AG Optical Systems

Newtonian Astrograph Manual

Version 2 2012

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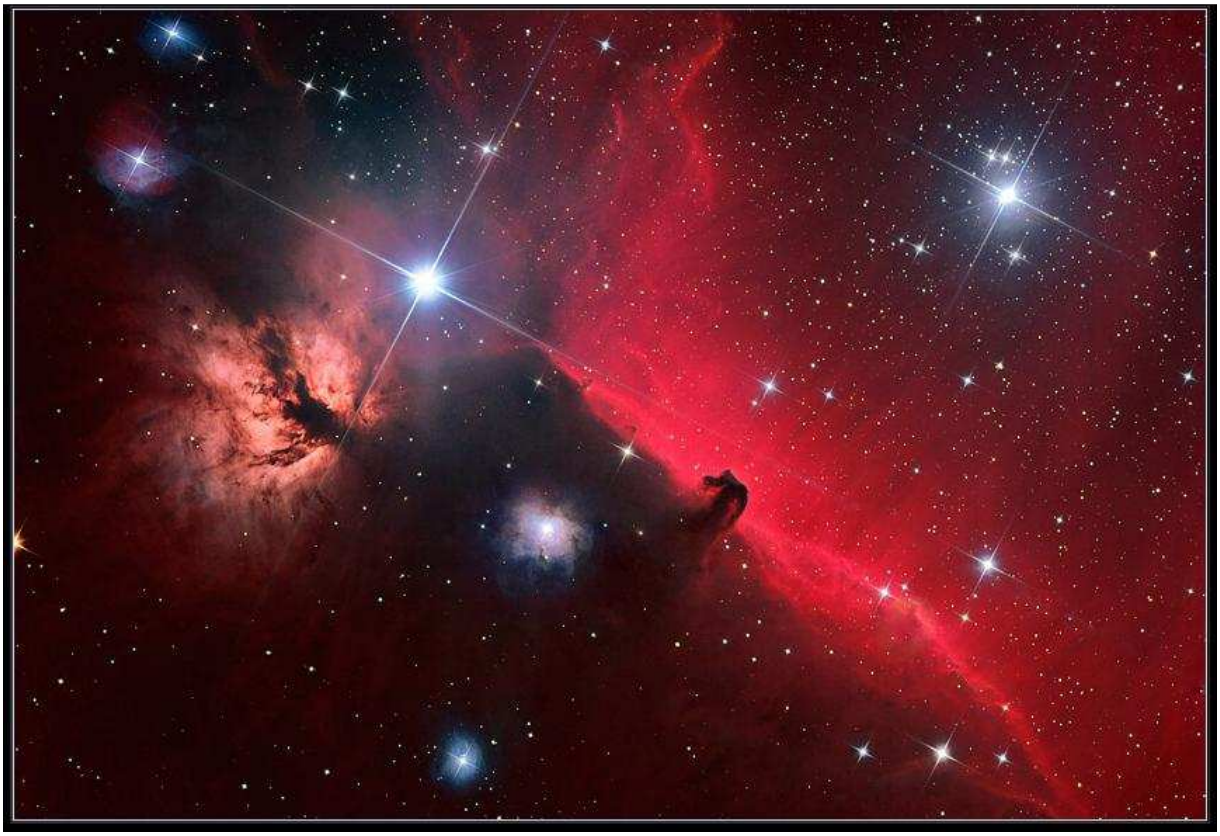


Introduction

Thank you for your purchase of an AG Optical Systems Newtonian Astrograph. Your telescope has been carefully crafted using modern manufacturing technologies and high-tech materials to provide outstanding, reliable performance. As with any high quality optical instrument, care must be taken in the use and maintenance of the telescope to ensure it performs to its maximum potential. Should you have any questions that are not addressed by the contents of this manual please contact AG Optical Systems.

System Specifications

System Focal Length: F3.8 (with Wynne corrector)
Primary Mirror Substrate: Schott Borofloat
Primary Mirror Coating: Enhanced aluminum
Secondary Mirror Substrate: Schott Borofloat
Secondary Mirror Coating: Enhanced aluminum
Back focus: 80 mm from last lens surface of Wynne corrector to focal plane
Cooling fans: 12 vdc, center pin positive, 5.5 x 2.1 mm jack

