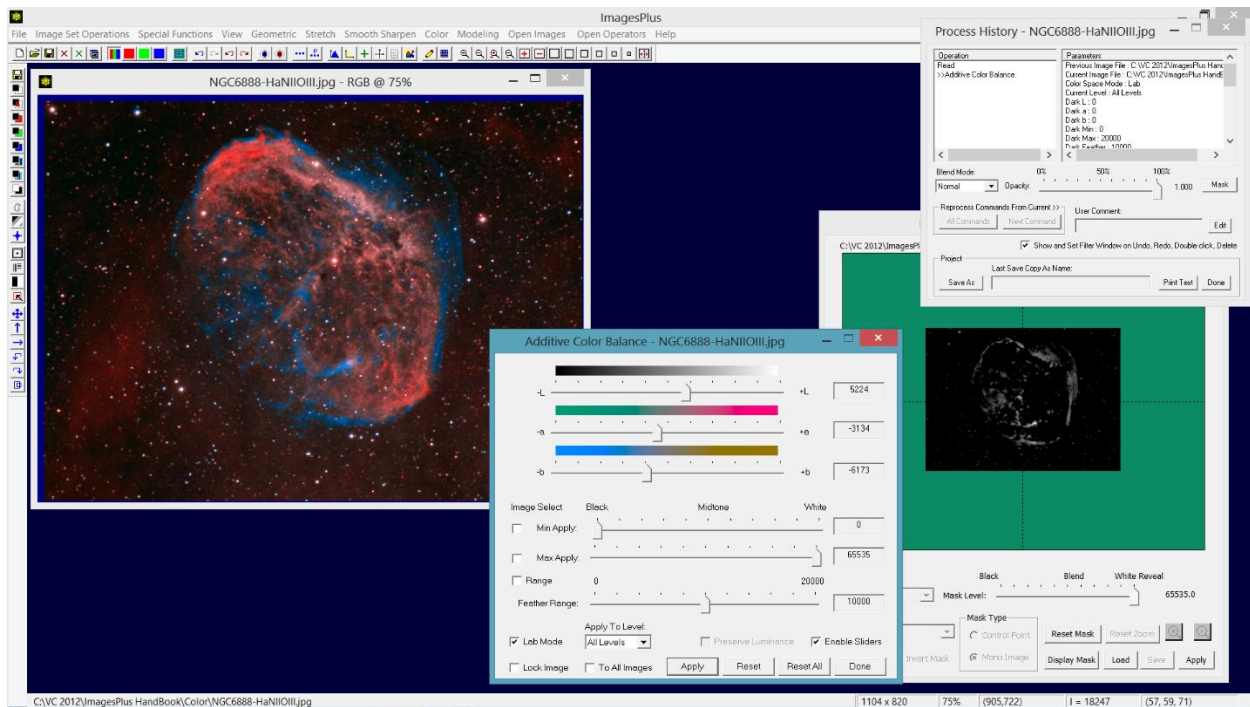
Figure 31 The mask restricts Additive Color Balance to the blue areas of the mask. Adjust the color and luminance controls of Additive Color Balance in RGB mode or Lab Mode. Blend mode and opacity of the Additive Color Balance adjustment layer are set using the *Blend Mode* and *Opacity* controls on the Process History window. Also see the mask tools section of the Layers, Blend Modes, Opacity, and Mask chapter of the ImagesPlus concepts and user manual for additional information about creating and using masks.

If *Lock Image* is checked when the tool is applied to an image then the tool will always be applied to the same image until the image is closed or *Lock Image* is unchecked. This option is used to apply the tool to the same image without selecting the image when multiple images are open.

If *Tool All Images* is checked then the tool will be applied to all open images that are compatible with the tool.

Enable Sliders is used to control the automatic application of the tool. If checked then the tool will be applied after each change in a sliders. If you want to adjust multiple sliders before the tool is applied then uncheck *Enable Sliders,* adjust the controls then press *Apply*.

Reset is used to return the color sliders to their default position of no change in Lab Mode or RGB mode. *Reset All* is used to return all controls to their default position of no change in Lab mode and RGB mode. *Apply* is used to apply the current setting to the current image. Press *Done* or the X at the top right of the tool to close the tool.

Selective HSL Color Balance

The Selective HSL Color Balance tool is used to scale red, green, and blue in a hue, saturation, and luminance range. The hue, saturation, and luminance range can be selected from the preset values in the *Color* and *Apply To Level* list or selected from the image using the mouse.
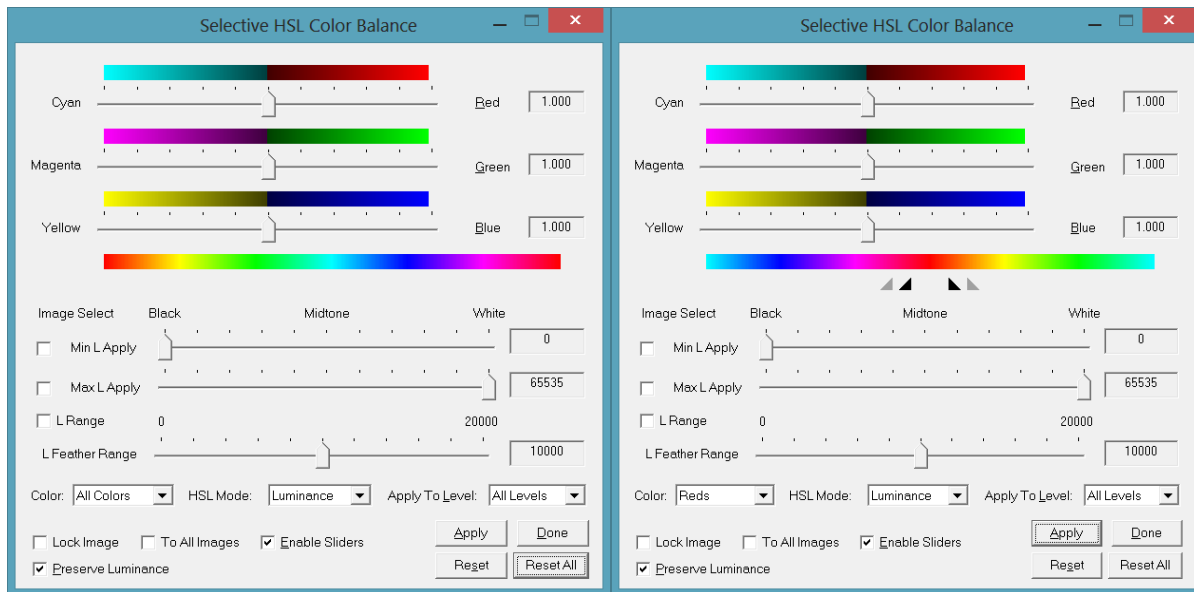
Hue Range Selection The color spectrum bar in the middle of the tool is used to define the hue range. If *All Colors* is selected as the hue range in the *Color* list then no hue range triangles appear under the color spectrum bar as shown by the image above on the left. In this case Selective HSL Color Balance will be applied to all pixels of an image the fall within the feathered luminance and feathered saturation range specified by *Min Apply, Max Apply, and Feather* Range. If a hue range has been selected using the *Color* list or the mouse then hue range triangles are displayed under the color spectrum bar as shown by the above image on the right. The two inner black triangles define the hue range where the Selective HSL Color Balance tool is applied at 100% opacity. The gray triangles on either side of the black hue range triangles define the hue feather size. The triangles are moved using the mouse to refine the hue range and feather size.

