the ASTROGRAPH

Volume 38 No. 5 April/May 2007

the ASTROGRAPH

Change of Address Notices - in order to expedite your change of address please send it to us promptly and include the old mailing label from your last issue. Remember the Post Office will not forward CDs unless you guarantee forwarding postage by leaving a deposit.
Renewal Notices - Unlike other publications that hound you with renewal notices, the ASTROGRAPH is currently sending out only one renewal notice. When you renew please use the self addressed envelope, or notify us that it is a renewal. Only include a mailing label if there is no indication of your current address.
Articles and Photographs - If possible send us articles on **3.5" floppy IBM compatible disks.** Any word processor is acceptable (WordPerfect is preferred).

COVER PHOTOGRAPH

Object..M16 and M17
Photographer..Lee C. Coombs
Instrument...........................70mm (diameter) F/5.1 Tele Vue Pronto
Exposure/Film.........30 minutes/Kodak Ektachrome Professional 200
Date...13 August 1999

VOLUME 38 No. 5
EDITOR..Robert C. Price
CONTRIBUTING EDITOR..................................Ralph Proctor
PROOFING CONTRIBUTOR................................Linda Miller
CONTRIBUTORS..Lee C. Coombs

Features

Departments

The ASTROGRAPH is published in Adobe PDF format six times a year as follows: No. 1, August/March, No. 2 December/March, No. 3 December/March, No. 4 February/March, No. 5 April/May, No. 6 June/July. **Mailed CD** subscription rate is **$15.00** per year for the United States or any address with a U.S. zip code. Mailed CD subscription rate for Canada is $20.00 per year. Mailed CD subscription rate for Mexico is $30.00 per year. Mailed CD subscription rate for all other foreign countries is $35.00 per year. Subscriptions and all manuscripts and photographs submitted for editorial consideration should be sent to **the ASTROGRAPH, Post Office Box 369, Dumfries, VA 22026**. NOTE: for persons submitting articles please indicate if you do not want your name and address to appear at the conclusion of the article. Photographs are kept on file for possible use as illustrations at a later date unless accompanied by a self addressed envelope with return postage. AIRMAIL CD subscription rates per year: U.S. $22.00, Canada and Mexico $31.00, all other foreign countries $35.00.

Product Evaluation: SBIG ST-2000XCM

by

Robert C. Price

The SBIG (Santa Barbara Instrument Group) ST-2000XCM is a CCD camera with integrated electronics and built-in TC-237H CCD for auto guiding. This particular unit can produce a one shot color image or a black and white image. The SBIG ST-2000XCM uses the Kodak KAI 2020M image CCD sensor. This CCD image sensor is 1600 by 1200 pixels in extent with each pixel being 7.4 microns square. The physical dimensions of the CCD chip are 11.8mm by 8.9mm. The SBIG ST-2000XCM optical head weighs 2 pounds and measures 5 inches on a side and 4 inches deep. The SBIG ST-2000XCM comes in a hard shell carry case. The SBIG ST-2000XCM comes with a t-thread adapter and lens cap for a 2 inch eyepiece holder. Figure 1 shows the SBIG ST-2000XCM mounted to the author's NP-101. Figure 2 shows the SBIG ST-2000XCM and its carrying case.

Initial tests on the SBIG ST-2000XCM were from the author's backyard 28 miles south of Washington D.C. This test consisted of mounting the SBIG ST-2000XCM to the author's Tele Vue NP-101 and Losmandy G-11 equatorial mount. A Williams Optics 2 inch prime focus camera adapter just barely provided the back focus distance necessary to focus the SBIG ST-2000XCM. Several short 5 minute exposures were taken of the Orion Nebula, M81 and 82, and M51 to get a feel for how well this CCD performed and to determine what processing was necessary to obtain a good final image. The noise characteristics of the SBIG ST-2000XCM are discussed on page 76. Figure 3 shows a 5 minute exposure of M81 and M82 using the SBIG ST-2000XCM. This is a portion (about 85 percent) of the original image with adjustment of the raw image in its SBIG default format, dark frame subtraction, hot pixel reduction, and Adobe Photoshop processing. By comparison, a 4 minute 18 second exposure taken with a Hutech modified Canon 350D, is shown in Figure 4. The Canon image is also the original image without any hot pixel reduction or dark frame subtraction, but with similar processing in Adobe Photoshop. Both images seem to record the fainter stars equally well. The saturation levels of the brighter part of the galaxies seems al-

Above, Figure 1: SBIG ST-2000XCM product evaluation. Shown above is the SBIG ST-2000XCM optical head attached to the author's Tele Vue NP-101 with a Williams Optics prime focus adapter.

