Baader OAG

This document describes how to setup and use the Baader OAG for the Flip Mirror II.

This is incredibly more complicated than using a simple guide scope, but is really worth it on telescopes with long focal lengths – like SCTs.

All of the discussions and examples in this document refer to a Celestron C11 EdgeHD telescope with a focal length of 2800mm. The idea will be the same for other telescopes but you may have to use different setting values that are appropriate to your telescope.

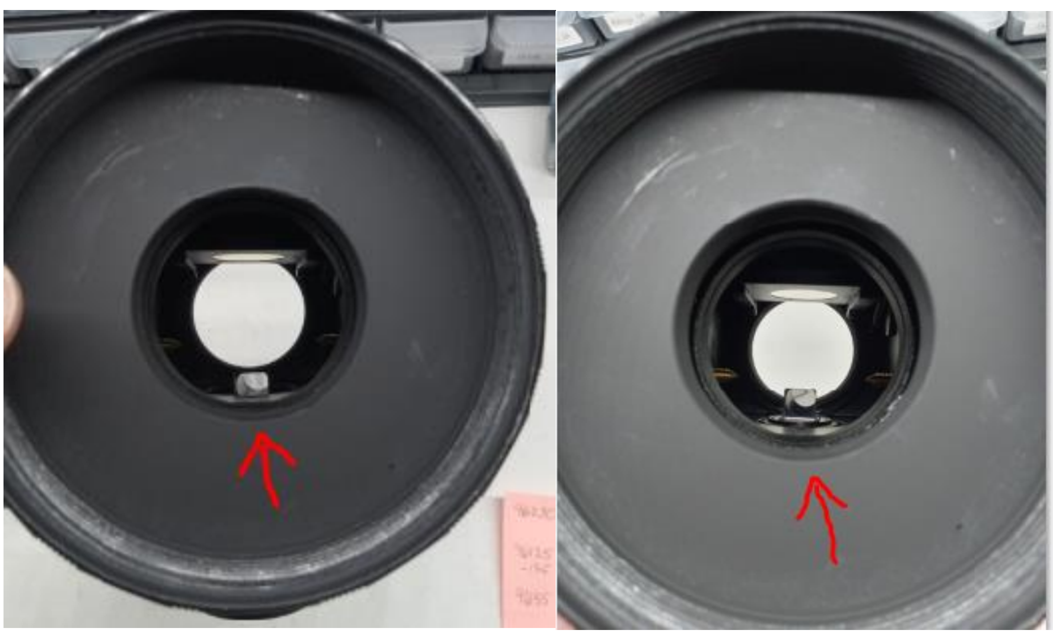
Contents

OAG Collar Configuration

The first thing to realize is that the collar hardware is configured so that it can be assembled in four different manners – all of which move the mirror higher or lower in the flip mirror light path.

Below you can see how collar is assembled without the optional spacer (seen underneath the collar assembly below) so the mirror is 'low' (left image) and 'high' (right image.) Note that the difference between these two is simply that the collar plug (removed from the flip mirror) is simply flipped over so the long end is either down (for 'low' mirror) or up (for 'high' mirror.)

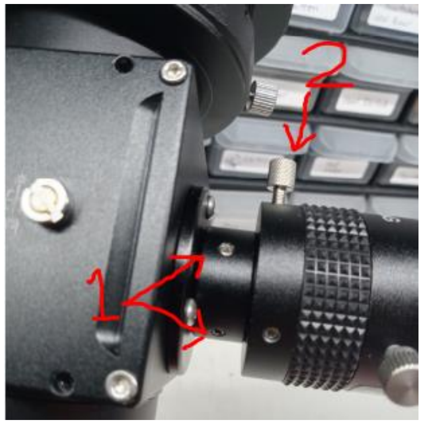
Using the optional spacer would make each of the scenarios so the mirror is even lower. Below you can see how each of these configurations changes the prism's position in the M48 light path.



Note how much more of the prism is exposed to the light path in right 'high' configuration. The low configuration is intended for cases where the S52 Flip Mirror light path is chosen.

OAG Prism Alignment

It is important that the prism is properly aligned so that it does not distort the light path. Here are the steps I took to align the prism using the picture below (1) are the rotational set screws, and (2) is the tilt adjustment.



Step 1 – Rotational Adjustment

Place your eye where the guide camera would be fastened at the end of the prism assembly and point the flip mirror telescope input at something bright. After getting everything centered, you should see something like the left image below where you see the telescope edge of the flip mirror. You may have to adjust the ‘tilt’ until you do see this. Loosen the 2x rotational set screws and turn the prism camera collar until the telescope edge of the flip mirror appears properly centered in the bottom of the image.

