

Swope Manual

This manual describes how to take direct imaging CCD data on the Las Campanas 40-inch Swope telescope with the 4Kx4K E2V CCD231-84 detector in use since October 2013. The new detector is read out through 4 amplifiers producing four independent files called ccdnnnc1.fits - ccdnnnc4.fits. The pixel size is 15 micros, and the pixel scale is 0.435 "/pixel producing a total FOV of 29.7 X29.8 arc minutes. The SWOPE-CCD application consist of different controls:

1) Science Camera and Filter wheel control 2) Guiders control 3) Telescope control

In addition to these GUIs there are the image viewer (Quick look tool), the dewar status window, the airmass display and the object list window. A password protect mode allow to access engineering GUIs.

The quadrants as seen in the Quick-Look tool are named counterclockwise beginning from the top right quarter of the image (i.e., top right is c1, top left is c2, bottom left is c3 and bottom right is c4).

CCD command window

This window control the CCD camera and the filter wheel. Exposure are started with the **Start** button. Macro can be started with the **Execute** button.

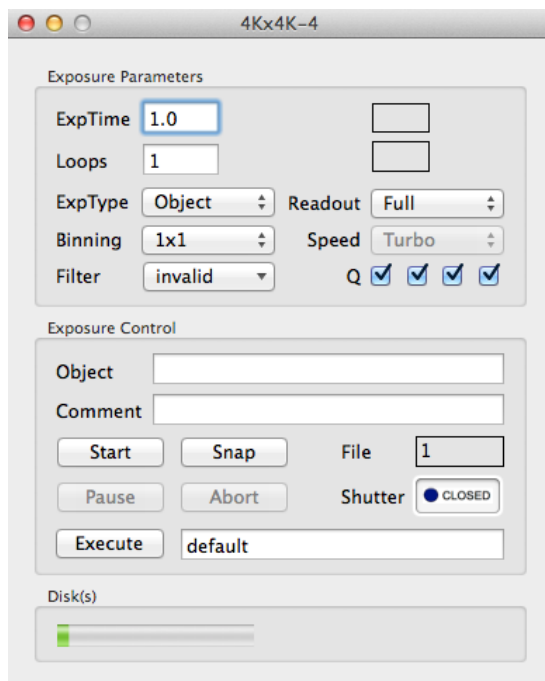


Figure 1. CCD main window

Exposure parameter

ExpTime is the exposure time in seconds for the next observation. For this parameter and the ones for Loops and File# the entry window will be highlighted red after the number is typed. The value is not recorded by the program until the user hits Enter. The exposure time can be changed at any time during the exposure. Remember to hit Enter to validate the new value.

Loops: Setting up a loop can be a convenient way to take flat fields and bias, or to make a series of observations in order to split the total exposure into shorter individual ones.

ExpType: The exposure type (saved in the fits header) can be set to "Object", "Focus", "Bias", "Dark", or "Flat". Selecting "Bias" will automatically set the exposure time to 0 seconds. Selecting "Dark" will disable the shutter for the exposure. Selecting "Focus" will enable a focus sequence, automatically setting the loop number to 7 (this can be changed if desired). The focus frame will be saved under a normal filename (e.g. ccd0065.fits). In this frame, the spacing between the first and second images will be larger than for the rest of the sequence, allowing identification of the sequence order.

Binning can be set to 1, 2, 3 or 4 in rows and columns. Note that the readout time given in this manual is for 1 x 1 binning.

Filter: There is room for 10 different filters in the filter wheel. Clicking on the button will present you with the available filters.

One or more Quadrants can be selected to be read instead of the whole detector (note that this will not save time because each quadrant is read independently). The selection is enabled by clicking the Q checkboxes

Object: Enter here the title you want for the image.

File: File number will be automatically incremented for every new exposure.

Execute: This command is used to start a macro. The macro file name must be specified on the next window to the right. This option is useful when shutter time and/or linearity tests are performed. More details here

Speed: only the Turbo readout speed is available at the present time.

Shutter: This is a flag that indicates whether the shutter is open or closed.

Snap will make a 4x4 binned image of the current field without incrementing the file number. The exposure time is as selected in ExpTime.

