Collimation Procedures

General

By nature, all mechanical or optical constructions are imperfect: to overcome this state of affairs, a set of adjustment mechanisms are available to the user to perfect the optical geometry of the telescope. Collimation is therefore the set of adjustment operations that consist of collinear input all the optical axes of the components of the optical chain (Primary Mirror (M1), Secondary Mirror (M2), Focuser (PO), Eyepiece, Sensor, etc.). The distance between mirrors must be respected.

A misalignment leads to a degradation of the image quality. Depending on the optical formula, the collimation setting is more or less sensitive.

There is not just one method for adjusting the collimation of your device, and each optical formula requires its own methods. It will be up to the user to choose their method(s) according to their situation.

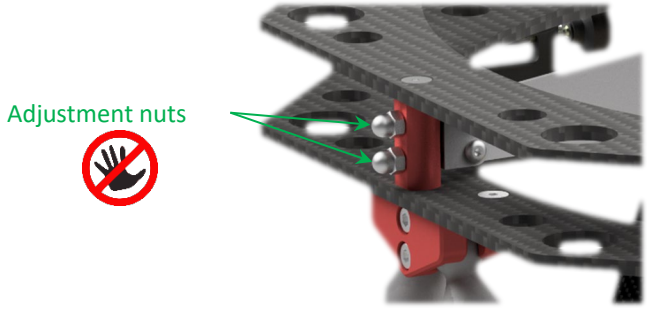
Collimation tools themselves are prone to imperfections. It is the user's responsibility to choose quality tools and ensure that they are properly adjusted.

Workshop adjustment

The settings described below are for information purposes only. Except for extensive maintenance, the user should not interfere with the settings described below.

Spider Hub Position

The axle of the hub has been perfectly adjusted to the axle of the primary cage.

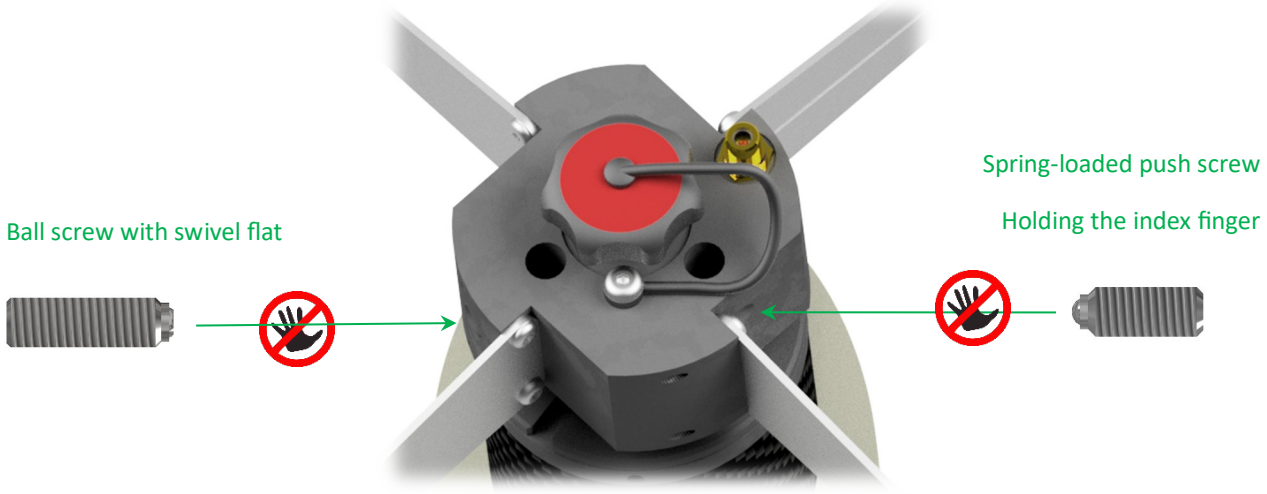


Hub Centering

Radial stop adjustment of the Secondary Optical Unit

(Newton-Cassegrain only)

The positions of the Radial Thrust Bearing and the Spring-Loaded Push Screw have been perfectly adjusted.



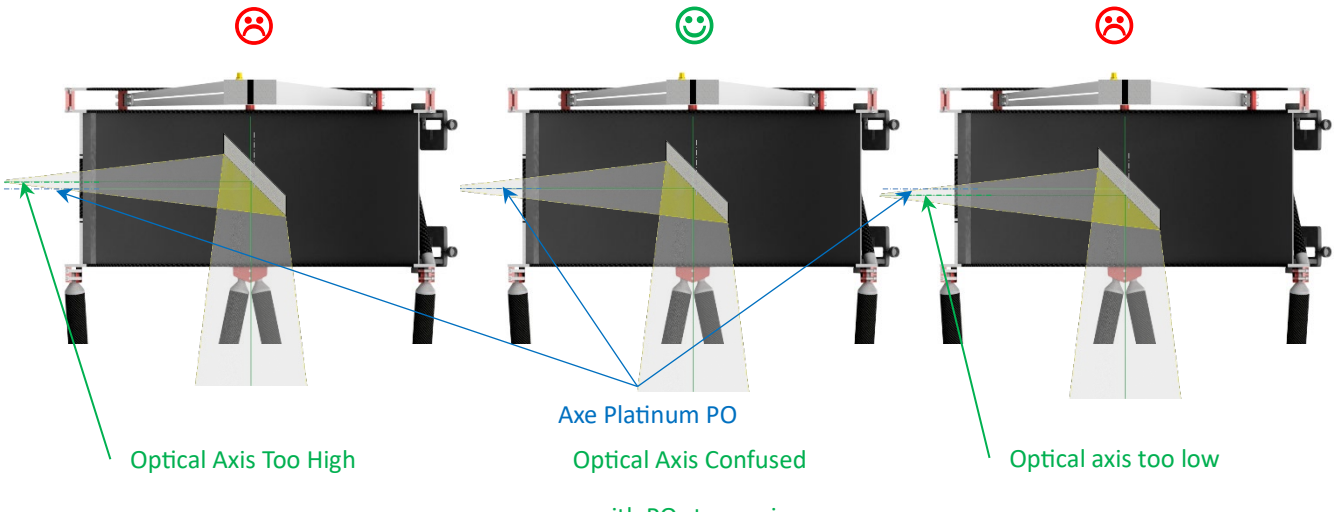
Radial stop adjustment Secondary optical unit

Adjusting the Offset and Height of the Elliptical Secondary Mirror

(Newton et NC)

The offset adjustment* was achieved in the workshop by precisely gluing the M2 to its mandrel.