Receiving the Telescope

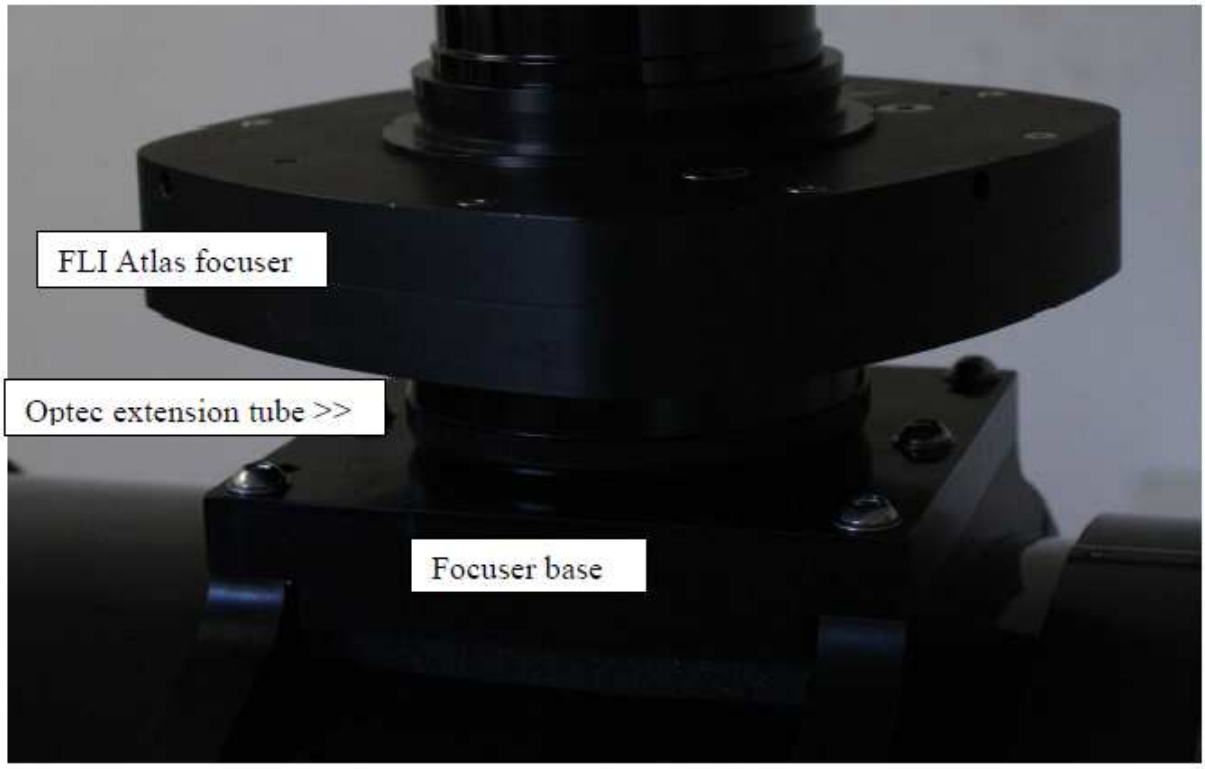
Please inspect the shipping box for any damage when you receive the telescope from the shipper. If any significant damage to the box is visible (crushed corners, major tears in the cardboard, water damage, etc.) you may want to bring it to the attention of the delivery person and document the damage by taking images of it.

Once you have the box opened, carefully inspect the telescope for any damage and, if any should be found, document the damage with a photograph and immediately contact the shipping company and AG Optical Systems.

Initial Assembly

Very little assembly is required to prepare your AG Optical Systems astrograph for use. You will need to attach the Atlas focuser and 3.5” Optec extension tube to the focuser base by following these steps:

1. Locate the 3.5” (diameter) Optec extension tube. Threaded into one end of this tube will be the Optec extension tube-to-Atlas adapter. The other end will consist of a male thread. Carefully thread the male threaded end of the extension tube into the focuser base that is attached to the tube until a snug fit is achieved.
2. Slide the Atlas focuser over the Optec extension tube-to-Atlas adapter and secure it firmly using the three set screws located on the sides of the Atlas focuser.
3. Collimating the telescope is the next step!



Collimation

Precise collimation is critical to ensure the full potential of your AG Optical Systems astrograph is realized. Due to the fast focal ratio of your AG Optical Systems astrograph, even very slight adjustments to the alignment of the primary and secondary mirrors will have a noticeable effect on the quality of the image at the focal plane. Best results will be achieved when you use quality collimation tools and follow a systematic approach. Be patient and do not settle for anything less than "text book" perfect collimation.

AG Optical Systems suggests you read many of the excellent online resources describing how to collimate a Newtonian telescope. These resources provide a rich wealth of detailed theoretical and practical information that will enable you to achieve precise collimation of your AG Optical Systems astrograph.

To facilitate the collimation process, the primary mirror of your astrograph has been center marked with a small collimation target. This "center spot" will greatly aid in the initial alignment of the primary and secondary mirror.

