

ASTRO-PHYSICS, INC

ASTRO-PHYSICS has been developing telescopes and accessories for the advanced amateur since 1975. We now offer an extensive line of precision telescopes and mountings, all with outstanding performance for a variety of observing needs. If you have decided that refractors fit your requirements, you will find our line of Apochromats to have the highest performance of any refractor on the market. Our telescopes were developed with the active observer in mind. We have concentrated on those things that make observing a joy: sharp high-resolution optics, rugged vibration-free mountings and easy to use effective accessories.

HISTORICAL PERSPECTIVE

Astro-Physics has been at the forefront of optical design during the last decade. In the early 1980s, Mr. Roland Christen, founder and president of Astro-Physics introduced the first high performance affordable apochromats to the amateur market. These early Astro-Physics refractors were quite revolutionary and were a major influence in the rebirth of refractors.

The more common achromats available at that time showed significant chromatic aberration even with focal lengths of f15. They were (and still are) very long and awkward, particularly if portability to a dark sky site is desired. Both 5" f12 or 6" f15 doublet tube assemblies (focal lengths of 75 and 90 inches respectively) require a substantial mount on a tall pier or tripod to accommodate the length of the instrument and counteract the torque reaction that is inevitable when the breezes blow. The chromatic aberration coupled with the enormous size and weight of these instruments and their mountings deterred many amateurs from using refractors larger than 4" in the 1960s and 70s.

As an avid amateur astronomer, Roland was dissatisfied with the telescopes that were available in the 1970s. He knew that even the achromats then available showed snappier images than his 8" SCT, but he wanted a shorter scope which could be used for photography as well as high definition planetary images. Over a period of several years, he designed and built several refractors with shorter focal lengths using a triplet design. The color correction was very good even as short as f6.

In the 1980s, Astro-Physics' optical designs evolved several times and with each new design, new levels of performance were achieved. The quality of construction of the tube assemblies, sophistication of the mounts and range of accessories have also improved each year.

In 1992, we are very proud to introduce our new line of refractor lenses which incorporate ED glass in various optical designs, each with their intended purpose. We believe that Astro-Physics refractors set the standard for optical performance, appearance and mechanical construction in an amateur telescope.

ASTRO-PHYSICS DESIGN PHILOSOPHY APOCHROMATIC LENS DESIGN

Our objectives are APOCHROMATIC, which means that the images are essentially free of false color, both visually and photographically. We have chosen Super ED to be the heart of our optical designs because of its excellent light transmission and superior correction of all the monochromatic and polychromatic aberrations. Super ED is more advanced glass than the more common varieties used in commercial refractors.

The Star 130 and 155 Super ED Doublet Apochromatic offer excellent color corrections through the visual wavelengths. These

are great a great choice for those with a limited budget who want the superb, crisp, contrasty images of an apochromatic refractor.

The StarFire EDT design (which includes the 105 Traveler EDT) consists of three matched optical glasses to combine the colors of the visual spectrum into intense, sharp, concentrated images. The views are extraordinary. As you can see on the specification sheets, the superb color correction of these EDTs surpasses the fluorite doublets, particularly in the far violet part of the spectrum where Technical Pan films have their highest sensitivity.

The StarFire EDF design, available in 155mm and 206mm diameters, were developed with fast focal ratios of f7.5 and f8 respectively, for amateurs who long to achieve superb, wide field astrophotos. The EDF refractors feature giant focusers to allow coverage of very large film formats with minimal vignetting. In the hands of knowledgeable astrophotographers, these instruments can produce superb, professional astrophotos of all your favorite deep sky objects. Images are so sharp, it takes 30" x 40" enlargements to resolve the finest details.

One of the important advantages of a short focal length is that the mounting can be smaller, lighter and more compact. The result is a highly portable refractor system with superior imaging qualities, ideal for a wide variety of astronomical work from high power lunar/planetary to deep sky astrophotography.

MOUNTINGS

Astro-Physics mountings are designed for solid stability under a variety of observing conditions. At the same time, the mounts are truly portable so that amateurs can transport them to their favorite dark sky site and set them up quickly and accurately. The mountings break down into manageable sizes, but when set up, they are extremely rugged and steady platforms. We have also developed a very accurate worm gear set to insure smooth, effortless tracking of celestial objects for all visual and photographic purposes.

To achieve these performance criteria, we combined the latest technology with time tested design concepts. The basic mounting configuration was engineered with proper vibration and strength of materials criteria. As in a good building design, all loads are channeled into massive load-bearing cross sections to their final destination - the ground. This is done in a way that minimizes weight and size while maximizing rigidity. Examples of this are the tension rods on the piers and thrust bearings on the polar and declination axes that transfer a tremendous amount of load in relation to their size. To this stability, we have added a drive that is accurate and sophisticated enough for the most demanding application. We started with a custom manufactured fine pitch worm gear and added a high resolution stepper motor with a modern push button controller that makes tracking the stars a snap, even for beginners.

ACCESSORIES

To these basic telescope components, we have added a whole list of accessories that make our telescopes versatile. From camera adapters to telecompressors, we have carefully designed them for their functionality and compatibility. They are all tested and proven in the field under actual observing conditions.

We offer a unique, unobstructed, highly corrected optical system designed to give a lifetime of observing pleasure. When choosing a telescope, we encourage you to compare, side by side, optical and mechanical qualities with scopes of similar and even greater size.

ASTRO-PHYSICS FACILITIES AND STAFF

In September 1990, our dream of moving into a new, specially designed facility came true. Since Astro-Physics is one of the few telescope companies that actually makes most of the items in their product line, we needed a building that would allow us perform each function in the most efficient manner.

Over the years, we have assembled a staff of talented, skilled craftsmen dedicated to producing very high quality products. They take personal pride in their accomplishments and your satisfaction.

OPTICAL PRODUCTION

We manufacture all of our telescopes in our modern optical facility, so our telescope optics are 100% AMERICAN MADE. We use only precision "A" grade optical glass which has high light transmission characteristics, and is free of striae and imperfection. Each time we begin a new production run of lenses, Roland computer optimizes the design based on the melt characteristics of the glass. Our opticians adjust the tooling accordingly to achieve the desired curves. Our lenses are polished on pitch and hand-corrected on a double-pass autocollimator. Each lens is tested, polished and retested repeatedly throughout the production process. We continue until the desired performance is achieved. We do not employ mass production techniques; each lens is treated as an individual. This process is very time consuming, but there is virtually no other way to achieve the level of resolution, definition and contrast that advanced amateurs demand.

The combination of the apochromatic lens design; careful, precise optical production techniques and well baffled tube assemblies result in a clean optical system with superior contrast and light grasp.

MACHINING CAPABILITIES

Most of our components are machined in house on our ultra-modern 3-axis CNC. Our highly skilled machinists maintain very accurate tolerances so that parts fit together very precisely with no slop. As a result, our mountings are very rigid and our focusers are smooth with no wobble.

MOUNT ASSEMBLY

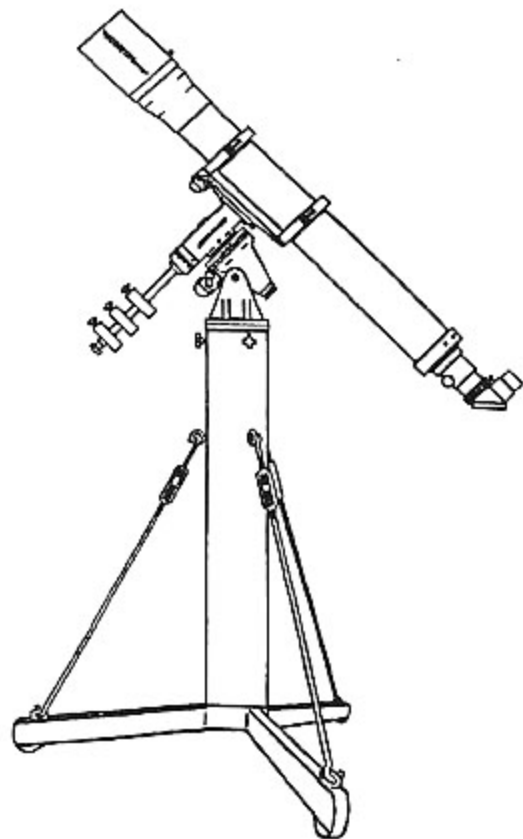
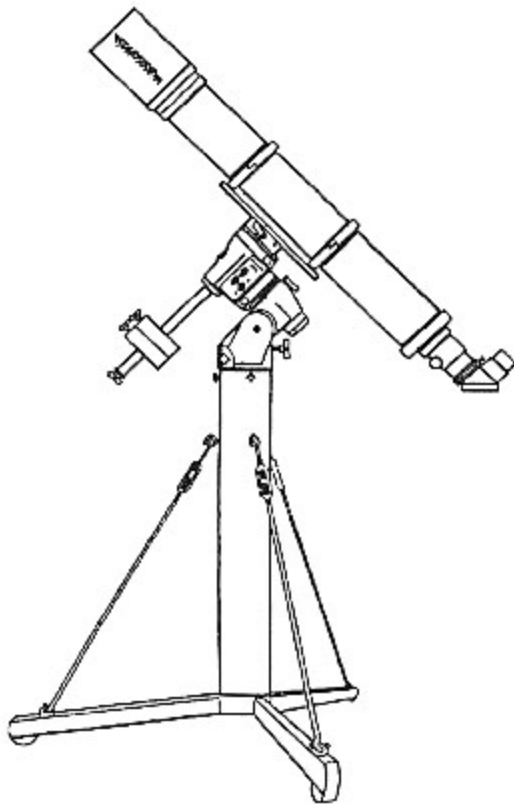
Our mount assembly department is staffed by a highly competent amateur telescope maker, now turned professional. Since he is an advanced user and observer, he understands how a precision mounting should feel and be adjusted. He brings this experience to the construction of each mounting. The components of our hand controllers are carefully soldered to the circuit boards and tested prior to shipment.

PACKING AND SHIPPING

When you receive your order, you will discover that a great deal of care was given to the safe packing of each item. It is very rare that any item is damaged in shipment.

OFFICE PERSONNEL

The office staff will be your primary source of information regarding products and prices, estimated delivery dates and the status of your order. If we can be of assistance to you in any way, please ask.



A s t r o - P h y s i c s

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APOCHROMATIC LENS DESIGN

Our objectives are APOCHROMATIC, which means that the images are essentially free of false color, both visually and photographically. We use three matched optical glasses to combine the colors of the visual spectrum into intense, sharp, concentrated images. The optics are based on the award-winning Christen Triplet design, featuring very low residual aberration in a short focal length design. Mr. Roland Christen is the founder and owner of Astro-Physics. Please refer to the attached sheet "Color Correction Curves of Astro-Physics Refractors" for a further discussion and comparison of optical designs.

The combination of the apochromatic lens design and careful, precise optical production techniques results in a clean optical system with superior contrast and light grasp. When seeing permits, powers up to 100X per inch of aperture are possible for lunar/planetary or double star work. The wide-field performance of this optical design is outstanding. Images on color film are crisp and sharp with no annoying blue halos around bright stars. Wide-field 2 inch oculars can be used for low power visual exploration of the sky. Deep sky objects stand out in stark contrast against velvet black skies.

One of the important advantages of a short focal length is that the mounting can be smaller, lighter and more compact. The result is a highly portable refractor system with superior imaging qualities, ideal for a wide variety of astronomical work from high power lunar/planetary to deep sky astrophotography.

