

Sommers-Bausch Observatory 20" Telescopes

Opening Procedure



**IMPORTANT: THIS MANUAL IS FOR REFERENCE ONLY. DO NOT OPERATE THE
TELESCOPES WITHOUT ATTENDING AN OFFICIAL TRAINING SESSION.**

NEVER attempt to disassemble the instruments or remove/change their attached cords.

Last Modified: 25/11/19

Preparing the Telescopes

1. Turn on the computer using the covered switch on the left of the control panel. *Note this switch acts like a button and should not be forced to stay in the up position.* Put the cover back down to prevent accidental contact.
2. Complete the **[Telescope Login Form]** in the first tab of the internet browser.
3. Check the weather before opening the roof, both with the computer but also with your eyes (Go Outside). If it is raining, snowing, or if the wind gusts are over 30 mph in the last hour (check the ATOC weather station tab on the browser), do not open the roof.
4. On the control panel, press the green **[START]** button to turn on the telescope. You must press hard enough to hear and feel a heavy click. You should hear fans turn on, the focuser whir.
5. If desired, turn on the TVs using the remote control.
6. Make sure everything is clear of the roof (i.e., binoculars, people's heads, etc...).
7. Turn on the red lights (dimmer knob just inside the building) and turn off the flood lights.
8. Open the roof using the green (middle) **[Open]** button on the north wall. You can press the red (top) **[Stop]** button at any point to stop the roof.
9. Open TheSky by clicking on the black "X" on the task bar.
10. Press "Ok" or wait for the time to expire.
11. **Artemis Only:** If using the piggyback, slew to the **[Piggyback Cover]** position, below the horizon, either by selecting it in the sky view or searching for it in the **[Find]** pane.
12. Remove the red cover from the aperture of the main telescope and place it in the box labeled "Covers" on the north wall.
13. **Artemis Only:** Remove the red cover from the aperture of the piggyback telescope, if you plan to use it, and place it in the box labeled "Covers" on the north wall.
14. Remove the cover from the eyepiece on the telescope and place it in the box labeled "Eyepiece Covers" in the closet.
15. In the **[Camera]** pane, on the left side of the screen, select **[AutoSave...]**.
16. Select **[Choose...]**, and then in the navigation bar, select the **[Current Semester's]** folder. Then select the class you are observing for from the list. Then, click **[Select Folder]** and **[Ok]**.
17. **Artemis Only:** If you are using the Artemis piggyback repeat steps 13 and 14 replacing **[Camera]** pane with **[Autoguider]** pane.
18. If taking Scientific Data: In the camera pane, press the **[Temp. Setup...]** button, and change the camera set point to 30°C BELOW ambient rounded to the nearest 5°C. Also ensure that both checkboxes are checked. Press **[OK]** to exit the set-point window. Please refer to the Data Acquisition section for instructions on how to manage the temperature of the camera.
19. Observe!

If you ever feel that the telescope is going to an unsafe place, or is moving when you don't want, press ABORT in the top toolbar of TheSky or the STOP button on the control panel.

Moving the Telescope

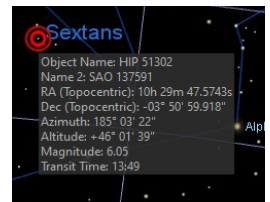
Remember: Always check that your object is inside the horizon limits (the orange line) before slewing the telescope. Additionally, check the area around the telescope prior to moving and announce the movement to the rest of the observers.

- **Left Click in Sky View:** This puts the selected object in the Find pane of TheSky, where you can check the object properties and issue slew commands.
- **Searching by Name:** In the Find pane, search for the object you want. Make sure the object is listed in the Find pane as the selected object. Capitalization and whitespace do not matter in the search bar. Make sure to press the **[Center]** button in the Find pane to ensure that your object is inside the horizon limits.
- **Coordinates:** If you know the RA/Dec coordinates of the object you want to look at, you can enter those by going to the **[Telescope]** pane → **[Tools]** → **[Slew To Coordinates...]** and enter the position in the “Equatorial Coordinates” panel. **Before Slewing**, press **[Center Chart on RA/Dec]** to ensure that your object is inside the horizon limits, then press **[Slew to RA/Dec]**.
- **Manually:** Using the hand paddle on the telescope, you can manually move the telescope around the sky. Turning the knob on the paddle between the different numbers will change the rate at which the hand paddle moves the telescope.

