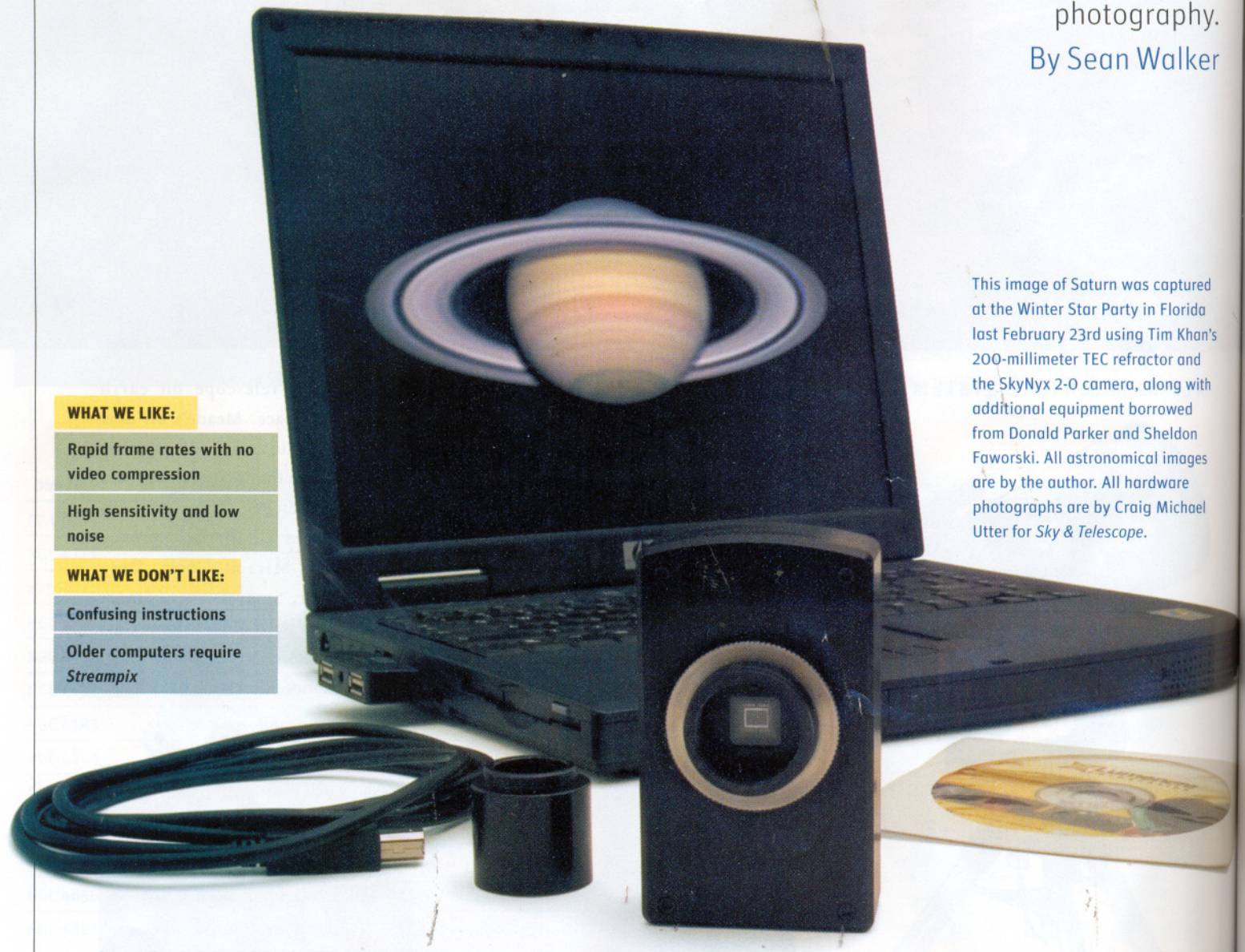
S&T | test report

Planetary photographers have taken notice of Canada-based Lumenera Corp. and its line of high-speed digital cameras. Capable of capturing video clips at up to 60 frames per second, the company's new Lw1075M CCD camera has been renamed SkyNyx 2-0 for introduction to the astronomical market.

