

Takahashi Epsilon 210 Collimation Procedure

By Fred Garcia & Richard Jacobs, M.D.

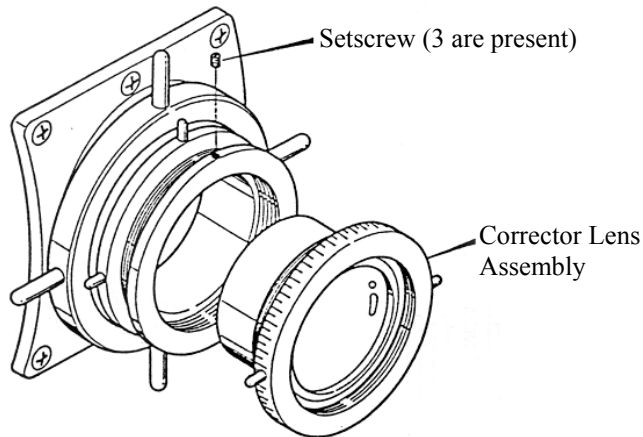
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The Takahashi ϵ -210 is one of the finest astrophotography instruments that I have ever owned. The scope is well built and has flawless optics. Like all telescopes, to achieve optimal performance, the ϵ -210 must be properly collimated. Although the ϵ -210 is designed to hold its collimation quite well, one occasionally finds the need re-collimate the telescope. The ϵ -210 owner's manual describes one method of collimation. This document describes another method that I have found to be more easily understood and more quickly executed.

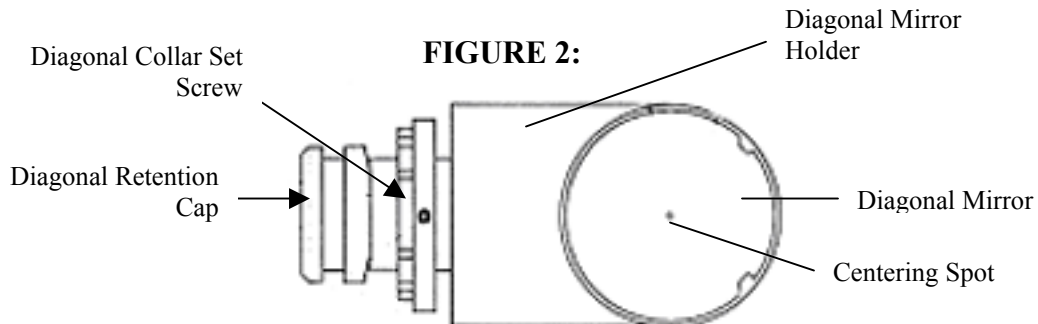
Procedure

1. **Collimate the Primary Mirror.** The Primary Mirror must be collimated first. Although the Takahashi ϵ -210 manual describes a method to collimate the primary mirror, I have found the following method to be much easier.
 - a. Remove the corrector lens from the helical focuser by loosening the three (3) set screws that hold it in place. (Figure 1) Do not drop it. Place it in a safe place.

FIGURE 1:



- b. Obtain a large piece of white poster board. Cut a small hole (about 0.5" X 0.5") in the middle of the poster board. This small hole will be a "peep hole" through which you will look down the open end of the optical tube assembly.
 - c. Remove the diagonal mirror by loosening the diagonal retention cap and the three (3) diagonal collar set screws in the diagonal mirror collar. Be careful not to drop the diagonal mirror (Figure 2).