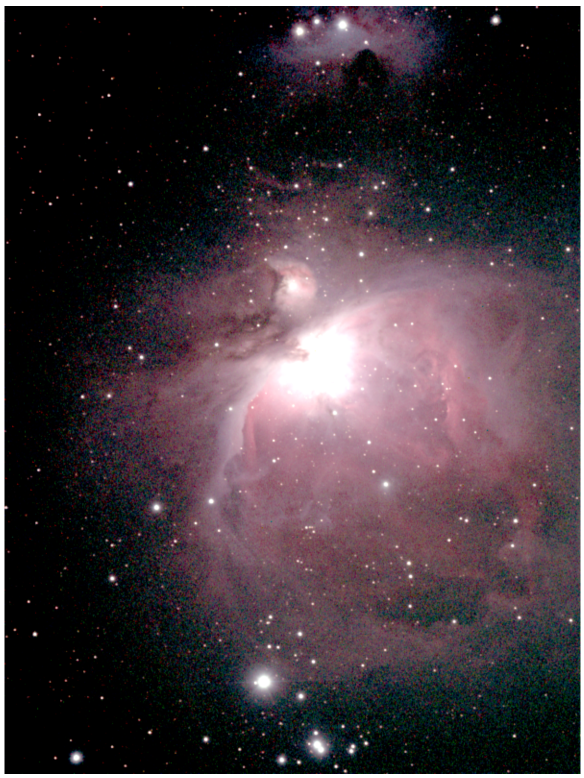
most identical. Without the adjustment of the SBIG image in its raw format, the central portion of M81 would be saturated with a total loss of detail. This raw format image adjustment was not the case with images of the Orion Nebula taken with the SBIG ST-2000XCM. As can be seen in Figures 5 and 6, both images appear to have similar saturation levels without the SBIG image, Figure 5, needing any adjustment in its raw format. Both images seem to be able to record faint stars equally well. Figure 5 is a 5 minute exposure of the Orion Nebula taken with the SBIG ST-2000XCM and has been heavily processed in Photoshop after dark frame subtraction and hot pixel reduction. Figure 6 is a 5 minute exposure of the Orion Nebula taken with a Hutech modified Canon 350D. The Canon image is the raw image processed in Adobe Photoshop but without dark frame subtraction or hot pixel reduction. Both images were reduced 50 percent and printed to scale to illustrate the difference in size of these two sensors. The SBIG ST-2000XCM has a CCD sensor 11.8 by 8.9 mm while the Canon 350D has a CMOS sensor 22.2 by 14.8 mm. Each SBIG CCD pixel is 7.2 microns square while each Canon 350D CMOS pixel is 6.4 microns square. As a general rule, the larger the pixel the better the dynamic range because the larger pixel can absorb more photons before being saturated.

The Canon images taken in Figures 4 and 6 were taken from the same location but under slightly better sky transparency conditions than the SBIG images. Slightly fainter nebula features should be expected in these images. The most striking difference between the image taken with the SBIG ST-2000XCM in Figure 5 and the image taken with the Hutech modified Canon 350D in Figure 6 is the blue ring around the bright star just south of the Orion Nebula. Because the same telescope was used in both images this is not a case of chromatic aberration. It appears that the Hutech modified Canon 350D has better sensitivity to the blue end of the spectrum than the SBIG ST-2000XCM. Note that NGC 1982, the nebulosity just north of the Orion Nebula, is better defined in the image taken with the Hutech modified Canon 350D. The author had noticed that in a comparison of the unmodified Canon 350D and Hutech modified Canon 350D (images taken of the same object the same night using both cameras) that the Hutech modified Canon 350D did have slightly better blue sensitivity.

Above, Figure 2: SBIG ST-2000XCM product evaluation. Shown above is the SBIG ST-2000XCM in its case.