Premier Planetary Imager

A new camera raises the bar for solar-system photography.

By Sean Walker



This image of Saturn was captured at the Winter Star Party in Florida last February 23rd using Tim Khan's 200-millimeter TEC refractor and the SkyNyx 2-0 camera, along with additional equipment borrowed from Donald Parker and Sheldon Faworski. All astronomical images are by the author. All hardware photographs are by Craig Michael Utter for *Sky & Telescope*.

WHAT WE LIKE:

- Rapid frame rates with no video compression
- High sensitivity and low noise

WHAT WE DON'T LIKE:

- Confusing instructions
- Older computers require *Streampix*

PLANETARY PHOTOGRAPHY has grown in popularity and quality during the past few years. With webcams and software that can sort thousands of frames to pick the sharpest ones to combine, successful planetary photographers are no longer limited to locations with ideal atmospheric seeing. But there are still limits to webcam imaging. For example, amateurs working with inexpensive webcams are forced to record video clips at only five frames per second in order to avoid image-compression artifacts inherent with faster frame rates on relatively slow USB 1.0 connections. To eliminate these problems, some pioneering individuals began searching for faster, more powerful cameras. Their search ended at Lumenera Corp., a Canadian company that specializes in high-end cameras for science and industry.

While writing about planetary imaging last year (*S&T:* October 2005, page 115), I became intrigued by the stunning images produced by well-known amateurs Damian Peach in England and Paolo Lazzarotti in Italy. Based on their experiences, we decided to take a closer look at the Lumenera Lu075M camera. After just a few nights of testing, it was clear to us that the camera would be a Hot Product pick for 2006 (*S&T:* January 2006, page 98). What follows is our in-depth evaluation.

I began working with monochrome and color versions of the camera on loan from Lumenera late last year. Then early this year the company sent us its new "astronomical" version of the monochrome camera, called the SkyNyx 2-0, which will be available around the time this issue reaches readers. While the version I tested has the same housing as the older Lu075M model, Lumenera's Thomas Maroney told us that a new housing is being developed for astronomical cameras.

The SkyNyx 2-0 has better noise characteristics at high gain settings than the Lu075M. The camera has a high-speed USB 2.0 computer interface that allows recording up to 60 frames per second of uncompressed video using the CCD's entire 640-by-480-pixel format. Even faster frame rates are possible when a sub-frame portion of the chip is used, though this will be limited by the brightness of the subject. Uncompressed video is important because compression loses data and produces lower-quality, noisy frames, which require many frames to be stacked to achieve a smooth final image.

Although the Lumenera cameras are made for still images, there are freeware programs such as *AMCap* (http://noeld.com/programs.asp?cat=video) and *Lucam Recorder* (www.astrofactum.de) that run the Lumenera in video mode with an interface similar to those used for popular webcams.

The original Lumenera camera arrived with a small AC power adapter and a 6-foot (2-meter) USB cable, as well as a CD-ROM containing software drivers and the software for single-frame capture (*Lucam*). I also received a trial version of *StreamPix*, a video-capture package by Norpix, but more about this software later. While I had to supply my own adapter to couple the camera's C-mount to my telescope, the adapter is included if you purchase the camera from Adirondack Astronomy or Astromeccanica.

Planet Flicks

Lumenera SkyNyx 2-0 camera (formerly called Lumenera Lw1075M) and USB cable.

US price: $995
(bundled with StreamPix: $1,495)

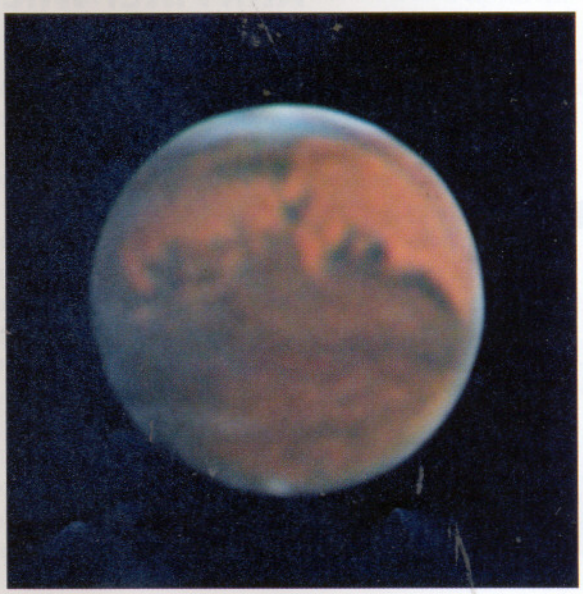
North America:
Adirondack Astronomy,
72 Harrison Ave., Hudson Falls,
NY 12839; 877-348-8433;
www.astrovid.com.

