Application Note
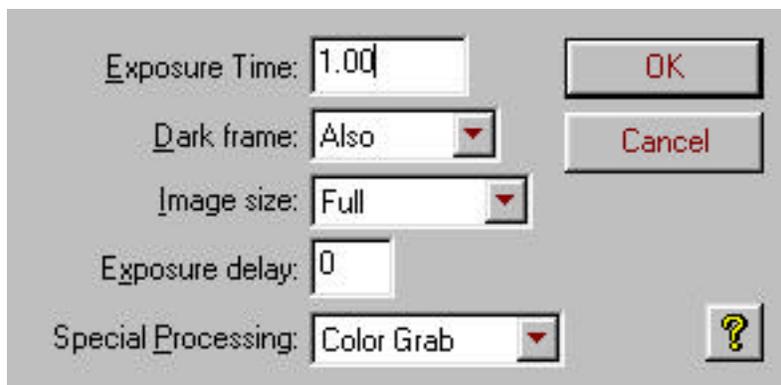Quick Guide to Color Imaging with CCDOPS
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While CCD cameras are inherently monochrome (black & white) devices there exists an easy way to obtain color images - the RGB imaging technique. An RGB exposure consists of three individual images exposed through Red, Green and Blue filters which are eventually combined into a single composite color image. One limitation of astrophotography with traditional color film emulsions is that the light sensitivity to different wavelengths (colors) of light can vary tremendously, causing unusual color shifts to occur in the final picture. However, tricolor CCD exposures can be carefully calibrated to achieve a very realistic color balance and show faint deep-sky objects as they would actually appear – if only we had eyes as sensitive as a CCD detector!

CCDOPS makes acquiring RGB images very easy. This tutorial was written specifically for the ST-237 / CFW-5C color filter wheel, using CCDOPS version 5.12 for camera control, but the same general instructions apply when using any of the color capable SBIG CCD cameras with CCDOPS software.
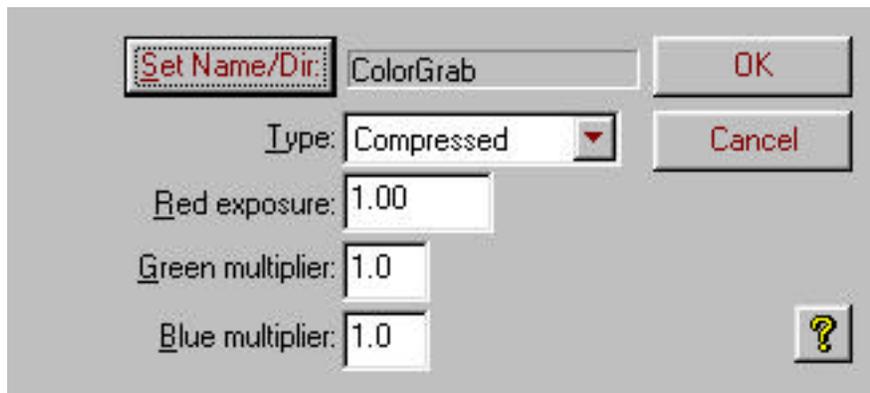
Step 1- Using Color Grab to acquire the images:

CCDOPS makes acquiring color images easy. The Color Grab function automatically takes all three exposures and adds the correct extensions. Here's how to use this function:
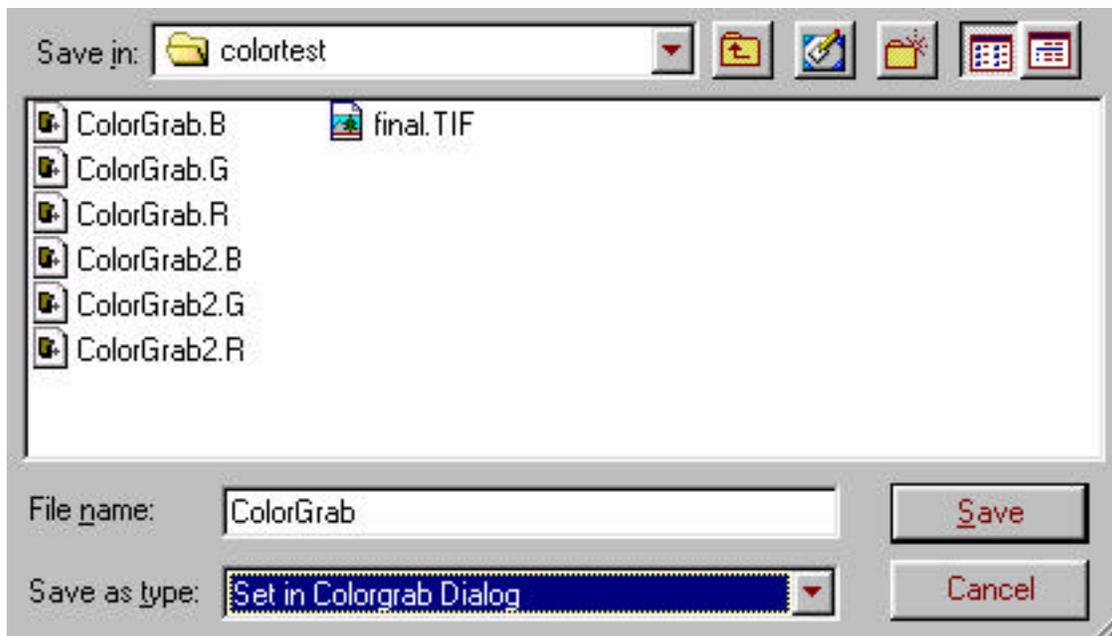
Start up CCDOPS and connect your camera. Select Camera → Grab from the top menu bar or "Grab" from the icon bar. The Grab dialog box looks like this:

Set your exposure time, dark frame options and image size like usual. For your first attempt I suggest settings like those shown above. For learning how the color process works feel free to experiment without having the camera attached to a telescope –the final image will look like a color dark frame instead of an astronomical image. Set the "Special Processing" menu to "Color Grab" and click on the "Ok" button. The next dialog box that appears looks like this:
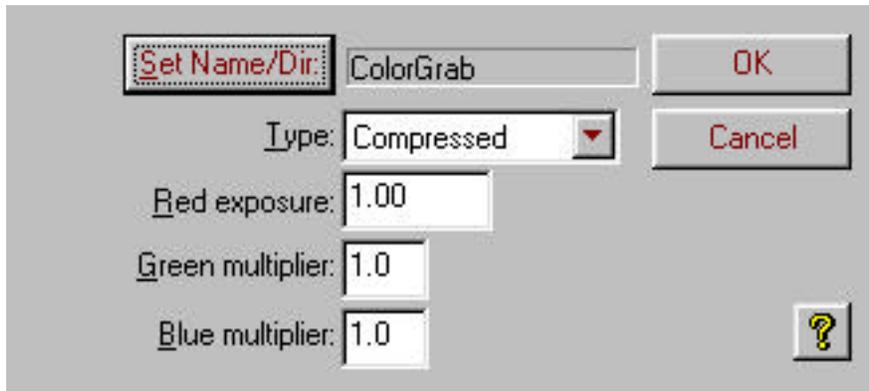
The "Set Name/Dir" button lets you specify where you want to store all three images that will be taken. Click on that button now:

The new window should look familiar; it's a standard Windows file save dialog box. Enter a unique file name that will be used for each of the three images – "ColorGrab" is the default. Note that when CCDOPS takes the exposures it automatically adds the proper color extension to identify the different images. ColorGrab.B is a blue-filtered exposure, for example. Use the "Save in" drop-down menu at the top of the window to specify exactly where you want to save the files. It's a good idea to create a directory for each different object you are imaging, this makes it easier to find the correct files later when you perform the RGB combine. Click on "Save" when you are done setting the directory path and file names.

