OCAL2.0-4.0Electronic Collimator

manual

Version4.0

March 2026

Thank you for purchasing and using the OCAL Electronic Collimator.

This product is designed for collimation of Newtonian reflectors, SCT, RC, and other types of reflecting telescopes.

The core principle of the OCAL Electronic Collimator is: in a perfectly collimated optical system, the centers of all optical elements must be precisely aligned. This product greatly improves the accuracy limitations of traditional collimation methods, with a theoretical collimation accuracy of 0.08 mm. Actual performance depends on the machining and assembly precision of your telescope. Full collimation can be completed using this device alone.

After generations of iteration (Gen 2, 3, and 4), the new Gen 4.0 collimator delivers significant improvements in image clarity and collimation precision. It shows clearer primary mirror markers and richer reflection details, while maintaining excellent performance even in systems with correctors.
Please read this manual carefully before use to help you achieve perfect telescope collimation in the shortest time.

For any questions, please contact us via email:
huogo558@gmail.com

We will respond and assist you as soon as possible.
Visit our official website:
www.ocalworld.com/en

directory

1. Product Introduction

1.1 Product Parameters

The product has a cubic design. Dimensions (diameter, height) and weight may vary slightly between versions.
It connects to computers and mobile devices via a dual male USB-A to USB-C cable and OTG interface, with a 5V power supply.

1.2 Package Contents
(Contents listed are for Gen 4 only. Other versions are not specified here; please refer to the actual contents in the package.)

The package includes:

1 x collimator main unit,
1 x M42-to-M48 adapter ring,
1 x M42-to-1.25-inch adapter tube,
1 x OTG adapter
1 x USB-A to USB-C data cable.

包装盒

1.3 Software

The software can be downloaded from the download section of our official website
This model supports both computer and mobile use, and is currently compatible with
Windows, Android, and macOS

1.4 Product safety issues

This product has obtained the US FCC certification and EU CE certification, ensuring
the safety of electrical and communication connections related to life and property.

2、 Pre-use work for the product

2.1 How to install the Collimator

Attach the collimator to the eyepiece holder of the telescope.
This product uses an M42 thread interface. The recommended installation methods are as follows:
If your telescope's eyepiece holder has a built-in M42 male thread, simply screw the product into the eyepiece holder until fully seated.
If other adapters are required (such as 2'' to M42 adapter, M42 to M48 male adapter, etc.), please choose accordingly based on your specific telescope model.
This product can be mounted on a coma corrector.
Note that version 2.0 may cause reduced visual clarity in this setup.

## 2.2 How to connect to a computer

Simply connect this product to your computer's USB port using the included USB cable. No driver installation is required.

2.3 Precautions before use
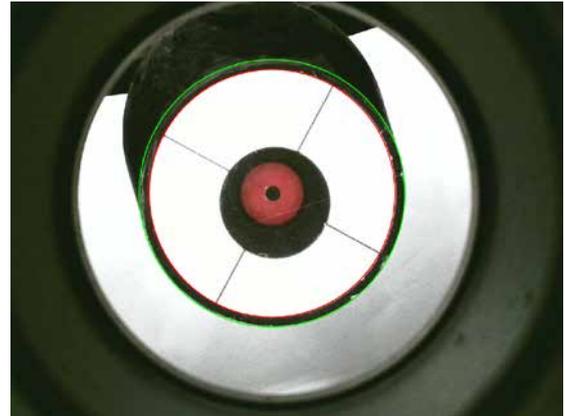## 2.31 Explanation of the Eye Point
We have named the distance from the collimator to the camera's focal plane the eye point.
Let's look at the differences between the A and B eye point combinations.

A
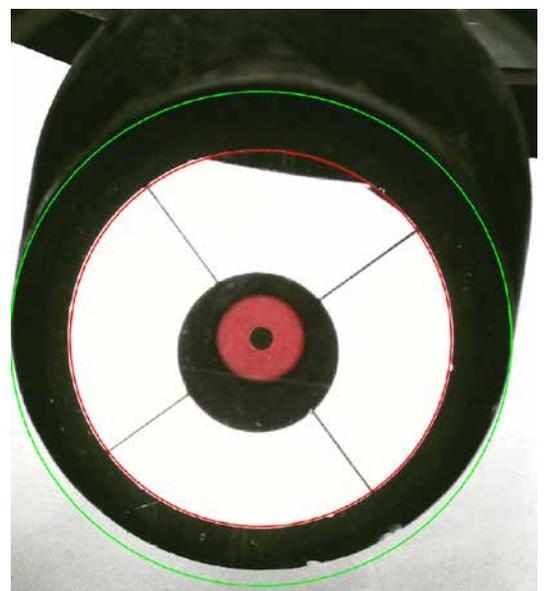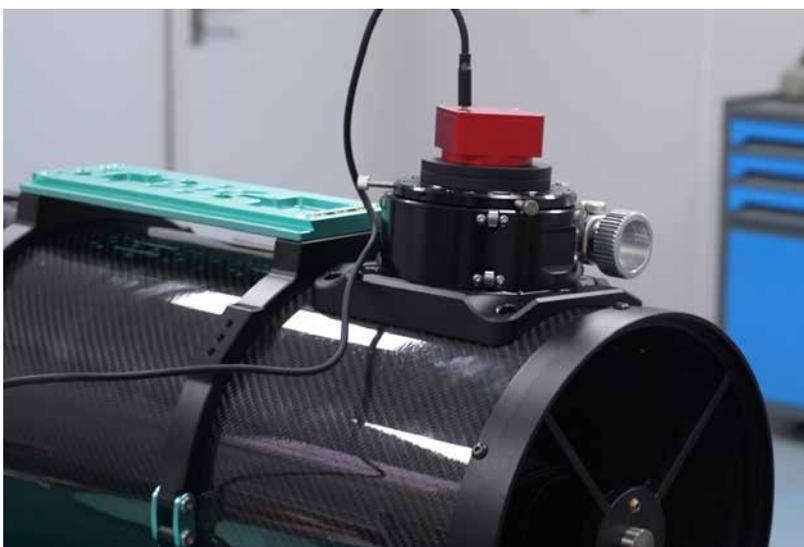
Fitted with a 40 mm extension tube.

B

It can be clearly seen from the comparison:

In combination A, the collimator is closer to the secondary mirror, and the spacing between the red circle and green circle on the secondary mirror is larger.

In combination B, the collimator is farther from the secondary mirror, and the red and green circles are much closer.

Theoretically, the core of optical axis collimation is to keep the secondary mirror concentric with the primary mirror.

