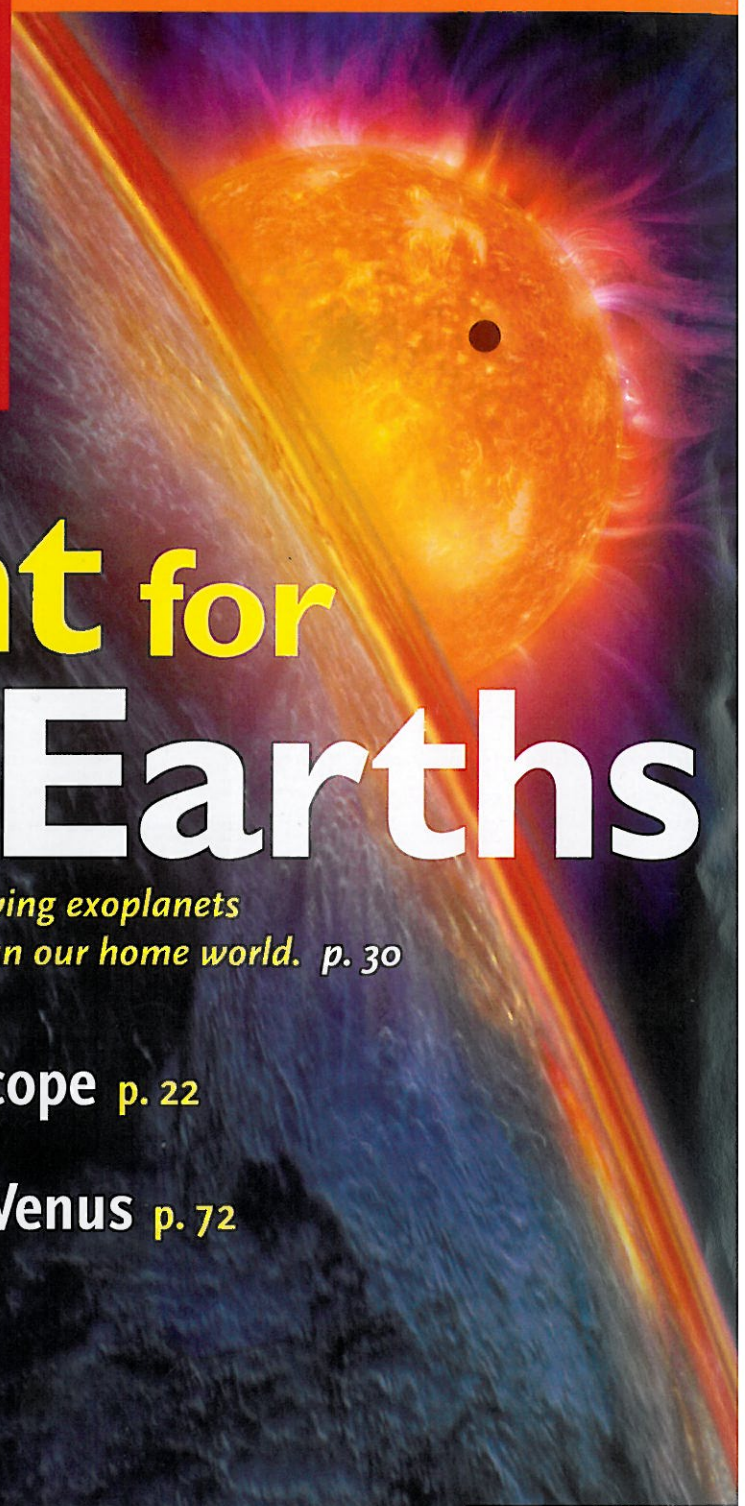
Amateur's Award-Winning Asteroid Research p. 60

SKY & TELESCOPE

THE ESSENTIAL MAGAZINE OF ASTRON



OCTOBER 2010

The Hunt for Super-Earths

Astronomers are studying exoplanets just slightly bigger than our home world. p. 30

NASA's New Jet-borne Telescope p. 22

Peer Through the Clouds of Venus p. 72

See Comet Hartley 2 p. 56

S&T Test Report: Megapixel Imaging for Less p. 38

Visit SkyandTelescope.com

$5.99 US
Display until October 4, 2010
10
0 74808 02207 6

Dennis di Cicco

ıpixel Imaging for Less:

ɜIG's ST-8300M CCD Camera

Don't be fooled by the price; this camera is built for serious deep-sky imaging.

SBIG's ST-8300M CCD Camera

U.S. price: $1,995
Santa Barbara Instrument Group
147-A Castilian Dr., Santa Barbara, CA 93117
805-571-7244; www.sbig.com

OVER THE YEARS, many of the products I've tested have held surprises. SBIG's new ST-8300M CCD camera was not one of them. And that alone speaks volumes, since the bar had been set very high for this product from the moment its carefully guarded development was announced last October.

