

William Optics RedCat 51 Astrograph

Despite its compact size and small aperture, this astrograph produces superb images.



RedCat 51LX APO 250mm f/4.9

U.S. Price: \$748
williamoptics.com

What We Like

- Superb edge-to-edge sharpness and even illumination
- Precise focusing and camera rotation
- Integrated Bahtinov focusing mask

What We Don't Like

- Filter swaps require camera removal, or purchasing a \$180 filter-drawer accessory



I WAS FIRST DRAWN TO William Optics' popular refractor, the little 51-mm RedCat, via YouTube videos that owners presented promoting its qualities. It's through YouTube that many newcomers to the hobby now learn about equipment and how to use it.

While I question some of the YouTubers' methods and equipment choices, in this case the popularity of the RedCat proved warranted. For deep-sky photography, small refractors provide wide fields of view, ease of mounting and guiding, and portability. The RedCat ticks all those boxes and more.

With a unit on loan from a local dealer, ferventastronomy.com, I tested



▲▲ The author used the William Optics RedCat to capture IC 1396 (left) and fainter Sharpless 2-129 in Cepheus using a Canon EOS Ra camera. This is a stack of four 12-minute exposures at ISO 5000 through an Optolong L-Enhance filter blended with six 8-minute exposures taken without a filter at ISO 1600.

▲ The RedCat 51LX includes a 21-cm-long (8¼-inch) mounting bar with a Vixen-style dovetail on one side and an Arca-Swiss dovetail on the other. The top bracket is a recommended option. The rear cell includes a 48-mm male thread that accepts a wide T-ring (one is attached here). The lens cap incorporates a Bahtinov mask for precise focusing.

ALL PHOTOS BY THE AUTHOR

a sample of the upgraded RedCat 51LX introduced in early 2020.

Optical Performance

The William Optics RedCat is a 51-mm $f/4.9$ refractor using a Petzval design with a doublet front element incorporating FPL-53 glass, plus a single central element and a single rear lens, which together serve as a field flattener. While an instrument with only 51-mm aperture is limited for visual observation, the RedCat is designed primarily for imaging, making it an astrograph. Think of it as a specialized telephoto lens with a 250-mm focal length.

As such, my first thought upon seeing the RedCat was: Why would I need it? I already have a 200-mm telephoto lens that, at $f/2.8$, is one and two-thirds photographic stops faster. One night I shot the same field with both the RedCat and my 200-mm, a premium Canon L-series lens.

Sure enough, the RedCat did prove sharper and with less chromatic aberration (in fact, none) than the telephoto — but only when the Canon lens was used wide open at $f/2.8$. Stopping the 200-mm lens down to $f/5$ to match the RedCat's f -ratio leveled the playing field. The lens now closely matched the RedCat for both on- and off-axis sharpness and lack of color aberration. Indeed, I gained a new respect for the Canon lens, which I had long considered to be a little soft. But extracting its best performance required stopping it down more than I usually do and also precisely focusing the lens using the RedCat's included Bahtinov mask.

Nevertheless, the RedCat's pinpoint stars corner-to-corner on a full-frame detector are impressive. And bright stars don't exhibit the diffraction spikes introduced by diaphragm blades when shooting with a telephoto lens stopped down. Only slight vignetting was visible in the extreme corners of the field.

The RedCat's \$748 price is similar to the Canon 200mm $f/2.8$ L-series lens I compared it to, with the lens offering more speed when needed, but comparable sharpness when stopped down. So, the question remains: Why buy a

