

Telescope Startup & Calibration Guide (Lights, Camera, Action!)

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The following is a detailed step-by-step guide for getting the telescope and camera up and running from a cold start. At first glance this looks like a ton of information and will be somewhat confusing the first time you go through the process. However after a couple of startups it will become much easier and quicker to do. This guide assumes you've completed the CCD Imaging Lab and have at least perused theSkyX manual.

POWERING UP:

At the base of the telescope pier there is a small door in the floor, marked out in yellow tape. This gives you access to the power switches for the observatory and telescope, Turn on the following:

Telescope Switch *ON*, this will power up the telescope controller and camera. You should hear the filter wheel clicking.

Red Lights (with dimmer) *ON*

There is also access to the white light switch here (labeled lights) and each of the 4 red lamps has an ON/OFF Switch.

LINKING UP:

Open theSkyX from the shortcut on the desktop.

Under the Telescope tab on the left, click the "*Start Up*" drop down menu and then "*Connect Telescope.*" The status should change from a red "*Not Connected*" to a green "*Connected*"

Under the Camera tab, click "*Connect.*" The Status should now be a green "*Ready*" You'll want to start cooling the main imaging camera right away as it will take 20 – 30 minutes for the temperature to stabilize.

Click "*Temp. Setup...*" and verify that the temperature setpoint is at the desired temperature and that the temperature regulation is on. We used to set the temperature to -20C but that created ice on the CCD. We now operate above the dew point at ~0C. Also verify that the fan speed is set to medium or high under "Camera Setup.../Camera Setup/Settings. You should be able to hear if it is on.

Verify that the filter wheel is connected under the *Filter Wheel* tab. When you change between filters you should hear a clicking noise. If it is not connected, click *Connect*.

CALIBRATING THE TELESCOPE

In theory you are now connected to the camera and telescope through theSkyX. But the telescope doesn't know where it is pointing. Do the following:

First you need to open the dome. Make sure the dome rotor switch is on and the hooks (at top of small lower dome shutter) holding the dome shut are opened. Flip the red toggle switch in the northwest quadrant of the dome. The dome should now be opening. When it is finished, disconnect the cord dangling from the motor as it will get yanked when rotating the dome.

Use the *Hand Paddle* on the desk to center a bright star in the telescope's Finder Scope. Some good stars for this are Arcturus, Castor, Pollux, or Spica. They are very bright and easy to find in the southern sky as well as in TheSkyX.

In TheSkyX, press CLRL+F and type in the name of the star you've chosen to calibrate on.

Under the camera tab, take an image on the Imaging CCD by pressing "*Take Photo*." A 0.1 second exposure should do the trick. A window with the picture should pop up on your screen.

Using the Hand Paddle on the *Pan* speed, center the star in the Imaging Camera field by moving the scope, taking an image and adjusting accordingly. Do this until the star is centered in the CCD field.

Once you're satisfied with your positioning go back to TheSkyX and click the *Telescope* tab then click *Start Up/Star Synchronization*. A pop up window should appear that says some nonsense about Synchronization. Click Sync, and then yes on the next pop up window if the star name is correct. Yet another pop up window should appear. Quickly press "*Load Cal Star No. 1*" and the "OK." For some reason there is a count down timer of 15 sec to do this just to add a sense of urgency, so hurry up. Don't make the telescope gods mad.

You would think that having been calibrated with one star, knowing the sidereal time, and our location would be enough known variables for the telescope to be able to be calibrated with the entire sky. Unfortunately, our software is not that sophisticated. Repeat the star calibration process for two or three more known stars, adding Cal Star's 2, 3, and/or 4.

You should now have TheSkyX calibrated with the telescope's field of view.

MOVING THE TELESCOPE VIA TheSkyX

You can move the telescope directly using the hand paddle and the telescope's position in TheSkyX will update as you move.

To find an object to slew to in TheSkyX you can either click on it directly or use the *find* function again. After a star or object is selected, you can slew to it by clicking "*Slew*." The telescope will do the rest of the work now. You do have to rotate the dome yourself though.

Take an image with your imaging CCD to check that you've indeed found your object.

IMAGING

Imaging is fairly straightforward. Under the *Filter Wheel* tab, select your filter and click "*Move now*." Then under the *Camera* tab, set your exposure time, frame type, and autosave options.

Check that the camera temperature is stabilized then go ahead and click "*Take Photo*." You can also take multiple images at a time with the "*Take Series*" function.

TELESCOPE FOCUS CALIBRATION

You will need to calibrate the telescope's focus as it drifts over time. Open Jupyter notebooks and open the file Desktop/focus_curve.ipynb

Find an area of the sky with moderate star density, like an open cluster, and take an image with the telescope.

With the "Starizona" telescope focus controller on the desk hold the out button for a little bit (of order a thousand on the position reader,) and take another image. The stars should now look terribly out of focus like bright donuts rather than points. Create a focus images folder. Take an image with this focus. Write down the position on the Starizona panel and enter it into the python script where it says "record the focus values..." in the "focusvals" list. Make sure you change thedir to the directory of your focus folder.

Change the focus a bit on the Starizona panel back towards to in-focus value, take a new image and record the position again. Iterate this process until the stars come into focus, then pass through focus, and then are distinctly out of focus again. Run the python script.

What this script does is determine the point spread function of the stars in each image, plot them side by side and locates a minimum. This minimum should be where the stars are in focus. Set the position on the Starizona panel to that minimum value.

You should now be getting nice sharp images, but verify this by eye as well. Don't just blindly trust the machines and a program you were given.

That's pretty much all you need to know for now. Happy Stargazing!