There were good reasons that expectations ran so high for this camera. Foremost is the company itself; SBIG has remained solidly focused on the astronomy community since it arguably launched the amateur CCD revolution more than 20 years ago with the introduction of its ST-4 audoguider/imager. Then there's the new camera's 8.3-megapixel KAF-8300 chip, which has generated more interest among amateur astronomers than any other CCD in recent memory. Unveiled with the lowest price of any similarly featured camera, the ST-8300M understandably drew considerable interest from the get-go.

Amateur astronomers have had an especially positive response to the KAF-8300 chip since Kodak introduced it several years ago. It's a full-frame CCD with a 3326×2504 array of 5.4-micron-square pixels. The active imaging area measures a very respectable 18 by 14 millimeters, and the chip has antiblooming protection, which helps prevent unsightly streaks from appearing on bright objects in the image. The CCD is also very sensitive, with a quantum efficiency that peaks at almost 60% in the middle of the visual spectrum and is close to 50% at the astronomically important deep-red wavelength of hydrogen-alpha light.

Except for the FW5-8300 Filter Wheel, everything seen here is included with SBIG's ST-8300M CCD camera. The camera body and filter wheel have standard female T-thread mounts.

ALL PHOTOS BY THE AUTHOR; ASTRONOMICAL IMAGE PROCESSING BY SEAN WALKER

WHAT WE LIKE:

Full-featured CCD camera at a remarkable price

Compact, lightweight, and well made

WHAT WE DON'T LIKE:

Presently, a limited selection of "non-standard" 36-mm-diameter filters

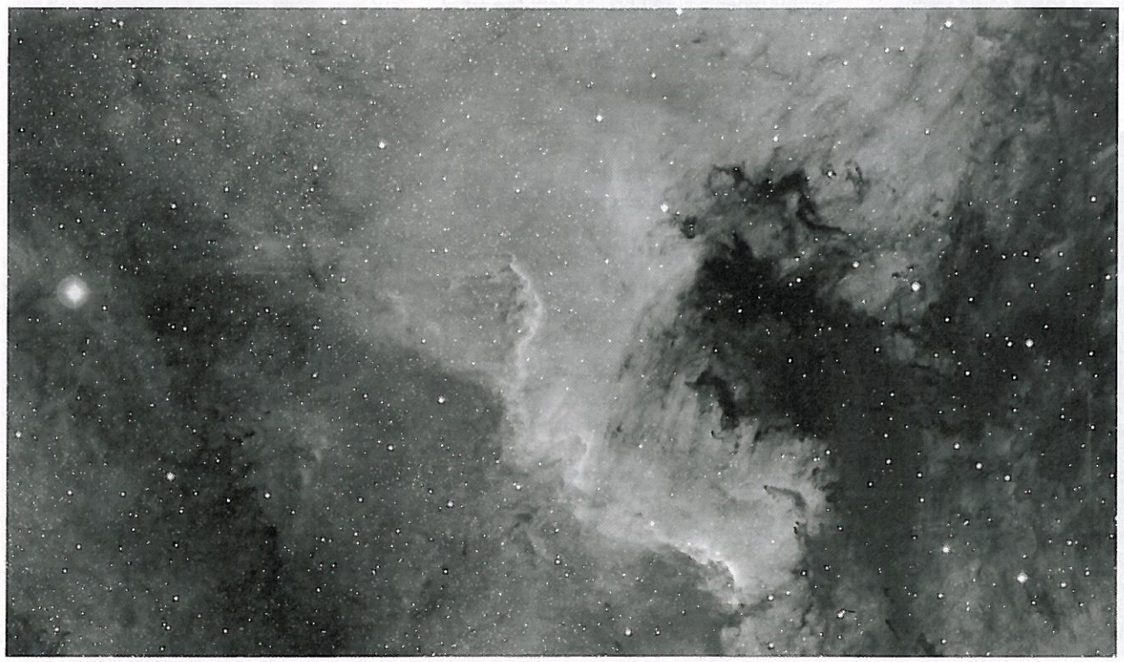
Equally interesting are the chip's small pixels, which make the CCD attractive to astrophotographers imaging with today's popular short-focus refractors and camera lenses. To achieve the often-recommended scale of 2 arcseconds per pixel for deep-sky work, the KAF-8300 requires an effective focal length of only 560 mm. Furthermore, at that focal length the chip covers a generous 1.8°-by-1.4° field of view. For optimum imaging at longer focal lengths, you can bin the ST-8300M's CCD 2×2 or 3×3 to create pixels that are effectively 10.8 or 16.2 microns square, respectively.