Focusing the Telescope

Camera: (If you plan to use the piggyback, you can use the same star to focus on.)

1. Select a 3rd to 4th magnitude star in the sky view and press **[Slew]** in the **[Telescope]** or **[Find]** panes. *This star should be somewhat nearby to your desired target to ensure optimal focus.* (Hovering over a star will bring up a box listing its magnitude.)
2. Make sure the mode selector on the imaging train is set to **[Camera]**.
3. In the **[Camera]** pane select the **[Focus Tools]** tab, then the **[@Focus3]** button.
4. Set the **[Exposure Time]** to 2 s, **[Binning]** to 4x4, and the **[Filter]** to H-Alpha.
5. Press **[Take Sample Photo]** and wait for the image to download.
6. Press the **[+ Magnifying Glass]** button until it says 1:4 in the top left corner of the @Focus3 window, and then center the brightest star.
7. Press **[Set Subframe to Current View]**.
8. Press **[Autofocus Now]**. The system will now attempt to automatically focus the camera. This should take about 2 to 3 minutes. If it is having trouble, please use the legacy camera method.
9. Close the @Focus3 Window, either by clicking **[Close]** or the **[X]**.
10. Switch to the **[Take Photo]** tab, not button to collect data.



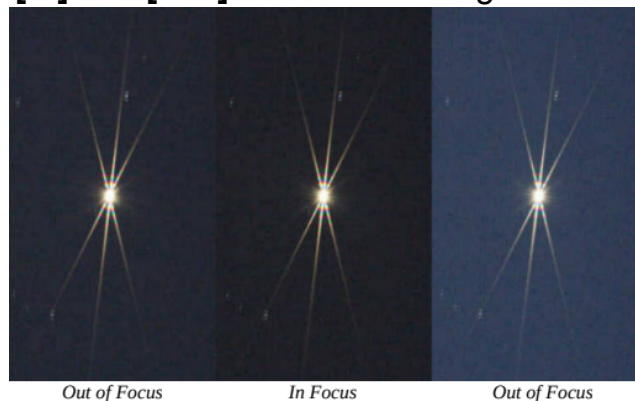
NEVER attempt to disassemble the instruments or remove/change their attached cords.

Eyepiece:

1. Make sure the mode selector on the imaging train is set to “eyepiece”.
2. Using the black (Course) and/or gold (fine) focus knobs next to the eyepiece, move the focus setting in or out until the point source is as small as possible (a ring/donut shape means the telescope is very out of focus).

Legacy Camera Method:

1. Make sure the mode selector on the imaging train is set to **[Camera]**.
2. Place the Bahtinov Mask on the end of the telescope and slew to a moderately bright star (between 0th and 3rd magnitude) by either selecting the star in the sky view, or searching for it, then pressing **[Slew]** button in the **[Telescope]** or **[Find]** panes. *This object should be somewhat nearby to your desired target to ensure optimal focus.*
3. In the **[Filter Wheel]** pane, set the filter to r.
4. In the **[Camera]** pane, switch to the **[Focus Tools]** tab, set the exposure to 1 sec with 1x1 binning, and ensure “Take Photo Continuously” is Unchecked. Then press the **[Take Photo]** button. *Depending on the brightness of the star, you may need to adjust the exposure time.*
5. Click on the **[Subframe]** icon (white box with a cursor) in the image window and then drag a box around the star (being sure to capture *all* the diffraction spikes.) *(The Subframe checkbox should automatically turn on in the **[Focus Tools]** tab.)*
6. Check **[Take Photo Continuously]** and restart the imaging series. Using the **[Focuser]** pane, perform a Bahtinov focus for the telescope. See the following images for what the image should look like. Use the **[Amount]** dropdown to set the step size and the **[In]** and **[Out]** buttons to change focus.



11. When you are satisfied with the focus, switch to the **[Camera]** pane, and stop the focus series using the **[Abort]** button and uncheck **[Subframe]**
12. Remove the Bahtinov mask from the telescope (you may have to slew south to safely reach it). The telescope is now focused.
13. Switch to the **[Take Photo]** tab, not button to collect data.

