Tilt Corrector
TC 900

User Manual
rev. 2022-11-09

ASTRODEVICE

1

2

3

4

Package contents:

1. Tilt Corrector
2. M4x8 screws (6 pcs)
3. M4x4 headless screws (4 pcs)
4. M2.5x10 screws with washers (4 pcs)

First read the entire manual and make sure that everything is clear to you.
Only then start working with TIlt Corrector.
If you have any questions, please contact Astrodevice.

Introduction

Tilt Corrector is a device for adjusting tilt angle of the camera in the optical path of the telescope. It works with any telescope and ZWO ASI 2400 MC Pro, ASI 2600 MM/MC Pro and ASI 6200 MM/MC Pro cameras. The tilt adjustment screws can be accessed from the back of the camera, so that the camera does not need to be removed from the set during adjustment, and the entire adjustment procedure can be carried out with a live preview of the result. In addition to such continuous operation, a special procedure, described further in this manual, makes it possible to transfer the determined settings to the camera's original black tilt plate or to the Astrodevice filter drawer.

Usage

The device is designed to work in conditions of 0-40 degrees Celsius (32°F - 104°F).

High temperatures

Although PET-G is relatively robust, too high a temperature can lead to deformations. If you don't even notice them, the micro structural changes can cause the device to become uncalibrated. Therefore, do not store or use the Corrector at high temperatures. Adopt the rule of thumb that if it's too hot for you, so is for the device.

Low temperatures

Our accessories have been successfully tested in temperatures as low as -20 degrees Celsius (-4°F). Although the use of the device in freezing temperatures is technically possible, there is a risk associated with the phenomenon of ice

condensation. If water freezes in the crevices of the structure, ice can damage the accessory and lead to its destruction. Therefore, if you intend to use the Correctorin freezing weather at your own risk, make sure that the environment is dry.

Under all conditions, work with the device should be personally supervised. Before use, make sure that the accessories and their threads are not damaged and that they are securely mounted. Never use a defective device.

Technology, design and elements

Tilt Corrector was made with 3D printing technology using carbon fiber reinforced PET-G plastic. Refinement with this material significantly strengthens the construction and on the outside it manifests itself with a characteristic, slightly rough texture.

The device consists of two coaxial rings (fig. 1 - R1, R2) connected by three adjustment screws (S1, S2, S3). The narrower ring, R1, is mounted to the camera housing through mounting holes H1 - H4. Rotation of screws S1, S2 and S3 pushes back the wider ring R2, and thus changes the camera's tilt angle. Clockwise rotation of the screws moves the planes away from each other, while counterclockwise rotation brings them closer together. The position where the planes of the rings touch each other, no adjustment has yet been made, this initial position, will be referred to as the *zero position*.

The back of the Tilt Corrector shows 2 groups of components, each of which consists of three elements arranged around the perimeter every 120 degrees.

In the first group there are three bridges B1, B2 and B3 on the center of which there are adjustment screws BS1, BS2, BS3. The bridges are permanently mounted with side construction screws marked with a red x marker. Please do not nor unscrew these mounting screws, as this may lead to irreparable damage of the drawer.

The second group contains three tabs T1, T2 and T3 for mounting the original tilt

plate. Each tab is bolted with two removable TS screws. In place of the tabs, other brackets can also be screwed on, for mounting the Astrodevice FD 900 M87 filter drawer.

As you will notice, this manual repeatedly points out that this work should not use force. You are dealing with fine threads and strong yet small parts. Everything should work smoothly and if there is any resistance, it should be even and easy to overcome. A noticeable, slightly greater resistance to the rotation of the screws occurs only when adjusting the tilt - this is appropriate and desirable.

Do not tighten the screws forcibly, do not tighten them brutally, because then you create stresses in the material, which can lead to distortion of the image or damage to the structure of objects.

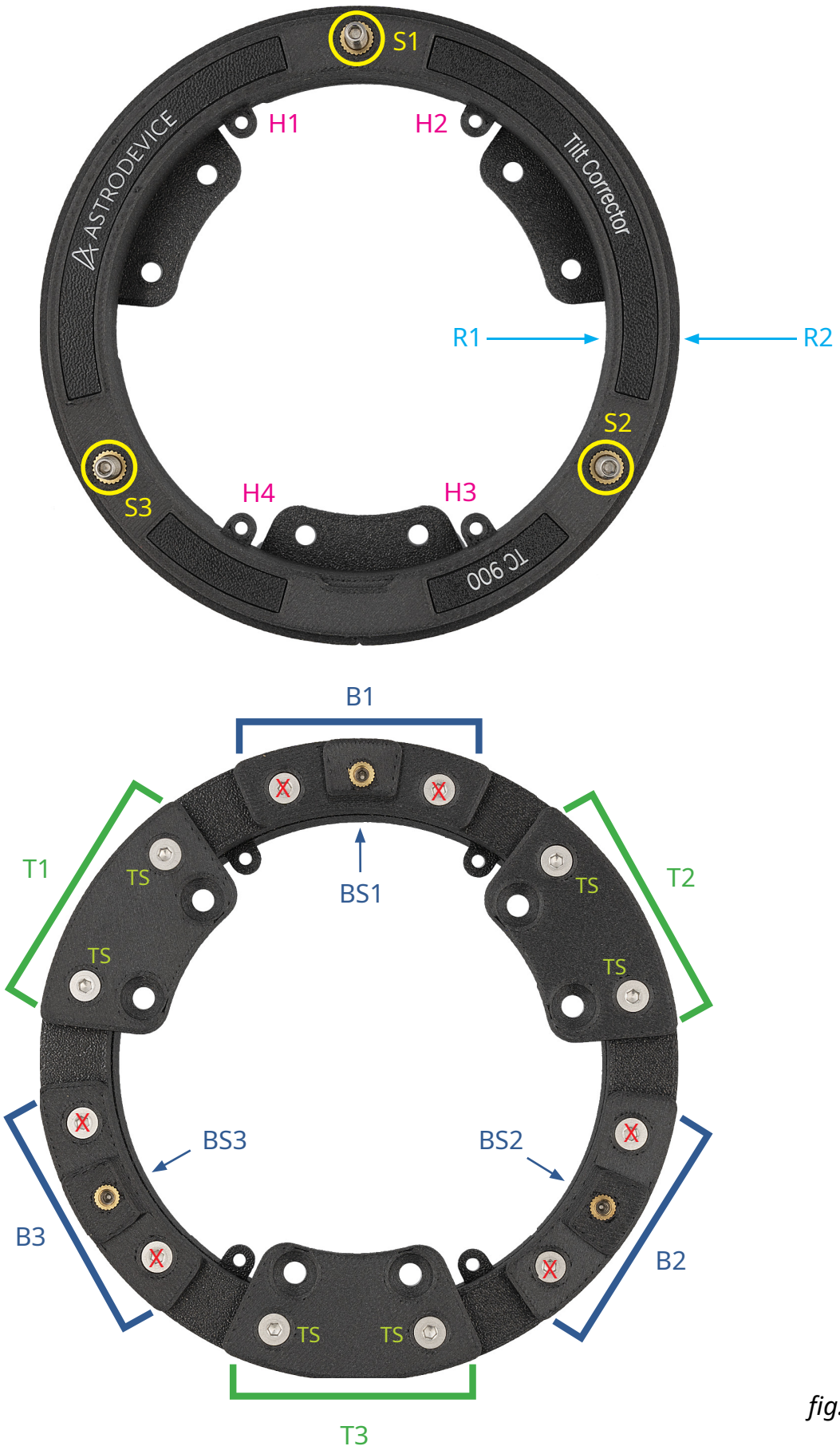
S1
H1
H2
ASTRODEVICE
Tilt Corrector
R1
R2
S2
S3
H4
H3
TC 900
B1
T1
TS
BS1
TS
T2
TS
TS
BS3
BS2
B3
B2
TS
TS
T3

fig. 1

Installation

The installation procedure follows two successive steps:

1. mounting the Tilt Corrector on the camera

2. mounting to the camera with the Tilt Corrector:

   A. original black tilt plate
      or
   B. Astrodevice filter drawer FD 900 M87

After completing steps 1 and 2, the camera can be mounted on a telescope.

***

STEP 1

Mounting the Tilt Corrector on the camera

Before you proceed, prepare a small ziplock bag into which you can hide the screws you will be removing. This will make your work much more efficient.

1. **Place the camera on a flat table with the tilt plate facing up.**

   See fig. 2.

2. **Remove the three screws holding the tilt plate.**

   Use 2 mm hex wrench, like the one provided with camera. See fig. 3. Be careful, as tiny screws may fall. Secure them after removal so that they are not lost.

3. **Remove the tilt plate.**

   See fig. 4.

