

# Orion® EON™ 70mm ED Quadruplet Astrograph Refractor Telescope

#10383

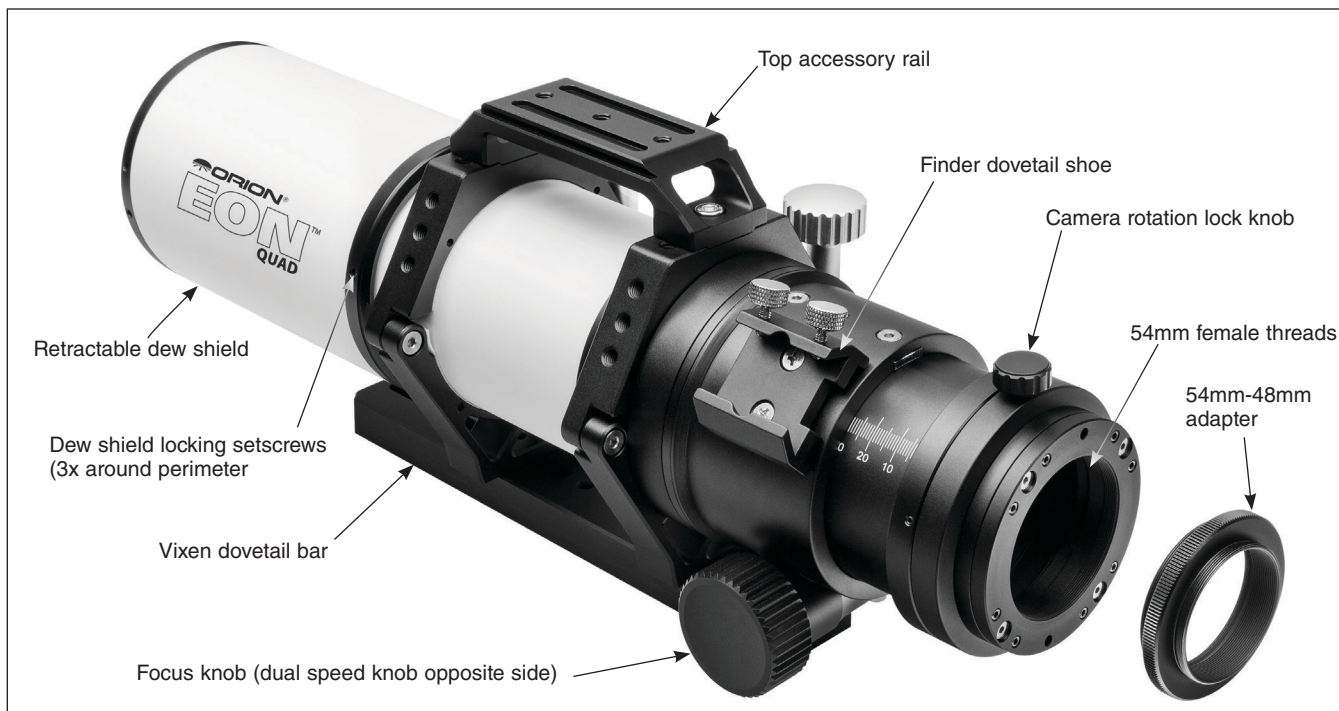
*Congratulations on your purchase of the Orion 70mm ED Quadruplet Astrograph Refractor! The EON has been designed with exceptionally high quality, precision ED optics and superior mechanical construction, making it ideally suited to high-performance imaging with today's larger format CCD and CMOS cameras. These instructions will familiarize you with the features of your instrument and how to use it.*



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**Figure 1.** Features and parts of the EON 70mm ED Quadruplet Astrograph

**WARNING:** Do NOT look at the Sun without a professionally made solar filter on the telescope; serious eye damage may result if you look at the Sun with any unfiltered optical instrument. Do not leave the telescope unsupervised around children. Always cover the lenses when leaving the telescope in direct sunlight.

