Dennis di Cicco

Astro-Tech's 14-inch f/8 Ritchey-Chrétien Telescope

ALL PHOTOS BY THE AUTHOR

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U.S. price: $5,795
Astronomics.com

UNFORTUNATELY George Willis Ritchey didn't live to see it happen, but the optical design he codeveloped in the early 1900s proved to be profoundly important to professional and amateur astronomers during the latter half of the 20th century. Clearly gifted, albeit eccentric, Ritchey helped usher in the age of astrophysics working with George Ellery Hale at Yerkes and Mount Wilson observatories. Following his success building Mount Wilson's 60-inch reflector, Ritchey used it to take the finest deep-sky photographs of the day. But he was well aware that coma — the optical aberration that turns stars into seagull-shaped flares away from the center of the field — limited what could be sharply photographed with traditional Newtonian and Cassegrain reflectors.

Around 1910, Ritchey pooled his practical knowledge of telescope optics with the mathematical skills of his Mount Wilson colleague Henri Chrétien, to come up with a Cassegrain design that theoretically produced excellent star images across a wide field. But no funds were available for the construction of a

Astro-Tech's 14-inch f/8 Ritchey-Chrétien telescope is seen here in the author's suburban-Boston backyard observatory mounted on a Software Bisque Paramount MX and fitted with the SBIG STT-8300 CCD camera used for all the accompanying deep-sky images except where noted. As with most open-tube telescopes, a light shroud is recommended if the scope is used around any ambient light sources, including computer screens.

prototype, in part because the primary and secondary mirrors were hyperboloids and thus deemed too difficult to fabricate and test.

Decades passed before a Ritchey-Chrétien scope (or RC for short) was tested photographically on the sky. And it wasn't until 1955, 10 years after Ritchey's death, that a 40-inch RC he built for the United States Naval Observatory was relocated to Arizona and began producing Ritchey's long-promised results. Indeed, the ultimate success of the 40-inch paved the way for the design being adopted for virtually every large-aperture professional telescope made during the next half century, including the Hubble Space Telescope.

In the early 2000s, amateurs too turned to the Ritchey-Chrétien design as they transitioned from film-based to digital astrophotography and wanted large-aperture telescopes capable of delivering quality star images across the digital detectors then becoming available. Those RCs were expensive, but so too were large-format digital cameras, and most amateurs able to afford one could also afford the other.

Today, however, astrophotographers are using a wide range of modestly priced digital cameras, including DSLRs, and that's driving a market for suitable imaging telescopes that are also modestly priced. And for many, the new line of Astro-Tech truss-tube RCs fills the bill. Costing a fraction of what previous RCs cost, some must wonder if the manufacturer cut corners or sacrificed quality. To find out, we borrowed the Astro-Tech 14-inch RC from Astronomics, and I tested it last fall and winter from my suburban-Boston backyard observatory.

Impressive Specs

On paper the AT14RCT looks incredible for a telescope costing $5,795, given that 14-inch RCs in the past were priced well into the 5-digit range. In addition to the carbon-fiber truss tube, a trio of cooling fans for the primary mirror, a dual-speed 3-inch Crayford-style focuser, and a pair of Losmandy-style dovetail mounting bars, the scope features both mirrors made of fused quartz. With the exception of Questar telescopes, this thermally stable material has rarely been offered as an option for amateur scopes (and even in the case of the already pricy Questar, a quartz mirror added a roughly 25% premium to the cost).

Out of the box, the AT14RCT looks every bit as good as its specifications do on paper. The machining is first rate, and the fit and finish excellent. Without the focuser attached, the scope weighs about 65 pounds (29 kg). At its widest part, the tube is 20½ inches (52 cm) across, and excluding the focuser it's 39 inches long.

The scope has a fixed focus, which I measured as falling almost exactly 11

As detailed in the text, the scope proved to be a delight for visual deep-sky observing even though Ritchey-Chrétiens are most often considered as imaging instruments. The supplied 3-inch Crayford-style focuser was fine for eyepieces and lightweight cameras, but struggled with heavy imaging setups.

inches outside the back of the telescope. This is more than enough room to fit even complex imaging setups that include, say, a flip mirror, off-axis guider, motorized focuser, filter wheel, and camera. Given that imaging setups can weigh 15 pounds or more, and a guide scope can add a few more pounds, the AT14RCT should be used with a mount rated for at least 90 pounds. That's the suggested limit for Software Bisque's original Paramount MX that I used for all of my testing. It worked well in all but the windiest conditions when I was using a guide scope and very heavy camera.

I was in for an unexpected treat on my first night. To check the optical collimation, I slipped a high-power eyepiece into the focuser and examined the image of a bright star. The collimation was spot on, so I switched to a low-power eyepiece to see if stars appeared uniform across a larger field. They did. Furthermore, the view was beautiful, with the subtle hues of stars clearly visible — this is after all a 14-inch telescope.