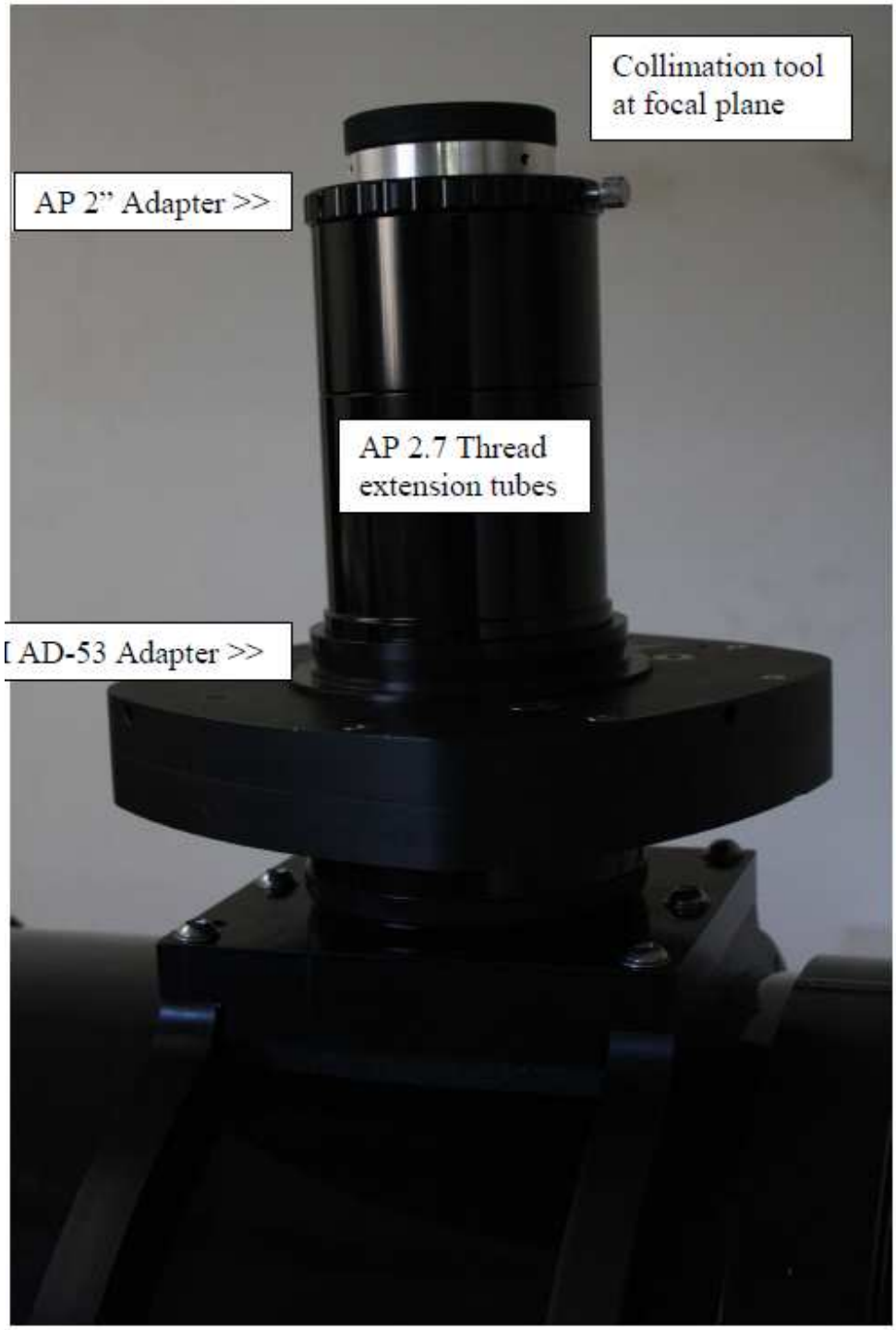
AG Optical Systems suggests that you follow an identical process each time you insert a collimation tool into your 2" adapter. Due to a lack of standardized manufacturing tolerances for collimation tools and 2" adapters, significant variation in the location of the collimation tool within the adapter is possible. This variation makes it difficult to achieve repeatable and precise results when collimating

optical systems with fast focal ratios. You may consider using only one set screw (the same one each time) when placing collimation tools into your adapter and then using only the minimum pressure necessary to hold the tool in place.

Suggested Collimation Tools

- 2” laser collimator (preliminary secondary adjustment)
- 2” Cheshire sight tube (primary collimation)
- 2” autocollimation tool (precise secondary collimation)
- Focuser adapters to allow the use of 2” collimation tools
    - AG Optical Systems suggest the use of the FLI AD-53 Adapter, Astro-Physics adapters (A1008-A, A3502-A and ADA2003) to locate the collimation tools at the focal plane of the system.

NOTE
It is very important that the surface of the collimation tool (i.e. where you place your eye) is located as closely as possible to the focal plane of the telescope. For your AGO Newtonian the focal plane is located approximately 8.5” from the surface of the tube.


Collimation tool
at focal plane
AP 2" Adapter >>
AP 2.7 Thread
extension tubes
AD-53 Adapter >>

Collimation Process Overview

Below is a general overview of the collimation process. Detailed instructions follow in the subsequent section.

1. Place the telescope on your mount and point the telescope approximately 45 degrees above the horizon.
2. Insert the proper combination of adapters into the Atlas focuser to place the collimation tools at the focal plane. (approx. 8.5" above the surface of the carbon fiber composite tube)
3. Insert a quality 2" laser and make initial adjustments to the secondary to place the laser beam at the center of the primary mirror.
4. Insert 2" Cheshire tube and make adjustments to the primary mirror to center the "Hotspot" reflection.
5. Insert 2" autocollimation tool and make adjustments to the secondary mirror to align "Hotspot" reflections in central and off-axis view ports.
6. Re-insert 2" Cheshire to confirm primary is still aligned. If it is not, adjust the primary mirror and then repeat step 5.
7. Iterate steps 5 and 6 until text book alignment is achieved.

AG Optical Systems uses the Catseye "Hotspot" center dot and detailed instructions on how to use this type of center spot to collimate your telescope are reprinted below with permission from Catseye.

Catseye provides an excellent tutorial video at the following link:

http://www.catseyecollimation.com/cegallry.html#xlkvideo

Detail Instructions – AutoCollimation Process

Using the *INFINITY XLK™* w/HotSpot

ALL PICS & ILLUSTRATIONS COMPLIMENTS OF JASON KHADDER

See a video instructional tutorial at: http://www.catseyecollimation.com/cegallry.html#xlkvideo

Note: For the best results in eliminating axial errors, the *INFINITY XLK™* should be used along with a Cheshire or Barlowed laser (to adjust the Primary). That said, the *XLK™* can often achieve "very good" results as a stand-alone tool by iteratively achieving image convergence in the CENTRAL pupil when adjusting the Primary mirror and paired discs in the OFFSET pupil when adjusting the Secondary mirror.

