



Schmidt-Cassegrain Optical Tube Assembly

Instruction Manual

C8



C9.25



C11



C14

A telescope is an instrument that collects and focuses light. The nature of the optical design determines how the light is focused. Some telescopes, known as refractors, use lenses. Other telescopes, known as reflectors, use mirrors. The Schmidt-Cassegrain optical system (or Schmidt-Cass for short) uses a combination of mirrors and lenses and is referred to as a compound or catadioptric telescope. This unique design offers large-diameter optics while maintaining very short tube lengths, making them extremely portable. The Schmidt-Cassegrain system consists of a zero power corrector plate, a spherical primary mirror, and a secondary mirror. Once light rays enter the optical system, they travel the length of the optical tube three times.

The optics of the Celestron Schmidt-Cassegrain telescopes have Starbright® coatings - enhanced multi-layer coatings on the primary and secondary mirrors for increased reflectivity and a fully coated corrector for the finest anti-reflection characteristics.

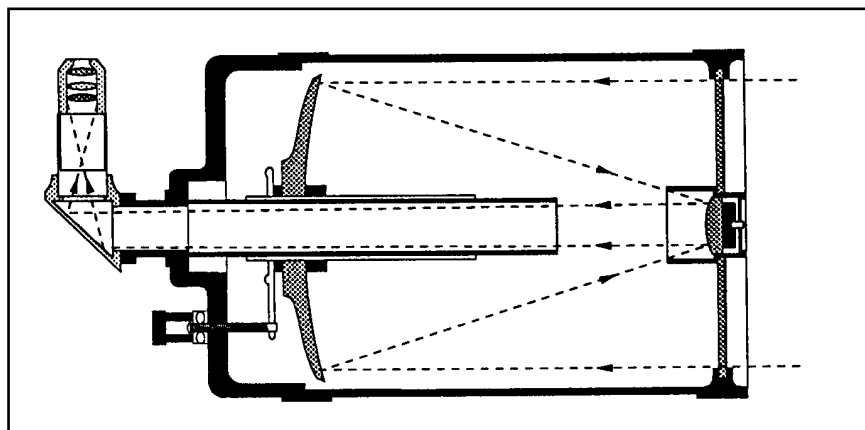


Figure 1-1
A cutaway view of the light path of the Schmidt-Cassegrain optical design

	8" OTA	8" OTA-CF	9.25" OTA	9.25" OTA-CF	11" OTA	11" OTA-CF	14" OTA	14" OTA
Part Number	91024	91023	91027	91026	91036	91035	91037	91038-XLT
Focal Length	2032mm F/10	2032mm F/10	2350mm F/10	2350mm F/10	2800mm F/10	2800mm F/10	3910mm F/11	3910mm F/11
Eyepiece	25mm – 1.25" (81x)	25mm - 1.25" (81x)	25mm - 1.25" (94x)	25mm - 1.25" (94x)	40mm - 1.25" (70x)	40mm - 1.25" (70x)	40mm - 2" (98x)	40mm - 2" (98x)
Star Diagonal	90° - 1.25"	90° - 1.25"	90° - 1.25"	90° - 1.25"	90° - 1.25"	90° - 1.25"	90° - 2"	90° - 2"
Finderscope	6x30	6x30	6x30	6x30	9x50	9x50	9x50	9x50
Optical Tube	Aluminum	Carbon Fiber	Aluminum	Carbon Fiber	Aluminum	Carbon Fiber	Aluminum	Aluminum
Fastar Compatible	No	Yes	No	No	No	No	No	Yes

Attaching the Visual Back

The visual back is the accessory that allows you to attach all visual accessories to the telescope. The 8", 9.25" and 11" optical tubes come with the visual back installed. The 14" OTA comes with a thread on 2" star diagonal instead of a visual back. If it is not already on the tube it can be attached as follows:

1. Remove the rubber cover on the rear cell.
2. Place the knurled slip ring on the visual back over the threads on the rear cell (Fig 1-2).
3. Hold the visual back with the set screw in a convenient position and rotate the knurled slip ring clockwise until tight.

Once this is done, you are ready to attach other accessories, such as eyepieces, diagonal prisms, etc.

If you want to remove the visual back, rotate the slip ring counterclockwise until it is free of the rear cell.

Installing the Star Diagonal

The star diagonal is a prism that diverts the light at a right angle to the light path of the telescope. This allows you to observe in positions that are physically more comfortable than if you looked straight through.