To select a hue range from an image choose *Select Hue* from the *HSL Mode* list. Three hue selection options will appear under *Image Select*. Check *Hue Range* to select a hue range with no luminance and saturation restriction*, HL Range* to select a hue and luminance range with no saturation restriction, or *HSL Range* to select a hue, saturation, and luminance range then left click on the image. The hue range will be set using the triangles under the color spectrum bar. The luminance range will be set using the *Min L Apply, Max L Apply,* and *L Feather Range* sliders. The saturation range will be set using the *Min S Apply, Max S Apply,* and S *Feather Range* sliders. The *HSL Mode* list is used to set the sliders to *Luminance* or *Saturation* mode so that the values can be modified. See Figure 32.

Select Luminance in the HSL Mode list to set the sliders to luminance mode. The *Min L Apply* and *Max L Apply* sliders define the luminance range [min apply value, max apply value] where Selective HSL Color Balance is applied at 100% opacity. The *L Feather Range* slider is used to define the feather radius for pixel values less than the min L apply value and greater than the max L apply value. For example, suppose min L apply is set to 7500 and max L apply is set to 32000 with L feather radius of 1500 then Selective HSL Color Balance is applied at 100% in the luminance range [7500, 32000]. Selective HSL Color Balance is not applied at pixel values less than 6000 = 7500 – 1500 or greater than 33500 = 32000 + 1500. Selective HSL Color Balance is applied from 0% to 100% as pixel values increase from 6000 to 7500 and as pixel value decrease from 33500 to 32000.
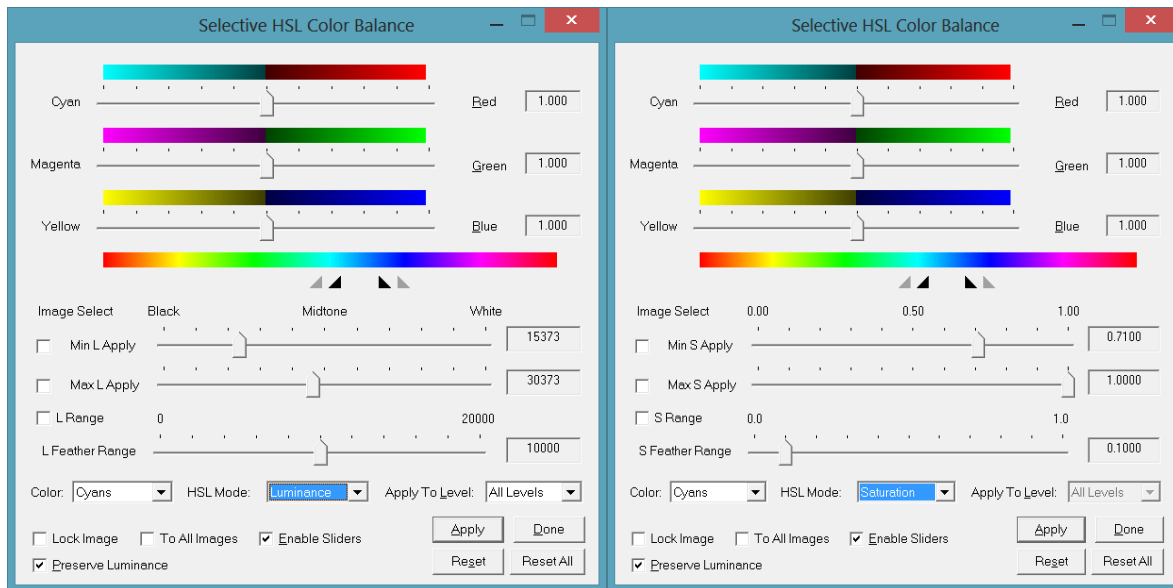
Figure 32 Luminance mode is shown in the left with saturation mode on the right.

The *Min L Apply* and *Max L Apply* values in Figure 32 can be set by a left click on an image. To select *Min L Apply* or *Max L Apply* using the mouse check the box to the left of *Min L Apply* or *Max L Apply* then click on the image. Check the *L Range* bow then left click on an image to set both *Min L Apply* and *Max L Apply.*

The *Apply To Level* list can also be used to set the luminance range controls to preset *All Levels, Dark, Mid-tone,* or *Light*. The preset luminance range can then be modified by moving the *Min L Apply, Max L Apply,* or L *Feather Range* sliders.