The height of the Secondary Elliptical Mirror has been perfectly adjusted to completely cover the section of the cone of light emanating from the Primary Mirror (offset adjustment) and to reflect the optical axis in the center and perpendicular to the PO support plate.



Height Adjustment of the Secondary Elliptical Mirror

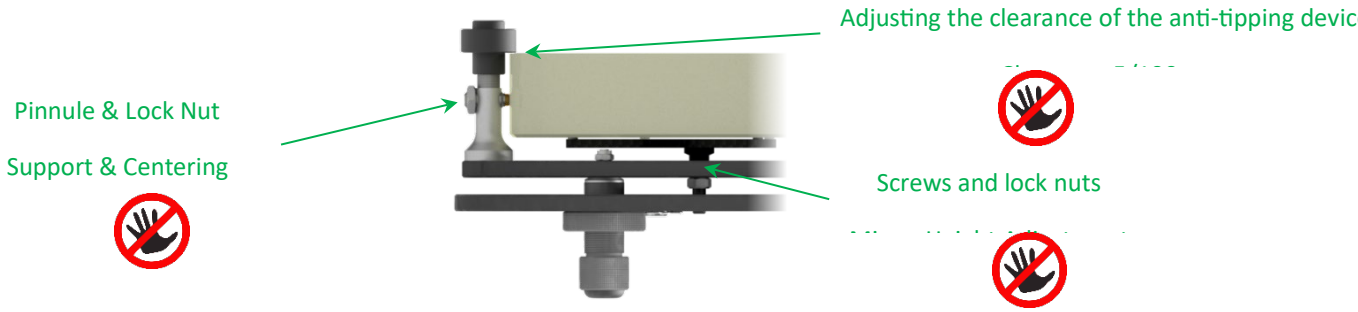
Please note:

- The height of the Secondary Mirror (M2) can be adjusted by acting on the 3 collimation screws in the same way.
- One turn of the 3 screws corresponds to a displacement of the M2 Elliptical of 1.00mm
- When collimating, it is advisable to compensate for a displacement of one collimation screw by a reverse displacement of the other 2 screws in order not to move the mirror on the optical axis of the device.

Offset: calculated offset between the Optical Axis and the Geometric Axis of the Elliptical M2.*

Installing the Primary Mirror

The barrel has been adjusted so that the mirror is perfectly centred and perfectly positioned in height (position of the neutral fibre on the pinnules).

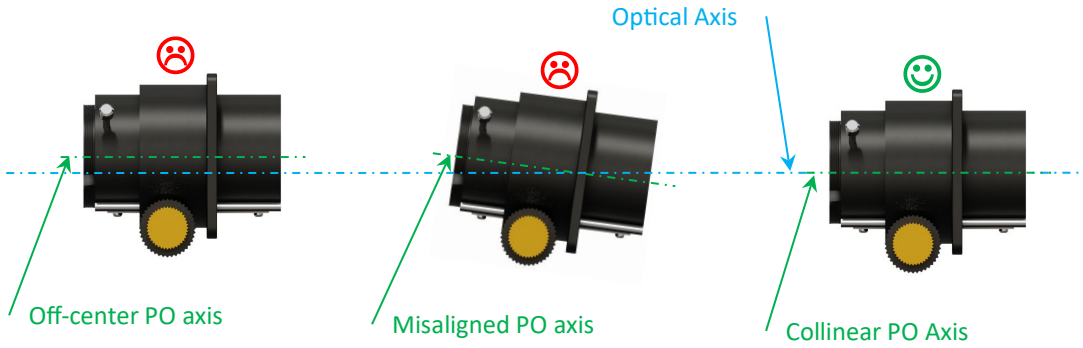


Adjusting the Barrel

The mirror must rotate without play, freely on its supports without any constraints.

Installing the focuser

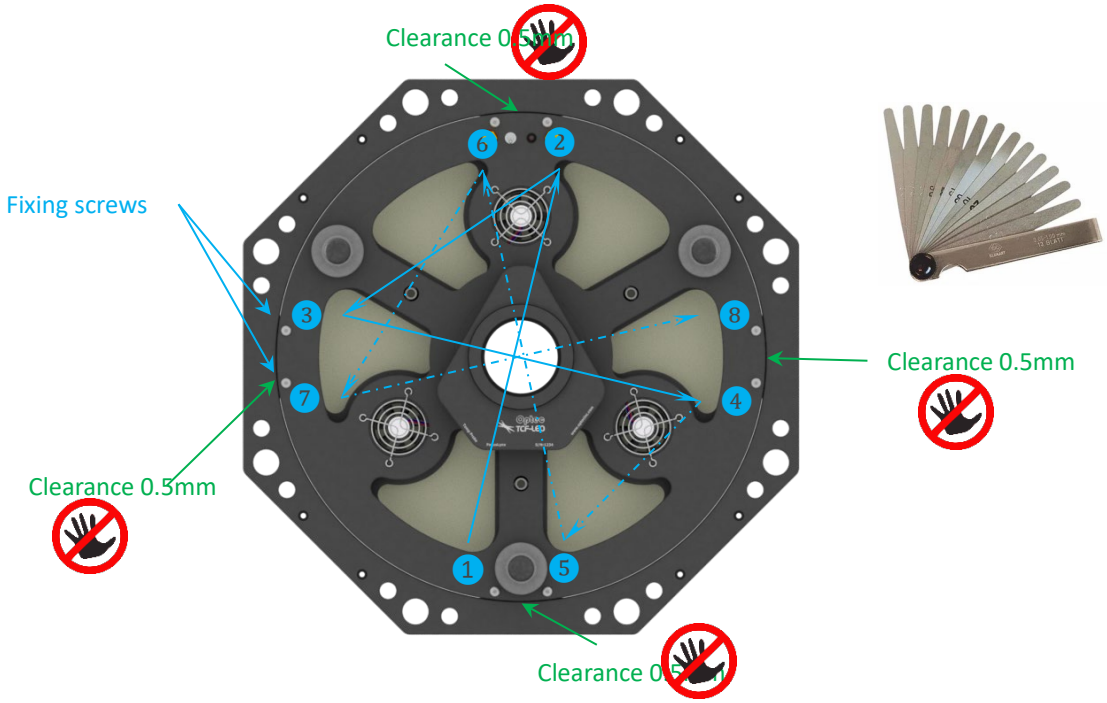
Tilt Adjustment: The axis of the focuser has been centered and aligned with the optical axis of the mirrors.
Depending on the configuration and the choice of focuser, adjusting the tilt is more or less easy. Typically, it is a push-pull screw system that provides the slewing functionality. It should be noted that some models of focusers do not have tilt adjustment: this makes the operation particularly difficult.



