Instrument User's Guide
SBIG: CCDOps 3.95

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(modeled after documentation
written by S. Slivan
for previous equipment)

Objective:
Describe how to use the SBIG camera as instrument on the WAO C14's (and 8"),
including focusing.

Prerequisites:
Familiarity with the basics of using the WAO C14's (and 8"). Power on, movement in
RA, DEC, finderscope, fine-motion controls, focus control, accessory kit.

Familiarity with the basics of using a Macintosh PC (Power on, desktop, pull-down
menus, finder, mouse, active and inactive windows).

1 Starting Up

1. Startup of shed computers
   • Turn on the power strip behind the computer (look for the white arrows).
   • Turn on the power strip on the telescope pier.
   • Turn on the SCSI box behind the computer (black box with switch on side).
   • Turn on the CPU box under the telescope (black box with switch on side).
   • Turn on the computer (round button on lower right of monitor).

2. Start CCDOps by clicking near the middle of the menu bar which runs along the top of
   the screen. A menu will pop up. Select “CCDOps 3.95 alias” from the menu.
   The program pops up a menu that shows you the status of the camera
3. Once you have started the program, choose "camera/camera setup" from the menu and set the temperature regulation to active. The set-point should be around -5.0.

Once you press okay the camera will begin to cool and you should see the temperature begin to drop. It will stabilize in a short time, you should see the % next to the temperature value drop below 100%. You want to let the temperature stabilize before you focus or take data. If the percentage does not drop below 100% in 10 minutes, you should change your set point to be something slightly higher than the value registered on the screen. Monitor the percentage throughout the night, you can make it lower as the ambient temperature drops.

You control the resolution (binning) by adjusting the resolution mode:

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Binning</th>
<th>Saturation Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>None</td>
<td>16383</td>
</tr>
<tr>
<td>Medium</td>
<td>2x2</td>
<td>32767</td>
</tr>
<tr>
<td>Low</td>
<td>4x4</td>
<td>65535</td>
</tr>
</tbody>
</table>

Unless you have a reason for using some other mode, "medium" should be optimal.

2 Focusing

In order to obtain the best possible data from your image, you must pay some attention to getting the best focus possible. Unlike focusing when viewing through an eyepiece or a 35mm single-lens-reflex camera, when you focus the CCD camera you'll
not be able to directly observe the image to determine its quality, and it may take a little practice to get the knack of dealing with the display between when you make an adjustment and when you see its effect on the display screen.

You can reduce the delay choosing a focus star bright enough to be well exposed with only a short (~0.1 sec) integration time and also by only digitizing the small part of the image that contains the star.

1. If you are using any filters for your project, you want to put the filter in at this time.
2. Select a relatively bright star (+2.5 to +3.5) that is well above the horizon (that way you are looking through less atmosphere, less seeing or scintillation problems closer to the zenith). You want something that is bright enough to focus with in a short time, but dim enough not to saturate the detector.
3. With the flip-mirror in the "visual" position, acquire the star in the CCD field and do a preliminary focus by eye in the acquisition eyepiece.
4. Now, flip the mirror so that the light goes to the CCD rather than your eye. Choose "Camera/focus" from the menu to bring up the focus control window.

The exposure time is measured in seconds. Change the exposure time to something short, like 0.1. There are three options under frame size, "full, planet, dim". Choose "full" to begin with so you get the entire image and can figure out where your star is located. Click ok -- the computer will tell you the image is being taken and then displayed. Be aware that the first image of the night is always a throw-away. You will need to take a second image to begin focusing.
Make sure as you adjust the focus that you wait about two image cycles to be sure you see the results of your adjustment, again there is a delay from the time you make the adjustment with the focus knob to what is displayed on the screen.

5. To make this process go quicker assuming you know where your star is on the image, you can use "Planet" mode in which it will take a full image and ask you to move a box to the place in the image you want to expose. Click on the box and move it to where your star is located. Then press "resume". Again it will take a picture, but this time only of the small area you have selected. It will continue to take pictures until you stop it.

6. While it is going you can adjust the focus on the telescope and view the result. A sufficiently out-of-focus image will appear as a "doughnut" shape owing to the secondary mirror obstruction of this Schmidt-Cassegrain design of telescope.

