Amateur Astronomy

Magazine

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The Binocular Summation Factor and its Relevance for Deepsky Observing

Observing the Moon
Part IV

Amateur Telescope Making
Design considerations for building a Sudiball Telescope

Star People
Imaging heaven and earth with Wally Pacholka - 3x Time-Life Picture of the year Photographer

Observing
Deep Dky Treasures
Looking South
Touring The Trumpler Classes
Sunspots

Reviving a Vintage Orange Tube C8 with the The Hotech Collimator

Star Party Calendar
Uncle Rod's Cracker Barrel
Image Gallery
Shorts From Down Under

Issue 81
Winter 2014 **$6.50 US**

Reviving a Vintage C8 with the Hotech Collimator

Article and Photos by Robert Reeves

The Hotech Advanced CT Laser Collimator has four lasers. The center laser projects the alignment cross while the three outer lasers project the beams used to align optical components. The reflected laser beams play across the target face on the collimator to show optical alignment.

Reviving a Legend: Adventures with the Hotech Advanced CT Laser Collimator

The decline began slowly, almost imperceivably at first. After a while, it was noticeable, something was not right with my astronomical companion of nearly four decades. Soon however, it was unmistakable...my friend was sick and getting worse with time. After my long-time observing buddy couldn't perform under the night sky I knew I had to do something. I wasn't going to let my faithful friend fade into oblivion without a fight.

No... none of my human friends were ill, thank goodness! It was my constant astronomical companion for the past 38 years, my beloved orange tube Celestron 8, that was performing worse with time. No mater what I did; clean the optics, collimate the secondary, use a Crayford focuser, install primary mirror locks...nothing perked up my orange tube buddy. Each of my lunar shots taken with an Imaging Source DMK-41 camera were out of focus on one side of the image. The Imaging Source checked the camera and assured me it was fine. For a time I simply cropped the poor half of the image and mosaicked multiple frames. But soon that became a tiresome drudge and something had to be done.

At the height of my imaging frustration I attended the Arizona Science and Astronomy Expo (ASAE) in Tucson in late 2012. My duties there as the Master of Ceremonies left me little time to prowl the 100 astronomy vendors. My friend Rik Hill was under no such limitation and spotted the Hotech Advanced CT Laser Collimator that had been reviewed earlier in Amateur Astronomy by Rod Mollise. As an optician, Rik thought this device may be the solution to my focus problem. He introduced me to optical engineer David Ho, owner of Hotech.

David listened to my optical problem and offered a few suggestions. As I watched him demonstrate the Advanced CT Laser Collimator, I knew what Santa was going to leave me under the Christmas tree.

As Uncle Rod explained in an earlier issue of AA, the Hotech Advanced CT Laser Collimator is a device that projects three parallel laser beams into a Schmidt-Cassegrain telescope. By adjusting the optics in response to how the beams reflect onto a circular target pattern, the telescope can be aligned for optimal performance.

Reviews of the Advanced CT Laser Collimator may leave one with the impression this device is only for use with the popular short-tubed Schmidt-Cassegrain telescopes. The "CT" in the device's name is for "Cassegrain Telescope" and the collimator will work equally well on standard Cassegrain telescopes, though there are few of this style telescope in amateur hands.

The telescope and collimator alignment procedure is a little different without the corrector plate installed. When the collimator is misaligned without the corrector, a dual crosshair pattern will be seen. When the two cross hairs merge, the collimator is aligned with the telescope.

The accuracy of the optical alignment as measured by the Hotech collimator is, of course, dependent upon how parallel the three laser beams are. To assure myself they were parallel, I aimed the collimator at a paper target several inches away and marked the location of the laser spots. I then placed the paper 30 feet away and aimed the lasers at the charted spots. They matched perfectly!

In addition to the instructions packaged with the collimator, David Ho has a number of excellent instructional videos on YouTube that describe the function and operation of the Advanced CT Laser Collimator. Use the search-word "Hotech" to locate them. These videos even include collimating the Celestron Edge HD, a telescope with a removable secondary that simplifies some of the procedures I used on my much older Celestron.