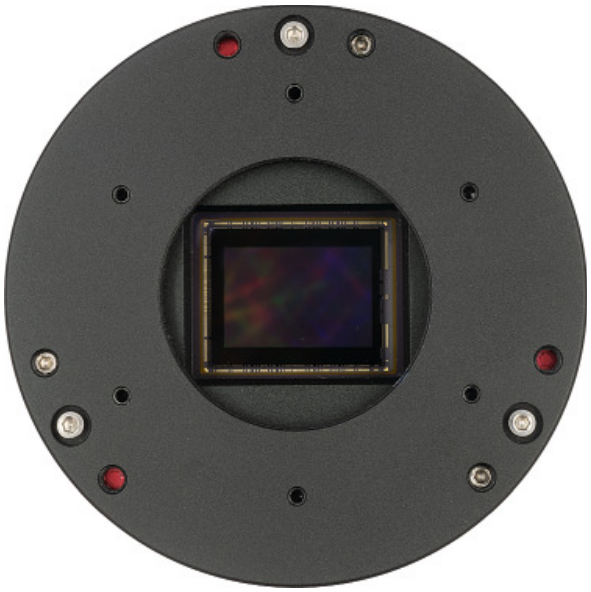

fig. 2

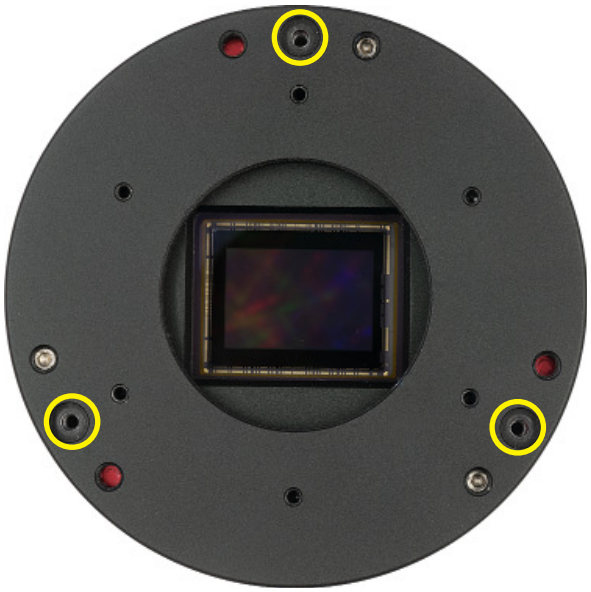

fig. 3

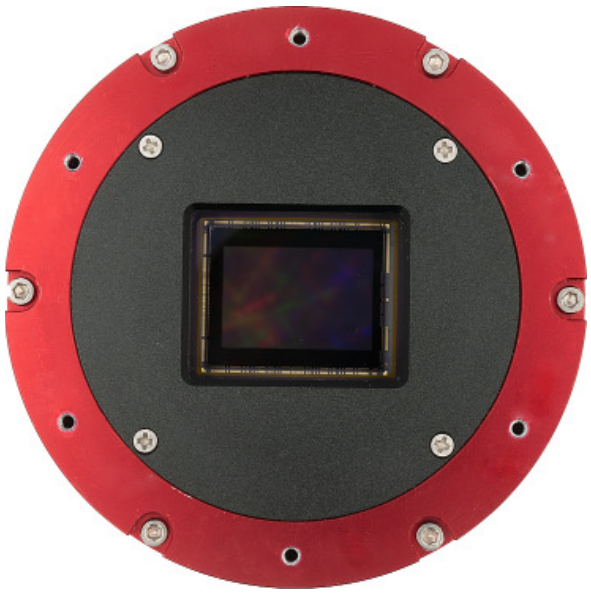

fig. 4

4. **Remove tilt adjustment bolts.**

   Remove three M4x4 headless screws from the tilt plate. They are originally used for tilt adjustment. They are very small. Secure them in a safe place so they don’t get lost. See fig. 5.

   After this step, the original black tilt plate should be free of any screws. See fig. 6.

5. **Prepare the camera housing for Tilt Corrector mounting.**

   The Tilt Corrector is mounted to the camera using the four screws originally tightening the top of its housing. In total, on the sensor side, the camera housing is bolted with six screws, but only four will be used to mount the Tilt Corrector. This eliminates the risk of disassembling the housing, as the two screws remain in place at all times during installation. This step involves temporary removing four of the six screws of the camera housing, and then screwing new screws in through the holes in the Tilt Corrector ring.

   Using a 2 mm hex wrench, remove the four M2.5x8 screws marked in fig. 7 in blue. Note that these are the screws located above and below the longer edge of the sensor. After removing the screws, your camera should look like the one in fig. 8.

   As in previous cases, also hide these screws in a safe place, preferably in a ziplock bag that you have prepared for this purpose.

6. **Prepare Tilt Corrector**

   Tilt Corrector is supplied with the rings as close to each other as possible. In order not to cause stress during installation, you should start by loosening the contact between rings, that is, moving them away from each other to a safe distance of about 1,5 mm. To do this, use a 2 mm hex wrench to turn each of the adjustment screws S1, S2 and S3 two full turns clockwise. Please also unscrew the three tabs T1, T2 and T3 located on the back of the Tilt Corrector (see fig. 9).

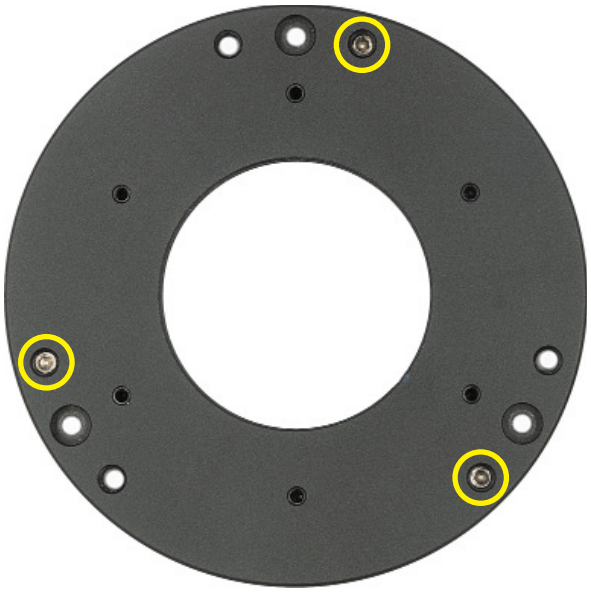

fig. 5

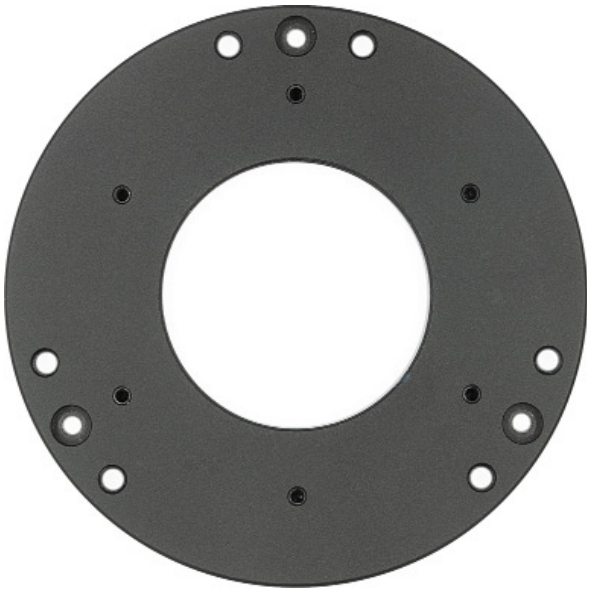

fig. 6

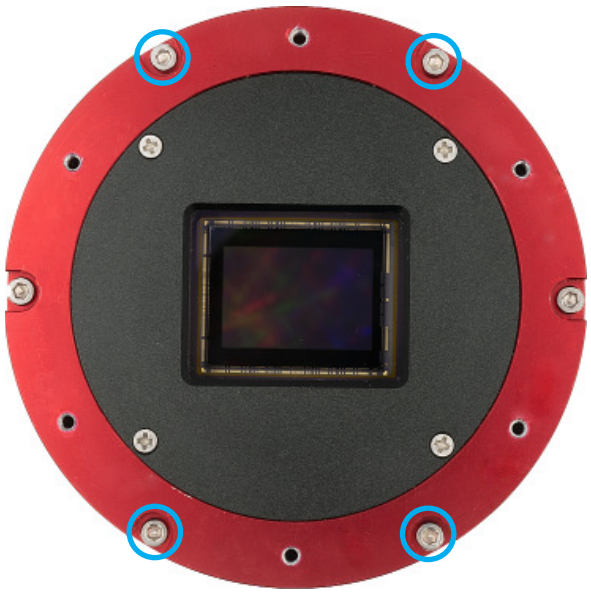

fig. 7

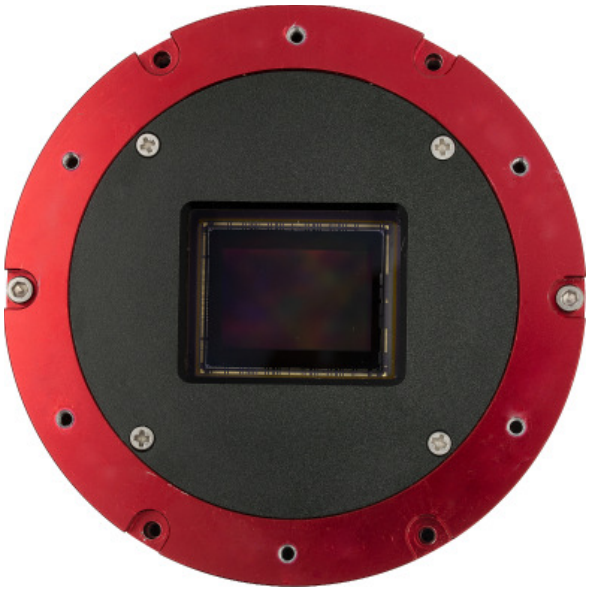

fig. 8

fig. 9

7. Mount Tilt Corrector on the camera

Place the Tilt Corrector in front of you in the position as shown in fig. 10.

Note the vertical line visible in front of you and the notch located on the top plane of the Tilt Corrector. Both of these features are marked on fig. 10 in green. The line serves to give you an easy indication of how the Tilt Corrector should be positioned relative to the camera during installation. The Tilt Corrector should be put on the camera in such a way that the line is on the same side as the black dot on the camera housing. Then, when the Tilt Corrector is slid onto the camera, the notch will overlap the black dot.

Now turn the Tilt Corrector upside down, in such a way that the characteristic line is still in front of you (fig. 11).

Grasp the Tilt Corrector with both hands and slide it on top of the camera (fig. 12). Look from the top and fine-tune the positioning so that the Tilt Corrector’s mounting profiles go into the notches in the housing from which you previously removed the screws (fig. 13). The fit is tight, but tailored. Work gently and do not apply too much force. Corector’s holed mounting profiles must pop all the way into place - then you will be left with about 3 mm of free space above them (fig .14).

