



BEAUTY IN THE EYE OF THE BEHOLDER

The new 90mm f/6.9 apochromatic refractor from William Optics of California is notable for its optical and mechanical excellence. Capable of being mounted on either a sturdy camera tripod (left) or a more robust altazimuth mount (below), this compact instrument can be used to examine the rings of Saturn at night or the feathers of a bird by day. Our tests revealed textbook images from 19x to 155x.

Two new apo refractors from William Optics

Ever since their introduction in the 1980s, apochromatic refractors have captured the attention of backyard astronomers

WILLIAM OPTICS APOCHROMATIC REFRACTORS ARE BOTH BEAUTIFUL to look at and beautiful to look *through*. The craftsmanship is second to none, making it a pleasure to handle and test the two telescopes pictured here.

I can hear you already asking, Why would anyone spend so much for such a small telescope? True, an 8-inch Newtonian reflector on a Dobsonian mount can be purchased for under \$600. Apochromatic refractors aren't for everyone. But more and more backyard astronomers have been attracted to them. Here's why.

When well made, an apochromatic refractor is the purest type of optical system, unobstructed by a secondary mirror in the light path, as is the case with Newtonian reflectors and all forms of Cassegrain telescopes. All other things being equal, this means that a 4-inch apo refractor will reveal fine detail equivalent to that seen in a

5-to-6-inch centrally obstructed telescope.

In practice, though, the refractor is often sharper than that, because all other things are *not* equal—light entering a refractor is immediately bent (refracted) by the main lens as it makes one pass down the tube, rather than the two or three passes made in the

other types of scopes. And that one pass is cone-shaped, progressively farther from the tube wall, also unlike the other types, which make the first pass at full diameter. This is especially relevant, because subtle thermal currents that hug the inside of a telescope tube's wall contribute to poor seeing.

THE BIG PICTURE

For these reasons, the refractor enjoys a well-deserved reputation for sharp, steady star images, superb planetary views and maximum overall performance per inch of aperture. However, the relatively modest aperture of refractors does mean that deep-sky objects are not displayed as prominently as they are in larger telescopes of other types.

But why the price differences between telescope types, with apo refractors at the high end? Most of this has to do with getting rid of the chromatic aberration, also called false colour and residual colour,

LOOKING SHARP

William Optics also offers this solid altazimuth mount suitable for both daytime and nighttime viewing with the 90mm apo or similar-sized small-aperture telescope. Readers with cross-over interests with astronomy, such as birding and boating, might consider this a dual-purpose instrument.



that afflicts normal refractors (known as achromatic refractors). In an achromatic refractor, chromatic aberration is seen as a purple fringe around bright stars and planets and the Moon.

The effect of chromatic aberration is minor in apertures under 90mm, and it can be minimized by keeping the telescope's focal length long—usually $f/10$ or longer. For achromatic refractors 90mm and above, especially in focal ratios of $f/8$ or less, chromatic aberration is obvious. This doesn't mean achromatic refractors are to be shunned. They still produce fine images. And because they cost far less than apo refractors, they remain popular. But they do much better, and become powerful photographic tools, if the chromatic aberration is reduced to invisible levels.

Elimination of chromatic aberration in refractors became possible beginning in the 1980s, with the availability of expensive high-index glass. A refractor that makes use of this glass to reduce chromatic aberration to low levels is known as *apochromatic*. Unfortunately, the various manufacturers have never agreed on what level of chromatic-aberration reduction defines apochromatic. Thus not all refractors designated as apochromatic effectively vanquish chromatic aberration. You have to read the technical specs, or reviews like this, to find out how a telescope tests in the field. In general, though, price is a good guide. It costs more to make a true apo refractor.

AUTHENTIC APOS

To turn to our case in point, the William Optics 90mm and 110mm refractors are true apos. I could not detect false colour on any celestial object, from bright stars like Vega and Capella to Jupiter and the Moon. Star images in wide-field views are pinpoint. At high power, dazzling sunlit mountains on the Moon stand out like pure white snow peaks against the black velvet of adjacent shadows; stars show textbook diffraction rings.

I stayed up much later than I had intended while testing these scopes, enjoying views of clusters, nebulas, multiple stars, galaxies—all exquisitely sharply defined. The Hercules cluster (M13) at 154x in the FluoroStar 110mm, for example, displayed myriad tiny stars in and around the grey glow of the unresolved horde of stars toward the core—not too shabby for a 4.3-inch telescope.