The eye point only affects the vertical alignment of the secondary mirror. Its function is to adjust the secondary mirror height so that the green circle aligns with the top and bottom edges of the secondary mirror, and the red circle aligns with the edge of the primary mirror.

Only when the collimator is at the correct eye point position, and the secondary mirror and primary mirror are adjusted to be concentric, will the optical axis be truly collimated. Otherwise, collimation errors will occur.

Note: The position of the eye point shown in this tutorial is not an exact position, but a rough position for easy understanding.

Installing an ocal on a Newtonian reflecting telescope

What is the eye point, why should OCAL be placed in the eye point?

CMOS and eye point position

0.8X correction lens

eye point position

cmos position

b

b1

a

a1

C1

a+b=750mm

a1+b1=750mm
a1+c1=750X0.8=600mm

Only when OCAL is installed at the eye point, the secondary mirror can be in the same circle up, down, left, and right

In the first telescope, the focal length of its primary mirror is 750mm, which is the distance a+b,

This position is the focal point of the camera, and also the eye point of OCAL to watch the secondary mirror

In the second telescope, because the correction mirror is reduced by X0.8, the focal length of the entire system is
Change to a1+c1=750x0.8=600mm, that is, the position of the focal point of the camera, but
What the correction mirror reduces is the focal length of the system, and does not reduce the focal length of the primary mirror and the position of the eye point Still at a1+b1=750mm

According to the diagram, the eye point is the distance from the primary mirror to the CMOS (focal plane position).

For standard Newtonian telescopes such as Sky-Watcher F4 and F5, simply install the collimator at the focal plane where the CMOS is located during actual imaging, and adjust until all centers are aligned to complete collimation.

However, there are special cases (see the second diagram of the eye point):

Fast-ratio Newtonians such as the OCAL H-2 astrograph, Takahashi Newtonians, and SharpStar Newtonians cannot directly use the above method.

The reason is:

The focusing position of the camera CMOS is achieved using a focal reducer/corrector. With a 0.8× reduction factor, the effective focal length of the system is shortened by 20%, but collimation must be performed using the native focal length of the primary mirror. Therefore, the collimator must be extended backward by a certain distance.

In practice, this extension is difficult to achieve:

Taking the H-2 as an example, the native focal length is 560 mm ÷ 0.8 = 700 mm, requiring an extension of approximately 140 mm behind the focal plane.

This results in an overly small image of the secondary mirror, makes it difficult to find sufficiently long extension tubes, and mechanical accuracy cannot be guaranteed.

Therefore, a simplified and practical collimation method is recommended:

Use the markings on the H-2 secondary mirror as the reference, adjust until concentric, and secondary mirror height alignment is complete.
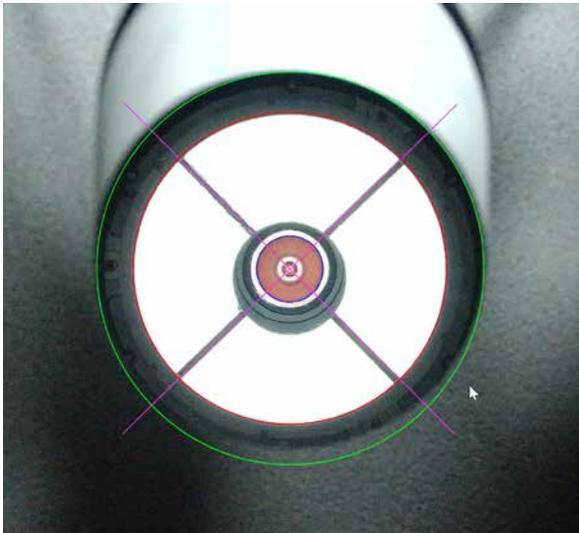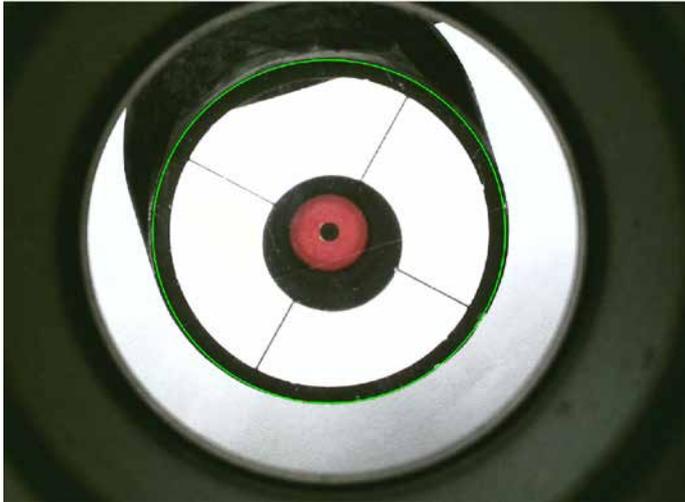

2.32 Paste a piece of white paper

If a piece of white paper is placed behind the secondary mirror, the edge of the secondary mirror corresponding to the green circle will be much easier to observe, as shown in the image.

Note: Version 4.0 provides good visibility even without the white paper.

White paper effect

Effect without white paper

2.33 Input of center calibration code

Each collimator comes with a unique center calibration code.

First, find the serial number of your collimator, then download the center calibration code file and locate the code

corresponding to your unit.

Enter the X and Y values of the center calibration code (e.g., X: 1900, Y: 1100) into the corresponding fields in the software's centering calibration interface.

The center calibration code is precisely factory-calibrated.

