How to Choose a CCD Camera

September 28, 2016

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Guidelines for selecting the best camera for your telescope and observing conditions:

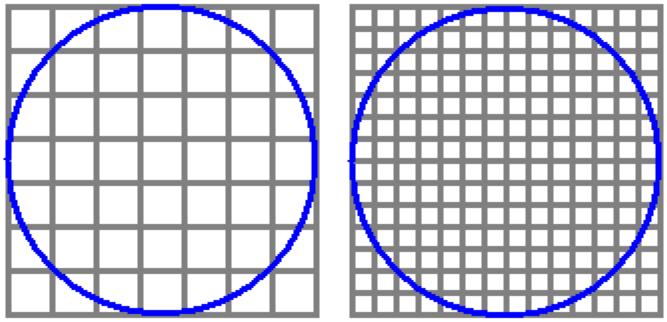
This section outlines some of the basic issues one should consider when making a camera selection: Cost, size, field of view, sensitivity, resolution, cooling, guiding and software.

1. Cost / Size

The best camera for you isn't always the biggest or most expensive. An expensive camera with pixels that are too big can be a waste of good money. An inexpensive camera with lots of small pixels may not be appropriate for your telescope and might suffer from poor sensitivity, again wasting money. A camera that is too big or too small for your scope and mount will result in disappointment. A camera that is too big and heavy can tax your mount. One that is too small will not give you much satisfaction. Take some time to think about how you intend to use your camera and to learn about the various factors that can affect its performance for your intended use. As a very general rule, CCDs cost more the larger they are. So, the more you pay, the bigger the detector and the bigger the field of view it is capable of capturing in a single frame. There are exceptions, of course. For its cost point, the 8300 CCD is quite large (generous field of view) and has relatively small pixels (high resolution) and good sensitivity. SBIG offers two versions, the STF-8300 and STT-8300. The main difference in the STF and STT models is the greater cooling of the STT model and some additional features such as an optional self-guiding filter wheel and adaptive optics. Since they use the same CCD, the image size, resolution, etc., are identical. The camera with the next largest CCD is the STXL-6303 which costs about twice as much as the STT-8300 and over three times as much as the STF-8300.   Now there are models with even larger sensors than the 6303 and models with more sensitive sensors, but they also cost more. The 8300 in either model represents an excellent value.

After the overall size of the CCD, all else being equal, price is usually determined by the number of pixels and sensitivity of the CCD. That is, between two CCDs of the same size, type and sensitivity, the CCD with the greater number of pixels will generally cost more. Conversely, between two CCDs of the same size, type and number of pixels, the CCD with the greater sensitivity will generally cost more. Naturally, then, a large CCD with lots of pixels and high sensitivity costs the most and since the CCD itself is often the most expensive component in a camera, the more expensive the CCD, the more expensive the camera. If you intend to image primarily planets or bright objects or large fields of view through relatively fast optical systems, then sensitivity may not be so important a factor as the size of the CCD and the resolution. If, however, you intend to image small faint objects through a long focal length scope or if you intend to use narrowband or photometric filters, then the higher sensitivity of one of the full frame CCDs may be an important factor in your decision. Our advice to find the best balance of these factors is to set a budget for your camera system and then, based on your major interests, buy a camera within that budget that has the desired balance of CCD size, sensitivity and resolution to fit your telescope. Remember to add the cost of any accessories you intend to include like autoguider, filter wheels, etc., including software (see Section 6, below). Some important CCD parameters are discussed in more detail below.