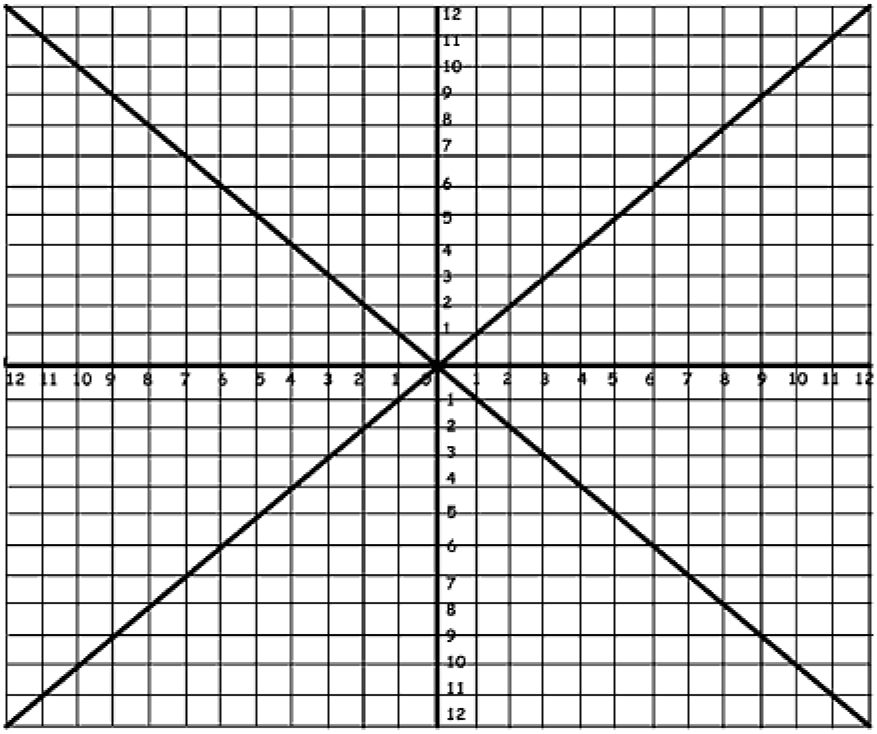
Step 2 – Tilt Adjustment

Slowly adjust the ‘tilt’ screw until you can no longer see the telescope edge of the flip mirror.

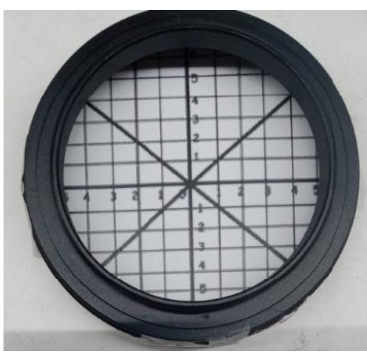

Your prism is now correctly aligned in the light path.

Step 2a - Alternative Alignment Tool

A more accurate alignment method is to build an alignment graticule as follows.



Take a graticule (example above) and cut it out so it fits over the end of the appropriately sized light path tube extension (see below where I used an M48-SCT adapter.)



Then you can accurately do the alignment while looking up the OAG tube as shown below.

Step 3 – Final Checks

Assemble your camera onto the flip mirror and verify that the prism does not interfere with the light path to your sensor. You will have to repeat this step if you get a camera with a larger light sensor, or if the camera sensor can be rotated into a position such that it ends up 'behind' the prism.

Although much less critical, you should also make sure the prism is not obscured by the flip mirror when the mirror is in the down position. This is less critical because it doesn't really matter if guiding is working when using the eyepiece – although it may be annoying to keep getting messages from the controller that guiding stopped.

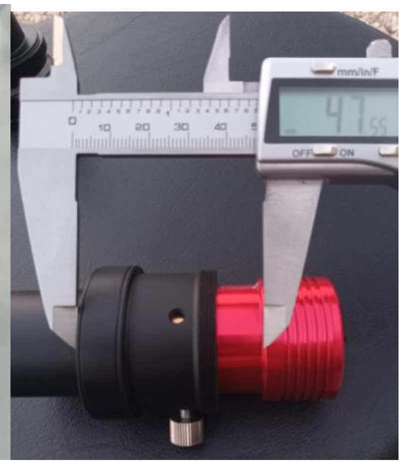
Guide Camera Focus

Assuming you setup the optical train properly, you should be able to get the guide camera into focus loosening the set screws in the collar and sliding the camera in and out until it gets into focus with the same telescope focus setting as the camera.

If you need to extend the guide camera further than the collar allows, you will need to make a T2 extender – shown below with a Baader ClickLock attached to it.


<u>The ClickLock turned out to be a really bad idea</u>. Because of the force required to lock and unlock the ClickLock (during focusing) it actually 'turns' the OAG throwing it out of alignment!

A much better solution is screw tightened T2 holder coupled to a T2 insert joined with an M42 female-female coupler (image left below.) To get the ASI120MM-Mini /174MM-Mini in focus on my optical train I had to add this extension and extend the camera tube 47.55mm out of the extension base (image below right.) Now the focus is easy to adjust without disturbing the OAG alignment.

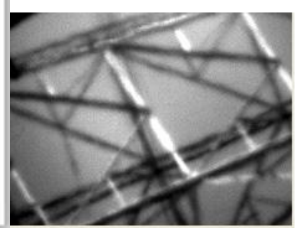



Example Images – Understanding How the OAG Works

Here are some example images taken of the radio towers behind my house using the same telescope focus setting.

Relative Gains and Frame Sizes

On the left is the ASI533MC Pro Image (gain 53/10ms) main camera image, and on the right is the ASI120MM-Mini OAG image (gain 21/1ms.) As can be seen, the OAG is picking off the middle part of the radio tower that is not visible to the ASI533MC Pro main camera using the OAG.

On the left is the ASI533MC Pro Image (gain 0/10ms) main camera image, and on the right is the ASI174MM-Mini OAG image (gain 141/1ms.)


Explanation of Bright Circle in Guide Images

You may have observed in the prior pages that the main camera image looks ‘normal’ whereas the guide camera image has a ‘bright circle’ in the center – see images below.


This was puzzling at first but makes sense when you think about it.

- The C11 telescope spec shows a 42mm image circle.
- The ASI533 (main camera) has a diagonal of 16mm.
- The Baader OAG has a diagonal of 9.5mm.
- The ASI174 Mini (guide camera) is 11.34x7.13mm (diagonal = 13.4mm)

So, the 42mm image circle fully illuminates the main camera sensor, whereas ONLY the center of the guide camera is fully illuminated by the OAG 9.5mm diagonal.

If, instead of using the Baader OAG, we used the ZWO OAG-L then the full surface of the guide camera would be illuminated evenly.

Image Orientation

Given the following main camera setup (left) and guide camera setup (right)

Will Produce the following where (1) is where the main camera is pointing when the guide camera shot (3) was taken, and (2) is the main camera tilted a little upwards to see what is above the building.

Note that (3) is flipped horizontally from the true image (but correct vertically.) Rotating the guide camera 180 degrees results in an image that is correct horizontally (but flipped vertically.)