Screw the Tilt Corrector to the camera using the four prepared screws with washers (fig. 15). Do not use force for installation. Be careful not to strip the thread. Do everything gently. Tighten the screws to the first resistance, but not too tight. The screw in the thread should turn freely. If you feel too much unnatural resistance, give up, remove the screw, take off the Tilt Corrector and try to screw in the screw alone making sure that it screws in lightly, correctly and there is no risk of stripping the thread.

fig. 10

fig. 11

fig. 12

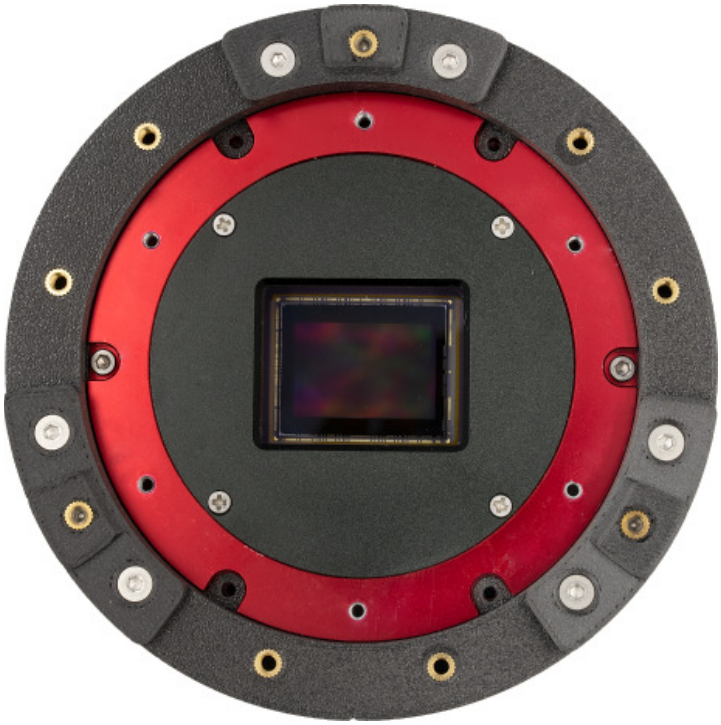

fig. 13

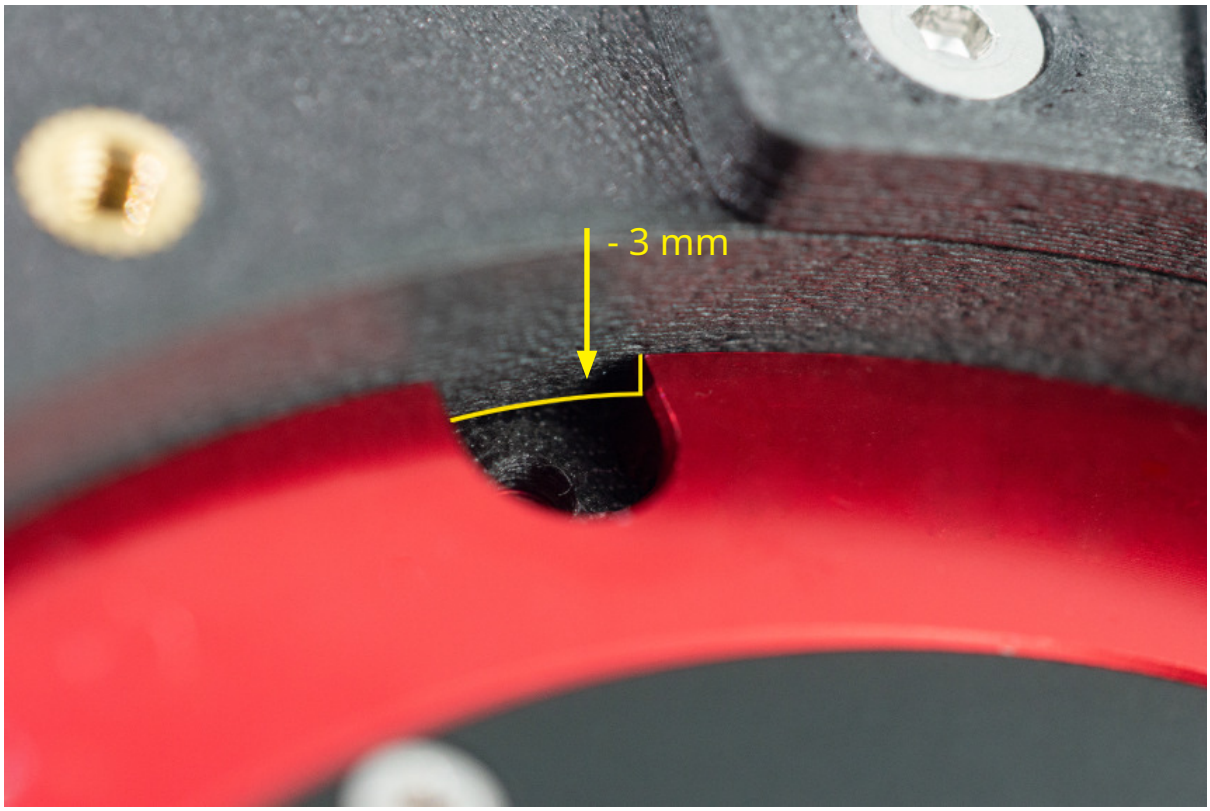

fig. 14

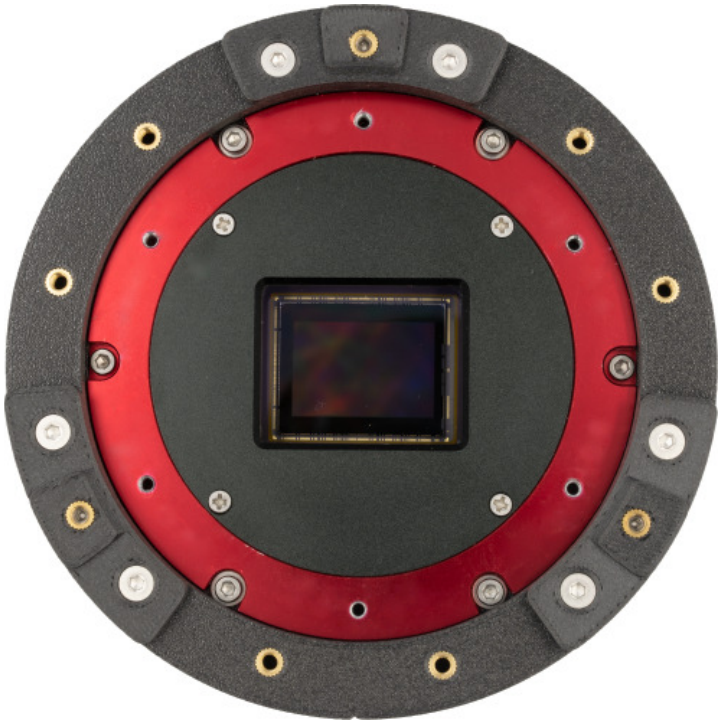

fig. 15

STEP 2A

Installation of the original black tilt plate in the Tilt Corrector

As already mentioned, the Tilt Corrector can work with both the camera's original black tilt plate and the Astrodevice FD 900 M87 filter drawer. Since the camera with the plate is the most basic set that can work with any telescope, this configuration will be discussed first. If you have a Celestron RASA 8 telescope and want to use the Astrodevice filter drawer, after reading this section, proceed to step 2B.

Place the original black tilt plate on the camera with the Tilt Corrector installed (fig. 16). Make sure that the screw holes in the tilt plate and in the Tilt Corrector are aligned with each other as shown (fig. 16, yellow lines). A good indicator of whether the tilt plate is correctly positioned is that the mounting holes of the tilt plate and the camera underneath overlap (fig 16, yellow circles).

Screw the T1, T2, T3 tabs to the Tilt Corrector, (fig. 17, green circles). Then tighten the tilt plate with the supplied M4x8 screws using a 2.5 mm hex wrench (fig. 17, red circles).

After screwing the tilt plate, return to the initial position by turning the screws S1, S2 and S3 back, which is the opposite direction from that shown in fig. 9. When returning to the zero position, do not use force. When you feel the first resistance, do not continue turning the screw. You should bring the rings towards each other, but not pull them further, causing tension. Work with sensitivity and gentleness.

Now your camera is ready to go. However, before you start screwing the accessory to the M42 thread on the front of the black tilt plate, note that over the length of the first 5 mm, the first mounted accessory must not be more than 70 mm in diameter (see fig. 18). For this reason, in most cases you cannot mount most filter drawers or a filter wheel to the tilt plate directly. If you would like to mount such an accessory, you must first screw on a spacer, such as a 6-millimeter length (see fig. 19 as an example). Note, that depending on the size of the filter and the focal length of the telescope, moving the filter away from the sensor may result in increased vignetting.