TERENCE DICKINSON



SHARP OPTICS Apochromatic refractors are prized by backyard astronomers for their outstanding visual and photographic performance. Per inch of aperture, an apo is the best you can get. The photo of the Triangulum Galaxy, above, for example, is a 9-minute shot at ISO 800 with a Hutech-modified Canon 20D DSLR taken through our test unit of the William Optics FluoroStar 110mm $f/7$, shown below. If shot through a similar-sized achromatic refractor, bright stars would be rimmed with blue or purple—false colour caused by chromatic aberration.



FOCUSER FACTS Focusers seem to have been the last aspect of telescope design to be modernized. Junky focusers are still being fitted to expensive telescopes. But, thankfully, many scopes now come with a focuser that (a) can accommodate 2-inch eyepieces, (b) doesn't slip when used with a heavy eyepiece or camera and (c) has, on a refractor, a 360-degree rotation feature. The focusers for the William Optics 90mm scope, top, and the 110mm, above, have all these capabilities. Not only that, they have dual-speed focusing knobs. The smaller knob changes focus at one-tenth the rate of the larger one—something you won't do without once you try it. The William Optics 110mm scope is available with either of these focusers.



A COMFORTABLE VIEW The William Optics FluoroStar 110mm apo refractor, above, easily passed our tests for optical and mechanical excellence for a premium-class telescope, one that should satisfy the most discriminating user. Seen here on a Vixen GP Deluxe mount, the telescope is also well suited to the popular Sky-Watcher HEQ-5 and EQ-6 mounts. The telescope should be especially attractive to backyard astronomers looking for a high-performance instrument equally suited to visual and photographic applications.

BAFFLING OPTICS Looking down the tube of the 110mm apo refractor reveals some of the tube baffles that dampen stray light and internal reflections, producing velvet-black sky backgrounds when conditions permit.

PRODUCT REVIEW (CONTINUED FROM PAGE 21)

At 22x in the Megrez 90mm, the 2.3-degree-wide view of the Pleiades was simply stunning, augmented by a touch of the Merope Nebula. If you want excellent optics providing sharp, uncompromising views of celestial showpieces, these scopes deliver!

Matching the topflight optics are the superb mechanical fittings of both instruments. Silky smooth two-speed focusers, rotatable through 360 degrees, highlight both telescopes. Flawless fit and finish and the best retractable dewcap I have ever seen mark these as first-rate instruments. We are in the same league here as such highly respected names as Tele Vue, Takahashi and Astro-Physics—the cream of apo refractors. In this rarefied company, William Optics' prices are eminently reasonable.

As with the other high-end manufacturers just mentioned, William Optics scopes are offered in basic form as tube assemblies without eyepieces, diagonal and mount. Purchasers build from there by selecting a mount based on the intended primary use:

land viewing (90mm model only), celestial viewing or astro-imagery. Ideal for the 110mm for both photography and visual would be either the widely available Sky-Watcher HEQ-5 or the EQ-6 Pro mounts.

William Optics uses the same objective lens in its ZenithStar 110mm apo refractor at a slightly lower price than the FluoroStar 110mm model tested and pictured here. With its robust 4-inch focuser, the FluoroStar is more specifically intended for astro-imaging as well as visual.

Since the early 1990s, apo refractors have proved to be the favourite instrument for astrophotographers. They are, in effect, giant telephoto lenses and are generally easier to use for astro-imaging than other types of telescopes. The fact that the same instrument is just as suited for observing as it is for photography gives apo refractors outstanding versatility in astronomy. ■

Editor Terence Dickinson bought his first apo refractor in 1984 and has owned at least one of these versatile instruments ever since.

PRODUCT SPECIFICATIONS

William Optics FluoroStar 110mm (4.3-inch) apochromatic refractor

Focal ratio: f/7 (770mm focal length)

Objective: air-spaced triplet FPL-53

Tube weight: 13.5 pounds

Length: 25 inches, with dewcap and focuser retracted

Accessories: fitted aluminum case

Focuser: fully rotating 4-inch, with 2-inch/1.25-inch fittings

Required accessories: 2-inch diagonal, eyepieces, mount, tripod

Tube-assembly price: US\$2,800 (includes mounting rings)

William Optics Megrez 90mm (3.5-inch) apochromatic refractor

Focal ratio: f/6.9 (621mm focal length)

Objective: air-spaced doublet FPL-53

Tube weight: 7.1 pounds

Length: 18 inches, with dewcap and focuser retracted

Accessories: fitted aluminum case

Focuser: fully rotating, with 2-inch/1.25-inch fittings

Required accessories: 2-inch diagonal, eyepieces, mount, tripod

Tube assembly price: US\$1,300

William Optics products are available from many Canadian telescope dealers.

Website: www.william-optics.com