SAC7 Air Cooled Astro-Camera

by Suk Lee click to email author

Our thanks to Digitec Optical for the loan of the SAC camera for purposes of this review.

A natural followup…

After reviewing the Meade LPI with its long exposure capabilities, it made sense to do a review of the SAC7 air-cooled astro-camera as a natural followup. I suggested this to Allister-genie and *poof* a SAC7 shortly showed up on my doorstep…

The SAC7 is advertised as being “a long exposure, 640x480 24 bit color imager capable of obtaining images of planetary, lunar, solar and deep space objects at a fraction of the cost of similar cameras.” At roughly 2x the cost of the Meade LPI, but a small fraction of the cost of a temperature-controlled, Peltier cooled, CCD astro-camera, does the SAC7 provide real DSO capabilities?

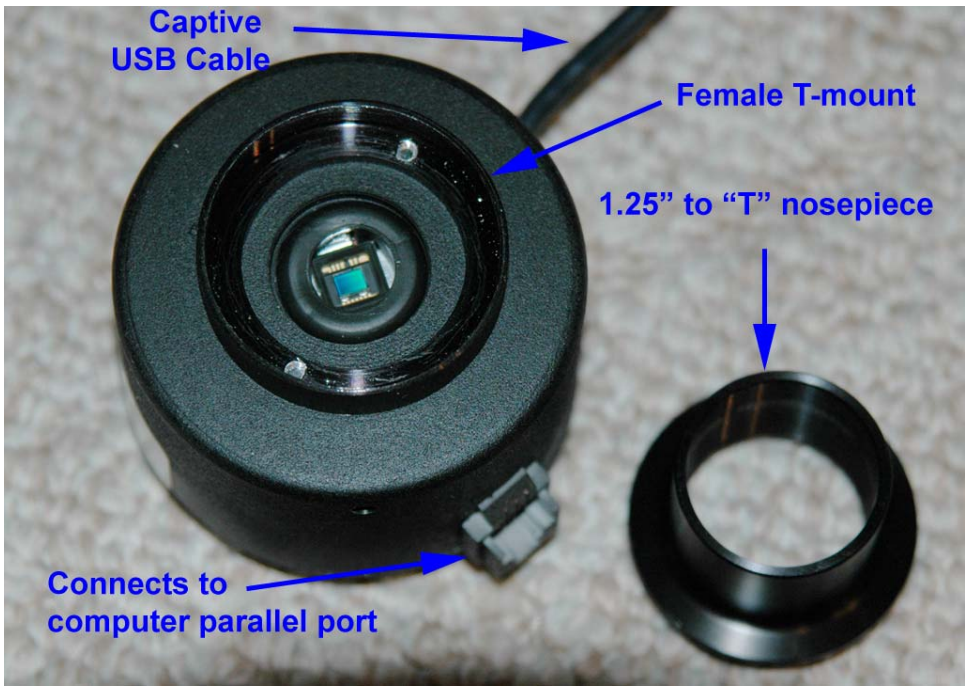
What's in the box?

The SAC7 comes with (clockwise from top left):
- Parallel port to camera cable
- Camera
- USB extension cable
- software mini-CDROM

As supplied the SAC7 is astrophotography ready, but the camera does not have a built-in IR block filter, which can be bought separately if desired.

SAC7 camera body

The SAC7 is built from a modified webcam, and so it's not surprising that it's very small and light.



The camera comes out of the box with a 1.25" nosepiece (threaded for filters) attached. Unscrewing it reveals a standard female T-mount, enabling you to hard-connect your Televue PowerMate (with the optional PowerMate T-adapter) directly to the camera for planetary imaging. The image sensor is smaller than the LPI, looking to be the same size as the TouCam Pro sensor (it's actually an earlier rev of the CCD chip in the Philips TouCam Pro). Since the nosepiece can be completely removed, the sensor is easily accessed for cleaning. The body itself is some kind of high density plastic, attractively finished in a dark grey crinkle finish. Good job on the packaging.

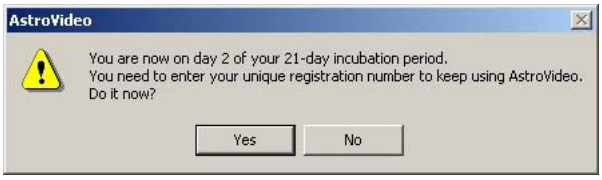
Software Overview and Initial Installation

The mini CDROM contains:

- installation instructions (README file)
- camera drivers for various operating systems
- COAA AstroVideo camera control/image integration software
- FitsView 32-bit FITs viewer/converter (not evaluated)
- 30 day trial version of Picture Window (not evaluated)
- 30 day trial version of Photoimpact 5 (not evaluated)

Installation is a little confusing, but if you read the README.txt on the CDROM and follow the instructions carefully, driver installation proceeds easily. AstroVideo is installed separately.

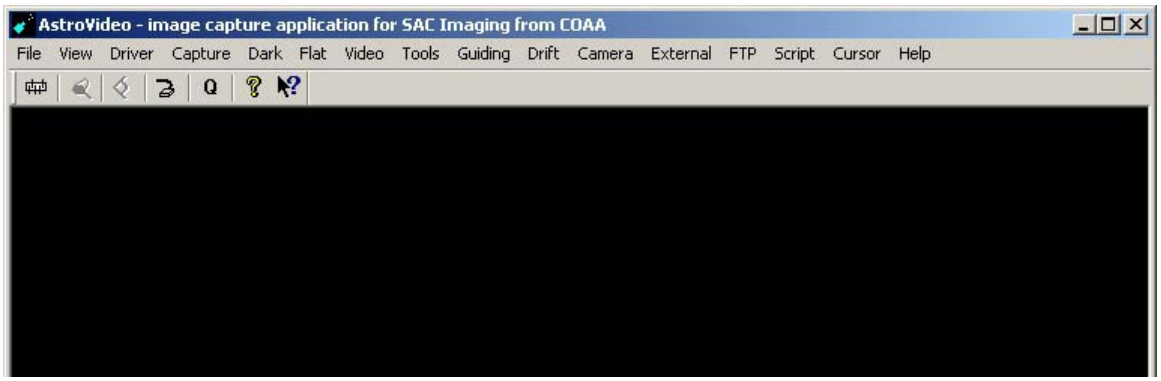
Starting AstroVideo brings up the following popup:



Clicking on “Yes” brings up the following:

Clicking on “Email serial number Now” automatically starts up your e-mail program, with a pre-addressed e-mail and your serial number, requesting a registration number.