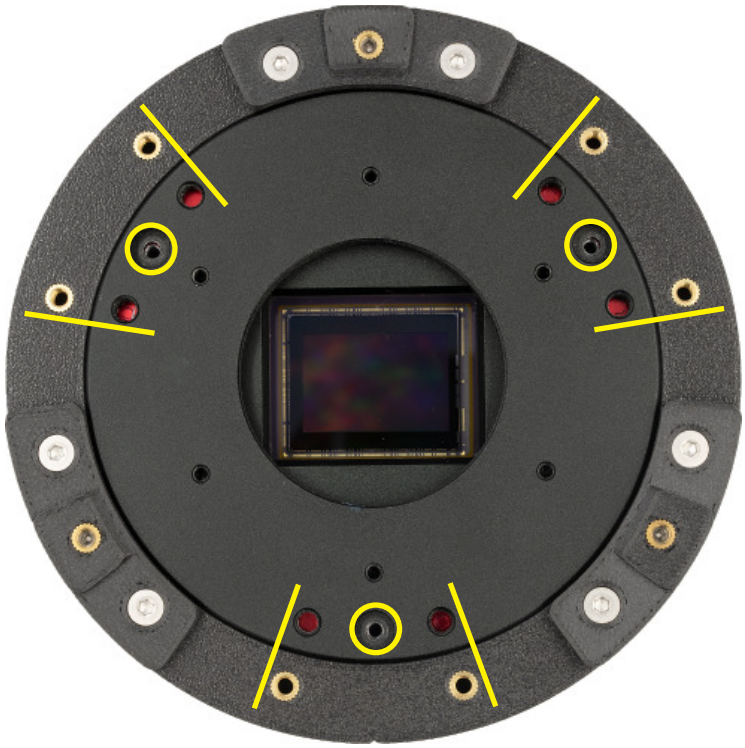

fig. 16

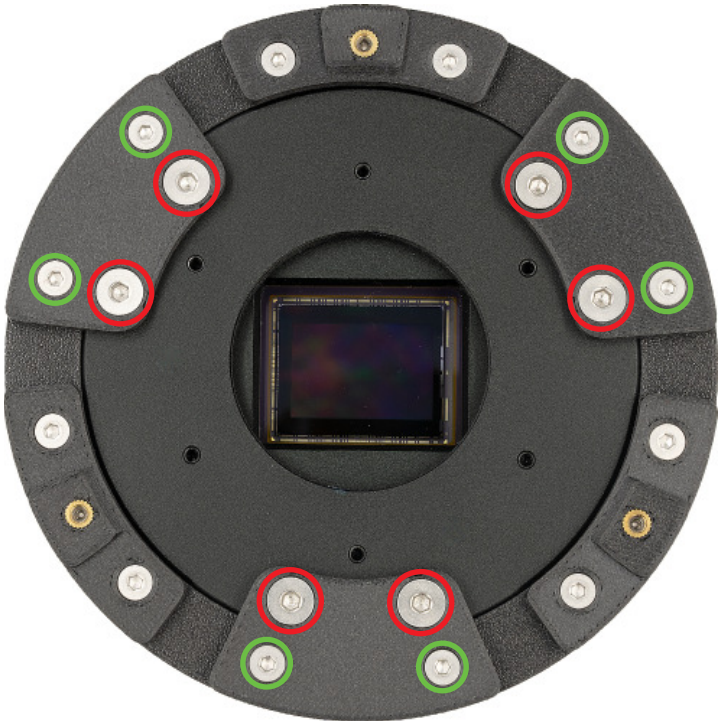

fig. 17

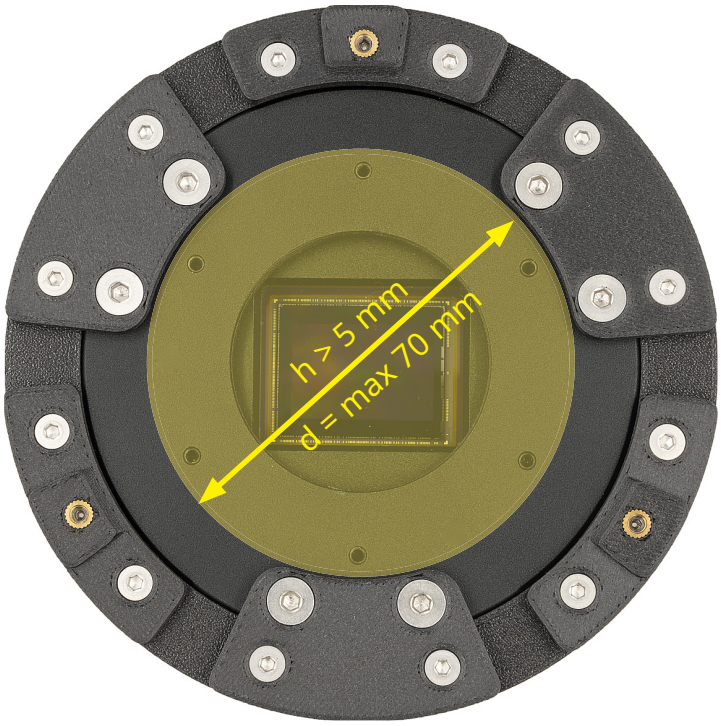

fig. 18

fig. 19

STEP 2B

Installation of the FD 900 M87 filter drawer in the Tilt Corrector

This step is for those with a Celestron RASA 8 telescope and an Astrodevice FD 900 M87 filter drawer.

•

Due to the geometry of the Tilt Corrector, working with the Astrodevice FD 900 M87 drawer is somewhat limited. When you use the Tilt Corrector, it is not possible to slide the filter sliders in and out. Therefore, in such a case, the sense of using the Astrodevice drawer can be twofold: first, you can use the Tilt Corrector to set the correct tilt in the drawer, and then remove the Tilt Corrector and use the drawer normally, with the correct tilt already established. You will learn about how to do this later in the manual. If, however, you care about continuous operation, that is, working with the Tilt Corrector on all the time, then you may work with the drawer as a filter adapter, making use of the front thread for 2" filters.

The FD 900 M98 filter drawer is equipped with five M2.5 screws for attaching it to the camera. Turn the drawer's large M87 nut so that the screw heads are exposed from the top of the drawer. Then slide the screws out of the drawer by pushing them out from the bottom.

Next, make sure that the screws used to adjust the tilt are completely retracted inside the drawer and do not protrude above the bottom surface.

After these two operations, the bottom of the drawer should look like this, as shown in fig. 20. The green circles mark the empty spaces left after removing the mounting screws. The red circles mark the tilt adjustment screws, which are made sure that they do not protrude above the mounting surface.

In this part of the work, the user's manual of the FD 900 M87 filter drawer may help you. It describes the construction and drawer in detail. The manual is available at:

https://astrodevice.com/user-manuals

Now, remove the slider (if there is one) from the filter drawer and put the drawer on the camera with the Tilt Corrector in place (fig. 21). Position the bottom U-shaped part of the drawer against the Tilt Corrector in the orientation as schematically shown in fig. 22.