If the circle center is far from your telescope's optical center, please verify that the center calibration code is correct, or check for excessive mechanical assembly errors.
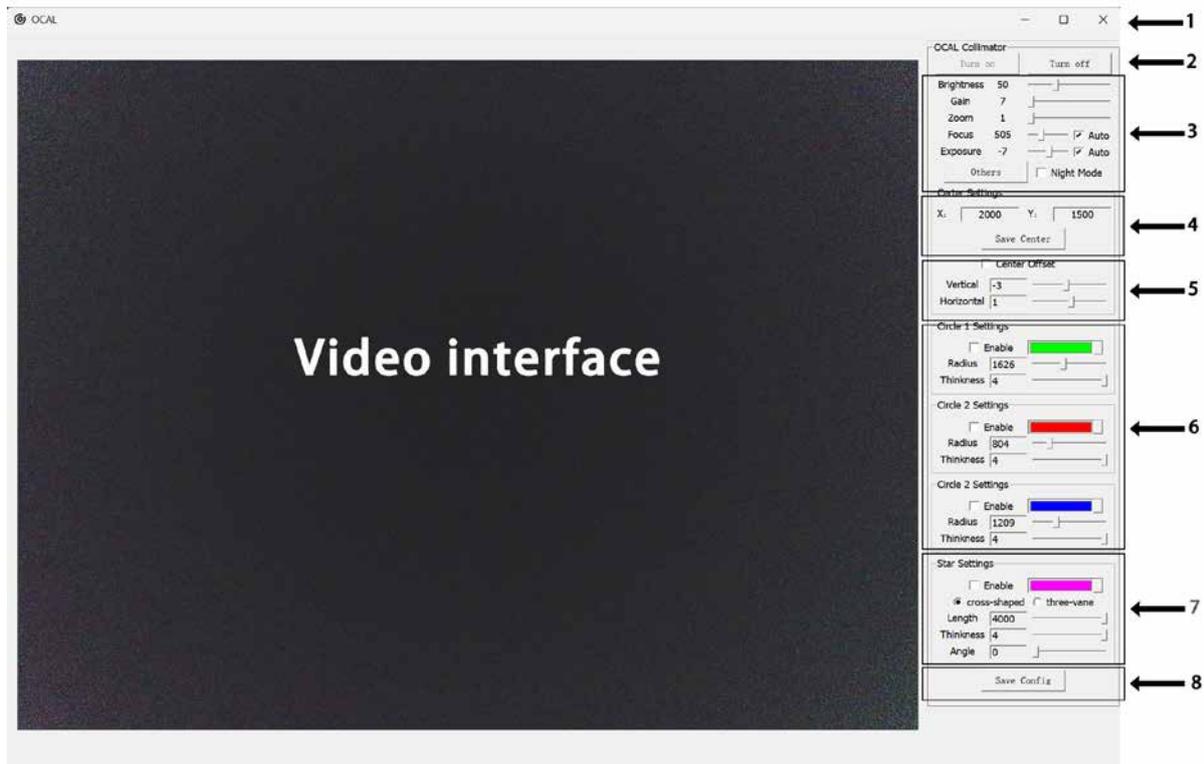

collimator SN： 3A 0090

3881	3A 0086	1911	1153
3882	3A 0087	1935	1117
3883	3A 0088		
3884	3A 0089	1917	1103
3885	3A 0090	1900	1100
3886	3A 0091	1890	1116
3887	3A 0092	1873	1074
3888	3A 0093	1861	1153

Download the document and find the center calibration code.

2.34 Software Basic Function Introduction

4.5 Basic Pages and Functions of Windows Software

1 Buttons for minimize, windowed mode, and close; in windowed mode, the software interface can be freely resized and scaled with the mouse.

2 Button for turning the camera on and off.

3 Controls for brightness, gain, video zoom (adjustable via mouse wheel), focus, and exposure.

Additional options are available in the settings menu, including a newly added night mode.

4 Enter the center calibration code values into the X and Y fields separately.

You must save the centering code; otherwise, settings will reset to default on next startup.

Use the center calibration code offset function as needed.

5 A detailed description is provided in the offset function introduction.

6 Three colored alignment circles, with radius adjustable via mouse wheel.

7 Buttons for crosshair and 3-vane spider.

8 Click Save Parameters when all settings are complete.

The software will load the last saved configuration on next startup.

For macOS, the software is available on the Apple App Store.

Search for CenterCalibrationCode and click the button at the bottom of the software to launch.

Camera parameters can be adjusted in Camera Settings, with functions similar to the Windows

2.35 Android software interface introduction

The Android version interface is different from the PC version, but the functions are similar. The image below shows the Android version interface.
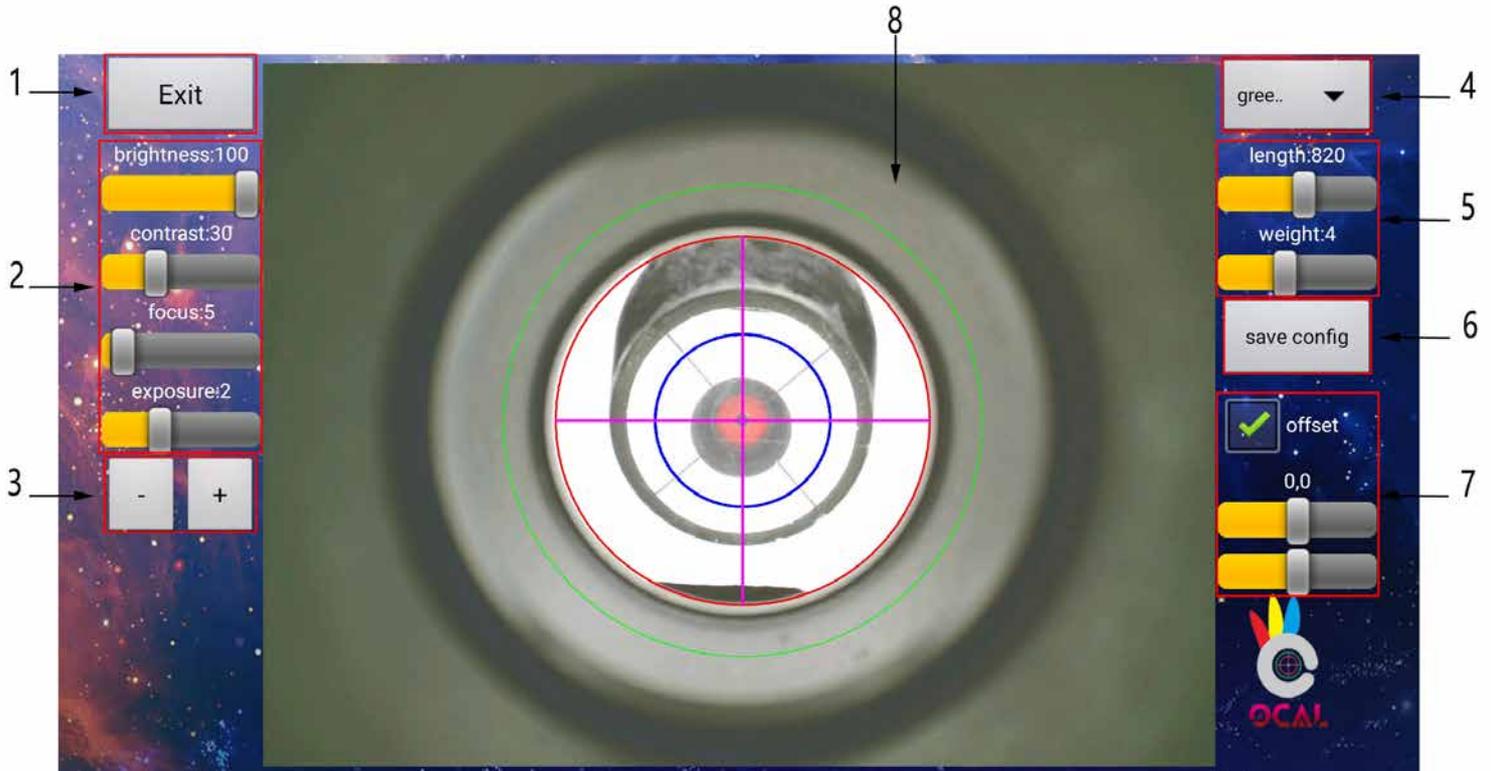
1 Exit button: Click to close the software.