It was thus with great anticipation that I set up the collimator, squared it with my telescope, and performed the sequence of adjustments. The final step was star test the alignment and perform any final tweaks to the SCT secondary. I was shocked to find the classical SCT out-of-focus doughnut looked more like a goose egg. Adjusting the secondary with the star image improved the photographic

Left: ***In order to verify the SCT visual back or aftermarket Crayford focuser is parallel with the telescope's optical path, the corrector plate is removed and the collimator is set up similar to a standard secondary alignment procedure.*** **Right:** ***With the corrector removed, the collimator's projected cross is centered on the Hotech eyepiece reflector target if the visual back or aftermarket focuser is aligned with the optical axis of the telescope.***

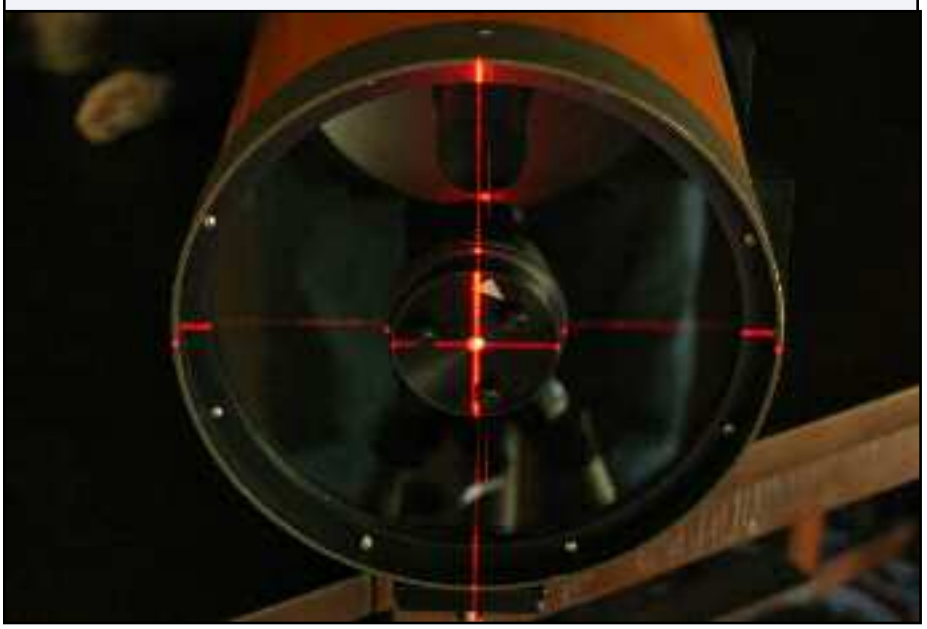
Left: ***To verify the visual back or focuser is parallel with the optical path, rack the focus in and out. The three laser spots should expand from a single point, but remain centered on the target crosshairs.***
Right: ***This is what you will see if the collimator is properly aligned with the telescope but the secondary mirror is offset. The central doughnut is not centered in the middle target ring of the collimator face. To center the secondary, the corrector plate is shifted within its mounting cell.***

image to some degree, but it was still far from the telescope's previous sharp, crisp image.

Puzzled by the collimation failure, I performed the same sequence of adjustments on a second "backup" orange tube C-8 that used to be the guide scope for my old Schmidt cameras in the film era. I achieved virtually the same goose egg-shaped SCT doughnut. Now I was really puzzled and worried about my beloved telescope.

Discussions with David Ho about the same apparent problem with two separate telescopes led to procedures designed to center the corrector plate and secondary within the desired optical path. After still achieving goose eggs, both literally and figuratively, I pondered the problem for a time. I am not an optician, but I am a good mechanic. I reasoned that mechanics are what hold the optics in collimation and there must be something mechanically wrong with both telescopes for both of them to develop the same symptoms.

When the secondary is properly centered and aligned, this is what you want to see. The projected laser cross pattern is centered on the secondary while the laser reflection pattern on the target face of the CT collimator shows the central doughnut centered within the inner target ring. The three secondary alignment lasers are symmetrically located within the same outer target ring. This telescope is ready for high resolution planetary imaging!