## 1. Parts List

- EON 70mm ED Quadruplet Refractor
- Objective lens cap
- Focuser end cap
- Tube rings (pair)
- Lower mounting dovetail bar
- Upper accessory rail
- Dovetail finder scope base
- 54mm-48mm step down ring (includes 48mmx0.75mm filter threads)
- 48mm-42mm step down ring (not shown)
- Hard case with custom foam interior

The EON 70mm ED Quadruplet refractor come ready for use from the factory. Your telescope's optics have been assembled and precisely collimated at the factory, so they should not require any adjustments. Please keep the original shipping box. In the unlikely event that you need to ship the telescope back to Orion for warranty repair service, you should use the original packaging

## 2. Features and Functions

Your EON 70mm Quadruplet has premium features designed to maximize the performance of the scope for imaging the night sky. Most notably, the air-spaced four-element designed objective lens contains Hoya FCD100 extra-low dispersion ("ED") glass, which minimizes chromatic aberration and also provide a very well corrected flat field of view for impeccably clean, sharp, high-resolution images without the need for extra field flattening lenses.

### Retractable Dew Shield

The dew shield of the EON 70mm Quad is retractable, allowing the telescope to become more compact for storage. To extend the dew shield, simply pull it forward until it stops. Extend the dew shield while imaging to block extraneous light and to forestall the formation of dew on the exposed surface of the objective lens. If you look closely at the back end of the dew shield bevel, you will find three small allen head setscrews (**Figure 1**), which can be slightly tightened down to secure the dew shield in place. Under normal operation this shouldn't be necessary, but if you use a light box to lay over the dew shield when the telescope is pointed straight up in order to capture flat field calibration frames, tightening these setscrews down will prevent the dew shield from contracting under the weight of the light box. Don't forget to loosen these setscrews slightly before retracting the dew shield.

### Dual-Speed Focuser

The 70mm Quad features an incredibly well build 3" rack-and-pinion focuser with 10:1 reduction gearing, and bias (diagonal) cut on the rack to provide exceptionally smooth, backlash-free

focus motion and excellent rigidity for holding heavy imaging trains. This rack-and-pinion design is superior to Crayford designs because there is no possibility of focuser slip with heavier loads or pointing high in the sky – critical when trying to obtain precise and repeatable focus, especially when using a robotic focus motor. Speaking of which, the focus knob on the 1:1 side is removable, revealing the 6mm diameter focus shaft below. This makes the focuser compatible with 3rd party electronic/robotic focusers that include a universal adapter in order to attach to the focuser housing. To remove the focus knob, use a 2mm allen wrench to remove the cover setscrew (closest setscrew to the black focus knob), and then rotate the focus knob while looking through this hole to find the shaft lock setscrew. Loosen this screw, and the focus knob will slip off. Do not attempt to remove the 10:1 reduction gear side of the focuser.

The focuser itself features a 29.5mm travel distance, and the light comes to focus 69.5mm behind the 48mm threads when the focuser is fully rotated inward. This should help you gauge what spacing adapters you may need for your specific camera combination.

To attach your camera, filter-wheel, or off-axis guider, you'll need to thread it directly onto the focuser. This telescope does not use a 2" or 1.25" slip fit eyepiece hole like visual telescopes – the thread-on connection is much more robust and flex free for obtaining the highest quality images. In order to be compatible with the most amount of camera gear on the market, we include several adapter rings. First, native to the 70mm focuser is a 54mm x 0.75mm thread pitch female thread. From there, you can step down to a male 48mm x 0.75mm "wide-t" thread, and from that, even further down to the 42mm x 0.75mm thread pitch standard t-thread. Cameras such as our StarShoot G10 and G26 utilize 42mm threads, and larger camera and accessories (such as our G24 Full Format camera and Nautilus filter wheel), can utilize the 48mm threads. Some larger camera/accessories may even utilize the full 54mm female thread on the focuser, but depending on the specific situation and components, you may need to purchase extra imaging adapter rings which are widely available on the internet.

### Camera Rotation

The focuser on the 70mm Quad allows full rotation of the camera. Rotating the camera can be useful for framing an imaging target on a camera's sensor for the perfect composition. The 70mm has a rotation interface directly behind the 54mm threads, in front of the drawtube (**Figure 1**). To rotate the camera, simply loosen the large rotation lock thumbscrew slightly, rotate the camera to the desired angle, and then tighten down the thumbscrew again. Be sure when rotating the camera, that you are NOT unthreading it from the focuser itself!

### Finder Scope Dovetail Shoe

Your EON 70mm Quad comes with a dovetail finder scope shoe (**Figure 1**) that allows attachment of an optional Orion finder scope, reflex sight, mini guide scope, or the Orion Dual Finder Scope bracket. Simply loosen the locking thumbscrew, slide your finder in until it is fully seated or centered, and then lock the thumbscrew back down.