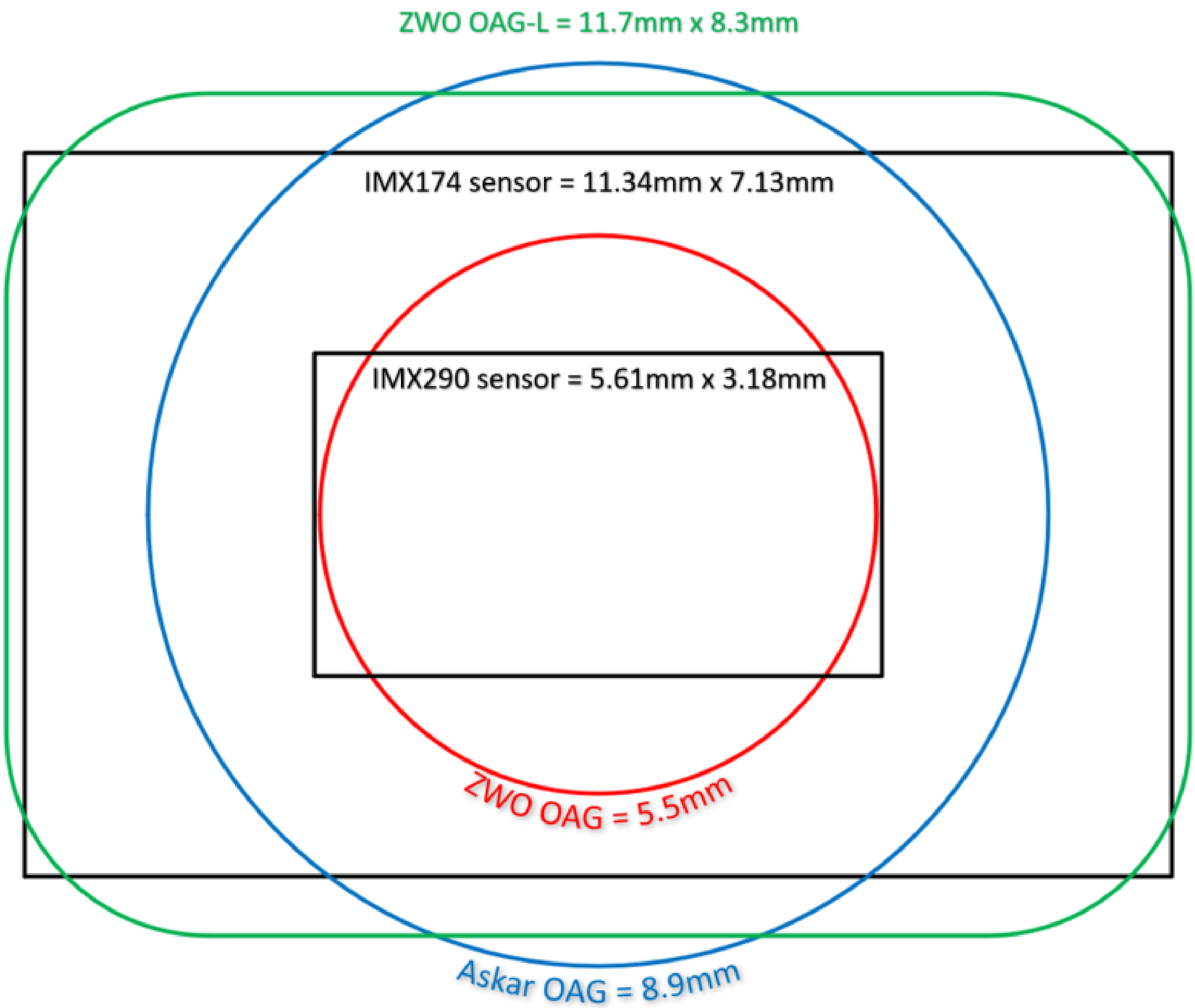
Common Image Sensors & OAG Diameters

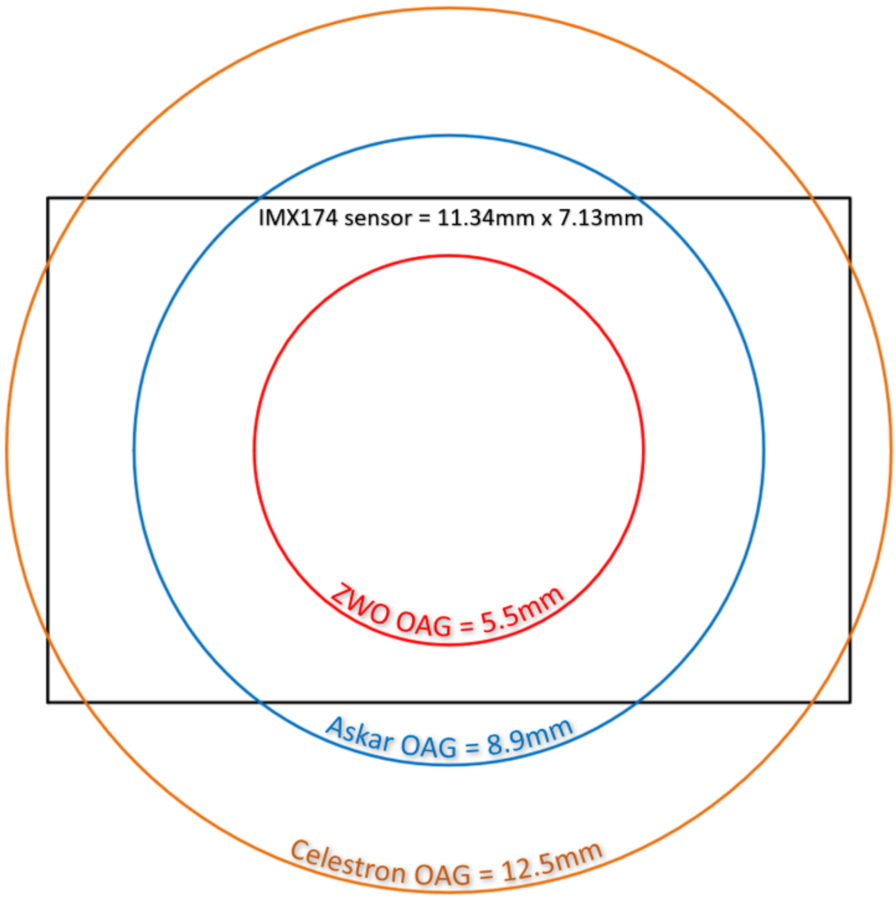
The following (courtesy of [CloudyNights]) illustrates how different OAG setups cover common guide scope sensors. To get the most out of your setup you obviously want the OAG to fully illuminate the sensor.