2 Sliders: Adjust brightness, contrast, focus, gain, and exposure by dragging the sliders.

3 Fine adjustment: Drag any slider, or use the plus/minus buttons for fine-tuning.

Single-click changes the value by 1; long-press increases the rate by 10x.

4 Overlay selection: Enable red, green, blue circles and crosshairs.

5 Adjustment for overlays: Modify the length and line width of the selected red, green, blue circles and crosshairs.

6 Save parameters:

Single-click: Save current settings.

Long-press: Enter the centering calibration code.

For the Android version, enter the X and Y values separately.

Example: If the code is 2000 1500, set X=2000 and Y=1500, then tap Save to apply.

7 Reticle drift function: Functions are identical to the PC version.

8 Video display area.

2.36 Center offest function

Due to tolerances in hardware manufacturing and assembly, the center of the collimator software may not fully align with the actual optical center of the telescope after entering the center calibration code.
Generally, an error of 4–8 pixels is considered normal and can be corrected using the Center Offset function.

It should be noted that this function is currently somewhat controversial, and its potential effects are not yet fully defined.
The specific operation is as follows:
First, locate a circular reference structure inside the telescope and adjust the green circle to be concentric with it.

If direct alignment is not possible, enable the Center Offset function and adjust vertically and horizontally until the green circle is concentric with the reference circle.

If the various circular structures inside the telescope cannot be aligned with one another and show significant errors, this is most likely due to mechanical assembly issues in the telescope itself.

Adjust the radius of the green circle, then find a circular structure as a reference to align the green circle concentrically with it.
(The reference circle should be determined according to your actual equipment.)
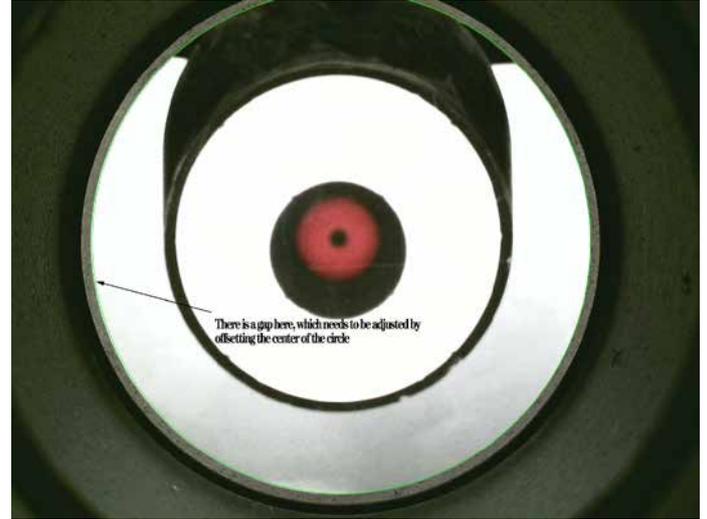
As can be seen in this image, no matter how it is adjusted, there is a clear gap between the green circle and the left side of the circular structure.
In this case, please enable the Center Offset function.
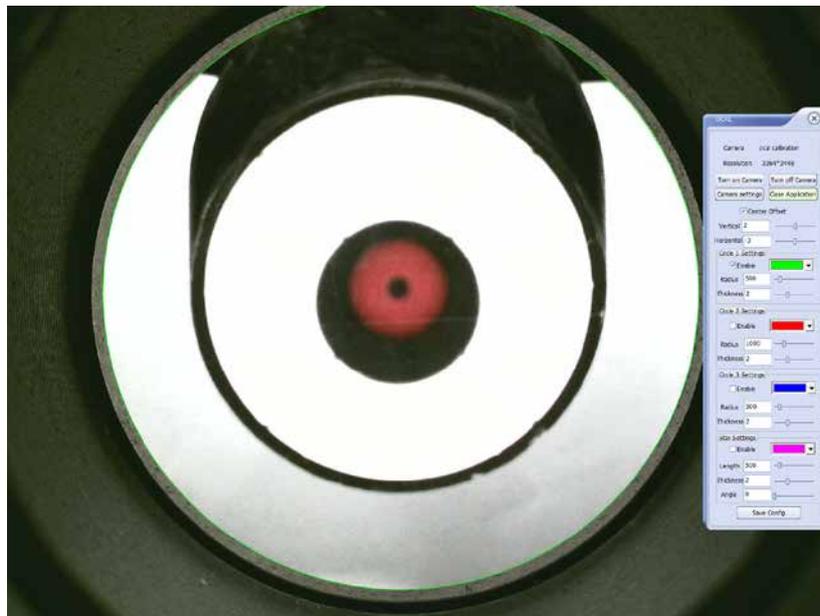
After adjusting +2 pixels vertically and -3 pixels horizontally,
the green circle is now concentric with the circular structure.