Tilt PO Adjustment

Mounting the Barrel in the Primary Case

The barrel was perfectly centred in the primary body.
There is a clearance of 0.55mm in the radius between the primary cage and the barrel



Mounting the Barrel with Thickness Gauges

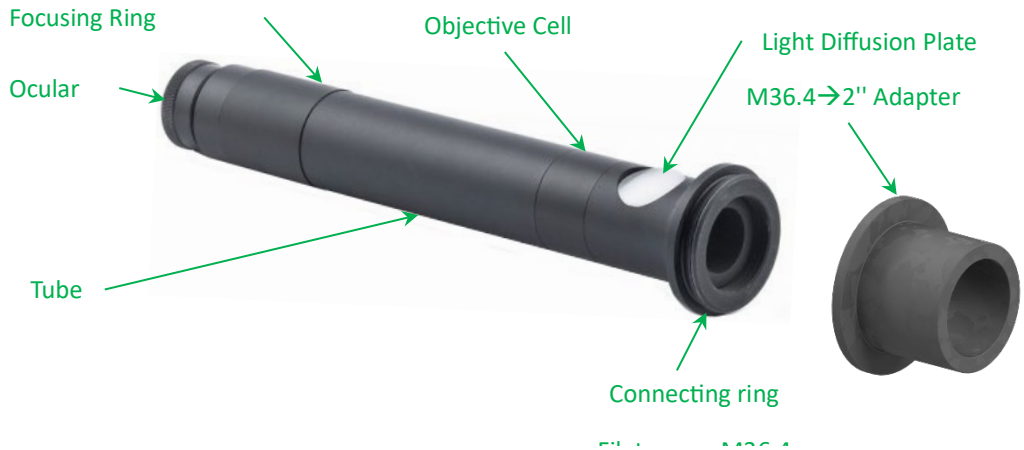
It is recommended to use off-the-shelf thickness gauges to ensure centering.
The tightening of the 8 cylinder fixing screws must be done gradually and according to a cross pattern ❶❷❸❹❺❻❼❽ with a tightening torque of 9.7 Nm.

Collimation

Collimation tools

The TAKAHASHI Collimation Microscope

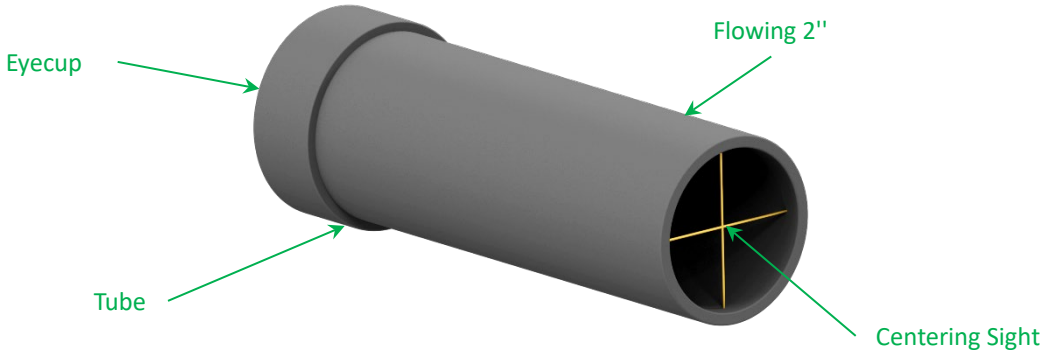
For the collimation of Cassegrain, Ritchey-Chrétien, Dall-Kirkham telescopes we recommend using the Takahashi Collimation Microscope (TCM).
It is a small 6x magnifying microscope with a sliding eyepiece, allowing consecutive sharpening of each element of the telescope.



Microscope de Collimation Takahashi

Le Cheshire

For the adjustment of the inner baffle, we recommend the use of a Cheshire.
It is a calibrated tube, with the eyecup positioned at the position of the focal plane, the eye positioned so that the target is centered on the center of the secondary mirror and the inner and secondary baffles must be joined.



Cheshire

Collimation laser

For roughing the collimation adjustment of the M2 secondary mirror of the Cassegrain, Ritchey-Chrétien, Dall-Kirkham telescopes or the adjustment of Newton type telescopes, we recommend that you use a quality collimation laser. Skyvision recommends that you purchase one of the following tools:

Farpoint 2'' Collimation Laser

Howie Glatter Collimation Laser 2''

Collimation lasers

Collimation eyecup

The collimation eyecup is an extremely simple tool, you can make it yourself and it will be very useful for adjusting the M2 Newton of the Newton-Cassegrain telescopes.

Collimation eyecup

Collimation of Cassegrain, Ritchey-Chrétien, Dall-Kirkham...

The settings described below are to be made by the user whenever necessary.
Skyvision recommends that you purchase the following 3 tools:

The TAKAHASHI Collimation Microscope
The Cheshire
Collimation laser

Preparation

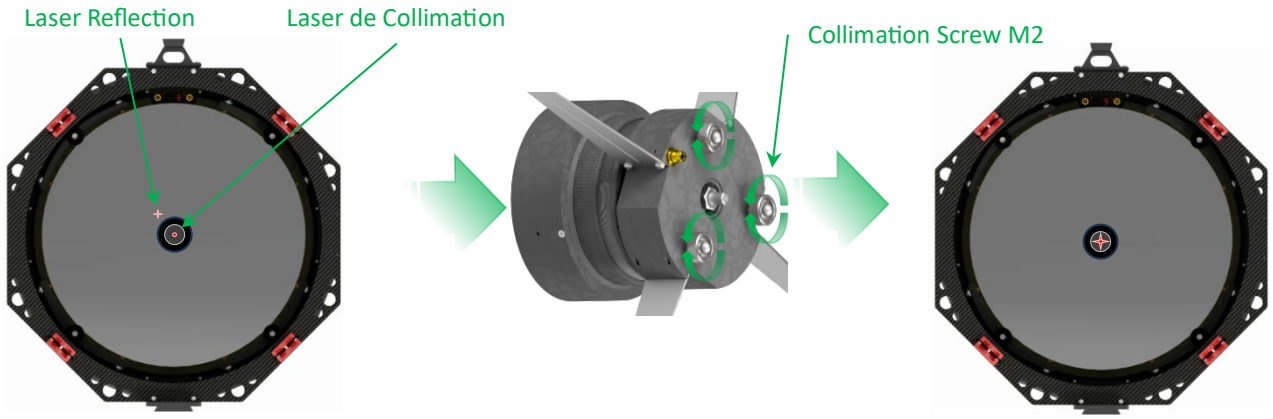
Point the telescope horizontally or pointing a little upwards (not downwards) in front of a bright, plain area such as a white wall.
Disassemble the Inner Baffle (for maximum field of view) by loosening the counter-tightening ring and then completely unscrewing the Baffle.

