

### Objectives:

There are a number of objectives for this observing session.

- (a) To gain practice with a CCD camera and its use.
- (b) To obtain a number of images of a deep-sky object using both clear and color filters.
- (c) To gain practice with using a telescope under computer control.

### Introduction:

Before heading up to the observatory, re-read the instructions for using the telescopes that you were given at the start of the course, and the instructions you were given on the use of the CCD cameras. You should also decide which object you are going to image. For your first attempts at color imaging, nebulae and planetary nebulae at the best as they show strong colors. Choose one of the following objects to image.

Nebulae	Planetary Nebulae
M 20	M 27
M 16	M 57
M 17	NGC 6543
NGC 7023	NGC 6781
NGC 6888	NGC 6960
IC 5146	

On arrival at the observatory, begin the start-up procedures as described in the instructions are ready the telescopes for observations. While the telescope is booting up, plug in the power supply for the CCD camera and make sure it is switched on. Then open CCDSoft and establish a connection between the computer and the CCD. Once this is done, set the temperature to -30 and start the cooling. By now, the telescope should have finished booting up and you can complete the telescope start-up. Once you have the telescope set up and under computer control, remove the any eyepiece and install the CCD camera if it is not already attached.

While it is still twilight, you need to take a number of images of the sky for flat fielding. To do this, you need to aim the telescope towards the west to a patch of sky that is still quite bright. Take flats with each color filter, starting with the red filter and ending with the blue. Then take flats with the "Clear" filter.

To take your flats, take a 0.05 second test image and check the brightness of the image, particularly in the center. If the data values around the center are above 7000, then go ahead and take 10 images. If the data values around the center are below 7000, then increase the exposure time to 0.1 seconds.

Once you have taken 10 flat field images with each filter, take 10 dark frames of the same duration as your flat fields, and then 5 dark frames of the same duration that your object images will be. **Make sure you name the darks differently so that you can tell which are for the flat fields and which are for the star images.**

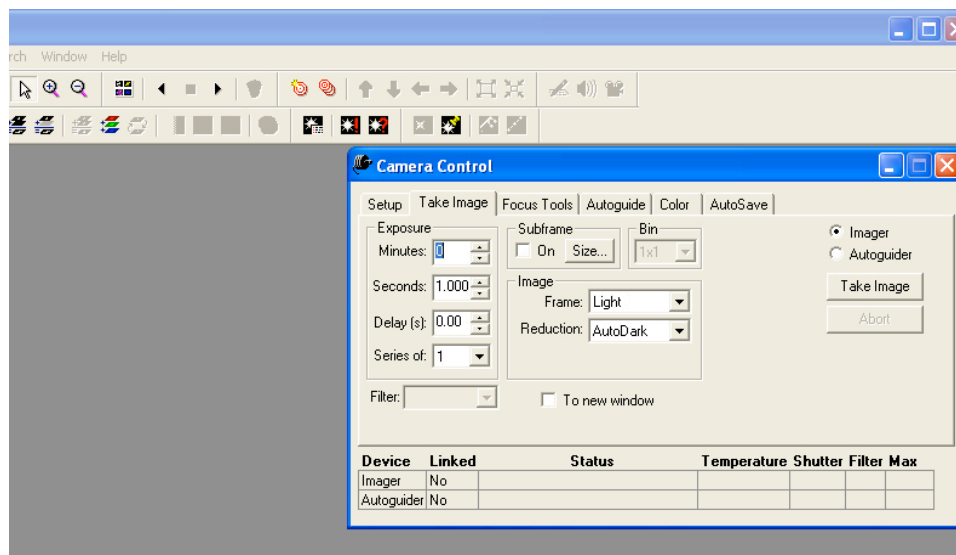
Now, move the telescope to your chosen object for tonight. Centre the object and make sure you have a star in the auto guider view as you did in the previous CCD imaging session.

**NOTE: The autoguider chip has a relatively poor response to blue light. So you will need to pick a fairly bright star as your guide star.**

Once you have everything set and are autoguiding, you are ready to start imaging your object. CCDSoft has a “**color**” menu that will allow you pre-set the settings for all of your images: exposure, filter, order, etc. This can be useful; however, I have found that this causes a big problem for the autoguider. The problem occurs when the system changes the filter on the CCD. When this happens, the brightness of the guide star changes, and the autoguider thinks that it has lost the guide star. It will then start moving the telescope, trying to find the star again, thus ruining the subsequent images. In view of this, I have found it to be much better just ignore the color tab and instead to use the “**Take Image**” tab as you did previously, and take images with each filter as a set, and then change the filter and restart the autoguider before starting the next set of images.

