Model ST-7XE/XME
CCD Imaging Camera

SBIG

ASTRONOMICAL
INSTRUMENTS

Model ST-7XE/XME Dual CCD Self-Guiding Camera

ST-7XME CCD IMAGING CAMERA

The Model ST-7XE/XME is a self-guided imaging camera and contains two CCD detectors; one for guiding and the other for collecting the image. They are mounted in close proximity, both focused at the same plane, allowing the imaging CCD to integrate while the PC uses the guiding CCD to correct the telescope. Using a separate CCD for guiding allows 100% of the primary CCD to be used to collect the image. The telescope correction rate and limiting guide star magnitude can be independently selected. Tests at SBIG indicate that 95% of the time a star bright enough for guiding will be found on the guiding CCD without moving the telescope, using an f/6.3 telescope. Carefully guided exposures up to one hour are possible, enabling a standard Celestron C-8 to capture images showing 19th magnitude stars from typical background observing sites. The imaging camera includes an electro-mechanical shutter, 16 bit analog to digital (A/D) converter, regulated temperature control, and has all of the electronics integrated into the CCD head. Communication to the PC or Mac is through the USB port.

The imaging CCD in the ST-7XE version is the enhanced KAF-0401E CCD from Kodak. This CCD is available with or without antiblooming protection (ABG). The non-ABG part has approximately twice the quantum efficiency of the antiblooming part. The Full Frame Resolution is 765 x 510 pixels at 9 microns square. The imaging CCD in the ST-7XME version is the new KAF-0402ME CCD from Kodak. The KAF-0402ME CCD has very high Quantum Efficiency, greater than 85% peak. The XME version is available only without antiblooming.

M82. ST-7E image using AO-7 adaptive optics device and 8" f/12.4 cassegrain telescope. *Primary image by Stan Moore with deconvolution by Benoit Schillings and color data supplied by by Al Kelly.*

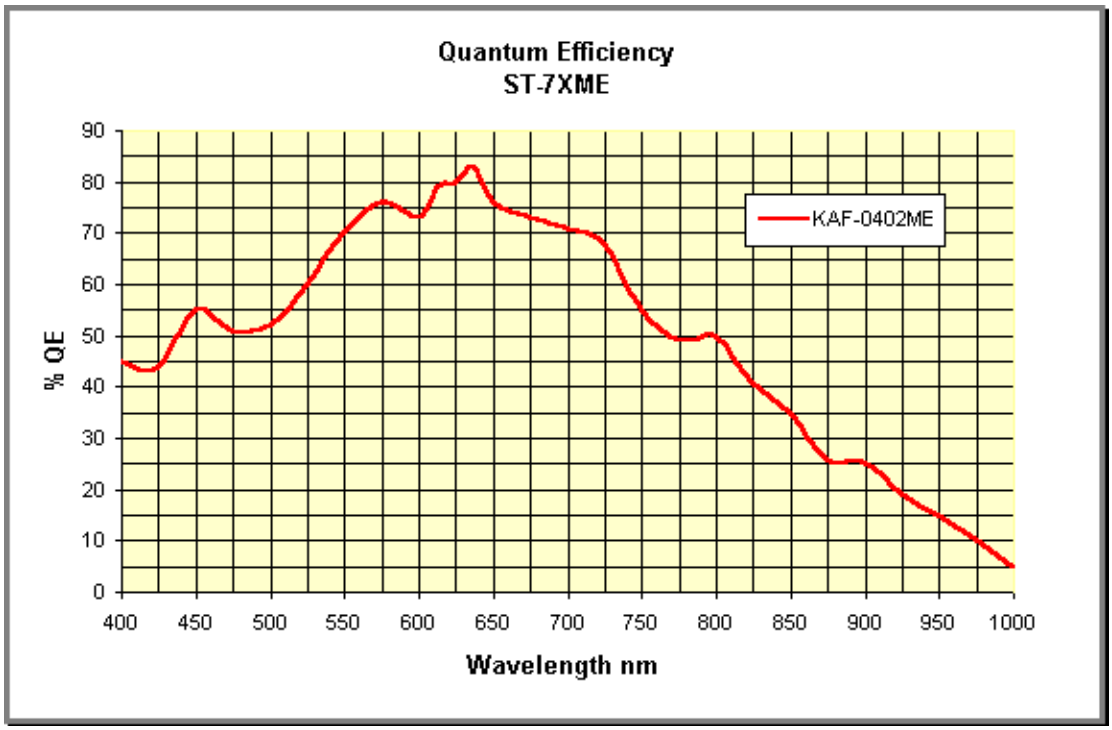
Each imaging camera is furnished with CCDOPS Windows operating software. Software for the Mac OS-X is also available. The CCDOPS Windows software includes camera control and image processing plus photometric and astrometric measurement functions. The CCDOPS Windows software is unsurpassed in performance and ease of operation. Optional operating software can be expanded to include remote telescope control, a large stellar data base from the SAO

catalog and Hubble Guide Star Catalog, plus a non-stellar data base from NCC, IC, PCC (Principle Galaxies Catalog), PK planetary nebulae, WDS (double star catalog), and GCVS (variable star catalog).