SBIG did not cut any obvious corners when creating this camera. The only feature lacking on the ST-8300M compared to SBIG's more-advanced imaging cameras is the company's patented internal autoguiding that uses a second, off-axis CCD mounted next to the imaging chip. Then too, guiding is no longer the prerequisite it once was for producing quality deep-sky images. Telescope drives have improved markedly in the past decade, and many of today's excellent astrophotos are made by stacking multiple 1-minute exposures, which can typically be made without guiding.

The ST-8300M is very compact, measuring just 4 by 5 by 2 inches (10 by 13 by 5 cm) and weighing 29 ounces (0.8 kg). The optional 5-position filter wheel ($695) adds 17 ounces, increases the cross section to 5 by 7 inches, and makes the camera 1 inch thicker, but the distance to the chip is still small enough to allow using the camera with standard lenses made for 35-mm cameras. To that end the ST-8300M has a ¼-20 "tripod" socket machined into its body, and SBIG already has optional adapters ($165) for Nikon and Canon FD lenses. The only caveat regarding the filter wheel is its use of "non-standard" 36-mm-diameter filters. Fortunately, three of the major players making filters for astronomical imaging — Astrodon, Baader, and Custom Scientific — offer this size.

The ST-8300M requires a single 12-volt DC power source capable of delivering 3 amps, and the camera comes with a "universal" adapter that runs on 100-to-240-volts AC. The only other cable needed is for the USB 2.0 connection between the camera and your computer. Because I already had USB 2.0 cabling snaked through my telescope mount, my setup also involved a small USB

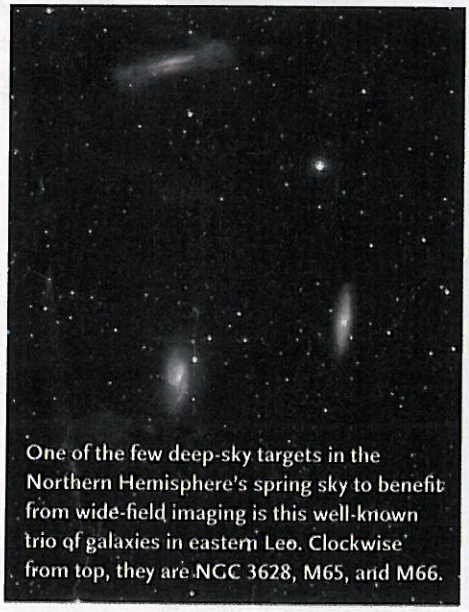
The ST-8300M's wide-field performance and impressive sensitivity to deep-red hydrogen-alpha light are apparent in this 2°-wide view of the North America Nebula's "Gulf of Mexico." The 2-hour exposure through a Baader 7-nanometer H-alpha filter was taken with a William Optics FLT-98 apo refractor working at f/5.1.



hub and a total of about 30 feet of cable, which worked flawlessly. The filter wheel's electrical connects are to the camera body, thus eliminating the need for additional power and communication cables dangling from the camera. To use the ST-8300M as an autoguider, there's an ST-4 compatible port on the body.

For image acquisition and processing, the ST-8300 ships with SBIG's *CCDOPS* version 5 as well as Software Bisque's *CCDSoft* version 5, both of which I've used in the past. My testing also included *MaxIm D/L 5.0*, since the program was already loaded on the 8-year-old Windows XP laptop used exclusively for image acquisition in my backyard observatory. My colleague Sean Walker and I calibrated and processed the images using a variety of computers and programs. The only downside to running the camera with a laptop bordering on dinosaur status was that my image downloads were about 33% slower than specified by SBIG, with full-resolution frames requiring about 12 seconds to transfer from the camera to the computer instead of the 8 seconds claimed by the company.

I used the camera last April, May, and June, at a time when the evening sky is dominated by relatively small galaxies. It wasn't until the end that I could image targets showcasing the camera's wide-field potential with the William Optics FLT-98 apo refractor I was using (see the Quick Look review on the facing page).



One of the few deep-sky targets in the Northern Hemisphere's spring sky to benefit from wide-field imaging is this well-known trio of galaxies in eastern Leo. Clockwise from top, they are NGC 3628, M65, and M66.

The ST-8300M's regulated, single-stage thermoelectric cooler never failed to hold the CCD's temperature at least 38°C below ambient air temperature. On nights when a slight breeze kept the air stirred up in my roll-off roof observatory, I could achieve a temperature drop of 40°C. Regardless, like many modern CCD chips, the KAF-8300M has particularly good thermal characteristics, typically generating a dark current of only 0.2 electron per pixel per second when cooled to just 0°C. This low thermal signal is very desirable for a deep-sky camera, especially one used with narrowband filters that allow only a small amount of light to reach the chip.

Despite its low price, the ST-8300M is a no-compromise CCD camera that delivers image quality consistent with SBIG's line of high-end cameras. And like so many other products in today's digital world (think computers and smartphones), the ST-8300M is proof that decreasing prices do not mean less performance.