To make a long story short, on more than one occasion I spent an entire night using the AT14RCT with eyepieces. It's a very nice visual telescope, which is something I hadn't considered beforehand given that RCs are mainly promoted for their imaging qualities. The scope has a focal length of 2,834 mm (my measurement), yielding an image scale of 72.7 arcseconds/mm. As such the maximum field of view possible with a 2-inch eyepiece is almost 1° across — pretty decent for a 14-inch Cassegrain system.

Visual observing also highlighted the advantages of the scope's quartz optics. I typically open my observatory roof at least an hour before using any

WHAT WE LIKE:

Excellent optical quality and focus stability

Fused-quartz mirrors with 99% reflective coatings

Rigid carbon-fiber truss tube

WHAT WE DON'T LIKE:

Requires a focuser upgrade for use with heavy cameras (but to be fair, this is clearly stated in the scope's documentation)

The AT14RCT is noteworthy for its remarkable focus stability. Despite falling temperatures, the author never refocused the scope during the 7-hour period when he gathered the red, green, and blue exposures for this view of the spiral galaxy M81.

scope so that the instrument can settle to ambient temperatures. If I don't, sudden temperature changes often distort telescope mirrors enough to make them temporarily unusable. This wasn't the case with the AT14RCT, which continued to perform well optically as the mirrors were cooling. Temperature acclimation, which is sped up by running the fans behind the primary mirror, is still important, because heat plumes rising from the warm mirrors can cause flaring on star images.

Imaging with the AT14RCT

As the astrophotos accompanying this review will attest, the scope produces great images. During one night with unusually good seeing conditions, I measured star diameters as small as 1½ arcseconds (full-width, half-maximum) in 10-minute exposures. This is exceptionally good performance.

This shot of the Crescent Nebula in Cygnus was recorded during a night of unusually good seeing for the author's location. Stars are only about 1½ arcseconds in diameter in this 290-minute exposure made through a hydrogen-alpha filter. All astronomical images in this review were processed by Sean Walker.

The carbon-fiber truss tube and quartz optics did an outstanding job of maintaining focus stability. On many nights I simply left the focus untouched after it was set at the beginning of the observing session. The image of the grand spiral galaxy M81 at left was captured during a 7-hour period on a chilly night last March. Stars appeared as sharply focused in the final exposures as they did in the first ones. And because this scope has only mirrors and no lenses, all wavelengths of light come to the same focus; there is no need to tweak the focus when shooting through any color filters.