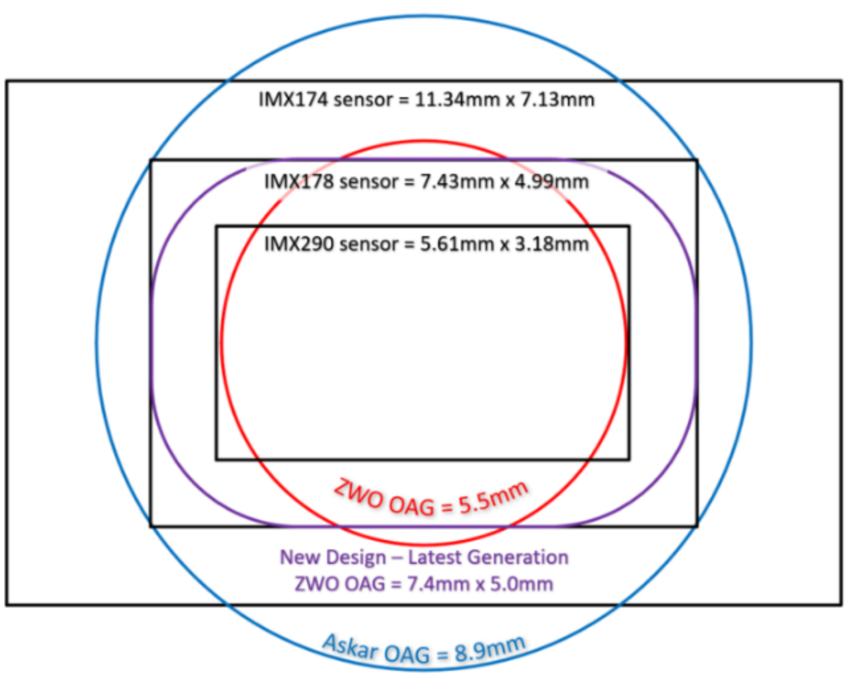
The ASI120MM-Mini uses the ARO130CS sensor (4.8x3.6mm) which is a little smaller than the IMX290 shown below.

The ASI174MM-Mini uses the IMX249 sensor which is the same size as the IMX174.

The Baader Flip Mirror II OAG uses a prism that is 9.5mm so it 'almost' covers the IMX174 sensor.




IMX174 sensor = 11.34mm x 7.13mm
ZWO OAG = 5.5mm
Askar OAG = 8.9mm
Celestron OAG = 12.5mm


IMX174 sensor = 11.34mm x 7.13mm
IMX178 sensor = 7.43mm x 4.99mm
IMX290 sensor = 5.61mm x 3.18mm
ZWO OAG = 5.5mm
New Design – Latest Generation
ZWO OAG = 7.4mm x 5.0mm
Askar OAG = 8.9mm

OAG Guide Camera Requirements

Due to the fact that the OAG only presents a small portion of the optical circle to the guide camera, and that it is being used on telescopes with long focal length (C11=2800mm) there may or may not be any bright stars for the guide camera to use.

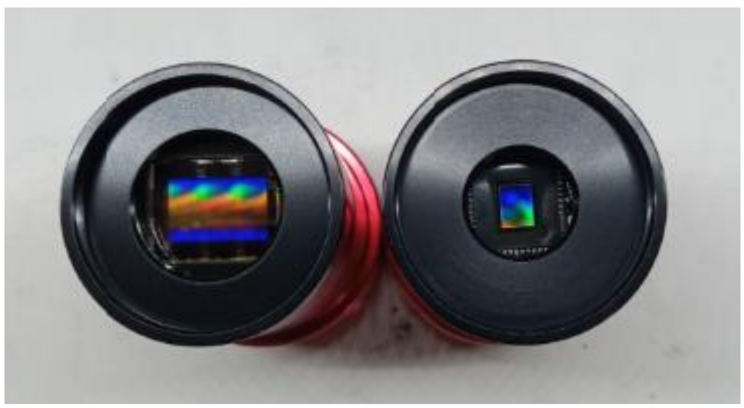
To overcome these problems, the guide camera must be:

- sensitive enough to pick up very faint stars using relatively short exposure times (1-2sec)
- or have a large enough sensor area to have a reasonable chance of seeing a brighter star

As it turns out the ASI120MM-Mini does not have these qualities as can be seen in the following section.

The sensor on the ASI174MM-Mini is over 4x larger than the 120 and appears to be more sensitive from the specs and reviews from other people. This worked much better in my setup.