To attach the star diagonal onto the 8", 9.25" and 11" optical tubes:

1. Turn the set screw on the visual back until its tip no longer extends into (i.e., obstructs) the inner diameter of the visual back.
2. Slide the chrome portion of the star diagonal into the visual back.
3. Tighten the set screw on the visual back to hold the star diagonal in place.

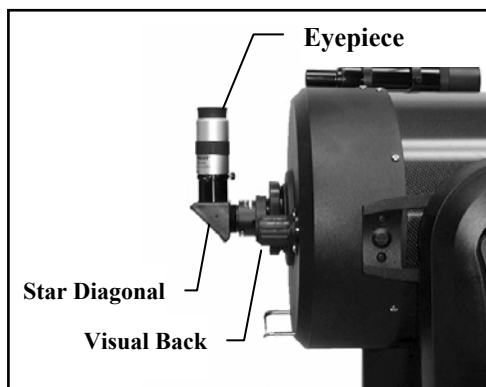


Figure 1-2 – 8", 9.25" and 11" Rear Cell

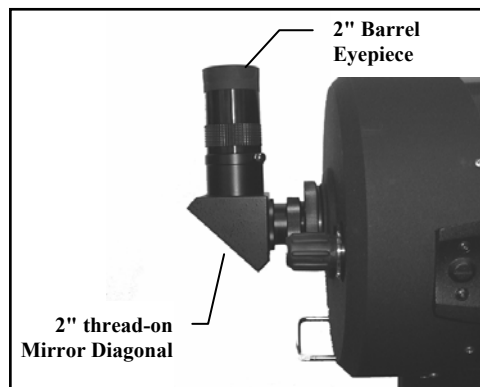


Figure 1-3 – 14" Rear Cell

The 14" OTA comes with a 2" mirror diagonal that attaches directly onto the rear threads of the optical tube. See figure 1-3.

If you wish to change the orientation of the star diagonal, loosen the set screw on the visual back until the star diagonal rotates freely. Rotate the diagonal to the desired position and tighten the set screw.

Installing the Eyepiece

The eyepiece, or ocular, is an optical element that magnifies the image focused by the telescope. The eyepiece fits into either the visual back directly or the star diagonal. To install an eyepiece:

1. Loosen the set screw on the star diagonal until the tip no longer extends into the inner diameter of the eyepiece end of the diagonal.
2. Slide the chrome portion of the eyepiece into the star diagonal.

3. Tighten the set screw on the star diagonal to hold the eyepiece in place.

To remove the eyepiece, loosen the set screw on the star diagonal and slide the eyepiece out. You can replace it with another eyepiece (purchased separately).

Eyepieces are commonly referred to by focal length and barrel diameter. The focal length of each eyepiece is printed on the eyepiece barrel. The longer the focal length (i.e., the larger the number) the lower the eyepiece power and the shorter the focal length (i.e., the smaller the number) the higher the magnification. Generally, you will use low-to-moderate power when viewing. For more information on how to determine power, see the section on "Calculating Magnification."

Installing the Finderscope

The Celestron tube assembly come with a finderscope used to help you locate and center objects in the main field of your telescope. To accomplish this, the finder has a built-in cross-hair reticle that shows the optical center of the finderscope.

Start by removing the finder and hardware from the plastic wrapper. Included are the following:

- Finderscope
- Finder Bracket
- Rubber O-ring
- Three Nylon Tipped Thumbscrews (10-24x1/2")
- Two Phillips Head Screws (8-32x1/2" or 10-24x1/2")

To install the finderscope:

1. Attach the bracket to the optical tube. To do this, place the curved portion of the bracket with the slot over the two holes in the rear cell. The bracket should be oriented so that the rings that hold the finder are over the telescope tube, not the rear cell (see Fig 1-4). Start threading the screws in by hand and tighten fully with an Allen wrench.
2. Partially thread-in the three nylon-tipped thumbscrews that hold the finder in place inside the bracket. Tighten the screws until the nylon heads are flush with the inner diameter of the bracket ring. Do NOT thread them in completely or they will interfere with the placement of the finder. (Having the screws in place when the finder is installed will be easier than trying to insert the screws after the finder has been installed.)
3. Slide the rubber O-ring over the back of the finder (it will NOT fit over the objective end of the finder). It may need to be stretched a little. Once on the main body of the finder, slide it up about one inch from the end of the finder.
4. Rotate the finder until one cross hair is parallel to the R.A. axis and the other is parallel to the DEC axis.
5. Slide the eyepiece end of the finder into the front of the bracket.