Select Saturation in the HSL Mode list to set the sliders to saturation mode. The *Min S Apply* and *Max S Apply* sliders define the saturation range [min apply value, max apply value] where Selective HSL Color Balance is applied at 100% opacity. The *S Feather Range* slider is used to define the feather radius for pixel values with saturation less than the min S apply value and greater than the max S apply value. For example, suppose min S apply is set to 0.25 and max S apply is set to 0.75 with S feather radius of 0.20 then Selective HSL Color Balance is applied at 100% in the saturation range [0.25, 0.75]. Selective HSL Color Balance is not applied at pixel values with saturation less than 0.05 = 0.25 – 0.20 or greater than 0.95 = 0.75 + 0.20. Selective HSL Color Balance is applied from 0% to 100% as pixel saturation values increase from 0.05 to 0.25 and as pixel saturation value decrease from 0.95 to 0.75.

The *Min S Apply* and *Max S Apply* values in Figure 32 can be set by a left click on an image. To select *Min S Apply* or *Max S Apply* using the mouse check the box to the left of *Min S Apply* or *Max S Apply* then click on the image. Check the S *Range* box then left click on an image to set both *Min S Apply* and *Max S Apply.*

Note that a pixel must satisfy the feathered hue, feathered luminance, and feathered saturation range constraints otherwise Selective HSL Color Balance will not be applied at the pixel.

Selective HSL Color Balance can be used with a mask using the same steps as shown above in the Additive Color Balance tool and also in the mask tools section of the Layers, Blend Modes, Opacity, and Mask chapter of the ImagesPlus concepts and user manual.

A mask created using the Selective Color Mask tool has all of the hue, saturation, and luminance selection contained in the Selective HSL Color Balance tool and also allows additional processing like smoothing, curves, and painting to help refine the area where the mask is applied. The Custom Luminance Mask and other masks tool offer additional options for making masks.

Preserve Luminance automatically moves the other two colors in the opposite direct as the color slider being adjusted.

If *Lock Image* is checked when the tool is applied to an image then the tool will always be applied to the same image until the image is closed or *Lock Image* is unchecked. This option is used to apply the tool to the same image without selecting the image when multiple images are open.

If *Tool All Images* is checked then the tool will be applied to all open images that are compatible with the tool.

Enable Sliders is used to control the automatic application of the tool. If checked then the tool will be applied after each change in a sliders or triangle. If you want to adjust multiple controls before the tool is applied then uncheck *Enable Sliders,* adjust the controls then press *Apply*.

Reset is used to return the hue, saturation, and luminance range for a given color in the *Color* list to their default position of no change.

Reset All is used to return all controls for all selections in the *Color* list to their default position of no change.

Apply is used to apply the current setting to the current image.

Press *Done* or the X at the top right of the tool to close the tool.

Hue-Saturation-Luminance

The Hue-Saturation-Luminance tool is used to rotate hue and adjust luminance and saturation in RGB mode or Lab mode. Only a hue range can be selected using the Hue-Saturation-Luminance tool. If a hue, saturation, and luminance range is required then a selective HSL color mask can be assigned using the same steps as shown above with the Additive Color Balance tool.