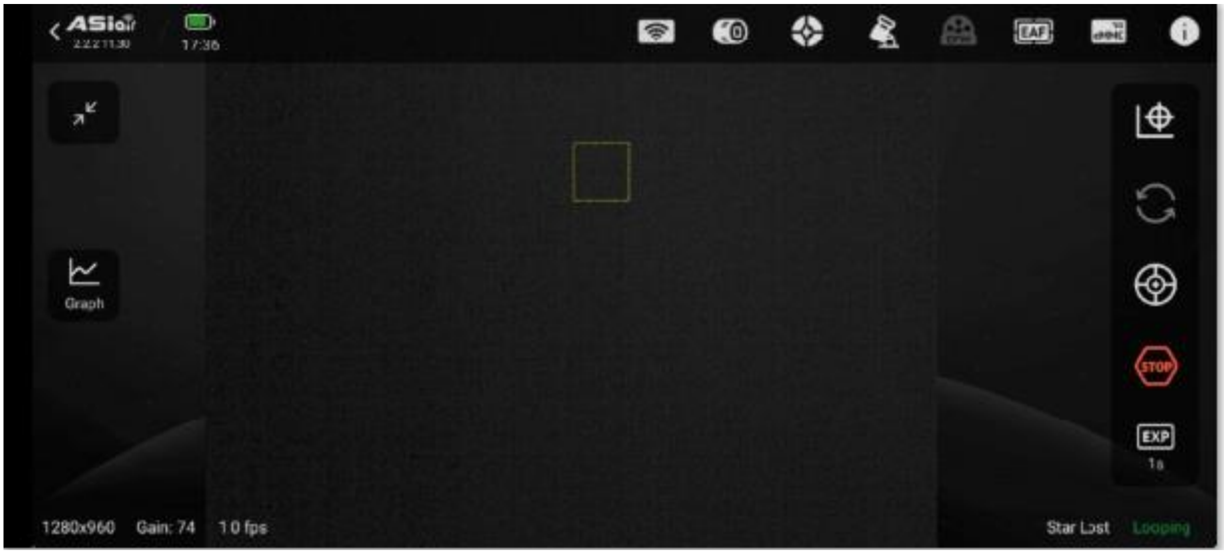
Here is a side-by-side comparison of the ASI174MM-Mini (left) and the ASI120MM-Mini (right.)



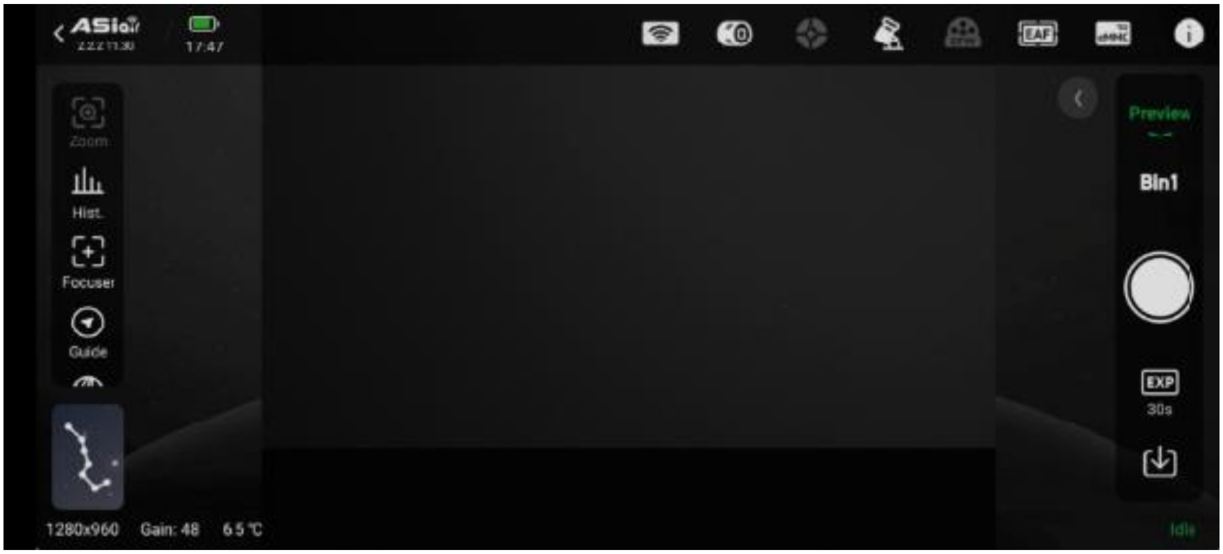
ASI120MM-Mini Test Results

As a test I setup the Baader OAG using the ASI120MM-Mini as the guide camera on a very calm night. After polar alignment, I pointed the scope to Jupiter.

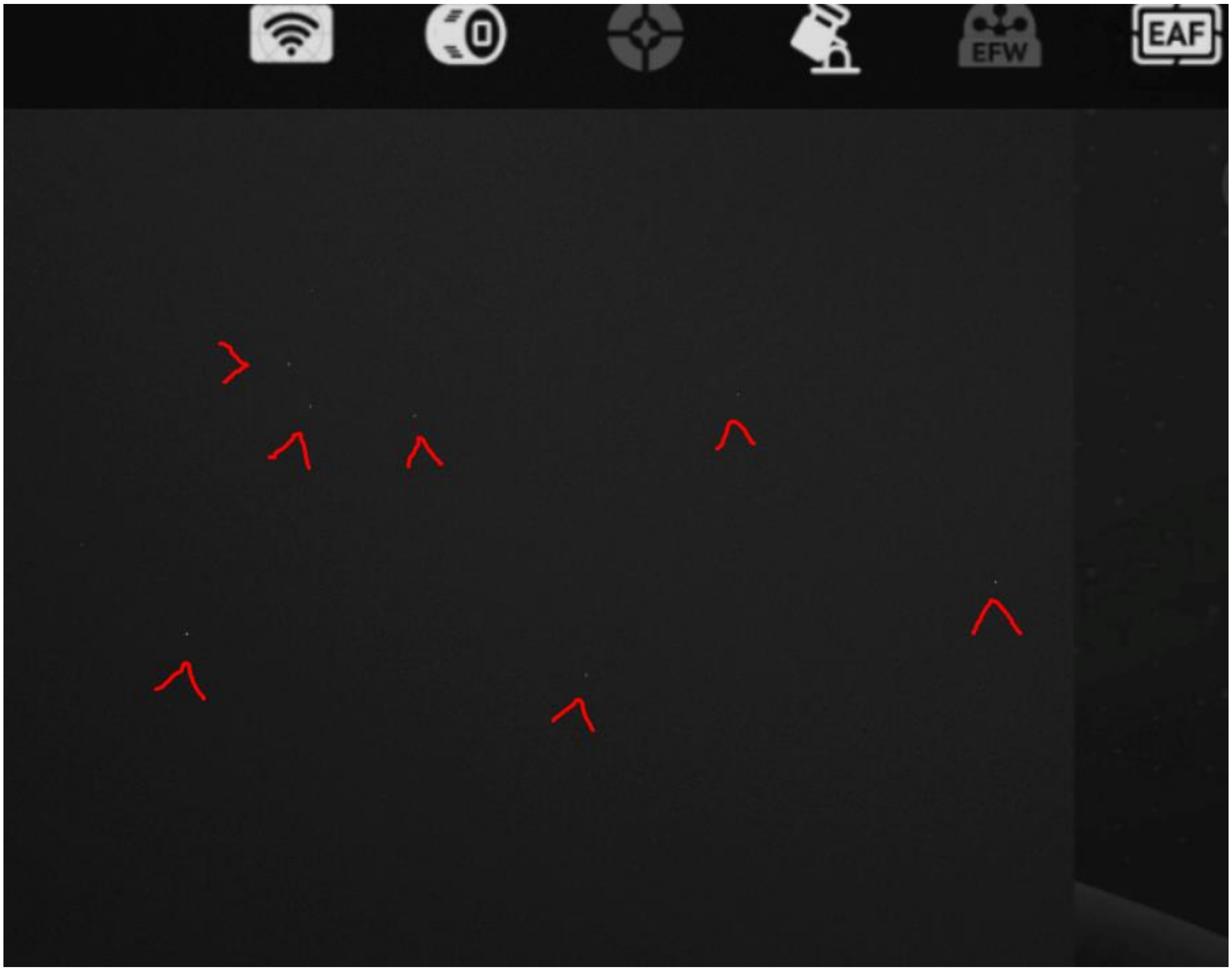
Trying to setup the guide scope using the ASIAir tools were ineffective. The screen below shows that a 'spec' of light would be briefly identified as a star (see yellow box below) and would be lost a moment later. It was impossible to lock onto any stars using the normal tools – even when the exposure time was increased to 10 seconds (the limit for the guide tool below.)