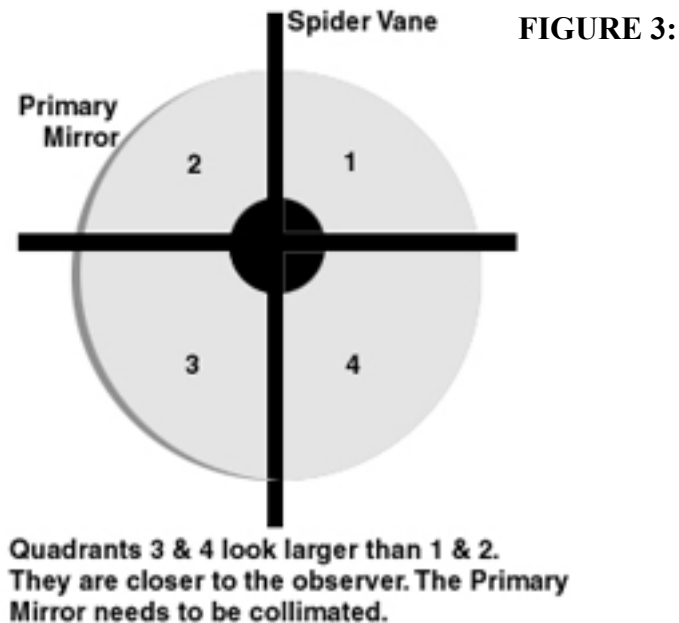


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- d. Remove the cover from the front of the ϵ -210. Lay the optical tube assembly horizontally on a secure surface. Now sit in front of the telescope with the opening of the optical tube assembly at eye level. Look down the opening of the optical tube assembly by looking through the peephole in the center of your white poster board. Move your head from side to side while looking through the peephole so that the spider vanes are exactly superimposed on the reflection of the spider vanes in the primary mirror. The superimposed spider vanes divide the primary mirror into four (4) sectors. If the primary mirror is properly collimated, the four (4) sectors of the primary mirror created by the spider vanes will be exactly equal. If this is so, you may now proceed to step two and collimate the diagonal mirror. You will not touch the primary mirror again. If the sectors are unequal, as in Figure 3, proceed to 1(e).



- e. Since the four (4) sectors are not equal, this indicates that the primary mirror is not collimated and is not pointed straight down the central axis of the optical tube assembly. The largest sector is closest to the front of the telescope and the observer. Adjust the primary mirror collimation screws (see below) until all four sectors look equal when peering through the poster board peephole. To collimate the primary mirror, please note the following.
- The primary mirror is secured to the primary mirror cell by the central mirror retention disk. To adjust the primary mirror collimation, you must first remove the central vent cap and the vent plate (Figure 4).

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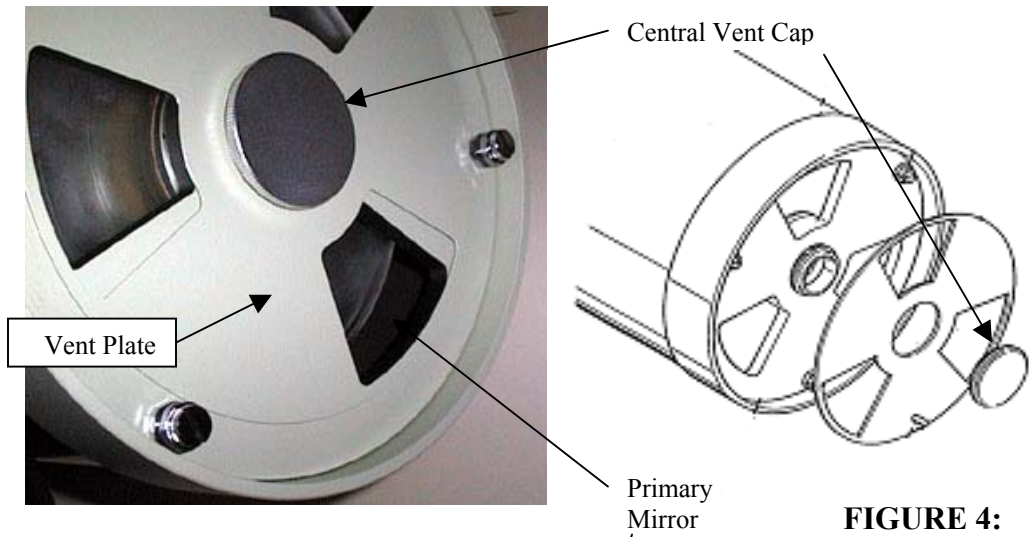
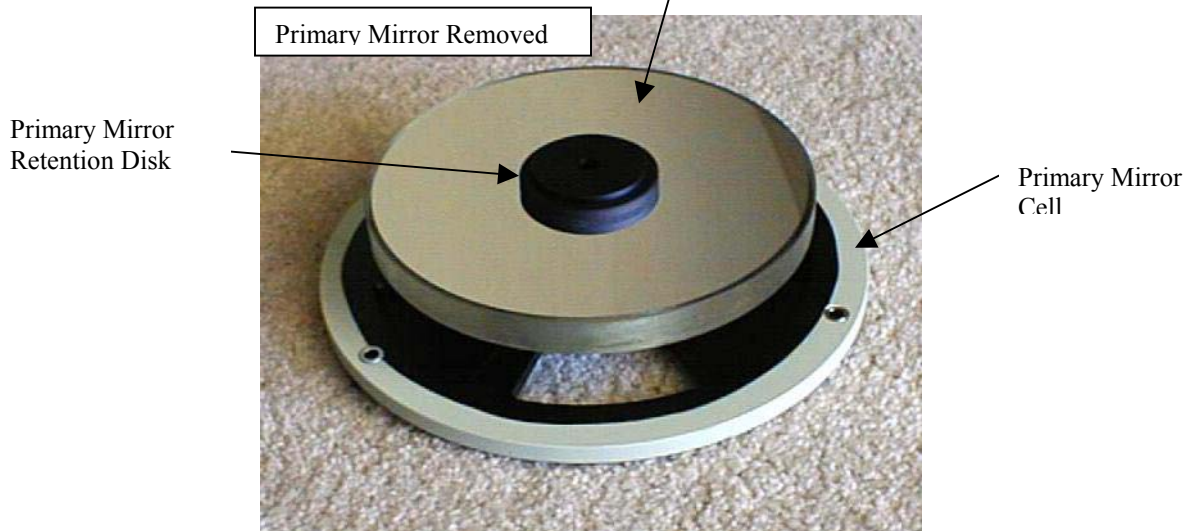


