How I Collimate My Schmidt-Cassegrain Telescope

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Amateur Astronomers often fear collimating a Schmidt-Cassegrain Telescope (SCT) for several understandable reasons:

The alignment requires adjusting three small screws at the front of the telescope. This can initially seem more intimidating, or delicate compared to collimating simpler designs, like Newtonian reflectors, where adjustments are more intuitive and visible.

SCT users are often concerned about accidentally cracking or damaging the corrector plate. These corrector plates appear fragile (and indeed, they are sensitive), and even though proper collimation rarely poses a genuine risk to the optics, the possibility of making a costly mistake can cause hesitation.

SCTs have a longer focal ratio (usually around f/10), making precise collimation critical to achieving sharp views, especially for high-resolution planetary or lunar observing. Small misalignments significantly degrade image quality, thus requiring careful, precise adjustments that can seem daunting to beginners.

Amateur astronomers often hear exaggerated stories that make astronomy seem complex. This misinformation can cause unwarranted fear.

Novice users might lack the confidence or skill to interpret star tests accurately or be uncertain about the sequence and incremental nature of collimation adjustments. Without experience or proper mentorship, the task can appear daunting.

Figure 1 - My Meade LX200 on an Atlas EQ G mount.

However, collimation plays a crucial role in maximizing the performance of your telescope. When it comes to aligning the optics of a Schmidt-Cassegrain telescope (SCT), the process is significantly simpler than that of a Newtonian telescope, and with a little practice, anyone can master it.

There are, however, some tips to ensure the process is done correctly and pitfalls to avoid. Ideally, collimation should only be necessary every few months. If you find yourself needing to adjust your

telescope's alignment more often than that, it may indicate that the mirror is not being securely locked in place after adjustments.

It's worth noting that, in my experience, the factory screws on an SCT's secondary mirror are generally superior for collimation compared to aftermarket thumbscrews. Thumbscrews often lack the precision necessary for accurate adjustments and do not hold the mirror as firmly, which can lead to more frequent collimation needs. Additionally, using thumbscrews may lead to a tendency for "collimation overkill," prompting users to adjust their telescopes far more often than needed. With proper usage, you should be able to enjoy months of use before needing to re-collimate your telescope.

Tools Needed

Unlike the collimation process for a Newtonian telescope, aligning a Schmidt-Cassegrain telescope (SCT) does not require any specialized equipment. The only tool needed is a standard screwdriver or hex key wrench for adjusting the screws on the secondary mirror. Be sure to perform the collimation test on a star in clear, dark skies for optimal results.

Procedure

Collimating an SCT involves tweaking the three screws located on the secondary mirror. This adjustment changes the mirror's tilt to ensure proper alignment with the primary mirror, which remains fixed in place. To evaluate the mirror's alignment, you will need to observe an out-of-focus star image.

Star Testing

To conduct the test, you will want to find a first or second magnitude star, preferably high overhead if possible, and center your telescope’s field of view on that star. Defocus the star until it takes on a donut-like appearance. The central hole in this donut represents the shadow of the secondary mirror. If this hole is not perfectly centered within the donut shape, it indicates that adjustments are necessary.

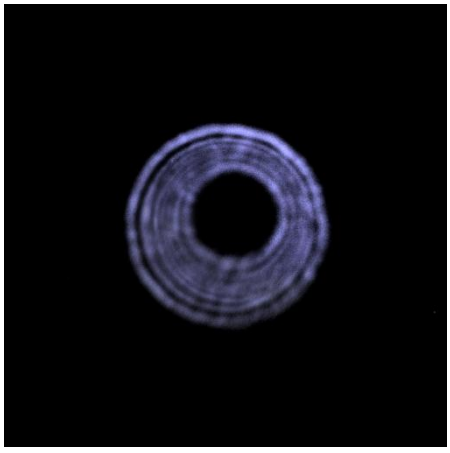

Figure 2 - Uncollimated defocused star.

It's essential to allow your telescope to thermally stabilize before collimation. If the telescope is still cooling to match the ambient temperature, the warm air radiating from the optics can create thermal distortions, misleading you into thinking the telescope is misaligned when it isn’t.

For the star test, select a high-power eyepiece, such as a 10mm or 12mm, which will yield magnifications in the range of 200-300x. Aim for a bright star, ideally one of first magnitude, as your subject. It's crucial to ensure that the star is centered in your field of view during the

collimation test. Observing a star at the edge may introduce distortions, particularly at lower magnifications, potentially leading to incorrect conclusions about the telescope's alignment.

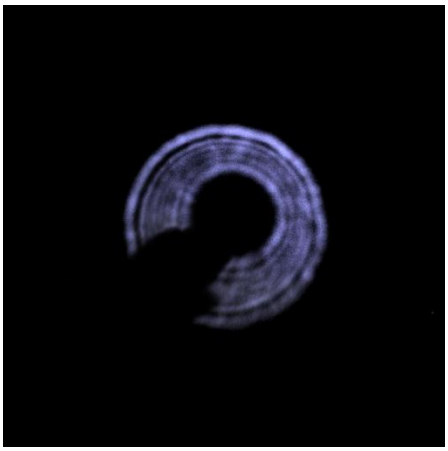

Figure 3 - Shadow of your hand pointing to the widest side of the defocused star.