Focuser Tilt Adjustment/Control

It is essential that the tilt of the OP is controlled and, if necessary, adjusted in order to be able to collimate a Cassegrain telescope correctly.
Insert the collimation laser into the PO, and check that the laser beam is pointing at the center mark of the Secondary Mirror (double concentric engraving). As the PO moves along its path, the impact of the laser should remain centered on the center mark of the M2. Otherwise, you will have to adjust the Tilt of your PO by referring to the manufacturer's manual.

Laser Roughing of the M2 Collimation Setting

In case of strong decollimation, it will be necessary to roughen the collimation adjustment of the secondary mirror M2: insert the Laser into the PO, and act on the 3 collimation screws of the M2 (on the hub) to center the reflection of the beam on the point of emission of the laser.

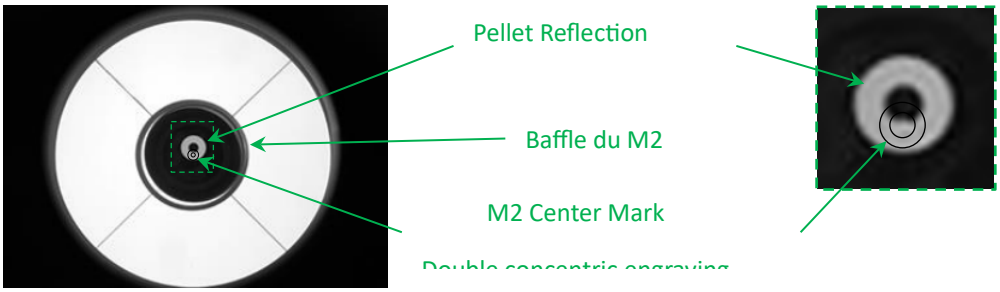


Laser roughing of the M2

Collimation of the secondary mirror (M2) with the Microscope

Install the Takahashi Collimation Microscope (TCM) in place of the eyepiece.
Point the diffusion plate at a bright spot (fluorescent light).

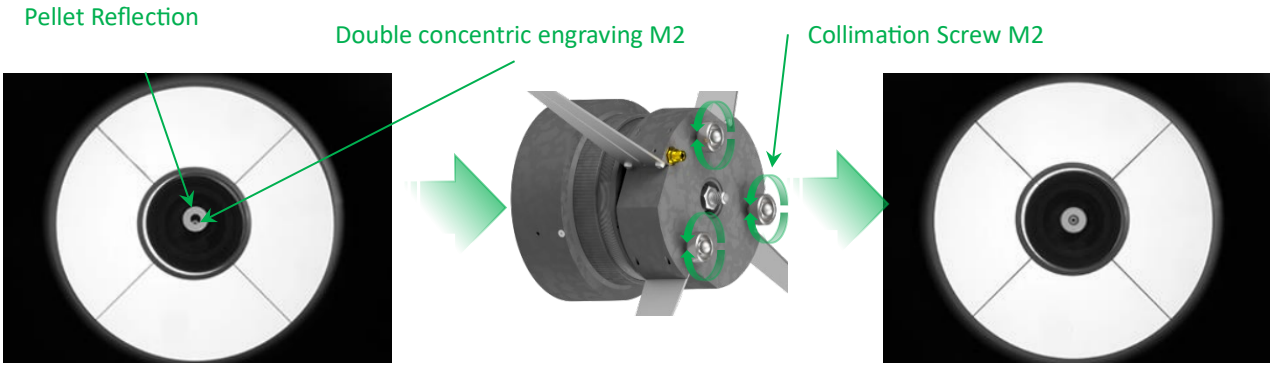
As an indication, when you look in the MCT, and the system is misaligned, you can see this kind of picture



As seen in the MCT: misalignment of optics

The goal now is to make all the visible rings concentric.

The secondary mirror is always set first.
The MCT Focusing Ring can be adjusted backwards and forwards to focus on each of the mirrors.
Focus on the M2 centering mark (double concentric engraving)
Act on the 3 collimation screws of the M2 (on the hub) to center the reflection of the MCT centering pad on the M2 centering mark.