fig. 20

fig. 21

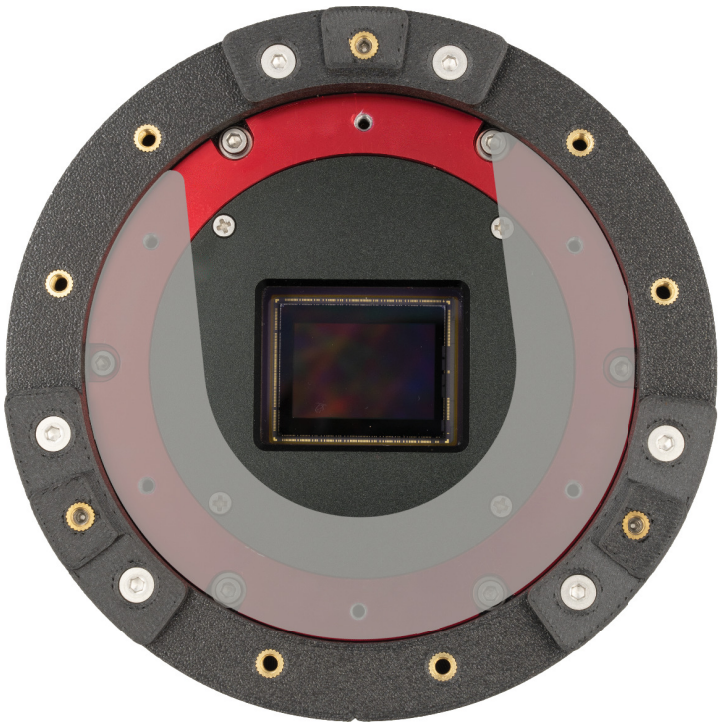

fig. 22

fig. 23

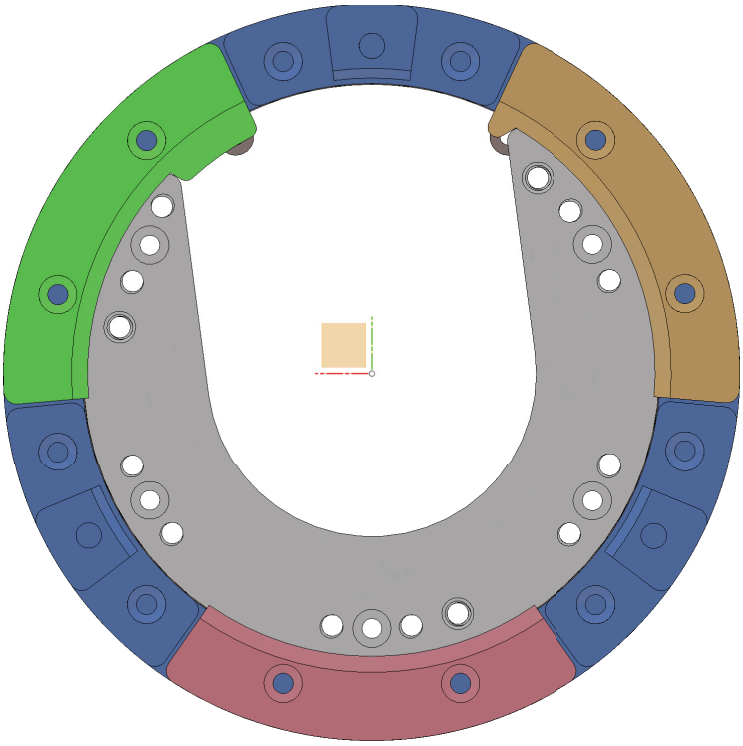

fig. 24

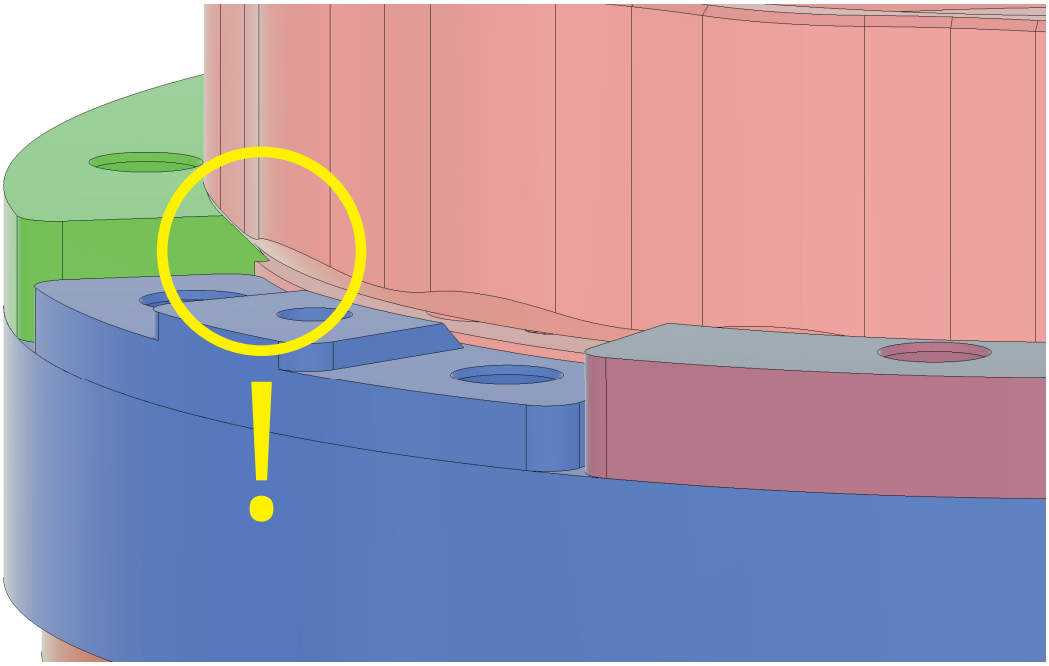

fig. 25

You will need to use three dedicated TD900 - FD 900 M87 brackets (fig. 23) to mount the filter drawer. These brackets are not part of the set and must be purchased separately. For more details, visit:

https://astrodevice.com/product/ adapter-fd-900-filter-drawer-to-tilt-corrector

Each of the brackets has a different shape, adapted to the place where it will be located. A diagram of the arrangement of each of the brackets is shown in fig. 24.

When you look at the side of each bracket, you will see that they have a profile with a sharp edge (see fig. 25). These edges are designed to hold the drawer, going into the gap between the “U” profile and the drawer’s M87 nut.

To secure the drawer to the Tilt Corrector, first install the middle bracket (the pink one on fig. 24). When installing it, raise or lower the drawer so that the sharp edge of the bracket enters the gap as described above. Screw in the bracket mounting screws, but do not tighten them all the way. Take up the play so that the heads of the screws protrude about 1 mm - 2 mm above the surface of the bracket (fig. 26).

Similarly, now install the left (the green one on fig. 24) and right (the yellow one on fig. 24) brackets so that together they form an arrangement, the idea of which is shown in fig. 24. only when all the brackets are in place, tighten the mounting screws to the end. As always - don’t use extensive force.

Now you can screw the filter into the front thread of the drawer and start your astrophotography work.

Make sure to read the FD 900 M87 drawer manual before screwing the kit onto the telescope.

fig. 26

Note that once the drawer is mounted in the Tilt Corrector, it is very hard or even impossible to rotate the M87 nut. Therefore, in order to get the correct angle of rotation of the camera relative to the telescope, you should do the following:

1. screw the camera onto the telescope, use piece of adhesive tape and mark the physical top of the large M87 nut.
2. pull the camera off the telescope;
3. loosen all mounting screws of the brackets and rotate the nut so that the previously marked top of the nut is in the desired relationship to the camera;
4. tighten the SD screws and screw the camera back onto the telescope.

Tilt adjustment

Mechanically, the tilt adjustment process is very simple and obvious. All you have to do is turn the screws S1, S2 and S3 (fig. 1), thereby moving the camera away from or closer to the telescope. Using a 2 mm hex wrench and turning the respective screw clockwise, you move the camera away from the telescope, while turning it counterclockwise brings it closer. Since the three points unambiguously determine a plane, the deviations at the three points unambiguously determine the plane in which the sensor is located.

Preliminary remarks

There are very many variables on which tiltt can depend. Sometimes it is related to the camera, sometimes to the adapter, sometimes to the telescope. Sometimes it is due to a dimensional mismatch between accessories, sometimes to an optical defect. Sometimes an image that is confusingly similar to a tilt image is actually an astigmatism image. Here we are dealing with such a large number of possible variants that it is impossible to give a single algorithm of operation that would be effective in all cases. The success of the correction depends largely on how much we know about the actual cause of the aberration. With this knowledge, we can guide the correction in a predictable direction, rather than just haphazardly turning the screws, becoming disappointed not only with the result, but also with the possible impermanence of the effect.

That’s why you should get as much data as possible about what exactly you’re dealing with before making adjustments.

Here are some quick tips that you should take into account:

1. Most often, tilt is caused by the inaccuracy of the connection between the camera and the telescope. The culprit then is the connector, threads or accessories between the telescope and the camera. Their mounting planes may be uneven, unparalell, there may be inaccuracies involving the tightening of the threads, etc. You can diagnose this type of tilt by changing the configuration of the camera-telescope connections. The feature of this type of tilt is that it changes, depending on the force of tightening the elements, their order, used accessories, etc.

2. Very rarely tilt occurs directly in the camera; if the camera has not been hit hard, for example, has not fallen from a height. The sensor is permanently welded to the circuit board and this is tightened to the solid housing with screws.

3. With some optics (e.g., Celestron RASA fast telescopes), the apparent effect to tilt can be caused by misalignment of the backfocus. In the center, stars will be in focus, but because the sensor is at the wrong distance from the telescope, the image cannot be focused across the entire plane. A characteristic feature of this type of problem is that the elongated shape of the stars is the same in each corner - the problem is symmetrical with respect to the optical axis.

4. Finally, tilt can be due to technical problems of the telescope. This is a very common cause with reflectors (telescopes with mirrors). Mirrors are heavy and their surface is optically very sensitive. Any stress created in the telescope, when transferred to the mirror, can cause astigmatism, giving a similar effect to sensor tilt. The problem is that there are several moving or potentially moving parts in reflectors - the focusing mechanism, the collimation mechanism, any mounting screws, the housing which is subject to deflection under the action of force moments, on top of that a heavy mirror wanting to flop. This kind of problem is hard to eliminate. Sometimes mirror lock helps, if the telescope has such a mechanism. Sometimes it helps to remove the electric focuser and relax tensions that has developed on the focus rod. While collimation can be corrected, astigmatism most likely requires service at a specialized workshop. Unfortunately, astigmatism is quite hard to determine without performing professional tests. Sometimes, however, it is pronounced enough to observe a characteristic feature: star shapes are elongated not only in the corners, but also in the center, where the star is in focus. Of course, it is necessary to rule out problems with mount tracking or guiding beforehand. However, if the elongation in the center is of the same length independent of the exposure time, and if the star flares are also asymmetrically elongated in the same direction - you are most likely just dealing with astigmatism. In this case, tilt is a secondary phenomenon, and its correction alone may not be able to sufficiently improve image quality. In other words, no change in the tilt of the sensor will fully remove the effects of astigmatism. An extreme case would be when mirror flop, or some other phenomenon, progresses during a photo shoot. At first you observe a small distortion, but after a few hours it is very large. In another situation, the image may dramatically change in quality after a meridian flip, or after pointing the telescope to a different altitude above

the horizon. Such a distortion, variable in nature, will also not be able to be corrected by any fixed setting. A telescope with this type of defect should be submitted for repair.

Of course, there may also be a situation that is a combination of several problems described above. Then, it will be all the more difficult to separate the components and determine a clear cause.

To find out what you're dealing with, it's worthwhile for you to perform several tests, including pointing the telescope at different parts of the sky, tightening the threads more or less firmly, and rotating the camera.

And this is what you should check first: whether the tilt you are observing rotates with the camera or not? If you rotate the camera 90 degrees relative to the telescope and the tilt image is identical to the previous one - this means that the tilt occurs in the camera or the accessory that rotated together with the camera. However, if after rotation, the shape of the stars has qualitatively changed in the corners of the frame - this means that the tilt is caused by any of the elements that remained stationary, such as the telescope. This is an important distinction. If your tilt rotates with the camera, you will be able to transfer the correction set with the Tilt Corrector to a tilt plate or Astrodevice filter drawer and later use the camera without the Tilt Corrector. If, on the other hand, the tilt stays in place when the camera rotates (and so its image changes when the camera rotates), then you will have to adjust the new tilt settings every time you change the angle of rotation of the camera relative to the telescope.

You can also try to measure what actually (in millimeters) is the extent of the tilt you want to correct. For this you need to have an electric focuser. To make the measurement, focus the star in the center of the frame (use Bahtinov mask) and record the position of the automatic foicuser. Remove the camera and insert a thin shim of known thickness (e.g. 0.5 mm) in the optical path. Put the camera back on and focus the star in the center again. Dividing the difference of the focuser position by the thickness of the shim, you will get the number of steps per 1 mm of distance in the optical path. You can take this measurements several times and average the results for a more accurate result. Now remove the shim, again focus the star in the center and again record the position of the focuser. Next, try to

sharpen the star located in one of the corners. Use the coefficient obtained earlier to calculate what the physical difference in distance in millimeters is about the difference in sharpening between the center and corner star. Similarly, measure the distances for the other corners. In this way, you will not only figure out by how much they are offset from the center of the sensor, but also whether this is a positive or negative value.