Hue selection and rotation requires two color spectrum bars. The *Map From* color spectrum bar does not change and is used as a color reference. The *Map To* color spectrum bar can be rotated using the *Hue* slider and also has black and gray triangles that define a hue range as described above in the Selective HSL Color Balance tool. Saturation is increased or decreased in the selected hue range by moving the saturation slider to the right or left, respectively. Luminance is increased or decreased in the selected hue range by moving the luminance slider to the right or left, respectively. See Figure 33 for an example of hue rotation of all colors and Figure 34 for an example of hue rotation in a hue range with luminance and saturation adjustment.
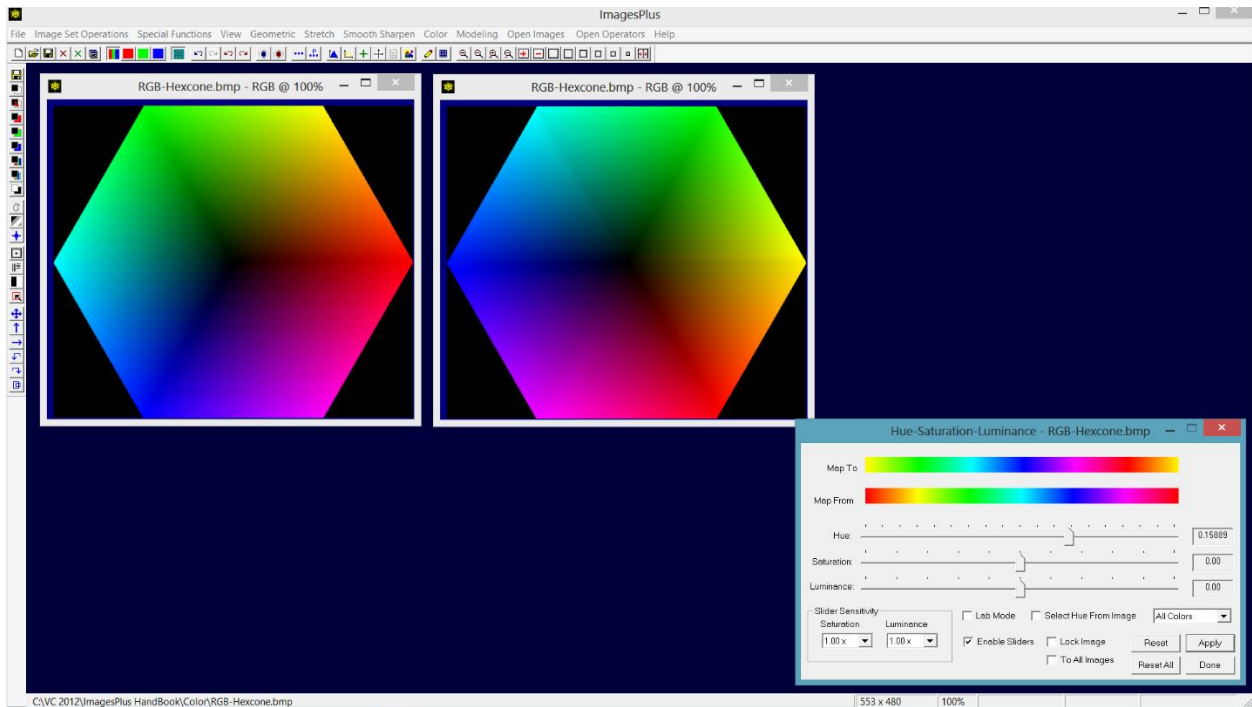
Figure 33 The *Hue* slider is moved to rotate all hues. The hue in the *Map From* spectrum bar is mapped to the hue straight above it in the *Map To* spectrum bar. In this case all hues are rotated and all pixels are effected by the *Luminance* and *Saturation* sliders.
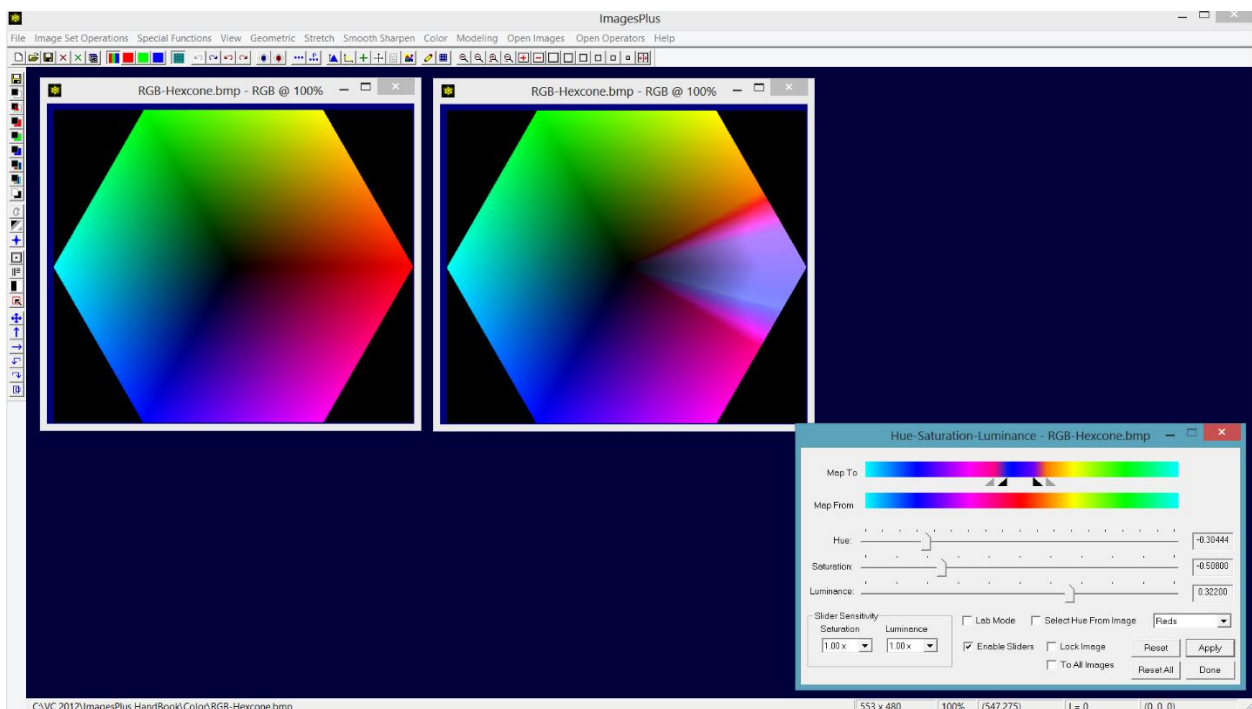

Figure 34 A hue range can be selected using the *Color* list box or from an image. Check the *Select Hue From Image* box then left click on an image to set the hue range triangles. Move the *Hue* slider to the color on the *Map From* spectrum bar to rotate the selected hue. Saturation is decreased and luminance increased in the rotated red hue range at top center.
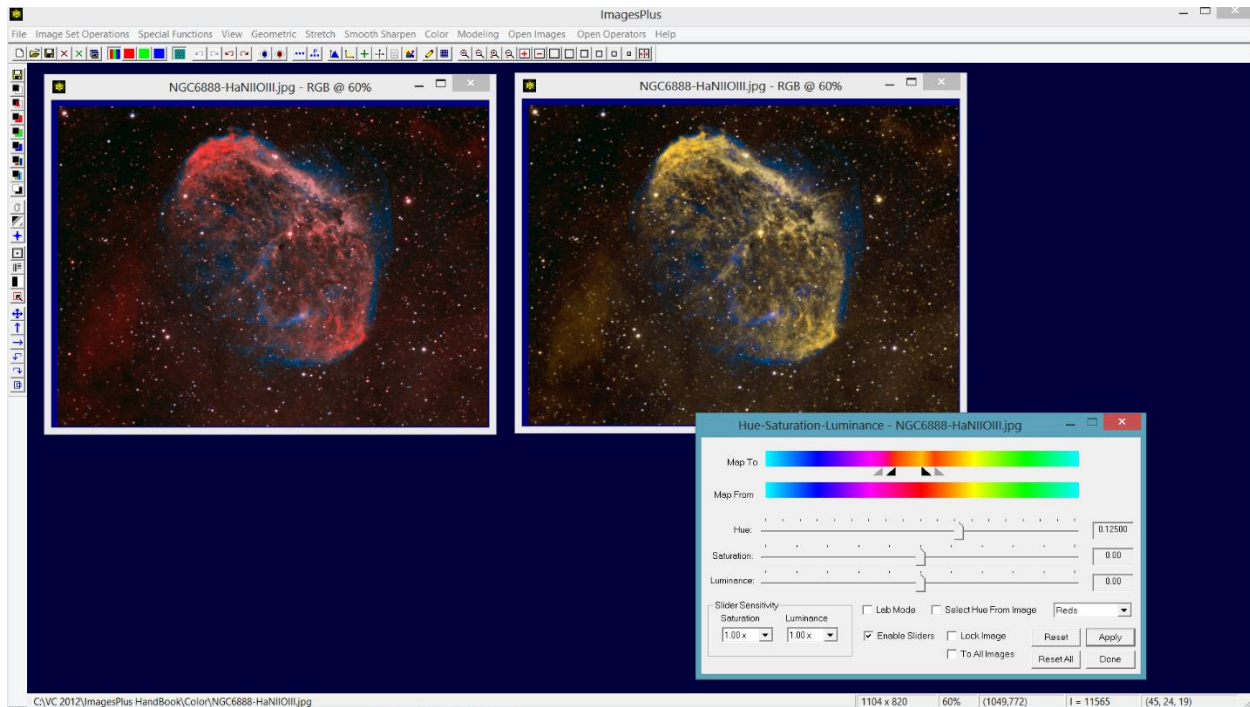
Figure 35 The reds in the image on the left are selected by checking the *Select Hue From Image* box then left-click on the red at the top of the Crescent nebula. The *Hue* slider is moved to the right to rotate red to yellow in the red hue range. Blue is outside of the red hue range so blue, cyan, and green are not changed by the hue rotation, saturation, or luminance sliders.