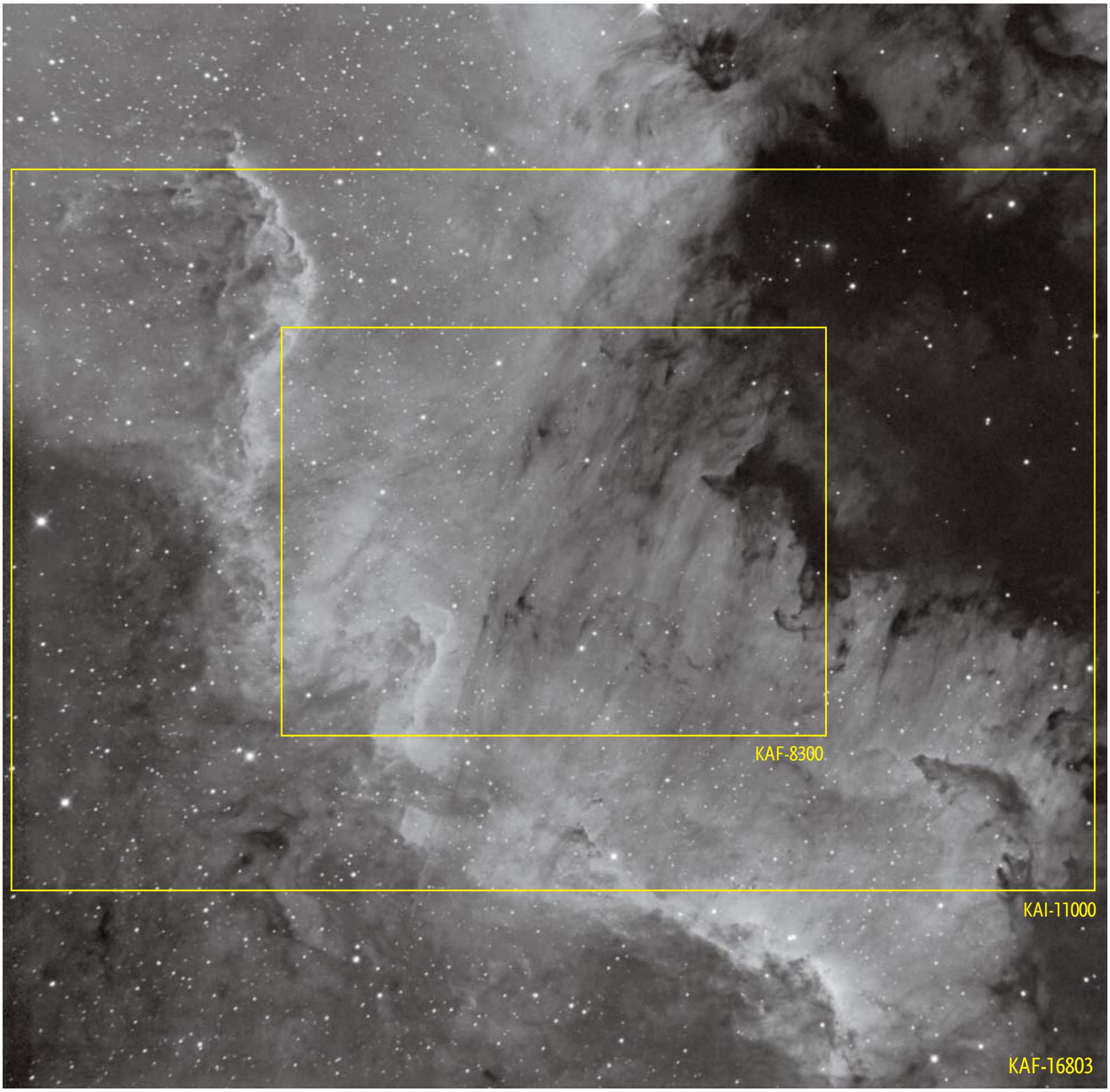
That said, there are several caveats that go with using the AT14RCT for imaging. The first involves the focuser, which is fine for visual observing and photography with relatively lightweight cameras, including most DSLRs. But the 5-pound load of my SBIG STT-8300 really pushed the focuser's limits. The friction drive often slipped, especially in cold weather. Except for the image of the North America Nebula on the facing page, I used only the focuser supplied with the scope, but on many nights it was challenging.

This, however, came as no surprise. The scope's documentation clearly states that heavy cameras will "probably require an upgrade to a rack-and-pinion focuser." Several options are spelled out, including adapters made by Feather Touch for mounting various heavy-duty focusers on the scope.

The other caveat involves an inherent aspect of RC optics. While the design is free of coma, its focal surface is curved rather than flat. In the days of emulsion-based astrophotography, photographic plates were gently bent to conform to an RC's curved focal surface. But that's not possible with digital detectors. The solution is to use a special field-flattening lens assembly mounted in front of the camera. Currently no field flattener is available for the AT14RCT. But you may not need one. For example, any image degradation due to the curved focal surface was all but invisible in my full-frame images made with the STT-8300 camera.

Larger chips will be more of a problem, especially if you're a stickler for pinpoint stars all the way to the corners of a frame. But even here there is a partial solution, and that is to focus the telescope at a point roughly halfway between the center and edge of the field rather than at the center. This slightly defocuses stars in the middle of the field while improving those at the edge. In practice this defocusing is usually invisible within the actual star images recorded by the CCD. The result is an image that *appears* uniformly focused across the frame.

I experimented with this technique when I tried several different models of large-format CCD cameras on



As explained in the text, the lack of a field flattener for the AT14RCT limits its use with large-format CCD cameras. Nevertheless, this 3-hour hydrogen-alpha exposure of the North America Nebula is a worst-case example for the KAF-16803 chip used for the exposure as well as the other CCDs indicated, since it was focused at the exact center of the field. Racking the focuser in a small amount will move the area of sharpest focus to an annular zone between the center and edge of any frame. This will improve star images at the corners of a field without noticeably affecting those at the center. The technique works for any optical system with a curved focal surface, but it is particularly effective with RC optics because they are free of coma and out-of-focus stars still appear round.

the scope. Although I couldn't get "perfect" star images all the way to the corners of a KAF-16803 CCD before those at the center appeared somewhat softened, I did get very decent results across almost all of a KAI-11000 chip (this detector is the size of a full-frame 35-mm camera). Such opinions, however, are quite subjective, so your mileage may vary.

Overall I'm very impressed with the AT14RCT. It's a great scope for visual observing as well as deep-sky photography. The lack of a field flattener limits its use with the largest CCDs, but that's not a handicap for anyone working with smaller detectors up to and including any of the highly popular KAF-8300-based cameras. And when you factor in the scope's cost, it's an outstanding value. It's a winner! ✦

***Dennis di Cicco** has been writing about equipment in the pages of* Sky & Telescope *for more than 40 years.*