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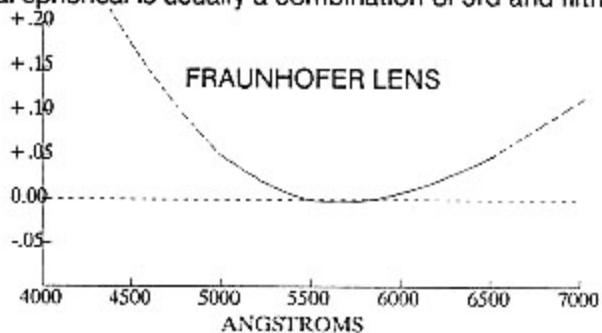
COLOR CORRECTION CURVES OF ASTRO-PHYSICS LENSES

These charts compare the color correction of the Astro-Physics lenses with achromats and fluorites. The amount of color seen visually increases directly with lens diameter and decreases with longer focal ratios. Generally for lenses longer than f8 in the 4 to 8 inch aperture range, the color error is not troublesome if it's less than .05% of the focal length. While color correction is the largest aberration, some lens designs have inherent higher order aberrations such as sphero-chromatism and zonal spherical aberration. These aberrations can also affect the sharpness and contrast of a lens. Lenses with sphero-chromatism are undercorrected for spherical aberration in the red waves, and show overcorrection in the blue and violet waves. Zonal spherical is usually a combination of 3rd and fifth order aberrations. These high order aberrations may show up as zones and turned edge, and in some cases they can be brought under control only with much difficulty, even by a skilled optician.

The following charts show the color error over the principal wavelength range, and highlights the useful visual spectral range of each lens.

FRAUNHOFER DOUBLET ACHROMAT

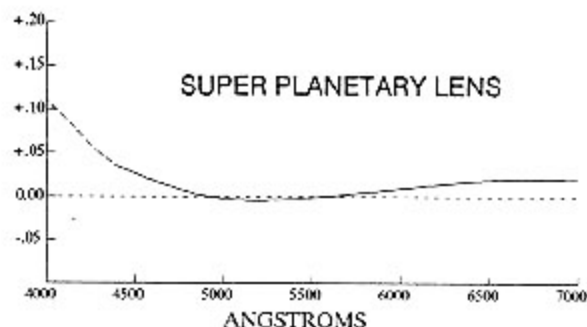
The standard doublet achromat has undergone little change since its invention. Secondary color error is about the same regardless of the combination of crowns and flints used. Higher order aberrations are usually very well corrected in the longer focal ratios. In small apertures and long focal ratios, the achromat shows little color, and is capable of good definition and contrast.



The reduction or elimination of secondary color requires an abnormal dispersion glass as one element in the optical system. The first practical apochromat was designed and built by Dennis Taylor over a century ago. His combination of Boron Flint glass and two normal glasses resulted in an f18 airspaced lens that had "sensibly perfect" color correction. These first triplets could only be made in long focal ratios because the glass was not very abnormal, and the elements required steep curves on the inner faces. Astro-Physics apochromat objectives all use a modern Boron Flint glass as the abnormal dispersion element. The two outer elements are chosen so that the overall combination is free of coma, spherical aberration and certain higher order aberrations. This allows us to put only spherical surfaces on all the elements and results in a very smooth overall figure.

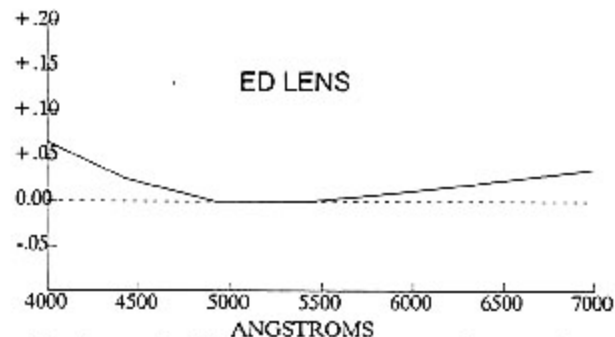
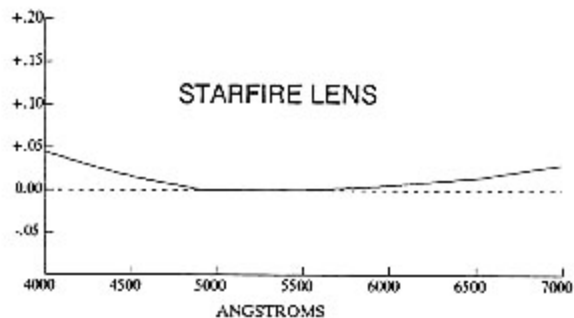
SUPER PLANETARY TRIPLET APOCHROMAT

This design meets the highest requirement for definition and contrast in a planetary lens. In a 6" F12 version, secondary color essentially vanishes in the visual spectrum, and the higher order zonal aberrations are insignificant from C to F (6563 to 4861 A). The design is a classic apochromat with three zero crossings where three colors come to the same focus. The lens is also free of coma, and can cover its own diameter when used with a suitable field flattener.



STARFIRE TRIPLET APOCHROMAT

By using an abnormal dispersion crown glass, the violet color can be substantially reduced. Star images show intense white Airy discs. The Moon and Planets show no false colors at any power. The design can be made as fast as F8 - F9 which makes them ideal for astro-photography. The Starfire design makes it possible to construct very high performance portable refractors.



ED DOUBLET APOCHROMAT

The first calcium fluoride apochromat lens was designed by Ernst Abbe a century ago. Since then this apochromat system has been rediscovered numerous times. Mike Simmons came up with the first well designed doublet using Calcium Fluoride as the crown element. This material is too expensive for practical lenses, but the new Fluoro-Phosphate (ED) glasses are less costly and offer the same performance. ED lenses are usually designed with the flint leading to protect the very soft crown element. Recent developments in ED glass technology have led to improved durability and resistance to weathering. These glasses are much superior to calcium fluoride crystal and allow the construction of high performance doublet apochromats.

ASTRO-PHYSICS

TRAVELLER 105 S EDT REFRACTOR

Imagine a refractor with a 105mm (4.1") aperture, focal ratio of f6, in a tube assembly that has an overall length of 19"! The Traveller 105 S EDT is the culmination of years of optical research aimed at developing a very fast and portable telescope that will allow you to enjoy sharp, high contrast images wherever you go. The 105S EDT has a fully machined tube assembly with a permanently aligned lens cell. Its construction is extremely rugged to allow it to withstand all the handling that is typical of airline travel. The lens uses a special new Super ED glass that allows colorfree performance at the

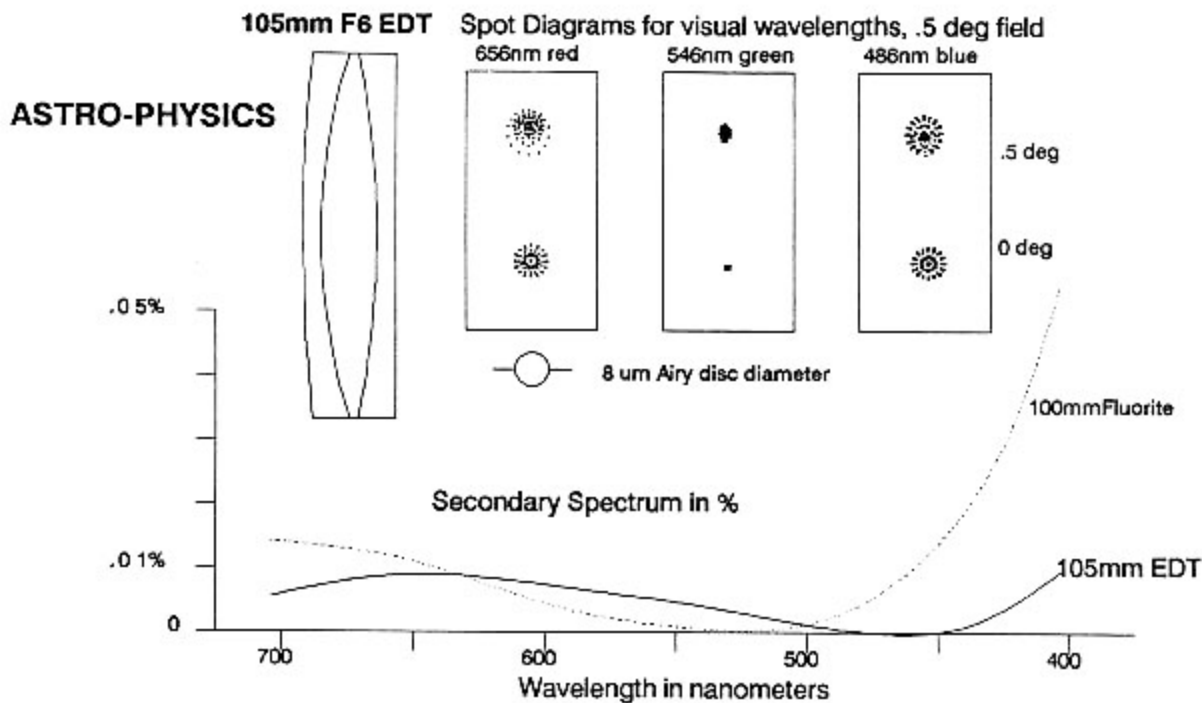


F6 focal ratio. Images of stars and planets are presented in their natural colors, and daytime objects appear sharp and contrasty without annoying purple fringes. This telescope is an awesome performer both at night and during the daytime using powers as low as 12x or as high as 400x. Of course the 105 S EDT is a natural for photography. Accessories allow you to shoot at f4, f6 or f12 with you favorite 35mm camera, or for super resolution you can couple a Pentax 6x7 camera body to the giant built-in focuser. Whether traveling to exotic eclipse locations, your favorite camping spot, bird watching expedition or just into your backyard; this little gem will provide you with hours of observing pleasure.

We invite you to compare the optical performance and mechanical construction of any other scope of comparable size on the market today. You will find that the Astro-Physics Traveller 105 S EDT is the finest, most versatile, yet rugged scope of its size class.

The optical design of the 105mm S EDT objective consists of a positive element of Super E.D. glass surrounded by two matching hard crown meniscus lenses. The two outer elements are chosen so that the overall combination is free of coma, spherical aberration and other higher order aberrations. All surfaces are spherical, which results in a very smooth overall figure. Under steady viewing conditions, you will see a hard white Airy disc at focus surrounded by the first diffraction ring. Inside and outside of focus, you will see an evenly illuminated, expanded disc with concentric Fresnel rings, with the outermost ring brighter and wider than the rest. Besides having ideal optical characteristics, the S EDT objective is significantly lighter than our older designs and the settling down time is also improved. On most nights, the lens is ready to go in 10 to 15 minutes and, even in sub-freezing conditions, it rarely takes more than 45 minutes to stabilize.

The mechanical construction of the Traveller is designed to be completely trouble free and permanently aligned. Its gorgeous tube assembly is precision machined in our shop with the most modern CNC equipment available. There are no fragile die casts in this telescope. Our expert craftsman transforms solid, aircraft quality aluminum into a fully baffled tube assembly with no less than 12 knife edge baffles in the focuser drawtube alone. We have endeavored to achieve the highest absorption of stray light possible to give you the maximum contrast. The black anodized exterior finish of the tube and dewcap will retain its deep, lustrous beauty forever. You will appreciate the unique design and fine craftsmanship of this telescope.



Color correction : Less than .01% focus variation from 706nm to 405nm.

Clear aperture : 105mm (4.13")

Focal Length : 610mm (24")

Resolution : 1.1 arc seconds

Magnification range : 12x to 400x

Tube assembly : Black anodized, 19" aluminum tube, fully baffled, permanently aligned cell construction, engraved focuser

Focuser type : 2.7" ID Astro-Physics rack & pinion focuser, 4.5" travel; 2" and 1.25" adapters; 2.5" extension

Telescope Length : 48 cm (19") with dewcap fully retracted

Tube Weight : 4 kg (9 lbs)

35mm prime focus field : 2.25 x 3.2 degrees @ f6

35mm Telecompressor field : 3.3 x 4.8 degrees @ f4

35mm field with 2x Barlow : 1.1 x 1.6 degrees @ f12

6cm x 7cm Photographic field : 5.6 x 6.6 degrees @ f6

FEATURES OF THE OPTICS

- Very high corrections of spherical and chromatic aberrations
- Visual and photographic focus is identical, eliminating the need for light absorbing filters
- Clear, colorfree glass types result in brighter, more contrasty images
- Stunning lunar / planetary and deep sky views
- Near ideal focal ratio for good deep sky astrophotography
- High resolution optics is a good match for fine grained Technical Pan emulsions.