3. Newtonian Reflector Collimation Tutorial

3.1 Unified coordinate system

To help you better understand this tutorial and quickly complete collimation using the 4-step method, we first define the coordinate system.
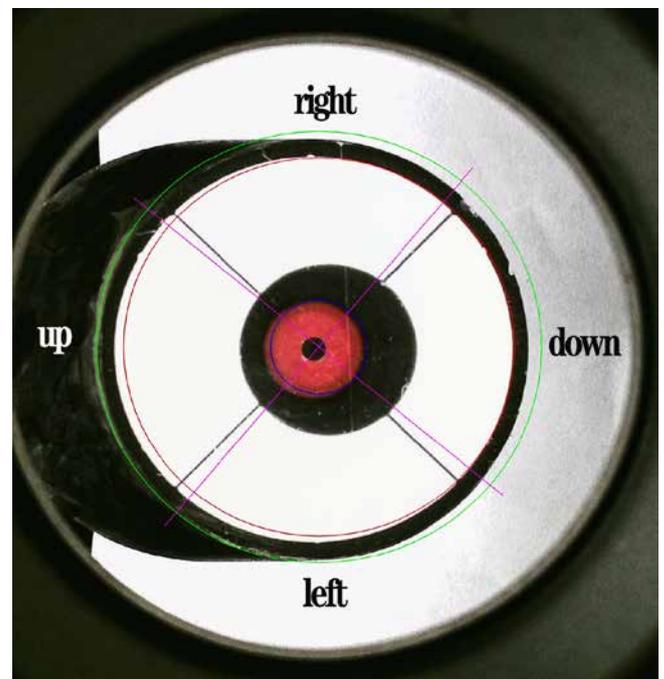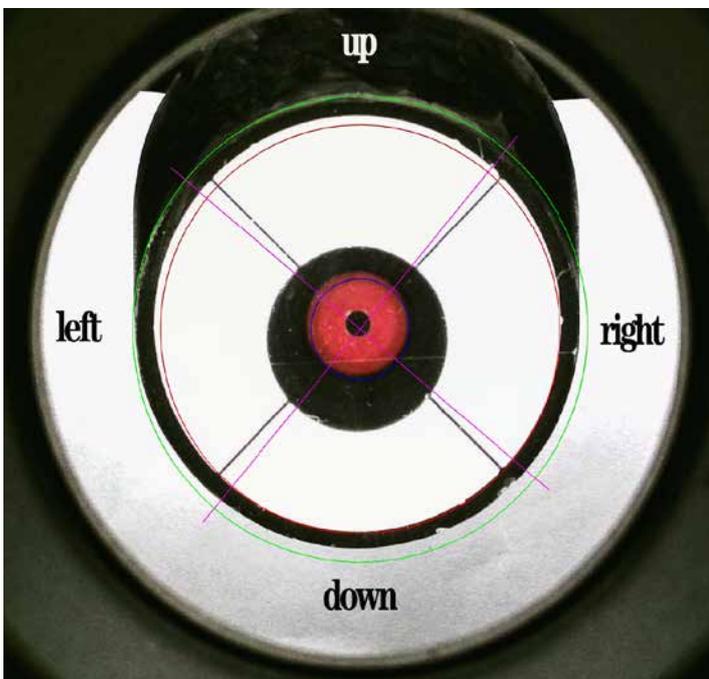
We define the direction toward the spider vane as up.

Based on this, we also define left, right, and down accordingly.

Regardless of how the secondary mirror appears to you,

the up, down, left, and right directions in this coordinate system remain fixed.

Secondary Mirror Screw Coordinate System

Coordinate System of the Secondary Mirror Screws

The secondary mirror coordinate system includes three angle adjustment screws (A, B, C) and one vertical height adjustment screw. Their functions are as follows:

The screw facing the focuser is defined as Screw A, which controls the tilt (elevation) of the secondary mirror.

Screws B and C control the left and right inclination of the secondary mirror.

In addition to the three angle adjustments provided by screws A, B, and C, the secondary mirror can also rotate freely 360° (as indicated by the circular arrow).

The large central screw adjusts only the vertical height of the secondary mirror, without affecting its angle or rotation.

3.2 4-step collimation adjustment

3.21 Secondary Mirror Positioning

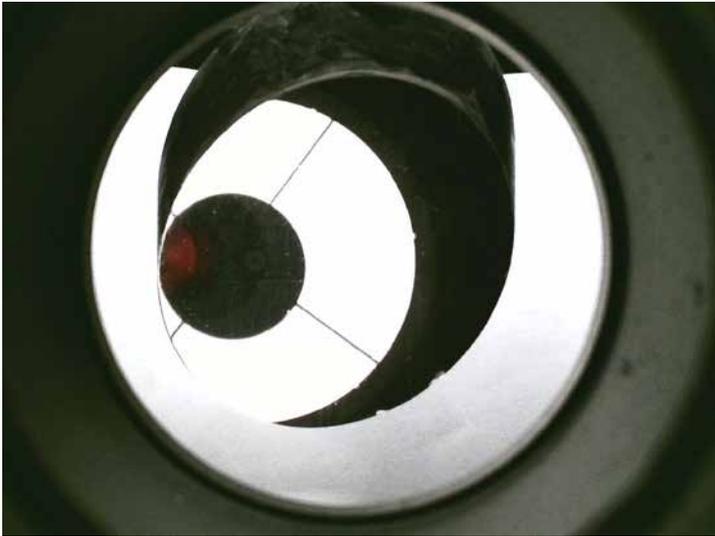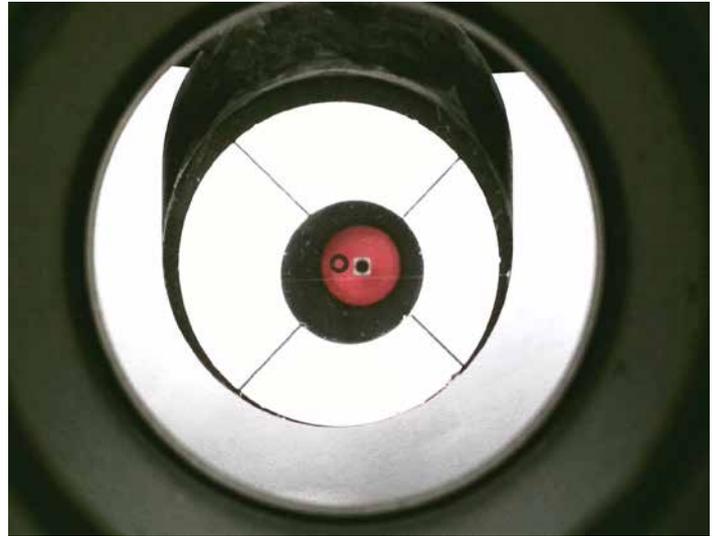
Figure 1 Initial state

