Astrovideo Camera CCD Sensitivity Comparison
by Jim Thompson, P.Eng
Technical Report – October 18th, 2011

Objectives:
Upon the request of a fellow video astronomer, I have added a couple of other CCD models to the list for comparison. All of the additional chips are black and white sensors. I have reduced and compared the data between chips in the same manner as my original report from August 2011.

Input Data:
I have compared six b&w CCD chips in total, all of which are Sony brand, with data on each chip coming from each respective Sony published spec. The figures below are copies of the spectral sensitivity plots as they appear in the Sony documents.

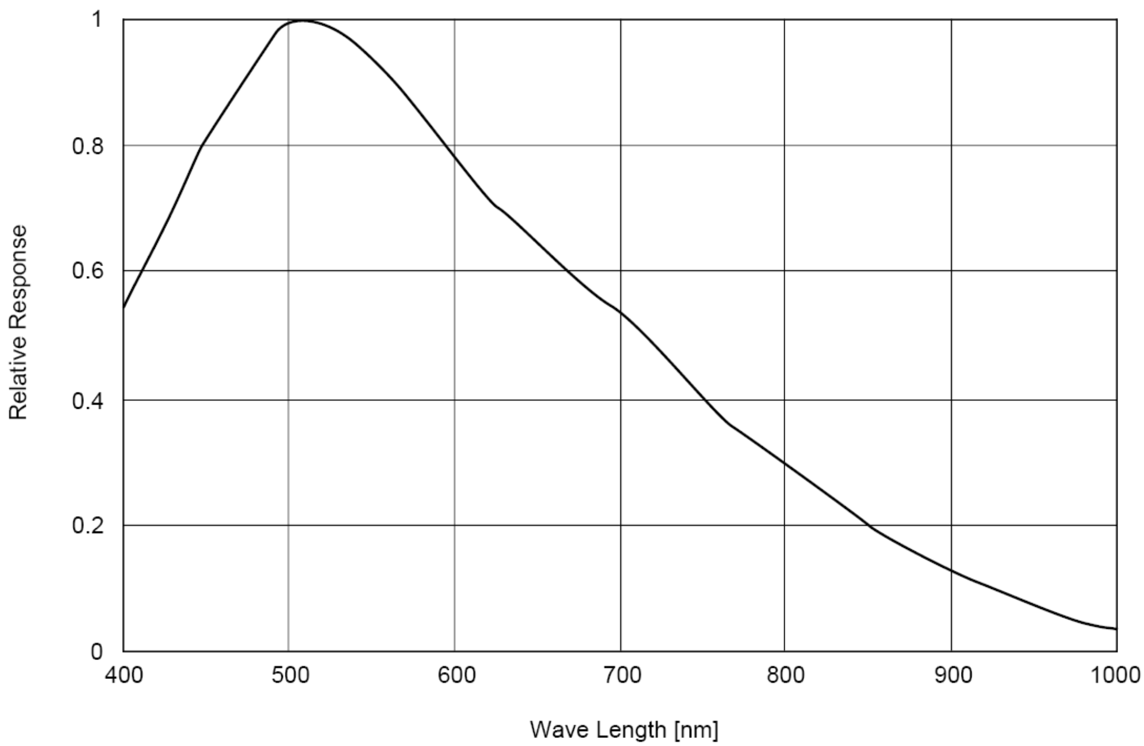

Figure 1 Spectral Sensitivity for ICX205AL

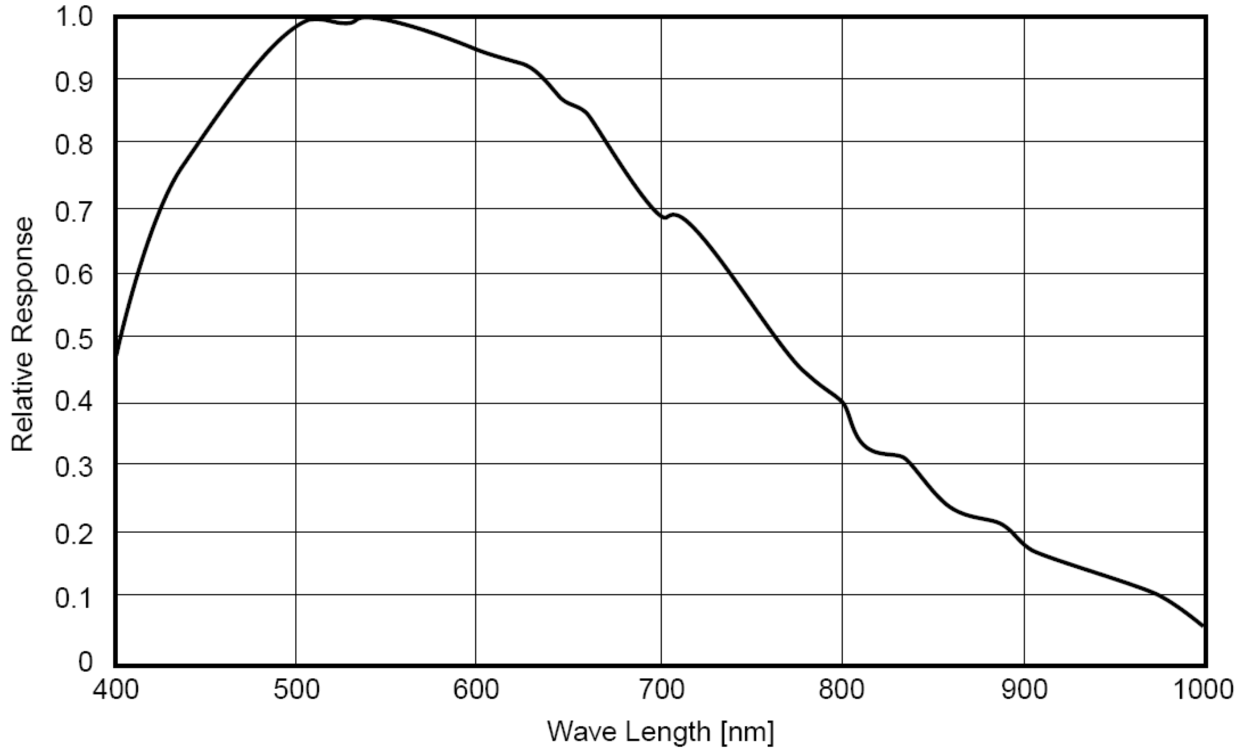

Figure 2 Spectral Sensitivity for ICX285AL

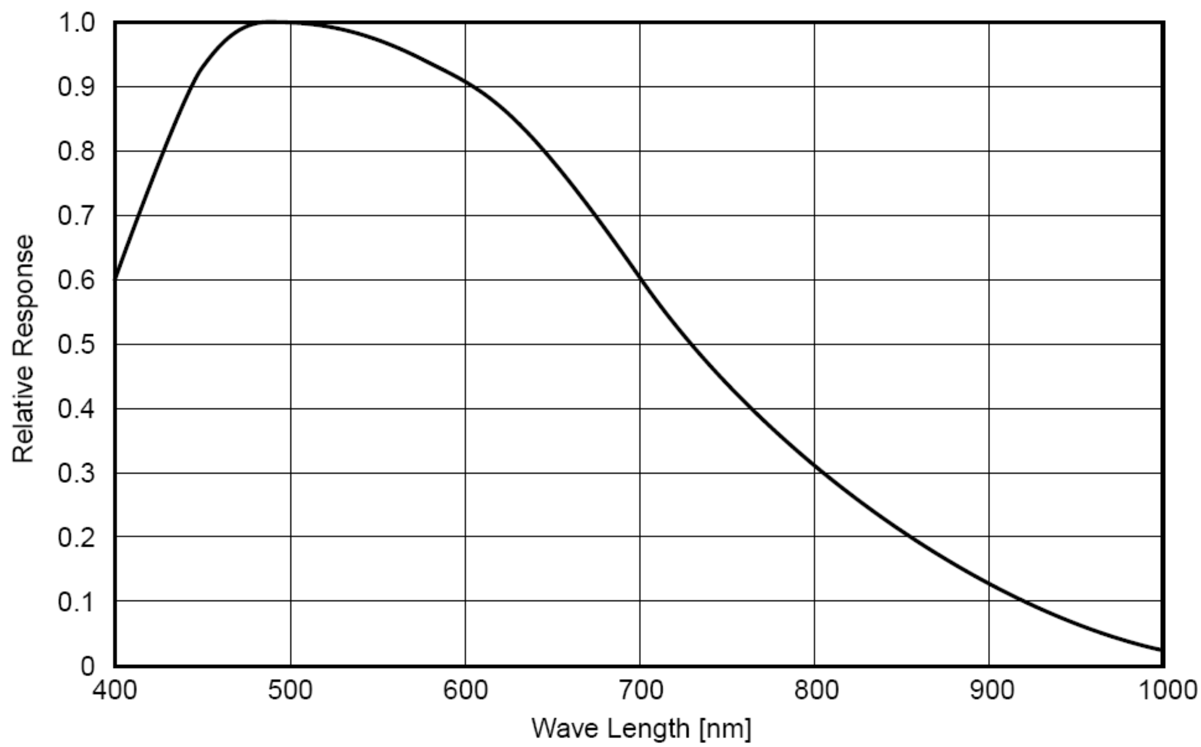

Figure 3 Spectral Sensitivity for ICX418ALL