It will also be extremely helpful to have software that shows a measure of distortion and thus shows the curvature of the optical plane and indicates the value and direction of tilt. Examples of such software are ASTAP (free) or CCD Inspector (paid). At this point, an important remark should be made. The indications of such programs are subject to error. The inaccuracy of the reported results is affected by, among other things, the distribution of stars in the frame, exposure time and atmospheric conditions. When measuring, the telescope should be pointed at an area with an even distribution of stars in the frame so that the statistical weight of one area does not dominate over another. The exposure time should not be too short, and all stars should be clearly visible. You should also set bin 1x1 and NOT use an auto focus program. Focus should be manually set in the center of the frame, such as using a Bahtinov mask. Despite all these efforts, the turbulence of the atmosphere often causes two identical images, taken one after the other, to give a different measurement result. Therefore, the indications of this type of software should be treated as a guideline, not as an absolute determination of the problem. The use of this type of software is useful for getting an idea of the direction (axis) of the tilt and the tendency that reveals itself when making changes. The most important arbiter of whether an image is correct or not is your eyes. To evaluate the image, zoom in on the center and each corner of the frame and judge whether the result is satisfactory. Don’t rely on the result given by the software, but primarily on your own judgment. Remember also that small distortions often averages out to the correct shape of the stars when stacking frames.

Algorithm of adjustment

1. Start working with the Tilt Corrector from the zero position.
2. Take the first photo and, looking at each corner of the frame in close-up, try to determine in which corner the problem is greatest. In other words, in which corner the stars are most distorted.
3. Locate the adjustment screw closest to that corner and rotate it 180 degrees. If you can’t determine which screw it is, turn any one you choose.

4. Take the picture again, sharpen the image in the center and check the result. If the shape in the corner has improved, continue adjusting until the result is satisfactory. If the shape has worsened, go back half a turn (90 degrees) and see if a smaller step improved the result. If not, try going back another 45 degrees or go back to the previous setting and start adjusting another screw.

The algorithm is to enter successive turns and observe the results each time. Assume that 180 degrees (half a turn) is a large shift, 90 degrees (a quarter turn) - medium, 45 degrees (1/8 turn) - small, about 20 degrees and less are fine adjustments.

If you know exactly how much the corners of the sensor are shifted (this point was described earlier), it will be easier for you to get an idea of how much more or less you should rotate the screws - one turn is 0.7 mm difference in distance where the screw is, and roughly 0.2 mm in the corner of the sensor. Note that two of the screws are close to the corners of the sensor, while the third raises the opposite edge (see fig. 30). The action of the screws is therefore not identical. Moreover, a given corner of the sensor may not be pushed further away from the telescope at all, but closer than the zero position. Then moving it further away only worsens the result, so it is necessary to leave it in place and move the others away.

The procedure for making adjustments largely involves adjusting the screws by trial and error. To ensure that this is not a completely blind job, previous experiments and specialized software that measures the results will help (these issues were described earlier). Then the work will be much more methodical. After each adjustment you should sharpen the image in the center of the frame and check the result. You need to figure out which screw at what turn makes what correction and thus arrive at the ideal position.

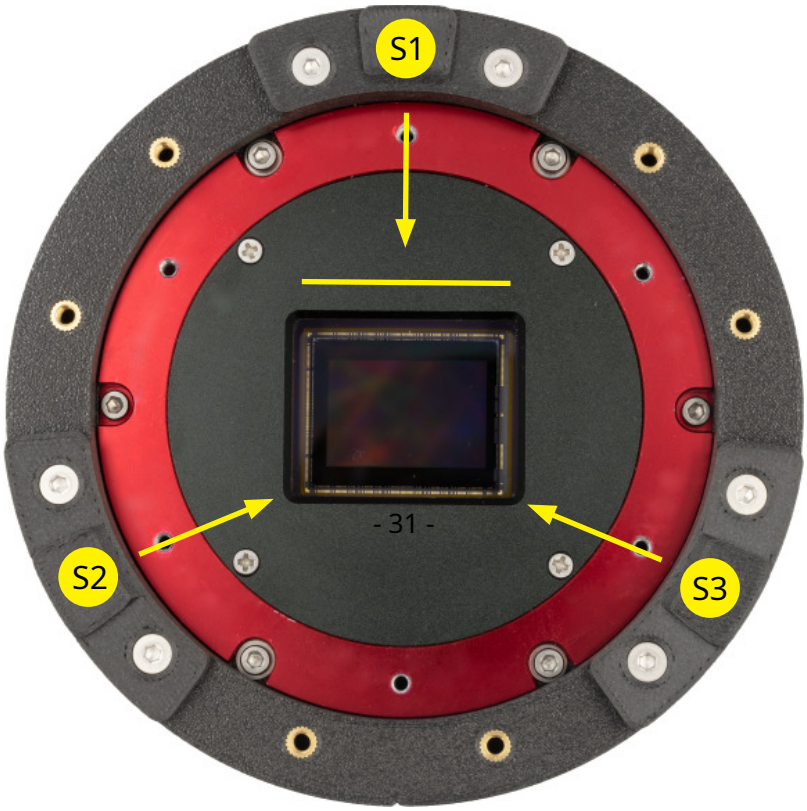

fig. 30

Transferring settings

Under certain conditions, it is possible to transfer the Tilt Corrector settings to the original tilt plate or filter drawer of the FD 900 M87.

This process makes sense in two cases:

1. if the tilt originated in the camera (the tilt rotates with the camera),
2. if the tilt is off-camera (does not rotate with the camera), but does not change over time.

The first case is obvious: if the tilt is in the camera, it is reasonable to make a correction to the element permanently associated with the camera.

In the second case, the situation is more tricky. If the tilt is external to the camera, any correction to the camera-related element will make sense if and only if the camera is put on the telescope always in the same position. Usually, however, users always mount the camera in the same way: placing the sensor perpendicular or parallel to the telescope's base. So if:

- your tilt is off-camera (e.g., formed in the telescope),
- you can mount the camera on the telescope in the same position after making a correction with Tilt Corrector,
- and tilt does not change over time.

, then copying the Tilt Corrector settings to a tilt plate or drawer makes as much sense as possible.

If you find that you would like to mount the camera in a new position, then you will need to make a new correction. If the tilt is beyond the camera, no correction in the component permanently bound to the camera will serve at other angles of rotation. This is fairly obvious, but it is important to keep in mind.

Also note that if the tilt varies over time or is dependent on the position of the telescope, no fix with an external accessory will be able to correct it. In such a case, only repairing the telescope will help.

Transferring settings to the original tilt plate

Before proceeding, prepare a small piece of adhesive tape, and a cup, glass or similar cylindrical shaped object with a diameter of about 50 mm - 60 mm (a little more than 2 inches).

1. After making the correction with the Tilt Corrector, remove the camera from the telescope. Note in what position it was placed there; what its angle of rotation was. If your tilt is created outside the camera, you will have to mount the camera in the same position after transferring the settings to the tilt plate. For convenience, before removing the camera from the telescope, you can take a photo so that you can later easily reconstruct the camera's position.

2. Unscrew any external accessories or connectors attached to the black tilt plate.

3. Place the camera on the table having the black tilt plate facing up.

4. From the first tab (T1, T2 or T3 - whichever you choose), unscrew one M4x8 screw (see fig. 31).

5. Carefully and slowly screw the headless screw into the black tilt plate. Stop as soon as you feel the first resistance indicating that the headless screw has passed through the tilt plate and touched the surface of the camera housing. (see fig. 32).

   IMPORTANT: do not use any force here. The screw is supposed to touch the camera surface and that's it. No pressure should be created there. It should be quite easy to feel this moment, because the headless screws into the tilt plate with very little resistance and the resistance that will be created when it touches the camera surface should be clearly felt.

   In each case described in the following paragraphs, for each successive headless screw, the screwing procedure should be the same.

6. Remove one M4x8 screw from the next tab and screw second headless screw in its place.

7. Remove one M4x8 screw from the last tab and screw the third headless screw in its place. After this step, the set should look as in fig. 33.