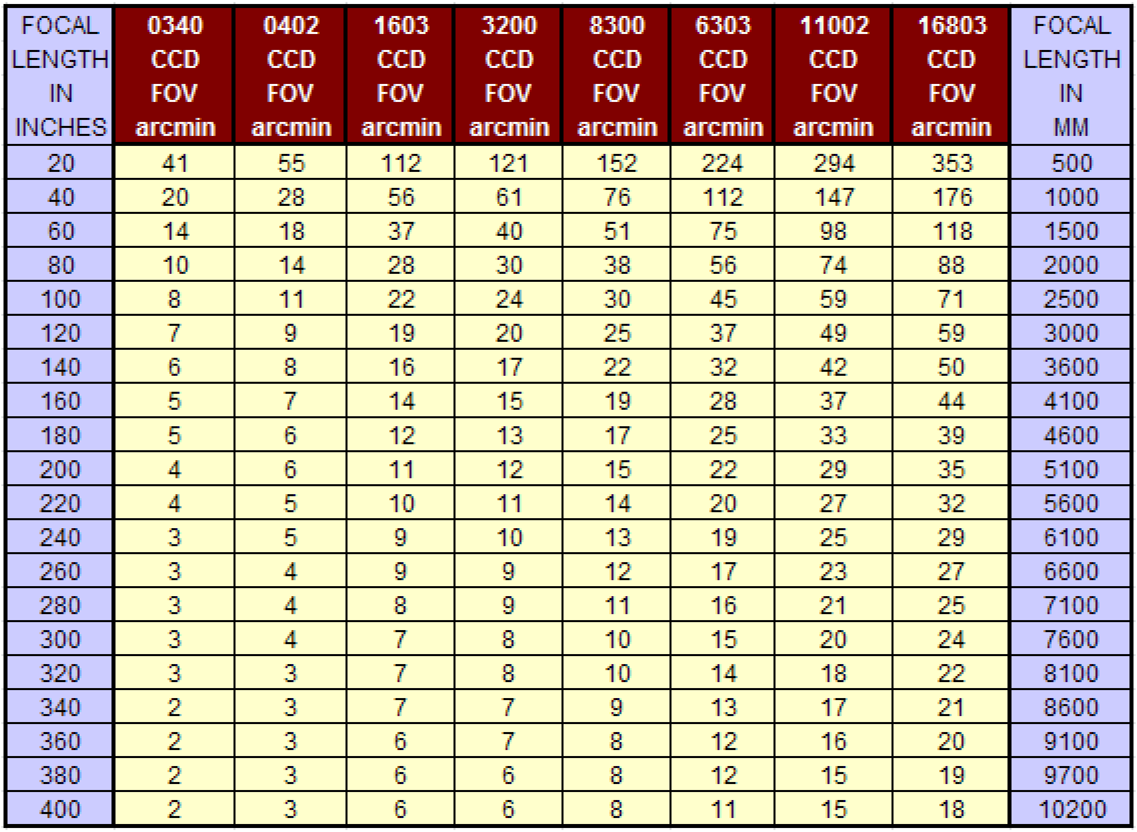
2. Field of View



The field of view (FOV) that your camera will see through a given telescope is determined by physical size of the CCD sensor and the focal length of the telescope. Note that this has nothing to do with the number of pixels. A CCD that has 512 x 512 pixels that are 20 microns square will have exactly the same field of view as a CCD with 1024 x 1024 pixels that are 10 microns square even though the latter CCD has four times as many pixels. This is also why binning 2×2 or 3×3 affects resolution but does not affect the field of view of the CCD. Larger CCDs have larger fields of view at a given focal length. You can change the field of view of a CCD only by changing the focal length of the telescope. By using a focal reducer you shorten the effective focal length of the telescope and increase the field of view (and make the image brighter in the process). By using a barlow or eyepiece projection you effectively lengthen the focal length of the telescope and decrease the field of view (and make the image dimmer in the process). In order to determine the field of view for a given CCD, note the CCD’s length and width dimensions (or diagonal) in millimeters and use the formula to determining the field of view for that CCD through any telescope as follows:

$$(135.3 \times D) / L = \text{Field of View in arcminutes}$$

where D is the length or width dimension of the CCD in millimeters, and L is the focal length of your telescope in inches. You can use the same formula to find the diagonal field of view if you know this dimension. So, for example, if you wanted to know the diagonal field of view of the STF-8300 when attached to a 5″ F/6 telescope you would first determine the focal length of the telescope by multiplying its aperture, 5 inches, by its focal ratio, 6, to get its focal length, 30 inches. The diagonal dimension of the CCD is 22.5 mm. To calculate the field of view multiply 135.3 x 22.5 = 3,044 and then divide by 30 = 101.5 arcminutes. By way of comparison, the diagonal field of view of the STXL-11002M through the same telescope would be 135.3 x 43.6 = 5,912.6 divided by 30 = 197.1 arcminutes, about twice the field of view. The table below shows the calculated diagonal field of view in arcminutes for several CCDs at various focal lengths (without regard for the pixel resolution at any given focal length).



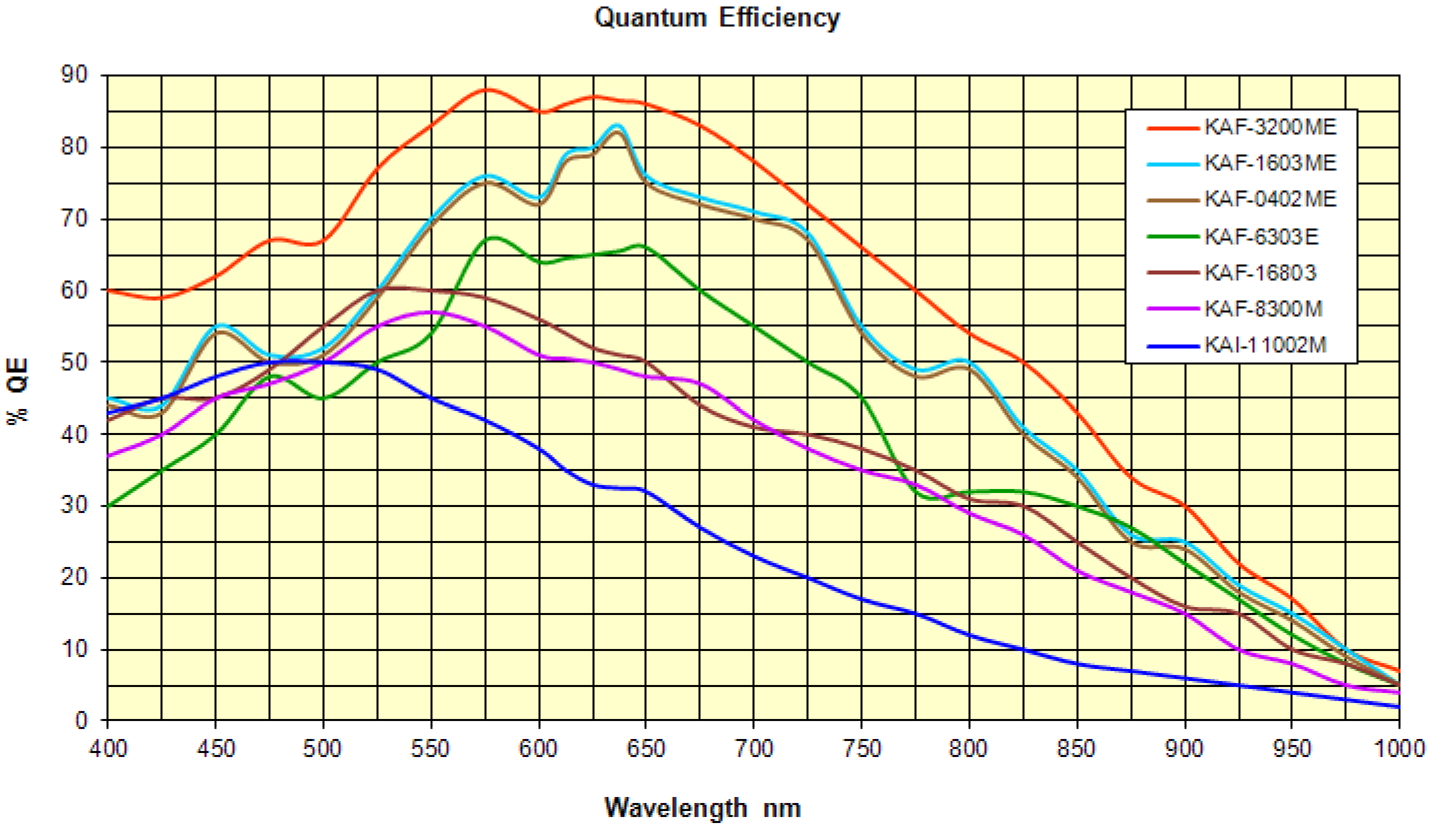
FOCAL LENGTH IN INCHES	0340 CCD FOV arcmin	0402 CCD FOV arcmin	1603 CCD FOV arcmin	3200 CCD FOV arcmin	8300 CCD FOV arcmin	6303 CCD FOV arcmin	11002 CCD FOV arcmin	16803 CCD FOV arcmin	FOCAL LENGTH IN MM
20	41	55	112	121	152	224	294	353	500
40	20	28	56	61	76	112	147	176	1000
60	14	18	37	40	51	75	98	118	1500
80	10	14	28	30	38	56	74	88	2000
100	8	11	22	24	30	45	59	71	2500
120	7	9	19	20	25	37	49	59	3000
140	6	8	16	17	22	32	42	50	3600
160	5	7	14	15	19	28	37	44	4100
180	5	6	12	13	17	25	33	39	4600
200	4	6	11	12	15	22	29	35	5100
220	4	5	10	11	14	20	27	32	5600
240	3	5	9	10	13	19	25	29	6100
260	3	4	9	9	12	17	23	27	6600
280	3	4	8	9	11	16	21	25	7100
300	3	4	7	8	10	15	20	24	7600
320	3	3	7	8	10	14	18	22	8100
340	2	3	7	7	9	13	17	21	8600
360	2	3	6	7	8	12	16	20	9100
380	2	3	6	6	8	12	15	19	9700
400	2	3	6	6	8	11	15	18	10200