FEATURES OF THE TUBE ASSEMBLY

- Reversing dewcap slides over cell for storage
- Fully baffled tube and focuser assures highest contrast
- Giant 2.7" focuser allows coverage of 6 x 7 formats
- Beautifully machined parts and expertly finished in hard black anodize
- 2" and 1.25" adapters with locking thumbscrew, threaded 2.5" extension tube
- Aluminum lens cover to protect against dust
- Sturdy foam padded carrying case

ASTRO-PHYSICS

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130mm StarFire EDT Refractor

The 130mm StarFire EDT is a very portable, lightweight refractor with a new triplet E.D. objective that is highly corrected for false color (chromatic aberration). The color error is less than .01% from 706nm to 405nm, compared to a 2 element Fluorite apochromat with .05%, and a Doublet Achromat with .45% color error over the same spectral range. In an age when Fluorite is being hyped as the best lens material for fast refractors, it is significant that Astro-Physics has developed a non-Fluorite objective with 5 times better chromatic aberration at a fraction of the cost of Fluorite. E.D. glass (E.D. stands for extra low dispersion) is a real glass, not a crystal like Fluorite. E.D. is a much harder, less fragile material with a much lower expansion coefficient than Fluorite. Unlike Fluorite, E.D. glass is not affected by atmospheric contaminants and acids. It is for these reasons that all the world's major camera manufacturers have discontinued using Fluorite in their apochromat lenses and have switched to E.D.

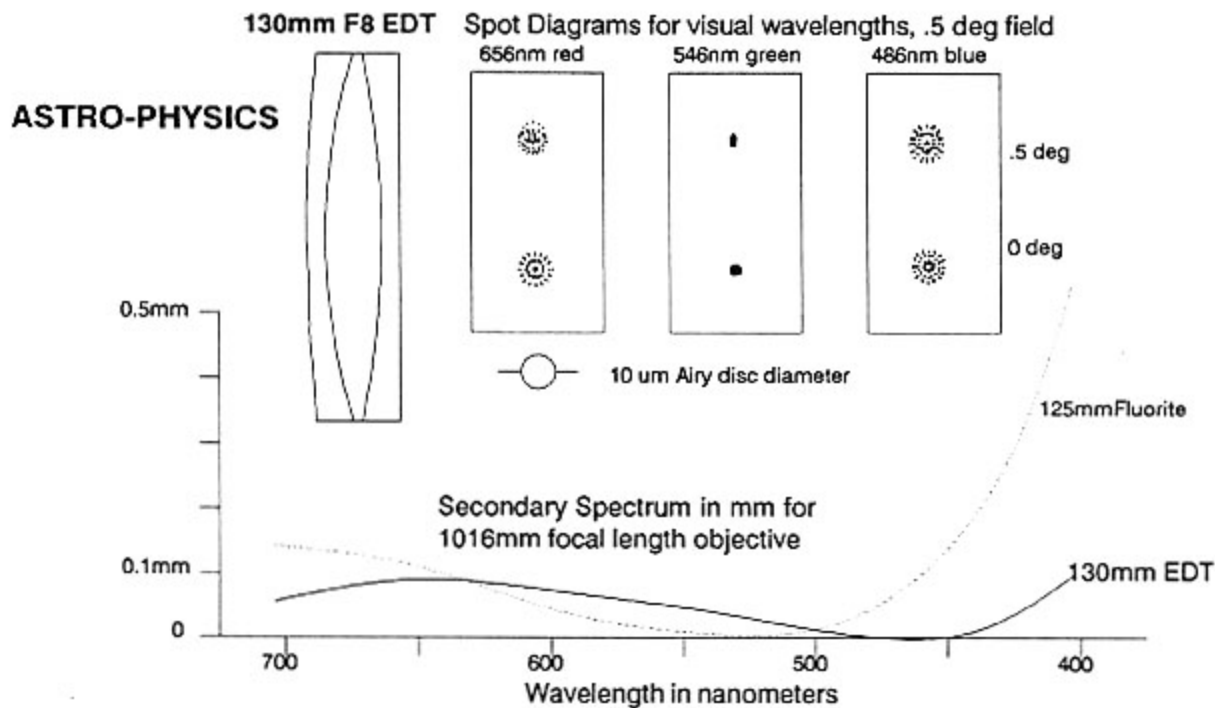
The extremely high color correction of the EDT design allows the construction of a relatively short focus objective that is superior to long focus achromats in contrast and definition of subtle planetary detail. The EDT lens is also perfectly matched to the characteristics of the fine grained Technical Pan emulsions which have their peak sensitivity at 405nm. With our matching accessories you can create impressive astrophotos on 35mm and 6x7cm film formats.

The optical design of the 130mm EDT objective consists of a positive element of E.D. glass surrounded by two matching hard crown meniscus lenses. The two outer elements are chosen so that the overall combination is free of coma, spherical aberration and other higher order aberrations. All surfaces are spherical, which results in a very smooth overall figure. Under steady viewing conditions, you will see a hard white Airy disc at focus surrounded by the first diffraction ring. Inside and outside of focus you will see an evenly illuminated, expanded disc with concentric Fresnel rings, with the outermost ring brighter and wider than the rest. Besides having ideal optical characteristics, the EDT objective is significantly lighter than our older designs and the settling down time is also improved. On most nights, the lens is ready to go in 10 to 15 minutes and, even in sub-freezing conditions, it rarely takes more than 45 minutes to stabilize.

We have also added significant improvements to the tube assembly to make it easier to transport and set up in the field. The dewcap is now reversible for more compact storage. It slides over the cell and is held in place with a thumbscrew. A metal dust cover protects the optical surface when not in use, and a foam fitted carrying case protects the tube assembly from rough handling. Of course, we have retained our superb custom focuser and fully baffled aluminum tube, as well as our unique fully adjustable push-pull cell. You will be pleased with the mechanical construction of this beautiful refractor and the way it performs optically will delight you.



130mm EDT Refractor shown on model 600 mount



SPECIFICATIONS

Color correction :	Less than .01% focus variation from 706nm to 405nm.
Clear aperture :	130mm (5.12")
Focal Length :	1016mm (40")
Resolution :	0.87 arc seconds
Magnification range :	18x to 500x
Tube assembly :	White, 5.5" aluminum tube, baffled, flat black interior, engraved push-pull lens cell
Focuser type :	2.7" ID Astro-Physics rack & pinion focuser, 4.5" travel; 2" and 1.25" adapters; 2.5" extension
Telescope Length :	914mm (36") with dewcap fully retracted
Tube Weight :	5.9kg (13 lb)
35mm photographic field :	1.3 x 2.0 degrees @ f8
35mm Telecompressor field :	2.0 x 3.0 degrees @ f5.3
35mm field with 2x Barlow :	0.7 x 1.0 degrees @ f16
6cm x 7cm Photographic field :	3.4 x 4.0 degrees @ f8

FEATURES OF THE OPTICS

- Very high corrections of spherical and chromatic aberrations
- Visual and photographic focus is identical, eliminating the need for light absorbing filters
- Clear, colorfree glass types result in brighter, more contrasty images
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- Reversing dewcap slides over cell for storage
- Fully baffled tube and focuser assures highest contrast
- Giant 2.7" focuser allows coverage of 6 x 7 formats
- Beautifully machined parts and expertly finished in hard polyurethane paint
- 2" and 1.25" adapters with locking thumbscrew, threaded 2.5" extension tube
- Aluminum lens cover to protect against dust
- Sturdy foam padded carrying case

6"f9 STARFIRE TRIPLET APOCHROMAT REFRACTOR

The Christen 6"f9 STARFIRE is a fantastic refractor that delivers the uncompromising performance of the classic long-focus instrument in a very compact and portable package. This telescope was designed on a challenge to deliver the absolute highest possible image quality for lunar/planetary observing while still remaining a truly portable instrument. The result is not only a fine planetary telescope, but also a superb deep sky instrument with unlimited photographic possibilities.

The heart of this system is a triplet lens design that virtually eliminates secondary color and higher order aberrations over the immense spectral range of 400nm to 700nm (from the edge of the U.V. to the infrared region). The lens design incorporates two special dispersion flints that are matched to the hard crown front element. The image quality, contrast and color correction is so good that it is hard to believe one is looking through a short focus refractor. At high power, the Airy discs are clean white dots with only the minutest amount of violet visible on stars such as Vega and Sirius. The moon and planets appear totally color-free at all powers.

SPECIFICATIONS:

Color correction :	Less than .05% focus variation from 706nm to 405nm (r to h wavelengths)
Clear aperture :	152mm (6")
Focal length :	1372mm (54", + -1.5") efl
Resolution:	0.74 arc seconds
Magnification range :	25x to 600x
Tube assembly :	White, 6.5" aluminum tube, baffled, flat black interior, engraved push-pull lens cell
Focuser type :	2.7" ID Astro-Physics rack & pinion focuser, 4.5" travel, 2" and 1.25" adapters, 2.5" extension
Carrying Case :	Foam fitted, vinyl covered plywood case
Telescope length :	1279mm (50") with dewcap fully retracted
Tube weight :	20 lbs.
35mm Photographic field at prime focus :	1.0 x 1.5 degrees @ f9
35mm Photographic field with Telecompressor :	1.5 x 2.2 degrees @ f6
35mm Photographic field with 2x Barlow :	0.5 x 0.7 degrees @ f18
6 x 7 cm Photographic field at prime focus :	2.5 x 2.9 degrees @ f9

6"f12 STARFIRE TRIPLET APOCHROMATIC REFRACTOR

The StarFire design has proven so popular in the past few years that we decided to offer the 6"f12 StarFire for the most discriminating lunar/planetary observer. Color correction is essentially perfect, far exceeding that obtained in even the finest achromatic doublets. Planetary contrast is crisp and sharp showing exquisite detail and natural coloration on the surface. The planets themselves are well defined disks against a black sky. Low power performance of these long focal length lenses is equally impressive. Giant wide-field oculars will show star fields and deep sky objects with high contrast just like our faster lenses do. Astrophotography is possible at f8 with the triplet telecompressor. The barlow may be used for photo-visual work at f24, and even longer focal ratios are possible with the eyepiece projection adapter.

SPECIFICATIONS:

Color correction :	Less than .05% focus variation from 706nm to 405nm (r to h wavelengths)
Clear aperture :	152mm (6")
Focal length :	1829mm (72", + -1.5") efl
Resolution:	0.74 arc seconds
Magnification range :	33x to 600x
Tube assembly :	White, 6.5" aluminum tube, baffled, flat black interior, engraved push-pull lens cell
Focuser type :	2.7" ID Astro-Physics rack & pinion focuser, 4.5" travel, 2" and 1.25" adapters, 2.5" extension
Carrying Case :	Foam fitted, vinyl covered plywood case
Telescope length :	1727mm (68") with dewcap fully retracted
Tube weight :	21 lbs.
35mm Photographic field at prime focus :	0.8 x 1.1 degrees @ f12
35mm Photographic field with Telecompressor :	1.1 x 1.6 degrees @ f8
35mm Photographic field with 2x Barlow :	0.4 x 0.6 degrees @ f24

6" f7.5 STARFIRE EDF TRIPLET APOCHROMAT REFRACTOR

This 6" f7.5 StarFire EDF was designed to be the ultimate astrograph while providing uncompromising visual performance. Outstanding photographs published in **Sky & Telescope**, **Astronomy** and various international astronomy magazines can only hint at the detail of the original prints and negatives. The 30" x40" print of the Lagoon and Trifid nebula that is on display in our showroom shows incredible pinpoint star images from one side of the print to the other with no sign of image degradation. Truly amazing! Photographic spot diameters measure 15-20 microns over a 5 degree field (4" circle). The fast f7.5 focal ratio captures elusive and faint deep sky objects easily with incredible detail. This lens has outperformed mirror type astrographs twice its size, as we had predicted.

The EDF is superb as a visual instrument as well. It is easily capable of high power observations of the moon and planets. Secondary spectrum is totally absent at any power. Deep sky views are equally impressive due to the very high transmission of the three glass types.