Above, Figure 3: SBIG ST-2000XCM product evaluation. Shown above is a 5 minute exposure of M81 and M82 taken with the SBIG 2000XCM.

Above, Figure 4: SBIG ST-2000XCM product evaluation. Shown above is a 4 minute 18 secont exposure of M81 and M82 taken with a Hutech modified Canon 350D.



Above, Figure 5: SBIG ST-2000XCM product evaluation. Shown above is a 5 minute exposure taken with the SBIG ST-2000XCM and printed to the same scale as the Hutech modified Canon 350D image, Figure 6.

Above, Figure 6: SBIG ST-2000XCM product evaluation. Shown above is a 5 minute exposure of the Orion Nebula taken with a Hutech modified Canon 350D and printed to the same scale as the SBIG ST-2000XCM image, Figure 5.

Above: Total solar eclipse diamond ring effect photographed by Lee C. Coombs on 29 March 2006 using a 600mm lens at F/9. Exposure was 1/500 second on Ektachrome 200 professional film.

Above: Total solar eclipse corona composite photographed by Lee C. Coombs on 29 March 2006 using a 600mm lens at F/9. Exposures were .05, 1/8 and 1/30 second on Ektachrome 200 professional film.

Astrophotography for April and May

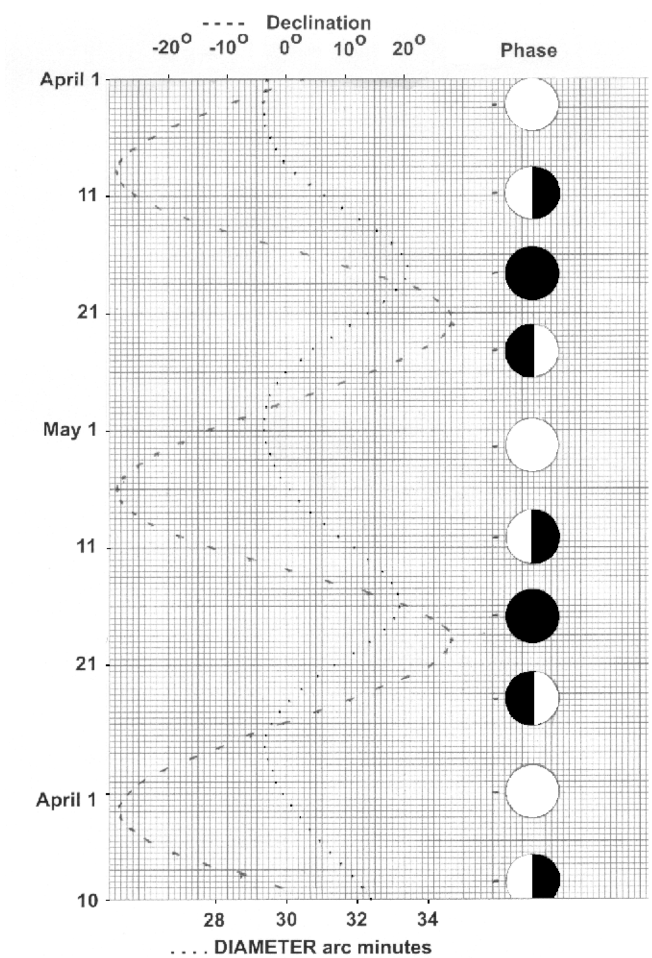
by

Ralph Proctor

Mercury begins April as a morning object high in the eastern sky. During April Mercury moves lower in the eastern sky and disappears into the Sun's glare during the last week in April, reaching superior conjunction with the Sun on 2 May. Mercury emerges from the Sun's glare in mid May as an evening object low in the western sky and reaches a greatest eastern elongation of 23 degrees on 2 June when it will be good photographic position with a declination of plus 25 degrees.

Venus begins April as an evening object high in the western sky. During April and May Venus moves higher in the western sky and reaches a greatest eastern elongation of 45 degrees on 9 June.

Lunar Declination and Diameter:



The Moon's waxing quarter phase will be located high on the ecliptic and in excellent photographic position during April (April 22) and May (May 19), with an apparent declination of up to +29 degrees.