Check *Lab Mode* to switch from RGB to Lab mode.

If *Lock Image* is checked when the tool is applied to an image then the tool will always be applied to the same image until the image is closed or *Lock Image* is unchecked. This option is used to apply the tool to the same image without selecting the image when multiple images are open.

If *Tool All Images* is checked then the tool will be applied to all open images that are compatible with the tool.

Enable Sliders is used to control the automatic application of the tool. If checked then the tool will be applied after each change in a slider or triangle. If you want to adjust multiple controls before the tool is applied then uncheck *Enable Sliders,* adjust the controls, then press *Apply*.

Reset is used to return the hue, saturation, and luminance range for a given color in the *Color* list to their default position of no change.

Reset All is used to return all controls for all selections in the *Color* list to their default position of no change.

Apply is used to apply the current setting to the current image.

Press *Done* or the X at the top right of the tool to close the tool.

HSL Micro Curves

The HSL Micro Curves tool is used to apply a curve to a hue, saturation, and luminance range. The selection of the HSL range is the same as described above for the Select HSL Color Balance tool. A pixel must satisfy the feathered hue, feathered luminance, and feathered saturation range constraints otherwise HSL Micro Curves will not be applied at the pixel. HSL Micro Curves can also be used with a mask.

A mask created using the Selective Color Mask tool has all of the hue, saturation, and luminance selection contained in the HSL Micro Curves tool and also allows additional processing like smoothing, curves, and painting to help refine the area where the mask is applied. The Custom Luminance Mask and other masks tool described in the Layers, Blend Modes, Opacity, & Masks chapter offer additional options for making masks.

If no hue range is selected then the color spectrum bar will have no black and gray triangles under it and the min max luminance and saturation controls will be applied to all colors.

In order to select a hue range from an image using the HSL selection tools built into HSL Micro Curves follow these steps.
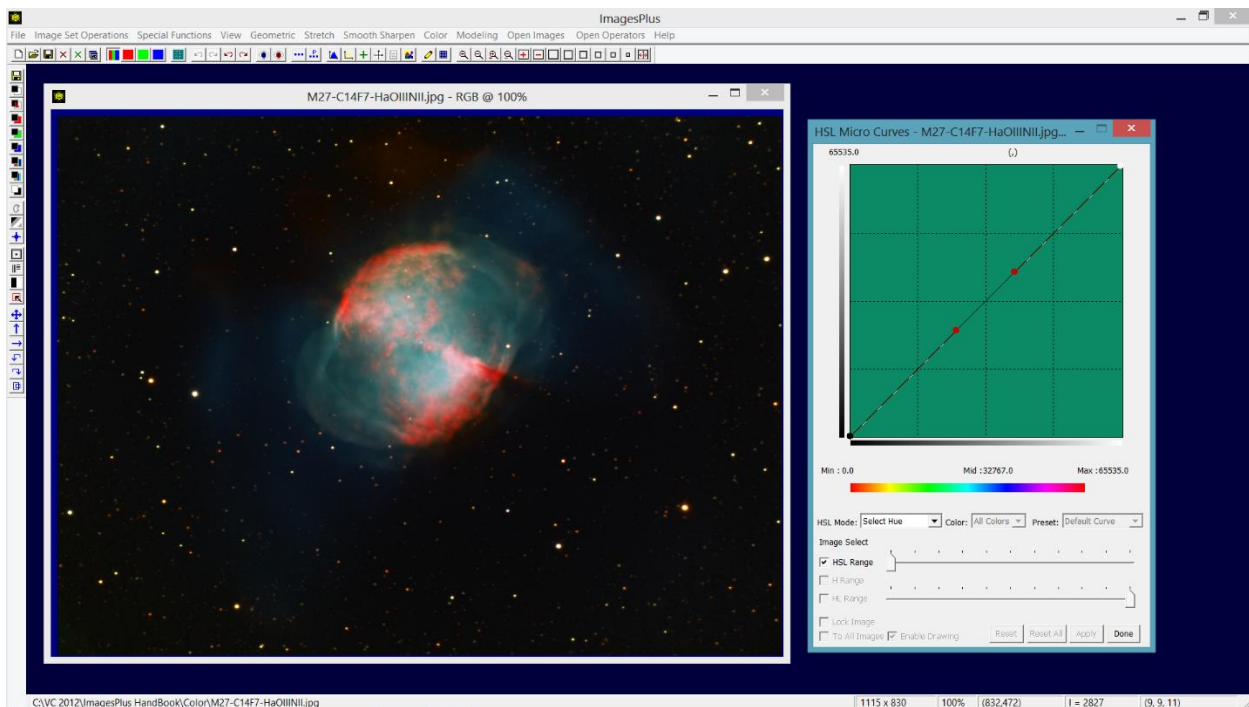