Once you know the field of view of the CCD then it helps to know how big the objects are that you intend to image. Celestial objects come in a very wide range of sizes. No one telescope / camera combination is appropriate for them all. Large objects are sometimes imaged by making a mosaic of several frames. Planets are best imaged with smaller cameras as the download times are shorter and the planets do not require a large field of view to see them in their entirety. For comparison, a few popular objects are listed in the table above with their angular sizes. It is easy to see that there is no one telescope / camera combination that will nicely frame all of these objects. Some of the largest objects (like the North American nebula) are best imaged using a camera lens.

Object	Approximate Angular Size
NGC7000 N. American Nebula	175 x 110 arcmin
M31. Andromeda Galaxy	190 x 60 arcmin
M42. Orion Nebula	85 x 60 arcmin
Disk. Sun / Moon	30 x 30 arcmin
M101. Face on spiral galaxy	22 x 22 arcmin
M13. Globular Cluster	6.6 x 6.6 arcmin
M104. Sombrero Galaxy	9 x 4 arcmin
M27. Dumbbell Nebula	8 x 5.7 arcmin
M57. Ring Nebula	1.4 x 1 arcmin
Jupiter	40 arcseconds

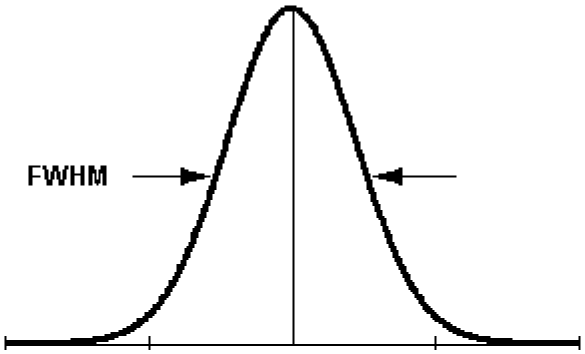
3. Sensitivity

Several things determine the ultimate sensitivity of your system such as focal ratio, pixel size and quantum efficiency of the detector. The quantum efficiency of the CCD is a measure of how efficient it is at converting incoming photons of light to electrons. The electrons in a pixel well are counted and determine the brightness value for that pixel. The more efficient the CCD is at converting photons to electrons, the greater the sensitivity on long exposures. A CCD with higher QE requires less time to acquire an image with equal signal to noise to one taken with a CCD having lower QE. The quantum efficiency of each of the new cameras is noted in the specification section of the camera page and a comparison chart may be seen
below.

