Drexel Lynch Observatory Open/Close Checklist

1 Opening up: Eyepiece Observing

1. Unlock the door from the inside to make sure that you don't get locked out.
2. Move the dome so that the slit is over the door (so that you can reach the handle).
3. First, open the slit. Make sure and stop the slit's opening before the metal bar reaches the hard stop. You have to decide whether you will be looking at objects closer to the horizon or zenith now (or have to close and re-open it later).
   - Zenith: Pull down the handle as you open the slit. It will make a "clunk" sound as it jumps free.
   - Horizon: Leave the handle where it is.
4. GENTLY pull the blue plastic cover off the telescope. You will need to get up on the ladder to get it over the top of the guide scope.
5. Open the cabinet (the combination is not 0123).
6. Remove the five protective covers and place them somewhere they won't get stepped on (or lost); e.g., in the cabinet
   - Front of the telescope
   - Yellow plug from inside the fine-focuser
   - Front of the finder scope
   - Rear plug from the guide scope (if you are going to use it)
   - Front cover of the guide scope (if you are going to use it)
7. Remove the 5lb weights hanging on the handle at the back of the telescope. Put them on the table.
8. Make sure that the the counterweights are at the "Park/Eyepiece" position marked on the track on the underside of the telescope. (Note that if you loosen the wingnut *too* much the whole thing will fall on your foot!)
9. Attach the 2" star diagonal to the main scope. (Leave the plug and the cap in the cabinet.) Depending on what eyepiece you choose, you may also need the 1.25" adapter plug. Make sure that the diagonal and the adapter are held tight by the set screws.
10. Choose an eyepiece. It isn't a bad idea to start with one of the cheap ones from the silver case until everything is setup. The 40mm will give you the widest field of view to start with. Insert the eyepiece into the diagonal and tighten the screws.
11. Attach the Focuser control box to the velcro on the right fork.
12. Set up the Mac on the left edge of the table by the pier. Leave it in its case for protection.

13. (If you are going to use the autoguider, this is the time to attach it to the guide scope.)

    Now let's start plugging things in.

14. Connect the ethernet-like plug Focus cable (which should be hanging from the focuser on the end of the telescope) to the focuser box.

15. Connect the focuser to the pier's USB hub with the cable in the focuser box (one end has a phone-jack like connector). Ensure the focuser switches are set to "manual" and "run".

16. Connect the focuser temperature probe to the focuser.

17. Plug the focuser box into the pier's outlet; use the plug with the transformer box.

18. Turn on the pier's outlet.

19. Turn on focuser.

20. Connect the telescope's RS232 port to the pier's USB hub with the RS232 cable from the cabinet.

21. Get the paddle out of the cabinet and plug it into the slot marked HBX.

22. Connect the telescope's power to the main power outlet on the west wall (near the dome roof controls and light switches).

23. Turn on the telescope with the switch. The paddle should beep and light up with a version number, and the fan on the back of the telescope should start blowing air out. Do the Mac setup while you are waiting for the telescope to initialize.

24. Plug the Mac into the wall power (not the Pier). You will have to prop it up using the carrying handle.

25. Attach the Mac to the to the pier's USB hub with the short black cable in the laptop bag.

26. Turn on the Mac and log in (password = stellar sequence + address).

27. Open The SkyX on the Mac. It should default location to Drexel Lynch Observatory and to the our equipment, but there are files saved with this information if not.

28. After the telescope has initialized, the paddle will ask for daylight savings time, the time and date. Input these values (slowly, but firmly). It can take as much as 5s for your input to respond (each time). Be patient.

29. Open the "telescope" tab in SkyX. Use the "Start Up" tab to connect to the telescope. Try a test move (at rate "move") to make sure that it is working. Avoid using the "slew" rate (or faster than 7 on the hand paddle as the telescope is nearly at the weight limit of the drive motors).

30. Use the "Tools" tab and selection "Location, time, and date". Copy the SkyX settings to the telescope. If the arrow button doesn't work, try a "refresh" first before trying the arrow button again.

31. Find a bright star that is close to the park position that you can use to focus on.

32. Set the focuser to 3500. Then unlock the primary mirror on the back of the telescope and adjust the focus knob until the star is close to best focus. (If the telescope was most recently focused for the CCD, you'll need to go about 3 turns left [counterclockwise]).

33. Re-lock the primary mirror.

34. For the rest of the night use the the SkyX to maintain focus. However, if you switch eyepieces, it may be faster to use the coarse focus again.