IMPORTANT: Best results are achieved with the *INFINITY XLK™* when the autocollimator mirror is at or very near the focal plane; in this scenario, all the reflections appear the same "size".

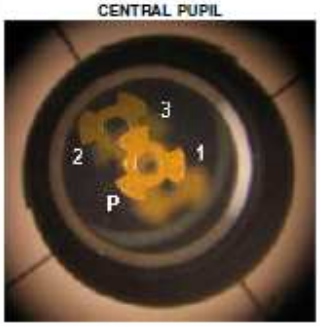
MIRROR ABOVE FOCAL PLANE

- Once you have gone through the procedure in the following pages, look closely in the OFFSET pupil. If unequal-sized images are present, adjust the focuser in or out as necessary to bring the images as close as possible to the same size before final alignment tweaks are made.

MIRROR BELOW FOCAL PLANE

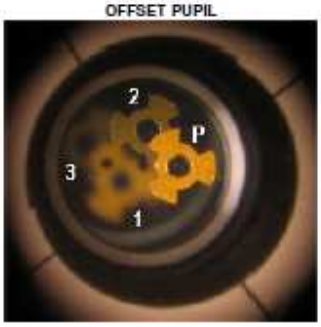
Identification of the Four Center Spot Reflections

CENTRAL PUPIL



- Reflection "P" is the sharpest and brightest of all the rest.
- Reflection "1" is oriented like "P" but is typically somewhat fuzzy.
- Reflection "2" is the sharpest and brightest inverted reflection.
- Reflection "3" is the dimmest inverted reflection & is somewhat fuzzy.

OFFSET PUPIL

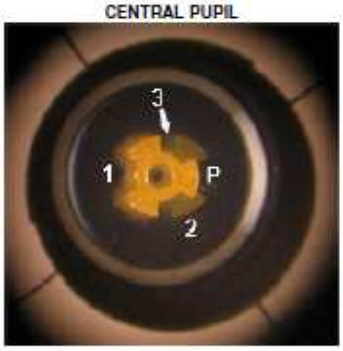


Successful Axial Convergence and What it Means!

Once the collimation exercise is done, when "all" tools simultaneously yield "textbook" visual queues, optical axes convergence has been accomplished. With sustainment of final adjustment settings, you can be confident that your scope will perform to its maximum image-detail-delivering potential that the atmospheric "seeing" will allow.

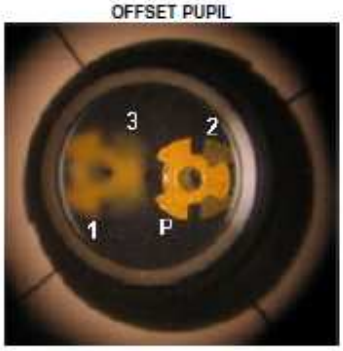
STEP 1: Assessing Overall Optical Axes Alignment:

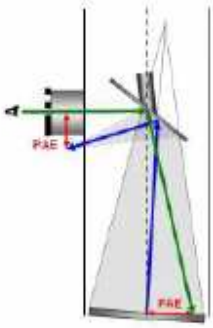
CENTRAL PUPIL



- Insert the ***INFINITY XLK™*** in the focuser & examine both pupil views.
- Axial alignment errors will likely be present as depicted.
- The objective will be to have only "P" be visible via the CENTRAL pupil & and a "Perfect" disc via the OFFSET pupil. Anything else is indicative of axial misalignment.

OFFSET PUPIL





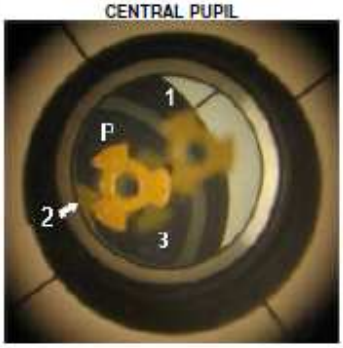
There are two types of axial alignment errors:

- FAE (Focuser Axial Error) is the distance between the primary mirror center point and the focuser axis.
- PAE (Primary Axial Error) is the distance between the primary mirror focal point and the focuser axis.

Eliminating both errors is the main goal of "axial" collimation. Typically, FAE is eliminated first by adjusting the secondary mirror then PAE is eliminated by adjusting the primary mirror.

STEP 2: Assessing FAE

CENTRAL PUPIL

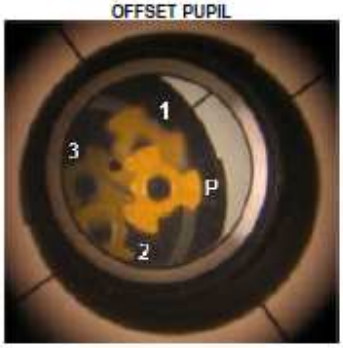


The "Carefully Decollimated Primary (CDP)" protocol was pioneered by Vic Menard

Using the CENTRAL pupil only:

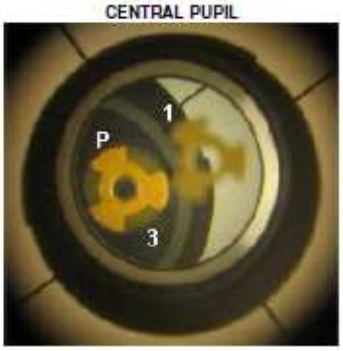
Intentionally de-collimate the primary mirror by slightly adjusting one of the 3 cell collimation knobs until reflections "1" and "2" are sufficiently separated to clearly see "P" and "3"