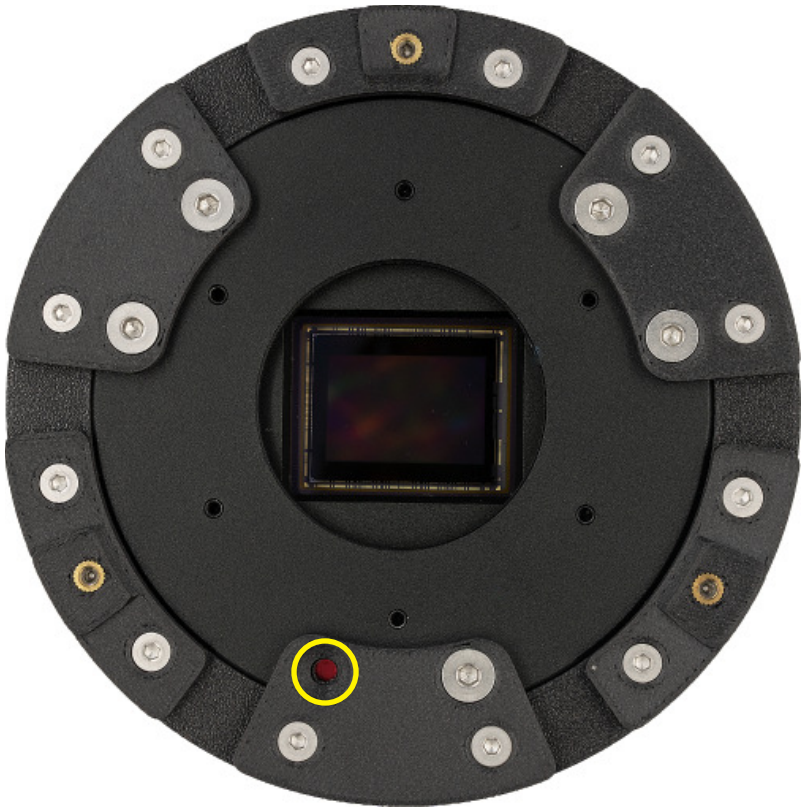

fig. 31

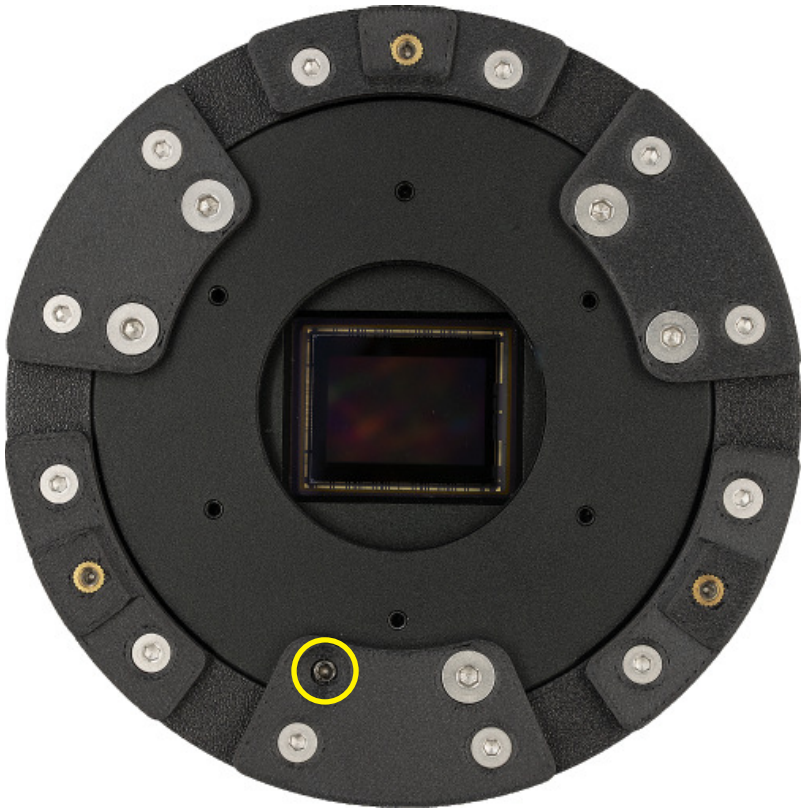

fig. 32

8. Remove the second M4x8 screw from the first tab and screw in the fourth headless screw in its place.

9. Remove the second M4x8 screw from the second tab and screw the fifth headless screw in its place.

10. Remove the second M4x8 screw from the third tab and screw the sixth headless screw in its place. After this step, the set should look as in fig. 34.

11. This way you should have all the M4x8 screws removed and in their place screwed in six headless screws in such a way that each of them touches the surface of the camera. For the record, the order in which you should have done this is shown in fig. 35.

12. Stick a small piece of adhesive tape on the top plane of the tilt plate. Stick it on on the side correcsponding with the the black dot on the camera housing and the structural line on the side of the Tilt Corrector (see fig. 36).

13. Unscrew the tabs from the Tilt Corrector (see fig. 37).

14. Remove the tilt plate very carefully from the center of the Tilt Corrector and place it centrally on the cylindrical object you prepared earlier. Be careful not to touch any of the headless screws. They should always remain in the air and not come into contact with anything (see fig. 38).

    Tip: to conveniently remove the tilt plate, you can screw any M42 fitting into its front thread, grab it and lift the tilt plate off the Tilt Corrector.

15. Unscrew the Tilt Corrector from the camera and in the holes where it was mounted, screw in the four original M2.5x8 screws. Do not use force while tightening the screws. Be careful not to strip the threads.

16. Put the tilt plate on the camera in the same orientation as it was placed before. The marker you painted with a marker pen will help you do this.

17. Tighten the tilt plate with the original screws.

Now your camera is ready to work. Remember that if your tilt has an origin outside the camera, you will need to mount it in the same position on the telescope as

when you made the corrections with the Tilt Corrector.