35. After you are in focus, reslew to the star that you are on, use the Sky X to center it in the eyepiece and then "sync" the current pointing into the TPoint model by choosing "Star Synchronization" on the "Start Up" tab in the telescope window. Hopefully that will allow you to point with sufficient accuracy throughout the night. At most you should only be one FOV off.

36. Go explore the sky! Push "Mode" on the handpaddle or "Abort" in the SkyX if the telescope starts to move to a dangerous position.

2 Closing Down: Eyepiece Observing

1. In the telescope window, disconnect SkyX from the telescope.

2. Move the scope to the "park" position (horizontal, facing south).

   - Use the "park telescope" option on the hand controller to do this.
   - Go up to the root menu by pressing MODE several times
   - Select "Utilities"
   - Push the UP menu arrow once and press enter "Park Scope"

   Now let's clean up once piece of equipment at a time.

3. Turn off the focuser using the switch on its box.

4. Uplug both cables from the focuser box and place the focuser box in its box (white).

5. Leave the focuser ethernet cable dangling.

6. Unplug the focuser and gently wrap up the power cord; put it in the box.

7. Unplug the red focuser wand (or the temperature probe) from the focuser; put the red wand in the box.

8. Put the focuser box in the cabinet (in the correct location).

9. Rehang the 5lbs weights on the handle on the back of the telescope.

10. Remove the eyepiece from the star diagonal. Put it back in its case. It should have covers for both the top and bottom and cardboard padding on each end in the box. Put the eyepiece box(es) back in the cabinet. (In the correct location).

11. Remove the star diagonal from the telescope. Put both caps back in it and put it in the cabinet (in the correct location).

12. Unplug the RS232 cable from the telescope base and from the pier's hub. Gently fold up the cable and put it into its bag and then into the cabinet.
13. Turn off the telescope on the base.
14. Unplug the hand paddle and put it back in the cabinet (in the correct location).
15. Unplug the telescope from the wall.
16. Close SkyX.
17. Turn off the pier's power.
18. Power down the Mac.
19. Unplug the Mac. Carefully roll the power cables and the USB cable and put them in the travel bag.
20. Zip up the travel bag and gently place the travel bag behind the CCD camera case.
21. Make sure that the counterweights are in the Eyepiece position.
22. Replace the 5 protective covers.
    - Front of the telescope
    - Yellow plug from inside the fine-focuser
    - Front of the finder scope
    - Rear plug from the guide scope
    - Front cover of the guide scope
23. While you are up on the ladder make sure that the primary mirror lock (to allow coarse focus) is in the lock position.
24. Put the tarp back over the telescope. Have one person climb the ladder and another hand the tarp up to them. Arrange it so that the telescope is completely covered. Do NOT tug the tarp. Lift it up and slide it. Otherwise it will catch and cause the telescope to slip. (See above if it does.)
25. Lock the cabinet and spin the tumblers.
26. Close the dome slit. You will need to shift the metal slide to make it move in the opposite direction. It will finish closing automatically. (If it won't move, try having someone go outside and push the back of it a little bit.)
27. While the slit is closing turn the dome such that the slit faces Disque. That way if you don't remember if it is closed or not, you can look out the windows of Disque to double check.
28. Make sure that the lights are off and that you have all your stuff.
29. Close the door to the dome behind you and make sure that it is locked.
30. Close the roof door behind you and make sure that it is locked.
31. E-mail Prof. Richards to confirm that nobody is still on the roof.
32. Return the keys that you checked out the next day.

3 Opening Up: CCD Observing

1. Unlock the door from the inside to make sure that you don't get locked out.
2. Move the dome so that the slit is over the door (so that you can reach the handle).
3. Open the slit. Make sure and stop the slit's opening before the metal bar reaches the hard-stop. You have to decide whether you will be looking at objects closer to the horizon or zenith now (or have to close and re-open it later).
   - Zenith: Pull down the handle as you open the slit. It will make a "clunk" sound as it jumps free.
   - Horizon: Leave the handle where it is.
4. GENTLY pull the blue plastic cover off the telescope. You will need to get up on the ladder to get it over the top of the guide scope.
5. Open the cabinet (the combination is not 0123).
6. Remove five protective covers and place them somewhere they won't get stepped on (or lost); e.g., in the cabinet
   - Front of the telescope
   - Front of the finder scope
   - Yellow plug from inside the fine-focuser
   - Yellow plug from the guide scope
   - Front cover of the guide scope; leave it on the top stair of the ladder as you'll need it to calibrate the auto guider.

