Starizona's HyperStar brings deep-sky imaging to the masses

ART Suffering No Longer Required

"You know, when i was your age..."

By Scott Tucker

Astrophotography used to be about having your priorities straight. When I finally obtained my dream telescope, loading it up to go observing quadrupled the value of my truck. As any experienced astrophotographer can tell you, the most important thing for imaging the night sky is a good mount, followed by a good telescope; all else is mere convenience – including vehicular transport, food, etc.

You had to be passionate about astrophotography. Not just any sane person could do it. It took a certain borderline lunacy to drive to the middle of nowhere, spend two hours setting up, take pictures for six hours, spend an hour tearing down, drive home, catch an hour of sleep before work, then discover that all that time and effort produced blurry and out-of-focus pictures; and the next new moon brought the chance to do it all again!

I started taking astrophotos near the end of the film era. I learned all that I could from reading books and surfing Web sites. As is my fashion, I quickly became obsessed. After a long time waiting and wishing, I finally received my dream scope: a 6-inch f/7 Astro-Physics refractor. I had a Pentax 6x7 camera body, an ST-4 autoguider, and a freezer stocked with rolls of Kodak PPF400 film.

So, I went out and did what astrophotographers were supposed to do. I crawled around in the dirt trying to see faint objects through the camera viewfinder. I used ridiculous contraptions to focus the camera – including a homemade knife-edge focuser constructed from a CD case, tape, and rubber bands. I spent countless hours perfecting my polar alignment technique. I froze in the winter, and I once danced around with jeans full of angry fire ants in summer (offering to give my scope away to anyone brave enough to go retrieve it from on top of the anthill).

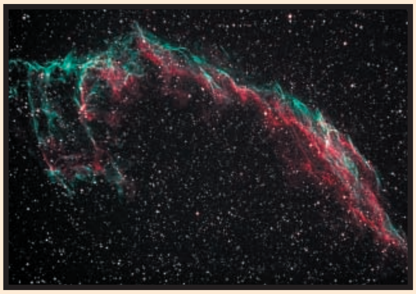
I drove hours from town to reach incredibly dark sites only to accidentally take eight hours of unfocused pictures. I had a bad batch of film turn all my photographs green. I opened the back of the camera when the film was still unwound inside. I contracted pneumonia while desperately trying to fashion a makeshift dew shield out of cardboard and double-sided tape at two o'clock on a cold, damp morning. I've unleashed furious fountains of profanity at poor, defenseless telescopes. I've groveled on my knees, begging the astronomy gods for forgiveness and clear skies and just once, please, couldn't I get a

Comparison of old school and new school deep-sky imaging. Left image of the Lagoon Nebula was taken with a Celestron 14-inch SCT, HyperStar lens, and SBIG ST-10XME camera. Right image was with an Astro-Physics 155EDF and film. The film shot is a 70-minute exposure, while the HyperStar image is a single 30-second shot! Note also the smaller stars in the HyperStar image, a result of the high-quality HyperStar optics and the shorter exposure time (resulting in fewer guiding errors and less atmospheric distortion). Left image by Dean Koenig and Scott Tucker, right image by Scott Tucker.

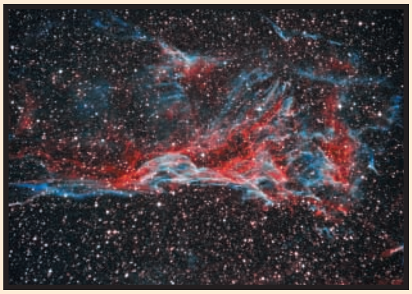
Higher-resolution version of the single 30-second, unguided HyperStar image from the comparison above. Image by Dean Koenig and Scott Tucker

This image of the Pleiades star cluster was captured using a Celestron 8-inch SCT, HyperStar, and SXV-H9C one-shot-color camera. Again the exposures were unguided and alt-az, for a composite of fifty 60-second exposures. Image by Gary Breneman.

An image of the Running Man nebula in Orion, taken using the same setup as the Orion Nebula image below. Again the exposure is thirty 30-second, unguided shots. Image by Dail Terry and Scott Tucker.



HyperStar is also ideal for narrowband imaging. Normally narrowband images take hours to capture, even with a sensitive CCD camera, because the filters let through so little light. But the results show fantastic detail and the filters block light pollution. The above image of the Veil Nebula in Cygnus was captured with a Celestron 14-inch SCT, HyperStar, and SBIG ST-10XME, using H-alpha, OIII, and SII narrowband filters. Exposures were three 5-minute shots through each filter. The same image taken with a "fast" f/5 wide-field refractor would require a total exposure time of over five hours! Image by Scott Tucker.