Subraster Allow to select subrasters on the chip. The regions can be defined giving its central coordinates followed by the width and height of the subraster (XYWH) or by its corners (XXYY). Savemode minimal will save only the selected region while savemode full will keep the original dimension of the quadrant filling with zero the region outside the selected.


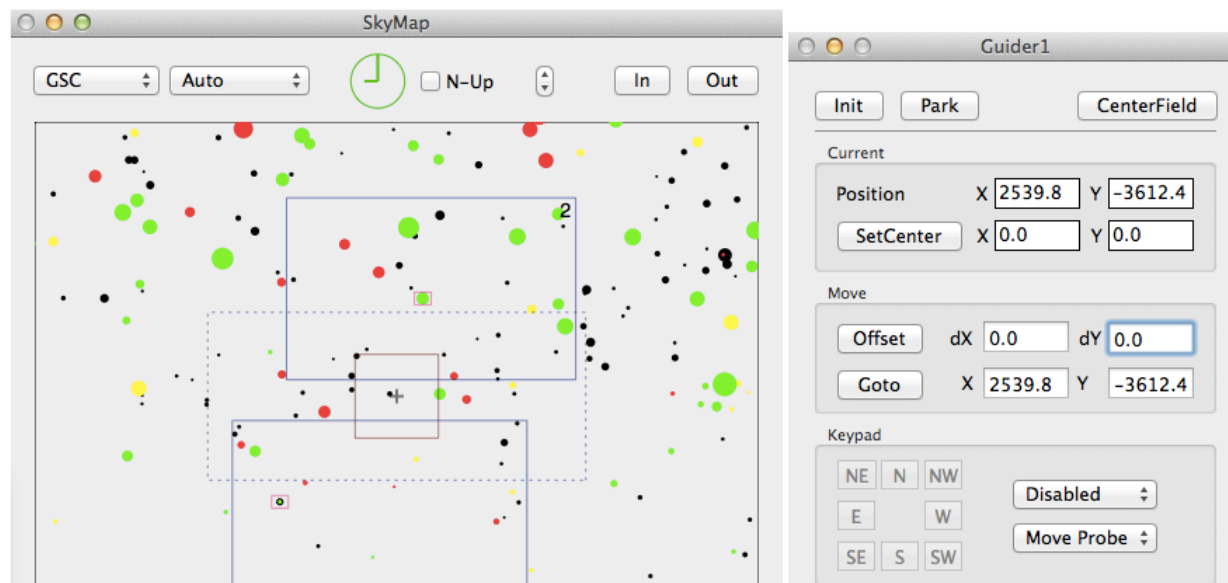


Figure 2. Subraster Window

Guiding

The main components of the guiding interface are Skymap, Guider1 and Guider2 windows.

Skymap display a star catalog and overlay of the science camera field of view (red box) the patrol area of the guiders (blue boxes) and the area where the guiders vignette the science array (dashed rectangle). By selecting a star the catalog entry will be displayed in the text box in the lower left of the window. The selection will also update the probe relative position on the **Guider** window. The probe will be moved to that position by pressing the Goto button. The guider probe can be also moved by selecting an offset or by using the keypad. The last section of the Guider window allow to select imaging mode (i.e. the guiding mode) or Shack-Hartman. The focus of the guiding camera can be changed using the text box in the last row or by moving the slider.



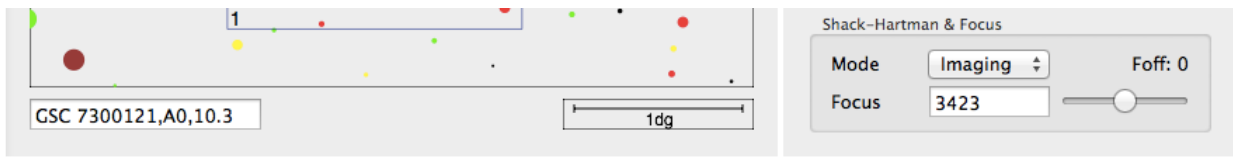


Figure 3. Skymap and Guider GUIs

Once the probe is at the desired position it should be possible to see the guiding star appear on one of the guider display (see fig. 4). To interact with the guiding software the corresponding screen has to be selected on the Belkin KVM which is mounted on the rack next to the observer workstation (link to image of the rack here).