Figure 2 Rotate the secondary mirror (360° rotational axis)Face the secondary mirror toward us; approximate positioning is sufficient.
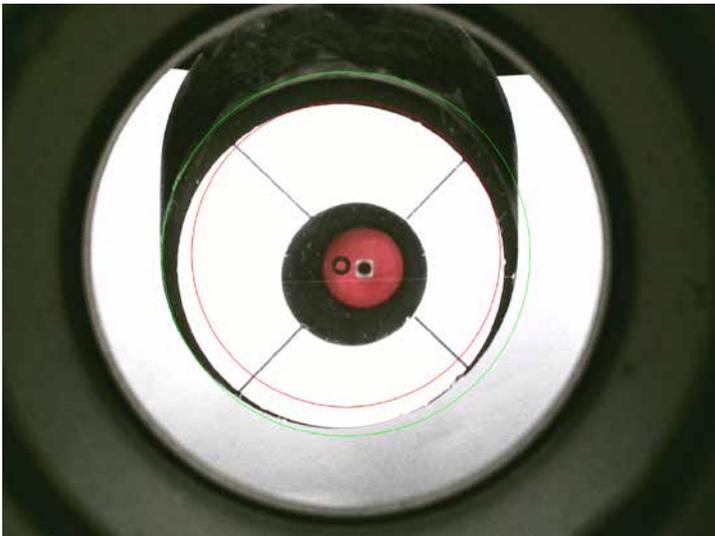

Figure 3
Turn on the red and green circles in the software.Adjust the red circle to approximately the same size as the primary mirror, and adjust the green circle to approximately the same size as the edge of the secondary mirror.
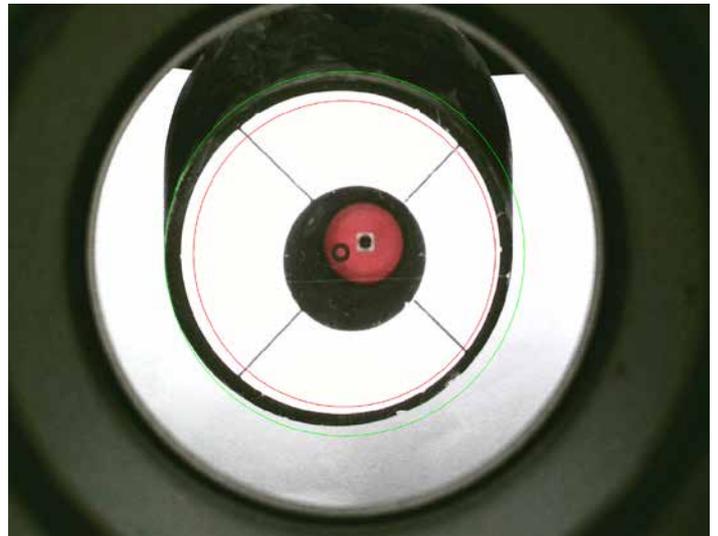

Figure 4
It can be seen from Figure 3 that the red circle has a large vertical elevation deviation from the primary mirror.
In this case, use screw A to adjust the elevation angle of the secondary mirror.
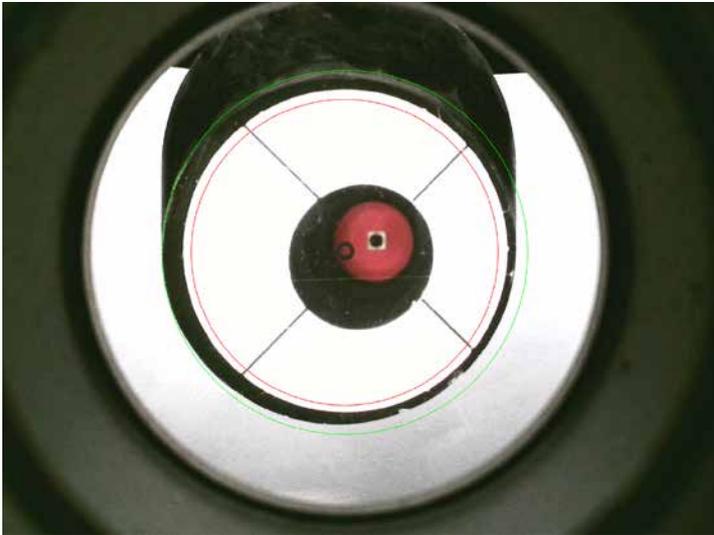
Figure 5
Rotate the secondary mirror. The left-right size
of the primary mirror is roughly aligned with the
red circle, so the primary mirror is now OK.
However, there is a large left-right deviation
between the green circle and the edge of the
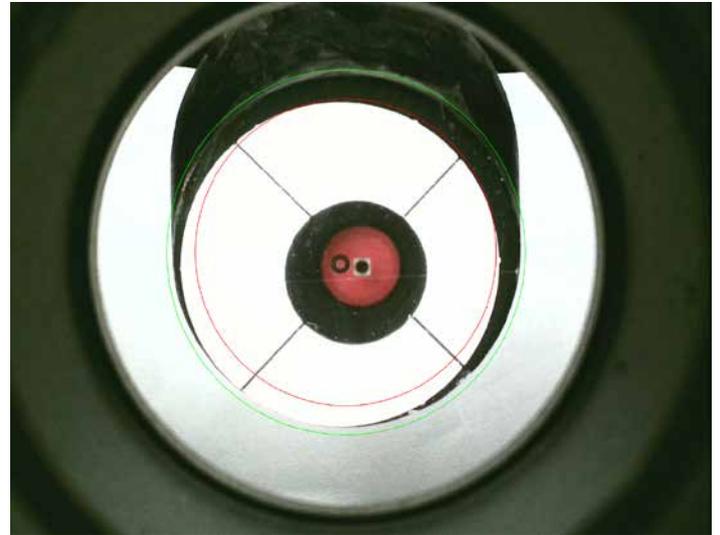secondary mirror.

Figure 6
Now adjust the edge of the secondary mirror
first.Please turn screws B and C to align the left
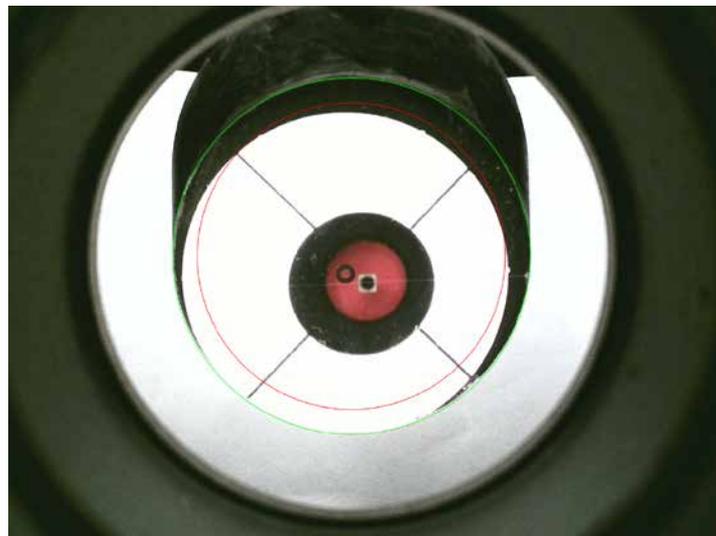and right edges of the secondary mirror with
the green circle.