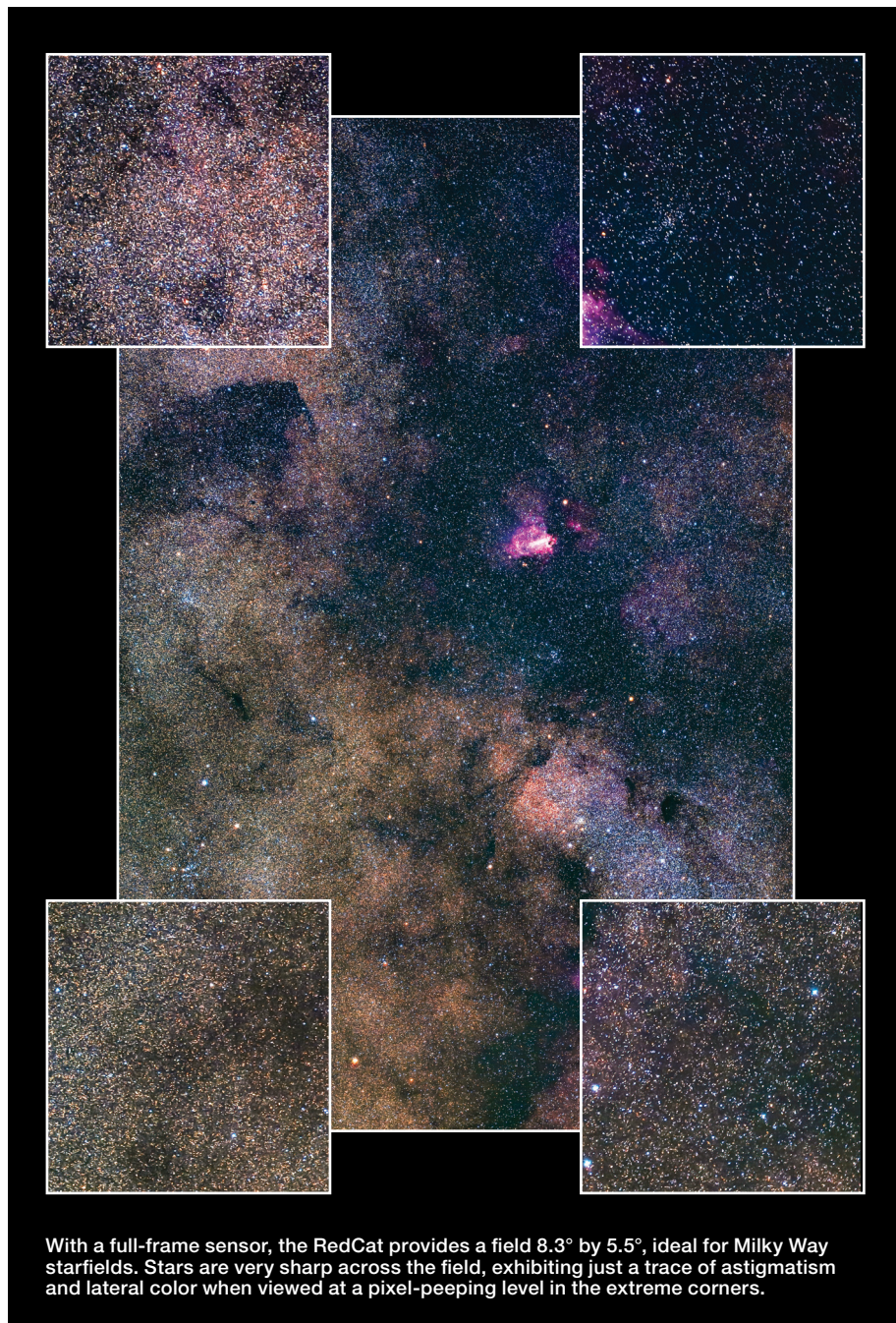
RedCat? While its optics are certainly superb, I found its mechanics are what set it apart.

Mechanical Features

The RedCat is heavier and longer than most 200-mm telephotos, but it has significant advantages over a conventional camera lens. Most importantly, the RedCat's design includes two means of easily rotating the camera for framing, with no worries about the setup slip-

ping, as it can when mounting a camera and telephoto lens tipped over on a ball head or other form of tripod head.

First, the entire tube and camera can be rotated within the mounting cradle. Alternatively, the camera can be rotated with respect to the tube using an integral camera-angle adjuster that is marked in one-degree increments. This can facilitate shooting multi-frame mosaics in which the camera has to be rotated by a specific amount to keep



With a full-frame sensor, the RedCat provides a field 8.3° by 5.5° , ideal for Milky Way starfields. Stars are very sharp across the field, exhibiting just a trace of astigmatism and lateral color when viewed at a pixel-peeping level in the extreme corners.

adjacent frames parallel. Even with single shots, I found the scale useful for rotating the camera by the angle I had determined ahead of time using planetarium software to plan the framing.

Rotating the camera did not introduce any focus shifts. Once the RedCat cooled down, its focus also stayed consistent through several hours of shooting, though my tests were on mild summer and autumn nights.

In addition, the RedCat's helical focuser is much more precise than those on typical camera lenses, and it is lockable, making it easy to nail and maintain focus. I did find that the lock ring occasionally seized tight when it warmed up after being brought indoors. Getting the RedCat as cold again as it was at night, in one instance by placing it in the freezer, freed it up.

The top surface of the mounting cradle has four small tapped holes of unspecified thread. An optional, but almost essential, carrying handle (\$45) can be bolted here that accepts the standard dovetail shoe now used by most finderscopes. It's where a small guidescope can attach, making for a quick yet secure connection.

Unlike a lens, the RedCat's rear



▲ With the dewcap reversed and stored on the tube (top), the RedCat is 24.1 cm long. The dewcap extends 10.1 cm beyond the objective, for good protection. With mounting bar and top bracket, the RedCat weighs 2.1 kilograms (4.6 pounds).

cell incorporates push/pull screws for adjusting the tilt of the camera to ensure uniform sharpness across the field. I had to make some initial adjustments as, out-of-the-box, images were a little softer on one side of the frame.

▼ An extreme blow-up of the field around Epsilon Lyrae shows the stars soft and aberrated with the author's 200-mm Canon lens at $f/2.8$, but comparable to the RedCat when stopped down to $f/5$ to match the RedCat's $f/4.9$ focal ratio.



When using a telephoto lens, shooting through a light-pollution or narrowband filter requires using a clip-in filter made specifically for that DSLR or mirrorless camera, often limiting the choice of filters. By comparison, the RedCat's rear cell accepts any standard 2-inch (48-mm) screw-in filter. However, despite the William Optics web page describing the RedCat as having a filter "slot," inserting a filter requires removing the camera and screwing the filter into the rear adapter ring. There is no drop-in slot per se.