Using the Camera

Taking Images

1. Ensure the mode selector on the imaging train is set to **[Camera]**.
2. In the **[Camera]** pane, and **[Take Photo]** tab not button, select **[Live Stack...]**. This will open a new window that has an automatic stacking feature.
3. In the top right corner set the exposure time and filter as desired, the default recommendation is 30 seconds, UV/IR Cut (L) filter, and 4x4 binning.
4. Press **[Start!]**. This will automatically take and stack images.
5. Adjust the **[Scale]** and **[Highlights]** sliders as desired to improve the image. In general, the **[Scale]** slider should be mostly to the left and the **[Highlights]** slider should be mostly to the right.
6. Press **[Stop!]** when you want it to stop taking additional images.
7. If you want to save the image to be viewed on other computers press **[Export...]**, then type in a name with ".jpg" at the end.

Other Settings and Features

- **Binning** – 4x4 Binning is recommended when using the camera for imaging.
- **Temperature Control** – The set point of the camera can (and should) be changed depending on the conditions in which you are taking data.
 1. In the **[Camera]** pane, click on **[Temp. Setup...]**, and then change the set point and confirm the changes.
 2. Set the camera to 30°C below the ambient temperature. It is generally a good idea to make $\Delta 5^{\circ}\text{C}$ steps when changing the temperature.
 3. If the temperature cannot get to the setpoint or has stabilized but is still using >80% cooler power, raise the temperature until neither condition is occurring.
- **Filter Wheel** – Use the filter wheel pane to change the filter by selecting the desired filter from the dropdown list and then pressing **[Move Now]**. Be wary that both telescopes might have slightly different filter sets, so pay attention when switching between them.

- **Taking Flats**

- Rudimentary dome flats are possible using the painted flat surface above Artemis, or the projector screen in front of Apollo. Both surfaces require the roof to be closed for use. Try to get the telescopes as perpendicular and as close as possible to the surfaces.
- Turn on the flat lamps using the white switches on the bottom of both telescopes. You will need to adjust the flat lamp brightness and exposure time to get a good flat field image.
- Remember to use the “Flat” frame type in the Camera window.
- For highest accuracy, you may take sky or super-sky flats instead.

- **FITS Preview** – TheSky will open the preview window when the first image is taken. This window is how you save images taken with the camera. The controls at the top also allow zooming in the image, and the graph-like button opens the stretch options panel. The best method is Heuristic, not SBIG. Finally, the second tab in this window allows you to examine the FITS header for the image.

Using the Piggyback System

The piggyback system has two devices controlled by TheSky, a camera and a focuser. The camera's pane is called **[Autoguider]** and the focuser's pane is labeled **[Focuser (Guider)]**. The panes and @Focus3, Live Stack, and Image windows for the piggyback will have a light blue background as opposed to the grey of the main camera panes and windows. The camera is a color sensor so there are no filters to use.

Focusing

1. Select a 3rd to 4th magnitude star in the sky view and press **[Slew]** in the **[Telescope]** or **[Find]** panes. *This star should be somewhat nearby to your desired target to ensure optimal focus.* (Hovering over a star will bring up a box listing its magnitude.)
2. In the **[Autoguider]** pane select the **[Focus Tools]** tab, then the **[@Focus3]** button.
3. Set the **[Exposure Time]** to 0.5 s and **[Binning]** to 4x4.
4. Press **[Autofocus Now]**. The system will now attempt to automatically focus the camera. This should take about 2 to 3 minutes.
5. Close the @Focus3 Window, either by clicking **[Close]** or the **[X]**.
6. Switch to the **[Take Photo]** tab, not button to collect data.

Taking Images

1. (If not already done) In the **[Autoguider]** pane select **[AutoSave...]**.
2. (If not already done) Select **[Choose...]**, and then in the navigation bar, select the **[Current Semester's]** folder. Then select the class you are observing for from the list. Then, click **[Select Folder]** and **[Ok]**.
3. In the **[Autoguider]** pane, and **[Take Photo]** tab not button, select **[Live Stack...]**. This will open a new window that has an automatic stacking feature.
4. In the top right corner set the exposure time as desired (default recommendation is 30 seconds) and 1x1 binning.
5. Press **[Start!]**. This will automatically take and stack images.
6. Adjust the color sliders until the background sky is gray or black. In general, the green slider will need to be lowered and the others can stay the same.
7. Adjust the **[Scale]** and **[Highlights]** sliders as desired to improve the image. In general, the **[Scale]** slider should be mostly to the left and the **[Highlights]** slider should be mostly to the right.
8. Press **[Stop!]** when you want it to stop taking additional images.
9. If you want to save the image to be viewed on other computers press **[Export...]**, then type in a name with ".jpg" at the end.