European price: €790
(bundled with StreamPix: €1,165)

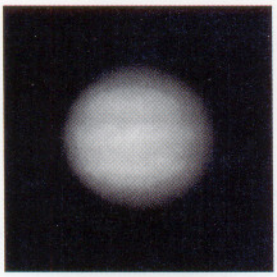
Astromeccanica, Pernice 71-54100
Romagnano, MS, Italy; +39 0585
831130; www.astromeccanica.it.

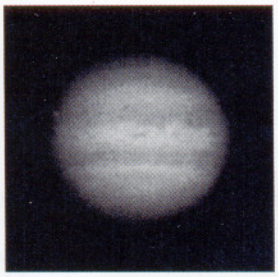
First Light

In a strange twist of fate it was clear the evening the camera arrived, so I quickly installed the camera drivers and software on my laptop computer and headed outside to capture Mars while it was still large enough to reveal fine details in my 7-inch

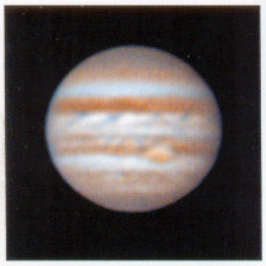


One of the SkyNyx 2-0's astronomical benefits compared with inexpensive webcams is its high sensitivity. This allows you to use greater magnifications (which produce dimmer images) with a given telescope. While recording Mars just after opposition last year, the author typically used an effective focal length of 15.2 meters with his 7-inch (178-millimeter) Maksutov-Newtonian telescope. This view was captured on the evening of November 26th, when the Martian disk appeared 17.7 arcseconds across.





Right: Because the Lumenera camera records video without image compression, the individual frames are relatively smooth even when the camera is set to maximum gain. The left image is a single frame of Jupiter from a SkyNyx 2-0 AVI movie clip made through a red filter on the morning of January 29th when the planet was only 24° above the horizon. Compare it with the red-channel image at right from a single frame captured with a ToUCam Pro 740. *Below:* The tricolor result obtained with the Lumenera camera and the author's 7-inch telescope.

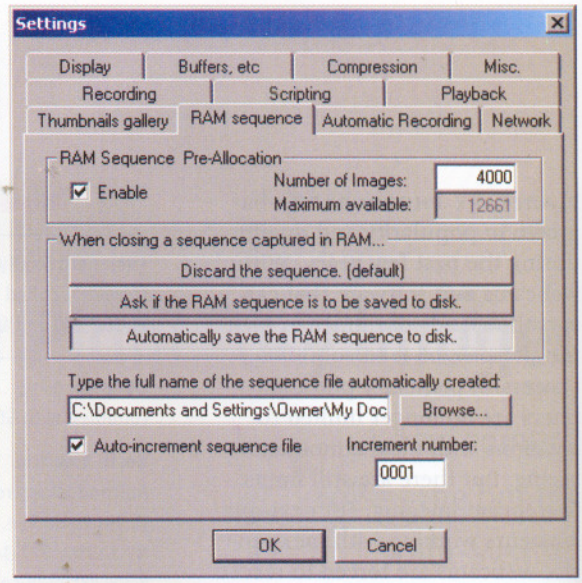


Maksutov-Newtonian telescope. That was a mistake.

The first problem I encountered was that my laptop's 1-GHz processor was too slow to run the camera with *AMCap*, since this software writes a large, uncompressed RGB video file (in AVI format) directly to the computer's hard drive. Because of dropped frames, I ended up effectively recording only 5 to 10 frames per second. This wasn't much better than the inexpensive webcams I've used and was especially troublesome since I wanted to shoot movie clips through separate red, green, and blue filters to assemble a color image with the monochrome camera.