**Figure 2.** The hinged tube rings

### Tube Rings and Mounting plates

Your EON 70mm refractor comes with a pair of heavy duty, CNC-machined, clamp-style tube rings (**Figure 2**). Each has a flat boss on the top and bottom with multiple threaded M6 (6mm diameter x 1mm thread pitch) holes on the top, bottom, and even sides, for attachment of accessories. Also included is a bottom Vixen shaped mounting plate made of machined and anodized aluminum. This allows the EON to attach to any mount compatible with the Vixen dovetail system. And if you have a Losmandy style mount head, Orion offers an optional adapter plate to allow use of the Vixen dovetail bar in the wider Losmandy cradle.

The top dovetail bar/handle of the 70mm Quad features an Arca-Swiss dovetail cut into the edge which is a popular dovetail shape in the larger photography industry. There are multiple M6 threaded holes on the top of this bar (except the center hole is 1/4"-20), as well as on the side of the rings that will allow you to attach any number of accessories to the tube.

### Hard Case

The hard case that comes with your EON should be used to transport and store the telescope when it's not in use, to keep the instrument clean and protected from damage.

## 3. Using Your Camera with the EON 70mm Quadruplet

Because of the 4-element design of this astrograph, you do NOT need to use a separate field flattener in order to achieve sharp images in the corners of your field. The best part of this feature is that you do not need to worry about achieving the dreaded and exacting 55mm spacing between your camera sensor and the

field flattener. Simply attach your camera (making sure the focus point is within the range of the focuser), and the resulting image will be very well corrected.

Finding focus can be a bit difficult the first time out, since there are so many different combinations of camera and accessory gear that can attach. A little time spent during the day with the back focus data of your specific camera and gear and a calculator can make life much easier.

### Focus distance example

Remember, the focuser has a 29.5mm range of travel, but your camera sensor has to sit 69.5mm back from the 48mm threads. So for example, the StarShoot G24 has a 17.5mm back focus from the front threads of the camera body, and also includes a 21mm and 16mm spacer. So  $17.5\text{mm} + 21\text{mm} + 16\text{mm} = 54.5\text{mm}$ . Since the EON focuses 69.5mm behind the 48mm threads,  $69.5\text{mm} - 54.5\text{mm} = 15\text{mm}$ . This means the focuser should be racked out approximately 15mm in this configuration to reach focus – well within the travel range of the focuser itself. If you have a filter wheel attached to the front of the camera, simply add the depth of the filter wheel to the back focus of the camera in order to get the new back focus of your camera/filter wheel combo. It is highly likely that in many camera combinations, especially without a filter wheel or off-axis guider in front of the camera, that you may need extra extension tubes in order to reach focus. Orion offers 42mm t-ring spacers (#5528) and 48mm spacers (#52715) in order to help achieve focus with any number of different cameras. If you are using an Orion StarShoot G10, G26 or similar cameras that do not include extra spacer rings and you are also not using an off-axis guider and/or filter wheel, it is recommended you purchase some of these extension rings to ensure you can adequately reach focus. Note: if you are using a DSLR, most all have a 55mm back focus, so they should work without any extra adapters or spacers necessary.

**Note about edge performance:** The optics are extremely well corrected for flatness of field out to the 43mm image circle periphery. In fact, it is better corrected than any improvement an add-on field flattener would normally provide with a standard refractor. However, as the camera sensor and field of view get bigger, there is always a tradeoff with edge of field performance. With an APS-C size sensor, the field of view is  $\sim 3.8 \times 2.6$  degrees, and the edge performance is quite excellent. With a 35mm format camera, you will be pushing to the edge of the image circle with a massive field of view of  $\sim 5.9 \times 3.9$  degrees. The edge performance is still very good, but perhaps not quite as perfect as with a smaller APS-C sensor.

### Filter Pocket Threads

Normally, filters would go into a filter wheel installed between the camera and the telescope, and that works perfectly well with the 70mm, especially if you use the Nautilus Filter Wheel. The Nautilus is compatible with all Orion brand filters, and many filters on the market that use the nominal 0.6mm thread pitch. But there is a growing number of vendors who utilize the camera attachment thread pitch (0.75mm) for some of their 2" filter threads, so we've included a female "wide" t-thread on the inside of the 54mm – 48mm adapter. Look into the "sky" end of this adapter ring, and you'll find female threads, which would match to a filter that uses 48mm x 0.75mm thread pitch (**Figure 3**).