While waiting for the registration number, AstroVideo will still run in full mode, but with the evaluation timer ticking away:

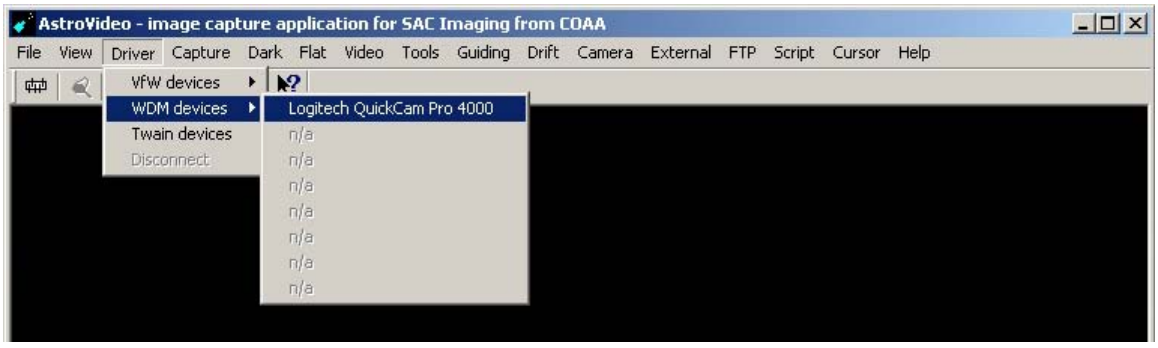


COAA promptly turned around the registration number overnight.

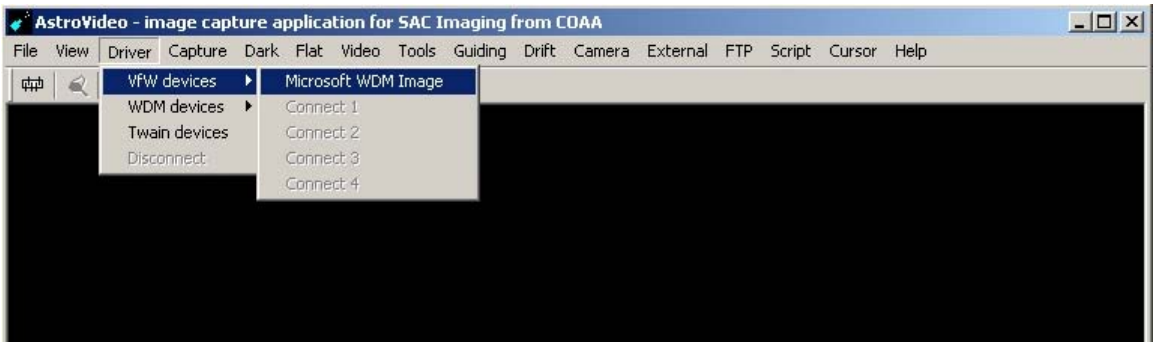
AstroVideo - Capturing your first terrestrial image

Acquainting yourself with the SAC7 and AstroVideo is easiest in the daytime where you have a bright stationary object. Select a terrestrial object far away enough from your scope that you can reach focus and select an object that has a bright glint on it. A reflection off of a street lamp, for example, is perfect. Focus with your eyepiece then remove the eyepiece and insert the SAC7. They likely will not be parfocal so expect to have to refocus. The purpose of selecting an object with a bright glint is to be able to see something to focus on.

Plug in the camera (you will immediately faintly hear the fan spinning) start up AstroVideo and set up the camera. You have a choice of using a WDM (Windows Driver Model) driver:

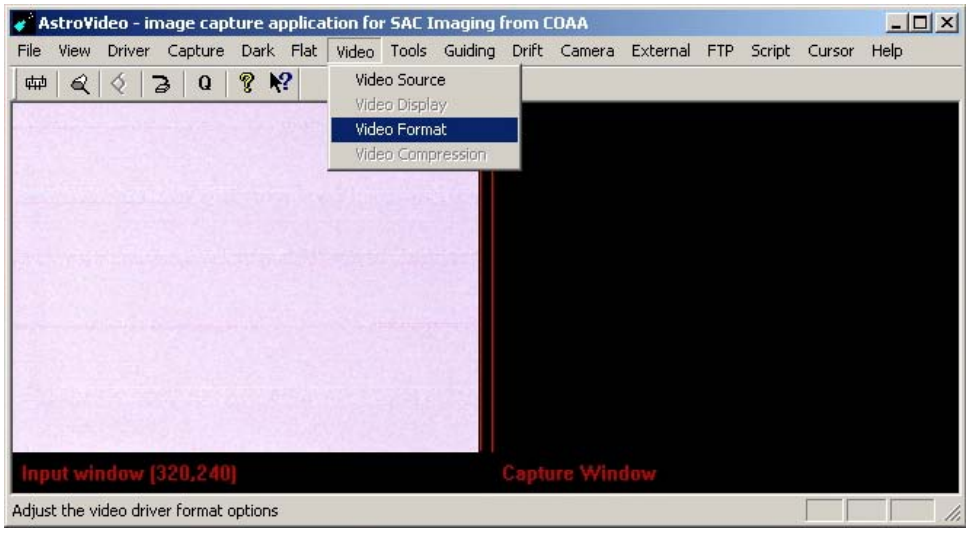


or you can select a VfW (Video for Windows) driver:

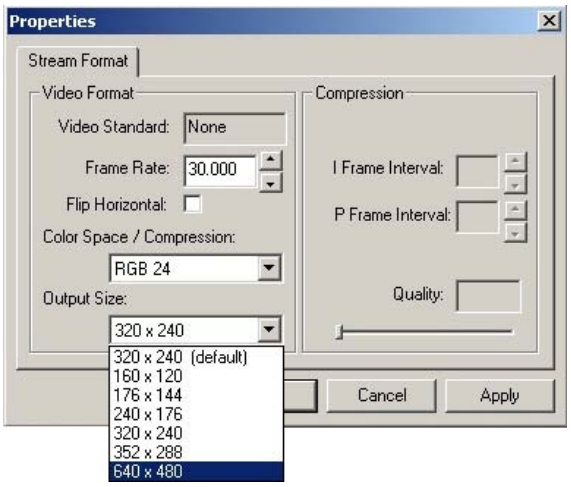


Select VfW mode. (Depending on your operating system, you may get slightly differently named options e.g. “Logitech USB Video” instead of “VfW”, but you should still be presented with two options)

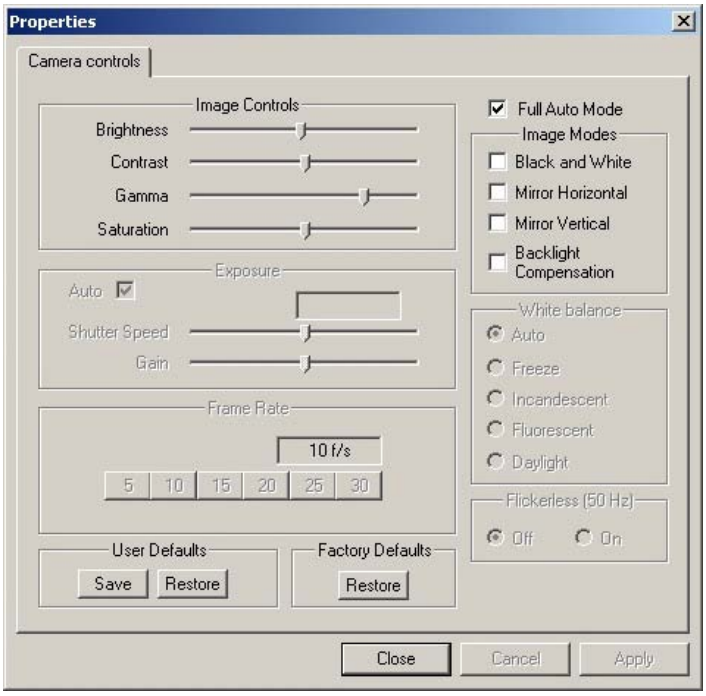
You can see that the SAC7 is based on the Logitech QuickCam Pro 4000. Once selected, AstroVideo immediately goes live:



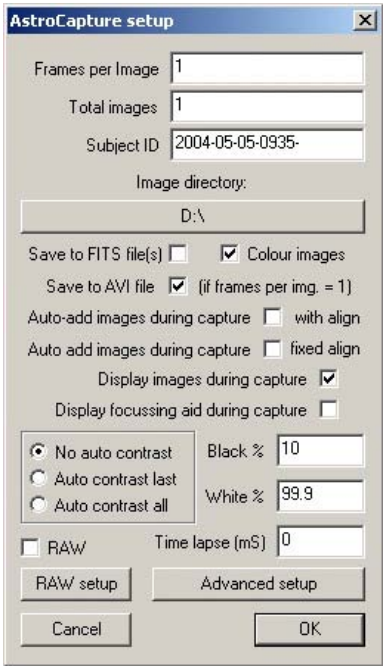
Selecting Video -> Video Format, select the 640x480 option:



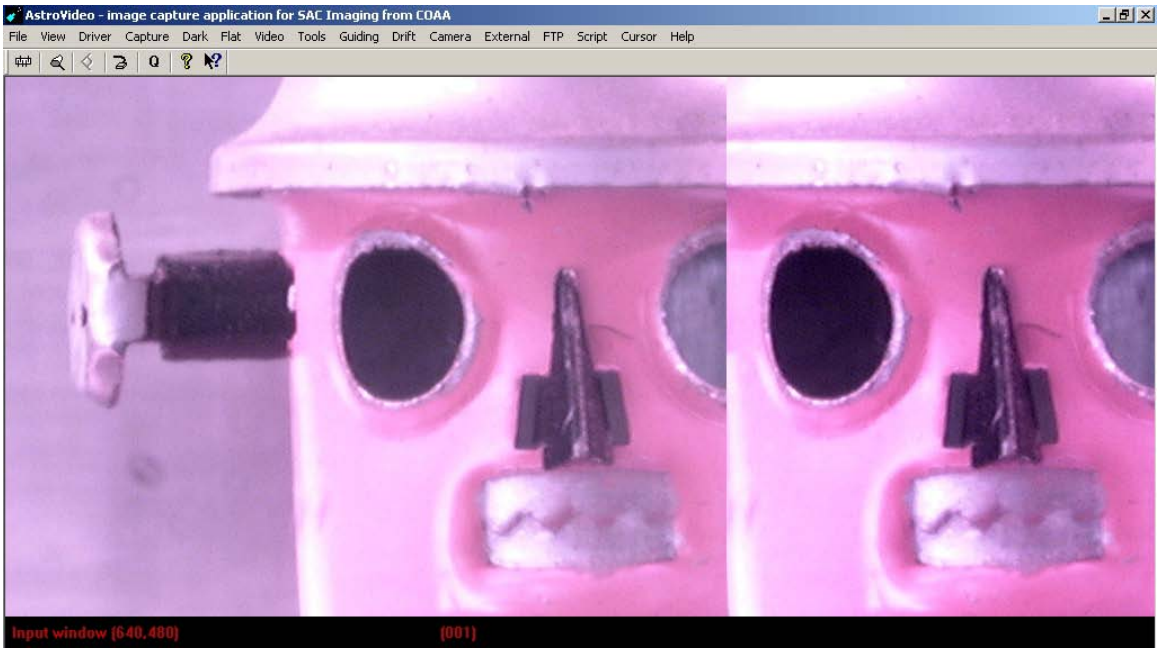
Select Video -> Video Source to bring up the camera control menu, and select “Full Auto” mode:



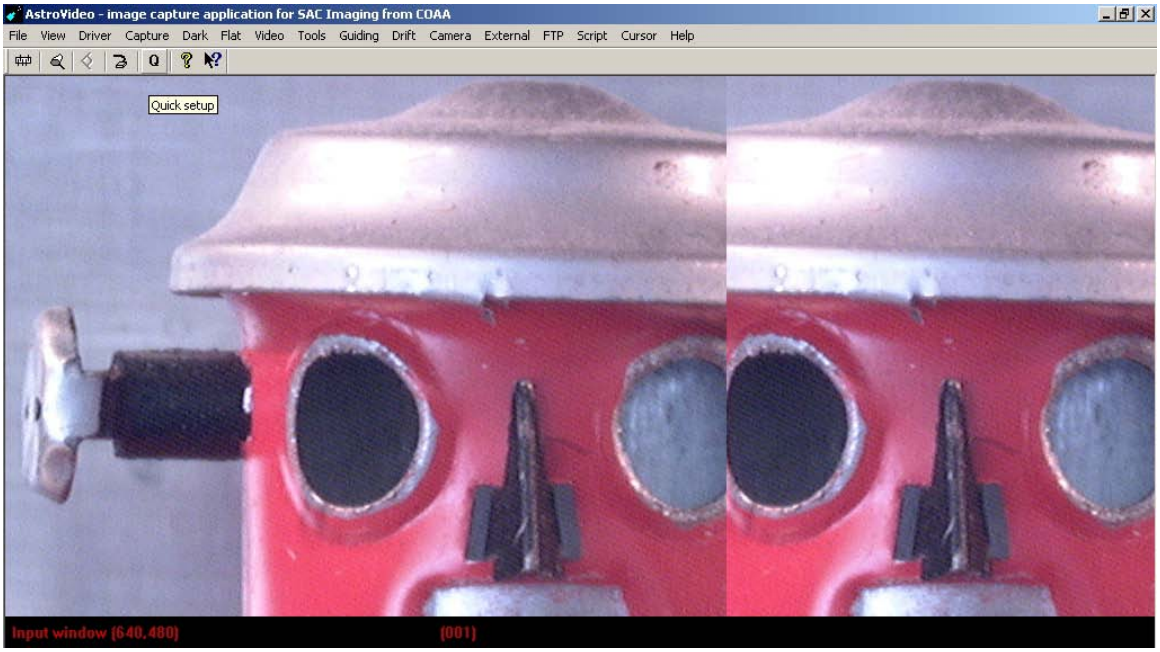
Focus your telescope, using the live image feed in AstroVideo, then select Capture -> Setup:



For the initial capture, set up as above (the file name is filled in automatically and can be changed) to capture a single frame. Select Capture -> Start to grab the one frame. The captured frame shows up beside the live image window:



This snap was taken in full auto mode, with automatic white balancing. Note that the colors are washed out – this is because there is no IR blocking filter built in and IR is leaking into all R, G, and B channels, effectively mixing white into the picture and reducing saturation. Adding an IR block filter – not included - gives the correctly saturated image (also taken in full auto mode):



There's some slight noise and some dust donuts visible. Switching to VfW mode and capturing 20 seconds of video at 10 frames per second (Capture -> AVI) and then stacking in Registax results in this smooth image:

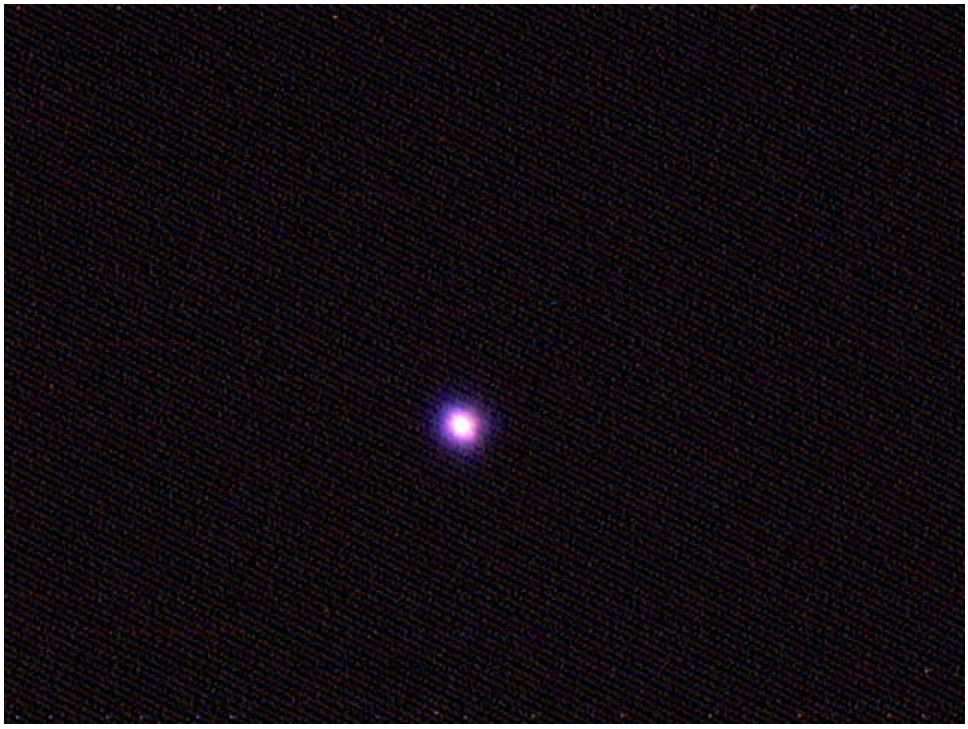
Time for some real imaging.