Figure 1-4

6. Slightly tighten the three nylon tipped thumbscrews on the front ring of the bracket to hold the finder in place.
7. Once on, push the finder back until the O-ring is snug inside the back ring of the finder bracket.
8. Hand tighten the three nylon tipped thumbscrews until snug.

Aligning the Finderscope

Accurate alignment of the finder makes it easy to find objects with the telescope, especially celestial objects. To make aligning the finder as easy as possible, this procedure should be done in the daytime when it is easy to find and identify objects. The finderscope has three adjustment screws that put pressure on the finderscope while adjusting the finder horizontally and vertically. To align the finder:

- 1 Choose a target that is in excess of one mile away. This eliminates any possible parallax effect between the telescope and finder.
- 2 Release the altitude and azimuth clamps and point the telescope at your target.
- 3 Center your target in the main optics of the telescope. You may have to move the telescope slightly to center it.
- 4 Adjust the screw on the finder bracket that is on the right (when looking through the finder) until the crosshairs are centered horizontally on the target seen through the telescope.
- 5 Adjust the screw on the top of the finder bracket until the crosshairs are centered vertically on the target seen through the telescope.

Image orientation through the finder is inverted (i.e., upside down and backwards left-to-right). This is normal for any finder that is used straight-through. Because of this, it may take a few minutes to familiarize yourself with the directional change each screw makes on the finder.

Focusing

The Schmidt-Cassegrain focusing mechanism controls the primary mirror which is mounted on a ring that slides back and forth on the primary baffle tube. The focusing knob, which moves the primary mirror, is on the rear cell of the telescope just below the star diagonal and eyepiece. Turn the focusing knob until the image is sharp. If the knob will not turn, it has reached the end of its travel on the focusing mechanism. Turn the knob in the opposite direction until the image is sharp. Once an image is in focus, turn the knob clockwise to focus on a closer object and counterclockwise for a more distant object. A single turn of the focusing knob moves the primary mirror only slightly. Therefore, it will take many turns (about 30) to go from close focus to infinity.

For astronomical viewing, out of focus star images are very diffuse, making them difficult to see. If you turn the focus knob too quickly, you can go right through focus without seeing the image. To avoid this problem, your first astronomical target should be a bright object (like the Moon or a planet) so that the image is visible even when out of focus. Critical focusing is best accomplished when the focusing knob is turned in such a manner that the mirror moves against the pull of gravity. In doing so, any mirror shift is minimized. For astronomical observing, both visually and photographically, this is done by turning the focus knob counterclockwise.

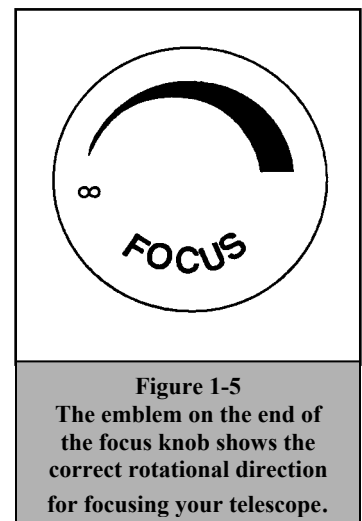


Figure 1-5
The emblem on the end of the focus knob shows the correct rotational direction for focusing your telescope.

C14 Users: Before turning the focus knob, remember to loosen the two mirror locking knobs located on the rear cell of the telescope. These knobs connect a screw to the primary mirror mounting plate and prevent the mirror from moving when locked down. These screws should be locked down when transporting the telescope.

Image Orientation

The image orientation changes depending on how the eyepiece is inserted into the telescope. When using the star diagonal, the image is right-side-up, but reversed from left-to-right (i.e., mirror image). If inserting the eyepiece directly into the visual back (i.e., without the star diagonal), the image is upside-down and reversed from left-to-right (i.e., inverted). This is normal for the Schmidt-Cassegrain design.