At first, I figured maybe I had something setup wrong, so I switched the ASI120MM-Mini to be the main camera and tried to see what settings were needed to actually see stars. My initial preview shots at 2, 5, and 10 seconds showed no stars at all – just a black screen. Finally at 30 seconds I was able to see stars which were 'extremely' faint – see below and enlarged image below it.



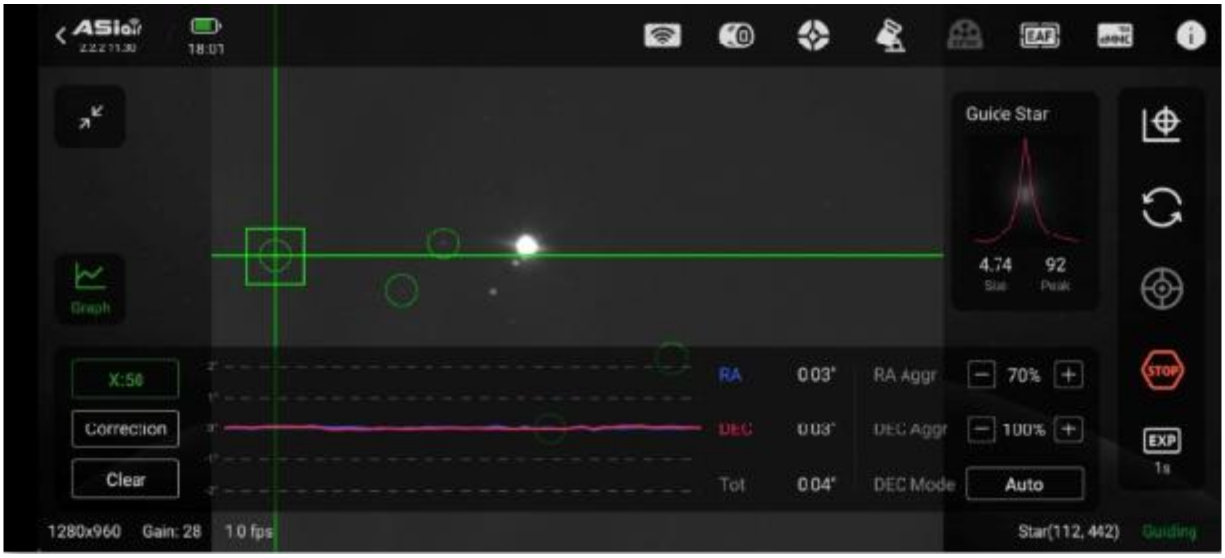
Here is a blown-up section of the previous 30 second exposure showing the actual stars. As you can see these appear as very faint pin-point stars and this is at gain 48 and a 30 second exposure.



This proves that the OAG is properly setup so that it can see stars, and in focus.

Therefore, the ASI120MM-Mini is simply inadequate for use as an OAG scope with a 2800mm focal length telescope.

The ASI120MM-Mini does however work adequately with its intended 120mm guide scope (in a non-OAG configuration) see below.



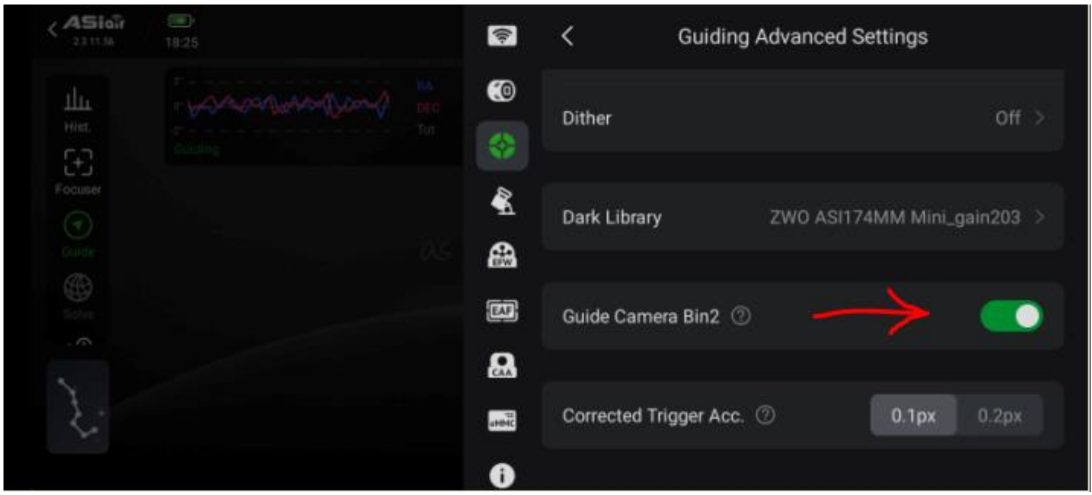
However, the 120mm guide scope is woefully small for a 2800mm telescope. Using the general rule of 1/3 focal length the guide scope should be at least 2800/3, or 933mm which would add considerable weight to the already heavy C11 setup and require a heavier duty mount.