7. Once your star is close to focused, press the "pause" button on the focus window and analyze the image some:

   Check the intensity to make sure it is not saturated (the goal is to have the star well-exposed, about 50% of full scale, but not over-exposed: see the resolution table above for saturation levels) . Also take a look at the background values to see what the background level is at. In the menu, click on "Display/Show Crosshair". This will give you values in the image under the crosshair as your scroll around with the mouse.
8. Adjust your exposure time and focus until you are satisfied. The shortest reliable exposure time is 0.05 sec (?). If your chosen focus star overexposes in this time you need to find a fainter star.

9. Once you have determined the exposure time, record it in your notebook along with a measure of the background intensity.

**3 Taking Data**

1. Now you are ready to take data. Dismiss the focus window and go back to the Camera menu. Use the "grab" command for taking individual images. In this case you set your exposure time and chose your image size, "full-half-quarter". If you are taking an image you want to use "None" under the dark frame option. If you are taking Dark frames, use "Only" here.

2. When you open CCDOps you should find an icon bar to shortcut using the menus for taking data:

You may find this useful.
3. Saving an Image:
Use the "File/Save As" command, rather than "Save". This is a safeguard so you don't overwrite an image.
For your data files, that you want to read with some image processing program you want to save it as a ".fits" file. The only problem with this is that you cannot reopen the file in the CCDOps program. To do that, you want to save it as a "compressed" or "uncompressed" file (likewise, these two image types can only be read by CCDOps).

Create a folder in the data files directory on the machine with your name. Inside this folder, create a folder with the date. Inside this you can save your images. Make sure you choose a useful name for each image and create a paper log file with the pertinent information about the image.
Example directory path:
Data Files:SusanK:20011009:
For example an image name might be:
date.imagename.fits (YYMMDD.XXX.fits) or some other descriptive title like:
Saturn1.fits, Saturn2.fits
4. Additional things to be aware of:

- While observing, keep an eye on the size of your stellar images. If they seem to have gotten blobbier over time, then either the focus has changed, the seeing has deteriorated, or both.
- Try to keep your target away from the edge of the array.
- As you work through your observing program, be aware of and check frequently for possible over-exposure. Especially as your airmass decreases over time this can be a danger.
- Be very careful to check what you have entered for your exposure time. At this point, we don't know the outcome of aborting an integration process. If you want to start a 60-sec exposure and accidentally type in 600-sec you may have to wait a bit for the longer exposure to finish. Whenever you enter a new exposure time, double-check for typos before hitting ok or <return>!

4 Calibration Data

SECTION TO BE WRITTEN
How many calibration images?
What kind of calibration images?
  0bias - take a dark image with 0.01 sec exposure, there is no bias setting.
  Dark - take dark images to match each exposure time and filters for your images
  Flat - take flat images to match each exposure time and filters for your images.
5 Shutting the system down

Go up to the camera menu and choose shutdown. This will turn off the cooler on the CCD and allow it to warm up before you shut it off. If you forget to do this before exiting CCDOps, the machine will ask you if you want to shut down the CCD and you can just hit enter. Wait about 30 seconds before flicking the switch on the CPU box controller.

1. Shut down camera by selecting Shutdown from the Camera menu in CCDOPS.
2. Exit out of CCDOPS by selecting Quit from the File menu.
3. Shut down the computer by selecting Shut Down from the Special menu.
4. Wait for the light on the computer's power button to go out, then turn off the SCSI box behind the computer.
5. Turn off the CPU box under the telescope.
6. Turn off the power strip behind the computer.
7. Turn off the power strip on the telescope pier.

- Make sure that all the lens and mirror covers are placed back onto the telescope.

6 Miscellaneous Notes

- If monitor is too bright or dim, open the monitor control panel (apple menu -> control panels -> monitors) and adjust both brightness and contrast.
- Check the position of the flip mirror, especially before taking a long exposure. If you can see through the eyepiece, the flip mirror is not lined up with the CCD.
- When using filters, be sure to slide the filter holder into the slot until the correct letter is visible just outside the flip mirror box. There should be a noticeable catch when a filter position is reached.
- Always have a filter holder in the slot to prevent dust etc. from entering the flip mirror chamber. There is a clear (C) filter available for this purpose.
- Keep in mind that the RA motor will drive the telescope much faster than the DEC motor.