Figure 1-6

Calculating Magnification

You can change the power of your telescope just by changing the eyepiece (ocular). To determine the magnification of your telescope, simply divide the focal length of the telescope by the focal length of the eyepiece used. In equation format, the formula looks like this:

$$\text{Magnification} = \frac{\text{Focal Length of Telescope (mm)}}{\text{Focal Length of Eyepiece (mm)}}$$

Let's say, for example, you are using the 40mm Plossl eyepiece. To determine the magnification you simply divide the focal length of your telescope (the C8 OTA for example has a focal length of 2032mm) by the focal length of the eyepiece, 40mm. Dividing 2032 by 40 yields a magnification of 51 power.

Although the power is variable, each instrument under average skies has a limit to the highest useful magnification. The general rule is that 60 power can be used for every inch of aperture. For example, the C8 is 8 inches in diameter. Multiplying 8 by 60 gives a maximum useful magnification of 480 power. Although this is the maximum useful magnification, most observing is done in the range of 20 to 35 power for every inch of aperture which is 160 to 280 times for the C8 telescope.

Determining Field of View

Determining the field of view is important if you want to get an idea of the angular size of the object you are observing. To calculate the actual field of view, divide the apparent field of the eyepiece (supplied by the eyepiece manufacturer) by the magnification. In equation format, the formula looks like this:

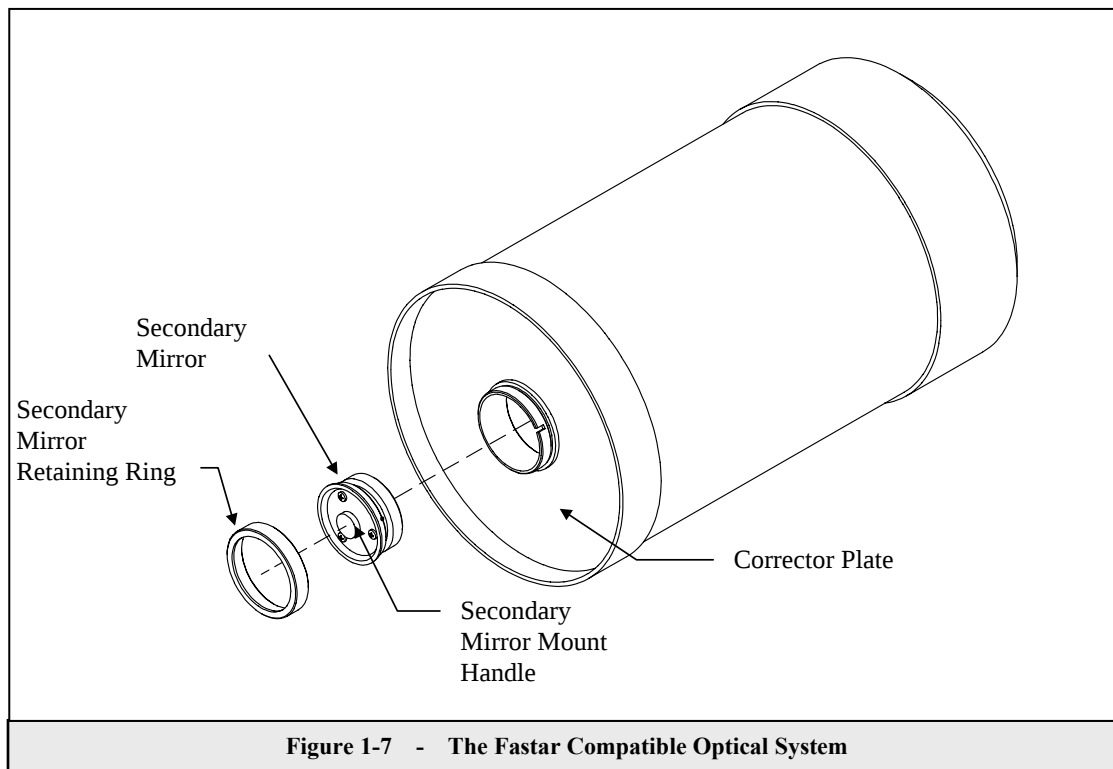
$$\text{True Field} = \frac{\text{Apparent Field of Eyepiece}}{\text{Magnification}}$$

As you can see, before determining the field of view, you must calculate the magnification. Using the example in the previous section, we can determine the field of view using the same 40mm eyepiece. The 40mm Plossl eyepiece has an apparent field of view of 46°. Divide the 46° by the magnification, which is 51 power. This yields an actual field of .9°, or nearly a full degree.