In the astrographic configuration, the lens is a 5 element design in 2 groups (3 elements in front, 2 in rear). The heart of the front triplet is an E.D. glass and 2 special dispersion flints. This combination totally eliminates all secondary spectrum, coma and spherical aberration. The rear group is a 2 element field flattener system that eliminates astigmatism and field curvature. In the visual configuration, the rear 2 element lens is removed and replaced with a standard visual adapter. This adapter allows all our usual accessories to be attached, as well as all standard 2" and 1.25" oculars.

The tube assembly comes fully baffled for a 5 degree 4" field. The giant 4" focuser is silky smooth and can be locked for long time exposure astrophotography. Although it is possible to attach your own custom made film holder, we have determined that the most practical camera back is the Pentax 6 x 7 medium format camera. Field coverage is 3 x 3.5 degrees. After 4 years of field research, we've chosen this camera because it holds the film critically flat without the use of special vacuum attachments. This is not the case with other, less expensive film backs. The Pentax allows the user to critically focus directly on the ground glass with a high power magnifier, assuring the highest possible resolution. Another feature is the extra large opening and minimum back distance to the film plane which minimizes the inevitable vignetting of the light in the extreme corners of the format. All the important color and black/ white films are available in the 120 format, which is not the case with large formats. It is for these reasons that we have standardized on the Pentax 6 x 7 and offer all the attachments necessary to use with the 6"EDF.

The Astro-Physics giant 4" focuser is truly versatile. The 4" ID of the drawtube will allow maximum coverage of the Pentax 6 x 7 cm negative for medium format photography. The inside of the drawtube has a series of knife edge baffles for maximum contrast. When you wish to use your 35mm camera with the Astro-Physics telecompressor for even faster exposures (f5), you can attach the 2.7" reducer and you are ready to go. The 2" and 1.25" adapters will allow you to use all of our standard accessories to maximize your visual and photographic applications.

SPECIFICATIONS:

Color correction :	Less than .004% focus variation from 405nm to 706nm (r to h wavelengths)
Clear aperture :	152mm (6")
Focal length :	1143mm (45") efl
Resolution :	0.74 arc second
Magnification range :	20x to 600x
Tube assembly :	White, 6.5" aluminum tube, baffled, flat black interior, engraved push-pull lens cell
Focuser type :	4.0" ID Astro-Physics rack & pinion focuser, 4.5" travel, 2.7", 2" and 1.25" adapters, 2.5" extension
Telescope length :	1041mm (41") with dewcap fully retracted
Tube weight :	23 lb
Field Flattener	2-element with multi-coatings
Carrying Case	Foam fitted, vinyl covered plywood case
35mm Photographic field at prime focus :	1.0 x 1.7 degrees @ f7.5
35mm Photographic field with Telecompressor:	1.5 x 2.5 degrees @ f5
35mm Photographic field with 2x Barlow :	0.5 x .85 degrees @ f15
6 x 7 cm Photographic field at prime focus :	3.5 x 3.0 degrees @ f7.5
Maximum Photographic Field :	5 degrees, 4 inch circle

STAR 12 ED APOCHROMAT REFRACTOR

We have developed an exciting new refractor based on a 2 element apochromat lens using a newly developed E.D. glass (E.D. stands for extra low dispersion) which has optical properties similar to Fluorite crystal. However, E.D. is real glass without the crystal planes of calcium fluoride materials that can absorb water in humid environments. E.D. glass is also a much harder and tougher material with a significantly lower coefficient of expansion. That means the lenses will stand up to years of use under all kinds of observing conditions. The lens design is a flint leading configuration with a very hard front element that will resist scratches from normal cleaning. Both elements are stain and water resistant. The front element is fully anti-reflection coated. As in Fluorite objectives, the rear element is left uncoated because E.D. glass cannot be subjected to the extreme temperatures required to fuse the coatings to the surface.

Our Star12 ED refractor delivers the pinpoint sharpness, clarity and high definition demanded by the perfectionist, yet is priced to appeal to the beginning astronomer. Its light weight 11 lb. package is nicely balanced and fits well on small to medium sized mountings such as our model 600 or the DX mount. The lens is a true APOCHROMAT, capable of focusing the important visual wavelengths into the Airy disc. Visually on the moon and planets, there is little or no color fringing even at the highest powers. Both Jupiter and Saturn show a wealth of detail. Double stars such as Epsilon Bootes show a clean split with plenty of dark sky between.



We have included refinements such as our custom focuser with brass locking ring, engraved lens cell, fully baffled aluminum tube, and snappy decal identifying the telescope as an E.D. refractor from Astro-Physics.

SPECIFICATIONS:

Color correction :	Less than 0.07% focus variation from 706nm to 405nm (r to h wavelengths)
Clear aperture :	120mm (4.7")
Focal length :	1016mm (40") eff
Resolution :	0.94 arc seconds
Magnification range :	18x to 470x
Tube assembly :	White, 5"aluminum tube, baffled, flat black interior, engraved lens cell
Focuser type :	2.7" ID Astro-Physics rack & pinion focuser, 4.5" travel, 2" and 1.25" adapters, 2.5" extension
Carrying Case	Foam fitted, vinyl covered plywood case
Telescope length :	1080mm (42.5") with dewcap in front of lens cell
Tube weight :	11 lbs.
35mm Photographic field at prime focus :	1.3 x 2.0 degrees @ f8.5
35mm Photographic field with Telecompressor :	2.0 x 3.0 degrees @ f5.7
35mm Photographic field with 2x Barlow :	0.7 x 1.0 degrees @ f17
6 x 7 cm Photographic field at prime focus :	3.4 x 4.0 degrees @ f8.5

ASTRO-PHYSICS 800 AND 600 GERMAN EQUATORIAL MOUNT

WITH

SBIG ST-4 CCD STAR TRACKER AND IMAGING CAMERA

One of the exciting new items in the astronomy market is the Santa Barbara Instrument Group's (SBIG) ST-4. It is a dual purpose CCD based instrument that functions as either a star tracker or imaging camera.

- **CCD Imaging Camera** - The reviews in *Sky & Telescope*, September 1990, pp. 250-255 and *Astronomy*, December 1990, pp 67-71 discussed the ST-4 capabilities as a CCD imaging camera and use with a personal computer.
- **Star Tracker** - This is the function that is most exciting to us. The CCD detector is mounted on the focuser of your guide telescope or primary telescope (if using an off-axis guider). After you select the guide star that you wish to use, the ST-4 centers the image on a pixel and holds that star in position by constantly monitoring it and sending correction signals to the telescope drive immediately. Your right ascension or declination motors will then be activated automatically to make the appropriate corrections. All of this happens in split seconds, with greater accuracy than is possible with manual guiding.

The Astro-Physics 800 and 600 mounts are ideal companions for the ST-4. The tangent arm design is particularly suited to precise photographic tracking because backlash in declination is minimized. If you are familiar with gear driven declination axes, you probably have discovered a significant amount of backlash inherent in the gear. Although the ST-4 can compensate for small amounts of backlash in declination, a long delay in reversal of direction (2 or more seconds) will reduce the ability of the unit to keep your guide star on target. The 800 and 600 mounts will track with 1 or 2 arc second accuracy.

Astro-Physics now offers a modification for our 800 and 600 German Equatorial mounts to integrate the function of the ST-4 with our hand controller. If you have ordered or plan to order one of our mountings, you may wish to consider the ST-4 modification which we can incorporate when building your hand controller. If you already own a 600 or 800 mount and plan to send it to us for modification, please give us a call so that we can plan our schedule accordingly, then send the following items :

Hand controller without cables
Cradle plate and tangent arm assembly (please do not send the entire mount!)
SBIG ST-4 - all components except the CCD camera

Tony Hallas and Daphne Mount have used the ST-4 extensively and are thrilled with its performance. Tony has remarked that his exposures of 60 minutes or more are a breeze because the human fatigue aspect is greatly reduced. Just think, after you set up your astrographic system and begin your exposure, you can take a break from the cold or mosquitos or enjoy visual astronomy with another scope. The ST-4 will keep your guide star centered on the crosshair with amazing accuracy. We believe that this autoguiding capability will encourage more amateurs to take astrophotos with long exposures on fine grain film. You will be able to record fainter detail, denser nebulosity and eliminate guiding errors.

If you would like more information about the ST-4, please contact:

Santa Barbara Instrument Group
1482 East Valley Road, Suite #601
Santa Barbara, California 93108
805-969-1851

ASTRO-PHYSICS 600 GERMAN EQUATORIAL MOUNT

The Astro-Physics 600 German Equatorial mount offers many fine features to provide superb performance in a compact, portable package. The aluminum castings were designed to enclose the worm gear and wheel, right ascension and declination motors. This protects your gears from dirt and dust, eliminates extraneous wires and provides a clean appearance

The 600 German Equatorial is constructed of the highest quality components to provide you with years of observing pleasure. All parts are machined of aluminum and stainless steel. We avoid the use of any steel or plated steel fasteners because they will deteriorate with time. This mount will not rust or bind up and will retain its appearance and function throughout the years. A truly quality instrument.

FEATURES:

- Virgin aluminum sand castings, precision hollow cast and machined for light weight and rigidity.
- Gears and motors are enclosed within the declination axis
- Precision 4" Worm Gear with + -5 arc second periodic error.
- Dual Axis Pulse Motor with 12 Volt Controller
- Large UHMW thrust bearings form ultra-stable thrust surfaces for tremendous rigidity in a small package.
- Hollow right ascension and declination shafts maximize strength at minimum weight.
- Right ascension shaft threaded for optional polar scope for quick, accurate polar alignment in the field - no more declination drift during those hour-long exposures!
- Removable stainless steel counterweight shaft for compact storage.
- Engraved setting circles with Porter Slip Ring Design; polar axis ring is driven; it follows the stars without needing to be reset each time you look at a new object.
 - Right ascension circle - 10 minute increments with 2 minute vernier
 - Declination circle - 5 degree increments with 1 degree vernier
- Fine altitude and azimuth adjustments for quickly and accurately zeroing in on the pole in the field.
- Dimensions: Distance from pier top to cradle plate - 15 inches
 - Cradle plate - length: 15", width: 6"
- Capacity: Will accommodate refractors up to 6" f9, reflectors up to 8", Cassegrains up to 10".
- Weight of equatorial head with counterweight shaft - 25 lbs.

AVAILABLE OPTIONS

Please see the accompanying information sheets for detailed descriptions of these options.

Modification to hand controller that will allow use of the ST-4 CCD Autotracker

Portable Pier - 6" diameter post; heights 46", 56" or 66"

6 Amp-hr, 12 Volt Rechargeable Battery Pack

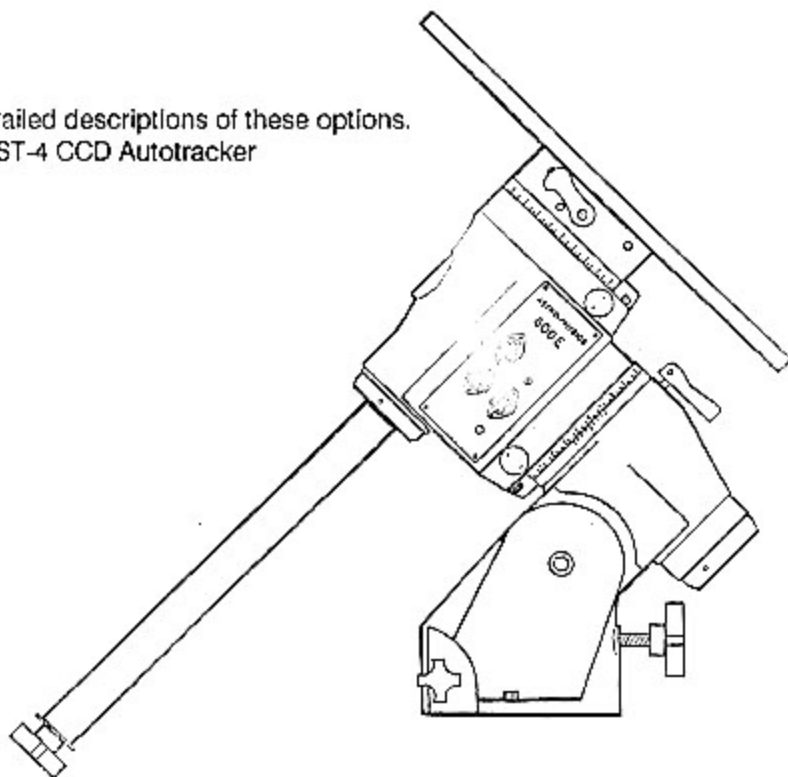
Stainless Steel Counterweights- 5 lbs., 8 lbs.