   Now we are going to start getting everything into place. Once that it done, we will work on plugging in everything. That way you don't trip over cords until the end.
7. Get the 2" star diagonal out of the cabinet. Leave the white plug and black cap in the cabinet.
8. Attach the 2" star diagonal to the guide scope. You'll also need the 1.25" adapter plug. Make sure that the diagonal and the adapter are held tight by the set screws.
9. Attach the Orion StarShoot Auto Guide (SSAG) camera to the guide scope:
   - Attach the 1.25" adapter (it is in the Orion SSAG box)
   - Tighten the set screws firmly
10. Remove the 5lb weights hanging on the handle at the back of the telescope. Put them on the table.
11. Attach the CCD to the rear of the telescope. Orient it so that its ports are facing directly down. **Important:** secure it to the telescope with the bungee cable. Also, double check that the screws are all holding it tight. This will save you around $10,000 if it should slip later on.

12. Adjust the counterweights to the "CCD" position marked on the track on the underside of the telescope. (Note that if you loosen the wingnut *too* much the whole thing will fall on your foot!)

13. Attach the Focuser control box to the velcro on the right fork.

14. Set up the Mac on the left edge of the table by the pier. Leave it in its case for protection. Do *not* turn it on yet.

    Now let's start plugging things in.

15. Connect the telescope's RS232 port to the pier's USB hub with the RS232 cable from the cabinet.

16. Connect the SSAG guide camera to the pier's USB hub using the cable from the cabinet. (It might be easier if you removed it from the star diagonal first so that you can see what you are doing.)

17. Do **NOT** connect a RJ-12 cable (with telephone jacks) to the guider!

18. Connect the CCD's power cable (big transformer in CCD case with a separate plug adapter that you need to attach) to the wall outlet. Take care to arrange that the cable has sufficient slack for large movement of the telescope (you might put the box on a high step on the ladder). Take **extra** care that you plug it in to the camera correctly—otherwise you will bend the pins!

19. Connect the CCD to the pier's USB hub with the USB cable in the CCD box.

20. Connect the ethernet-like plug Focus cable (which should be hanging from the focuser on the end of the telescope) to the focuser box.

21. Connect the focuser to the pier's USB hub with the cable in the focuser box (one end has a phone-jack like connector). Ensure the focuser switches are set to "manual" and "run".

22. Connect the focuser temperature probe to the focuser.

23. Plug the focuser box into the pier's outlet; use the plug with the transformer box.

24. Turn on the pier's outlet.

25. Turn on focuser.

26. Get the paddle out of the cabinet and plug it into the slot marked HBX.

27. Connect the telescope's power to the main power outlet on the west wall (near the dome roof controls and light switches).

28. Turn on the telescope with the switch. The paddle should beep and light up with a version number, and the fan on the back of the telescope should start blowing air out. Do the Mac setup while you are waiting for the telescope to initialize.

29. Plug the Mac into the wall power (not the Pier). You will have to prop it up using the carrying handle. Be careful during the night that moving the ladder doesn't pull on the plug.

30. Attach the Mac to the to the pier's USB hub with the short black cable in the laptop bag.

31. Make sure all the hub connections are tight.

32. Turn on the Mac and log in (password = stellar sequence + address).

33. Open The SkyX on the Mac. It should default location to Drexel Lynch Observatory and to the our equipment, but there are files saved with this information if not.

34. After the telescope has initialized, the paddle will ask for daylight savings time, the time and date. Input these values (slowly, but firmly). It can take as much as 6s for your input to respond (each time). Be patient.

35. Open the "telescope" tab in SkyX. Use the "Start Up" tab to connect to the telescope. Try a test move (at rate "move") to make sure that it is working. Avoid using the "slew" rate (or faster than 7 on the hand paddle as the telescope is nearly at the weight limit of the drive motors).

36. Use the "Tools" tab and selection "Location, time, and date". Copy the SkyX settings to the telescope. If the arrow button doesn't work, try a "refresh" first before trying the arrow button again.

37. Connect to the CCD camera in the camera window. This will also connect the focuser.

38. Click on "Auto Save" and change the file name and sequence as needed. Files will be saved based on the (UT) date in the "Images" folder on the desktop.