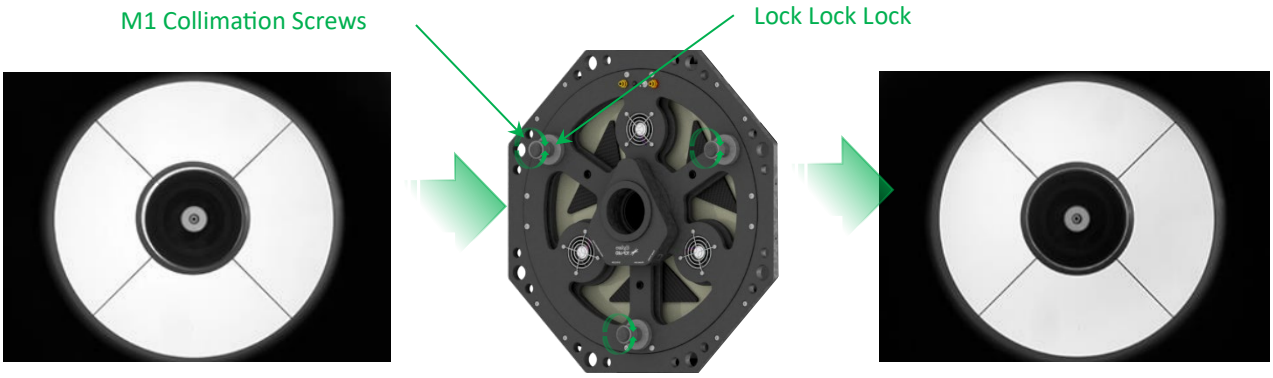


Adjusting the M2

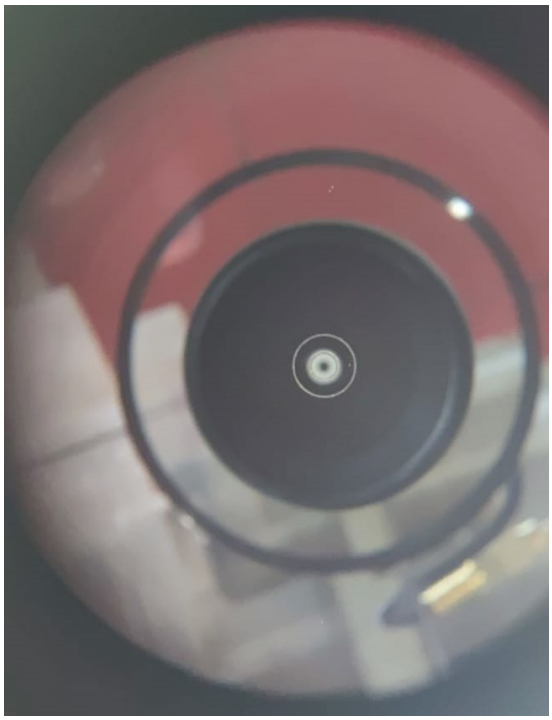
Real View Secondary Mirror OK

Primary Mirror Collimation (M1)

The primary mirror is always set second.
If adjustment of the primary mirror is necessary, after adjusting the secondary mirror, first loosen the Locking Nuts (on the back side of the telescope). The Collimation screws on the M1 can now be rotated to adjust the mirror.
The wider black circle should now be centered on the slightly narrower black outer ring.



Setting up the M1



Actual View: M2 Secondary Mirror and M1 Primary OK

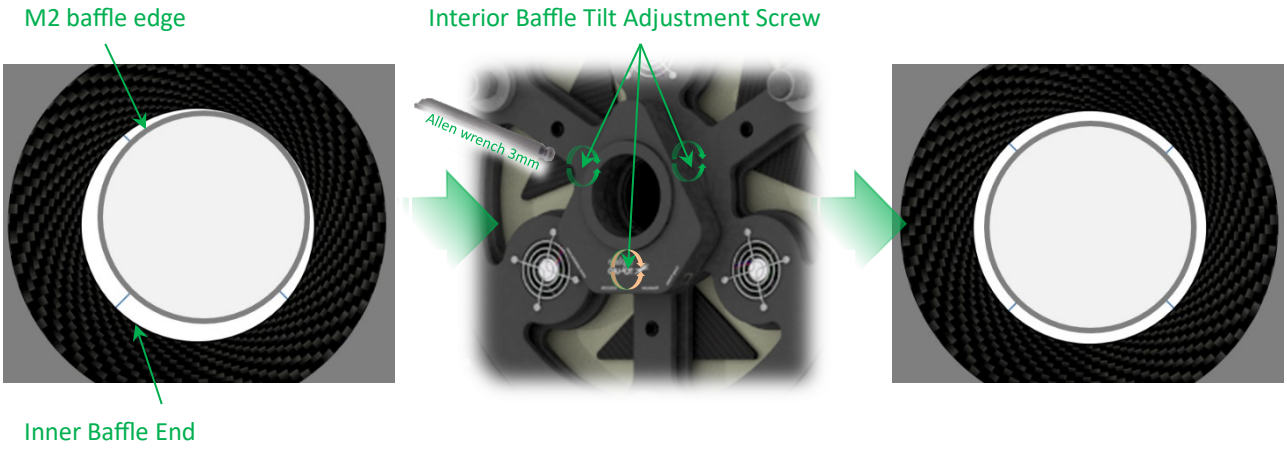
Gently tighten the locking nuts (if necessary, hold the M1 collimation screw at the same time)
At this point, the telescope should already be very well adjusted.
Reinstall the Inner Baffle

Adjusting the inner baffle

Perform this step only when the telescope is properly adjusted.
Adjusting the inner cabinet should only be required very rarely, if ever...

Setting up the Cheshire (positioning the eyecup at the position of the focal plane, positioning your eye so that the target is centered on the center of the secondary mirror)

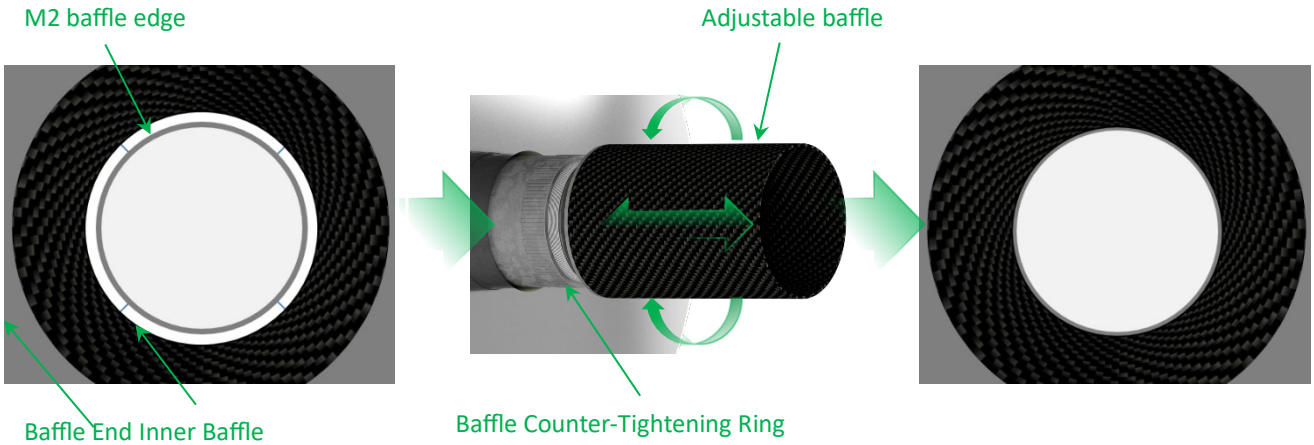
The tilt of the baffle is adjusted via 3 screws with 3mm footprints ⬢ accessible from the back of the telescope.



Tilting the Inner Baffle

Please note: depending on the focuser installed, not all screws are necessarily accessible. The 2-screw access is sufficient for fine adjustment. In this case, it is recommended to use an Allen wrench with ⬢ a 3mm ball tip.

