CELESTRON

Collimation Tool – #94183

Collimation

The optical performance of most Newtonian reflecting telescopes can be optimized by re-collimating (aligning) the telescope's optics, as needed. To collimate the telescope simply means to bring its optical elements into balance. Poor collimation will result in optical aberrations and distortions.

Before collimating your telescope, take time to familiarize yourself with all its components. The primary mirror is the large mirror at the back end of the telescope tube. This mirror is adjusted by loosening and tightening the three screws, placed 120 degrees apart, at the end of the telescope tube. The secondary mirror (the small, elliptical mirror under the focuser, in the front of the tube) also has three adjustment screws. To determine if your telescope needs collimation first point your telescope toward a bright wall or blue sky outside.

Never look directly at the sun with the naked eye or with a telescope (unless you have the proper solar filter). Permanent and irreversible eye damage may result.

Aligning the Secondary Mirror

If you have an eyepiece in the focuser, remove it. Rack the focuser tube in completely, using the focusing knobs, until its silver tube is no longer visible. You will be looking through the focuser at a reflection of the secondary mirror, projected from the primary mirror. During this step, ignore the silhouetted reflection from the primary mirror. Insert the collimating cap into the focuser and look through it. With the focus pulled in all the way, you should be able to see the entire primary mirror reflected in the secondary mirror. If the primary mirror is not centered in the secondary mirror, adjust the secondary mirror screws by alternately tightening and loosening them until the periphery of the primary mirror is centered in your view. DO NOT loosen or tighten the center screw in the secondary mirror support, because it maintains proper mirror position.

Aligning the Primary Mirror

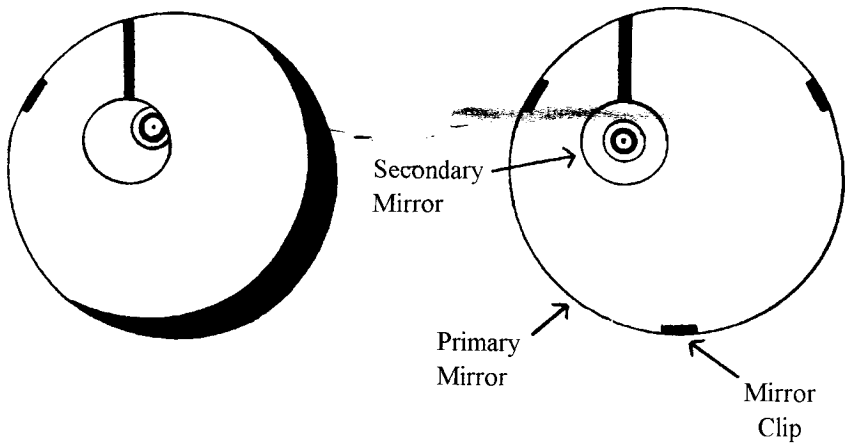
Now adjust the primary mirror screws to re-center the reflection of the small secondary mirror, so it's silhouetted against the view of the primary. As you look into the focuser, silhouettes of the mirrors should look concentric. Repeat steps one and two until you have achieved this.

Remove the collimating cap and look into the focuser, where you should see the reflection of your eye in the secondary mirror.

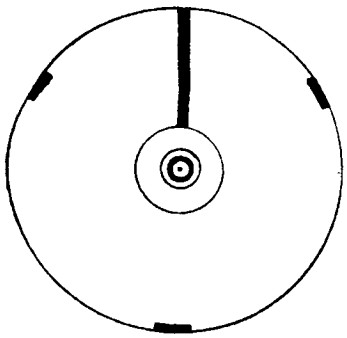
Newtonian collimation views as seen through the focuser using the collimation cap

Secondary mirror needs adjustment.

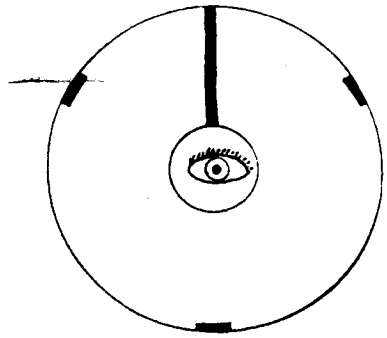
Primary mirror needs adjustment.



Both mirrors aligned with the collimating cap in the focuser.



Both mirrors aligned with your eye looking into the focuser.