Figure 36 In the *HSL Mode* list choose *Select Hue.* Check the *Hue Range* box to select only a hue range at a point in an image and leave the luminance and saturation constraints set to all values. Check the *HL Range* box to select both a hue range and luminance range and leave the saturation constraint set to all values. Check the *HSL Range* box to select a hue, saturation, and luminance range at a point in an image. In the above image HSL is checked so that the saturation of the bright pink area in the center of M27 can be increased.
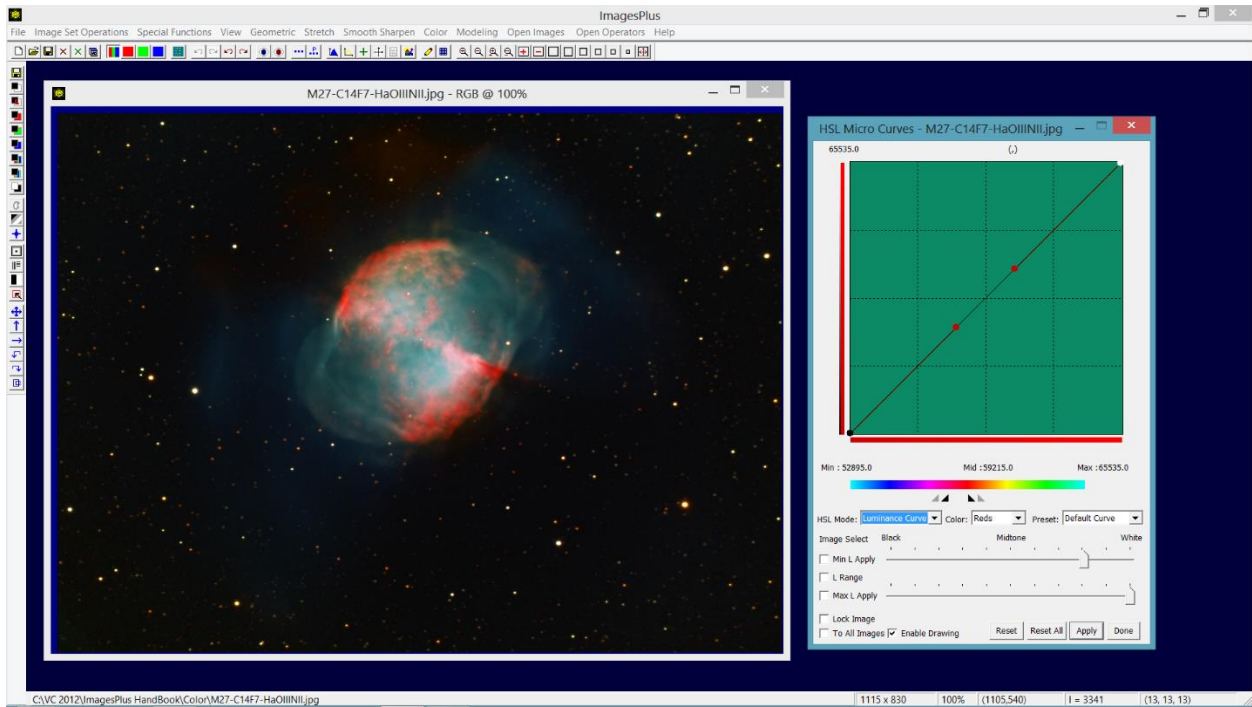
Figure 37 Left click on the bright pink area with low saturation in the center of M27 to select it as the HSL range. The hue range triangles now mark a red hue range and the luminance range sliders are set to the bright range of the pink area.
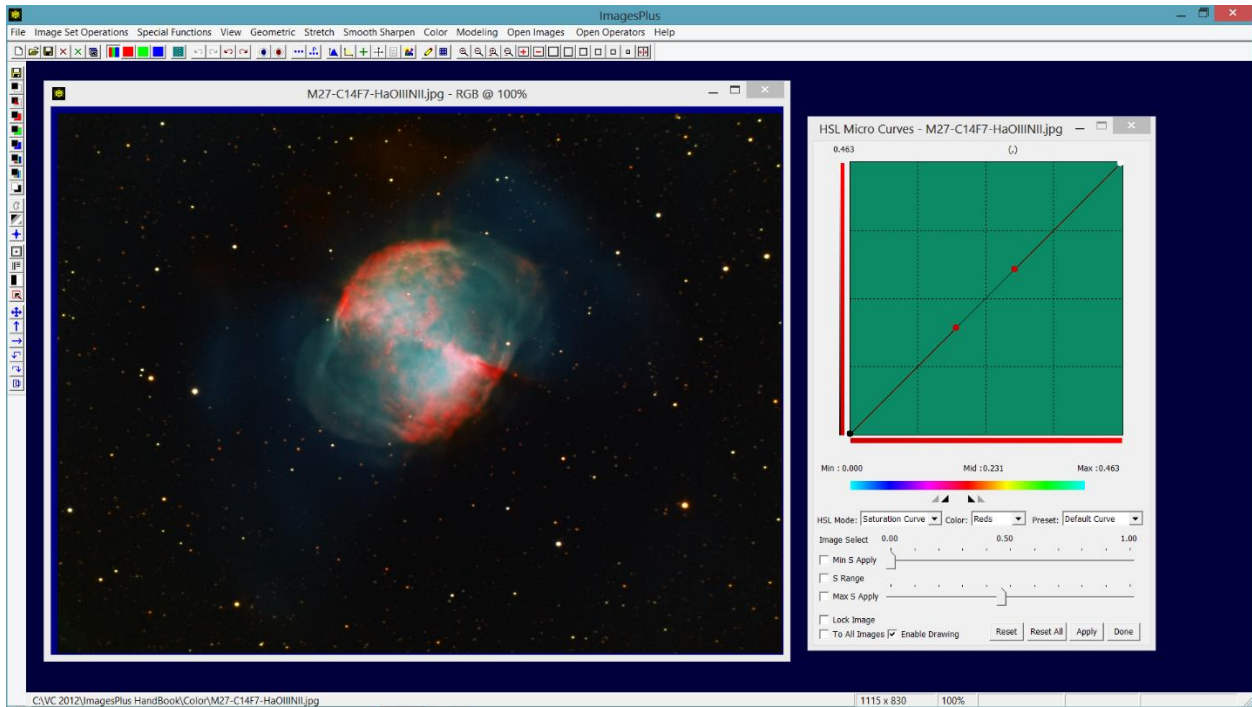