To adjust the range of intensities between black and white displayed the command SPAN is used. In order to guide the guiding box has to be moved on the star image using the cursors. To change cursor steps use the keys INSERT and DELETE.

Guiding is started with <F3> and it is stopped with <F1>.

A full detailed description of the guider software (GCAM) can be found at this address:

<http://confluence.lco.cl:8090/display/MATOP/Guider+Camera>

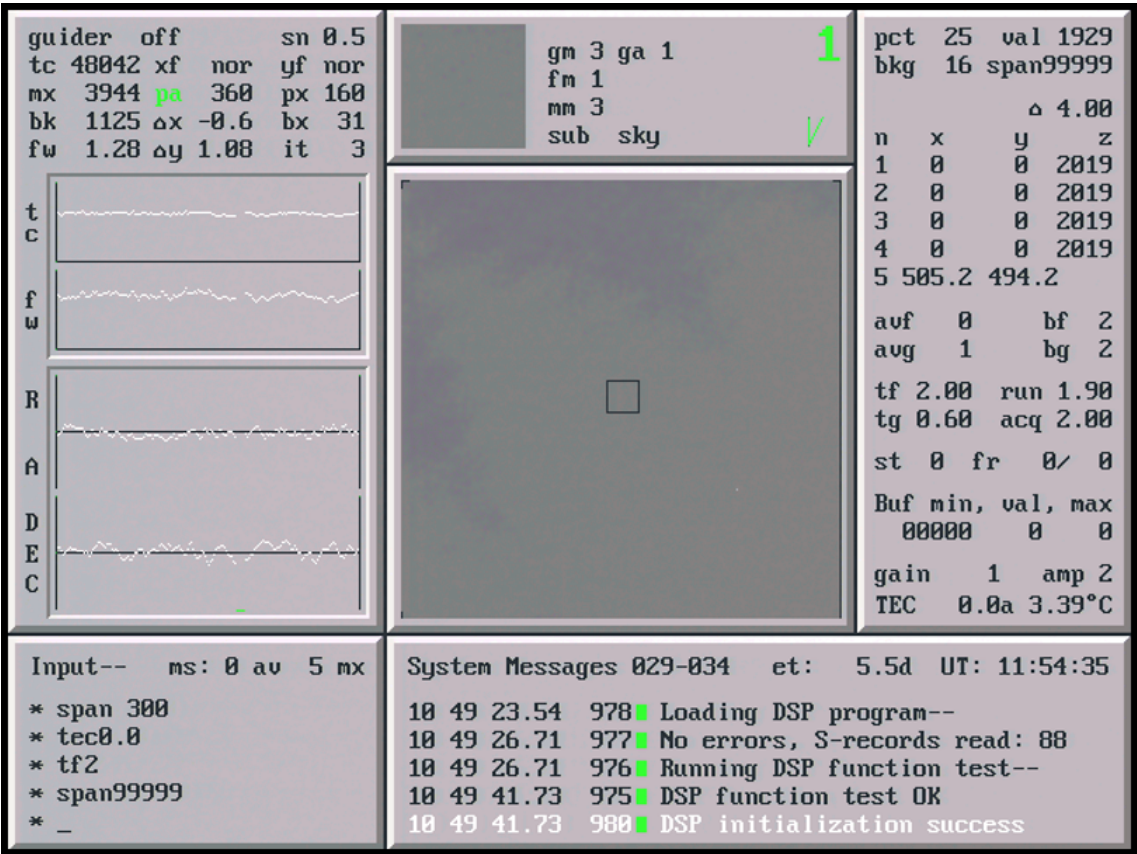


Figure 4. Guider Display Screenshot

Table 1. Quantum efficiency

Quantum Efficiency	
350 nm	42.1 %
400 nm	79.7 %
500 nm	85.8 %
650 nm	92.0 %
900 nm	62.5 %

Table 2. Gain and RON

Quadrant	Gain (sigma)	Readout Noise (sigma)
CCD1	1.045 (0.029)	3.026 (0.093)
CCD2	1.018 (0.028)	3.206 (0.102)
CCD3	1.003 (0.027)	3.414 (0.103)
CCD4	1.029 (0.029)	3.154 (0.099)