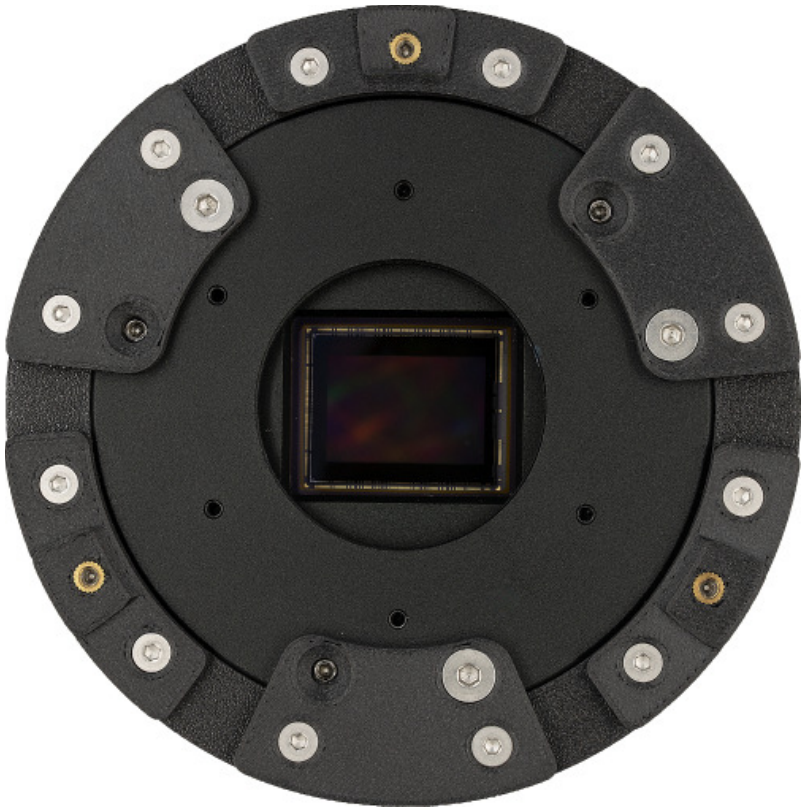

fig. 33

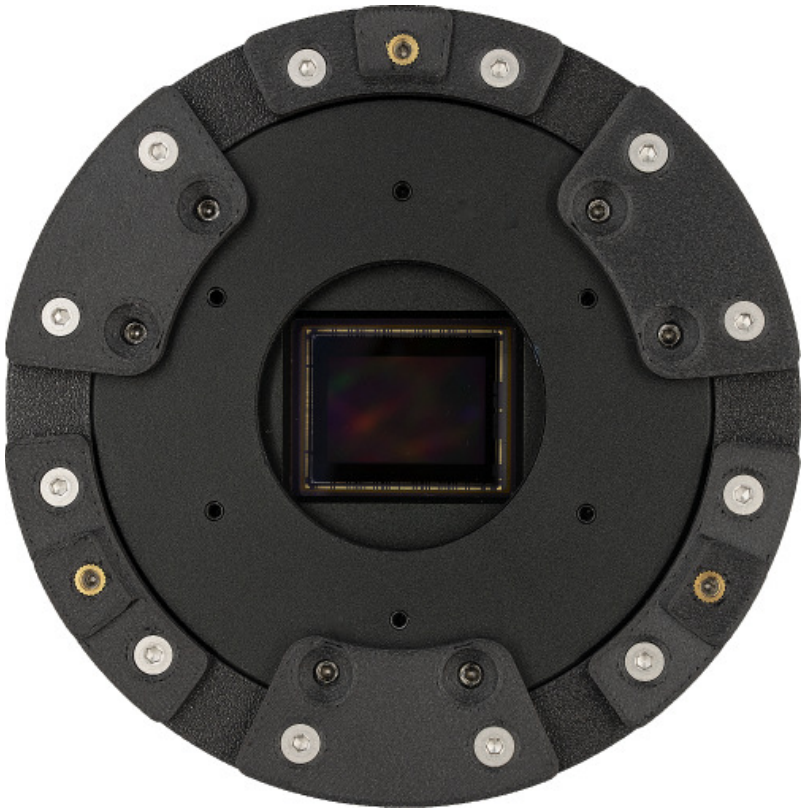

fig. 34

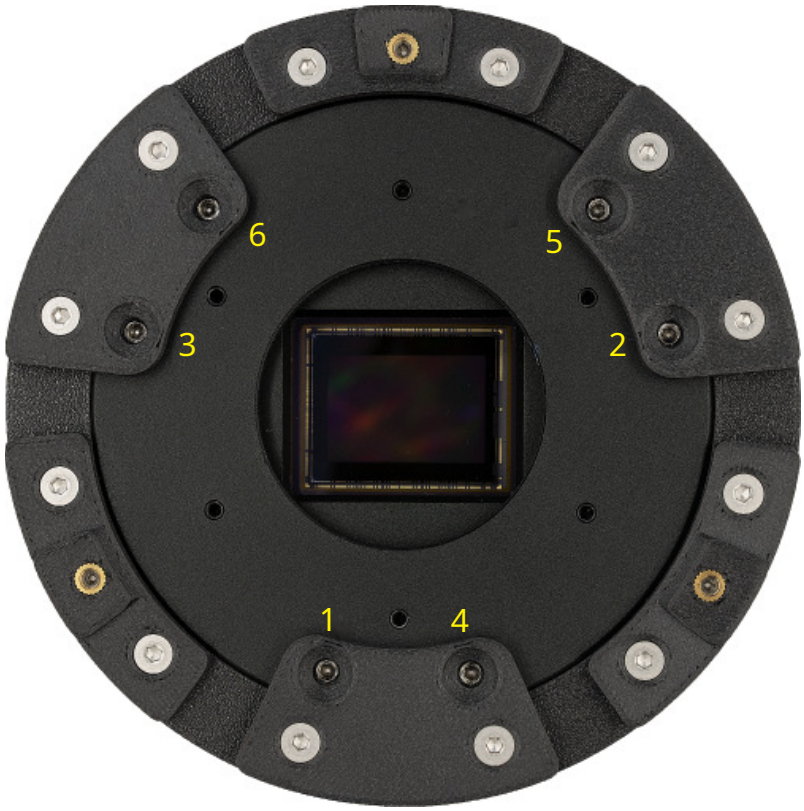

fig. 35

fig. 36

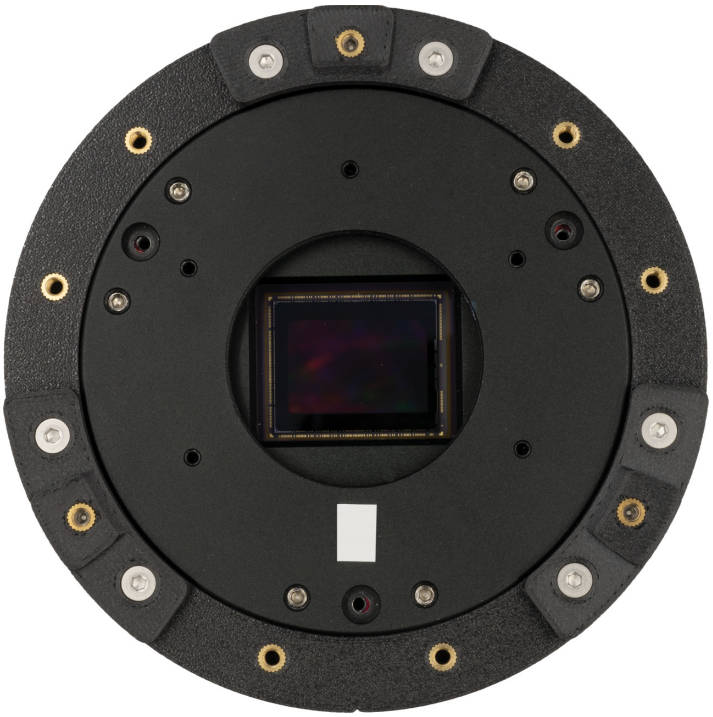

fig. 37

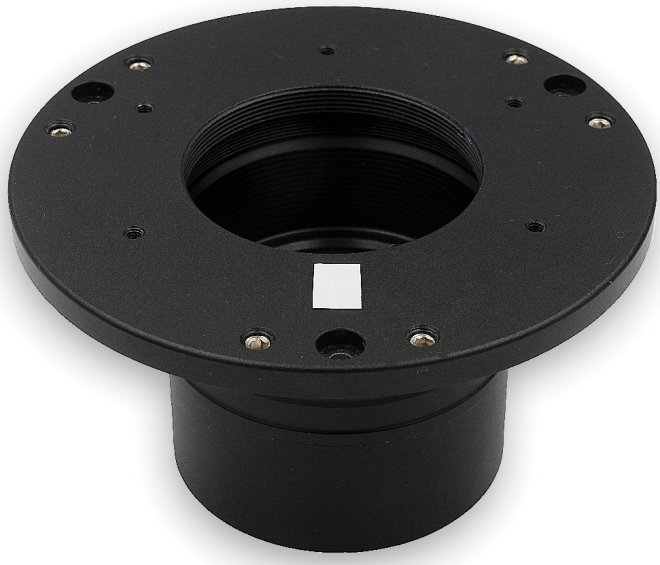

fig. 38

Transferring settings to the FD 900 M87 filter drawer

Before you get started, cut a strip of paper about 10 mm x 50 mm (~ 1/3” x 2”) from a thin sheet of paper.

Read first the instructions describing the transfer of settings to the black tilt plate (above). It will help you understand the principle, which is identical for the filter drawer. Thus, in the instructions for the drawer, we will be able to refer to the important differences between the procedures.

Three headless screws for adjusting the tilt are permanently embedded in the Astrodevice filter drawer. The threads in which they are located are much tighter than in the original black tilt plate. If you have read the procedure for transferring settings to the tilt plate, you know that the headless screws should be screwed in so that they touch the camera surface. However, in the case of the filter drawer, by turning the screws you will not realize when you touch the camera with them. The resistance is too strong for you to feel a subtle change. If you were to turn the adjustment screws in an attempt to feel them touch the camera surface, you would most likely not only not realize when it happens, but by turning further you would start to bend the whole structure. Therefore, for a filter drawer, the measurement of touching the camera surface will be different than for a tilt plate. To measure it, you will use a narrow strip of paper, which you should have prepared before proceeding.

1. After adjusting the tilt with the Corrector, take a picture of the front of the telescope so that you can later reproduce the current camera rotation.

2. Remove the camera with the Tilt Corrector and unscrew the front filter. Place the set on the table with the sensor facing up.

3. Slide the cut strip of paper into the gap between the camera and the filter drawer. Do it in such a way that the strip slides under one of the screw used for tilt adjustment (fig. 39).

4. Using a 2 mm hex wrench, start to screw in the tilt adjustment screw. After a minimal turn, try moving the paper strip to get a feel for whether the screw is already touching it (see fig. 40). If not, again take a minimal step and lightly turn the screw. Repeat the resistance measurement with the strip.

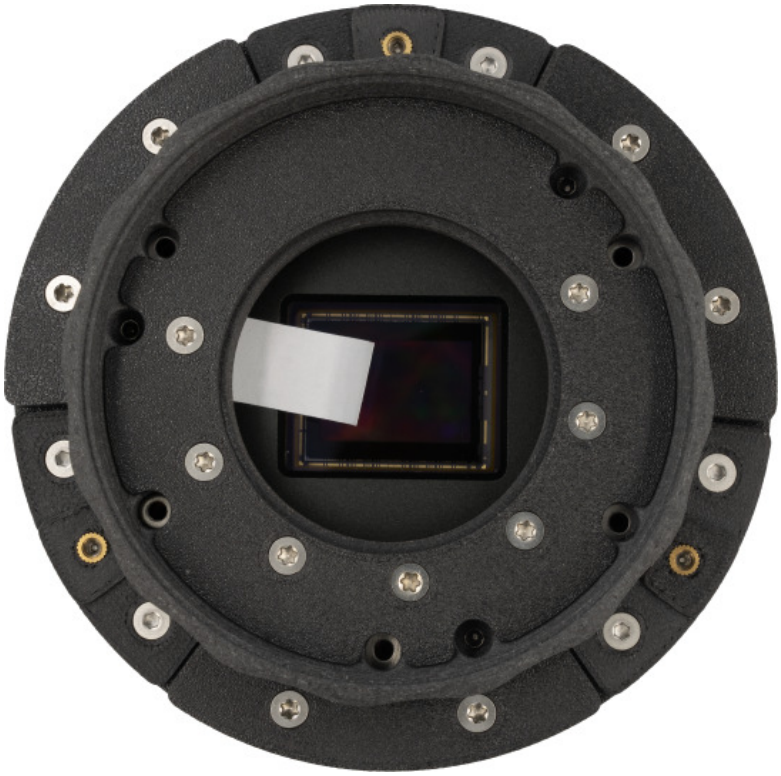

fig. 39

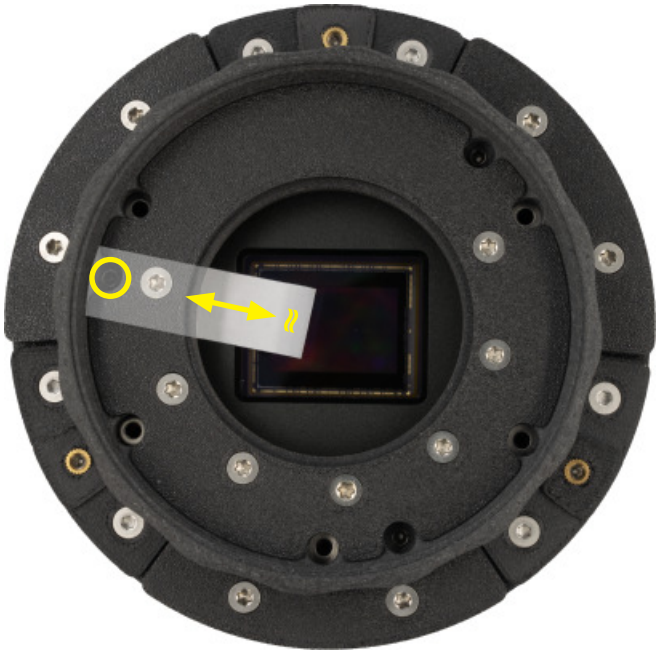

fig. 40

Note: In fig. 40, the outline of the white strip under the drawer has been artificially applied to the photo to better illustrate its placement.

5. Adjust the position so that you can feel the resistance, but still be able to still slide the strip out from under the screw. Then remove the strip and move to the next tilt adjustment screw.

   Note: going through this procedure will put each adjustment screw about the thickness of a sheet of paper above the surface of the camera housing. For a sheet of 80g/m2 paper, this is about 0.1mm. After adjusting the screws with the strip, you can lower each screw by about 0.1 mm by turning it 45 degrees clockwise. This action requires a lot of precision so that the rotation is the same for each screw.

   Tip: since for many a 0.1 mm backfocus deviation is of secondary importance when the tilt is set correctly, you may want to try putting the camera on the telescope first without further tightening the three screws by the thickness of a sheet of paper. It's a matter of trying the result, but it's worth starting there before you decide to fine-tuning each of the screws by a further 0.1 mm.

6. After adjusting all the screws, unscrew the mounting brackets, remove the drawer from the Tilt Corrector, unscrew the Tilt Corrector from the camera, screw the original mounting screws into the front of the camera housing and put the adjusted filter drawer on the camera.

Remember that if the tilt in your setup does not rotate with the camera, you must put the camera in the same rotational relationship to the telescope as when you used the Tilt Corrector. The photo you took before you removed the camera from the telescope will help you reproduce this position.

Backlash adjustment

In the Tilt Corrector, the S1, S2 and S2 screws used to adjust tilt are pressed by adjustment pins whose hex heads can be seen in the center of the B1, B2 and B3 bridges. At the factory, they are set so that the S1-S3 bolts can rotate about their own axis, but show no longitudinal play. However, over time, under the influence of work, such play may appear. If it occurs, it will manifest itself in the fact that rings R1 and R2 will not be connected rigidly, but there will be a perceptible longitudinal play between them. Should this happen, simply tighten the adjustment bolts using a 1.5 mm hex wrench. When adjusting, tighten the bolts all the way, but - as usual - not forcefully, so that the main screws S1-S3 can still rotate, but at the same time no longer show longitudinal play. Adjusting the screws embedded in the B1-B3 bridges is done with some resistance due to the fact that the threads are protected with a securing agent.

www.astrodevice.com