Mars begins April as a morning object low in the eastern sky in the constellation Capricornus, but moves into the constellation Aquarius in early April and then into the constellation Pisces in early May. During April and May Mars moves higher in the eastern sky, increases in brightness from magnitude +1.1 to +0.8, and increases in diameter from 4.9 to 5.8 arc seconds.

Jupiter begins April as a morning object high in the eastern sky in the constellation Ophiuchus. During April and May Jupiter moves higher in the eastern sky, increases in brightness from magnitude -2.3 to -2.6, and increases in diameter from 40.4 to 45.7 arc seconds.

Saturn begins April as an evening object high in the western sky in the constellation Leo, having reached opposition with the Sun on 10 February. During April and May Saturn moves lower in the western sky, decreases in brightness from magnitude +0.2 to +0.5, and decreases in diameter from 19.4 to 17.5 arc seconds.

Uranus begins April as a morning object low in the eastern sky in the constellation Aquarius having reached conjunction with the Sun on 5 March. During April and May Uranus moves higher in the eastern sky, remains constant in brightness at magnitude + 5.9, and increases in diameter from 3.36 to 3.48 arc seconds. Uranus is located at R.A. 23 hours 12.8 minutes declination -05 degrees 52 minutes on 15 April and at R.A. 23 hours 17.3 minutes declination -05 degrees 25 minutes on 15 May.

Neptune begins April as a morning object low in the eastern sky in the constellation Capricornus having reached conjunction with the Sun on 8 February. During April and May Neptune moves higher in the eastern sky, increases in brightness from magnitude +8.0 to +7.9, and increases in diameter from 2.22 to 2.30 arc seconds. Neptune is located at R.A. 21 hours 36.2 minutes declination -14 degrees 32 minutes on 15 April and at R.A. 21 hours 37.7 minutes declination -14 degrees 25 minutes on 15 May.

Pluto begins April as a morning object high in the eastern sky in the constellation Sagittarius. During April and May Pluto moves higher in the eastern sky, reaching opposition with the Sun on 10 June. During April and May Pluto remains constant in brightness at magnitude + 13.9. Pluto is located at R.A. 17 hours 55.1 minutes declination -16 degrees 25 minutes on 15 April and at R.A. 17 hours 53.3 minutes declination -16 degrees 23 minutes on 15 May.

Events:

Antares will be occulted by the Moon on 7 April (13 hours universal time) for the southern portion of South America, western Antarctica, and the western Oceania; and on 4 May (18 hours universal time) for New Zealand, Tasmania, part of Antarctica, and southeastern Africa.
Mars will be occulted by the Moon on 14 April (02 hours universal time) for southern and eastern Asia, India, and the eastern tip of Africa.
Uranus will be occulted by the Moon on 14 April (20 hours universal time) for eastern Siberia, Japan, Alaska, and northwestern Canada; and on 12 May (07 hours universal time) for the North Atlantic Ocean, all but the southeastern portion of the British Isles and eastern Greenland.
Saturn will be occulted by the Moon on 25 April (10 hours universal time) for northwestern Canada, northern Greenland, Alaska, and the eastern tip of Siberia; and on 22 May (19 hours universal time) for Europe, the British Isles, northeastern Africa, northwestern Asia, the Arctic regions, and northwestern Canada.
Regulus will be occulted by the Moon on 26 April (09 hours universal time) for northwestern North America and the Arctic regions; and on 23 May (16 hours universal time) for all but the eastern portion of Asia, northeastern Europe, the British Isles, Greenland, and the northeastern tip of Canada.

MINOR PLANETS

		position			
		15 April		**15 May**	
Planet	Magnitude	R.A.	Decl.	R.A.	Decl.
Ceres	09.3 - 09.3	00 hr 51.7 min	- 02 deg 49 min	01 hr 34.0 min	+01 deg 28 min
Pallas	10.6 - 10.3	22 hr 06.5 min	+06 deg 29 min	22 hr 33.2 min	+08 deg 56 min
Juno	09.8 - 10.6	13 hr 22.3 min	+01 deg 50 min	13 hr 03.4 min	+04 deg 16 min
Vesta	06.7 - 05.4	17 hr 00.5 min	- 14 deg 10 min	16 hr 49.1 min	- 13 deg 58 min