M1. ST-7E LRGB image taken with an AO-7 adaptive optics device through a 16" f/10 telescope. Corrections were made at 4Hz. *Courtesy Marko Moilanen*

More on the ST-7XME

In March of 2003, Kodak released two new versions of the CCD that SBIG uses in the ST-7XE cameras. The new CCDs are designated the KAF-0402E and KAF-0402ME. These CCDs have the same array architecture as the KAF-0401E NABG with some improvements.



Model ST-7XME self-guiding CCD camera with optional l35mm lens adapter

Of greatest significance is the increased quantum efficiency due to the addition of a microlens array over the pixels and the use of MAR coated cover glass on the KAF-0402ME version. The same kind of improvement has already met with great success in the ST-10XME camera. The peak quantum efficiency for the KAF-0402ME is almost 85%. It is the most sensitive CCD camera in its class. The QE for the blue wavelength of 400 nm is 50% higher than that of the previous KAF-0401E CCD (increased from 30% to 45% absolute QE) and 15% higher in the red spectrum near H-alpha (increased from 72% to nearly 85% absolute peak QE). The resulting high QE from UV to IR makes the ST-7XME perfect for imaging deep space objects such as dim galaxies and emission nebula. By fortunate circumstance, the peak QE occurs very near the H-alpha emission line at 656 nm, making this camera extraordinarily sensitive at this important wavelength. It could be said that this camera was "made for" capturing H-alpha! Previously, this level of QE was achievable only through the process of thinning the wafer and illuminating the image sensor from the backside. However, thinned, back-illuminated CCDs are very expensive. With the KAF-0402ME, similar performance to a back-illuminated CCD is achieved with lower dark current and superior cosmetic specifications in a full frame front illuminated detector.

A single 1200 second H-alpha exposure of the California Nebula taken with an ST-7XME camera through a 100 mm F/2.8 camera lens and H-alpha filter under the glare of a nearly full moon. Michael Barber / SBIG

Except for the increased QE, the CCD specifications remain the same as the ST-7XE. The cosmetic grades also remain the same: The ST-7XME is supplied with a Class 1 CCD as standard. A Class 1 KAF-0402E(ME) CCD has no column or cluster defects.

The KAF-0402ME is available in NABG only. With our new high speed electronics and USB interface, a full frame image will download in 1 second. Partial frame modes and focus mode will update faster than once per second. Kodak full frame CCDs are well known for their low dark current and low noise characteristics. Additionally, the new camera design has superior cooling and is water assist ready. Thermoelectric cooling to -40 degrees C below ambient is possible. Imagine focusing in full frame mode!

The KAF-0402E CCD, without microlens, is also available as an alternative to the microlens part for applications where a microlens may not be desired. The QE for the KAF-0402E CCD is essentially the same as for the previous KAF-0401E. The difference is the addition of greater static protection. The ABG version of this part, the KAF-0401LE remains unchanged. While we recommend that our customers select the ST-7ME for astronomy, we will continue to offer all three versions of the camera (ST-7XME, ST-7XE NABG and ST-7XE ABG) so long as Kodak continues to manufacture all three varieties of this CCD.

ST-7XE/XME Typical Specifications

CCD Specifications	
CCD	Kodak KAF-0402E/ME + TC-237
Pixel Array	765 x 510 pixels, 6.9 x 4.6 mm
Total Pixels	390,000
Pixel Size	9 x 9 microns
Full Well Capacity (NABG)	~100,000 e-
Dark Current	1e^-/pixel/sec at 0° C
Antiblooming	Standard (non ABG as option)

Readout Specifications	
Shutter	Electromechanical
Exposure	0.12 to 3600 sec., 10ms resolution
Correlated Double Sampling	Yes
A/D Converter	16 bits
A/D Gain	2.3e^-/ADU
Read Noise	15e^- RMS
Binning Modes	1 x 1, 2 x 2, 3 x 3
Pixel Digitization Rate	Up to 420,000 pxels per second
Full Frame Acquisition	~1 second

Optical Specifications (8" f/10)	
Field of View	12 x 8 arcminutes
Pixel Size	.9 x .9 arcseconds
Limiting Magnitude	Magnitude 14 in 1 second
(for 3 arcsec FWHM stars)	Magnitude 18 in 1 minute

System Specifications	
Cooling - standard	Single Stage Thermoelectric, Active Fan, Water Assist Ready -45 C from Ambient Typical w/water
Temperature Regulation	±0.1°C
Power	5 VDC at 1.5 amps, ±12 VDC at 0.5 amp desktop power supply included
Computer Interface	USB
Computer Compatibility	Windows, Mac OS-X
Guiding	Dual CCD Self-Guiding

Physical Dimensions	
Optical Head	5 inches dia. x 3 inches 12.5 cm dia. x 7.5 cm deep, 2 pounds/0.9 Kg
CPU	All electronics integrated into Optical Head, No CPU
Mounting	T-Thread, 1.25" and 2" nosepieces included
Backfocus	0.92 inches/2.3 cm

Specifications subject to change without notice