39. Record the ambient temperature in your observing log. Click on "Tempature setup" and set the temperature to 30 degrees **below ambient**. Turn on the temperature regulation. This will begin cooling the CCD. You might be able to go 10 degrees lower than that, but you risk frosting on the window of the CCD. Once the CCD is cool take 2 0s bias frames to clean out any excess charge that has built up.

40. Take a bias frame to clear out any charge that has built up and to make sure that all is working properly.

41. Continue with the instructions below as appropriate.

4 Setup for Taking Data

Before you can start taking data, you'll need to do some housekeeping. This includes

1. Taking bias and dark frames (either before or after the sky flats depending on how much time you have).

2. Taking sky flats.

3. Focusing the telescope.

4. Turn on auto guiding.

Below are detailed instructions for each of these.

4.1 Calibration Frames

- Take a throw-away bias. Indicate it as such in your log.
- Now take 10-20 "good" bias frames.
- Technically you want dark frames to match the exposure times of your "light" images. But you don't know that yet. So while you are waiting for it to get dark, take some longish ones. You can always scale them if you don't have time to take ones of the correct length later. Take 5 darks of at least 1 minute (longer if it is still too light out).

4.2 Sky Flats

- You should be able to start sky flats a few minutes into civil twilight (after sunset). Even before it is remotely dark enough to see stars.
- Point the telescope (and move the dome slit) at the southern sky a bit higher that the park position.
- Turn off the telescope tracking motor. "Tools", then "Turn Tracking Off" in the telescope window.
- Change filters to **blue** (using the filter wheel window).
- Take a 1s "FlatField" image.
- Check the counts using the cursor on the quick-look image. If it is between 20k and 40k counts, that's good. If if it less, increase the exposure time (applying a linear correction to the exposure time) and try again. If it is more than 40k, take a bias to clear out the charge and try again with 0.5s exposure. If it saturates again, take a bias and wait a few minutes before trying again.
- Once your first image is between 20k and 40k counts, then take additional images. Increase the exposure time by $\sim$ 1s between exposures if the counts drop below about 30k.
- You want 5 well-exposed images.
- Now do the same in both the **green** and **red** filters.
- **Turn tracking back on**

4.3 Focusing

- Slew to a star that you are familiar with.
- Make sure that it shows up in the finder scope. If not use the hand paddle to guide it there. Press and hold Enter. Then Enter again to "sync" the telescope to that point. (Alternatively you can sync it to the model in the SkyX.)
- In the camera window click on "Focus Tools".
- Change the settings to "Light", "AutoDark", and 0.5s exposures.
- Click on "Take Photo". This will continue taking (unsaved) photos until you tell it to "Abort".

- In the focuser window set the position to 3500 (half way in its range).
- Now undo the primary mirror lock on the back of the telescope.
- Turn the focus knob until the image of the star is no longer a donut (and you can see other stars in the field). It may help for 2 people to do this or for you to turn the monitor slightly so that you can see it.
- Re-engage the primary mirror lock.
- Back in the camera window, click on "@Focus2" to do an automatic focus loop.
- The settings should be: samples=4, averaging=2, range=5000.
- Click "OK" and watch the focus move and the images go out of, into, and out of focus.
- Wait until the status is "Ready".
- You should now be in focus. Repeat the @Focus procedure if the temperature drops more than a few degrees.

4.4 Guiding

If you are taking images longer than about 10 seconds, or just want to keep your object from drifting off while you take a series of images, then turn on autoguiding. You'll have to restart this anytime you slew the telescope somewhere new.

- Open the autoguide window.
- Connect if you are not already connected.
- Settings should be "Light", "AutoDark" (in both the Autoguide and Focus Tools tabs). Try 1s to start with. You shouldn't need to change things in "Setup", but those should be 10s for "Calibration time", 0.1s for "Minimum move", and PulseGuide for "Autoguide using".
- In the "Focus Tools" tab click "Take Photo".
- You will likely be so far out of focus that you won't see any stars at all. If there is a bright star in the main camera field of view you might see a faint hint of a really out of focus star.
- Move the focus knob *on the piggyback telescope* out (pretty far). If it won't move, the set screw on the bottom is probably too tight.
- Watch the stars appear. Keep adjusting the focus until you can see a handful of stars in the image and they look reasonably in focus.
- Click "Abort" to stop focus loop.
- Change to "Autoguide" tab.
- Click "Take Photo".
- Follow the directions about covering and uncovering the scope (this takes a dark frame that it will use to dark subtract the images).