Back issues of the ASTROGRAPH in its printed format are still available for $1.50 each ($2.00 for each color issue) plus postage. Currently the following issues are available:
Volume No. 6 issue 6
Volume No. 7 issue 5 and 6
Volume No. 8 issue 11, 3, 4, and 5
Volume No. 9 issue 1, 4, 5, and 6
Volume No. 10 issue 2, 3, 5, and 6
Volume No. 11 issue 1, 2, 3[1], 4, 5, and 6
Volume No. 12 issue 1, 2, 3, 4, 5, and 6
Volume No. 13 issue 1, 2, 3, 4, 5, and 6
Volume No. 14 issue 1, 2, 3, 4, 5, and 6
Volume No. 15 issue 1, 2, 3, 4, 5, and 6
Volume No. 16 issue 1, 2, 3, 4, 5, and 6
Volume No. 17 issue 1, 2, 3[2], 4, 5, and 6
Volume No. 18 issue 1, 4, 5, and 6
Volume No. 19 issue 1, 2, 3, 4, 5, and 6
Volume No. 20 issue 1, 2, 3[1], 4, 5, and 6
Volume No. 21 issue 1, 2, 3, 4, 5, and 6
Volume No. 22 issue 1, 2, 3, and 4
Volume No. 23 issue 4 and 5
Volume No. 24 issue 5 and 6
Volume No. 25 issue 1, 2, 4, and 6
Volume No. 26 issue 1, 2, 3, 5, and 6
Volume No. 27 issue 2, 3, 4, 5, and 6
Volume No. 28 issue 5 and 6
Volume No. 29 issue 1, 2, 3, 4, 5, and 6
Volume No. 30 issue 1, 2, 3, 4[1], 5, and 6
Volume No. 31 issue 1, 2, 3, 4, 5, and 6
Volume No. 32 issue 1, 2, 3, 4, 5, and 6
Volume No. 33 issue 1, 2, 3, 4, 5, and 6
Volume No. 34 issue 1, 2, 3, 4, 5, and 6
Volume No. 35 issue 1 and 2
NOTES: 1 - Color issue - $2.00 each
2 - Comet photography issue.
Postage (foreign and domestic) - Add $1.07 for the first issue and $0.75 for each additional issue.
MAILING ADDRESS:
the ASTROGRAPH
PO Box 369 Phone#
Dumfries, VA 22026 (703) 441-6778