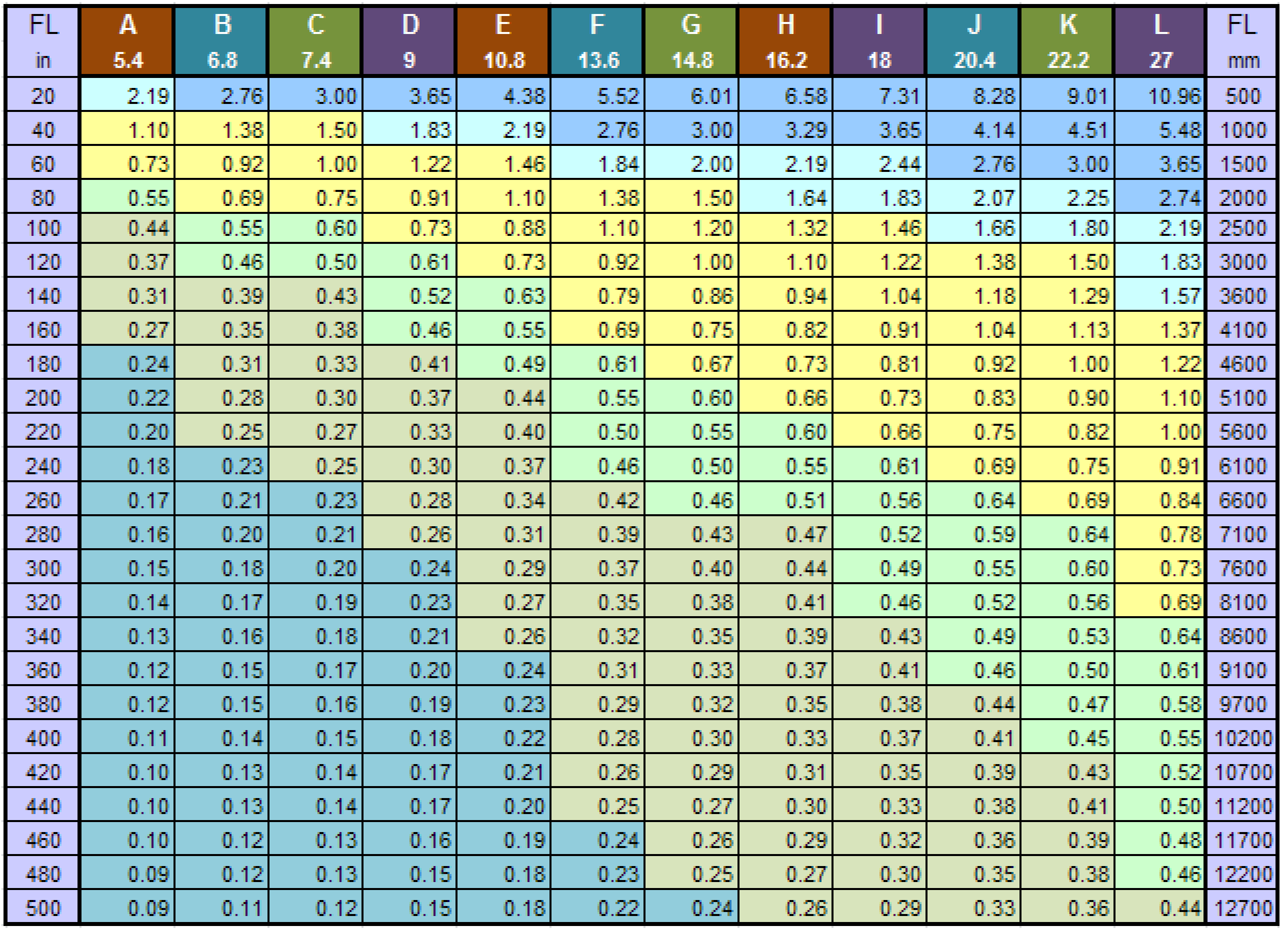


When considering QE, however, keep in mind that it is only one factor in the overall sensitivity of your camera / telescope system. A system with a faster f/ratio is more sensitive to extended objects than a slower system. Each pixel also acts like a small aperture when imaging extended objects. But smaller pixels may yield higher resolution without loss of sensitivity if properly matched to your telescope. Using pixels that are too small will result in oversampling, that is, sampling the FWHM with more pixels that are necessary. Using pixels that are too big will result in undersampling. Oversampling can result in some loss of sensitivity while oversampling results in loss of resolution of detail. The goal is to sample the FWHM (full width half-maximum) of best star images you seeing allows with 2 to 4 pixels. This will give the best balance of sensitivity and resolution. A good match of pixel size to focal length (see below) will optimize the sensitivity of the system without compromising resolution. In general, try to choo se as fast a system as you can manage that will yield an appropriate focal length for the pixel size of your camera and the CCD size of your camera. Or, if you already have a telescope with a fixed focal length and focal ratio, then select a camera with a pixel size to match. This is not an exact process. The telescope's focal length can be adjusted using a focal reducer or barlow. The camera's pixel size can be adjusted by binning 2×2 or 3×3 to effectively double or triple the size of the pixel. Often, the camera will be used on more than one telescope. So one should not be too concerned about finding the perfect match of pixel size to telescope. But it can help to find the "middle of the road" for your focal length where changes in focal length or pixel size will expand the usefulness of the CCD / telescope combinations.

