NOTES FOR SETTING UP THE
SBIG CCD ON THE 16” TELESCOPE

See “The ABC’s of the 16” Meade” manual for general information about setting up the 16” telescope.

1. With the usual setup, i.e., diagonal prism and eyepiece, go to a bright star (from the Meade STAR catalog), center it in the field of view, and match coordinates by pressing and holding the ENTER key. Make sure the finding scope is well aligned (see the 16” manual). After the CCD camera is attached, the finding scope is the only way you'll have to locate an object if it doesn't appear in the CCD frame.

2. Remove the eyepiece and diagonal prism from the telescope and put them back in the orange box.

3. Next attach the parfocal lens to the telescope back plate. The parfocal lens is designed to represent the approximate focus of the CCD when it's attached. The bright star should still be in the center of the field of view; however, it will be out of focus so you must refocus the telescope.

4. Remove the parfocal lens and store it in the warm room.
5. Next, unscrew the black end cap from the back plate of the telescope (see Figure 1). Be careful not to unduly torque the telescope when doing so. If the black end cap won't budge, don't force it but rather seek help from the instructor.

![Figure 1: Removing end cap](image1)

![Figure 2: Attaching JIM](image2)

6. Replace the black end cap with the JMI digital focuser, also known as JIM (see Figure 2). JIM lives in the warm room in a small cardboard box. JIM screws on directly to the back plate of the telescope in the same way as did the black end cap. When screwing JIM to the telescope or replacing the black end cap, again be careful not to unduly torque the telescope. When attaching either of these items, screw until snug but not overly tight; otherwise, you won't be able to remove it.

![Figure 3: Removing T-adapter](image3)

![Figure 4: Inserting CCD adapter](image4)

7. Next you will attach the CCD camera to JIM. While being stored, the camera has a standard T-adapter screwed into it (on the side opposite the cooling fan). That T-adapter must be removed (see Figure 3). Replace it with the grooved CCD adapter that should be stored with JIM. Remove it from JIM before screwing it into the camera (see Figure 4). Again, make it snug but not overly tight; otherwise, it will be difficult if not impossible to unscrew.
8. Next, insert the camera and adapter into JIM and tighten the thumb screw snuggly (see Figure 5). If the adapter must be inserted as far as possible into JIM; otherwise, the thumb screw will not be properly seated in the adapter groove. Proper installation will assure that the camera will not slip out of JIM even if the thumb screw becomes loosened. You should check the thumb screw during the observing run to be sure it is snug. Otherwise, the camera and move and your images might be blurred. Properly installing the camera is essential to protect the camera. (If the $10,000 camera were to slip out and fall to the ground, it would have to be returned to SBIG for repairs and wouldn't be available for the rest of the semester!) Orient the camera so that flat portion is at the bottom and is parallel to the Declination axis. This way, the horizontal rows of the CCD chip will be oriented E W and the vertical columns oriented N S.

Figure 5: Attaching the CCD camera
9. There are two other thumb screws on JIM. One of them engages the smaller drive gear to the larger focus gear. In normal operation, this should be tightened enough to engage the gears. The other thumb screw locks the drive shaft. It's a good idea to begin with this screw tightened as well even though it should be loosened when operating JIM remotely. If both of these screws are loose, the tube attached to the camera is free to “fall” about 4 inches and will appear that it and the camera are in danger of falling to the floor. In fact, there's a “stop” to prevent this from happening; however, you should avoid testing this fail safe mechanism.

10. From the warm room, pass the USB cord (for the CCD) and the phone line (for JIM) through the gray port in the far upper left (as you’re standing in the doorway facing into the room) corner of the warm room. Plug the cords in to their respective instruments. In order to avoid loosening the CCD mount, you should have a firm hold on the camera while inserting any cable into a jack on the CCD. In fact, it is a good idea to have a firm hold on the CCD whenever you attempt to adjust it mechanically.

11. Take the grey phone-looking cable (which is actually a 6-pin RJ12 Reverse Cable) from the CCD camera box and plug one end into the camera and the other end into the CCD Guider port on the telescope control panel. Remember to hold the CCD while doing so.

12. Plug the CCD power supply cable into the CCD case before plugging the power supply into the outlet on the floor. Again, hold the CCD camera while doing so.

13. Finally, plug the power supply power cord into the receptacle on the floor near the base of the telescope. Always do this last, after all the cables have been attached to the CCD camera.

14. Go to the warm room, plug in the computer, and turn it on. The login ID is observer and the password is astro. After the computer boots up, run the program CCDOPS.

15. Under the CAMERA tab, click SETUP. This will attempt to establish a link with the camera.

16. After the connection is established, SETPOINT is where you set the temperature (in degrees C) of the CCD. NOTE: The thermo-electric cooler in the camera can only cool the CCD chip to about 30°C below ambient temperature. Set the temperature to this value and wait for the chip to approach the set temperature. After it has reached the set point, if the cooler power (indicated on the bottom of the monitor) is at or below ~ 90%, there is adequate temperature regulation. If the cooler power is pinned at 100%, then the cooler isn't capable to cool the CCD chip to the set temperature. Raise the set point to something the cooler can comfortably handle. On the other hand, if the power is well below 90%, you can lower the set point temperature.

17. Check to make sure the bright star is centered in the guide scope. If not, move the telescope until it is. Do this with the N S E W keys on the keypad NOT by adjusting the guide scope. When the star is centered in the finder scope, go into the CAMERA tab (on the CCDOPS window) and click GRAB. This is how you take an image. You should be looking at a bright star and so need a very short exposure time. Typing in 0 seconds will take the shortest exposure possible, which is 0.12 seconds for this camera. Even so, the star will undoubtedly saturate the CCD.