I then tried *StreamPix* and realized rather quickly that I should have read the Help files before attempting to run this program, as it's unlike any of the webcam software I've used in the past. So much for trying to avoid the learning curve! Fortunately, clouds arrived and I was able to spend time examining the software and camera in detail before my next outing.

Like Lumenera's cameras, *StreamPix* is intended for industrial purposes, and many of its features are unnecessary for planetary imaging. After reading the Help files I was still confused about the best way to use the setup for astronomical imaging, so I contacted Lazzarotti, who kindly provided me with



A Lumenera movie clip made at high frame rates produces a huge data stream that can overwhelm computers with slow processors and hard drives, causing dropped frames and effectively slower frame rates. One solution is to use the optional *StreamPix* software, which can write a movie sequence directly to a computer's RAM and thus postpone saving it to the hard drive until after the video capture is finished. With this method the author effectively doubled his frame rate from 15 to 30 frames per second with his older-model 1-GHz laptop.

detailed instructions. This was a huge help, and soon I had the system running smoothly.

The biggest strength of *StreamPix* is its ability to write data from the camera directly to the computer's RAM. Later, you transfer the data from RAM to the hard drive as an AVI-format movie. By avoiding the steps of converting the data stream to AVI format and recording it on a relatively slow hard drive,

Atik Filter Wheel

As mentioned in the accompanying article, I preferred assembling color images from individual frames shot through red, green, and blue filters with the monochrome Lumenera camera. Early on, however, it became obvious that removing the camera from the telescope and switching filters for each video clip was impractical. Not only were the separate images usually rotated relative to one another, but also the process increased the chance of getting dust and fingerprints on the filters.

My solution to these problems was the filter wheel made by Atik Instruments ($199), which is available from Adirondack Astronomy (www.astrovid.com). This all-metal unit is beautifully machined and can hold five 1¼-inch filters. I found it to be an ideal match for the Lumenera camera.

Weighing only 11 ounces (310 grams), the Atik filter wheel has a 1¼-inch nosepiece for the telescope side and a male T thread with locking ring for the camera side (other fittings are available). Users must supply their own filters; I used Custom Scientific's red, green, and blue filters. Another space was filled with an infrared-pass filter that has proven beneficial for capturing surface detail on Mars.

The unit was very solid, even when used with a long stack of 1¼-inch Barlow lenses. Indeed, on nights of good seeing I was able to use such high magnifications that I had more than 9 inches of accessories between my focuser and the camera, yet the planets never jumped off the chip when I changed filters. The filter wheel turned very smoothly with an easily identifiable click-stop for each filter position.

StreamPix bypasses the frame-dropping problem that handicaps slower computers. This is my biggest justification for recommending this somewhat expensive program, especially for those with older computers such as mine.