The ASI120MM-Mini and 120mm guide scope is the configuration that I had been using since I received my C11. However almost all of my images are very blurry (which I had been able to sort of clean up using AutoStakkert) and I suspect that this is due primarily to the inadequacy of the guide camera setup.

ASI174MM Mini with OAG Workflow

Bin 2 Setting (one time)

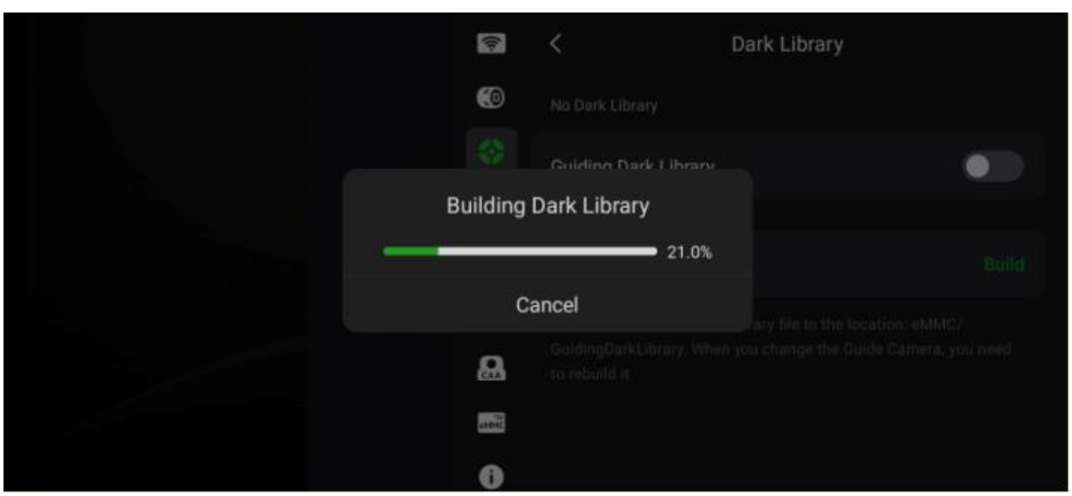
Enabling the Guide Camera – Advanced Setting – "Guide Camera Bin2" option will make it easier to see more dim stars. You should leave this setting enabled – you should only have to set it once.



Dark Frames (one time)

Dark frames in guiding are helpful just like on the main camera. You should experiment with a guide camera gain that produces visible stars without washing out the screen at about a 1 second exposure time.

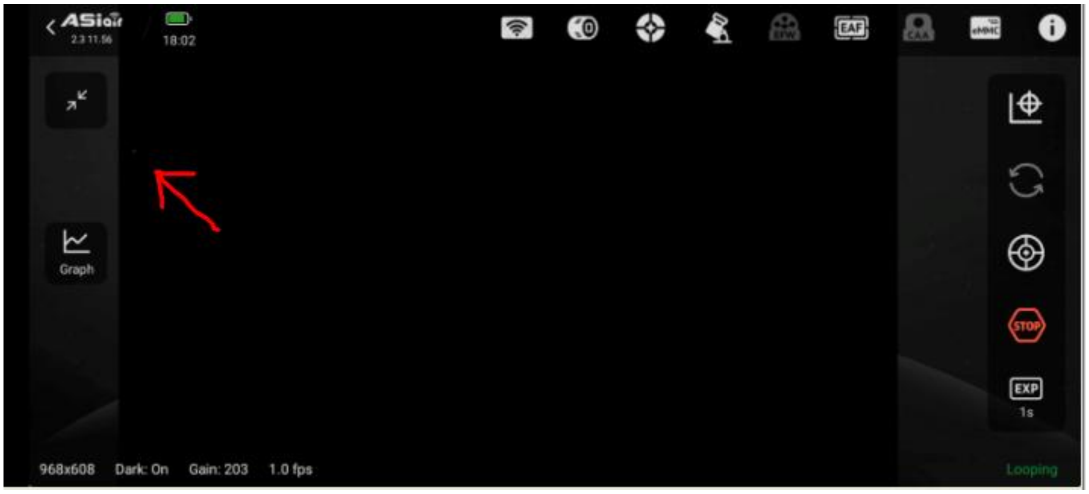
Once you have found the proper gain (mine was 203) you should make dark frames for this setting. You do this in the Guide Camera – Advanced Settings – "Dark Library" option. Make sure you do this in a dark environment (outside at night, or in a closet) with the telescope aperture cover in place. This will take a few minutes and the dark frames will be stored on your selected flash device.



Make sure the Dark Library option is enabled after you build the dark frames.