Davis and Sanford Adjustable Tripod

Polar Axis Scope with Illuminator

Hexagonal Mounting Rings

Carrying Case



ASTRO-PHYSICS 800 GERMAN EQUATORIAL MOUNT

The importance of mechanical stability in a mounting cannot be overstated. You may own a fine, high resolution instrument, but unless your mount is rock solid, you will rarely achieve the results that you want in the eyepiece or on film. The image will be subject to frequent movement, so you will not be able to perceive the subtlety of detail that would be possible if your image were steady. For astrophotography, movement in the image will result in a streak or blur on your negative.

Our mountings are engineered to be steady even in gusting winds. Both axes respond to fingertip pressure with no hint of backlash. Built-in clutches can be disengaged for ultra-smooth sweeping or locked for astrophotography. The thrust bearing design allows for compactness, yet this mount will carry large telescopes with ease. Gear accuracy is also exceedingly important. Our gears were specifically designed for precision tracking. The fine pitch gears on our drives are cut with Class AA hobbs on a highly accurate gear cutting machine. With easy polar alignment capabilities, it is possible to take excellent astrophotos with minimal or no guiding with most telescopes.

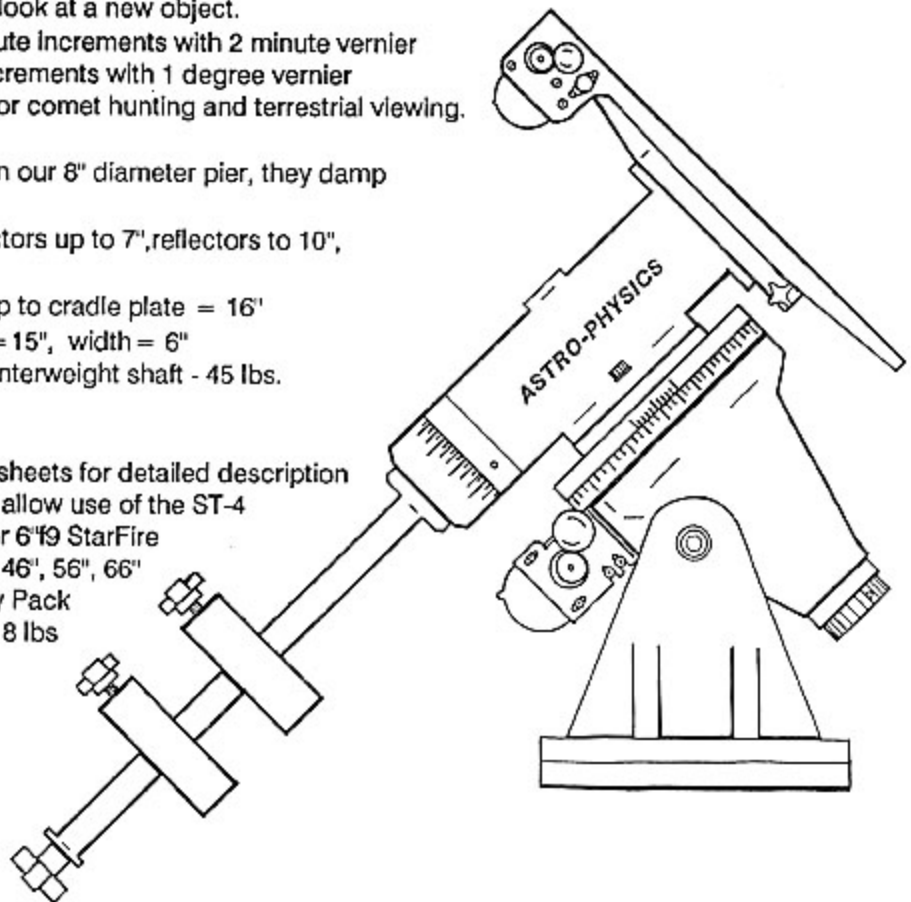
FEATURES:

- Virgin aluminum castings, precision hollow cast and machined for light weight, yet provides rigid performance.
- Precision 6" Worm Gear with ± 5 sec periodic error.
- Dual Axis Pulse Motor Drive with 12 Volt Controller
- Massive tapered Timken roller bearings form ultra-stable thrust surfaces for tremendous rigidity in a small package.
- Hollow 1.5" stainless steel right ascension and declination shafts maximize strength at minimum weight
- Right ascension shaft threaded for optional polar scope for quick, accurate alignment in the field - no more declination drift during those hour-long exposures!
- Removable 1.125" stainless steel counterweight shaft for compact storage.
- Polar and Declination axes come apart quickly for light-weight easy handling.
- Fine altitude and azimuth adjustments for quickly and accurately zeroing in on the pole in the field
- Engraved setting circles with Porter Slip Ring Design; polar axis ring is driven; it follows the stars without needing to be reset each time you look at a new object.
 - Right ascension circle - 10 minute increments with 2 minute vernier
 - Declination circle - 5 degree increments with 1 degree vernier
- Converts to an alt-azimuth mount for comet hunting and terrestrial viewing. Imagine, two mounts in one!
- When most scopes are mounted on our 8" diameter pier, they damp out in 1-2 seconds.
- Capacity: Will accommodate refractors up to 7", reflectors to 10", Cassegrains to 12".
- Dimensions: Distance from pier top to cradle plate = 16"
 - Cradle plate - length = 15", width = 6"
- Weight of equatorial head with counterweight shaft - 45 lbs.

AVAILABLE OPTIONS:

Please see accompanying information sheets for detailed description

- Modification to hand controller that will allow use of the ST-4
- Davis and Sanford Adjustable Tripod for 6" StarFire
- Portable Pier - 8" diameter with heights 46", 56", 66"
- 6 Amp-hr, 12 Volt Rechargeable Battery Pack
- Stainless Steel Counterweights - 5 lbs., 8 lbs
- Polar Axis Scope with Illuminator
- Hexagonal Mounting Rings
- Carrying Cases



ELECTRONICS FOR 600 AND 800 GERMAN EQUATORIAL MOUNTS

Synchronous or Stepper? The high-tech solution to modern telescope drives is now the stepper or pulse motor. Although the synchronous motor is a reliable way to achieve smooth, accurate guiding, the modern high-resolution stepper has definite advantages in controllability and power consumption. A stepper can be operated from a 12 volt source (with the proper electronic circuit), which eliminates the extra conversion to 110 Vac that a synchronous motor needs. This results in a smaller controller with far less power loss. The controller is so small that it can be put into the normal remote push button chassis with no separate power converter box needed. Unlike a synchronous motor, a stepper can be driven very slowly, or very fast, or can be instantly reversed to accomplish guiding and slewing functions all in one device. The extra convenience of the added controllability of the stepper system will be appreciated by casual observers and serious astrophotographers alike. Some mount manufacturers have given the stepper motors a bad name due to improper application. Too slow a stepping rate can cause stars to vibrate at high powers. Our steppers are driven at high pulse rates, effectively eliminating this problem. Our pulse motor drives are every bit as smooth and much more responsive than synchronous drives.

DUAL AXIS PULSE MOTOR WITH 12 VOLT CONTROLLER:

Designed for the utmost in convenience for the serious astrophotographer, this drive system operates from a portable battery pack or the cigarette lighter of your automobile. The palm-sized controller is a complete command center for all the guiding functions you will need for successful astrophotography. High resolution stepper motors deliver 150 inch-oz. torque with a fraction of the power required by normal synchronous motor-drive corrector systems. Included in the hand control is a variable drive rate for lunar/solar and sidereal tracking. A reversing switch for declination allows the 4 button controller to be properly oriented on both sides of the meridian. The fine-guiding rate is designed for accurate tracking of guidestars at very high powers. The slew rate is designed for leisurely cruising on the lunar surface or for rapidly centering objects in the field of view. Both guiding and slewing respond crisply to push button commands without hesitation, delay or backlash, thanks to the high resolving rate of the stepper motors. A built-in reticle control allows you to adjust the brightness of the guiding reticle of your guidescope during an exposure.

FEATURES:

- Dual high-resolution stepper motors for R.A. and Dec.
- Palm-size controller, 4"x 3"x 1.5" inches
- Power consumption: 0.25 amps @ 12 volts
- 4 Push buttons arranged in east-west, north-south configuration
- Adjustable drive rates for solar, sidereal, and lunar
- Toggle switch for guiding or slewing in both axes
- Toggle switch for reversing declination buttons
- Adjustable brightness control for guiding reticle
- Southern hemisphere: reversed R.A. on request

6 AMP-HR, 12 VOLT PORTABLE BATTERY PACK WITH RECHARGER:

This portable battery pack is the ideal power source to have when you are observing in the field. Just plug the connector into the base of your mount to power your drives and electronic accessories. This unit is completely maintenance free, safe and can be operated in any position. The battery pack is easily recharged by the self-contained charger which inserts into the battery pack and plugs into a standard wall outlet. Since it has no memory, it will recharge fully every time without a loss of capacity (unlike ni-cad batteries) The battery pack comes with a handsome carrying case, shoulder strap and self-contained battery charger.

HEXAGONAL MOUNTING RINGS

These mounting rings attach to the cradle plate of the mount to support your tube assembly. The unique hexagonal ring design allows you to support your guidescope, camera or other accessories requiring a flat mounting surface. These rings feature a hinged assembly with thumbscrew closure. They are felt-lined to prevent marring of your tube. The following sizes are available:

- | | |
|--|--|
| 5.0" Mounting Rings - for 5.0" tube diameter | 5.5" Mounting Rings - for 5.5" tube diameter |
| 6.0" Mounting Rings - for 6.0" tube diameter | 6.5" Mounting Rings - for 6.5" tube diameter |
| 7.0" Mounting Rings - for 7.0" tube diameter | |

STAINLESS STEEL COUNTERWEIGHTS

Our counterweights are precision machined from 303 stainless steel. A bronze sleeve is press fit into the center hole to prevent marring of your counterweight shaft as you adjust the position of your counterweights. The weights slip easily onto the counterweight shaft and are secured in position with a large hand knob. Keep in mind that you can adjust the position of the weights to counterbalance varying loads, however, the addition of a guidescope, camera and other heavy accessories may necessitate an additional counterweight. If you plan to mount your catadioptric, Newtonian or any other scope, figure that you will need a counterweight total approximately 80% of your tube assembly weight. We recommend the following combinations of weights for our refractors:

- | | |
|--|--|
| 4" f8 StarFire Tube Assembly - one 8 lb. weight | 5" f8 StarFire Tube Assembly - two 5 lb. weights |
| 6" f9 StarFire Tube Assembly - two 8 lb. weights | 6" f12 Tube Assembly - two 8 lb., one 5 lb. weight |
| 7" f9 StarFire Tube Assembly - three 8 lb. weights | |

POLAR AXIS SCOPE WITH ILLUMINATOR

This polar axis scope will allow you to quickly align your mount on the pole stars to ensure greater tracking accuracy throughout your observing session. The unit screws into the base of the polar axis. The illuminator can be attached to the polar axis scope enabling you to see the reticle clearly. On-off control and adjustable intensity. Operates with batteries.

SPECIFICATIONS OF POLAR AXIS SCOPE:

Magnification - 5 x
 Achromatic objective - 20mm
 Eyepiece - K22mm (Diopter adjustable)
 Field of view - 8 degrees

SPECIFICATIONS FOR ILLUMINATOR:

Rated Voltage - 3VDC
 Power consumption - 16mA
 Light - red LED
 Battery - Button type: two Varta V76 PX or equivalent

CARRYING CASES FOR 600 AND 800 GERMAN EQUATORIALS

These carrying cases will allow you to transport your mounting in a protective and stylish manner. The polar axis, declination axis, cradle plate, hex rings and counterweight shaft all disassemble quickly for packing. Your mount will not rattle around on the back seat any longer! Please note that these cases were not designed for airline transport.