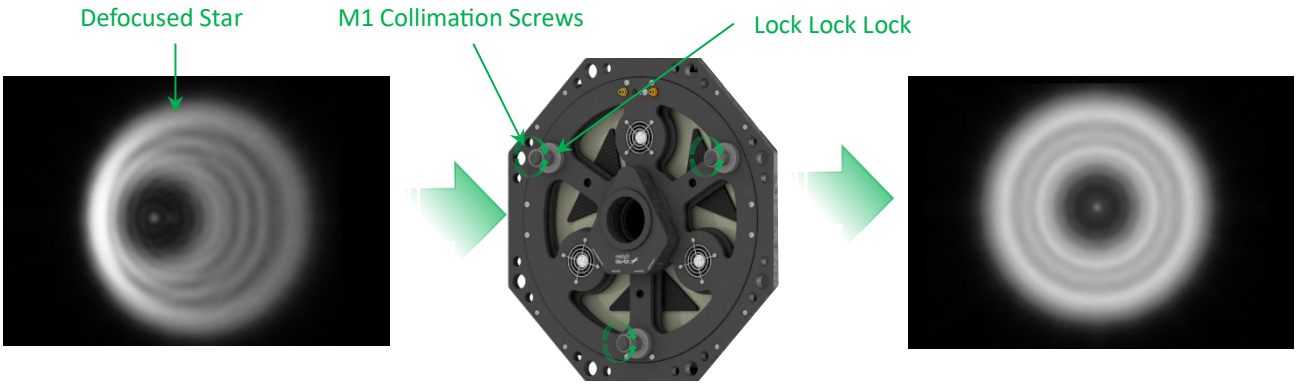
The height adjustment of the baffle is done by loosening the counter-tightening ring, then screwing/unscrewing it.



Note: One turn of the baffle corresponds to a displacement of 0.75mm.
Finally, make sure that the counter-tightening ring is tightened.

Finishing the Collimation of the Primary Mirror on Star

Once set to daylight with the MCT, the telescope should already be very well adjusted. The setting of the M1 can be further refined on a medium, stable, defocused star near the zenith with a magnification equal to the Ø of the M1 in mm (e.g. x300 for a Ø300mm).



Refining the M1 Star Tuning

The star must be located in the center of the field (far from the center, the astigmatism resulting from the construction of the telescope would falsify the results)
The diffraction rings of the star must be concentric, at which point the M1 will fit perfectly.

Newton...

The settings described below are to be made by the user whenever necessary.
Skyvision recommends that you purchase one of the following tools:

Farpoint 2'' Collimation Laser with Cheshire
Howie Glatter 2'' Collimation Laser with or without TuBlug 2''

Preparation

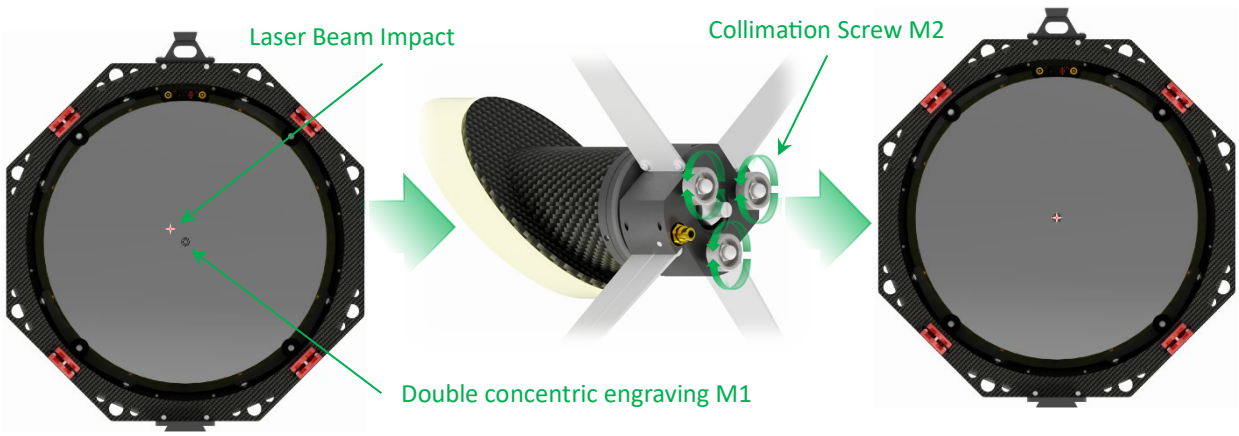
Install the collimation laser in place of the eyepiece. If a 45° sight device is available, orient it so that it is visible to the user from the rear of the telescope
Turn on the laser.

Focuser Tilt Adjustment/Control

It is essential that the tilt of the OP is controlled and, if necessary, adjusted in order to be able to collimate a Newtonian telescope correctly.
Insert the collimation laser into the PO, and check that the laser beam is pointing directly at the PO support. By moving the OP on its path, the impact of the laser must remain stationary. Otherwise, you will have to adjust the Tilt of your PO by referring to the manufacturer's manual.

Adjusting the M2 Elliptical Secondary Mirror

The secondary mirror is always set first.
Act on the 3 collimation screws of the M2 (on the hub) so that the laser beam, after reflection on the M2, points at the optical center of the M1 Primary Mirror. (Center materialized by a double engraving)

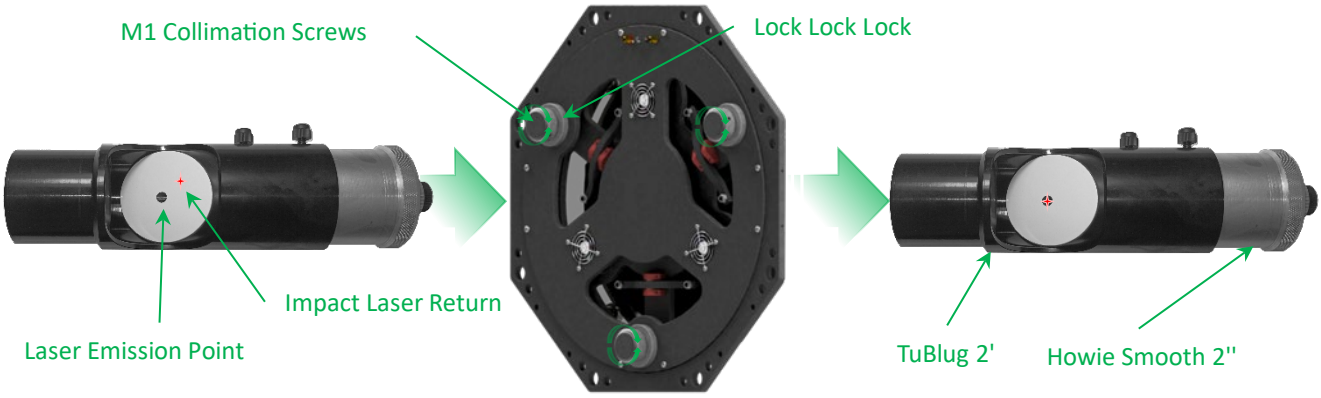


Adjusting the M2

Adjusting the M1 Primary Mirror

The primary mirror is always set second.
After adjusting the secondary mirror, first loosen the Locking Nuts (on the back side of the telescope). The Collimation screws on the M1 can now be rotated to adjust the mirror.