- On the resulting autoguider image double-click on the star that you wish to use as a guide star. Choose something that isn't right at the edge of the field, isn't too bright (not saturated) or too faint, and doesn't have another star of similar brightness too nearby.
- Click "Take Photo" again to confirm the brightness and location.
- Click "Autoguide" to start the autoguiding process.
- It will then take sub-frame images of that star nudge the telescope if the star drifts out of the box. If all is working well, you'll see the star bounce around, but never leave the field of view.
- Make sure that you stop autoguiding once you are done with your exposures and before you move the telescope somewhere new (so that it doesn't keep looking for a guide star that isn't there anymore).

I don't expect you to need to calibrate the autoguider, but if it seems that you do, see Page 469 of the TSX manual. For setup, make sure that is is set to "PulseGuide" and not "Relay".

5 Closing Down: CCD Observing

1. On the Mac, turn off temperate regulation using "temp setup" in the camera window. This will begin ramping the CCD back to ambient temperature in a controlled fashion. Do NOT unplug the camera until it has reached the (current) ambient temperature (the dome has likely gotten colder since you started).
2. In the AutoGuider window, disconnect SkyX from the auto guider.
3. In the "Shut Down" tab of the Telescope window, disconnect SkyX from the telescope.
4. Move the scope to the "park" position (horizontal, facing south).
   - This *cannot* be done in SkyX
   - Use the "park telescope" option on the hand controller to do this.
   - Go up to the root menu by pressing MODE several times
   - Select "Utilities"
   - Push the UP menu arrow once and press enter "Park Scope"
   - Do NOT turn off the telescope at this point

   Now let's clean up once piece of equipment at a time.
5. Unplug the RS232 cable from the telescope base and from the pier's hub. Gently fold up the cable and put it into its bag and then into the cabinet.
6. Turn off the focuser using the switch on its box.
7. Uplug all 3 cables from the focuser box and place the focuser box in its box (white).
8. Leave the focuser ethernet cable dangling.
9. Gently wrap up the phone jack/USB cable and put it in the box.

10. Unplug the focuser and gently wrap up the power cord; put it in the box.
11. Put the focuser box in the cabinet (in the correct location).
12. Unplug the USB cable from the guide camera and the pier's hub.
13. Roll up the guide camera's USB cable and put it in the cabinet on top of the Meade DSI box.
14. Remove the Orion SSAG camera from the diagonal.
15. Unscrew the 1.25" adapter from the Orion SSAG camera and put them back in its metal box (don't loose the padding).
16. Put the guide camera box in the cabinet (in the correct location).
17. Remove the star diagonal from the guide scope. Put both caps back in it and put it in the cabinet (in the correct location).
18. Turn off the telescope on the base.
19. Unplug the hand paddle and put it back in the cabinet (in the correct location).
20. Unplug the telescope from the wall.
21. Check the CCD temperature. **If it is within 2 degrees of ambient (or warmer), then continue. Otherwise wait until it is.**
22. Disconnect the CCD camera in SkyX using the camera window.
23. Unplug the temperature probe from the focuser on the back of the telescope.
24. Unplug the USB cable from the CCD camera and from the hub. Gently roll it and put it in the CCD box.
25. Unplug the CCD power. Separate the two pieces. Put the power brick in its spot and coil the attached cord above it. Roll up the other part of the cord and put it in the CCD box.
26. Rehang the 5lbs weights on the handle on the back of the telescope.
27. Remove the bungee cord and *carefully* loosen the thumb screws holding the CCD camera in place. Gently pull out the CCD camera. Put the cap back on the adapter and place it in its box.
28. Close up the CCD camera box. Leave it on the table for now.
29. Close SkyX.
30. Turn off the pier's power.
31. Unplug the USB cable from the Mac and from the pier's hub. Put it in the Mac travel bag.
32. Transfer any data from the Mac to your OneDrive account (or some other place that you have access to).
33. Unplug the Mac. Carefully roll the power cables and put them in the travel bag.

34. Power down the Mac and zip up the travel bag.

35. Place the travel bag on its side in the bottom, back-right of the cabinet. The cabinet is not square and the bag isn't either. It is a good fit.

36. Put the CCD case in the cabinet (sideways, handle facing left, top facing front).

37. Slide the counterweight on the bottom of the scope from CCD to Eyepiece. Again, careful not to loosen the wingnut too much.