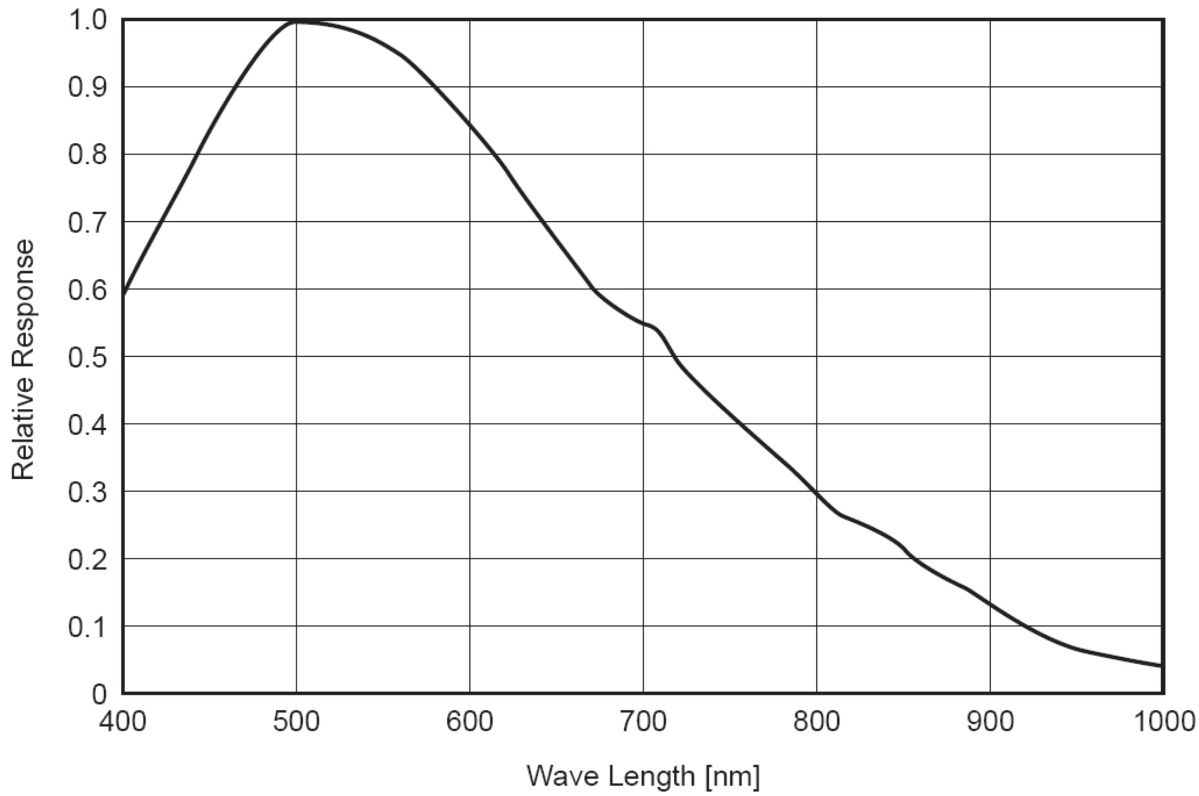

Figure 4 Spectral Sensitivity for ICX424AL

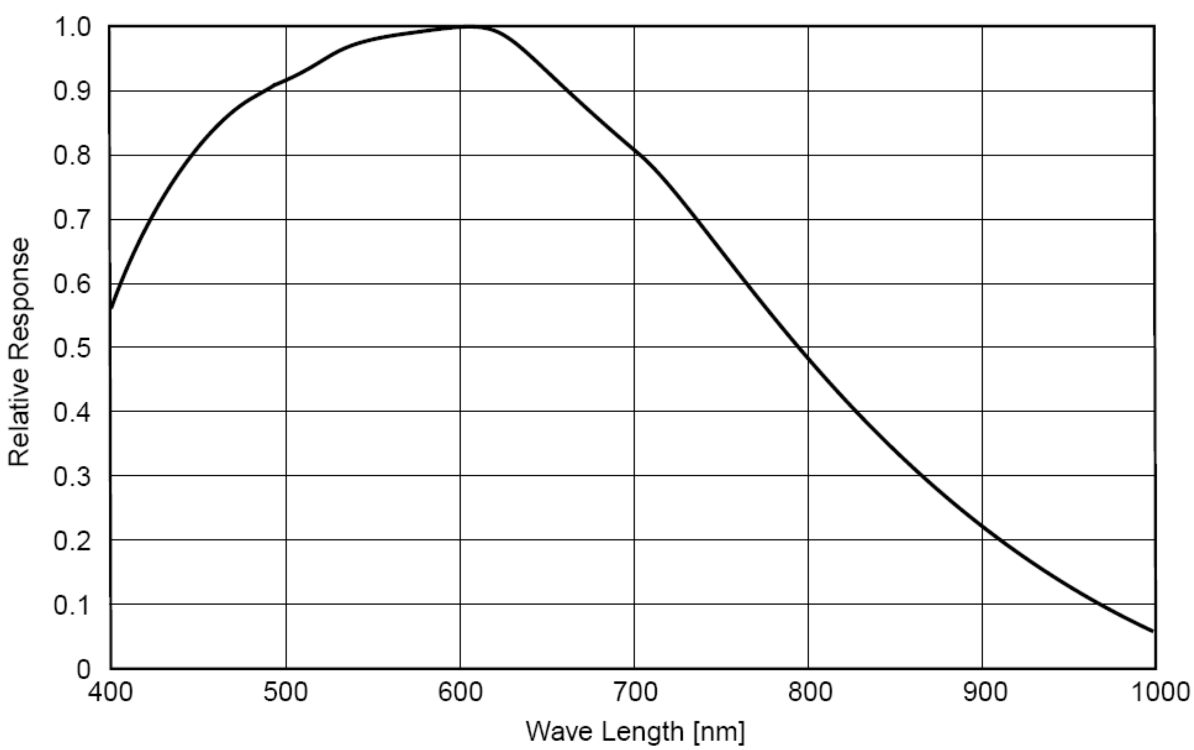

Figure 5 Spectral Sensitivity for ICX428ALL

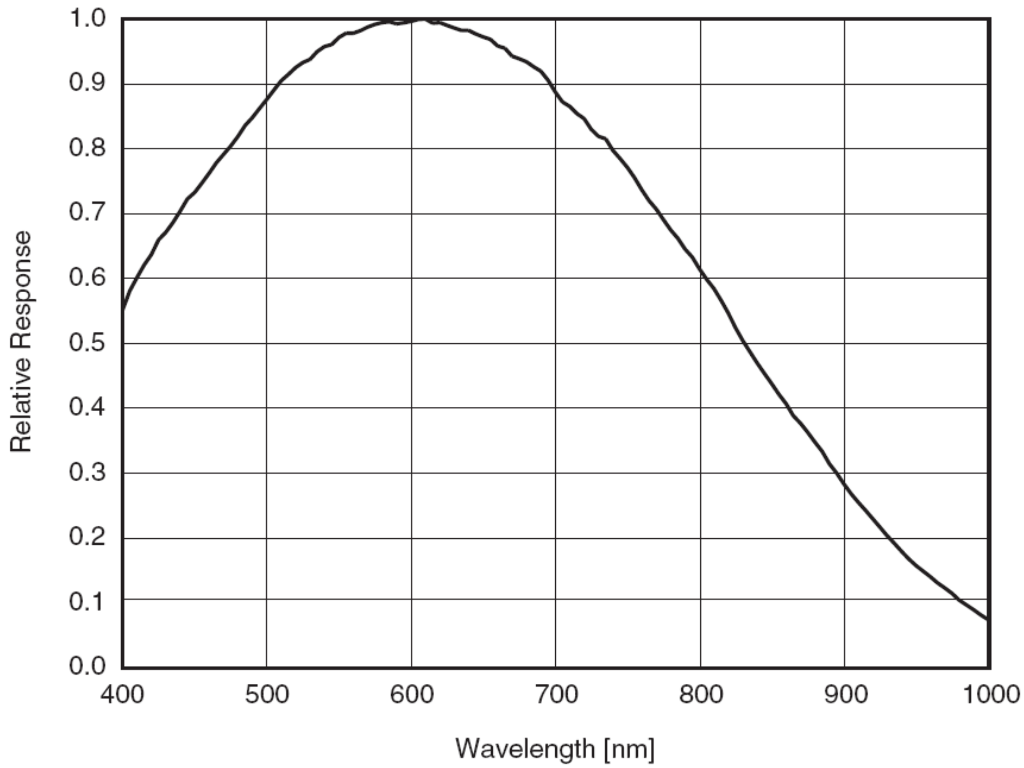

Figure 6 Spectral Sensitivity for ICX618ALA

Also provided in the Sony spec sheets are some basic sensor performance data. The most relevant values are listed below in Table 1.

CCD Model	Sensitivity (typical)	Dark Current	Pixel Size	Resolution	Image Size (diagonal)
ICX205AL HAD	450 mV	16 mV	4.65µm	1360 x 1024	8 mm
ICX285AL EXview HAD	1300 mV	11 mV	6.45 µm	1360 x 1024	11 mm
ICX418ALL	1100 mV	2 mV	8.4 x 9.8 µm	768 x 494	8 mm
ICX424AL HAD	880 mV	2 mV	7.4 µm	659 x 494	6 mm
ICX428ALL EXview HAD	1400 mV	2 mV	8.4 x 9.8 µm	768 x 494	8 mm
ICX618ALA EXview HAD	1200 mV	4 mV	5.6 µm	659 x 494	4.5 mm

Table 1 Summary of CCD Performance Data

Methology:

The data provided by Sony has been manipulated in exactly the same manner as I did in my original report from August 2011.