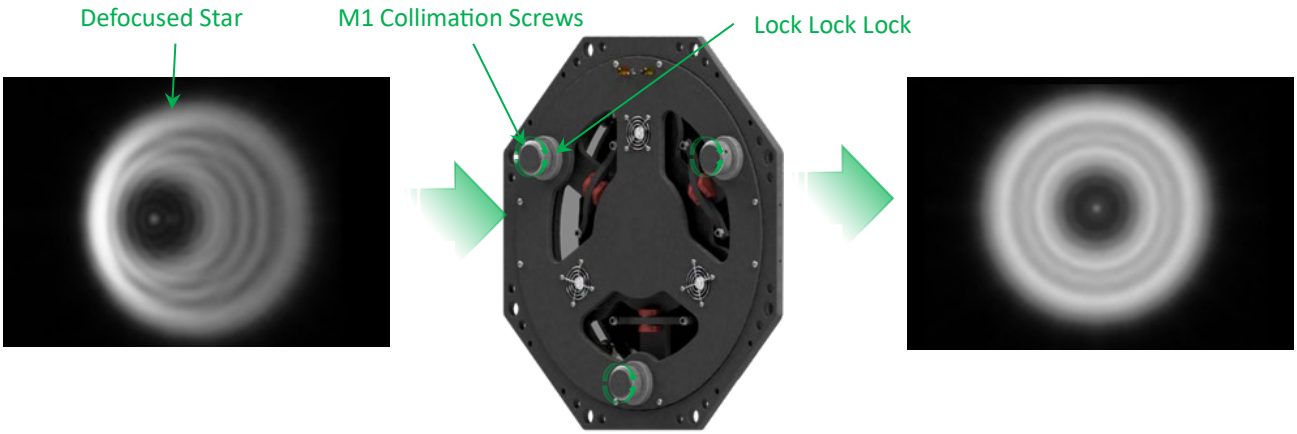
Act on the 3 collimation screws of the M1 (on the back side) so that the laser beam, after reflection on the M1, then on the M2 returns to its emission point (or to the center of the target).



Setting up the M1

Finishing the Collimation of the Primary Mirror on Star

Once set to daylight with the Laser, the telescope should already be very well adjusted. The setting of the M1 can be further refined on a medium, stable, defocused star near the zenith with a magnification equal to the Ø of the M1 in mm (e.g. x300 for a Ø300mm).

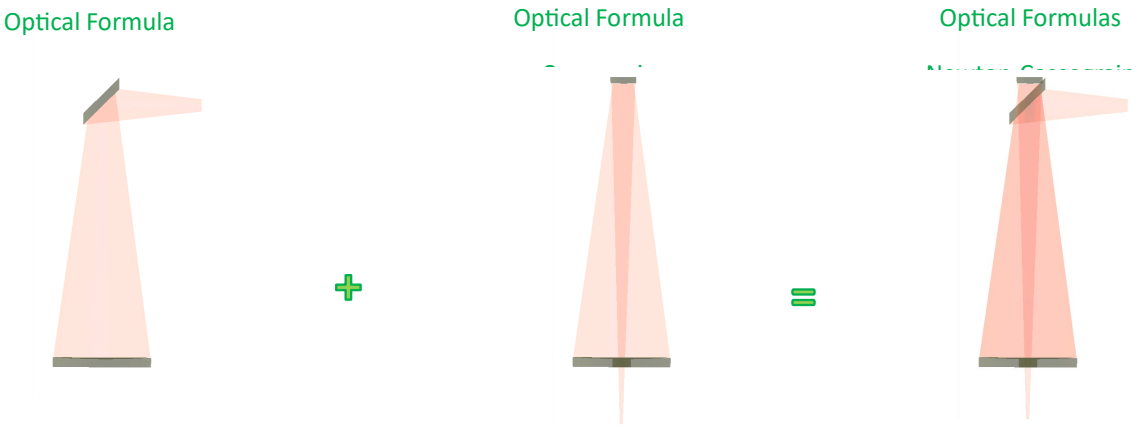


Refining the M1 Star Tuning

The star must be located in the center of the field (far from the center, the astigmatism resulting from the construction of the telescope would falsify the results)
The diffraction rings of the star must be concentric, at which point the M1 will fit perfectly.

Newton-Cassegrain

The Skyvision Newton-Cassegrain (NC) astrograph has the particularity of offering its user the 2 optical formulas Newton and Cassegrain by changing the Secondary Optical Block (Collimation Plate + Chuck + Secondary Mirror) (Skyvision tm).



Newton-Cassegrain Optical Formulas

Concept de Collimation du Newton-Cassegrain

The problem of the collimation of the Newton-Cassegrain telescope lies in the collimation of the Newton Optical Formula, because sharing the same Primary Mirror, the M1 is pierced in its center for the Cassegrain Optical Formula, and we know that to collimate a Newtonian telescope we generally need the mark of the optical center of the M1 to do it correctly. How do you get out of collimating the Newton with a hole in the middle of the M1?