FIGURE 4:



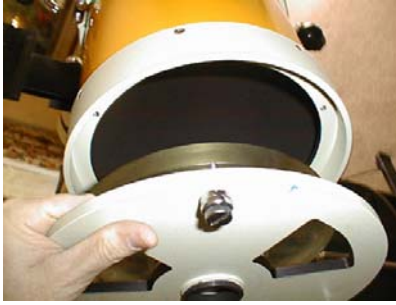
- The primary mirror cell is secured to the optical tube by the three (3) inner pull screws. Use a 17mm open-end wrench and screwdriver for most adjustments. If you ever want to remove the primary mirror and mirror cell for cleaning, make sure you mark the mirror cell and lower end of the optical tube so that the primary mirror can be correctly returned to its collimated position (Figure 5).

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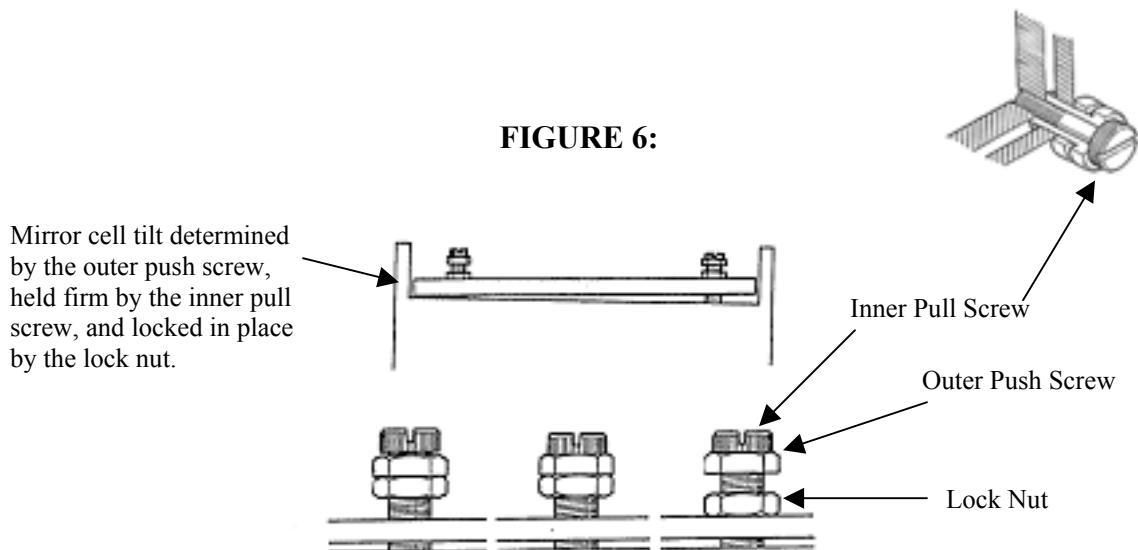
FIGURE 5:



Primary Mirror Cell is bolted to the bottom of the optical tube assembly by the 3 inner pull screws.

- The three (s) collimation screws for the primary mirror consist of an inner pull screw, an outer push screw, and a lock nut. (Figure 6) **NOTE: It is useful to think of the outer push screws as being completely responsible for setting the proper primary mirror tilt, and hence its collimation. The inner pull screws merely hold the mirror cell tight against the outer push screws. The lock nut holds the settings securely in place.**
- Loosen the inner pull screws, being careful not to let the primary mirror fall from the back of the optical tube. Then adjust the push screws until all four (4) quadrants of the primary mirror formed by the spider vanes, as viewed from the front, appear equal. Tighten down the pull screws and lock nuts. You will not touch the primary mirror again.

FIGURE 6:



2. Collimate the Diagonal, or Secondary Mirror.

- a. Place the Diagonal Mirror back in its holder and loosely tighten the diagonal collar set screws (Figure 2). Also, slightly loosen the push screws and the pull screws on the diagonal holder. The diagonal mirror should be safely in place but should be easily moved in all directions by hand without undue force. (Figure 7)

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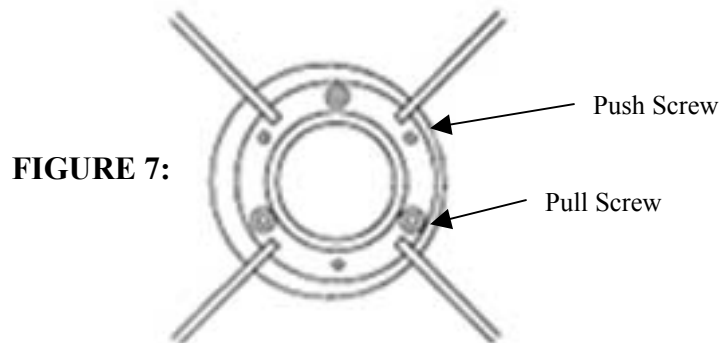


FIGURE 7:

- b. Put the sight tube (Figure 8) in place, loosen the camera orientation lock wheel, and rotate the helical focuser until the monofilament crosshairs of the sight tube superimpose the reflection of the spider vanes in the diagonal mirror.