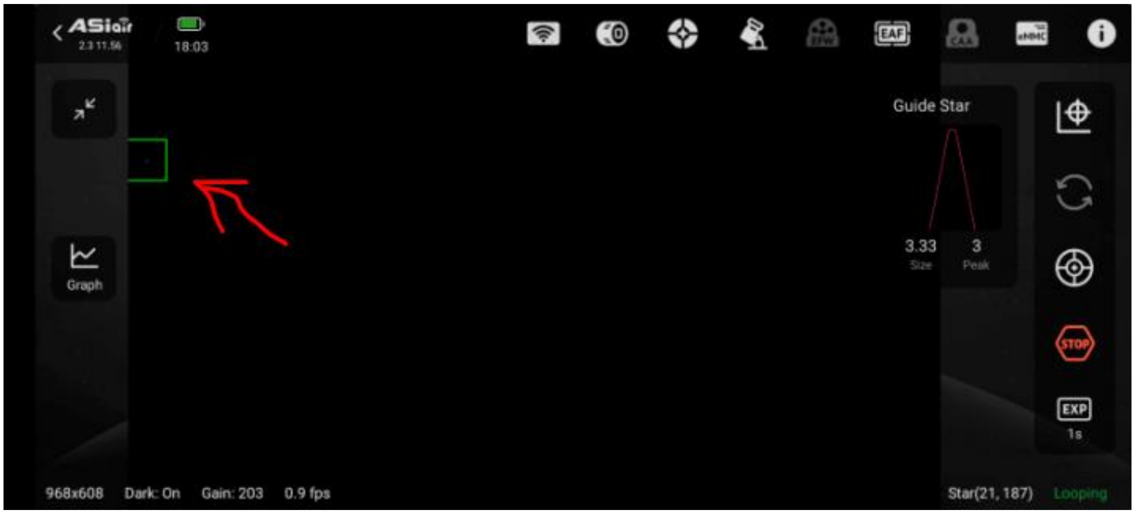
Setup Tracking (every new target)

Once you have moved the telescope to a new target you will want to start tracking. This is accomplished by the following non-intuitive steps.



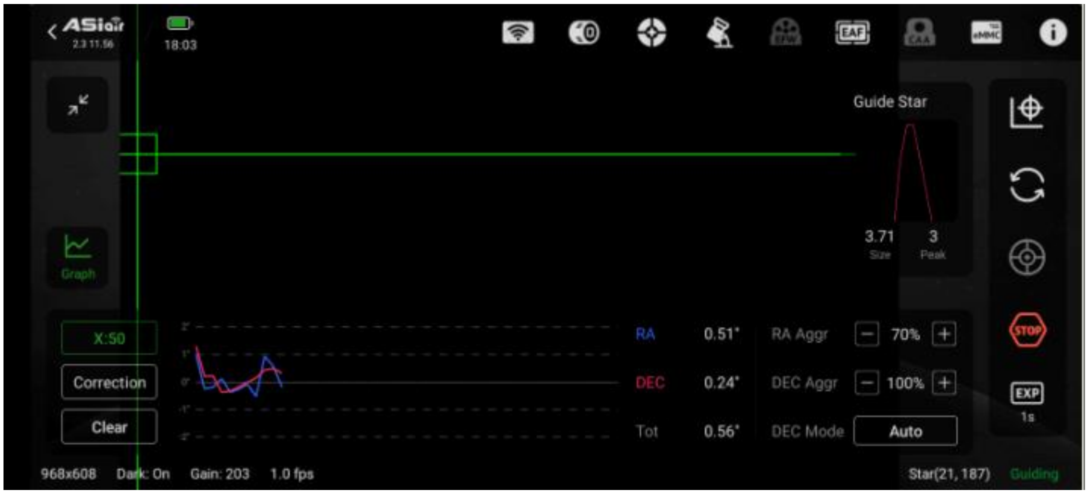
The first thing that is non-intuitive is that pressing the ‘target’ button (right side middle) will come up with a warning that ‘no stars can be found.’ This is incredibly frustrating when you get started because you can see several – albeit dim – stars on the screen.

What you need to do is ‘touch’ the star that you want to use with your finger so that a green box shows up around it as shown below.

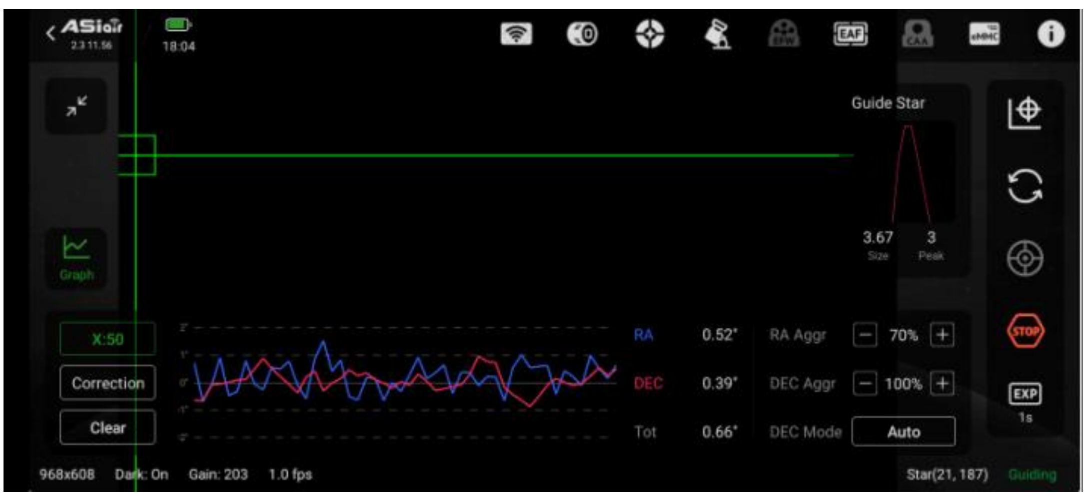


“Now” you can press the ‘target’ button and it will use the star you chose to track. It is generally better to choose a star near the middle of the screen, but the edges will work too. You want to choose the brightest star so it is easier to track as well. In some cases, you may not have much choice.

At this point you should see the guiding start as shown below.



Initially there may be some 'jumping around' of the guiding system until everything stabilizes. Over time this will stabilize and the graph will smooth out and you can see how close the guidance system is keeping your target (the smaller the deviations the better.)



At this point your guiding is working and you can close the window and proceed to taking pictures.