Look at the "Color Grab" dialog box again:

The "Type" menu allows you to set the file type used when saving the images. The choices are SBIG Uncompressed, SBIG Compressed, TIFF and FITS. Use whichever one you are most comfortable with, and one of the SBIG file types if you don't have a preference.
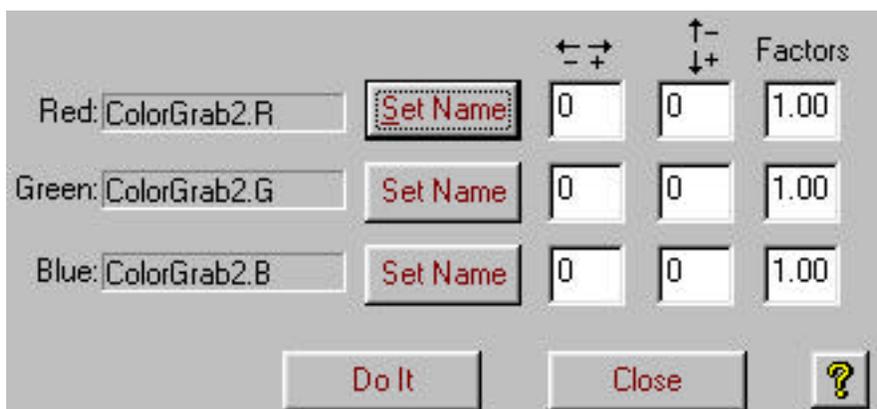
The Red, Green and Blue exposure multiplier boxes let you specify custom exposure ratios for each of the color images. CCDs do have different sensitivities to different wavelengths of light, and sometime it is necessary to expose for a longer (or shorter) time in one particular color to avoid a color imbalance in the final image. This is outside the scope of this introductory tutorial, just know that exposures can be adjusted to achieve very carefully calibrated true-color results. The SBIG user group is an excellent source of advice on this topic when you are ready to dig deeper into RGB imaging. For now, just know that the color filters used in the CFW-5C are carefully chosen to make the default 1 : 1 :1 color ratios produce excellent results over a wide range of exposures.

Click on "Ok" to start the exposure sequence. The software will take all three images and save them to disk automatically. The last image will remain onscreen when the Color Grab is finished.

Step 2 – RGB Combining:

You now have all three images exposed and saved to disk. Note that the individual RGB images are NOT in color! They will still be greyscale images until you combine them into the final color image. Here's how to do that:

Go to the "Utility" menu and select "RGB Combine". It's the last item in the menu. This dialog box appears:

The "Set Name" buttons are pretty self-explanatory, click on them and navigate to the folder where you saved your three RGB files. One nice feature of CCDOPS if that when all three files are in the same directory and you select the Red image, CCDOPS automatically loads the other two images based on their .B or .G color extensions. If the file names don't match the Red image or the extensions are not present, you will have to manually select each of the three images. Click on "Do It" when you are done and the color image will appear!

Since the ST-237A is an unguided camera, when you are taking Color Grab images with your telescope there is a possibility that the image will drift slightly over the time it takes to expose all three images. The +/- correction boxes after each image selection line in the "RGB Combine" dialog box allow you to make single-pixel adjustments to each color frame so the final composite image is aligned perfectly.

Also present in the "RGB Combine" dialog box is a "Factor" setting where you can change the RGB combination ratios to achieve a better color balance. This is different from the adjustment in the exposure setup dialog boxes since it does not adjust the exposure times – think of this setting as being like the color balance control on a television or monitor. For example, if the final image has a strong green tinted sky background, try reducing the Green image factor slightly, or increase both the Blue and Red. These controls should be used sparingly to avoid drastically altering the color balance of the object you are imaging!

Note that you can make adjustments to any of the settings in this RGB Combine dialog box and keep clicking on "Do It" each time you want to update the combined image – the image is not "final" until you dismiss the dialog box by clicking on "Close".

Also note that you cannot perform many of the image processing steps from the Utility menu on a color image. Remember to perform any of these steps you think are necessary (i.e. kill warm pixels) on each of the individual .R, .G and .B frames before you combine them.

Save your color image by selecting File → Save As from the top menu. Note that the only choice of file type is TIFF – the nature of a combined color image prevents it from being saved in one of the astronomical image file types like SBIG or FITS. The TIFF file type is recognized by many of the popular image processing programs like Photoshop or Paint Shop Pro; these programs are excellent tools when you want to crop, resize and perform final adjustments to your color images.

I hope this tutorial has made it easier for you to take your first color images! RBG imaging is fairly basic, there are certainly more advanced techniques like LRGB that can give you much more detailed results – as always, the SBIG user group, popular astronomy magazines and books on CCD imaging are an excellent resource for advanced tips and techniques to improve your color imaging. Good luck, and have fun!