Results:

The result of my calculation is shown in Figure 7. With this plot it is very easy to compare the different CCD chips. The selection of the best CCD chip to use in a camera for video astronomy is not as simple as picking the one with the highest sensitivity, you also need to consider the other parameters that are summarized above in Table 1. To help interpret the results, take note of the following:

- Dark Current: The dark current is a measure of how inherently noisy the image data from the CCD is. The lower the dark current, the better. This is very important when trying to view low contrast targets like nebulae or galaxies.
- Pixel Size: The pixel size is analogous to aperture in a telescope. A large pixel size will result in more light being brought in per refresh for that pixel, resulting in a corresponding increase in sensitivity of the device. The bigger the pixel size the better.
- Resolution: Within a fixed field of view, a higher resolution of pixels will result in more detail being visible. High resolution is very useful when viewing planets or the Moon where the surface details are numerous and small in size. Associated with a higher resolution is a larger burden on resources since the rate of data flow is higher per frame. As a result, large resolution cameras often have slower refresh rates.
- Image Size: The size of the image on the chip is a function of the pixel size and resolution of the CCD. When used with a telescope or lens system, the image size affects the field of view you will achieve. A larger image size will have a larger field of view for the same optics. For reference, the maximum diameter of the fully dilated human pupil is 7mm.

With these points in mind, the best CCD for video astronomy from the list above depends somewhat on the desired target. If planets, Sun and Moon are the main targets, then probably ICX285AL would be a good choice. If deep sky objects are the main targets, then it is a toss-up between the ICX418AL/ICX428ALL with their extremely low dark current and the ICX618ALA with its higher sensitivity. Probably the 418 and 428 would be the best choice in the end since the 618 is only about 9% more sensitive (than the 428) but has 2x the dark current, plus it has almost half the affective field of view of the 418 and 428 chips.

Equally important as the selection of the best CCD is the design and fabrication of the rest of the camera that houses it. A good chip requires equally good quality control (hot pixels!), signal conditioning, signal amplification, chip cooling, video post processing, etc or else the camera will not be able to take advantage of the good chip. A good CCD chip in a low quality camera will likely give disappointing performance. A good CCD chip demands high quality all the way!