The 800 mount is packed in a set of two cases. One case holds the polar axis assembly and the second case holds the declination axis with the cradle plate, mounting rings, hand control, power cords, polar axis scope and two counterweights

The 600 mount case was designed to carry the entire 600 Equatorial Head as well as the hand control, power cords and one counterweight.

	dimensions L x W x H	weight of case w/o mount	weight of case w/mount parts (excluding counterweights)
800 Polar Axis Case	13" x 12" x 17"	14 lbs	45 lbs
800 Declination Axis Case	18" x 18" x 11"	16 lbs	36 lbs
600 Mount Case	22" x 14.5" x 9"	12 lbs	41 lbs

PORTABLE PIER

This pier mounting features a unique tension design that combines rugged construction with light weight while eliminating flexure and annoying vibrations. Legs and tension rods attach without hardware, allowing field assembly in seconds. Tension rods are designed to not interfere when the telescope is pointed at the zenith. Turnbuckles allow you to tighten the rods and are the secret to the firm base of support that this pier provides. The center posts are constructed of aluminum tubing with a steel base bolted firmly in place.

SPECIFICATIONS:

	Pier for 800 Mount			Pier for 600 Mount		
	46"	56"	66"	46"	56"	66"
height of pier	8"	8"	8"	6"	6"	6"
diameter of post	24"	24"	24"	24"	24"	24"
length of legs	62"	72"	82"	56"	66"	76"
cradle height	13 lbs	15 lbs	17 lbs	8 lbs	9 lbs	10 lbs
weight of pier post	21 lbs	21 lbs	21 lbs	10 lbs	10 lbs	10 lbs
weight of pier base	6 lbs	6 lbs	6 lbs	5 lbs	5 lbs	5 lbs
weight of each leg	4 lbs	4 lbs	4 lbs	4 lbs	4 lbs	4 lbs
weight of 3 struts	56 lbs	58 lbs	60 lbs	37 lbs	38 lbs	39 lbs
total weight assembled						

DX GERMAN EQUATORIAL MOUNT

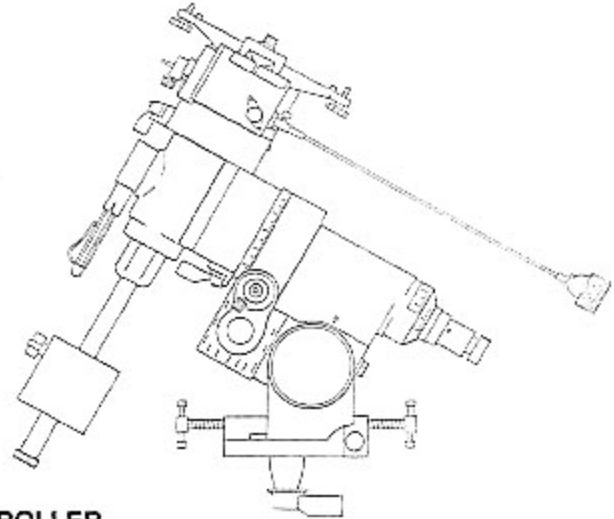
DX GERMAN EQUATORIAL HEAD WITH DUAL AXIS PULSE MOTOR

The DX mount is recommended for refractors up to 5.5" diameter as well as 8" SCTs and other scopes in the same size range. This mount is rugged and stable enough to make astrophotography and high power observing possible, without sacrificing true portability. The equatorial head is equipped with dual axis pulse motors, setting circles, fine azimuth and altitude adjustments, slow motion controls on flexible shafts, worm gears in both declination and polar axes and an 8 lb. counterweight. It features a high quality brass gear train with 7 arc second accuracy, and a built-in polar alignment scope with penlight illuminator that allows you to quickly align your mount on the pole stars to ensure greater tracking accuracy through out your observing session.

Following the motions of the stars is easy with the pulse motor drive. The motor is a high resolving type with fine steps for smooth motion at very high powers. A portable battery pack that operates with C cell batteries is included. The hand controller has buttons for reversing, stopping and 16x speed increase. It operates at sidereal rate only. Changes from Northern to Southern Hemisphere with the flip of a switch.

SPECIFICATIONS:

Polar axis shaft.....	1.66" diameter steel
Declination axis shaft	1.38" diameter steel
Polar axis gearing	144 tooth brass gear set
Periodic error	7 arc seconds
Declination adjustment.....	continuous 360 degree
Alignment adjustment.....	built-in polar axis scope, illuminator
Manual adjustment	flexible cables in both axes
Quartz Stepping Motor	
Rated voltage	7.5V to 12V DC
Battery	Six C Cell batteries
Power consumption	480mA
Weight of controller.....	6 oz.
Equatorial head weight.....	18 lbs.



SKYSENSOR 3 MICROCOMPUTER TELESCOPE CONTROLLER

If you observe from light polluted skies most of the time, as we do, the Skysensor is for you. Our suburban skies are so bright that only a few bright stars are visible. Star hopping is nearly impossible.

The Skysensor 3 is also great for beginners and busy people. Once you learn a few prominent stars, you can find any object (within the capabilities of your telescope, of course). You will be less frustrated and feel like a pro in no time. As you gain experience and confidence, you will learn your way around the sky. If your time is limited to an hour or two of observing now and then, you will derive great satisfaction from the quick setup of the DX mount and ease of finding your target objects with the Skysensor 3.

The Skysensor 3 is an integrated unit that serves as a hand controller with digital setting circles and timer for astro-photo exposures. Once you are polar aligned and inform the computer of your location and time, you can locate any object by entering the code number (from the Star Data table included), NGC, IC or Messier object numbers or the coordinates from your star atlas. The motor drive will slew to the correct position and the object will be ready for you to view. There is no limit to the number of objects that can be found since the coordinates from your star atlas will allow you to locate any position. We have found the Skysensor 3 to be very easy to use, accurate and a lot of fun.

Major Functions and Features of Skysensor 3

- The celestial objects stored in the memory of the Skysensor are based on the data of the year 2000. All other objects can be found by entering the right ascension and declination coordinates.
 - 285 fixed stars (brighter than magnitude 3.5)
 - 472 nebulae and clusters including all the Messier objects and NGC objects brighter than magnitude 10.
- The Skysensor displays the right ascension and declination coordinates of the direction that the telescope is pointing.
- Skysensor displays the right ascension, declination, celestial object number, magnitude, and classification of the celestial object of the search.
- The local time and universal time can be alternately displayed.
- The telescope can be moved to any desired direction with the pushbuttons at 0.5x, 2x or 32x normal guide speed.
- It is usable in both the Northern and Southern Hemispheres.
- The Skysensor is equipped with a red screen illuminator and map lamp with adjustable brightness control.

OPTIONAL POWER CORD

We offer a power cord that will allow you to operate your DX mount with a 12 volt battery or through the cigarette lighter of your car. Since the repeated purchase of C cell batteries is expensive and disposable batteries are an environmental concern, we suggest that you use a 12 volt rechargeable battery or your car battery to supply your power. Also, there is nothing more frustrating than finding out that your C cells have worn out in the middle of your observing session miles from home.

COUNTERWEIGHTS

The painted steel counterweights slip easily onto the counterweight shaft and are secured in position with a hand knob. One 8 lb. counterweight is supplied with the DX mount, you may need additional weights to balance your scope. Weights are available in 4,6,8 lb. sizes. We recommend an additional 6 lb. counterweight for the Star12ED and StarFire 130EDT.

ADJUSTABLE WOOD TRIPOD FOR DX

Height: Extends from 30"-40" maximum recommended height is 40"
Folded dimension: maximum diameter is 8.5", collapsed length is 34"
Material: Wood and painted steel
Weight: 16 lbs.

Advantages: Assembly is quick and easy. Compact when collapsed. Shelf handy for accessories. Can adjust legs to compensate for hilly observing site.

Disadvantages: Rather short for most people. Wide base to maneuver through doors. Shelf of tripod must be removed to collapse legs inward for transport (this is an inconvenience for all tripods with shelves). The more points of adjustment on any tripod, the less stable at maximum extension, however is quite stable at lowest height.

FIXED HEIGHT WOOD TRIPOD FOR DX- We recommend this tripod for most applications.

Height: 40.5"-43.5", slight adjustability depending on position of shelf, legs are not adjustable
Folded dimension: maximum diameter is 8.5", length of legs 45"
Material: Wood and painted steel
Weight: 14 lbs.

Advantages: Taller and more stable than adjustable wood tripod. Assembly is quick and easy.

Disadvantages: Wide base to maneuver through doors. Shelf of tripod must be removed to collapse legs inward for transport (this is an inconvenience for all tripods with shelves). Cannot adjust length of legs to compensate for hilly observing site.

PORTABLE PIER WITH DX ADAPTER

Diameter of pier post: 6"
Height: available in 46", 56" or 66" model, non-adjustable
Material: Black painted steel base and legs, black painted aluminum post
Weight: assembled 46" pier = 38 lbs., 56" pier = 40 lbs., 66" pier = 42 lbs.

Advantages: Our piers are the most rigid and sturdy on the market today, the best choice for astrophotography. Sets up quickly without tools.

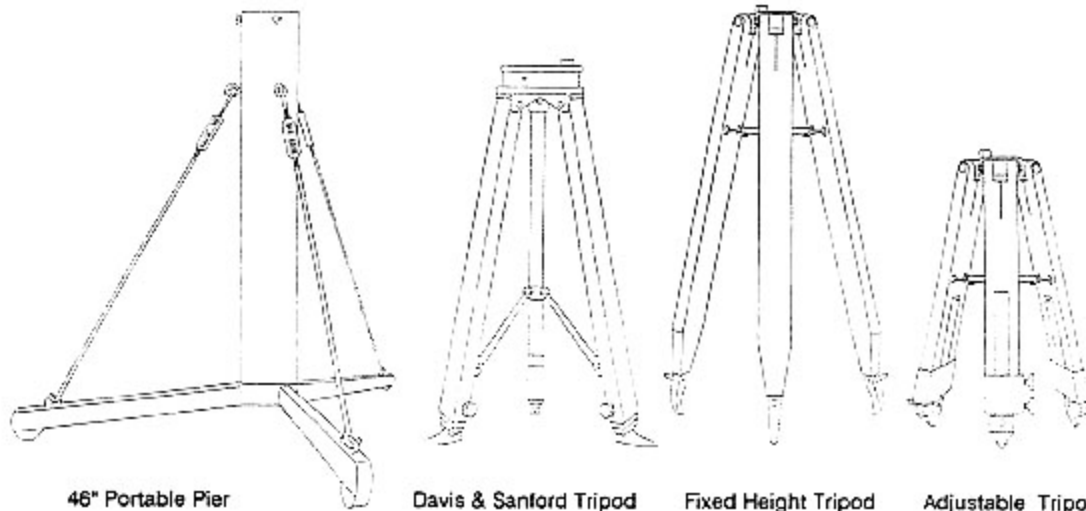
Disadvantages: This is the heaviest option. No shelf for accessories. Wide base to maneuver through doors.

SHORT DAVIS & SANFORD TRIPOD WITH DX ADAPTER

Height: extends from 29"-51", however maximum recommended height is 45"
Folded dimension: maximum diameter is 6.5", collapsed length is 34"
Material: Black anodized aluminum, black painted aluminum castings
Weight: 11 lbs.

Advantages: Light weight alternative. Folds up very compactly and is recommended for people who plan to transport their equipment as airline baggage for observing in exotic locations (or on a business trip). Legs fold inward so that you can maneuver through doors more easily.

Disadvantages: We prefer tripods that are sturdier for general use. No shelf for accessories.