OFFSET PUPIL



STEP 3: Eliminating FAE by adjusting the secondary mirror:

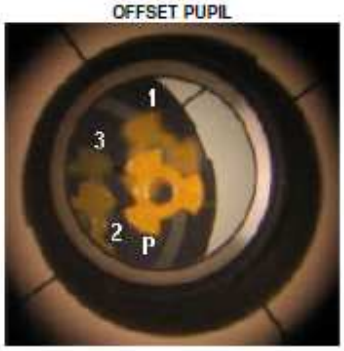
CENTRAL PUPIL

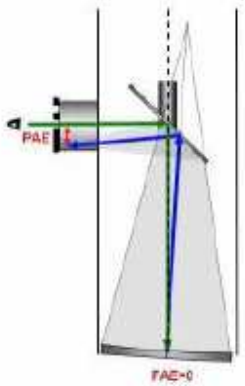


Using the CENTRAL pupil only:

Adjust only the secondary mirror until reflections "P" and "3" stack forming a prefect disc - an indication of FAE elimination.

OFFSET PUPIL



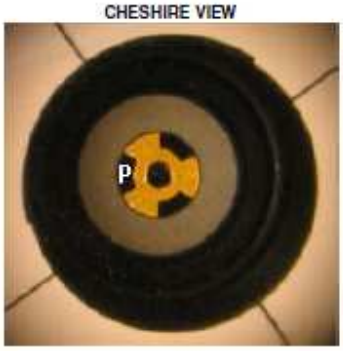


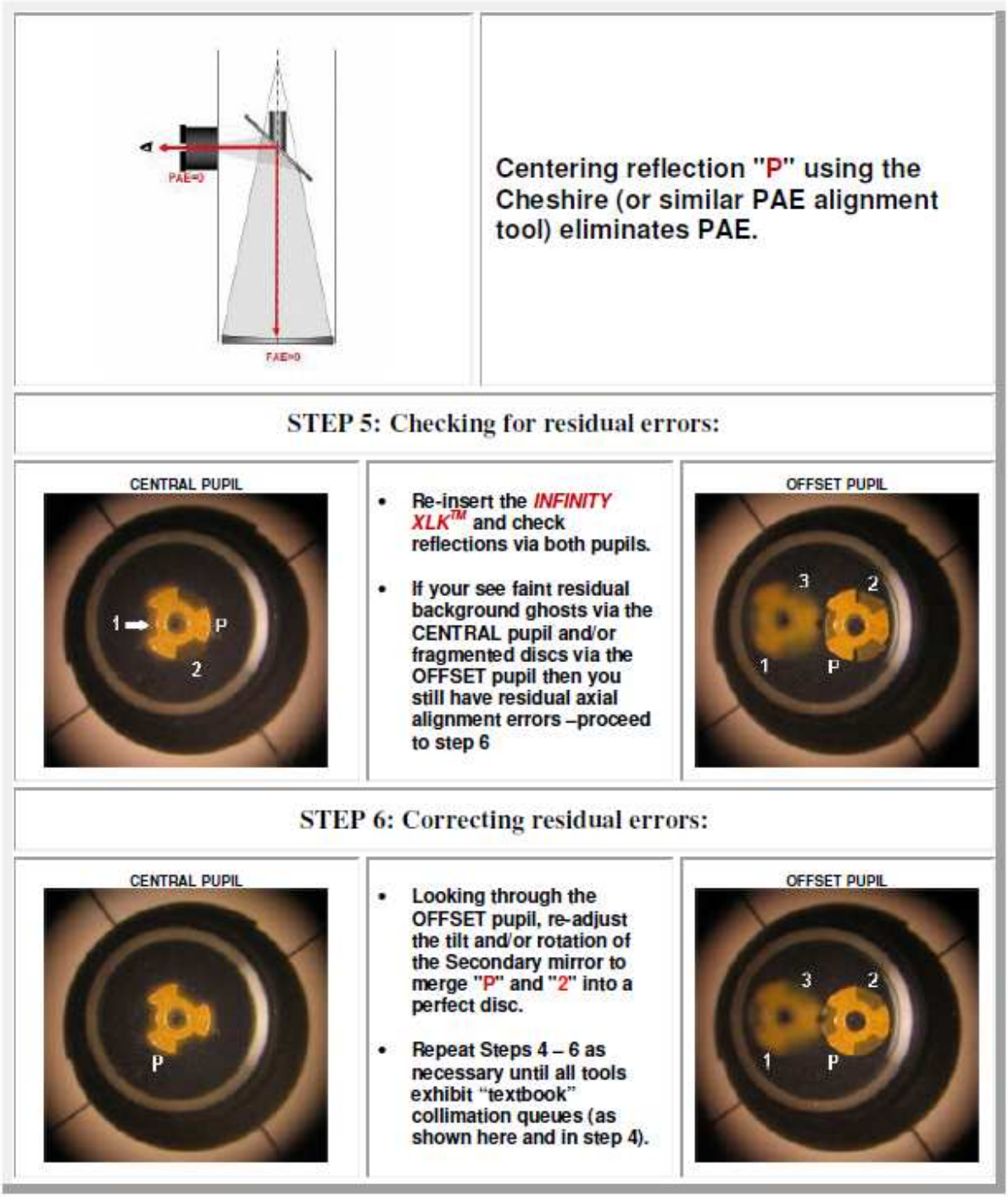
Stacking reflections "P" and "3" via the central pupil using the CDP eliminates FAE.

