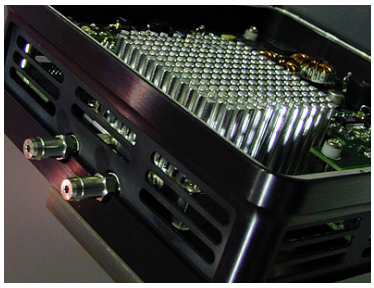
SBIG
ASTRONOMICAL INSTRUMENTS
a division of Aplegen, Inc.

STX-16803

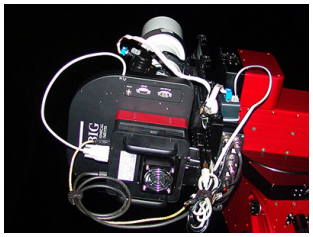
SBIG's New STX Series

The STX features include:

- 16 Megapixel KAF-16803 CCD with High QE and ABG
- 4096 x 4096 pixels at 9u
- Both Ethernet and USB 2.0 interface
- 12VDC Operation (Operates from 9 - 14VDC)
- Full Frame Image Buffer
- Multiple A/D Channels
- Image and Guide While Downloading
- Internal and External Self-Guiding (with Remote Head)
- Simultaneous Dual CCD Guiding
- Differential Guiding (patent pending)
- Continuous Guiding During Autograb
- Adaptive Optics Control with Internal or External Guider
- -50 degrees C Delta Cooling with Air Only
- Water Cooling Ready
- Even-illumination Mechanical Shutter
- User Rechargeable Desiccant Plug
- Variable Speed Fan Control
- Focus Mechanism for Tracking CCD
- Opto-isolated Relays for Telescope Control
- Tracking Relay LED Indicators
- Power Management with LED Indicators



These photos are of the first prototype STX camera, production models have a 3" threaded aperture accessory plate)



Note: The new FW5-STX filter wheel is shown below attached to the STX camera. The FW5-STX holds five 65mm square filters, or five 50mm square filters (with optional inserts).

This filter wheel is now available. 65mm square LRGB and Narrowband filters are currently available through SBIG from both Astrodon and Baader Planetarium.

Support for the following CCDs are also being considered for the STX series:

CCD	Pixels	Array	Pixel	Mono / Color	Notes
KAF-1001	1 Megapixel	1024 x 1024	24u	Mono	Full Frame, large pixels
KAI-4022	4.2 Megapixels	2048 x 2048	7.4u	Mono or Color	New CCD, 25% lower noise
KAF-6303	6.3 Megapixels	3060 x 2040	9u	Mono	Full Frame, High QE
KAF-8300	8.3 Megapixels	3326 x 2504	5.4u	Mono or Color	Full Frame Microlens ABG
KAF-9000	9 Megapixels	3056 x 3056	12u	Mono	Full Frame Microlens ABG
KAI-10100	10.1 Megapixels	3648 x 2760	4.75u	Color	2x2 Color Binning
KAI-11002	11 Megapixels	4008 x 2675	9u	Mono or Color	35mm format
KAI-16000	16 Megapixels	4872 x 3248	7.4u	Mono or Color	35mm format
CCD42-40	4 Megapixels	2048 x 2048	13.5u	Mono	Back illuminated High QE
CCD47-10	1 Megapixel	1056 x 1027	13u	Mono	Back illuminated High QE
CCD42-00	262,144 Pixels	512 x 512	24u	Mono	Back illuminated High QE

New Guiding Techniques for the STX

It is well known that the advantage of easier guiding through a separate guide scopes is often limited by differential deflection of the guide scope relative to the main optical axis due to mechanical flexure or shifting of the mirror in the main OTA. This difficulty is addressed with two new guiding techniques developed by SBIG and implemented in the STX series cameras: Simultaneous Guiding and Differential Guiding.