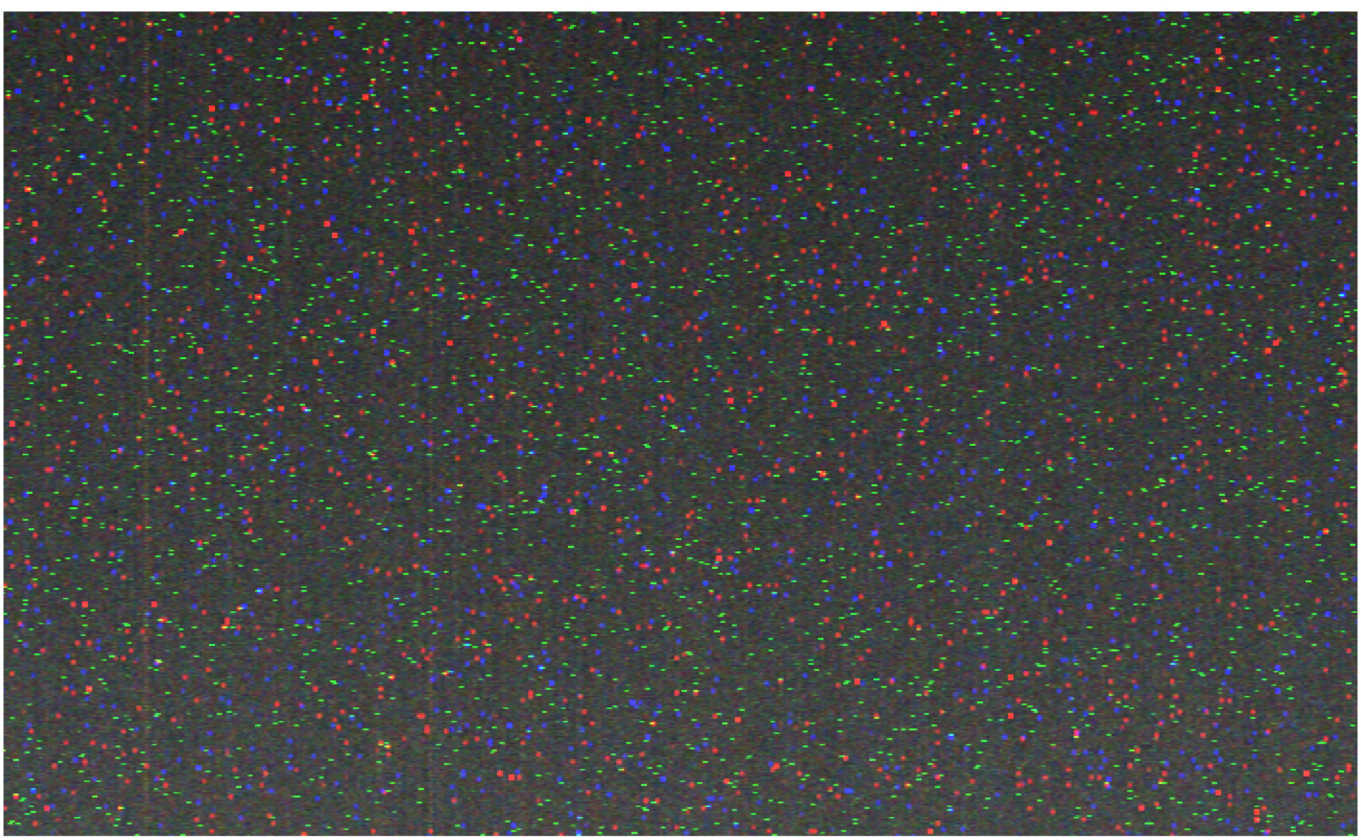
SBIG ST-2000XCM Image Noise Reduction

by

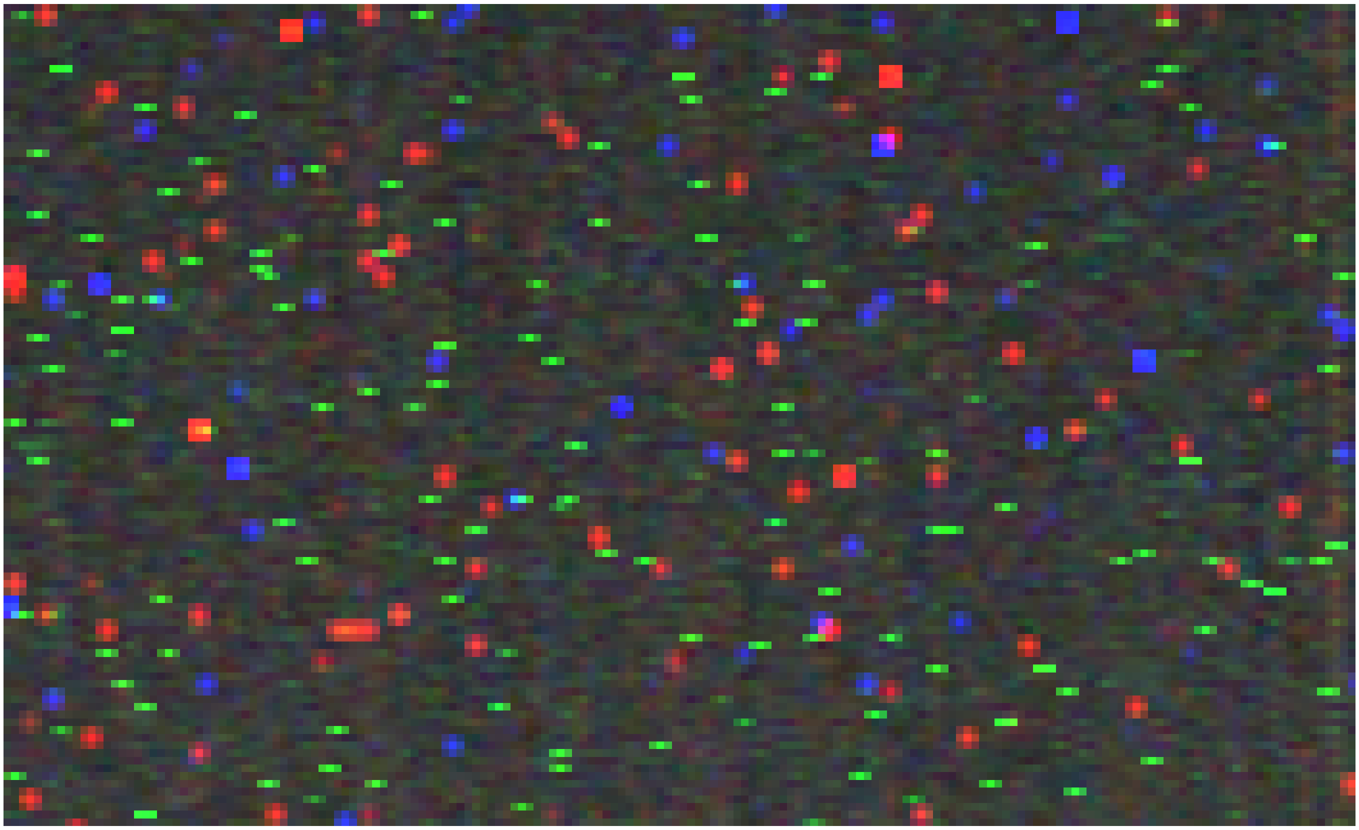
Robert Price

The problem with the early DSLR (Digital Single Lens Reflex) cameras such as the Canon 300D, when used for long exposures, was noise in the digital image. Manufacturers recognized this problem and such cameras as the Canon 20D and Canon 5D incorporated dark frame subtraction within the camera to help eliminate this digital noise. Later models such as the Canon 350D had such low noise that the author found it unnecessary to use dark frame subtraction even with exposures of 20 minutes.

The SBIG (Santa Barbara Instrument Group) ST-2000XCM is a recent CCD imaging camera designed especially for astrophotography. Unfortunately, its noise characteristics are similar to the old Canon 300D. The digital image is full of noise as can be seen in a 5 minute exposure shown in Figure 1. A closeup of the characteristic of this noise can be seen in Figure 2. The image processing provided with the SBIG ST-2000XCM can subtract a dark frame and the exposure control can take a dark frame immediately before the actual exposure is made with a shutter that closes for this purpose. The author's 5 minute exposure of M51 without dark frame subtraction is shown in Figure 3, and with dark frame subtraction is shown in Figure 4. Apparently the noise characteristics of the CCD change with time and the subtraction process is not perfect. All images in this article using the SBIG ST-2000XCM were taken from the author's backyard 28 miles south of Washington D.C. using a Tele Vue NP-101. In addition the problem of the dark frame subtraction causing negative image artifacts can be seen in images taken with the SBIG ST-2000XCM and are similar to those seen in images taken with the Canon 300D. The author's techniques to help reduce such image noise in Canon 300D images appeared in "Dark Frame Subtraction" June/July 2005 the ASTROGRAPH. The few artifacts, digital noise, and hot pixels that remain after dark frame subtraction can be cloned out of the image, or as in the image shown in Figure 5, a hot pixel elimination program can be used to automatically find the remaining hot pixels and eliminate them. Figure 6 and 7 show the before and after result of using all these techniques including level adjustment in Adobe Photoshop to eliminate noise and bring out the nebulosity in the author's 5 minute exposure of M42.



Above, Figure 1: SBIG ST-2000XCM image noise reduction. Shown above is a the noise in a portion (about 80 percent) of a dark frame. The dark frame is a 5 minute exposure with the SBIG ST-2000XCM CCD.