Getting Started on Vega

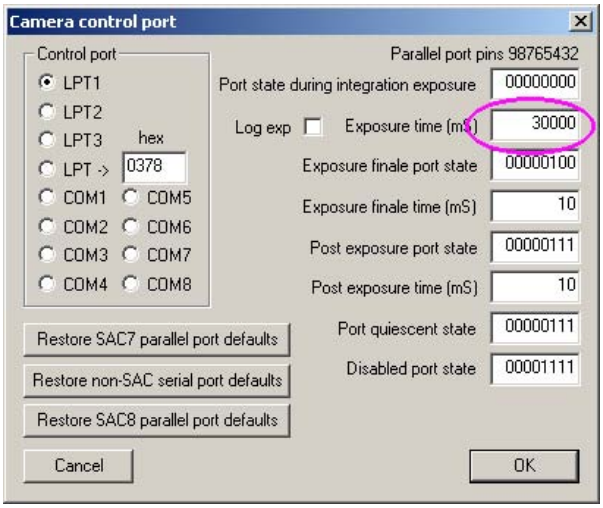
Vega makes a good starter target because it's bright and easy to focus on. For initial testing, I used a Megrez 80 refractor autoguided by an STV + e-Finder on an AP900 mount. Not exactly a starter

setup, but one that would allow me to capture images without worrying about tracking issues, and show the fullest capabilities of the SAC7.

Start up AstroVideo without the parallel port cable plugged in, and focus on Vega in normal “webcam” mode. Here’s a single 1/5 second exposure of Vega through the Megrez 80:



Now plug in the parallel port cable to both the camera and computer and go to Camera -> Setup long exposure control:



Make sure the appropriate LPT port is selected and that you have plugged in the parallel port cable to both the camera and your computer. Select the exposure time in milliseconds, in this case it was set to 30 seconds, and click “OK”. Go to Capture -> Setup as before and make sure Frames per Image is set to 1. Click on Capture -> Start to take the image. You should get a much deeper image reflecting the long exposure:

Now, getting long exposure mode to work is the point where a lot of people run into problems, yours truly included. After a week of frustration I couldn’t get long exposure mode to work, the SAC7 would only act as a regular webcam. There’s a LOT of debugging information on the SAC website, but the most useful information came from the Yahoo! SAC e-group.

First tip from that group was to make sure the parallel port was set to “EPP” mode. That sorted out some minor problems getting just a regular webcam image, but I still couldn’t get a long exposure. It turned out, as seems to be a fairly common problem, that the RJ cable supplied with the camera was

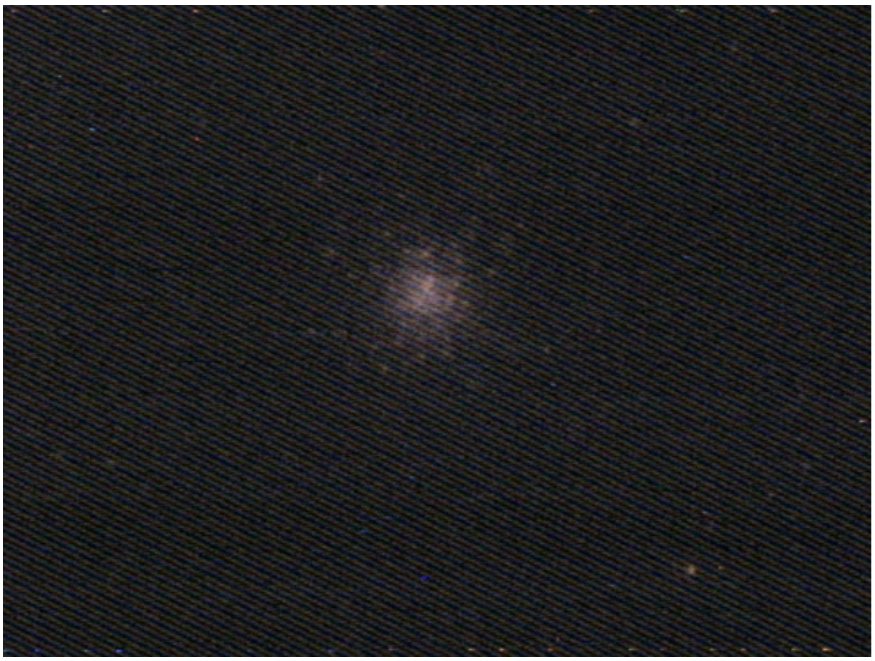
at fault! Replacing it with another (regular 4 wire will do) cable immediately enabled long exposure mode.

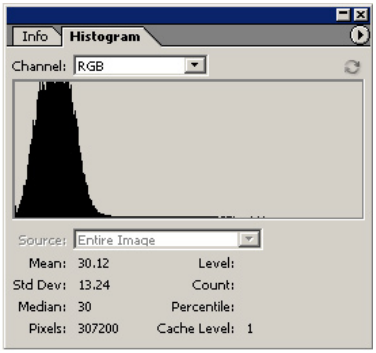
Frankly, if this were a $100 mod-ed webcam, I'd chalk it up to hard experience. But, for a nearly $400 item, this level of quality control is unacceptable – SAC ought to test out each cable before they ship their cameras.