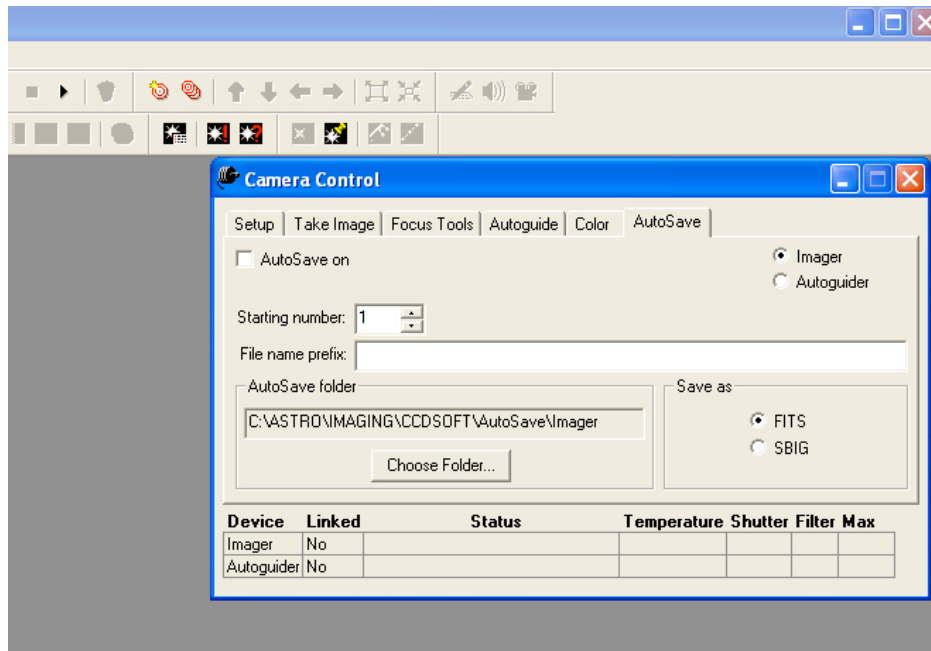
**The order in which you take your images will depend on whether your object is rising or setting. In the instructions below, I have assumed the object is setting. If it is rising you will need to reverse the procedure.**

Start by taking images with the “**Clear**” filter. To change the filter, go to the “**Image**” page on the “**Camera Control**” box.

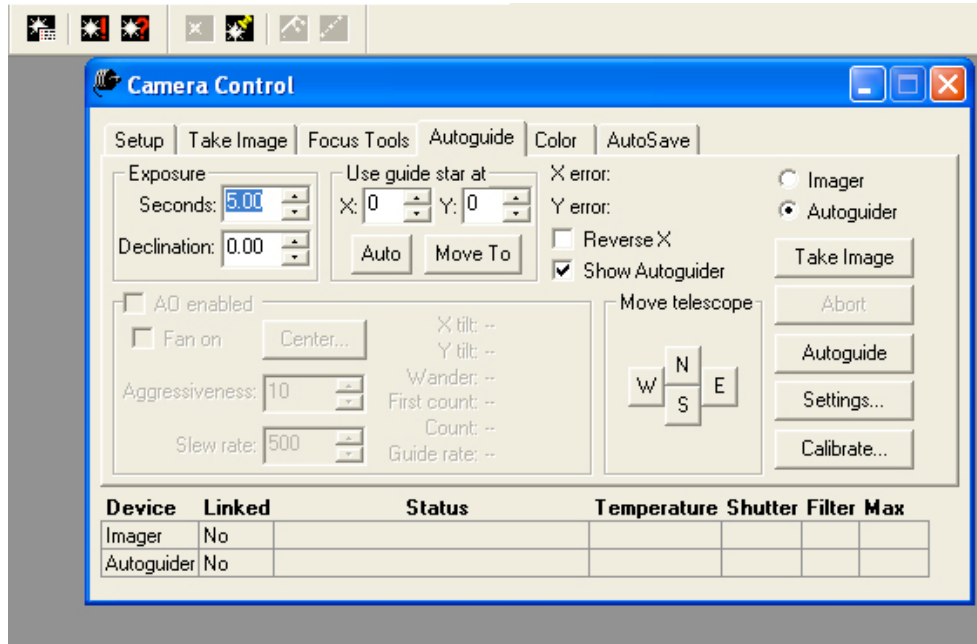


With the camera connected, the “**Filter**” window is active. Click on the arrow alongside this window and it will display a list of the filters. Click on “Clear” and the software will command the filter wheel to set to the clear filter. Now you can set your exposure times and the number of images to take.

Once you have done this, click on the “AutoSave” tab and set the directory where you want the images saved to, your name for the images, and the starting number. **MAKE SURE YOU TICK THE “AutoSave On” BOX!**



Now go to the autoguider by going to the “**Auto guide**” page and click on “**Take Image**”.



This will result in an autoguider image being displayed. Click on a bright star in the image, and then click on “**Autoguide**”. Now the autoguider will keep tracking the star. Move the resulting small image off to the bottom right of the screen where you can see it even when the main images start getting displayed.

With this done, go back to the “**Take Image**” page and start taking your images by clicking on the “**Take Image**” button. **Do not forget to record the details of each of the images you take in your log book!**

Once you have finished taking your “**Clear**” images. Go to the “**Autoguide**” page and “**Abort**” the autoguider. Then repeat the steps you took to take the “**Clear**” images, but this time, set the filter to “**Red**”. Then restart the autoguider and take your “**Red**” images. (Remember: there is no need to re-calibrate the autoguider!) **You will need to refocus at this point since the focus for the clear filter is usually slightly different from the other filters.** You can do this using the images from the autoguider while it is autoguiding. Once you are sure that the focus is correct, start taking a series of “red” images. **Make sure you reset the name of these images so you know which filter they were taken with!**

When these are done, “**Abort**” the autoguider once more, and then repeat the process with the filter set to “**Green**”. Finally, set the filter to “**Blue**” and take your blue filter images. Keep taking images for at least 90 minutes, or until 10:30pm, whichever comes later.

Once you have finished imaging your object, you can start shutting down the telescope. When you are finished with the dark frames, disconnect the CCD and close “CCDSOFT” and minimize “The Sky”. Then copy the images on to your memory stick.