38. Replace the 5 protective covers.

    - Front of the telescope
    - Yellow plug from inside the fine-focuser
    - Front cover of the guide scope
    - Rear plug from the guide scope
    - Front of the finder scope

39. While you are up on the ladder make sure that the primary mirror lock (to allow coarse focus) is in the lock position.

40. Put the tarp back over the telescope. Have one person climb the ladder and another hand the tarp up to them. Arrange it so that the telescope is completely covered. Do NOT tug the tarp. Lift it up and slide it. Otherwise it will catch and cause the telescope to slip. (See above if it does.)

41. Lock the cabinet and spin the tumblers.

42. Close the dome slit. You will need to shift the metal slide to make it move in the opposite direction. It will finish closing automatically. (If it won't move, try having someone go outside and push the back of it a little bit.)

43. While the slit is closing turn the dome such that the slit faces Disque. That way if you don't remember if it is closed or not, you can look out the windows of Disque to double check.

44. Make sure that the lights are off and that you have all your stuff.

45. Close the door to the dome behind you and make sure that it is locked.

46. Close the roof door behind you and make sure that it is locked.

47. E-mail Prof. Richards to confirm that nobody is still on the roof.

48. Return the keys that you checked out the next day.

6 Troubleshooting

There are instructions below for the following occurrances.

- Can't connect to devices.
- Telescope doesn't park properly.

- Telescope slips.
- Hand paddle resets (date is off by ¿1 month).
- You mess up inputting the time and date.
- The focus does not converge.

If the Sky X fails to connect to any of the devices, then something is wrong with the connections to the hub. You can confirm this as follows:

1. open a terminal window
2. type “cd /dev”
3. type “ls — more”
4. look for entries like “cu.usbserial” and “cu.usbserial-FTWHMTNT”.
5. if you don’t see those, then that is the problem.

Solutions:

1. tighten all the hub connections
2. try exiting and restarting the SkyX
3. if that doesn’t work, reboot the Mac
4. hopefully everything is happy now.

If the telescope fails to park in the correct position, release the RA/Dec locks (one at a time) and put it in the correct position.

- Release the RA lock and center the telescope.
- Re-engage the RA lock.
- Have a tall person grab the handle of the telescope with their left hand and release the Dec lock (turn the big, flat knob counterclockwise).
- Set the Dec to 50 degrees ($90 - 40 = 50$).
- Re-tighten the Dec lock.

If the telescope slips while no longer parked.

- Park the telescope
- Turn if off after it is completely done parking
- Follow the instructions above for failing to park in the correct position
- Turn on the telescope again

- Follow the usual startup procedures

If the handpaddle comes up with a date that isn't recent, then it was probably accidentally reset (e.g., if someone turned off the telescope before it was done parking). This is a big problem as it thinks that the telescope is in Irvine, CA (where it was made). To correct it, do the following:

- Using the handpaddle:
- Go to "Setup" and then "Site"
- Select "Pennsylvania" and then "Phildelphia"
- Press "Mode"
- Select "Telescope" from the "Setup" menu
- Select "Mount"
- Change mount to "Polar"
- In the SkyX, go to the "Telescope" window
- Selection "Location, Time, and Date" in the "Tools" menu
- First "Refresh"
- Then copy the SkyX information to the telescope.

If you mess up putting in the time and date, don't worry. Just enter the values using the handpaddle menu

- Go to "Setup"
- Go to "Date"; enter the current data
- Go to "Time"; enter the current time
- Go to "Daylight Savings"; confirm the correct setting

If the focus does not converge:

- Your star may be too bright (saturated pixels) or too faint (too hard for the automated algorithm to find it.
- The initial focus may not be good enough. Before you start the sequence you need to make sure that you see at least a couple of stars in the image and that those stars aren't clearly donuts.
- The initial focuser setting may be too small or too large. If you put in a range of 5000, that means that it will subtract 2500 and then move forward 5000 (in 3 steps). If you started at 1900, then you are asking it to move to -600. Make sure that you start at 3500 (or at least between 2500 and 4500 if you use the default range of 5000).

- If the star moves out of the field, then you probably have forgotten to turn tracking back on.
- If it still moves out of the field, then set the subframe size to 200 pixels instead of 100.
- If all else fails, do the best that you can with the manual focus on the telescope, then use the focuser window to make 200 step changes in the focus at a time. Once you get close, start making 50 step changes. You might want to look at the last image in SAOimage and not just the Sky X so that you can see the shape of the stars better. That will tell you if you need to go further (or if you went too far).