Visualizing the SCT optical path, I came to the conclusion that it might be possible to collimate the secondary as best I could using the three Bob's Knobs-style adjusters, but if the secondary mirror itself was skewed on its holder, the image would be reflecting off the wrong curve of the secondary and thus one side of the image could be out of focus. This called for some exploratory surgery.

After removing the corrector plates from both of my C-8s, I was surprised to see the secondary was secured using different systems on each scope. One secondary was held in place by the three collimation screws that pulled the aluminum secondary mounting plate against a pivot point. The other was held by the pivot point while the three collimation screws pushed against the mounting plate. It took a little while to deduce this mechanical difference between two similar age Celestrons, but no damage was done.

After extracting both secondaries (and keeping all components from each scope segregated), the cause of my

focus problems with both scopes was apparent….the secondary mirrors were de-bonding from their mounting plate. Both little mirrors were attached to their aluminum plate by a thin sheet of double-stick cork. The heat of more than three decades of Texas summers had weakened the adhesive.

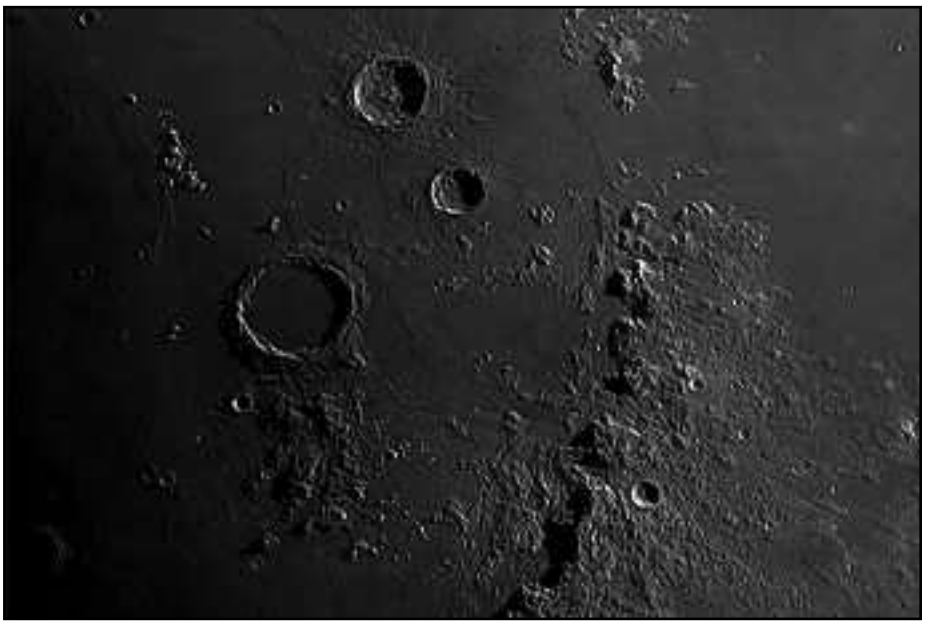
The solution to my focus problem was re-glue the secondary then collimate the optics and the aftermarket Crayford focuser I use on this scope. The immediate challenge was how to glue the secondary to its aluminum plate without scarring the aluminized surface. The plate is smaller than the mirror, making handling the assembly an interesting project. Complicating the challenge was the fact that the mirror needed to be secured to the plate with a tolerance of several thousandths of an inch so it would remain optically centered.

I decided the simplest course would be to make a soft nest from lens tissue and lay the mirror face down while I attached the plate to the back of the mirror. To glue the mirror I chose RTV silicone sealant that I use daily in the repair of diesel engines. I reasoned if this stuff can handle hundreds of degrees in a diesel engine, then holding the secondary mirror in Texas summer heat would be child's play.