Going Deep – M13

M13 is an ideal initial dark sky target as it's easy to find, large, and bright. Here's a succession of shots at various exposures, unedited (histograms were added in Photoshop but the images were unaltered) straight out of AstroVideo.

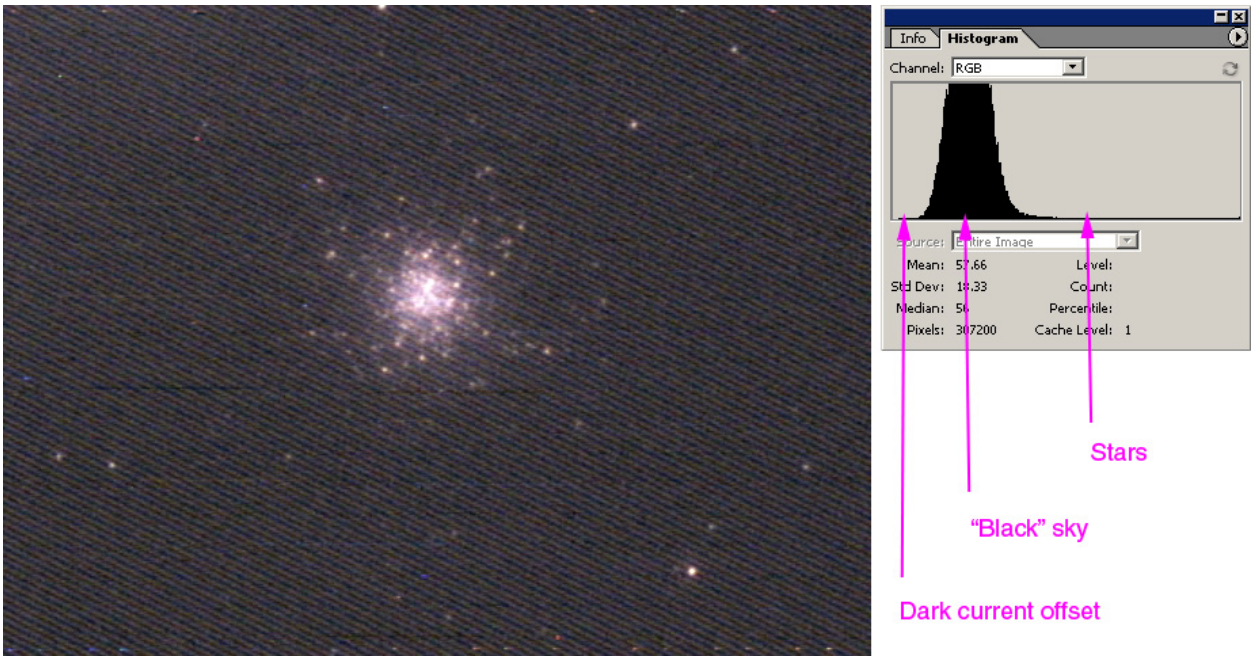
5 seconds:





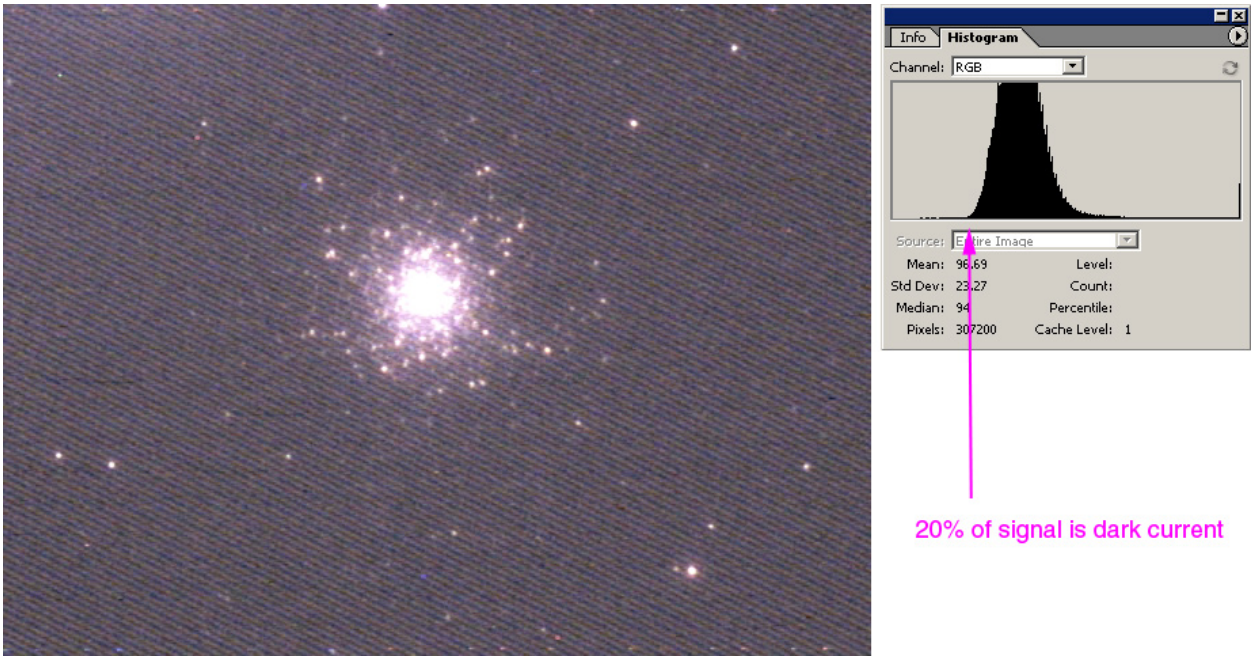
At 5 seconds exposure, the histogram is pressed to the left, indicating that very little dark current has accumulated.