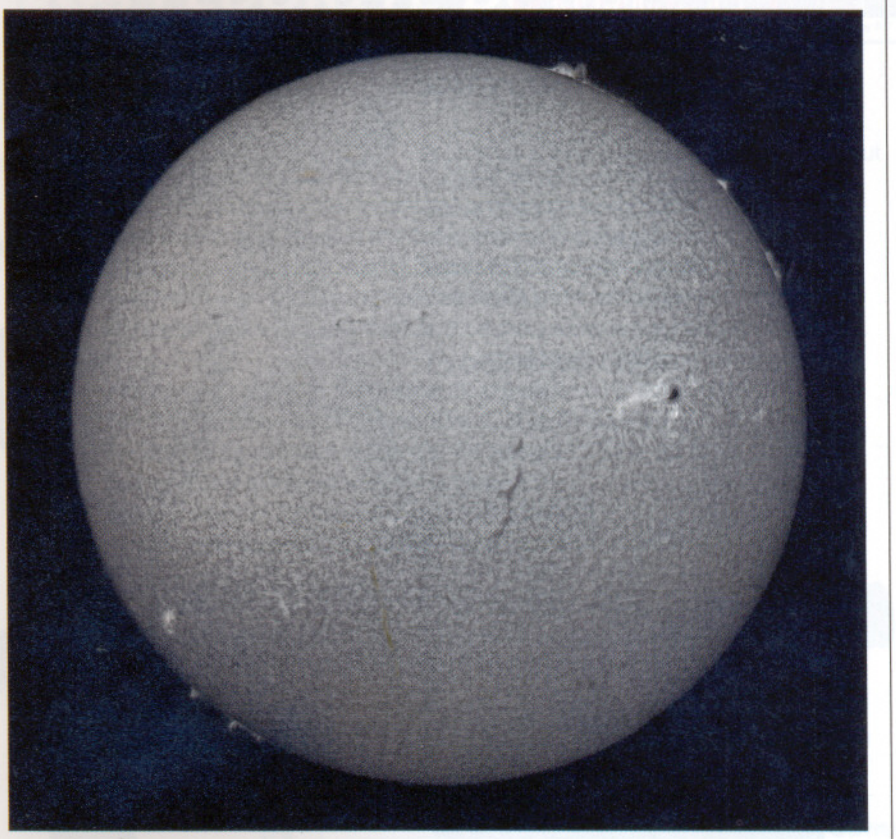
With *StreamPix* running on my laptop, I was able to record video at 30 frames per second, and even higher rates were possible when I used a sub-frame crop, though my 7-inch aperture produced images that were too dim to be useful at the reduced exposure times corresponding to the faster frame rates. *StreamPix*'s sub-frame feature allows you to crop the image to any size you wish, saving precious hard-drive space by reducing the amount of blank information in each movie sequence. The software also records a true monochrome movie, rather than generating unnecessarily large RGB movies that contain no additional information for a monochrome camera.

With the ability to rapidly record uncompressed frames, I could easily capture enough of them for stacking during short movie clips and thus "beat the seeing" even on mediocre nights. I quickly established a routine for recording red-, green-, and blue-filtered movie clips in rapid succession, which is important when making color images of the rapidly rotating planets Mars, Jupiter, and Saturn. While I didn't need separately filtered movies with the Lumenera color cameras, I still preferred the monochrome camera because of its higher sensitivity and the cleaner data stream. Furthermore, the best images I've seen of the planets have been captured using tricolor techniques, so everything points to it being the superior method.

While recording Mars, I was struck by how easy it was to get sharp images with the Lumenera camera. With a Philips ToUcam Pro 740, I was frequently frustrated by the poor seeing that usually occurs here in New England. But with the SkyNyx 2-0, even seemingly mediocre video clips produced quality results. Of course, I was still limited by the resolution of my telescope's relatively small aperture, but I found the uncompressed movie files far easier to process successfully.

Observers thinking of moving up to a Lumenera camera from a webcam should consider the magnification differences involved. The SkyNyx 2-0 has an array of 7.4-micron-square pixels, compared with the ToUcam's 5.6-micron pixels. Thus I had to increase my telescope's effective focal length by a factor of 1.32× to achieve the same per-pixel image scale. While this magnification increase reduced the image brightness, the Lumenera camera had no problem recording well-exposed video clips.

Although I had good success imaging planets, I had even better results using the Lumenera camera on my Coronado Personal Solar Telescope (PST). The camera provided extremely smooth images at low gain, and it proved very effective for shooting the low Sun in its daily journey through New England's winter sky. Compared with images from the ToUcam, the Lumenera images were far less noisy and easier to process.



In addition to its excellent planetary performance, the SkyNyx 2-0 is superb for imaging the Sun and Moon. The author captured the solar disk in hydrogen-alpha light last November 21st using his Coronado Personal Solar Telescope (PST). It's an 11-image mosaic, with each piece being a stack of 150 frames from the SkyNyx 2-0 that were combined with *RegiStax* and *MaxIm DL*.