STEP 4: Eliminating PAE by adjusting the primary mirror:

- Remove the *INFINITY XLK™* autocollimator and replace it with the *BLACKCAT XL™* Cheshire (or similar PAE alignment tool).
- Adjust only the primary mirror until Reflection "P" is perfectly centered in the Cheshire ring (or the return shadow of the center spot is centered on the Barlowed laser return screen).

CHESHIRE VIEW





Collimation Adjustment

Collimating an AG Optical Systems Newtonian is accomplished by making adjustments to the primary mirror cell and secondary mirror cell until the optical axis of both mirrors are coincident and co-axial with the mechanical axis of the focuser.

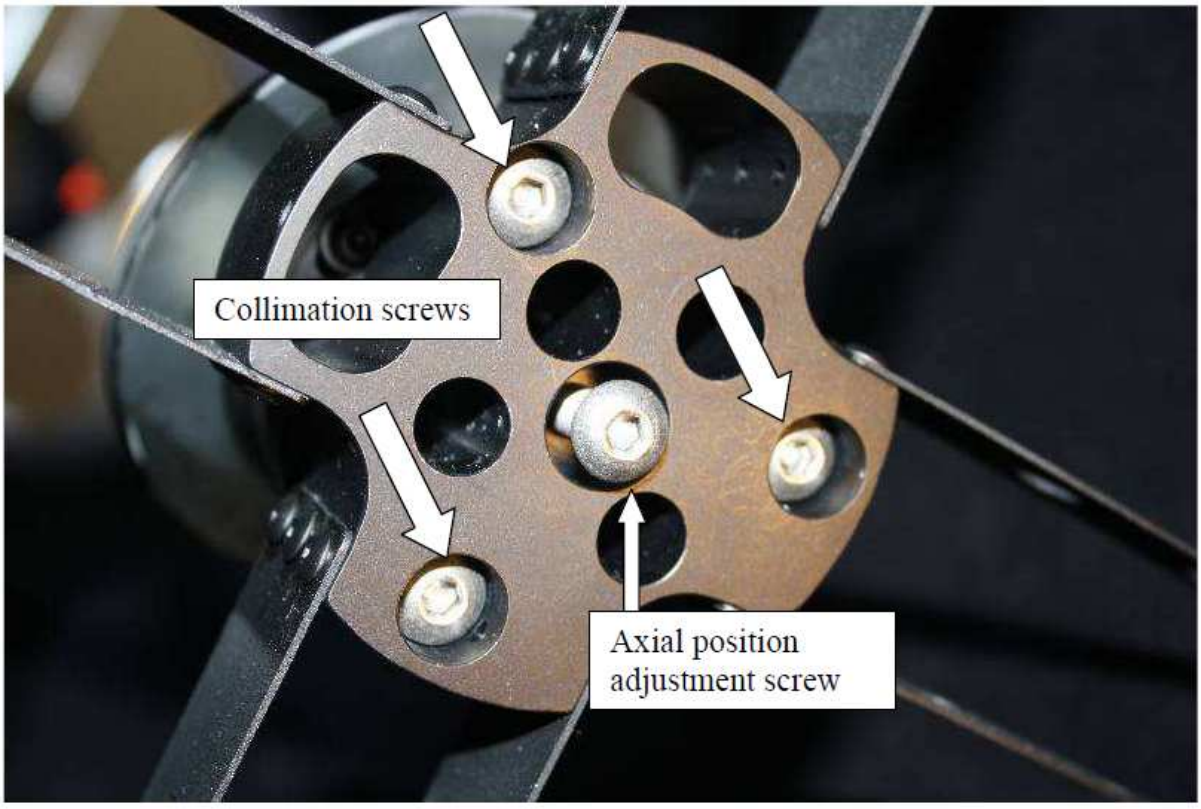
The key to successfully collimating your Newtonian astrograph is to use a systematic approach that involves making small adjustments to each mirror, assessing the results of the adjustments, and then making subsequent adjustments to further refine the collimation of the astrograph. Once collimation is achieved, the system will hold collimation for long periods of time unless the OTA is subject to rough handling.

Adjusting the Secondary Mirror

Making collimation adjustments to the secondary mirror:

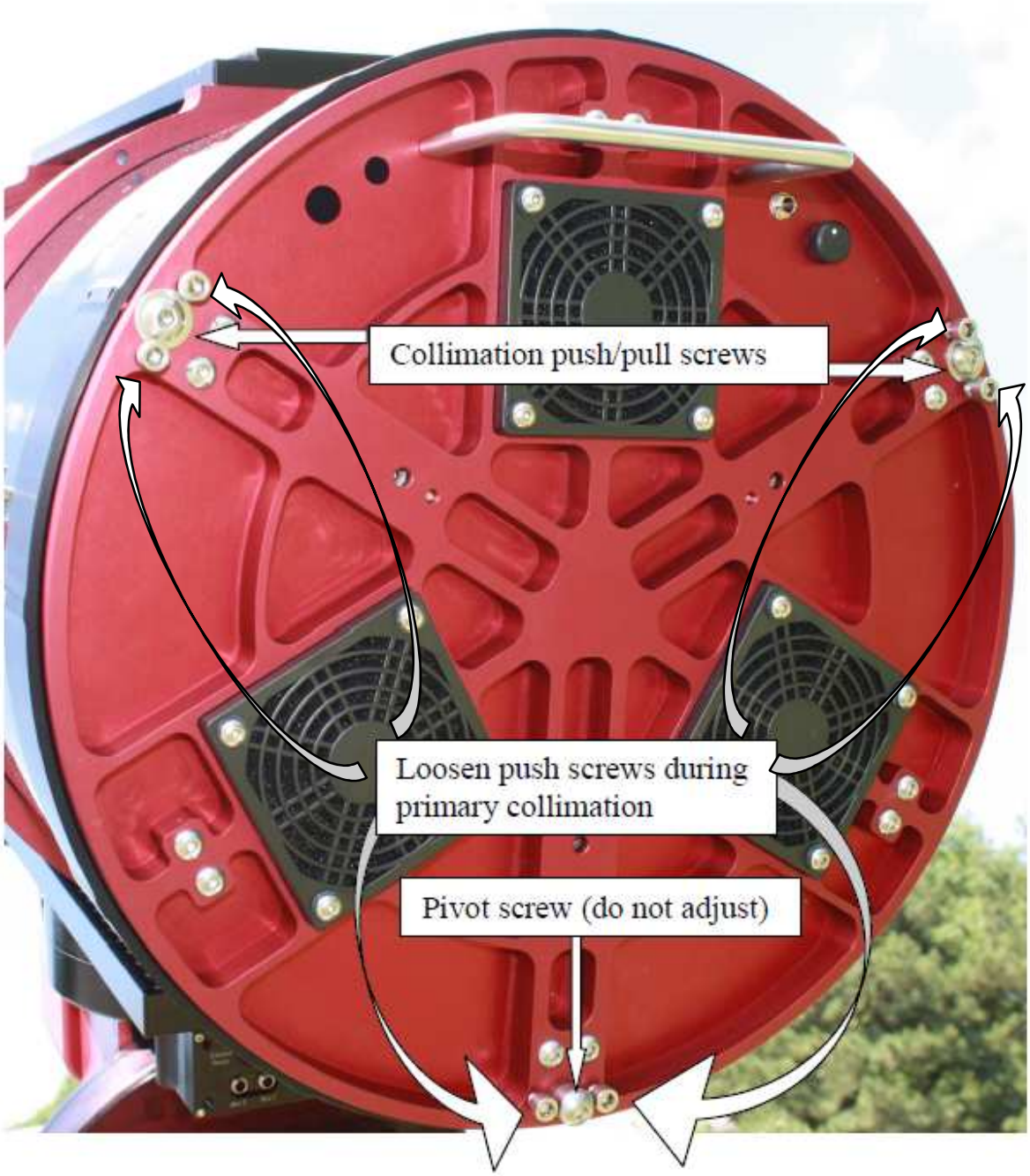
- Adjust the three 5/16-24 socket cap screws located in the hub at the center of the spider to adjust the tip/tilt of the secondary mirror. These three screws pull against a central pivot point so it may be necessary to loosen one screw and then tighten the other screws if you need to make a large adjustment. Fine adjustments can usually be made using one screw. Be careful, however, not to over-tighten any screw during this process…. snug is good enough.

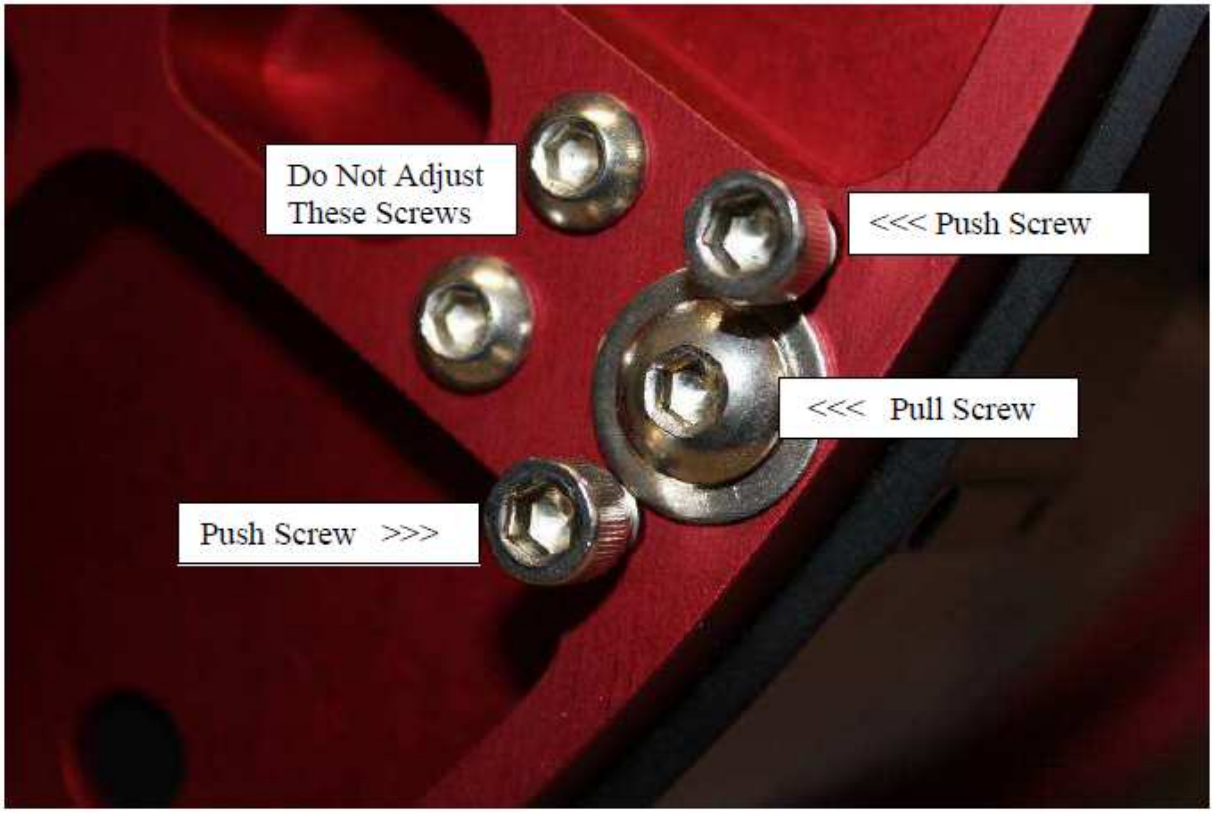
Note: Do not completely back out the three secondary collimation screws as the secondary holder will come lose. Damage to your system may result!



