Setting up for an Astronomical Viewing Session

By Louis Grace

Introduction

The UCSB physics department has three Celestron® Super C8 Plus telescopes, and one Celestron® NexStar 11-GPS telescope, so that professors and their students can examine a variety of astronomical objects. These telescopes, along with an assortment of oculars and accessories, are stored in two places:

1) The NexStar 11-GPS telescope is housed in an enclosure atop a tripod at the south end of the deck on the west side of the roof of Broida Hall (six-story wing). Inside this enclosure with the telescope are a plastic screw-top tub containing the star diagonal and visual back, three oculars (a 40-mm Plössl, a 25-mm super-modified achromat and a 10-mm Plössl) and a compass, a beige power strip and a short, orange extension cord. There is also a heater to prevent dew from condensing on the telescope. The heater itself is usually wrapped around the telescope tube, and the power supply and control for it sit on the base of the enclosure.
2) The three Super C8 Plus telescopes are stored in a small room at the top of the stairwell at the northeast corner of the six-story section of Broida. You need a special key to get into this room. One copy is available for loan from the lecture demonstrations area. The three telescopes sit against the wall opposite the door. In a cabinet next to the door are the following:
   a) A green power strip with a long, orange extension cord and two black extension cords.
   b) Three brown plastic cases. Initially, all of these contained oculars and other accessories. Odds are that all the lenses are now in one box. Each of the C8 telescopes should have one ocular, and a 10-mm ocular is with the NexStar 11. Minus this 10-mm and whichever lenses are in the C8 telescopes, there should be the following eyepieces: three 7-mm orthoscopic, two 10-mm Plössl, three 26-mm Plössl, three 36-mm Plössl and one 56-mm super Plössl. All fit a standard 1-1/4-inch mount, except the super Plössl, which fits a 2-inch mount. Inside the cases are also some lens paper, allen wrenches and a Polaris guiding plate (used to adjust for the offset between Polaris and the true celestial pole).
   c) A seasonal star chart (and other astronomy references).
   d) A Celestron® Neximage model 93712 solar system imager (CCD camera) and reducer lens (Celestron® model 94178).
   e) Several solar filters, one for the NexStar 11, and three others to fit each of the C8 scopes. There is also a Daystar H alpha filter combination for a C8 scope.

The 56-mm super Plössl affords the widest field of view of any of the oculars. To increase the field of view even farther, there is also a reducer/corrector, which shortens the effective focal length of the telescope by 37%, thus increasing the field of view by about 59%. This goes between the rear cell and the visual back, and is installed on the C8 telescope that has the 2-inch star diagonal on it. The 2-inch star diagonal has an insert so that it can accept either a 1-1/4-inch or a 2-inch ocular.

Setting up

The enclosure for the NexStar 11 should have within it everything necessary to operate that telescope (unless you would like to use an ocular of a different focal length from any of those in the enclosure). For instructions on how to set up the NexStar 11, please see *Observing Procedure for C11 GPS*.

To set up the Super C8 Plus telescopes, carefully remove them from the closet and carry them over to the deck at the east end of the roof. Place them where you think it most convenient. The Super C8 Plus has a clock drive, which enables it to track an object as it moves across the sky. Each telescope should have a line cord plugged into the clock drive, and wrapped around the back of the wedge. For each telescope, do the following:

1) Set the tripod so that the wedge faces north, and the axis about which the yoke rotates is in a plane pointing north. (NOTE: Depending on exactly how the wedge is attached to the top of the tripod, the yoke axis may not line up exactly with one of the legs. Be sure of what you are sighting when you try to aim the yoke.)
2) Adjust the tripod legs so that the scope is at the desired height, and the top of the tripod is level. A bubble level on the tripod head allows you to check this.
3) A lock at the top of one prong of the yoke fixes the declination. You can release this lock to rotate the telescope to the desired declination. Before you aim at an object for viewing, it is good to set the fine adjustment for the declination so that it is somewhere in the middle of its travel. That way, when you point the telescope to an object and retighten the lock, you should not have to worry that you will run out of range on the fine adjustment.
4) A lock at the base of the yoke fixes the yoke to the clock drive. Releasing this lock allows you to rotate the yoke to point the telescope to the desired location (right ascension). A knob next to this lock allows you to make fine adjustments to the right ascension.
5) Once you have the tripod at the right height and level, and roughly pointed, you can verify (or adjust) the northern alignment by pointing the telescope towards Polaris and centering it in the eyepiece. (It should be centered in both the finder scope and the eyepiece of the main telescope. If it is not, the finder scope should be adjusted.) To do this, loosen the release on the pivot at the top of the yoke, and swing the telescope tube until it is parallel with the yoke. If the telescope is not pointed directly at Polaris, rotate the tripod until it is. (If the tube and yoke are straight and the declination is off, the wedge is probably not adjusted properly.)
6) Plug in the clock drive. If you are also using the NexStar 11, plug the long orange extension cord into the beige power strip, which should be plugged into the outlet on the parapet near the tripod of the NexStar 11. If you are not using the NexStar 11, plug the orange cord directly into the outlet. Plug the green power strip into the orange extension cord. Now you can plug each of the Super C8 Plus scopes either directly into the green power strip, or into one of the black extension cords, which then goes into the green power strip.