Another section of the Veil supernova remnant, called Pickering's Wedge. This is the faintest part of the nebula, not often seen in this much detail. Again, narrowband filters allow very faint detail to be captured, and HyperStar allows this to be done quickly. Image taken with a Celestron 14-inch SCT, HyperStar, SBIG ST-10XME with H-alpha and OIII filters. Exposure is three 5-minute shots through each filter, for a total of only 30 minutes. Image by Scott Tucker.

This image of the Orion nebula was captured using a Celestron 11-inch SCT, HyperStar lens, and Starlight Xpress SXV-H9C one-shot color CCD camera. The image is a composite of thirty 30-second, unguided alt-azimuth images. Image by Dail Terry and Scott Tucker.

The space available here simply cannot convey the detail captured in these images. Please visit http://starizona.com/acb/hyperstar/hyperstar_article.aspx to view the images at full resolution.

halfway decent picture of the Horsehead Nebula? A sad sight, really.

Even as I slowly dragged myself up the steep learning curve of film astrophotography, I could see the revolution coming. People started taking really lousy CCD images, but they didn't have to develop film or scan negatives. They could tell immediately when the telescope was focused. It was only a matter of time before CCD cameras started producing good images. As they say, you either ride the steamroller of new technology or become part of the road.

So, I sold off my Pentax 6x7 and my freezer-full of PPF400. I couldn't believe how fast imaging had been made by the new technology. CCD cameras were up to fifty times more sensitive than film. Pictures that used to take hours now took only minutes.

But old habits die hard. Once the elite astrophotographers switched to CCD, they naturally began pushing the boundaries of the new technology. These were people who were not afraid of 2-hour exposures. Sure, you could spend ten minutes getting a picture of the Orion Nebula that matched a 2-hour film shot, but what would happen if you spent two hours with a CCD? Well, you'd get a pretty mind-blowing picture.

The magazines started filling up with stunning images from CCD cameras, and soon you could peruse an entire issue without spotting a single film photograph. The number of people engaged in astronomical imaging was slow to grow, however, despite the new technology eliminating the need for lying on the ground under a scope, squinting into a viewfinder to locate the Whirlpool Galaxy.

The primary reason for this slow growth was that people looked at those incredible images in the magazines, then looked at the listed exposure times and freaked out. The pictures had captions reading "L = 240 minutes, R = 120 minutes, G = 150 minutes, B = 180 minutes." Even with the cryptic letters, it's easy to see that those numbers add up to more than eleven hours of imaging time. Admittedly, that's a turnoff for casual stargazers.

The Need for Speed

The concept for the HyperStar lens stemmed from Celestron's original Fastar design. This system incorporated a corrector lens that mounted in place of the secondary mirror on a Schmidt-Cassegrain telescope. By placing a CCD camera at the front of the telescope rather than at the back, exposure times became twenty-five times shorter. This was a huge step forward in making deep-sky imaging more convenient. Images could now be captured rapidly, and guiding the telescope became unnecessary. But there were limitations to the system, and we at Starizona saw room for improvement.

One of the limitations was that the Fastar lens was designed when CCD chips were still small. An original disadvantage of CCD versus film was the much smaller size of a CCD compared to a 35 mm negative. As demand for more imaging real estate increased, and the cost of making CCDs decreased, chip size began to grow rapidly. The Fastar lens could not accommodate many of the newer camera designs.

Improvements in optical quality were also possible. HyperStar lenses produce spot sizes at the edge of the field at f/1.8, which are more than ten times smaller than those produced at f/10 by the same telescope. The latest HyperStar lenses include a built-in system for easy collimation. This allows any misalignment in the primary mirror of the telescope to be compensated. This is normally done by the secondary mirror, so it is possible that the user would never know that a primary mirror is misaligned until using a HyperStar lens. The HyperStar lens produces tiny star images across a very wide, flat field of view.

The latest big steps in the development of HyperStar were to make the lenses available for Meade telescopes as well as Celestrons and to redesign the 14-inch models (for both Meade and Celestron) to allow the use of the popular digital SLR cameras. The combination with a DSLR, such as the Canon Digital Rebel XTi, provides a very large field of view (1.9°x1.3°) and one of the easiest means for capturing deep-sky images.

Suffering For Your Art

There is a great sense of accomplishment that comes from suffering to achieve a goal. That's why people run marathons or climb mountains. Not just anyone is willing to endure the pain and wheezing associated with pounding out 26.2 miles or slogging through thigh-deep snow at 25,000 feet. However, that leaves those achievements to an elite few; and, in a sense, that was what astrophotography was like.