Built-in Guiding CCD with Adjustable Focus

Simple self-guiding and control of our Adaptive Optics accessory using just the internal tracking CCD will be a standard feature. The guiding CCD in the STX cameras will be a new KAI-340 CCD with 640 x 480 pixels at 7.4u. As the imaging CCDs get larger, the guiding CCD gets pushed farther away from the center of the optical axis. Depending on the nature of the optical system, this can cause the image on the guiding CCD to be slightly out of focus when the image on the main CCD is in focus. To address this, the new STX cameras will have a user accessible adjustment for changing the focal point of the on-board guiding CCD.

Optional Remote Guide Head

A Remote Guide Head will be optional for the STX cameras. Self-guiding through a separate guide scope or off-axis guider, and control of the Adaptive Optics accessory, can be done using the Remote Guide Head instead of or in addition to the on-board guiding CCD. The same KAI-340 CCD will be used in the new Remote Guide Head made for the STX series cameras.

Simultaneous Guiding*

The external guide head will not only continue to guide while the imaging CCD is downloading an image, but it can be operated simultaneously with the on-board guiding CCD. This allows a unique type of guiding through a separate guide scope that will correct for differential deflection by using the external guider to make fast corrections while the on-board guider makes slow corrections. Differential deflection tends to occur over a longer period of time than drive errors, typically minutes vs. seconds. A long exposure taken with the built-in guider is capable of reaching dim stars without searching, even through narrowband filters, and a long exposure with slow corrections with this on-board guider will correct for the slow differential deflection typically experienced with a separate guide scope. In the mean time, the Remote Guide Head can simultaneously make fast corrections using the brighter stars easily found with a short refractor mounted piggy back to the main OTA. This technique, developed independently, is similar to the technique employed successfully by Italian amateur Filippo Ciferri using two separate cameras for which he deserves full credit. With the STX, however, a single camera and remote head will perform both the fast and slow guiding, as well as the imaging, all at the same time, using a single instance of the control software and only one connection to a computer.

Differential Guiding*

SBIG has a patent pending on a new guiding technique using an artificial guide star. Although artificial stars are used in a variety of techniques on professional telescopes, the SBIG technique is somewhat different and easy to implement on amateur scopes. An artificial star is created near the focal plane of the imaging CCD and an image of this star is retro-reflected into a separate guide scope. By using one real star in the FOV of the guide scope and the artificial star image reflected from the main scope, the difference in separation caused by telescope pointing errors is used to make the corrections to the telescope drive. There is no problem with differential deflection and a single CCD external guider can be used to monitor both the real and artificial guide stars. The artificial star image is not seen by the imaging CCD.

* Note: Simultaneous and Differential Guiding are features still under development. All STX cameras will be able to use these features when the software becomes available.

Features

USB 2.0 and Ethernet

Both USB 2.0 and Ethernet will be available on each STX camera. The user will not have to choose the interface at the time of purchase. The STX cameras will have the same convenient I2C AUX port that we use on the ST and STL cameras for power and control of accessories such as filter wheels and Adaptive Optics, and will operate from any unregulated 12VDC source.

12VDC Operation

In similar fashion to the STL cameras, the STX will internally regulate a 12VDC supply so that the camera can be connected directly to any unregulated 12VDC source such as a car battery. The camera will have 4 power LEDs that will indicate if the supply voltage drops to 11, 10 or 9 volts and when it is "good." Operation of the camera is possible with a supply voltage of 9.1 to 14 volts DC.

Full Frame Image Buffer

The STX series cameras will have a full frame image buffer for storing image data during download. The STX will be able to image during download process. We are exploring the possibility of using this buffer for pre-processing pixel defects based on a defect map provided by the CCD manufacturer, at the user's direction.

Multiple A/D Channels

Having multiple A/D channels available makes a number of things possible. For instance, the STX cameras will be able to download and guide, or guide with two guiders all at the same time. Guiding can continue uninterrupted using the Remote Head during an autograb sequence, or an automated LRGB sequence, just as it would if you were using a

SBIG
ASTRONOMICAL INSTRUMENTS
a division of Aplegen, Inc.

separate camera or autoguider independent the camera.