USING THE AUTOGUIDER (Artemis Only)

- Without using the autoguider, you are limited to exposures of 5 to 10 minutes (depending on the part of the sky being pointed at) before you start to notice smearing in the image. This is because of slight imperfections in the pointing and tracking accuracy of the telescope. With the autoguider running, you can boost your exposures to around an hour (perhaps higher, but it's best to take multiple exposures at that point).
 - The autoguider on Artemis is the piggyback telescope.
1. Slew to a 3rd to 4th magnitude star, ideally close to zenith.
 2. Switch to the **[Autoguider]** pane, and **[Autoguide]** tab, and set the **[Exposure Time]** to 0.005s, then press **[Take Photo]**.
 - a. Adjust the exposure time as needed so the 3rd to 4th magnitude star has good signal to noise but is not saturated.
 3. In the autoguider image (blue window background), **double click** on the star. You should see a grey box flash around the star.
 4. Press **[Calibrate]** to enter the calibration routine, verify the **[Calibrate X (and Y) Relay for]** field is set to 1,000 arcseconds and press **[OK]**. This should move the star down, up, left, right to calibrate how motor movements equate with star movements.
 5. If the calibration is successful and accurate there will be 4 green arrows, on the chart in the confirmation window, that all start at the same point and are at right angles pointing in 4 directions and have approximately the same length.
 - a. If the chart is not as described or it says the calibration failed there are three likely causes. If you cannot identify a possible cause run the calibration again and closely watch the images it takes.
 - i. The star moved off the guider detector while calibrating.
 1. Center the star in the Guider FOV using the jog controls in the **[Telescope]** pane.
 - ii. The star is saturated.
 1. Reduce exposure time.
 - iii. The signal to noise is too low.
 1. Increase exposure time.
 6. Slew to your science target.
 7. In the **[Autoguider]** pane, select the **[Focus Tools]** tab and set the **[Exposure Time]** to 1 second, verify that **[Subframe]** is unchecked, and **[Take Photo Continuously]** is checked.
 8. Press **[Take Photo]**, and make sure that there is a usable guide star (>2,000 counts above background, the higher the better, but not saturated) in the field, that is isolated from other stars and the edge of the image by at least 200 pixels. If you do not have such a star, try increasing the exposure time. You should not need more than 10 seconds.
 9. In the **[Autoguider]** pane and **[Focus Tools]** tab, press **[Abort]**.
 10. In the autoguider image (blue window background), **double click** on your chosen guide star. You should see a grey box flash around the star.
 11. Press **[Autoguide]**. The autoguider will start to take a series of images using a small frame centered on the selected guide star.
 12. Begin your science exposure in the **[Camera]** pane.
 13. Watch both the autoguider image and the "Guide error" numbers on the autoguider window.
 - a. The star should remain in the center of the guide image, and the guide error numbers should stay within 10 pixels of zero. Additionally, you can press **[Graphs]**, in the **[Autoguider]** pane, and **[Focus Tools]** tab, to bring up handy plots of the guiding error

(use the mouse scroll bar to adjust all three graphs to range from -10 to 10 pix). If it stops guiding well, you will need to start again from step 7.

14. When you are done autoguiding, or if you are moving to a new object, simply press **[Abort]** in the **[Autoguider]** pane, and **[Autoguide]** tab. **You must abort guiding before moving to a new object.**

Sommers-Bausch Observatory 20" Deck Telescopes

Closing Procedure



NEVER attempt to disassemble the instruments or remove/change their attached cords.

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Shutting Down the Telescopes

1. **Artemis Only:** If using the piggyback, slew to the **[Piggyback Cover]** position, below the horizon, either by selecting it in the sky view or searching for it in the **[Find]** pane.
2. **Artemis Only:** Replace the red cover(s) on the aperture of the telescope(s) and the eyepiece cover.
3. On the top tool bar in TheSky, press **[Park]**. The telescope will immediately begin to slew back to its park position (on the meridian, above the southern horizon).
4. Ensure that any eyepiece filters that were used are removed and put the mode selector back into eyepiece mode.
5. Rotate the eyepiece/camera assembly so the eyepiece is pointing up.
6. Once the telescope is finished parking, close TheSky.
7. Replace the red cover(s) on the aperture of the telescope(s) and the eyepiece cover.
8. Make sure everything is clear of the roof, just like in the opening procedure. This is particularly important for Friday Night Open House volunteers, as the public will often move the binoculars around the deck.
9. Press the orange (bottom) **[Close]** button on the north wall.
10. Switch back to the first tab in the web browser and complete the logout form.
11. **If there were any issues, either one you fixed yourself, called us for, or is unresolved please also complete the problem report form.**
12. Close all open applications and Shutdown the computer by clicking the start menu and pressing the Shutdown button in the lower left of the start menu.
13. Turn off the TVs, if used, using the remote control.
14. Press the red **[STOP]** button on the Control Panel. You will need to press hard enough to hear and feel a heavy click in the switch.
15. Clean up the deck, put everything back where you found it, turn off the lights, and close the door to the uncovered deck.
16. Perform one final “stop-look-listen” to check for any anomalous lights or noises. If you are the last group in the building, make sure to shut off all lights and lock the front door. *Note: students in the observing or programming classes should be ignored, pretend they are not there, and completely shut down the building.*