Figure 38 Set *HSL Mode* to Saturation Curve to see the saturation constraint of the bright pink area with low saturation. The saturation *Min S Apply* and *Max S Apply* are set to the low saturation range of the pink area.
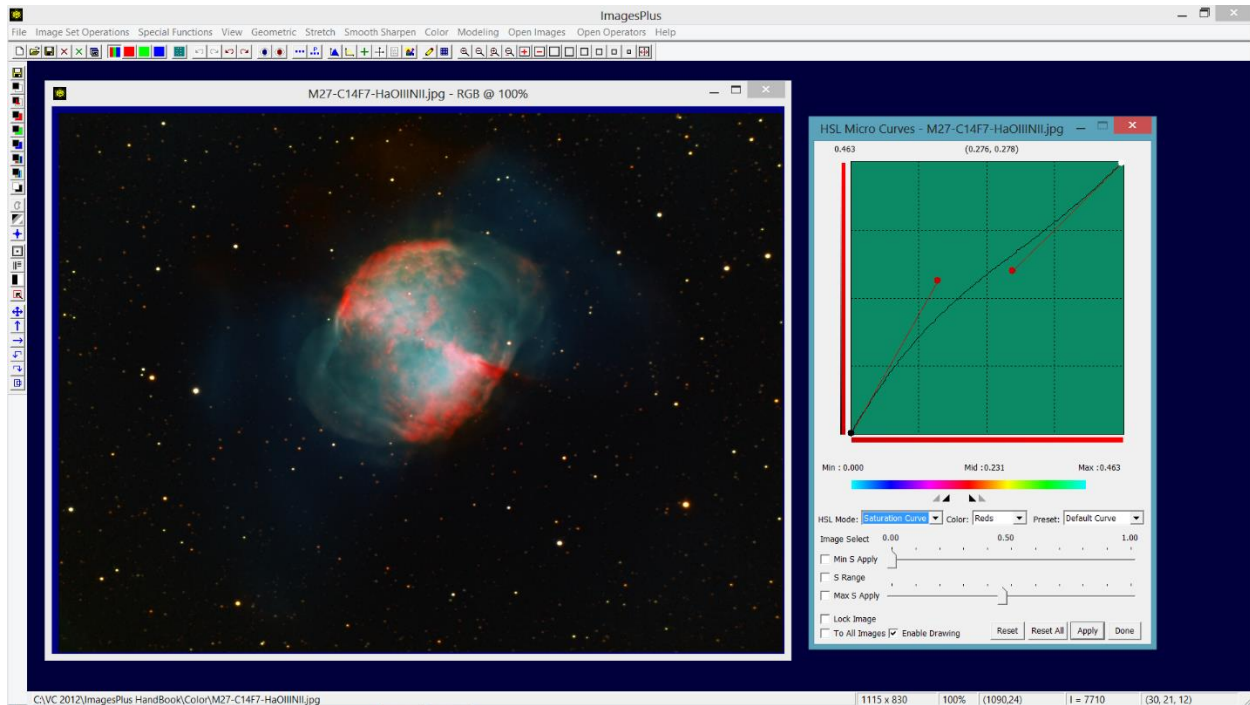
Figure 39 Increase the saturation in the low saturation pink area using the curve. Left click and drag a red control dot of the curve to change the shape of the curve. To change the position of the lowest saturation shown by the black dot left click on the left vertical side of the green grid above the black dot. The position of the highest saturation marked by the white dot can be changed by a left-click on the right vertical side of the green grid.