Senior editor ***Dennis di Cicco*** *is amazed that it's been 20 years since he reviewed SBIG's ST-4 in the September 1990 issue.*

Above: **Using the same setup as for the North America Nebula, the author captured this view of the western half of the Veil Nebula. It was made from 30-minute exposures through red, green, and blue filters. North is at left.**

Below: **This author's setup for all the astronomical images in this review included an Astro-Physics Mach1 mount and home-made guidescope.**

Quick Look

William Optics FLT-98 f/6.3 Apo Refractor

U.S. price: $2,395
Worldwide dealer list available online at www.williamoptics.com

THE TIMING WAS PERFECT. I was just beginning my tests of SBIG's ST-8300M CCD camera when I spotted the William Optics FLT-98 f/6.3 apo refractor at the Northeast Astronomy Forum last April. The scope's 618-mm focal length is an excellent match for the camera's 5.4-micron pixels, producing an image scale of 1.8 arcseconds per pixel. Equally attractive for astrophotography is the FLT-98's built-in digital focusing scale (called the Digital Display Gauge, or DDG for short) and $269 optional Adjustable Flattener Reducer IV (AFR-IV). The AFR-IV has a 0.8× magnification factor, and while its made for several William Optic refractors, with the FLT-98 it yields an effective focal length of 500 mm and an image scale of 2.2 arcseconds per pixel on the ST-8300M. A loan was quickly arranged for this review.

Visually, the FLT-98's air-spaced triplet objective, made with extra-low dispersion (ED) glass, delivers the bright, crisp, color-free star images that we've all come to expect from modern apochromatic refractors. But with photography being my main interest, I didn't linger at the eyepiece.

In addition to delivering excellent star images across the ST-8300M's CCD, the field flattener has a unique feature, making it especially useful with astronomical CCD cameras. For the best optical performance, the spacing between any field flattener and the camera's focal plane must be critically set. All the flatteners I've used in the past have been made with the 55-mm back focus dictated by the T standard established for 35-mm cameras. That's great if you shoot with DSLRs, but there's no industry standard for the back focus of astronomical CCD cameras. Getting the proper spacing for these cameras usually means cobbling adapters and a lot of trial-and-error experimenting.

WHAT WE LIKE:

- Excellent apo performance
- Built-in digital focusing scale

WHAT WE DON'T LIKE:

- Focuser may flex under heavy loads

The position of the AFR-IV's two-element lens can be varied within the body of the flattener by more than 20 mm with a simple twist of an external ring. It was thus a simple matter of screwing the flattener onto the ST-8300M's filter wheel and shooting a couple of short test exposures at different lens positions to zero-in on the optimum spacing. What a joy it was to nail the proper setting without endless tinkering with adapters and spacers.

The field illumination with the AFR-IV is notably uniform across the ST-8300M's chip, and I really only needed to use flat-field images for calibration when there were image artifacts due to dust on the camera's filters and/or CCD window.

It's probably a carryover from years of doing "old-fashion" astrophotography with film and manual guiding, but I like being outside with a telescope while shooting pictures. So I've never considered it a burden to manually focus my cameras even in this age of sophisticated autofocus gizmos.

Nevertheless, I immediately took a real liking to the DDG. It displays the position of the focuser's draw tube to an accuracy of 0.01 mm. This is a bit of overkill, and even with a deft touch on the scope's fine-focus knob, it's challenging to set a position this accurately. But achieving an accuracy of 0.05 mm is a breeze, and that was certainly accurate enough for my setup and observing conditions. I've never used a manual system that was faster to focus than the DDG. It's great.

The DDG is powered by a small, internal 12-volt battery, and its large digits are very easy to read. The display has red backlighting controlled by a separate on/off button. The battery lasts a long time, especially if, unlike me, you remember to turn off the backlighting when you're done using it!

The FLT-98's focuser is a modified-Crayford design with ball bearings encasing a moving stainless-steel rail on the drawtube. The manufacturer doesn't specify its load capacity. While I had no flexure problems during 10-minute exposures with the 4.1-pound load of the AFR-IV and ST-8300M, heavier cameras might present problems for setups involving a guidescope (focuser flexure is rarely a problem with off-axis guiding).

Overall, this imaging setup was extremely nice. I only wish I could have used it to advantage on the big, splashy targets that become available in my late-summer and autumn evening skies. ✦

— D. di C.

Above: **Weighing 13 pounds (5.9 kg) and measuring just 20 inches (51 cm) with the dewcap retracted, the William Optics FLT-98 comes with this exceptionally heavy-duty carrying case.**

Right: **The author quickly took a liking to the FLT-98's built-in digital readout for the position of the focuser's drawtube.**