Figure 7
Shrink the green circle to fit the secondary mirror more
closely,and fine-tune screws B and C for more precise
adjustment.The alignment between the green circle and the
left/right edges of the secondary mirror is now good,
but the red circle is misaligned with the reflecting surface of

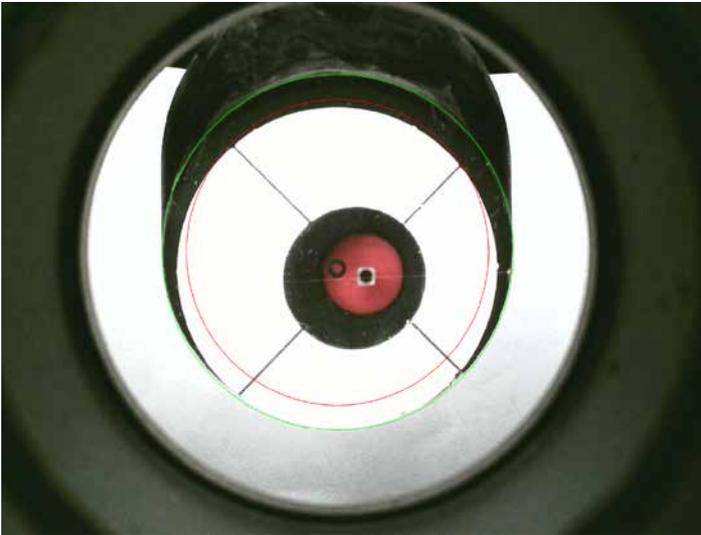## 3.22 Step 2 – Separate Positioning of Secondary and Primary Mirrors

Figure 8
Rotate the secondary mirror slightly to make the red circle align evenly with the primary mirror on the left and right.
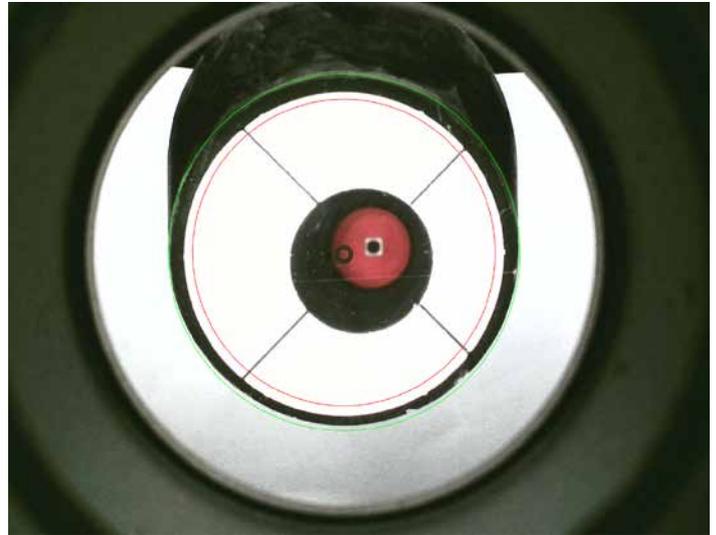At this point, there is a large vertical gap.

Figure 9
Adjust screw A. At this point, the secondary mirror is fully adjusted.

Summary

Screw A controls the elevation adjustment of the secondary mirror.

Whether the elevation is properly adjusted is determined only by checking if the red circle and the upper/lower edges of the primary mirror are concentric.

Screws B and C control the left/right edge alignment of the secondary mirror.

Do not use screws B and C to adjust any parameters related to the primary mirror.

The rotation angle of the secondary mirror is only used to align the red circle with the left/right edges of the primary mirror, ensuring accurate left/right calibration.

3.23 Step 3 – Judging the Correct Height of the Secondary Mirror

There is a gap between the secondary lens and the green circle, indicating that the height of the secondary lens is incorrect and needs to be adjusted

Figure 10

A gap can be seen between the bottom of the secondary mirror and the green circle, indicating that the height of the secondary mirror is incorrect.

Adjust the large central screw of the secondary mirror to lower its height, then repeat the previous steps.

3.24 Step 4 – Adjustment of the Primary Mirror

The primary mirror is adjusted by turning the primary mirror screws.

This product provides two functions for you to calibrate the primary mirror:

1 Enable the crosshair function and check whether it aligns with the spider vane.

2 Check whether the blue circle and the red collimator are concentric.
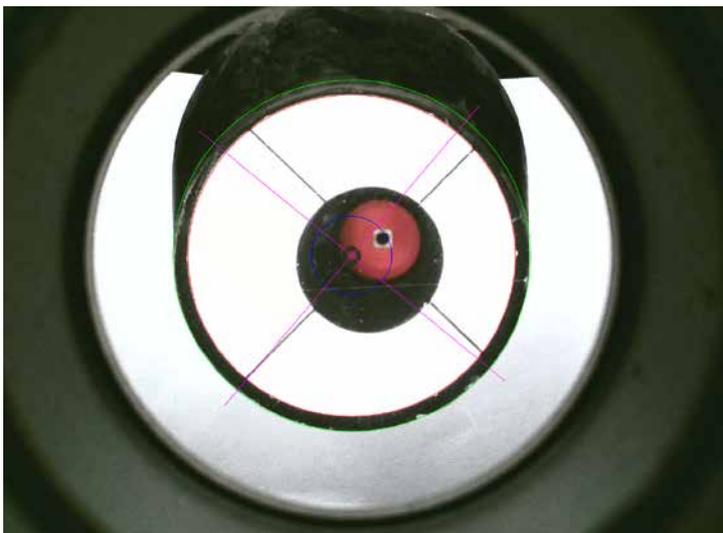
First, adjust the blue circle to roughly match the size of the red collimator. Then enable the crosshair function. You will see a large misalignment between both the blue circle and the red collimator, and the crosshairs and the spider vanes. This indicates a significant collimation error of the primary mirror.

Adjust the primary mirror by gently pushing or turning its three collimation screws. The process is intuitive: simply make small adjustments in the direction that brings the elements into alignment.