To convert degrees to feet at 1,000 yards, which is more useful for terrestrial observing, simply multiply by 52.5. Continuing with our example, multiply the angular field .9° by 52.5. This produces a linear field width of 47 feet at a distance of one thousand yards. The apparent field of each eyepiece that Celestron manufactures is found in the Celestron Accessory Catalog (#93685).

Fastar Lens Assembly Option – Using your CGE telescope at f/2 with optional Fastar Lens Assembly

Some C8 and C14 optical tubes are equipped with a removable secondary mirror (see Table 1-1) that allows you to convert your f/10 telescope into an f/2 imaging system capable of exposure times 25 times shorter than those needed with a f/10 system! With the optional Fastar lens assembly you can easily convert your Fastar compatible telescope to f/2 prime focus use in a matter of seconds.



The Fastar compatible CGE telescope's versatility allows it to be used in many different f-number configurations for CCD imaging. It can be used at f/2 (with optional Fastar Lens Assembly), f/6.3 (with the optional Reducer/Corrector), f/10, and f/20 (with the optional 2x Barlow) making it the most versatile imaging system available today. This makes the system ideal for imaging deep-sky objects as well as planetary detail. Described below is the configuration of each F-number and the type of object best suited to that kind of imaging.

The above figure shows how the secondary mirror is removed when using the optional CCD camera at f/2 and the Fastar Lens Assembly.

Warning: The secondary mirror should never be removed unless installing the optional Fastar Lens Assembly. Adjustments to collimation can easily be made by turning the screws on the top of the secondary mirror mount without ever having to remove the secondary mirror (see Telescope Maintenance section of this manual).

The F/# stands for the ratio between the focal length and the diameter of the light gathering element. A C8 optical tube has a focal length of 80 inches and a diameter of 8 inches. This makes the system an f/10, (focal length divided by diameter). However, the C14 optical tube has a 154 inch focal length with a F-ratio of f/11. When the secondary is removed and the CCD camera is placed at the Fastar position, the system becomes f/2, this is a unique feature to some Celestron telescopes (see figures below).

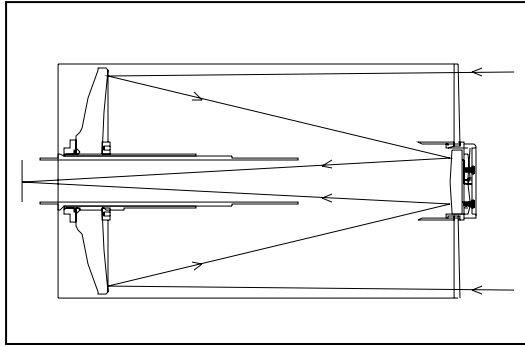


Figure 1-8

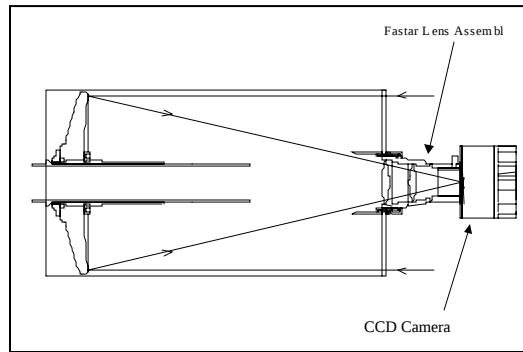


Figure 1-9

The key factors for good CCD imaging are; exposure time, field-of-view, image size, and pixel resolution. As the F/# goes down (or gets faster), the exposure times needed decreases, the field-of-view-increases, but the image scale of the object gets smaller. What is the difference between f/2 and f/10? F/2 has 1/5 the focal length of f/10. That makes the exposure time needed about 25 times shorter than at f/10, the field of view 5 times larger and the object size 1/5 compared to that of f/10. (see Table below)

	Telescope Model	Standard Cassegrain f/10	With Reducer/Corrector f/6.3	With Fastar Lens Accessory f/2
FOCAL LENGTH & SPEED	CGE 800	80" (2032mm)	50.4" (1280mm)	16" (406.4mm)
	CGE 1400	154" (3910mm)	88.2" (2239mm)	29.4" (746mm)
ST 237 F.O.V.*	CGE 800	8 x 6.1 (arc min)	12.6 x 9.7 (arc min)	40 x 30 (arc min)
	CGE 1400	4 x 3 (arc min)	7 x 5.5 (arc min)	22 x 17 (arc min)

* Field of view calculated using SBIG ST 237 CCD camera with 4.7mm x 3.6mm chip.