18. When the image displays, a box/menu will display also. Setting the zoom factor to 1:2 should display the entire image for you, and not one zoomed in portion. If the star is not in the FOV, you can try taking a longer exposure of a few seconds to maybe 10 seconds. If the star is close to the
edge of the chip, that edge may be slightly illuminated, and can help you find the star. In the worst instances, where you just can’t find the star, you may need to swap out the CCD for the parfocal eyepiece and begin again, i.e., go back to step 3 or maybe even step 1.

19. Now focus the telescope again. The parfocal lens only gives you an approximate focus. It is useful to place the three-holed focus cover over the front lens of the telescope (the same position as the lens cover). This cover is located in a box on the warm room roof. In addition to helping you focus the telescope, it has the advantage of stopping the aperture (reducing the light entering the telescope), which reduces the saturation for a bright star. With the focus cover in place, an out-of-focus image of the star will show three stars, while in-focus images will merge them into one star. With the plate attached, take a quick image. If the three stars are far apart, use the coarse focus knob on the telescope to bring them approximately together. (Remember the convention of always turning the focus knob in the clockwise direction – see the 16” telescope manual.) This will provide a rough focus that will be refined later.

20. Center the star in the CCD frame. Under the TRACK tab, click MOV TELESCOPE. X-PLUS moves the image to the right and Y-PLUS moves the image down. The number you enter for the movement is the number of seconds that the telescope will move (at its “guide” speed). Start off with a 10-second movement to get an idea of how much the image will shift, and then calibrate your movements from there.

21. When the star is centered on the chip, telescope pointing can be corrected by matching coordinates. If the bright star is no longer on the keypad, simple re-enter it after pressing the STAR (#6) key on the keypad. Press ENTER to load the coordinates and then press and hold ENTER to match the coordinates. After doing so it’s a good idea to check the position of the star in the guide scope for future reference. It’s advisable to go to another bright star near to the object you want to observe and match coordinates on it as well. Then the telescope should easily point to your object of interest.

22. Fine Focus: Using the black RJ12 reverse cable in JIM’s box, plug JIM’s keypad to the phone jack hanging on the wall in the warm room. At this point you should go to the observing platform to make sure JIM’s drive gear is engaged. You must loosen the thumb screw that locks the focusing mechanism in order to operate JIM (see 9. Above). Use the GRAB command to take an image of the bright star and use JIM’s keypad to change the focus so as to make the three images merge as closely as possible to a single image. Then remove the three-hole cover from the telescope aperture.

23. Now go to the observing platform and use the guide scope to locate a nearby faint star. Using the N S E W keys on the keypad, move the telescope so that the star is centered in the finding scope. Take a few images of the faint star, to get a good exposure time; ~1 second would be good.

24. Go to the CAMERA tab, and then FOCUS. Set the exposure time; again 1 second is good if it gives a relatively strong signal. This mode will keep on taking exposures one-after-the-other. Set a PLANET frame, and adjust the frame location and size. The smaller the size, the shorter the readout time, which is good. However, once the readout time is a small fraction of the exposure time, there is no point in making the PLANET frame smaller. Use JIM’s keypad to precisely focus the image as the exposures are taken. You can do this both visually and by noting the peak ADU counts, which is given in a side box. If you are using multiple filters, it’s a good idea to focus on
each filter. Simply record the best focus number for each filter. Finally, the focus of a telescope will change during the night if the ambient temperature changes. You should check the focus several times during your observing run.

25. A few helpful CCDOPS hints.
   a. Filters: There are four broad band filters in the filter wheel: $B$, $V$, $R$, and $I$. These can be changed by the CCDOPS program which designates them as $B$, $G$, $R$, and Infrared.
   b. AUTOGRAB takes a series of images and automatically saves them to a specified directory.
   c. You most likely want to select AUTO for the DARK FRAME, unless the CCD has been cooled to well below 0°C. CCDOPS will automatically subtract the dark frame and bias from the science image. Your instructor will usually specify whether DARKs are necessary.
   d. FLATS: Move the dome until the piece of masking tape at the bottom of the rotating dome lines up with the piece right next to the dome gear box. The flat screen is now properly in place. Move the telescope so that it is pointing to the illuminated screen. Plug in the flat lights with the large orange plug. Usually take 4 exposures per filter with exposure times such that the signal is in the 5000 to 10,000 ADU range. The DISPLAY/CROSSHAIRS allows you to query the signal level in any part of the image.
   e. DARKS: If darks are taken during the early evening hours when it is still somewhat light outside, take care to cover the dome windows with the aluminum covers. The dome shutter should be closed.

Shutting down

26. The park spot for the dome is also when the masking tape pieces line up.
27. Slew telescope to 0 Dec and 0 hour angle.
28. Turn power off on telescope control panel.
29. Shut down CCDOPS and then computer. It’s advisable to unplug the computer as well.
30. Turn off JIM’s keypad and unplug it from the white phone jack hanging on the wall.
31. Unplug CCD and telescope power cords floor receptacles.
32. Unplug various cords to instruments (phone cords, CCD power cord, and USB cable).
33. Unplug telescope keypad and put back in the orange box.
34. Remove CCD from JIM. Bring CCD and CCD power supply back to warm room to put away. Remove the grooved CCD adapter from the camera and replace it with the T-adapter.
35. Remove JIM from telescope and put him away. Secure the grooved CCD adapter in JIM for storage.
36. Screw the black end cap onto the back plate of the telescope (remember not to over tighten) and attached plastic cap to it.

37. Put primary lens cover on the main telescope and the lens cap on the finding scope.

38. Put the plastic dust cover back on telescope.

39. Unplug floor lights, plug bird/squirrel repeller back in, flip lights and the dome power switches off.

40. Put toolbox back in the metal cabinet.