Normally, the three screws do not need to be turned much.
It is incorrect if any screw is tightened too much or is about to be removed.
The trick is: if you cannot push a certain screw,
you can loosen the other two screws instead.
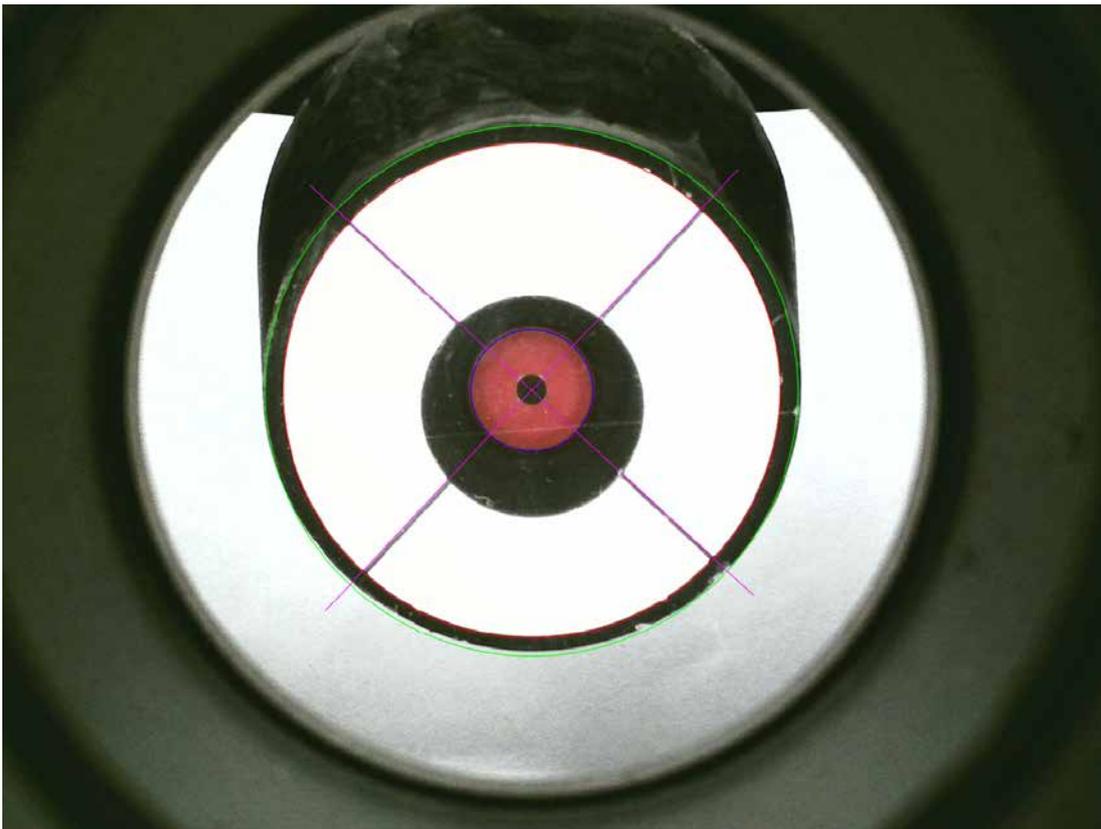
The primary mirror adjustment is now complete. This is the final state, which has several characteristics:

1 The green circle is concentric with the secondary mirror, and the red circle is concentric with the primary mirror (at the correct eye position).

2 The crosshairs align with the spider vanes.

3 The blue circle is concentric with the collimator.

4 The primary mirror center mark falls inside the collimator lens or within the black circle on the 4.0 collimator.
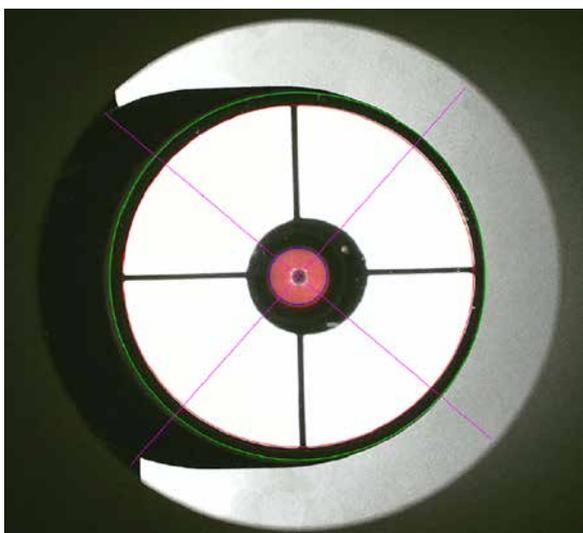
Additional Notes:

On the premise that features 1 and 2 are accurately aligned, conflicts may sometimes occur between features 3 and 4.

For example, when the blue circle is adjusted to be concentric, the primary mirror center mark will not be in the exact center. Conversely, when the primary mirror center mark is centered, the blue circle will be offset (as shown in the left image: the blue circle shifts slightly to the left when the center mark is centered). Based on this observation, the phenomenon is most likely caused by an error in the primary mirror center mark.

To verify this inference, we disassembled the telescope and measured the primary mirror.
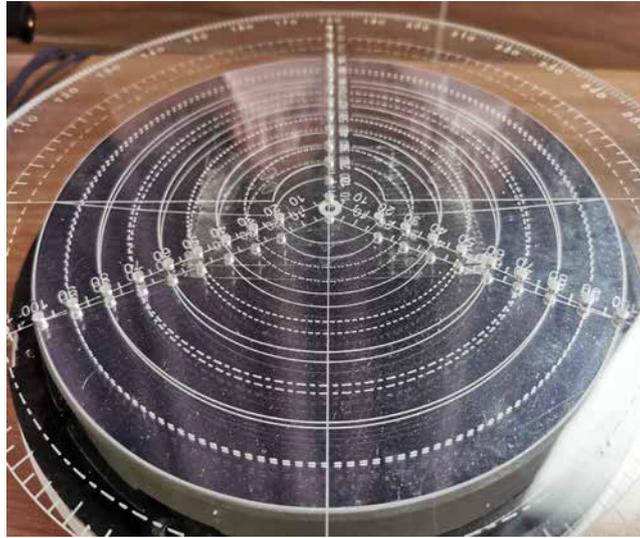
The center mark on the primary mirror was offset by 2 mm. A new reference mark has been made.

4、A Practical Case Study

To better see the details when using this product, auxiliary lighting is required.
We recommend adjusting the telescope during the daytime by pointing it at the sky.If you are working at night, use a flat, even light source or a brightly lit wall.
Large-area lights are also a good choice, such as a computer screen.
Whenever possible, always check the collimation before using the telescope
to avoid any misalignment caused by vibration or bumps during transportation.

Thank you for taking the time to read this guide.