In addition to the recommended tools for collimates of Cassegrain and Newton

- TAKAHASHI Collimation Microscope
- Cheshire
- Collimation Laser

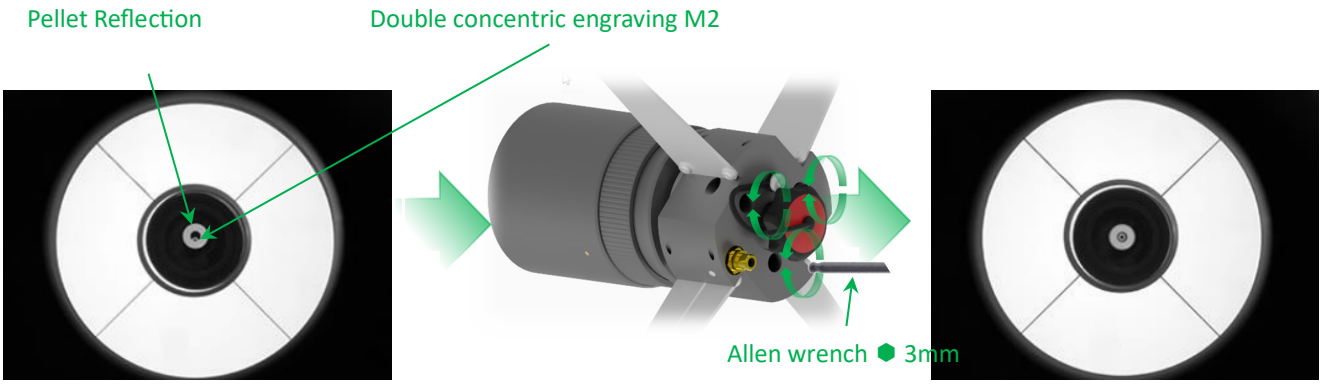
Bring a

- Collimation eyecup

First of all, the Cassegrain Optical Formula must be collimated

Collimation of the Cassegrain Formula

See paragraph 4.3.2 Cassegrain collimation with collimation finish of the primary mirror on star.

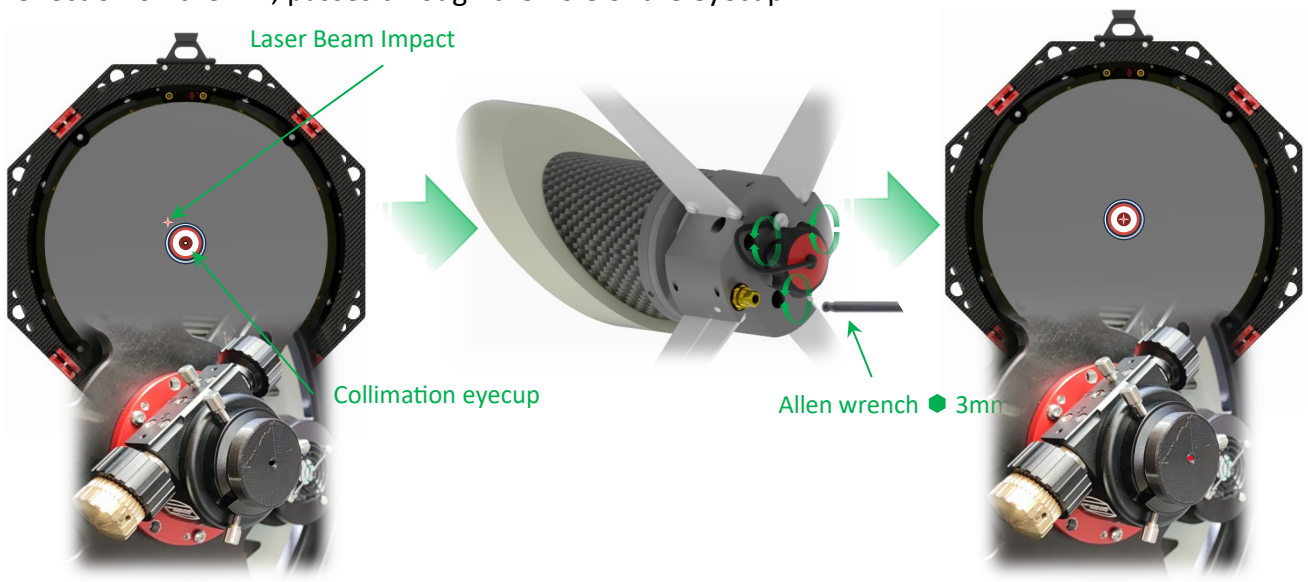


Variant Setting M2 paragraph 4.3.2.4

After this step, the Primary Mirror is correctly positioned for the Cassegrain formula but theoretically also for the Newton formula: indeed, the 2 optical formulas are confused, the Primary Mirrors (M1) of the 2 formulas have the same position.

Collimation of the Newton Formula

Once the Cassegrain Optical Formula is well collimated:
Install the Newton Secondary Optics Unit in place of the Cassegrain BOS, install a collimation eyecup in the Cassegrain Focuser (PO), and the collimation laser in the Newton PO.
Act on the 3 collimation screws of the M2 (on the hub) so that the laser beam, after reflection on the M2, passes through the hole of the eyecup



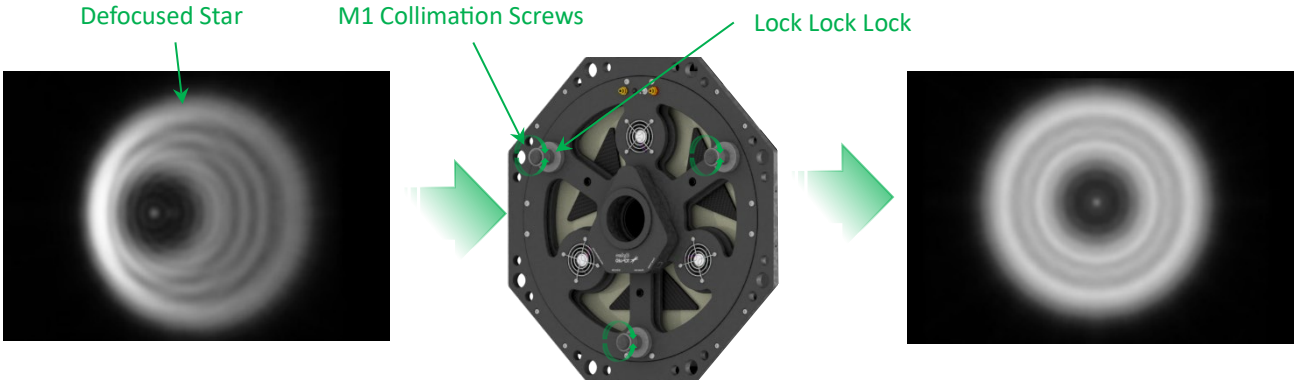
Adjusting the M2

The setting of the M1 Primary Mirror, whether it is the Newton Optics or Cassegrain formula, can be further refined on star.

Finishing the Collimation of the Primary Mirror on Star

Once set to daylight with the TAKAHASHI Collimation Laser and Microscope, the telescope should already be very well adjusted. The setting of the M1 can be further refined on a

medium, stable, defocused star near the zenith with a magnification equal to the Ø of the M1 in mm (e.g. x300 for a Ø300mm).



Refining the M1 Star Tuning

The star must be located in the center of the field (far from the center, the astigmatism resulting from the construction of the telescope would falsify the results)
The diffraction rings of the star must be concentric, at which point the M1 will fit perfectly.