Finding the correct screw to adjust by pointing to the narrow part of the donut

The next step is to identify which adjustment screw to manipulate. A simple method involves placing your finger in front of the telescope's aperture.

As you do this, you'll notice the shadow of your hand appearing over the star image. Gradually move your finger around until it aligns with either the narrowest or widest part of the donut-shaped defocused star image.

Observe the position of your finger in relation to the secondary mirror screws. Whether your finger is closest to a screw or directly opposite it is not crucial; what matters is determining how to adjust the screw. Depending on whether your finger aligns with the thin or thick portion of the donut, you'll either need to tighten or loosen the corresponding screw to achieve proper collimation.

Whether you need to tighten or loosen the screw you've identified depends on the focus of the star image. A common approach is to tighten the screw first and observe if the star image improves. Keep in mind that adjusting the screw in the right direction will shift the entire star image toward the thicker section of the donut shape. Start by turning the screw about an eighth of a turn.

Repeat this until the shadow of the secondary in a defocused star is centered. ***Be very careful when adjusting the screws that the wrench or screwdriver does not slip and scratch the corrector plate.***

If tightening one screw worsens the collimation, return that screw to its original position and try tightening one of the other two screws instead. It's essential to ensure that all the screws are snug when you're done. Avoid loosening one screw without tightening the others to compensate, as loose screws can result in collimation issues when you move the telescope.

Collimated

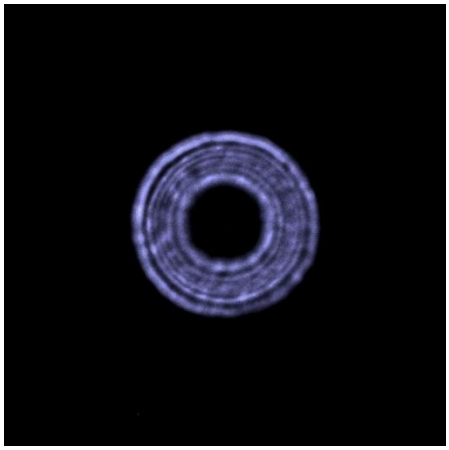

Figure 4 - Collimated defocused image of a star.

Once you've made the necessary screw adjustments, re-center the star in your field of view by repositioning the telescope. After completing the adjustments, ensure that the screws are securely tightened so that the defocused star image appears uniformly concentric, as illustrated below. The star should eventually focus into a crisp point without any irregular flaring. While the overall clarity of the star image will be influenced by the magnification used and the atmospheric conditions, it should ultimately be symmetrical and perfectly After you've tightened the screws, make sure to reposition the telescope so that the star is centered in the field of view. Once you've completed the adjustments, the screws should feel firm and the image of the slightly out-of-focus star should be perfectly symmetrical, as illustrated.

At this stage, you might feel like you've finished, and indeed, your telescope should perform very well optically— so take a moment to congratulate yourself!

However, if you're like me and believe that "good enough" isn't truly good enough, you'll want to make one final adjustment to achieve optimal results. Make slight tweaks to your focus so that the star is just a fraction out of perfect clarity. If your telescope is properly aligned at this point, you should observe a tiny white dot at the center of the shimmering diffraction pattern.

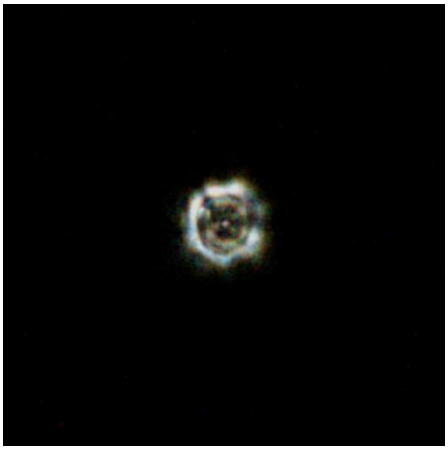

Figure 5- Star image showing Poisson's Spot

Perfectly collimated image as defined by the "Poisson's Spot"

This tiny dot is referred to as "Poisson's Spot" and signifies the true focal center of your diffraction pattern. Achieving perfect centering of this spot is crucial before you consider your adjustments complete.

If it's slightly misaligned, don't hesitate to make minor adjustments to one or more of your collimation screws while striving to keep the star image well-centered.

With patience and determination, you'll eventually witness a stellar sight: the star should come into sharp focus, forming a pristine point without any asymmetrical flaring. The overall clarity of the star image

will vary based on magnification and atmospheric conditions, but it should maintain a symmetrical and flawless appearance.