Select an object at which to point the telescope. By using the aforementioned adjustments and locks, point the telescope at the object, lock it in place, and make any fine adjustments necessary. If the alignment is good, the object should stay in the field of view during the viewing session. Depending on how good the alignment is, you may have to make small adjustments periodically to keep the object in view. Note: The dial at the base of the yoke is moveable, so you can rotate it so that the appropriate time of day lines up with the reference mark (depending on whether you have the telescope pointed

towards the horizon, vertically, or towards an object whose right ascension you know). The degree scales on the pivot at either side of the yoke are also moveable, so that you can adjust them for zero or 90 degrees declination, or to the declination of an object whose right ascension and declination you know. Then, if you know the right ascension and declination of an object, you can use the scales to point the telescope towards it.

Putting things away

Once you have finished using all the telescopes, put the NexStar 11 away as described in *Observing Procedure for C11 GPS*.

1) Unplug all the telescopes, and gather the various cords that came from the telescope closet.
2) Replace the cap on the entrance aperture of each telescope, and, making sure that the ocular is held securely in the star diagonal, loosen the locks and rotate the telescope so that the entrance aperture faces the bottom of the yoke, and the ocular is pointing upwards.
3) Gently wind the power cord around the back of the wedge, and tuck the plug into the windings.
4) Gather any unused oculars in the brown case, covering their ends, as is possible, with caps.
5) Carry the telescopes back to the closet, and place them along the back wall so that they clear each other, and both the room door and the left-hand cabinet door clear the closest tripod legs. You may have to shorten the legs a bit to make this easier to do.
6) Place the brown case with the lenses, and the three extension cords, in the cabinet, along with anything else you used.

When you are finished, make sure that the door to the telescope closet is locked, and that all roof entrances are locked.

A note on magnification and field of view

The magnification of a telescope is the ratio of its focal length to that of the eyepiece ($M = f_o/f_e$). The focal length of the NexStar 11 is 2800 mm, and that of the Super C8 Plus is 2000 mm. The field of view (FOV) is the apparent FOV of the eyepiece divided by the magnification. All the oculars have an apparent FOV of 46°, except for the 25-mm SMA and the 56-mm super Plössl, whose apparent FOV is 52°. As noted above, insertion of the corrector/reducer increases FOV by about 59%. This corresponds to a reduction in magnification of about 37%.

For example, if we wish to know the magnification and field of view of the NexStar 11 with the 25-mm SMA eyepiece, the focal length ratio gives M = 2800 mm/25 mm = 112, and the apparent field of view of this eyepiece divided by the magnification gives FOV = 52°/112 = 0.46°. If we installed the corrector/reducer, the effective focal length of the telescope would be 1764 mm, and we would have M = 71 and FOV = 52°/71 = 0.74°.

If you know the angle subtended by the object that you would like to see in the telescope, with these calculations you can determine whether or not the object will fit within the field of the eyepiece, or how much of the field it will occupy. The table below gives the results of these calculations for the various

oculars in each of the telescopes. For each combination, **M** is the magnification for the telescope and eyepiece only, and **FOV** is the field of view for the same combination. $\mathbf{FOV_{corr}}$ is the field of view for that combination with the corrector/reducer inserted. **M**, of course would be decreased by an amount corresponding to the increase in **FOV** as described above.

NexStar 11-GPS and:	M	FOV	FOV_{corr}
7-mm orthoscopic	400	0.12°	0.18°
10-mm Plössl	280	0.16°	0.26°
25-mm SMA	112	0.46°	0.74°
26-mm Plössl	108	0.43°	0.67°
36-mm Plössl	78	0.59°	0.94°
40-mm Plössl	70	0.66°	1.04°
56-mm Super Plössl	50	1.0°	1.6°

Super C8 Plus and:	M	FOV	FOV_{corr}
7-mm orthoscopic	286	0.16°	0.26°
10-mm Plössl	200	0.23°	0.36°
25-mm SMA	80	0.65°	1.03°
26-mm Plössl	77	0.60°	0.95°
36-mm Plössl	56	0.83°	1.3°
40-mm Plössl	50	0.92°	1.5°
56-mm Super Plössl	38	1.4°	2.3°