

Collimating the NTT Optical Light Path

The New Technology Telescope (NTT) is an open-truss Newtonian with folded optics. Following are step-by-step instructions for collimating this type of telescope with a laser collimator and sight tube.

Remember that you are working with a mirror image and the adjustment to be made may actually be the opposite of what you perceive to be correct. For example, you may find that you need to make a rotational adjustment of the tertiary such that the reflected image of the secondary appears to be moved further out and away from concentricity and then discover that the next step of adjusting the tilt of the tertiary brings everything into perfect collimation.

1. Remove the tertiary (diagonal flat) mirror.
 2. Place the laser* collimator in the top of the focuser drawtube above the secondary flat housing such that the laser beam is projected down through the center of the drawtube and onto the primary mirror.
 3. Adjust (collimate) the drawtube (with secondary flat) such that the laser beam is directed through the center of the spider and lands on the center of the primary mirror. This establishes the optical axis of the telescope.
 4. If necessary, adjust the spider so that the laser beam passes exactly through the center of the spider. (NOTE: There is no offset built into the NTT Telescope.) ← Incorrect?
 5. Adjust the primary mirror such that the laser beam is directed back into its source at the drawtube.
 6. Cover the primary mirror and move the laser collimator from the secondary drawtube to the ocular holder on the side of the upper nose assembly. The laser beam will be directed across the nose assembly and shine on the inside of the upper nose assembly opposite the ocular holder.
 7. Adjust the angle of the ocular holder up and down such that the beam is parallel to the primary mirror. This can be checked by measuring up from the edge of the primary mirror first at the laser source (at the ocular holder) and then at the laser beam opposite the ocular holder. Adjust the field ocular holder/field de-rotator plate with the four leveling screws until the measurement is the same at both locations.
 8. Adjust the ocular holder such that the laser beam passes directly over the center of the spider. Recheck step 7. The focuser is now aligned with, and perpendicular to, the axis established in step 3.
 9. Remove the laser collimator. Reinstall the tertiary mirror and visually align it with the ocular holder.
- The object at this point is to align or collimate the tertiary and secondary flats as if they comprised a simple two-mirror Newtonian system (ignoring the primary mirror for now). The adjustments which may be required are:
- Axial placement of the tertiary vertically ("up and down") along the optical axis,
 - Rotation of the tertiary,
 - Tilt of the tertiary and
 - Collimation of the secondary flat.

10. Place the sight tube in the ocular holder. Looking through the peep hole, adjust the tertiary in rotation and axial placement until the reflection of the secondary appears to be centered in the tertiary.
11. Remove the sight tube and place the laser collimator in the ocular holder. Adjust the tilt of the tertiary such that the laser beam is projected to the center of the secondary flat (i.e. through the center of the focusing drawtube). It may be helpful to have a pin hole or other center mark placed in the drawtube.
12. Remove the laser and replace it with the sight tube. Using the sight tube, adjust the tilt of (collimate) the secondary until all the reflected images in the field of view are concentric.
13. Go back to step 10 and repeat each step in sequence until the desired result of each step is in place simultaneously and no further adjustment is required.
 - ▶ Collimation of the secondary and tertiary is now complete and no further adjustment to either of them should need to be made beyond this point.
14. Uncover the primary mirror. Using the sight tube, adjust and collimate the primary mirror such that all reflected images (i.e. all mirrors and the ocular holder) are in concentricity with each other. When an accurate result is achieved, the reflected images of the two sets of spiders (upper and lower) will also be superimposed on each other.
15. When the desired result of step 15 is produced, you can double check your work as follows. Place the OTA in the horizontal position. Stand in front of it at approximately two times the focal length. Place your eye on the optical axis and observe the reflections. All the reflected images will be centered (concentric) with each other and you will see only one set of spider vanes.
16. Star test the telescope and, if necessary, make any final adjustments.
 - ▶ Collimation is now complete.
 - * CAUTION: Do not look into the laser source when it is in operation. Also avoid having the reflected beam (off an optical surface) shine in your eyes.

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