4. Resolution (Pixel Size and Focal Length):



Resolution comes in two flavors these days. In the commercial world of digital devices, the word resolution is often used synonymously with the number of pixels used in a device. You are used to seeing ads for scanners with a “resolution” of 2,000 x 3,000 pixels, etc. Computer monitors have various “resolution” settings which are basically the number of pixels displayed. We use the word here in its literal sense, which is ability to resolve detail. Typically, seeing limits the resolution of a good system. Seeing is often measured in terms of the Full Width Half Maximum (FWHM) of a star image on a long exposure. That is, the size of a star’s image in arcseconds when measured at half the maximum value for that star in a long exposure. As a general rule, one wants to sample such a star image with at least 2 pixels, preferably 3 or even more depending on the processing steps to be performed and the final display size desired. This means that if the atmosphere and optical system allow the smallest star images of say 2.6 arcseconds in diameter (FWHM) then one needs a telescope focal length and pixel size that will let each pixel see about 1/2 to 1/3 of 2.6 arcseconds. In this example the individual pixel field of view should be on the order of 1.3 to 0.86 arcseconds per pixel for an optimum balance of extended object sensitivity to resolution of fine detail. If you aim for a pixel FOV of about 1 arcsecond per pixel through a given focal length, then you should be fine for the majority of typical sites and imaging requirements. If your seeing is better than typical, then you should aim for 0.5 or 0.6 arcseconds per pixel. If your seeing is much worse than typical, then you can get away with 1.5 or even 2 arcseconds per pixel. The table below shows the field of view per pixel for each of our cameras at various focal lengths. Select the focal length or range of focal lengths of your telescope in inches or millimeters and look across the table for a pixel size that yields a pixel field of view in the range that suites you seeing. A legend below the table gives the pixel size of various sensors binned and unbinned for reference. The columns are color coded so the same color column heading indicates a sensor or sensors with the same pixel size unbinned and binned 2×2 and 3×3. Also below the table is a general guide of the resolution to look for under some typical seeing conditions. Note that the exception to these general rules is planetary imaging where, because the objects are relatively bright, sensitivity is not an issue and resolution is paramount. In this case, aim for 0.25 to 0.5 arcseconds per pixel (green area). Also note that a camera with smaller pixels may be binned 2×2 or even 3×3 to create larger pixels and expand the useful range of the camera. The overall field of view of the CCD does not change however, and a camera with larger pixels and a larger field of view might be preferable if it will not be used on shorter focal length instruments.



FL	A	B	C	D	E	F	G	H	I	J	K	L	FL
in	5.4	6.8	7.4	9	10.8	13.6	14.8	16.2	18	20.4	22.2	27	mm
20	2.19	2.76	3.00	3.65	4.38	5.52	6.01	6.58	7.31	8.28	9.01	10.96	500
40	1.10	1.38	1.50	1.83	2.19	2.76	3.00	3.29	3.65	4.14	4.51	5.48	1000
60	0.73	0.92	1.00	1.22	1.46	1.84	2.00	2.19	2.44	2.76	3.00	3.65	1500
80	0.55	0.69	0.75	0.91	1.10	1.38	1.50	1.64	1.83	2.07	2.25	2.74	2000
100	0.44	0.55	0.60	0.73	0.88	1.10	1.20	1.32	1.46	1.66	1.80	2.19	2500
120	0.37	0.46	0.50	0.61	0.73	0.92	1.00	1.10	1.22	1.38	1.50	1.83	3000
140	0.31	0.39	0.43	0.52	0.63	0.79	0.86	0.94	1.04	1.18	1.29	1.57	3600
160	0.27	0.35	0.38	0.46	0.55	0.69	0.75	0.82	0.91	1.04	1.13	1.37	4100
180	0.24	0.31	0.33	0.41	0.49	0.61	0.67	0.73	0.81	0.92	1.00	1.22	4600
200	0.22	0.28	0.30	0.37	0.44	0.55	0.60	0.66	0.73	0.83	0.90	1.10	5100
220	0.20	0.25	0.27	0.33	0.40	0.50	0.55	0.60	0.66	0.75	0.82	1.00	5600
240	0.18	0.23	0.25	0.30	0.37	0.46	0.50	0.55	0.61	0.69	0.75	0.91	6100
260	0.17	0.21	0.23	0.28	0.34	0.42	0.46	0.51	0.56	0.64	0.69	0.84	6600
280	0.16	0.20	0.21	0.26	0.31	0.39	0.43	0.47	0.52	0.59	0.64	0.78	7100
300	0.15	0.18	0.20	0.24	0.29	0.37	0.40	0.44	0.49	0.55	0.60	0.73	7600
320	0.14	0.17	0.19	0.23	0.27	0.35	0.38	0.41	0.46	0.52	0.56	0.69	8100
340	0.13	0.16	0.18	0.21	0.26	0.32	0.35	0.39	0.43	0.49	0.53	0.64	8600
360	0.12	0.15	0.17	0.20	0.24	0.31	0.33	0.37	0.41	0.46	0.50	0.61	9100
380	0.12	0.15	0.16	0.19	0.23	0.29	0.32	0.35	0.38	0.44	0.47	0.58	9700
400	0.11	0.14	0.15	0.18	0.22	0.28	0.30	0.33	0.37	0.41	0.45	0.55	10200
420	0.10	0.13	0.14	0.17	0.21	0.26	0.29	0.31	0.35	0.39	0.43	0.52	10700
440	0.10	0.13	0.14	0.17	0.20	0.25	0.27	0.30	0.33	0.38	0.41	0.50	11200
460	0.10	0.12	0.13	0.16	0.19	0.24	0.26	0.29	0.32	0.36	0.39	0.48	11700
480	0.09	0.12	0.13	0.15	0.18	0.23	0.25	0.27	0.30	0.35	0.38	0.46	12200
500	0.09	0.11	0.12	0.15	0.18	0.22	0.24	0.26	0.29	0.33	0.36	0.44	12700

For Reference:

	Unbinned	Column	Binned 2x2	Column	Binned 3x3	Column
KAF-0340	7.4	C	14.8	G	22.2	K
KAF-0402	9	D	18	I	27	L
KAF-1603	9	D	18	I	27	L
KAF-3200	6.8	B	13.6	F	20.4	J
KAF-8300	5.4	A	10.8	E	16.2	H
KAF-6303	9	D	18	I	27	L
KAI-11002	9	D	18	I	27	L
KAF-16803	9	D	18	I	27	L