Those shooting with cooled CMOS cameras likely wouldn't need to use this filter placement, as the RedCat's 55 mm of back focus should accommodate an external filter wheel. But that's not an option for DSLR cameras that require all the available back focus.

Inserting a filter required removing the camera, then replacing it after screwing in the filter, which inevitably introduced field rotation. I like to blend filtered and unfiltered images to achieve a more natural color balance. If the two sets are rotated with respect to each other, aligning them requires cropping, perhaps spoiling the composition and some loss of the wide field the RedCat can deliver.

A better option for DSLR users would be a drawer for inserting a filter without having to touch the camera. Fortunately, Starizona (starizona.com) offers an after-market filter drawer, for \$180. But installing it requires removing the RedCat's tip-tilt plate, one of the features added to the RedCat in its 2020 upgrade. Removing the plate maintains the 55 mm of back focus needed for optimal field flattening with DSLRs. Images taken with the Starizona filter drawer in place showed uniformly sharp focus across the full-frame Canon Ra, so the loss of the tip-tilt plate wasn't detrimental.

On the plus side, the metal lens cap cleverly incorporates a plastic Bahtinov mask to aid in achieving precise focusing, a convenient design touch. In all, the mechanical features of the RedCat do make it easier to mount, focus, frame, filter, and guide than with telephoto lenses.



▲ *Top:* Two-inch filters screw into the rear adapter ring that goes between the rear adjustable cell and the 48-mm T-ring. Note the indexed camera rotator. *Bottom:* The after-market filter drawer from Starizona adds the convenience of quick filter changes but requires the removal of the RedCat's tip-tilt rear cell.

Mounting Options

With its included Vixen-style dovetail bar, the RedCat 51 can go on most any small equatorial mount. However, the RedCat's small size invites mating it to a small camera tracker for utmost portability. The combination that William Optics illustrates in the RedCat's Quick Start Guide, and that has proven popular with YouTubers who promote it, is pairing the RedCat with iOptron's Sky-Guider Pro tracker (\$498 plus tripod).

While I typically refrain from using any tracker with lenses longer than 135 mm, I tried the RedCat with the Sky-Guider Pro and found the combination does work, albeit with some caveats. The SkyGuider Pro tracks well enough that out of dozens of one-minute unguided exposures, about half were untraced enough to be suitable for stacking.

A better portable package, say for airline travel, would be mating the RedCat to a Sky-Watcher Star Adven-



▲ The RedCat can be mated to a tracker such as iOptron's SkyGuider Pro, a popular combination but one that lacks fine adjustment in declination.

turer 2i Pro Pack (\$419 plus tripod). The Star Adventurer's declination bar has a manual slow motion, a feature missing



The RedCat works well with light-pollution and narrowband filters for enhancing emission nebulae. But at its f/4.9 speed, sub-frames need to be 8 to 16 minutes long through a filter, as they were for this image.

on the SkyGuider Pro, which significantly improves your ability to precisely frame your subject. In tests with the new Wi-Fi-enabled Star Adventurer 2i, autoguiding proved almost essential, as it did with the scope mounted on the SkyGuider Pro, with two-minute exposures at ISO 3200 working well to ensure no declination drift.

So, yes, in a pinch the RedCat can be used with a camera tracker. However, for use at home or any site you can drive to, a far more solid choice is a full German equatorial mount. I tested the RedCat on Sky-Watcher's new lightweight EQM-35 mount (\$725). The improved tracking and dual-axis guiding allow longer exposures at lower ISOs, producing images with less noise and wider dynamic range. When shooting with focal lengths of 250 mm or more, having Go To and electric slow-motion controls make finding and framing targets so much easier than with a tracker.

Recommendations

Unless airline portability is paramount, I recommend using the RedCat on a full German equatorial mount. Even a lightweight mount will yield better images more consistently than using the Red-



▲ *Left:* An ideal combination for portability and affordability in a deep-sky imaging system is pairing the RedCat with Sky-Watcher's EQM-35 Go To mount. *Right:* The RedCat comes in a zipped, padded case with cutouts for accessories. With its accessory handle attached, the tube doesn't quite fit.

Cat on a small camera tracker pressed to or beyond its limits. Many influential but novice YouTubers have yet to learn just how important a solid mount is for deep-sky imaging.

By contrast, bigger isn't always better with optics. The little RedCat is a fine example of a small astrograph that is easy to use yet can produce publication-quality results. For an advanced astro-

photographer, the RedCat can serve as a wide-field complement to a larger telescope. For the beginner, the RedCat can provide top-class images without breaking the bank. But do match it to a solid mount.

■ See more of Contributing Editor ALAN DYER's images, tips, and product reviews on his website at amazingsky.com.



◀ Ignoring the clash of colors, the Sky-Watcher Star Adventurer 2i serves as a good mount for situations in which portability is important.

▼ As a test of this compact combination, the author mounted the RedCat with the EOS Ra camera on a Sky-Watcher Star Adventurer 2i tracker to shoot a set of 18 two-minute autoguided exposures at ISO 3200. It worked!