The HSL range built into the HSL Micro Curves tool works well for small changes to an image. The boundary of the HSL range can become difficult to blend into the image is a large luminance or saturation change is applied. In this case use a selective color mask with HSL Micro Curves as shown below for additional control of the HSL range.
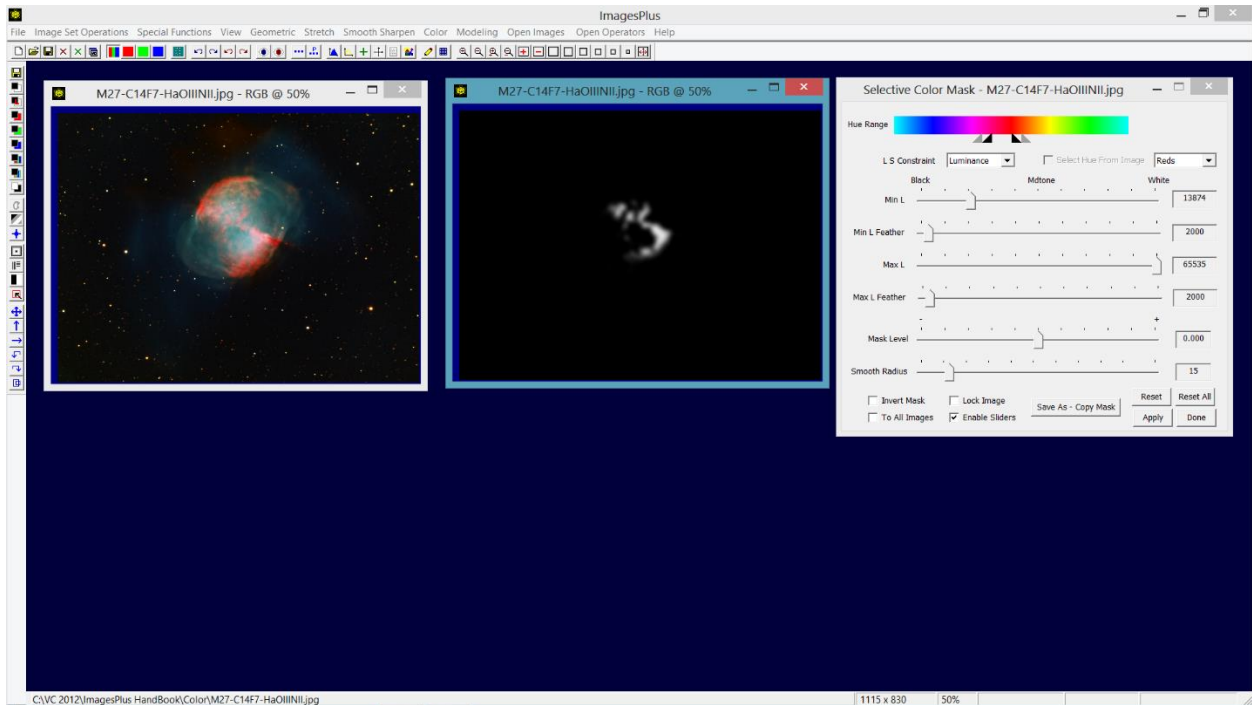
Figure 40 The Selective Color Mask is used create a smoothed mask of the low saturation pink area in the center of M27. The Save As – Copy Mask button is used to name the mask and set it as the current system mask.
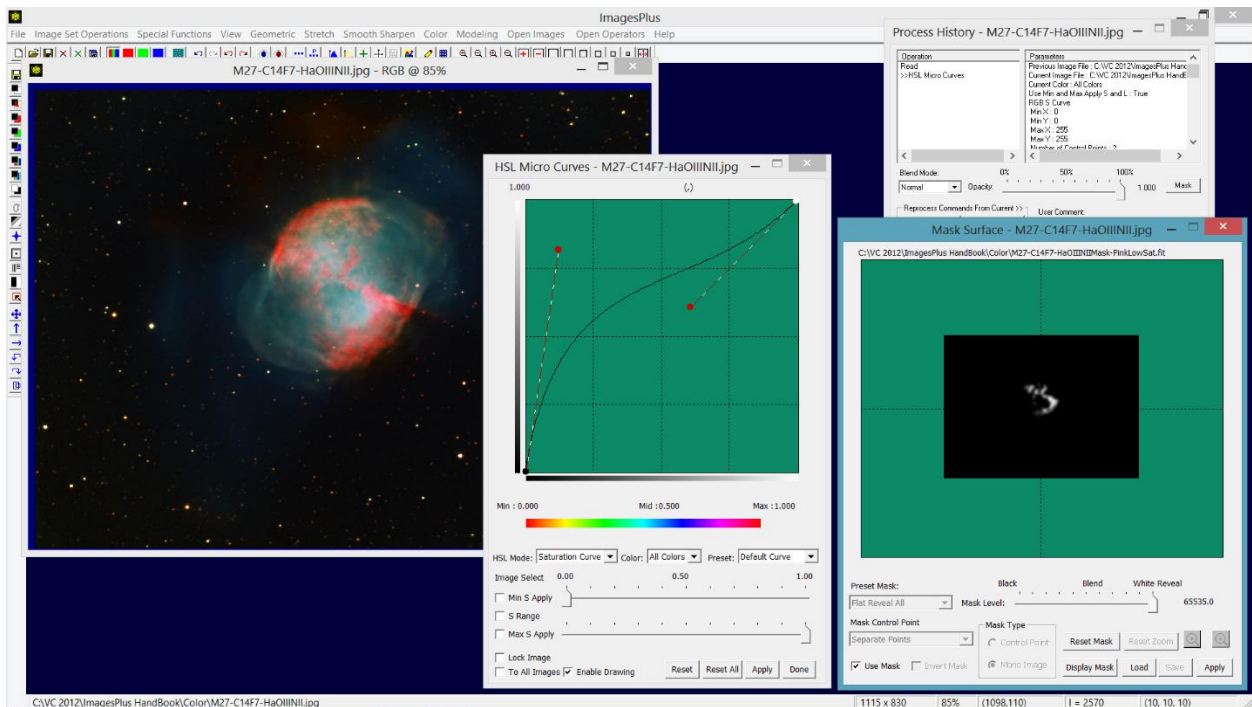

Figure 41 The low saturation pink mask is used with HSL Micro Curves to perform a larger increase in saturation since the mask has been smoothed. The mask is assigned to HSL Micro Curves as described above in the Additive Color Balance tool section.

If *Lock Image* is checked when the tool is applied to an image then the tool will always be applied to the same image until the image is closed or *Lock Image* is unchecked. This option is used to apply the tool to the same image without selecting the image when multiple images are open.

If *Tool All Images* is checked then the tool will be applied to all open images that are compatible with the tool.

Enable Drawing is used to control the automatic application of the tool. If checked then the tool will be applied after each change in a curve or sliders. If you want to adjust multiple sliders or curves before the tool is applied then uncheck *Enable Sliders,* adjust the controls and press *Apply*.

Reset is used to return the curves, hue, saturation, and luminance range for a given color in the *Color* list to their default position of no change.

Reset All is used to return all controls for all selections in the *Color* list to their default position of no change.

Apply is used to apply the current setting to the current image.

Press *Done* or the X at the top right of the tool to close the tool.

Image files used in this chapter are available at Color Models and Color Tools Image Files.

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