🟦	> 2.0	Undersampled for typical seeing. OK for wide field imaging or nights of very poor seeing > 5 - 6 arcseconds FWHM
⬜	1.4 - 2.0	Good for nights of poor seeing > 4" FWHM or for typical nights where sensitivity is more important than resolution
🟨	0.65 - 1.5	Ideal for most imaging during nights of typical seeing of 2 - 4 arcseconds FWHM on long exposures
🟩	0.5 - 0.65	Good for planetary imaging anytime and deep space on nights of exceptional seeing of 1.5 - 2 arcseconds FWHM
▨	0.25 - 0.5	Planetary imaging anytime and high resolution deep space only on the best nights with the best optical systems
🟦	< 0.25	High resolution imaging of bright objects like the sun and moon where sensitivity is not an issue

One of the first things you might notice about the pixel FOV chart (or pixel resolution chart), above, is that the 0402, 1603, 6303, 11002 and 16803 all have the same pixel field of view. This is because they all have 9 micron pixels. This means that the ST-

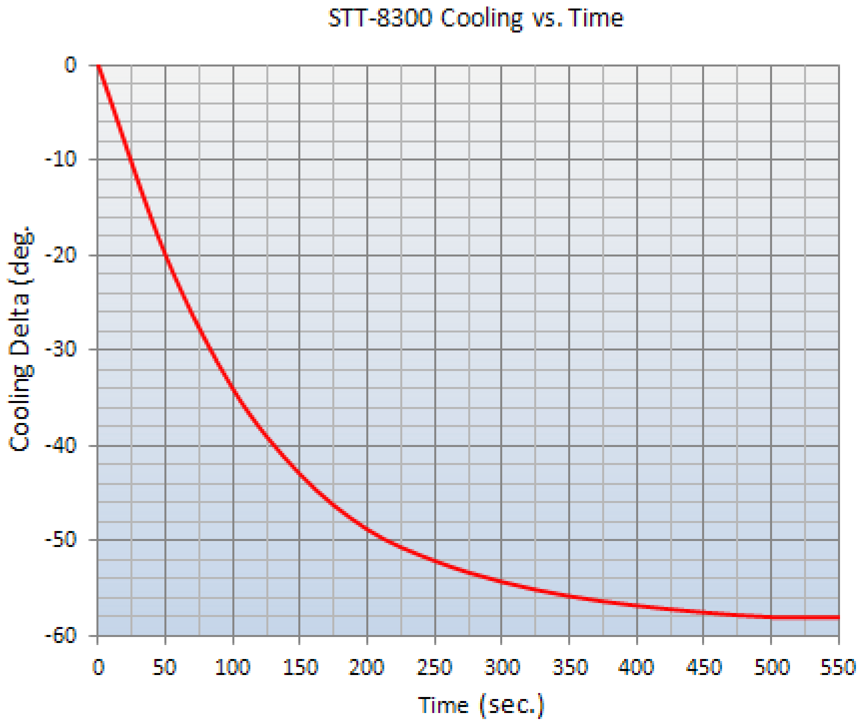
402 camera has the same resolution (ability to resolve detail) as the STX-16303 even though it has only 365,000 pixels compared to latter's 16 million pixels! The big difference between them is the overall size of the sensor, i.e., field of view. Another interesting fact to keep in mind is is that the 0402 is more sensitive than the larger sensors due to its higher QE. The second thing to glean from the pixel FOV table above is that the 8300 has the highest resolution (smallest pixel size) followed by the 3200. And since the 3200 is also the most sensitive front illuminated sensor available to amateurs today, it is also much more expensive than the 8300. However, if you are imaging wide fields, large objects, using a short fast optical system, it is difficult to beat the 8300 for value due to its relatively large area.

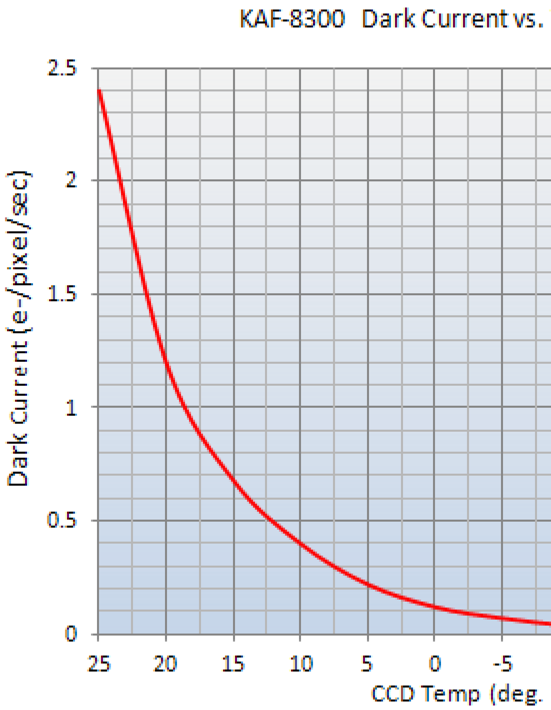
Finally, this section needs a caveat that all of these efforts to match pixel size to your telescope are a guide only and should not be taken as a hard and fast rule that you must follow. When using an STXL-11002 camera with a 35mm camera lens, for instance, beautiful wide field images are routinely captured even though the focal length of the lens is too short for the tables above and the pixel field of view or resolution is several arcseconds per pixel.

5. Cooling and Dark Current Noise

There are several possible sources of noise in an astronomical CCD image, but by far the greatest contribution to noise in a CCD image typically comes from a combination of three sources: (a) Read Noise, (b) Dark Current Noise and (d) Sky Background. These terms are defined more fully in the section CCD Imaging 101. Our cameras are designed to minimize read noise and there is little that the user can do to affect this source of noise in an image. Many claims are made about the low noise of cameras manufactured by various companies, but independent tests have shown that SBIG consistently produces exceptionally low noise cameras. Also, fortunately, for the vast majority of imaging applications, read noise is insignificant compared to the other two sources of noise in typical long exposure astronomical imaging. This leaves us with Sky Background and Dark Current.