Improved Cooling

Our engineers have modeled an optimum cooling design for this camera using a large custom pin grid array heat sink mated directly to the hot side of the 2 stage TE cooler to achieve maximum heat dissipation with a single large fan. The STX is designed to achieve a minimum delta of -50 degrees C with air only, and a similar delta with water only.

Water Circulation Ready

While the design is aimed at sufficient cooling without water assist, it is possible to use water instead of air or in addition to air for optimum cooling. Using water instead of air will not require the use of a fan. Chilled water may also be used alone or with the fan for even greater cooling.

Even-illumination Shutter

Starting with the first ST-7 camera, SBIG has incorporated an even-illumination shutter for taking short exposure flat field frames on all self-guiding cameras. However, the rotating disk design becomes rather large with ever increasing CCD sizes. Therefore, a new shutter design will be introduced with the STX series that reduces the overall size and weight of the camera body, while maintaining even illumination on short exposures with large CCDs.

Variable Speed Fan Control

If the user desires air cooling only, the fan speed is controllable through software. Variable speed control allows the user to "tune" to fan to eliminate any resonance with the user's telescope thus suppressing harmonic vibrations.

Focusing Mechanism of Tracking CCD

As CCDs get larger, the tracking CCD is moved farther off-center from the optical axis. This can result in out-of-focus guide stars. In order to compensate for different telescopes and different tracking CCD locations, the built-in guider will have a small, user accessible, focus adjustment for the tracking CCD. Once this is set for a particular camera and scope combination, it will not be necessary to change it.

Opto-isolated Relays for Telescope Control

These isolated relays will not require an external Relay Adapter box or other opto-isolator to work with virtually any telescope mount that accepts autoguider inputs for guiding control.

Tracking Relay LED indicators

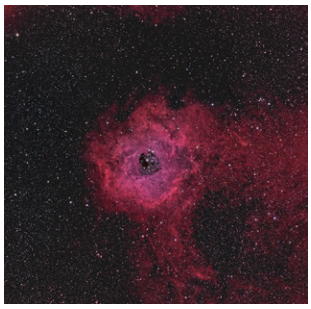
This handy set of 4 LEDs will tell you at a glance if the camera is issuing corrections to the mount in +X, -X, +Y or -Y directions during an imaging session.

Adaptive Optics and Filter Wheels

Due to the sizes of some of the planned CCDs, a new 0 and Filter Wheel will be designed for the STX cameras. Filters for most of these chips will need to be larger than 1.25". Some need to be larger than 2" or 50mm round. A five position 65mm square filter wheel is available as of December 2009 and 65mm filters are available from several suppliers. In addition, 50mm filters may be used if the internal tracking CCD is not used for guiding.

STX-16803 Test Images

M31 courtesy Martin Pugh, Prototype STX-16803, Takahashi FSQ-106

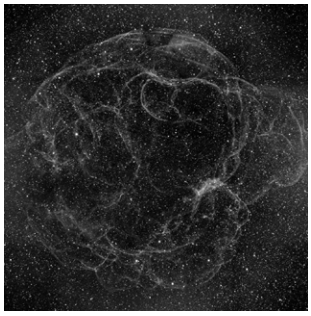


Rosette Nebula courtesy Martin Pugh, Prototype STX-16803, Takahashi FSQ-106

M45 and surrounding nebula courtesy Martin Pugh, Prototype STX-16803, Takahashi FSQ-106

Orion's Belt Stars, Horsehead Nebula and Flame Nebula courtesy Martin Pugh, Prototype STX-16803, Takahashi FSQ-106

Crescent Nebula courtesy Jim Burnell, Prototype STX-16803, TeleVue NP127is



Simies 147 courtesy Jim Burnell, Prototype STX-16803, TeleVue NP127is

Santa Barbara Instrument Group, a division of Aplegen, Inc. | 147-A Castilian Drive, Santa Barbara, CA 93117
t 805.571.7244 | f 805.571.1147 | w www.sbig.com | e sbig@sbig.com

SBIG ASTRONOMICAL INSTRUMENTS
a division of Aplegen, Inc.

STX16803.072011