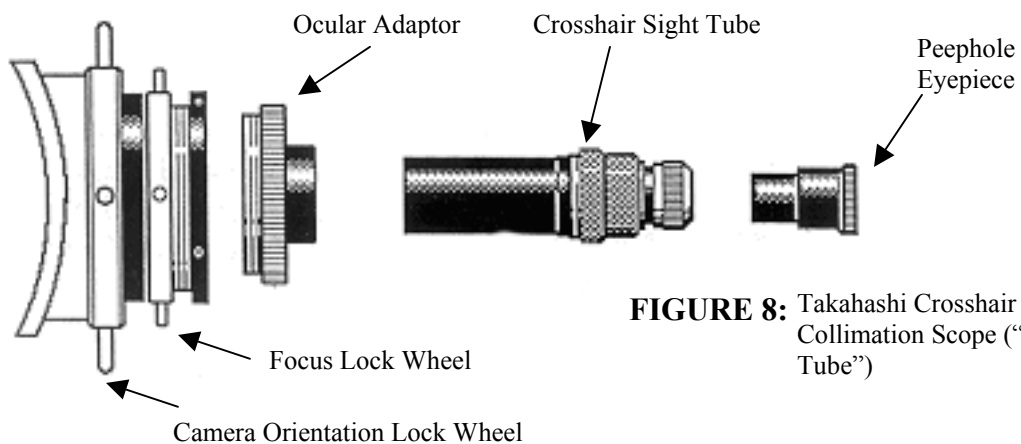


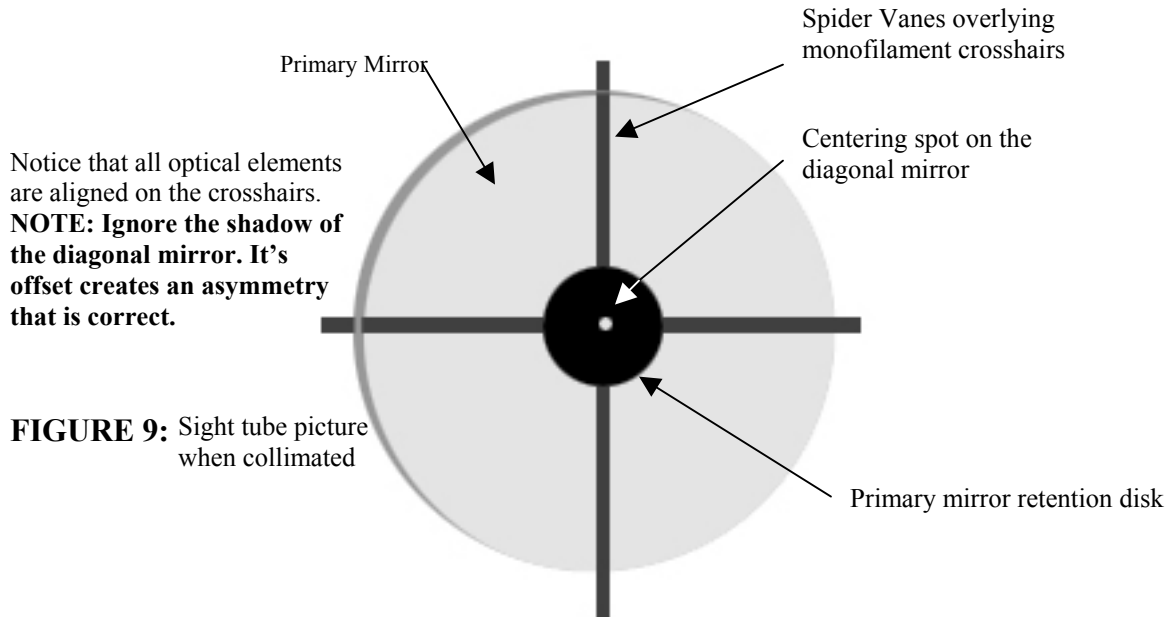
FIGURE 8: Takahashi Crosshair Collimation Scope ("Sight Tube")

- c. While looking in the Takahashi collimation scope, reach around and grasp the diagonal mirror holder and gently manipulate it until the centering spot on the diagonal mirror and the center hole in the primary mirror retention disk are both centered on the monofilament crosshairs of the crosshair sight tube. Also, the monofilament crosshairs of the sight tube should exactly overlies the reflection of the spider vanes in the diagonal mirror, when they are oriented properly and when the diagonal mirror is exactly collimated. The diagonal mirror should be able to rotate on its collar axis, move up and down the long axis of the scope, and tilt in all directions, if the setscrews have all been loosened. If the diagonal mirror cannot be placed in the required position, loosen some of the axial setscrews and/or push-pull tilt screws until the diagonal mirror can be properly positioned. Now all setscrews should be sequentially tightened until the diagonal mirror is held firmly in place. The visual picture through the sight tube should be as shown in Figure 9.

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Once the telescope is fully collimated and secured, you may want to take a small rubber mallet and strike the end rings of the optical tube assembly lightly to relieve any uneven tension in the collimation screws. If the collimation pattern has shifted, make the necessary adjustments and repeat the process until the collimation settings are stable. The telescope should hold its collimation now during normal handling.

Finally, replace the corrector lens in the helical focuser and tighten the three (3) set screws. The telescope should be ready for star testing. This is described in other references and on the Internet.