Unlike read noise, sky background and dark current noise accumulate over time. The sky background is often the limiting factor in taking astronomical images, unless one has very dark skies or is imaging through narrowband filters. In our area, here in Santa Barbara, at f/6, we are typically limited to around 10 – 15 minutes of exposure time before sky background overwhelms the dark current noise. One way to reduce sky background is to use a red filter or narrowband filter when imaging certain kinds of objects. With an H-alpha filter, for instance, exposures of half an hour to an hour are not a problem. Also, in any long exposure the final source of noise that must be minimized is dark current noise. Fortunately, dark current can be reduced in a CCD by reducing the temperature of the CCD. This is why nearly every astronomical CCD camera features thermoelectric cooling of the sensor. Typically the dark current present in the CCD is reduced by 50% for every 6 – 7 degrees C of cooling. In other words, if the CCD has 10e-/pixel/second of dark current at 25 degrees C, and the temperature of the CCD is lowered to 18 or 19 degrees C then the dark current will be reduced to only 5e-/pixel/second, and if the temperature is lowered another 6 or 7 degrees to around 12 degrees C then the dark current will be 2.5e-/pixel/second, and so forth. Our STF series cameras are capable of cooling the CCD to almost 40 degrees below the ambient temperature, and the STT and STXL series can cool to -50 to -60 degrees C below ambient. This means that the dark current can be reduced to as little as 1/1000th of what it would be at room temperature.



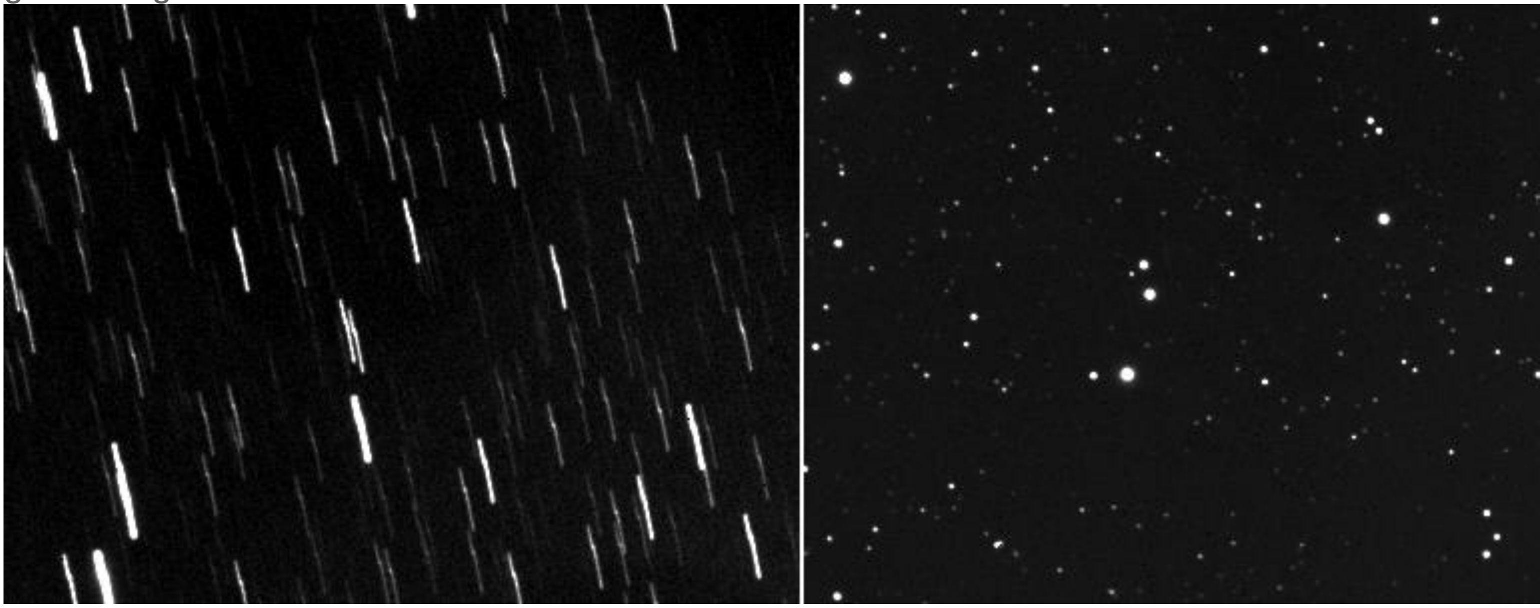


The two charts above show the effect of cooling on a KAF-8300 CCD in the STT-8300 camera. The chart on the left shows the TE cooling ability of the STT series camera. The camera will reduce the temperature of the CCD as much as -55 degrees C below the ambient temperature within approximately 6 minutes after the cooler is engaged. High precision electronics regulate the setpoint to within +/- 0.1 degrees C. So even if the ambient temperature is +30C to +35C (around 90 degrees F), the camera will still cool the CCD to an absolute temperature of -20C. This is more than adequate for the 8300 as the dark current is reduced to less than 0.01e- even at -10C.