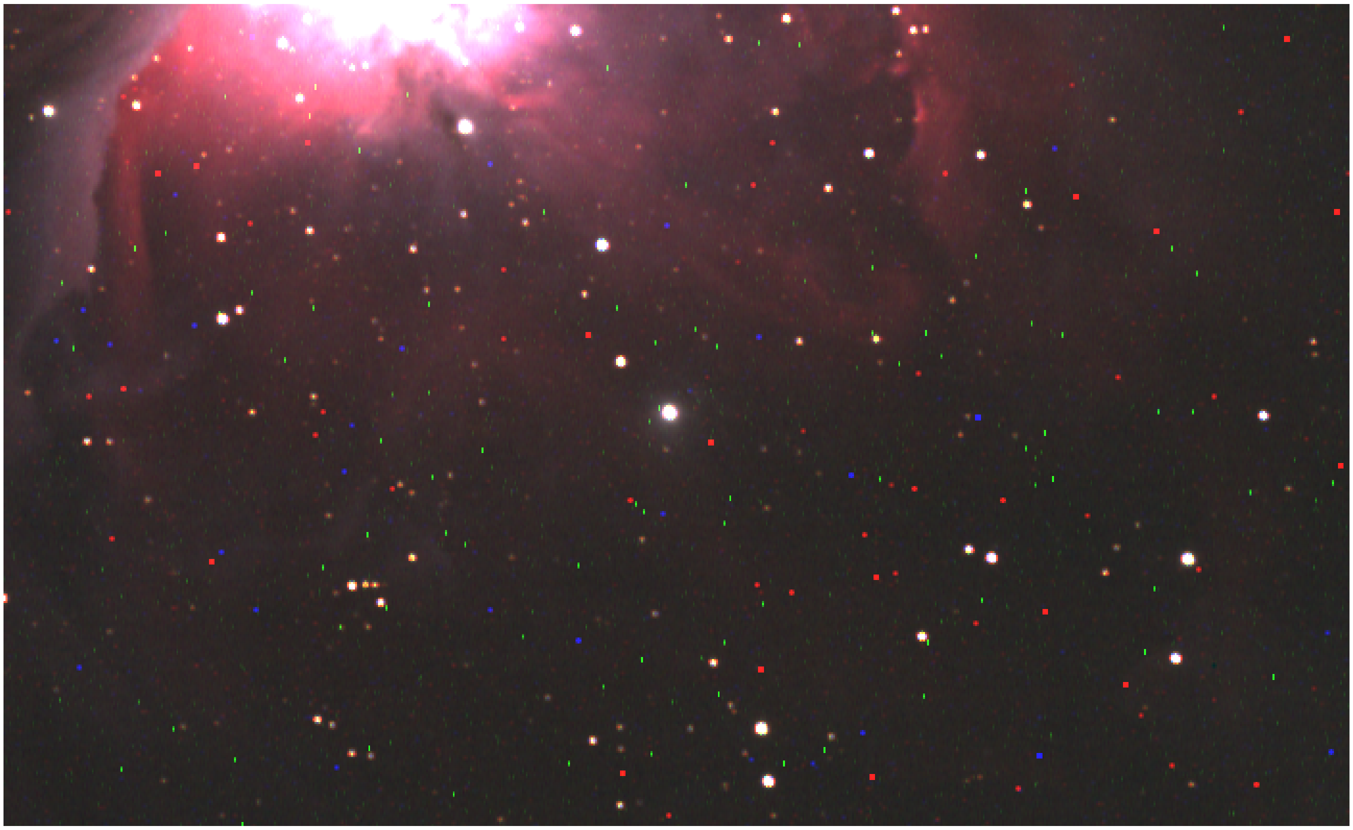


Above, Figure 2: SBIG ST-2000XCM image noise reduction. Shown above is an enlarged portion of Figure 1 to show the characteristic features of the SBIG ST-2000XCM CCD noise.

Above, Figure 3: SBIG ST-2000XCM image noise reduction. Shown above is a 5 minute exposure of M51 without dark frame subtraction.

Above, Figure 4: SBIG ST-2000XCM image noise reduction. Shown above is a 5 minute exposure of M51 with dark frame subtraction of the raw image within the SBIG supplied image program.

Above, Figure 5: SBIG ST-2000XCM image noise reduction. Shown above is the same image shown in Figure 4 but after using a hot pixel elimination program.



Above, Figure 6: SBIG ST-2000XCM image noise reduction. Shown above is a portion of an image of the area south of M42. This is the raw image saved in TIFF format without dark frame subtraction. Exposure was 5 minutes.

Above, Figute 7: SBIG ST-2000XCM image noise reduction. Shown above is the same image shown in Figure 6, but with dark frame subtraction, hot pixel elimination, and level adjustment in Adobe Photoshop.

Above: Gamma cygnus region photographed by Lee C. Coombs on 13 August 1999 using a 70mm (diameter) F/5.1 Tele Vue Pronto. Exposure was 30 minutes on Ektachrome 200 professional film.