NEVER attempt to disassemble the instruments or remove/change their attached cords.

Sommers-Bausch Observatory 20" Deck Telescopes

Safety/Troubleshooting



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General Deck and Building Safety

- After hours, if you do not need building access for students or the public, please keep the front door locked. Anyone who should be in the building after hours by themselves will have key-card access to the front door.
- In a true medical or safety emergency, call 911 and assist them in getting to the observatory. Call Rose Smith directly as soon as you are safe and off the phone with emergency personnel.
- Both the roof and the telescopes have the potential to seriously harm people or objects on the deck. Always make sure that people and objects are well away from danger before moving the roof or telescopes. Always yell “slewing” or (“moving the telescopes” for the public) before moving the telescopes. Remember that during busy nights, the deck might be loud enough that people have a hard time hearing yelling, so you may have to physically go to people in the way and get them to move.
- It is possible to get locked out on the open deck when the doors close and latch. Always check the deck before leaving to make sure nobody is trapped. If you become stuck on the open deck, **DO NOT** try to climb down over the walls.

Troubleshooting

- **The eyepiece/camera is not showing anything** – Make sure that the mode selector knob on the instrument pack is on the correct setting and turn it all the way until it stops. Also make sure you have removed the covers from the telescope.
- **The camera is not displaying an image** – Make sure that you are using an exposure length that is correct for the object you are looking at. Make sure you are using the correct filter as well; narrow-band filters on certain objects may require multi-minute exposures to make anything appear. Also try changing the stretch function in the FITS preview window to check if anything faint is present.
- **The telescope is not responding to slew commands** – Check if the telescope is pointed dangerously close to the horizon. **Carefully** try to manually slew the telescope back towards zenith. Contact SBO staff if this issue continues.

Emergencies

- Deck Emergencies – These are emergencies that can either be fixed with a little troubleshooting, or by calling SBO staff for assistance. These include:
 - **Roof does not close** – If the roof does not close when the close button is pressed or stops moving while it is closing. If possible, attempt to open the roof again for a few seconds, stop it, and then try to close it again. If this does not work, or if it stops again farther up, please call SBO staff.
 - **Weather starts up** – If it begins to rain, snow, or hail at all, immediately work as a team to park the telescopes and close the roof as fast as possible. Also replace the covers on the telescopes as fast as possible. If the roof won't close, use the tarps in the closet to fully cover the telescopes, and **call SBO staff immediately**.
 - **Power loss** – If the building experiences power loss, the telescopes and computers have about 15 minutes of backup power available. Immediately follow the shutdown procedure as quickly as possible. If there is any chance of precipitation, please use the tarps in the closet to cover the telescopes and move as much as possible to dry locations on the deck. The roof is unable to operate without building power. Call SBO staff as soon as possible after completing the shutdown procedure.
- Medical/Safety Emergencies – These are emergencies that necessitate calling 911 immediately. In these emergencies, **always** call 911 first and follow their instructions. They may need assistance getting to the observatory. Call Rose **immediately**, once it is safe to do so (emergency responders have arrived and you are no longer on the phone with 911).
 - If there is someone in the building that you consider to be a potential threat to others in the building, call 911 as soon as it is safe to do so.
 - During an emergency, evacuate as many people as possible. If the emergency is a physical threat and evacuation is not possible, get as many people as possible into the 24" dome and shut and lock the doors. The safest location in the building is the control room and dome for the 24" telescope, as they are behind 2 sets of locked doors from the exterior of the building.
 - Remember not to move injured people, unless leaving them is dangerous.