Does the Lumenera camera live up to its reputation? I feel it does. But there are a few caveats. It certainly captures smoother individual frames than inexpensive webcams, but at a premium price. And in order to take full advantage of the Lumenera you either have to have a computer capable of high write speeds, such as a 2.6-GHz processor with a 7,200-rpm hard drive, or you need the optional *StreamPix* software. If capturing the best solar-system images possible is your goal, then this camera is worth the investment. ✶

Assistant editor Sean Walker *has spent most clear nights during the past eight months capturing planetary images with a variety of cameras.*

S&T RATINGS

Lumenera SkyNyx 2-0	
Camera	★ ★ ★ ★
***StreamPix* software**	★ ★ ★ ½
Overall	★ ★ ★ ★

★★★★★ Sensibly perfect. No meaningful improvements possible.
★★★★ Any shortcomings will go unnoticed in normal use.
★★★ Problems noticeable but do not seriously affect performance.
★★ Problems noticeable during normal use – performance compromised.
★ Problems so severe that the equipment is virtually unusable.

Ratings are intended to convey performance compared with equivalent equipment and should not be used to predict the relative performance of instruments having markedly different specifications.

Bottom Line Summary: *The Lumenera SkyNyx 2-0 is a high-sensitivity, low-noise monochrome camera capable of recording high-quality images of solar-system objects with modest telescopes.*

new product showcase

▼ **ASTRO-TECH LINE** With its initial foray into the field of high-quality accessories for backyard stargazers, Astronomy Technologies has released an impressive array of small refractors and star diagonals. The new 80-millimeter f/6 achromat ($379) and 66-mm f/6 ED apochromatic doublet ($329) include features not normally found at these prices, such as a dual-speed Crayford-style focuser and a custom-fitted, foam-lined case. Purchasers can choose from a variety of tube finishes.

Astro-Tech's line of mirror diagonals ranges from a 1¼-inch model with a 99% reflective coating ($69.95) to 2-inch versions for conventional focusers and threaded for Schmidt-Cassegrain telescopes (starting at $79.95). All 2-inch models include 1¼-inch adapters and are available with standard enhanced-aluminum or 99% reflective dielectric coatings. A 45° erect-image 1¼-inch prism diagonal ($59.95) is also available. All models feature non-marring compression rings.

■ Available from Astronomics, 680 SW 24th Ave., Norman, OK 73069; 800-422-7876; www.astronomics.com, and High Point Scientific, 442 Route 206, Montague, NJ 07827; 800- 266-9590; www.highpointscientific.com

▲ **ZOOM PRESCRIPTION** Tele Vue has updated its popular 1¼-inch 7–24-millimeter zoom eyepiece ($240) to accept its Dioptrx astigmatism correctors. Now observers can put away their glasses and enjoy this versatile eyepiece unimpeded by the restrictions of limited eye relief. The eyepiece features Tele Vue's unique click-stop zoom feature, ideal for bino-viewers, and includes a fold-down rubber eyeguard. The new eyepiece design also mates with Tele Vue's camera adapter for variable-magnification photography.

■ Tele Vue Optics, 32 Elkay Dr., Chester, NY 10918; 845-469-4551; www.televue.com

▶ **DSLR CONTROL** Astrophotographers using Canon digital single-lens reflex (DSLR) cameras will appreciate DslrStar ($180) from Cercis Astro. The unit allows long-exposure sequences, including dark frames, to be programmed and controlled either through a computer or in stand-alone mode. The unit records exposure information such as time, temperature, mirror lock-up, and delay between exposures. Housed in a rugged metal case, DslrStar comes with an AC power adapter, USB cable, Canon A612 basic cable, and CD-ROM containing Windows software. It sports input jacks for camera cables and an autoguider port compatible with any telescope that has TTL guider inputs. DslrStar currently supports Canon cameras including the 300D, 10D, 20D, 20Da, and Digital Rebel.

■ Cercis Astro, 108 West Franklin Ave., Pennington, NJ 08534; 609-737-5120; www.cercisastro.com

New Product Showcase is a reader service featuring innovative equipment and software of interest to amateur astronomers. The descriptions are based largely on information supplied by the manufacturers or distributors. *Sky & Telescope* assumes no responsibility for the accuracy of vendors' statements. For further information contact the manufacturer or distributor. Announcements should be sent to nps@SkyandTelescope.com. Not all announcements will be listed.