Night Time Star Collimating

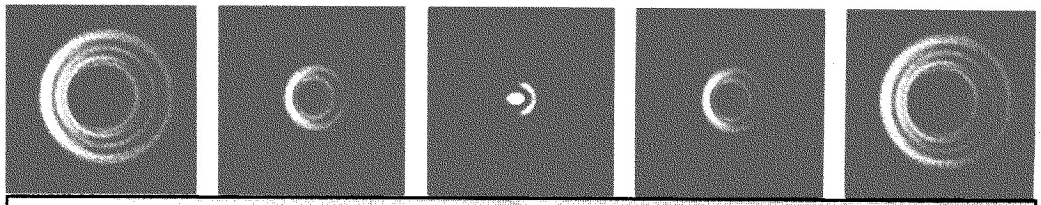
After successfully completing daytime collimation, night time star collimation can be done by closely adjusting the primary mirror while the telescope tube is on its mount and pointing at a bright star. The telescope should be set up at night and a star's image should be studied at medium to high power (30-60 power per inch of aperture). If a non-symmetrical focus pattern is present, then it may be possible to correct this by re-collimating only the primary mirror.

Procedure
(Please read this section completely before beginning)

To star collimate in the Northern Hemisphere, point at a stationary star like the North Star (Polaris). It can be found in the north sky, at a distance above the horizon equal to your latitude. It's also the end star in the handle of the Little Dipper. Polaris is not the brightest star in the sky and may even appear dim, depending upon your sky conditions.

Prior to re-collimating the primary mirror, locate the collimation screws on the end of the telescope tube. These three screws are to be adjusted one at a time. Normally, motions on the order of an $^1/_8$ turn will make a difference, with approximately a $^1/_2$ to $^3/_4$ turn being the maximum required.

With Polaris or a bright star centered within the field of view, focus with either the standard ocular or your highest power ocular, i.e. the shortest focal length in mm, such as a 6mm or 4mm. Another option is to use a longer focal length ocular with a Barlow lens. When a star is in focus it should look like a sharp pinpoint of light. If, when focusing on the star, it is irregular in shape or appears to have a flare of light at its edge, this means your mirrors aren't in alignment. If you notice the appearance of a flare of light from the star that remains stable in location, just as you go in and out of exact focus, then re-collimation will help sharpen the image.



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.

Take note of the direction the light appears to flare. For example, if it appears to flare toward the three o'clock position in the field of view, then you must move whichever screw or combination of collimation screws necessary to move the star's image toward the direction of the flaring. In this example, you would want to move the image of the star in your eyepiece, by adjusting the collimation screws, toward the three o'clock position in the field of view. It may only be necessary to adjust a screw enough to move the star's image from the center of the field of view to about halfway, or less, toward the field's edge (when using a high power ocular).

Collimation adjustments are best made while viewing the star's position in the field of view and turning the adjustment screws simultaneously. This way, you can see exactly which way the movement occurs. It may be helpful to have two people working together: one viewing and instructing which screws to turn and by how much, and the other performing the adjustments.

IMPORTANT: After making the first, or each adjustment, it is necessary to re-aim the telescope tube to re-center the star again in the center of the field of view. The star image can then be judged for symmetry by going just inside and outside of exact focus and noting the star's pattern. Improvement should be seen if the proper adjustments are made. Since three screws are present, it may be necessary to move at least two of them to achieve the necessary mirror movement.

ANSWERS TO FREQUENTLY ASKED QUESTIONS

Q. If I re-collimate the primary mirror, will alignment remain as I set it?
A. Yes, unless or until the telescope is severely jarred or bumped.

Q. Is exact collimation necessary?
A. For the majority of users, the collimation of the telescope, as delivered, will be satisfactory. Probably only those requiring extremely sharp imagery will want or need to perform collimation, and then only once.

Q. Why is it necessary to re-center the star after each mirror adjustment?

A. All Newtonian telescopes have what is called off-axis coma. Due to this, the best images are always obtained in the center of an eyepiece view. Therefore, that is where you should judge star symmetry.

Q. On some nights the star's image fluctuates in size, position and symmetry without my doing anything. What is the cause of this?
A. This represents turbulent "seeing," which is caused by several. Some steps you can take to minimize visual disturbances are to let the telescope tube remain outside for 30 minutes before judging symmetry, allowing time for the temperature within the telescope tube to balance with that of the outer environment. It will also help to wait for a still night or a still time of night. Further, be aware that using your telescope near a heat source such as a rooftop, car hood or any surface retaining daytime heat on a cool night will cause local thermal turbulence and must be avoided.

Q. What if the daytime adjustment appears off after star collimating the primary mirror at night?
A. If star images look great, that is the bottom line. No further adjustment is necessary.

Warranty: Two year limited warranty. See the Celestron Accessory Catalog (#93685) for complete warranty details or contact Celestron
#94183 (0903)

CELESTRON 2835 Columbia Street, Torrance, CA 90503 • Phone (310) 328-9560 • Fax (310) 212-5835