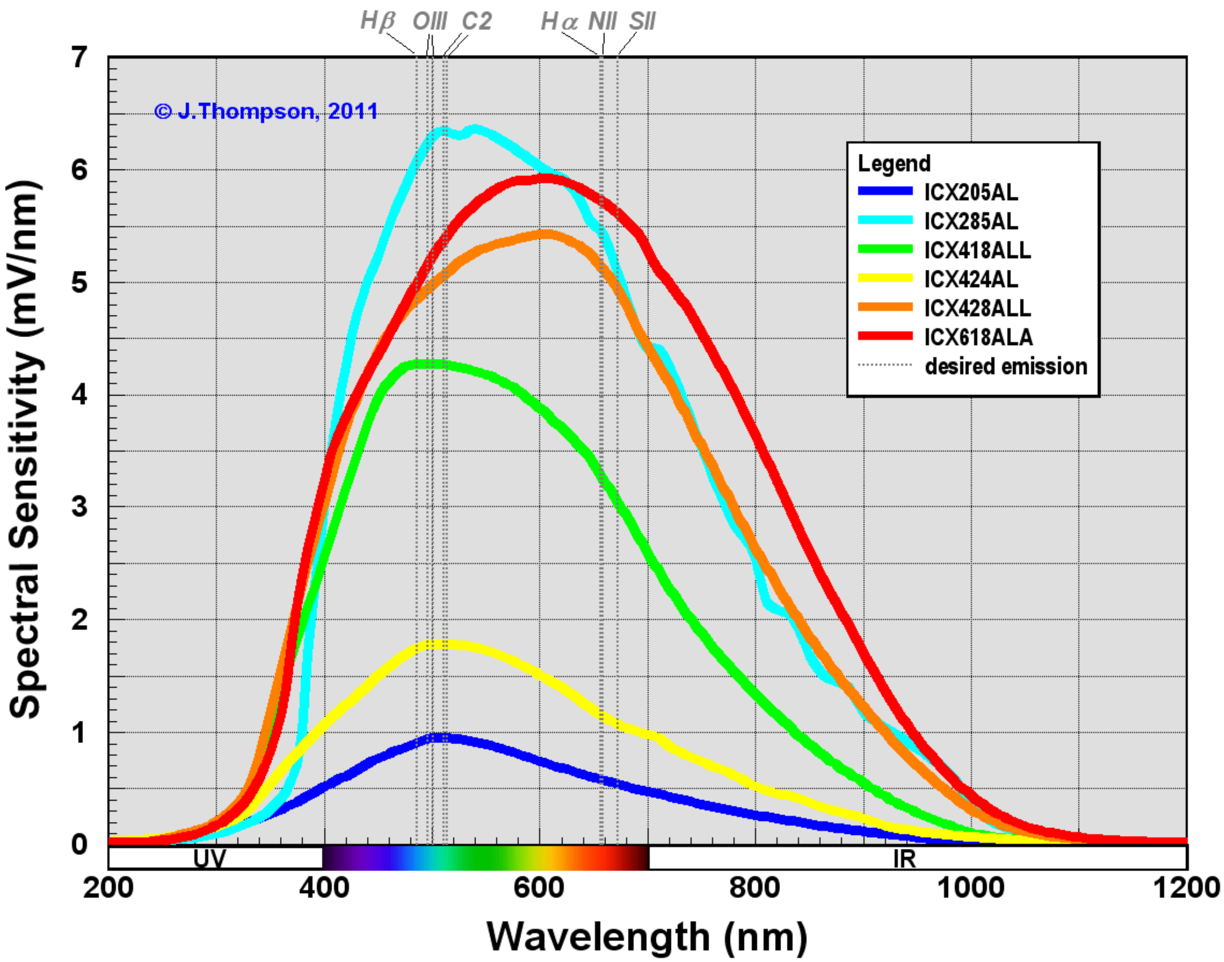

Figure 7 CCD Absolute Sensitivity Comparison

I hope my work is useful to the video astronomy community. If you have any questions, please feel free to contact me at: top-jimmy@rogers.com

Cheers,

Jim Thompson
AbbeyRoadObservatory