15 seconds:

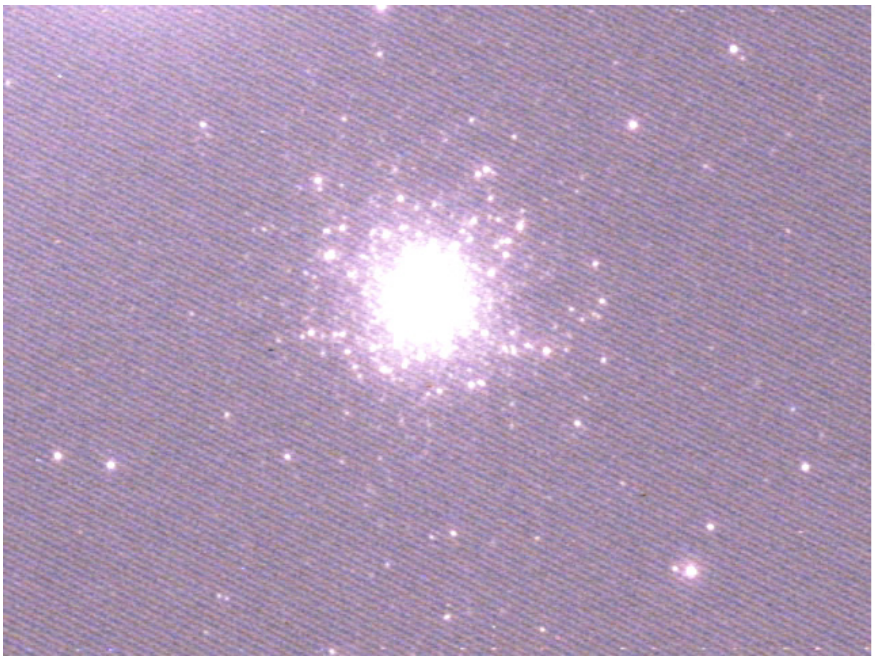


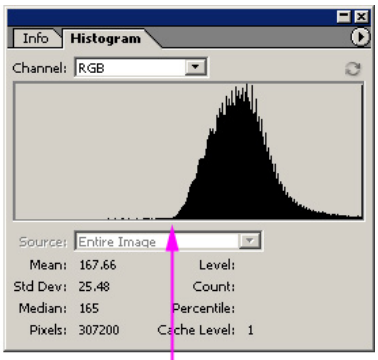
The histogram is now displaced to the right, showing some accumulation of dark current. At 15 seconds, about 10% of available signal dynamic range has been used up by the dark current, so we can definitely increase exposure some more.

30 seconds:



60 seconds:



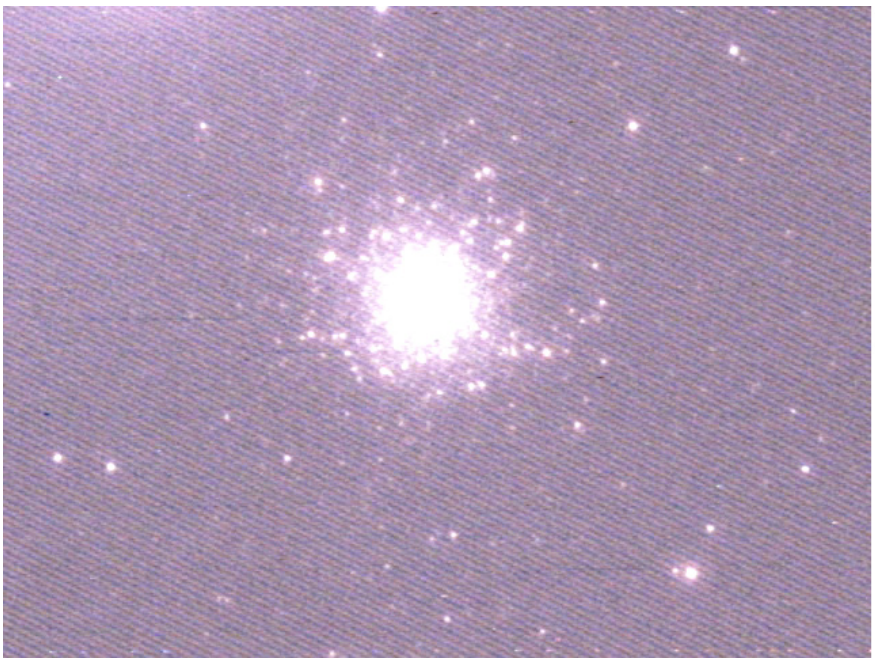


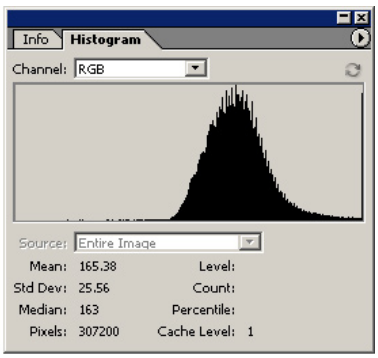
Half of image is dark current, stars are white-clipped

At 60 seconds, about half the image dynamic range is taken up by dark current (ambient temperature was in the mid 60s, a cold winter night would dramatically reduce dark current), and the stars are clipped, but the skyglow histogram is intact, so this is the longest reasonable exposure to take under these conditions.