Table 1-2

Care and Cleaning of the Optics

Occasionally, dust and/or moisture may build up on the corrector plate of your telescope. Special care should be taken when cleaning any instrument so as not to damage the optics.

If dust has built up on the corrector plate, remove it with a brush (made of camel's hair) or a can of pressurized air. Spray at an angle to the lens for approximately two to four seconds. Then, use an optical cleaning solution and white tissue paper to remove any remaining debris. Apply the solution to the tissue and then apply the tissue paper to the lens. Low pressure strokes should go from the center of the corrector to the outer portion. **Do NOT rub in circles!**

You can use a commercially made lens cleaner or mix your own. A good cleaning solution is isopropyl alcohol mixed with distilled water. The solution should be 60% isopropyl alcohol and 40% distilled water. Or, liquid dish soap diluted with water (a couple of drops per one quart of water) can be used.

Occasionally, you may experience dew build-up on the corrector plate of your telescope during an observing session. If you want to continue observing, the dew must be removed, either with a hair dryer (on low setting) or by pointing the telescope at the ground until the dew has evaporated.

If moisture condenses on the inside of the corrector, remove the accessories from the rear cell of the telescope. Place the telescope in a dust-free environment and point it down. This will remove the moisture from the telescope tube.

To minimize the need to clean your telescope, replace all lens covers once you have finished using it. Since the rear cell is NOT sealed, the cover should be placed over the opening when not in use. This will prevent contaminants from entering the optical tube.

Internal adjustments and cleaning should be done only by the Celestron repair department. If your telescope is in need of internal cleaning, please call the factory for a return authorization number and price quote.

Collimation

The optical performance of your telescope is directly related to its collimation, that is the alignment of its optical system. Your telescope was collimated at the factory after it was completely assembled. However, if the telescope is dropped or jarred severely during transport, it may have to be collimated. The only optical element that may need to be adjusted, or is possible, is the tilt of the secondary mirror.



Figure 1-10
The three collimation screws are located on the front of the secondary mirror housing.

To check the collimation of your telescope you will need a light source. A bright star near the zenith is ideal since there is a minimal amount of atmospheric distortion. Make sure that tracking is on so that you won't have to manually track the star. Or, if you do not want to power up your telescope, you can use Polaris. Its position relative to the celestial pole means that it moves very little thus eliminating the need to manually track it.

Before you begin the collimation process, be sure that your telescope is in thermal equilibrium with the surroundings. Allow 45 minutes for the telescope to reach equilibrium if you move it between large temperature extremes.

To verify collimation, view a star near the zenith. Use a medium to high power ocular — 12mm to 6mm focal length. It is important to center a star in the center of the field of view. To judge collimation. Slowly cross in and out of focus and judge the symmetry of the star. If you see a systematic skewing of the star to one side, then re-collimation is needed.

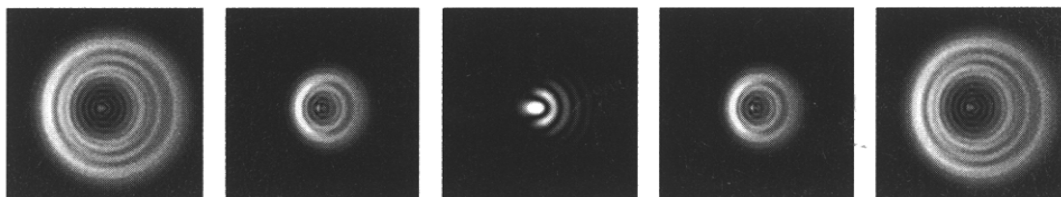


Figure 1-11 -- Even though the star pattern appears the same on both sides of focus, they are asymmetric. The dark obstruction is skewed off to the left side of the diffraction pattern indicating poor collimation.

To accomplish this, you need to tighten the secondary collimation screw(s) that move the star across the field toward the direction of the skewed light. These screws are located in the secondary mirror holder (see figure 1-10). Make only small 1/6 to 1/8 adjustments to the collimation screws and re-center the star by moving the scope before making any improvements or before making further adjustments.

To make collimation a simple procedure, follow these easy steps:

1. While looking through a medium to high power eyepiece, de-focus a bright star until a ring pattern with a dark shadow appears (see figure 1-11). Center the de-focused star and notice in which direction the central shadow is skewed.
2. Place your finger along the edge of the front cell of the telescope (be careful not to touch the corrector plate), pointing towards the collimation screws. The shadow of your finger should be visible when looking into the eyepiece. Rotate your finger around the tube edge until its shadow is seen closest to the narrowest portion of the rings (i.e. the same direction in which the central shadow is skewed).