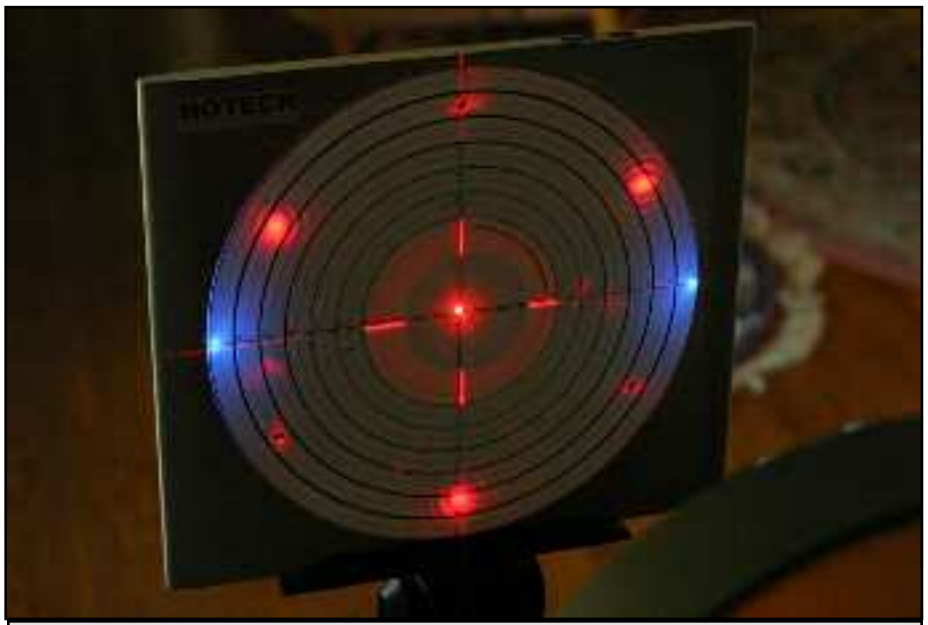
Another challenge was centering the plate on the mirror back. A thin layer of RTV is pliable for a while before it cures. This allowed me to use a digital caliper to measure the distance from the edge of the aluminum plate to the edge of the mirror at the north-south and east-west locations and minutely nudge the plate to center with an accuracy of several thousandths of an inch. I rechecked the position frequently in case there was creep while the RTV cured.

Inspired by the focus problem with my near-antique C-8, David Ho devised several additional procedures for using the Advanced CT Laser Collimator to adjust the position of the corrector plate and the alignment of the Crayford focuser. The alignment of the Crayford is checked prior to reinstalling the cor-

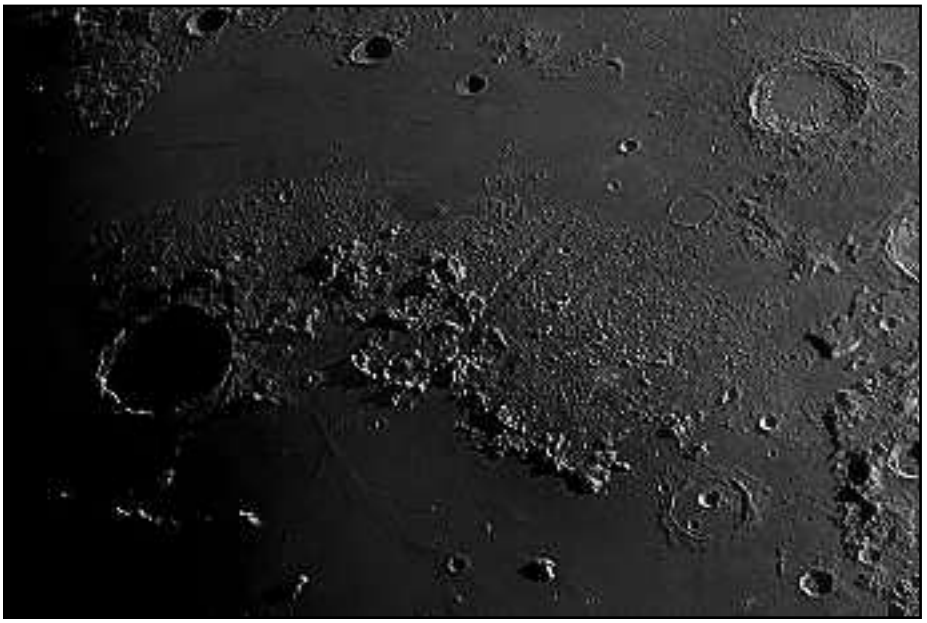
After performing the alignment procedures for the focuser, secondary placement, and secondary collimation, the first quarter moon was imaged on June 16, 2013, at 2000 mm Cassegrain focus.