There is, however, a respect in which that analogy fails. While standing on the summit of Everest is a goal with no easy means of achievement, that is not necessarily true for all pursuits. For example, you can go to Yosemite and spend two days scaling the 3,000-foot vertical face of El Capitan – sleeping on a portaledge, thrashing your hands on the sharp rock, and generally scaring yourself to death – or you can walk up the trail on the other side. Both get you the same view of the sun setting over the valley.

Think of HyperStar as the trail. You can suffer if you want, and there will always be some who wish to push the boundaries. You can use narrowband filters and spend two hours imaging with a HyperStar lens. Just like those who were willing to take two-hour exposures with CCDs and make a great leap beyond film, the results of deep exposures at f/1.8 are stunning and a greater leap yet. But HyperStar has opened up the possibility of taking great astrophotos to the average amateur astronomer. High-quality images people are proud to display on their Web sites, or frame and hang over their sofas, are now possible for just about anyone with a few minutes to spare.

Or, Pleasantly Relaxing For Your Art

In 2003, I took a Celestron 14-inch telescope and HyperStar lens to the Table Mountain star party in Washington State. It's a great star party in a beautiful location, but there is a drawback to holding a star party in Washington in July: the sun doesn't set until 9 p.m. Despite darkness not fully setting in until after 11 p.m., and despite stopping for a half hour to photograph a lovely aurora display, we managed to capture high-quality images of twenty-two deep-sky objects – from the Swan Nebula to the Pinwheel Galaxy – and still be in bed by 2 a.m.

The ultimate HyperStar revelation came when we discovered it was possible to capture amazing images without the hassle of polar alignment. Among the most popular telescopes for amateur astronomers are the fork-mounted, alt-azimuth Schmidt Cassegrains. While extremely convenient for visual observing, it was necessary in the past to mount the telescope on an equatorial wedge and accurately polar align it for deep-sky astrophotography. This added weight, cost, and hassle, and it required a whole new skill set. The ability to capture images with an unguided, alt-az mounted, computerized telescope was inconceivable just a few years ago. Now, thanks to HyperStar, we regularly receive great images from customers after their first night out.

Living in the Future is Great!

Recently, we drove out into the desert to set up an 11-inch SCT and HyperStar. We used the telescope in alt-azimuth mode, focused the telescope using a wireless autofocuser, and located faint objects with ease using the telescope's computer. The entire setup procedure took less than half an hour. In the old days I would still have been polar aligning with the painful task of focusing and finding objects still to look forward to.

As we began taking images, the absurdity set in of how easy this was in comparison to the methods of astrophotography just a few years ago. I laughed and said, "This isn't real astrophotography. There isn't enough suffering!" What used to take hours to do, months to learn, and years to perfect was now being accomplished in seconds, hours, and weeks. Suddenly, anyone could do astrophotography and get incredible results.

That night, we captured images of seventeen deep-sky objects with a total of over two hundred individual exposures. We were done and completely packed up to leave by 11 p.m. In the past, I was happy if I was taking my first exposure by 11. It was like wearing down a pencil doing long division and then being shown a calculator. "Hey pal, there's an easier way. Here, try this."

In much the way that computerized telescopes brought easy stargazing to the masses, HyperStar is revolutionizing deep-sky imaging. Popularizing imaging can only be a good thing. As the population spreads into rural areas, bringing light pollution with it, visual observing is becoming more challenging than ever. Viewing the Horsehead Nebula is difficult using a 20-inch telescope from a dark site. On the other hand, it is a common target when we are teaching new HyperStar owners in the Starizona parking lot which is next to a major six-lane road!

An 8-inch telescope and 30-second exposures will now show you the colorful wonders of the universe better than you could ever see them visually in even the largest telescope. Welcome to the painless future of astrophotography. ATT

HYPERSTAR INSTALLATION

One of the first questions people ask is how to install the HyperStar. People are understandably nervous about taking apart the optics in their telescope, but installing and removing the HyperStar is extremely easy and fast. Switching from the standard visual setup to the HyperStar imaging configuration (or the reverse) takes less than two minutes.

Compatible telescopes have a retaining ring which is removed from the secondary mirror assembly. The secondary mirror is then lifted out of the telescope and placed into a protective holder included with the HyperStar lens. The retaining ring goes onto the holder to prevent the mirror from falling out of the holder. The CCD camera is threaded onto the HyperStar lens, and the entire HyperStar/camera assembly is threaded onto the secondary housing in the corrector plate. Plug in the camera's cables and you are ready to go! Reverse the process to remove the HyperStar and replace the secondary mirror. The mirror is indexed so it goes back in the same way it came out, eliminating any need to collimate the optics after using HyperStar.

For non-compatible telescopes, a kit is available from Starizona to convert the telescope to HyperStar compatibility. See the HyperStar Web site at or contact Starizona at 520-292-5010 for more details.