6. Guiding

The need for guiding is often overlooked – or thought of only after everything else – when initially building an imaging system. Many other camera manufacturers do not even offer a guiding solution. Some offer hybrid solutions letting the beginner look for a guiding camera elsewhere. From its inception, however, SBIG has offered guiding solutions for astrophotographers and astroimagers. Twenty-four years ago, our first product, the ST-4 Autoguider, revolutionized astro imaging. Shortly thereafter we patented Track & Accumulate, and then Self-Guiding. In the following years we introduced Adaptive Optics, the STV stand-alone video guider, the SG-4 stand-alone autoguider, the ST-I Autoguider and Planetary imager and most recently received a third patent for Differential Guiding. The point here is that Guiding is an extremely important function in astronomical

CCD imaging that should not be trivialized. Without good guiding you will not get very good images.



As the resolution of CCDs increases with more and smaller pixels, guiding becomes more critical. Small pixels mean long exposures to get good images, along with increased sensitivity to guiding. This was the reasoning that led SBIG to invent and patent self-guiding in 1994: We wanted to make the longer exposures required easier. Do not be mislead by advertising – even good PEC correction will only allow you to expose for about a minute before trailing is noticed in most cases. A minute is not long enough!

Once one has decided to implement some sort of automatic guiding to enable longer exposures to be captured, one has a variety of choices. Four approaches are guiding with an autoguider using a radial off-axis guider, guiding with an autoguider using a separate guide scope, Track and Accumulate, an SBIG patented technique where multiple images are added together with shifts to produce a longer equivalent exposure, and self-guiding. Let us look at the advantages of each.

Many radial off-axis guiders have a severe problem in that a small prism or mirror is used to pick off a tiny portion of the light to direct to the eyepiece. Guide stars tend to be dim, and one is forced to rotate the assembly to find a guide star. When one rotates the assembly, the star motion directions (in response to guiding inputs) also rotate, and one is forced to recalibrate the autoguider quite often. Also, the dim stars force some autoguiders to require very long exposures, negating their ability to compensate for periodic errors and drive hops. In short, many radial guiders are clumsy to use. This is why our OAG-8300 Off-Axis Guider uses a larger than normal pick-off mirror and has built-in optics that double the field of view of the guide camera.

Another alternative, a separate guide scope, works quite well for refractors and fast Newtonians, but poorly for SCT systems. The problem here is differential deflection – slight tilts or wobbles of the primary mirror can shift a star position significantly on the imaging CCD. The mirror tends to shift since the gravity loads change as the telescope counteracts the earth’s rotation. Our experience with differential deflection is that one can only go about 5 to 10 minutes before it becomes a problem. Also, by the time one has bought an autoguider, and a separate guide scope with mounting rings, one has spent more money than an SBIG Self-Guiding solution costs relative to its cheaper competitors. And you still have to manually find guide stars.

Our patented Track and Accumulate is a good technique at fast F ratios or with large pixels. The key to Track and Accumulate working well is to be able to use an exposure long enough that the noise due to the photon flux in the sky background dominates the readout noise. This technique is particularly effective for the ST-6 with its large pixels, where 30 seconds at F/6.3 is long enough that the sky background dominates. It is less useful for cameras with smaller pixels.

Self-guiding is the premier approach. The full aperture of the main telescope is used, allowing maximum sensitivity. Differential deflection does not occur, since the optical system is common to imaging and guiding CCDs. Long exposures can be commanded between readouts of the imaging CCD. And, a feature not to be downplayed, one has the ability to select the guide star using the computer, with total control over the guiding process. You can see the image the guider is working with, instead of wondering whether or not the guider is in focus. With self-guiding you can take much longer exposures, and you can do it with ease. You will obtain much better images, which is why you wanted the camera in the first place!

To summarize, we make the well autoguiders and yet we chose to make them unnecessary with Self-Guiding. Why would we do this? We did it for several reasons – to save our camera users money, and time, to improve the tracking, and to simplify the tracking process to where it is no longer a burdensome chore of astrophotography. We have since discovered that self guiding is an enabling feature, enabling an adaptive optic system that can improve atmospheric seeing and eliminate wind and drive fluctuations. Astronomical applications demand the self-guiding capability! Do not underestimate the challenge of capturing well guided hour long images!

7. Software

Unlike DSLRs, virtually every astronomical CCD camera is operated with a computer or laptop. So, no matter how good your CCD camera might be, if it does not have good control software its just an expensive bunch of wires and metal. After all is said and done, if a camera is difficult to use at the telescope, no matter how good the hardware, image quality will suffer. Getting focused, framing an object that is difficult to see, processing the results, etc., all go into the final result. Good software makes these and other tasks easier to get right. Most other manufacturers supply only bare bones control software, or even less, just the drivers, assuming the user will purchase third party software to make their cameras functional. SBIG cameras come with our CCDOPS software, which makes effective imaging possible out of the box. For more advanced control, including operating all of your observatory equipment, we offer MaxIm DL software. A variety of third-party products are also available.

CCDOPS version 5 is included with all SBIG cameras at no additional charge. CCDOPS v. 5 is SBIG's full featured camera control software for Windows. Our own software package has evolved over the past 20+ years into one of the best, if not the best, basic camera control packages offered by any astronomical CCD camera manufacturer. This software controls all camera functions, self-guiding, autoguiding, color filter wheel and adaptive optics. It also has easy to use single-shot color processing for SBIG color cameras. In addition, CCDOPS includes PlanetMasterTM is free with all SBIG cameras and can be downloaded for free from our web site.

Maxim DL Pro is the leading CCD imaging software package, and it fully supports SBIG cameras, filter wheels, and AO accessories, plus a huge variety of third party astronomical equipment. A 30 day trial version available. (SBIG is now part of Diffraction Limited, the makers of MaxIm DL.)

MPO Canopus and PhotoRed software for astrometry and photometry with any photometric system (camera, filter wheel and photometric filters).