An enlarged crop of the Alpine Valley from the 16 June Cassegrain focus image clearly shows the central rille within the Alpine Valley. The rille usually requires Barlow magnification to be seen.



This is what you want to see when everything is correctly aligned.



Another lunar target not easily seen at Cassegrain focus is Hadley Rille on the eastern shore of Mare Imbrum. After a tune up with the Hotech Advanced Laser Collimator, Hadley Rille is resolved without additional Barlow magnification.

rector plate. The laser collimator is set up similar to how it is used for normal tweaking of the secondary. Without the corrector installed, the laser cross pattern used to align the collimator with the telescope is projected onto the Hotech reflector mirror installed in the Crayford focuser. By adjusting the set screws that hold the Crayford to its telescope adapter ring, the laser cross is centered in the reflector target installed in the eyepiece holder. If additional focuser angle adjustment had been required, thin shims could have been placed between the focuser flange and the Cassegrain tailpiece.

The next step was adjusting the corrector plate to properly center the secondary mirror in the optical path. There is only about a tenth of an inch side-to-side play between the corrector plate and its holder in the telescope barrel, but this is an important adjustment. The proper placement of the corrector and secondary assembly is monitored by observing the "doughnut" of light that fills the central target ring on the face of the Advanced CT Laser Collimator. When the collimator is properly aligned with the telescope, the doughnut should be symmetrically placed within the center target. If it is offset slightly, the corrector is moved within the limits of its mounting cell to recenter the doughnut. This can usually be accomplished by leaving the corrector retaining ring loose nudging the corrector with the secondary cell.

If the corrector plate movement needs to be more forceful, a trick is to remove the secondary and drill and tap four small set screw holes at the 12-, 3-, 6-, and 9-o'clock positions. Turn the tube assemble nose down while drilling and tapping. Collect drilling chips with a vacuum cleaner hose followed by blotting the machined area with the sticky side of masking tape. Use nylon set screws, NOT metal screws, to gently jack the corrector plate into proper position,

After adjusting the position of the corrector and secondary assemblies, the rest of the optical system is collimated using the normal Hotech procedures for tweaking an SCT secondary. A final bench check is to rack an attached aftermarket focuser fully in, then fully out. If it is truly parallel to the optical path, the three laser dots will expand then shrink back together while staying centered on the printed cross hairs on the reflector target. A final star collimation refinement may be necessary as well.

Once the loose secondary was fixed, how did the additional laser collimation steps help my photo focus? I will let the accompanying images of the Moon speak for themselves. As a long time lunar imager, I can say that the central rille within the Alpine Valley to the east of Plato is an elusive target. The feature is considered a good resolution test for lunar images. It usually requires the use of long focal length with a Barlow to resolve the Alpine Valley rille. After tuning my 38 year old C-8 with the Hotech Advanced CT Laser

Collimator, the rille is quite evident at the 2000 mm focal length Cassegrain focus. Further down the terminator, Hadley Rille is also quite distinct. Even when new, my telescope never achieved resolution this good. Under good seeing conditions, it will now image detail at Cassegrain focus that used to require Barlow magnification.

The bottom line is don't think the Hotech Advanced CT Laser Collimator is solely for tweaking the secondary mirror. The device provides an unparalleled amount of data useful for tuning telescope optics with three references on the collimator target: the three laser dots, the centering crosses, and the doughnut shadow as well the three laser dots and cross on the reflector target installed in the eyepiece holder. These references are very useful for diagnosing telescope problems and will help with the critical steps of insuring the secondary is properly centered and an aftermarket focuser is parallel to the optical path. Performing all the checks available through the Advanced CT Laser Collimator revived my ailing telescope and transformed it from a near paper weight to a fantastic planetary imaging scope.

If your Schmidt-Cassegrain telescope is delivering images that are softer than those achieved by similar instruments, try the additional collimation steps with the Hotech Advanced CT Collimator. I'll bet the Hotech collimator will perk up your telescope just like it did mine.

The Hotech Advanced laser Collimator is in stock and available at Hotech's authorized dealers.