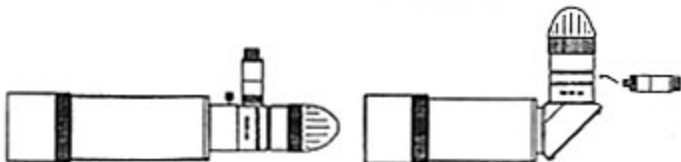


ACCESSORIES

8x50 RIGHT-ANGLE OR STRAIGHT-THROUGH FINDERS WITH ILLUMINATED RETICLE

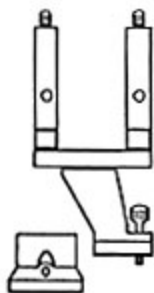
Our imported finders feature a unique eyepiece with crosshairs in the center of the field which can be illuminated with the matching self-contained, battery-powered LED. The 1.25" diagonal and eyepiece provide a wide field of view to assist you in locating your favorite objects.

Both finders are black and include a dustcover for the lens and a built-in dewcap. The right angle finder has a rubber eyecup and the straight through model includes a dustcover for the eyepiece. The rheostat control on the illuminator allows you to control brightness of the reticle. You will really appreciate the handy quick release finder bracket which is described below.



QUICK RELEASE FINDER BRACKET

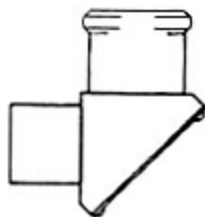
The quick release finder bracket was designed by Astro-Physics to make your life easier. Now, you can attach and detach your finder in seconds while retaining the alignment. The base of the bracket mounts onto the predrilled holes of your Astro-Physics refractor. The remainder of the assembly with the finderscope slips into the groove of the base bracket and tightens quickly with a thumbscrew. Now you are ready to go! There are no mounting screws to get lost in the grass or snow and your fingers won't freeze as you struggle with tools. The die cast mounting bracket includes fine adjustment screws with nylon tips to help protect the finish of the finder. This accessory is a must!



You may even want to consider the purchase of extra bases that you can mount permanently on your other telescopes. This will allow you to use the same bracket and finder interchangeably.

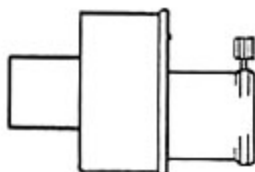
1.25" AMICHI PRISM DIAGONAL

This right-angle diagonal contains a roof prism erecting system which allows normal orientation of the subject in your eyepiece. No more inverted or upside-down images! Terrestrial viewing is also more enjoyable when using the Amichi or porro prism diagonal with your favorite eyepiece. Amichi prism diagonals are not recommended for astronomical use.



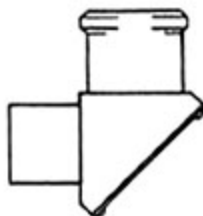
1.25" PORRO PRISM DIAGONAL

The porro prism diagonal provides straight-through viewing. Image orientation of the subject in your eyepiece is normal so it is easy to compare the star fields in your eyepiece with your star charts. Also recommended for daytime nature use of your refractor when straight-through viewing is preferred. Porro prism diagonals are not recommended for astronomical use.



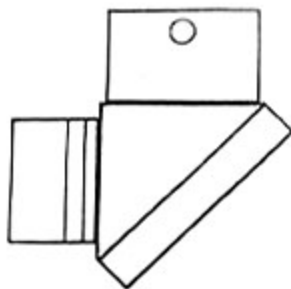
1.25" PRISM DIAGONAL

Right-angle diagonal prisms are fully coated and accept 1.25" eyepieces. Image orientation when used with a refractor is right side up with left/right reversal. Prism diagonals are not recommended for fast (f6) refractors.



2" MIRROR DIAGONAL

If you own or plan to add the popular 2" widefield eyepieces to your collection, you will need a high quality 2" diagonal. This precision diagonal can also be used with 1.25" eyepieces when used with an adapter. Please note that while the adapter is NOT included with the purchase of the diagonal, you can either use the 1.25" adapter that is included with our 2.7" Astro-Physics focuser or purchase it as a separate item.



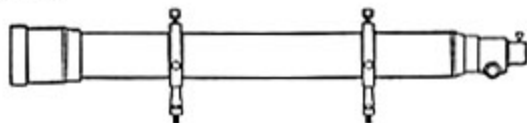
PIGGYBACK CAMERA BRACKET

Attach this bracket to your favorite 35mm camera, then screw to the predrilled rings on the top of the hex rings. The unique micro-adjust knobs allow you to frame star fields easily in 2 axes.



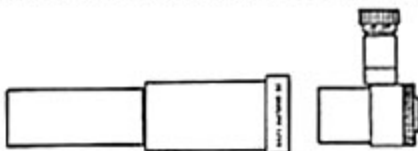
80 x 900 mm GUIDESCOPE

For serious astrophotography, a full 80mm (3") of aperture provides bright star images to facilitate guiding. Our imported guidescope includes a fine achromatic lens coupled with a smooth 1.25" helical rack and pinion focuser with a full 5.5" of travel. Two half-inch wide aluminum bands are attached to the optical tube in order to protect the finish from marring. The guidescope rings (4" I.D.) are mounted onto these aluminum bands and the three alignment thumbscrews are adjusted to position the scope. A dewcap and dustcover are included. You will need to purchase a 1.25" diagonal if you do not wish to view straight through. For manual guiding, we suggest a 12.5mm illuminated eyepiece and 3x barlow.



12.5mm ILLUMINATED EYEPIECE:

This 1.25" illuminated orthoscopic eyepiece will allow you to keep your guidestar in the center of your eyepiece. When illuminated, the crosshairs of this reticle stand out in stark contrast against the black sky allowing you to keep your star in the center of the field with ease. The etched glass double cross hair reticle includes a diopter adjustment to allow focusing of the eyepiece onto the reticle pattern. This feature compensates for individual eye variation. The self-contained battery unit provides a compact power supply. Standard filters can be used in the threaded barrel.



3x BARLOW:

Increase the power of your eyepiece with this 1.25" barlow. A great addition to your guiding equipment.

ASTRO-PHYSICS 2.7" FOCUSER

For the amateur who wants a smooth, yet solid focuser, we manufacture our own model of high quality components. Our focuser features a drawtube of 2.7" inside diameter which allows the avid astrophotographer to use a medium format camera to capture images in a 2.25" x 2.25" format with minimal vignetting. The helical rack and pinion provides ultra-smooth motion for precision focusing. Our knurled aluminum knobs were designed with comfortable, firm handling in mind. The adapter thumbscrews are substantial and easy to grasp.

Brass locking rings are an important feature of our focuser. We realize that many of our customers use a variety of heavy and expensive accessories including 2 lb. eyepieces, 35mm and medium format cameras, binocular viewers, etc. So, we designed our focuser with recessed brass locking rings at each thumbscrew location. As you tighten the thumbscrew, the brass locking ring clamps onto the part that has been inserted. Consequently, your focuser drawtube, 2" accessories and 1.25" accessories are held securely in place. As an added advantage, the brass will not mar the surface of your accessories.

This focuser is included with all of our StarFire refractors. The 2.7" focuser is a first class choice for the do-it-yourselfer who takes pride in constructing his own tube assembly.

FEATURES:

- All components are machined of high quality aluminum. Housing is black anodized.
- Brass locking rings to secure focuser drawtube, 2" and 1.25" accessories.
- 2" adapter is aluminum, black anodized, screws into focuser tube, brass locking ring, thumbscrew.
- 1.25" adapter is aluminum, black anodized, slips into 2" adapter or 2" diagonal, brass locking ring, thumbscrew.
- Inside diameter of focuser draw tube is 2.7"
- Focusing travel with the 2" adapter is 4.4"
- Focusing travel with telecompressor is 5.0"
- Overall length of the focuser when fully racked in with 2" adapter is 4.8"
- Overall length of the focuser when fully racked in with 1.25" adapter is 5.25"

FOCUSER EXTENSION

Our focuser extension tube screws securely into the focuser drawtube of the Astro-Physics 2.7" focuser and accepts 2" accessories. This extension will provide you with 2.5 additional inches of focuser travel necessary for straight through viewing.

2" PHOTO-VISUAL BARLOW AMPLIFIER (2x)

This custom-made accessory doubles the focal length of the objective for high-power photo-visual observation. The 2-element design uses special glasses to preserve the fine color correction of the main objective. The optical elements are hand-corrected and precision centered to insure that no aberrations are introduced into the system. The large optics will accept both 1.25 and 2 inch oculars and will cover a 2 inch photographic field with pinpoint images to the edge. The barlow also features a brass locking ring as described for the 2.7" focuser.

FLAT FIELD PHOTOGRAPHIC TRIPLET TELECOMPRESSOR (0.67X)

Three elements of special optical glass are used to match the characteristics of our triplet objectives in this flat field design. The result is a telecompressor with diffraction-limited performance over the 35mm format. The field is absolutely flat with no coma, astigmatism or distortion. Deep sky objects are recorded in a fraction of the time needed at prime focus. This well corrected accessory lens preserves the high contrast and superb color correction of the main objective. A must for the serious astrophotographer. Please order either the 2" and 2.5" version depending on your focuser. Please specify the type of camera that you plan to use.

CAMERA ADAPTER WITH T-RING FOR 35mm CAMERA

This camera adapter allows you to mount your 35mm camera to any focusing unit accepting 2" accessories for wide-field astrophotography. It is machined of aluminum and black anodized. The camera adapter is threaded for the popular 48mm filters. Please specify the type of camera you plan to use.

CAMERA ADAPTER WITH EYEPIECE PROJECTION TELE-EXTENDER AND T-RING FOR 35mm CAMERA

You can use the camera adapter alone for prime focus astrophotography or insert your favorite eyepiece into the eyepiece projection tele-extender for achieve higher powers and closer views of your object. The assembly consists of a 2" prime focus camera adapter threaded for the popular 48mm filters and a removable 1.25" eyepiece projection assembly.

PENTAX 6 x 7 cm CAMERA ADAPTER WITH FIELD FLATTENER Please specify 4", 5", 6" or 7" StarFire.

This accessory allows you to couple the medium format Pentax camera to your StarFire telescope for truly superb wide field photographs. The built-in field flattener lens produces sharp star images over the entire format. Enlargements of 16"x20" are possible without fuzzy images or loss of detail.

CARRYING CASES FOR TUBE ASSEMBLIES

Attractive, durable cases are now available to protect and transport your Astro-Physics tube assembly. These cases were made to our specifications to be reasonably lightweight, yet sturdy. They are constructed of wood with an attractive, vinyl covering. Your tube assembly will be cushioned on the sides and bottom with a layer of 1" foam and on the top with a thick foam padding. All corners are protected with a stainless steel reinforcing cap. Latches assure that the case remains closed. The 4" f8 StarFire case has one handle, all the other cases have three handles.