**Figure 3.** The Filter pocket threads inside the 54mm-48mm adapter (NOTE, 48mm-42mm adapter ring not shown).

## 4. Care & Maintenance

Give your refractor reasonable care and it will last a lifetime. When not in use, keep the telescope in its padded case and keep the objective dust cover on, as well as the cap on the focuser end. Store it indoors or in a dry garage. Do not leave the telescope outside except when using it. If a scratch appears on the tube, it will not harm the telescope. Smudges on the tube can be wiped off with standard household cleaners.

### Dealing with Dew

When you are ready to pack up your telescope at the end of the night, avoid immediately storing it if you encountered heavy dew and the telescope is damp. Instead, bring the telescope inside and allow the moisture on the telescope to evaporate. If dew forms on the objective lens, then leave the dust cover off of the telescope until all the moisture has evaporated. Once the telescope has completely dried out, place it back in its case.

### Cleaning Optical Surfaces

In general, your telescope will only need to be cleaned on a very minimal basis. Dust particles on the objective lens do not affect the optical quality of your EON. Loose dust can simply be blown off with air, using a compressed air can or blower bulb. Any remaining dust is best left alone, unless the build-up is extreme. Fingerprints and water marks should be cleaned from your telescope's objective lens. Any quality optical lens tissue and cleaning fluid specifically designed for multi-coated optics can be used to clean the telescope's objective lens as well as the lenses of your eyepieces and finder scope. Never use regular glass cleaner, or cleaning fluid designed for eyeglasses.

Before cleaning with fluid and tissue, however, blow any loose particles off the lens with a blower bulb or compressed air, or lightly brush the lens with a soft camel hair brush. Apply some

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cleaning fluid to a tissue, never directly on the optics. Wipe the lens gently in a circular motion, then remove any excess fluid with a fresh lens tissue. Oily fingerprints and smudges may be removed using this method. Use caution; rubbing too hard may scratch the lens! Clean only a small area at a time, using a fresh lens tissue on each area. Never reuse tissues.

## 6. Specifications

Optical tube:	Seamless aluminum
Optics:	Air-spaced quadruplet, including Hoya FCD100 ED glass
Lens cell:	Machined aluminum
Aperture:	70mm
Focal length:	350 mm
F-ratio:	f/5
Image circle:	43mm
Lens coatings:	Fully multi-coated (all air-to-glass surfaces multi-layer coated)
Tube baffles:	Multiple knife edge baffles
Tube length,dew shield fully retracted:	12.75" / 324mm
Weight: (with tube rings and dovetail bar attached)	8.5 lbs. / 3.9 kg
Tube rings:	Split, felt lined, multiple threaded attachment holes
Focuser:	Dual Speed (10:1), bias cut rack-and-pinion, rotatable
Focus knob shaft diameter:	6mm, with flat side included
Drawtube travel:	29.5mm
Back focus	69.5mm (from the base of 48mm threads on 54-48mm adapter)
Rotatable focuser:	Yes
Dew shield	Retractable and lockable
Finder scope:	Optional, dovetail finder scope shoe included
Dovetail mounting plate	Vixen dovetail shape
Case:	Hard case with custom cut foam interior

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### **One-Year Limited Warranty**

This Orion product is warranted against defects in materials or workmanship for a period of one year from the date of purchase. This warranty is for the benefit of the original retail purchaser only. During this warranty period Orion Telescopes & Binoculars will repair or replace, at Orion's option, any warranted instrument that proves to be defective, provided it is returned postage paid. Proof of purchase (such as a copy of the original receipt) is required. This warranty is only valid in the country of purchase.

This warranty does not apply if, in Orion's judgment, the instrument has been abused, mishandled, or modified, nor does it apply to normal wear and tear. This warranty gives you specific legal rights. It is not intended to remove or restrict your other legal rights under applicable local consumer law; your state or national statutory consumer rights governing the sale of consumer goods remain fully applicable.

For further warranty information, please visit [www.OrionTelescopes.com/warranty](http://www.OrionTelescopes.com/warranty).



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