3. Locate the collimation screw closest to where your finger is positioned. This will be the collimation screw you will need to adjust first. (If your finger is positioned exactly between two of the collimation screws, then you will need to adjust the screw opposite where your finger is located).
4. Use the hand control buttons to move the de-focused star image to the edge of the field of view, in the same direction that the central obstruction of the star image is skewed.
5. While looking through the eyepiece, use an Allen wrench to turn the collimation screw you located in step 2 and 3. Usually a tenth of a turn is enough to notice a change in collimation. If the star image moves out of the field of view in the direction that the central shadow is skewed, than you are turning the collimation screw the wrong way. Turn the screw in the opposite direction, so that the star image is moving towards the center of the field of view.

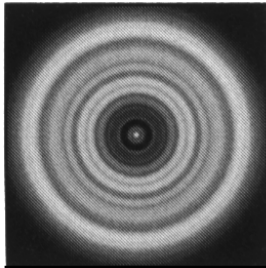


Figure1-12
A collimated telescope should appear symmetrical with the central obstruction centered in the star's diffraction pattern.

6. If while turning you notice that the screws get very loose, then simply tighten the other two screws by the same amount. Conversely, if the collimation screw gets too tight, then loosen the other two screws by the same amount.
7. Once the star image is in the center of the field of view, check to see if the rings are concentric. If the central obstruction is still skewed in the same direction, then continue turning the screw(s) in the same direction. If you find that the ring pattern is skewed in a different direction, than simply repeat steps 2 through 6 as described above for the new direction.

Perfect collimation will yield a star image very symmetrical just inside and outside of focus. In addition, perfect collimation delivers the optimal optical performance specifications that your telescope is built to achieve.

If seeing (i.e., air steadiness) is turbulent, collimation is difficult to judge. Wait until a better night if it is turbulent or aim to a steadier part of the sky. A steadier part of the sky is judged by steady versus twinkling stars.

CELESTRON TWO YEAR WARRANTY

- A. Celestron warrants this telescope to be free from defects in materials and workmanship for two years. Celestron will repair or replace such product or part thereof which, upon inspection by Celestron, is found to be defective in materials or workmanship. As a condition to the obligation of Celestron to repair or replace such product, the product must be returned to Celestron together with proof-of-purchase satisfactory to Celestron.
- B. The Proper Return Authorization Number must be obtained from Celestron in advance of return. Call Celestron at (310) 328-9560 to receive the number to be displayed on the outside of your shipping container.

All returns must be accompanied by a written statement setting forth the name, address, and daytime telephone number of the owner, together with a brief description of any claimed defects. Parts or product for which replacement is made shall become the property of Celestron.

The customer shall be responsible for all costs of transportation and insurance, both to and from the factory of Celestron, and shall be required to prepay such costs.

Celestron shall use reasonable efforts to repair or replace any telescope covered by this warranty within thirty days of receipt. In the event repair or replacement shall require more than thirty days, Celestron shall notify the customer accordingly. Celestron reserves the right to replace any product which has been discontinued from its product line with a new product of comparable value and function.

This warranty shall be void and of no force or effect in the event a covered product has been modified in design or function, or subjected to abuse, misuse, mishandling or unauthorized repair. Further, product malfunction or deterioration due to normal wear is not covered by this warranty.

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Some states do not allow the exclusion or limitation of incidental or consequential damages or limitation on how long an implied warranty lasts, so the above limitations and exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Celestron reserves the right to modify or discontinue, without prior notice to you, any model or style telescope.

If warranty problems arise, or if you need assistance in using your telescope contact:

Celestron
Customer Service Department
2835 Columbia Street
Torrance, CA 90503
Tel. (310) 328-9560
Fax. (310) 212-5835
Monday-Friday 8AM-4PM PST

This warranty supersedes all other product warranties.

NOTE: This warranty is valid to U.S.A. and Canadian customers who have purchased this product from an Authorized Celestron Dealer in the U.S.A. or Canada. Warranty outside the U.S.A. and Canada is valid only to customers who purchased from a Celestron Distributor or Authorized Celestron Dealer in the specific country and please contact them for any warranty service.



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Item # 91024-INST
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