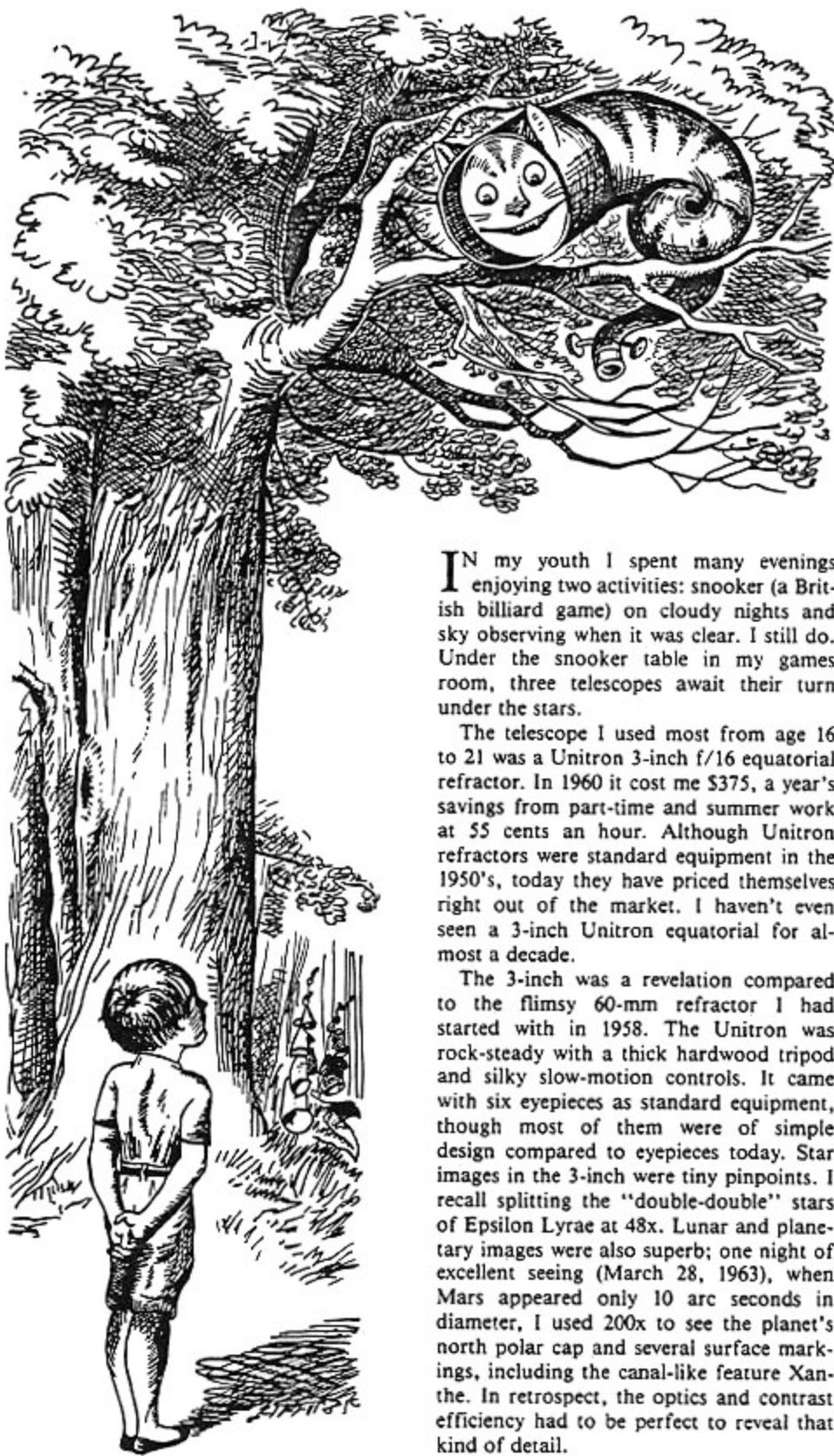
CASE SPECIFICATIONS:

4" f8 Tube Assembly with dewcap	. . . . .	39.0" x 8.0" x 8.0"	. . . . .	.12 lbs
5" f8 Tube Assembly with dewcap	. . . . .	42.0" x 9.5" x 9.5"	. . . . .	.15 lbs
6" f9 Tube Assembly with dewcap	. . . . .	66.5" x 10.5" x 10.5"	. . . . .	.23 lbs.
6" f12 Tube Assembly with dewcap	. . . . .	81.0" x 10.5" x 10.5"	. . . . .	.30 lbs.
7" f9 Tube Assembly	. . . . .	69.0" x 11.0" x 11.0"	. . . . .	.26 lbs.

Amateur Astronomers

Conducted by Stephen James O'Meara

ADVENTURES IN REFRACTORLAND



In my youth I spent many evenings enjoying two activities: snooker (a British billiard game) on cloudy nights and sky observing when it was clear. I still do. Under the snooker table in my games room, three telescopes await their turn under the stars.

The telescope I used most from age 16 to 21 was a Unitron 3-inch $f/16$ equatorial refractor. In 1960 it cost me \$375, a year's savings from part-time and summer work at 55 cents an hour. Although Unitron refractors were standard equipment in the 1950's, today they have priced themselves right out of the market. I haven't even seen a 3-inch Unitron equatorial for almost a decade.

The 3-inch was a revelation compared to the flimsy 60-mm refractor I had started with in 1958. The Unitron was rock-steady with a thick hardwood tripod and silky slow-motion controls. It came with six eyepieces as standard equipment, though most of them were of simple design compared to eyepieces today. Star images in the 3-inch were tiny pinpoints. I recall splitting the "double-double" stars of Epsilon Lyrae at 48x. Lunar and planetary images were also superb; one night of excellent seeing (March 28, 1963), when Mars appeared only 10 arc seconds in diameter, I used 200x to see the planet's north polar cap and several surface markings, including the canal-like feature Xanthe. In retrospect, the optics and contrast efficiency had to be perfect to reveal that kind of detail.

Furthermore, the exceptionally long $f/16$ focal ratio reduced chromatic aberration almost to zero. Only on Venus did a tinge of purple emerge. Today such performance is sometimes called apochromatic. I remember being shocked when I finally got to peek through bigger refractors and saw the violet haloes around Jupiter, Saturn, and brighter stars.

But I was even more dismayed by the erratic performance of the Newtonians used by most of my colleagues. Their telescopes ranged from a 6-inch $f/10$ that produced pinpoint stars and excellent planetary detail to pitiful telescopes that could never be properly focused. At the time I was unaware of the devastating effects of improper collimation, tube currents, and large-aperture seeing limitations that plague Newtonians. I attributed it all to poor optics.

Regardless, that experience led me to purchase a larger refractor — a 7-inch $f/17$ built by Harold Brown of Toronto. I bought it from a local amateur for \$200 in 1966; the owner regarded it as a white elephant and was glad to remove it from his garage. It had been used on a pier in the open for years, protected by a boat cover. The mount was, in effect, a rusted piece of yard sculpture. I could only salvage the counterweight. Likewise, the focuser was trash.

*Over the past 30 years,
my observing started
with refractors
and has come full circle.*

A few months later, however, it came to life in my roll-off-roof observatory in suburban Toronto. The "Big Eye," as everyone called it, was the largest refractor in amateur hands in Canada. But as we all learn sooner or later in the backyard astronomy game, big isn't necessarily better. Anything moderately bright through the 7-inch was adorned with a purple wreath. The homemade objective also suffered from astigmatism. To eliminate most of it I had to diaphragm the objective to $5\frac{1}{4}$ inches, which made it a fine $f/23$ system. In any case, two years later a large shopping center was built about a mile away, greatly reducing the observatory's effectiveness. In 1969 I sold everything.

From 1970 to 1983 I purchased and sold a variety of Newtonians, Schmidt-Cassegrains, and Maksutovs. Although I enjoyed them all, none gave razor-sharp images like the old Unitron. I wasn't

about to return to small aperture. But why couldn't the performance of the 3-inch be scaled up to larger instruments? That bothered me.

Theoretically, an unobstructed optical system is the optimum design, and among amateur instruments available commercially that means the refractor. Furthermore, small imperfections in a lens' figure introduce far less aberration into the image than mirror defects. But the refractor's nemesis is chromatic aberration, which skyrockets as aperture increases. A 6-inch f/10 refractor has more than 30 times as much as a 3-inch f/15. To produce the same color-free images as the 3-inch, the 6 must have its chromatic affliction reduced by 97 percent.

In the late 1970's I heard about Takahashi's new fluorite refractors with exceptional color correction. More recently, other manufacturers have offered similar instruments. Fluorite, when used as one of the full-aperture elements in a doublet objective, eliminates false color to below the visual threshold, even on Venus. Four-inch models marketed by Takahashi and Celestron are superb performers — expensive but worth it for the purist. However, the cost of 5-inch or larger versions remains astronomical.

By 1984 another option had appeared on the scene: apochromatic refractors by

Illinois-based Astro-Physics. These telescopes have triplet objectives that virtually overcome chromatic aberration. In 1985 I ordered a 5-inch f/12. After my first night with that telescope, I knew the quest was over. Here was a telescope that acted like a scaled-up version of my old 3-inch Unitron. After a few months of observations with it, I couldn't resist ordering a family of three shorter focal ratio Astro-Physics refractors: a 4-inch f/6.5, 5½-inch f/7, and a 7-inch f/9.

*Apochromatic refractors
offer a new level of
observing experience
for the purist with money.*

The 4- and 5½-inch refractors perform as well as the 5-inch f/12, though the former has a bit more residual color and the latter a shade less due to more exotic glass. Their shorter tubes make them excellent field telescopes. The 4-inch is particularly versatile atop a Celestron Super Polaris mount. It fits in my Firebird and can be set up in about three

minutes to provide perfectly framed views of the Pleiades at 20x or sharp images of the planets at 150x.

servers judged the 7-inch to be about equal to a good 10-inch f/5.6 Newtonian in showing faint objects. It was considered superior in revealing fine details such as dust lanes in galaxies and individual stars in the cores of globular clusters. At 180x the great cluster in Hercules (M13) became a mass of tiny stellar points. Planetary performance was no contest. And at 40x the 1°.6 field was stunning, framing the galaxies M81, M82, and NGC 3077 in Ursa Major beautifully.

Of course the comparison was partly unfair in that the refractor cost several times as much as the Newtonian. But it does demonstrate the several-inch advantage gained by unobstructed high-contrast optics that transmit about 97 percent of the light entering the lens.

The Astro-Physics refractors cost between \$300 and \$500 per inch of aperture (tube assembly only), which is less than some manufacturers charge for traditional refractors. Fluorites start at about \$400 per inch; some models are well over \$1,000 per inch. Tele Vue's Genesis refractor has a fluorite corrector only, and its performance is, I'm told by those who have tested it, comparable to true fluorites and the Starfires.

Yet why pay \$3,000 for an equatorially mounted 5-inch apochromatic refractor when you can get a fully loaded 8-inch Schmidt-Cassegrain or a 17-inch Dobsonian for the same outlay? Why, indeed?

Since this is a blatantly biased personal account, all I can write is why I have been smitten by apochromatic refractors. To me, telescope viewing is primarily an aesthetic experience — a private journey in time and space. Stars look like tiny pinpoints to the unaided eye, and that's the way I want my telescope to show them. Planets should appear as sharp-edged globes that focus to perfect clarity when the seeing is good. A faint star and a faint galaxy should always look completely different. In wide-field viewing the images should be in focus over the entire field.

Those are my (extremely high) criteria for a pleasurable observing experience. I don't want to see fuzz, flares, and waviness caused by mediocre optics or incessant tube currents. I want images as close to the real thing as possible. Now that I am seeing them in my new refractorland, I'm spending more time than ever at the eyepiece. You may not agree with my priorities. I expect that most amateur astronomers won't. Apochromatics aren't as compact as Schmidt-Cassegrains, nor can they compete with the brute aperture of large Newtonians. But they come closest to my idea of a perfect telescope.

TERENCE DICKINSON
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Canada

minutes to provide perfectly framed views of the Pleiades at 20x or sharp images of the planets at 150x.

The 7-inch took 20 months to arrive, but it was worth the wait. The Astro-Physics design so effectively suppresses chromatic aberration it's as if the refractor has been reinvented. The Starfire series is virtually color-free. There remains a touch of false color that can be seen in stringent tests. For example, in my 7-inch a bit of spurious blue appears around Vega and a vague touch of blue around Venus. I have not seen chromatic aberration on other planets or the Moon.

Despite its low altitude from Canada, Saturn looked particularly impressive last year through the 7-inch. Cassini's division was obvious all the way around. I may have glimpsed Encke's too. Saturn's disk displayed several pale belts in addition to the conspicuous North Equatorial Belt, which contained some threshold detail. In the spring of 1988, gibbous Mars, only 9 arc seconds in apparent diameter, revealed a huge south polar cap, Syrtis Major, and Libya in average seeing. By opposition time the detail was overwhelming — more than I could draw. I was delighted to see, for example, the forking of Tithonius Lacus, which might represent detection of 75-mile-wide features on the planet.

In deep-sky tests, three experienced ob-

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Mr. Dickinson is a former editor of Astronomy magazine. He has authored several books about astronomy:

Sky Guide (with Sam Brown, Camden House)
Mag 6 Star Atlas (w/ V. Costanzo & G.F. Chaple, Edmund Scientific)
Halley's Comet: Mysterious Visitor From Outer Space (Edmund Scientific)
The Universe and Beyond (Camden House)
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