Making collimation adjustments to the primary mirror

- Collimation adjustments to the primary mirror are made by adjusting two sets of screws on the mirror cell back plate. Each set consists of a single, spring-loaded "pull screw" (which is a 5/16-24 TPI button cap screw) and two "push screws". A third set of screws is identified by a thick pair of spherical washers located under the 5/16 button cap screw. No adjustment to this screw is required. However, during the collimation process, the "push" screws associated with this "pivot" screw should be loosened to allow the mirror cell to freely pivot. During coarse adjustment of the primary it is most simple to loosen all of the "push" screws a couple of turns and use only the "pull" screws to collimate the primary mirror. Remember….. do not adjust the "pivot" screw.


Collimation push/pull screws
Loosen push screws during primary collimation
Pivot screw (do not adjust)



Insert Wynne Corrector

After completing the collimation process, install the Wynne corrector/CCD camera assembly on the scope and take an image being careful to accurately focus the system. AG Optical Systems has found that focusing on a star located mid-way between the center and corner of the chip often provides the best results.

To install the Wynne corrector, insert the Wynne corrector into the Atlas focuser and firmly tighten the three set screws in the FLI Atlas to lock the Wynne corrector into place. Thread the CCD camera onto the Wynne corrector adapter (which should be attached to the Wynne corrector).

Tips

- Use the diffraction spikes around moderately bright stars to help determine when you have achieved focus. Out of focus stars will show four pairs of diffraction spikes. When focus is achieved each pair of diffraction spikes will converge into a single, sharp spike. If any diffraction spike is wider than the other three, then the system is not precisely collimated. You can use this approach to dial-in collimation under the stars if the results obtained using the collimation tools are not satisfactory.
- Focus very carefully as even a slight amount of defocus can cause off-axis stars to be oblong and distorted.
- Ensure that your collimation tools are located at the focal plane of the system

- Leave the cooling fans constantly running at a medium to slow speed as this will help keep the telescope thermally equalized as well as help prevent dew from appearing on the secondary mirror.
- Don’t give up until you achieve text book collimation. Even slight miscollimation will cause stars to be oblong somewhere on your CCD chip.
- Do not over-tighten collimation screws…. snug is good enough!
- Use high quality collimation tools

Care and Cleaning

Warm water or gentle household cleaners (such as Windex) may be used to clean the exterior of your AG Optical Systems astrograph. Paint thinners and other strong chemical solvents should not be used as they may cause damage to the finish of your astrograph.

WARNING
AG Optical Systems recommends that you **always** keep your AG Optical Systems astrograph covered when the telescope is exposed to direct sunlight. The black finish (paint or clear coated carbon fiber) rapidly absorbs heat which, in extreme cases, could cause damage to the paint and in any case causes undesirable heating of the telescope.

Cooling Fan Operation

Your AG Optical Systems astrograph is equipped with three fans to decease the time it takes the primary mirror to achieve thermal equilibrium with ambient air. These fans require 12 volt DC power that is supplied via the center pin positive 5.5 mm x 2.1 mm female connector located on the back plate of the telescope.

The speed of the fans can be adjusted using the small black knob located on the back plate. AG Optical Systems recommends that you ramp the fans to their highest speed and then slow them to the speed you desire. Only a slight turn on the knob is required to adjust the speed of the fans.

Warranty

AG Optical Systems warrants the products it manufactures against defects in materials and workmanship for a period of two years for the original purchaser of the item. AG Optical Systems at its sole discretion will determine if the product has defective materials and/or workmanship. The customer will be responsible for paying all shipping costs associated with the return of the item and must contact AG Optical Systems prior to returning the item. If AG Optical Systems determines the item to be defective in materials and/or workmanship, AG Optical Systems will reimburse the customer's shipping costs and pay for shipping to return the item to the customer.

The terms of this warranty are void if the product is used for a purpose for which it was not designed (to include solar observations) or is subject to abuse beyond normal use. Items not manufactured by AG Optical Systems are covered by the terms of the original manufacturer.