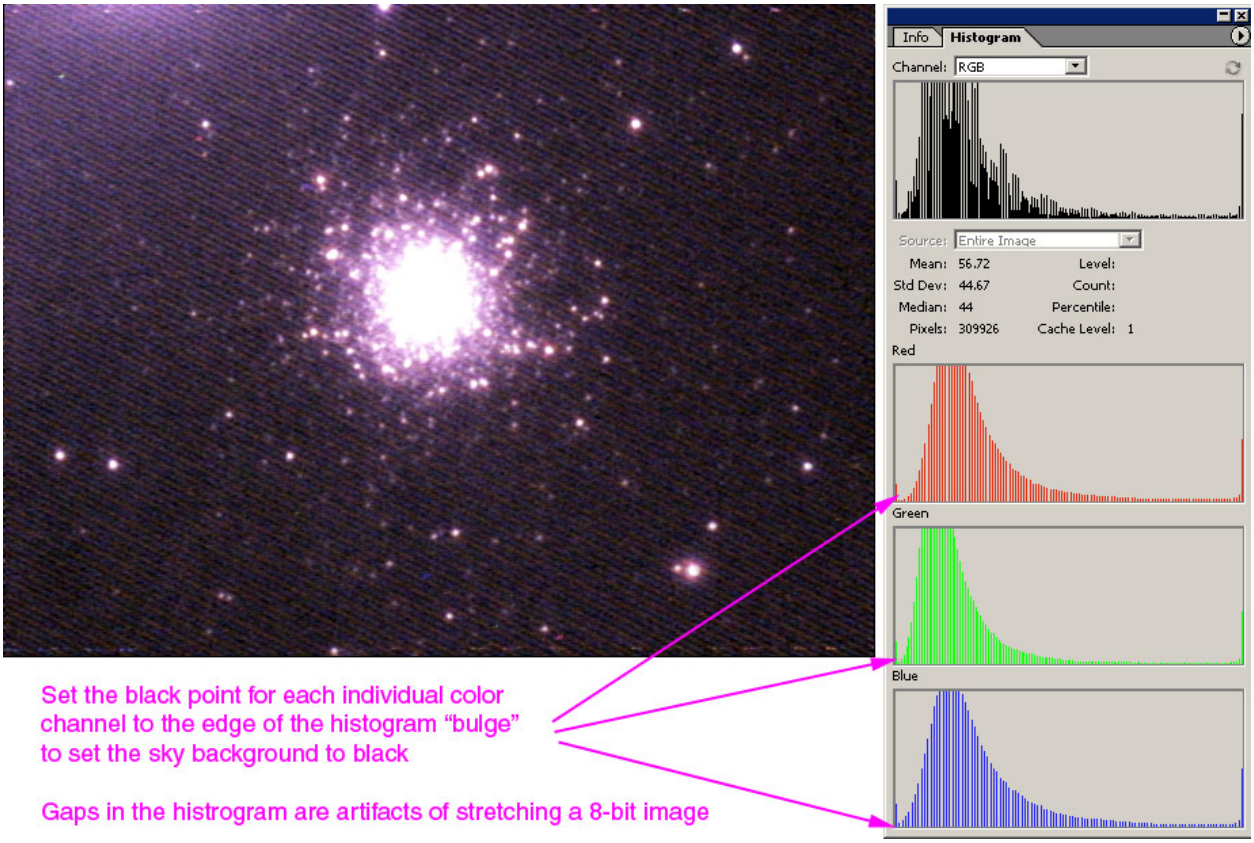
AstroVideo provides a capability to automatically subtract dark frames.

60 second shot, with an 80 second dark frame subtracted:





There's a little bit of electrical noise (the diagonal banding) that I'm not sure is intrinsic to the SAC7, or part of my setup. I took 4 images and stacked them (averaged) to reduce the effect and reset the black point to eliminate the dark current image offset:



Pretty nice for a 4 minute image.

Other objects, M57 and M82

4 images of 30 seconds each, dark subtracted, stacked, black point reset, red channel midpoint adjusted down a bit:

3 images of 60 seconds each (, dark subtracted, stacked, black point reset, red channel midpoint adjusted down a bit:

Imaging with a Larger Telescope

I also tried imaging DSOs with a Mewlon 250. Since the Mewlon's focal length is 3000mm, it's necessary to use a focal length reducer to get down to a reasonable image scale with the SAC7. I used a Meade 0.33x reducer to get down to about 1500mm.

Here's Jupiter and the four Galilean moons captured to give a sense of image scale compared to normal high-resolution planetary shots:

M57, 3 stacked shots of 60 seconds each, dark-subtracted, black and white points adjusted:

M13, 4 stacked shots of 60 seconds each, dark-subtracted, black and white points adjusted:

Planetary Imaging

For planetary imaging I used a Mewlon 250 and 2x PowerMate. Due to the recent terrible seeing conditions in my area I was unable to capture any decent high-resolution shots, however, from using the camera I noted that:

- low-light sensitivity seems comparable to a Philips TouCam Pro (although the SAC7 is known to use a slightly sensitive earlier version of the Sony chip used in the Philips TouCam Pro)
- the frame rate achievable with various freeware capture programs, 5 to 10 fps, was the same as the TouCam Pro

Based on the good low-light sensitivity and frame rate achievable with the SAC7, my opinion is that the SAC7 makes a fine planetary imager.

Summary

Pros

- Very complete product package – comes with everything you need except an IR filter (which may not be necessary depending on which planets are being imaged)
- Small CCD size lends itself to good DSO imaging scale with short refractors
- Enough sensitivity for brighter DSOs – can image virtually all of the Messier clusters and the brighter galaxies
- Terrific price/performance ratio

Cons

- Output is 8-bits/pixel, limiting ability to stretch histogram without introducing artifacts
- Poor quality control on parallel port cable led to debugging frustration
- Small CCD size leads to very high magnifications with typical SCT focal lengths – need to use a 0.33x reducer
- Not cooled, so exposure times are limited by thermal noise (the SAC7B offers unregulated Peltier cooling a little over $100 more than the SAC7)

The SAC7 offers good planetary imaging capabilities, and more than a taste of DSO astrophotography at a very reasonable price. It's a great way to test the CCD astrophotography waters without jumping into an immediate large investment.

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