FINGER LAKE INSTRUMENTS COOLED CAMERAS

What's the difference between an interline and a full frame CCD?

Interline CCDs use part of each pixel to collect light, and part of each pixel to store and move charge. The storage area has a metal mask to prevent corruption of the image during readout. New CCDs have a microlens over each pixel to focus incoming light onto the photodiode portion of the pixel so that light is not lost landing on the metal masks. Because only part of the pixel is used to collect light, the full well capacity of interline CCDs is typically lower than comparably sized full frame pixels. Interline transfer CCDs shutter the image by moving the charge from the photodiode to the storage diode side of the pixel. As a result, interline exposures can potentially be very short. For FLI cameras, interline exposure times can be as low as 30 microseconds (as opposed to about 30 milliseconds for an electromechanical shutter). Usually interline CCDs are used without electromechanical shutters. However, it is complicated to take a dark image without a shutter unless you have some way of keeping the camera in a 100% dark environment. Full frame sensors use 100% of each pixel to collect, store, and transfer charge. They require an electromechanical shutter unless the camera is going to be used in a 100% dark environment. Full frame devices typically have higher full well capacities and higher quantum efficiencies than interline sensors.

What's a back-illuminated CCD?

CCDs are slabs of silicon like photovoltaic cells. Gate structures are added to the top (usually polysilicon or indium tin oxide) so a charge can be applied to corral electrons where they were created (in order to get an image). These gate structures block incoming light and reduce the quantum efficiency (QE). One way to improve QE is to flip the CCD over so that the gates are on the bottom, then grind down CCD until it is about 15 microns thick. The gates are still close enough to the front surface that charge is captured where it is created. Back-illuminated or thinned CCDs have very high quantum efficiencies, but typically cost much more than front-illuminated CCDs.

How does FLI cool the sensor?

FLI uses Peltier devices, which are thermoelectric coolers that get cold on one side and hot on the other when electricity is applied. Designing a CCD chamber than can keep a seal for many years is part of the engineering; efficiently dissipating the heat generated by the cooling is another part. Typically the temperature sensor for a camera is installed in a copper block that links the CCD to the Peltier cooler. If there is a problem with contact between the copper block and the sensor, the block may be cold but the sensor may not be fully cooled. In this case, you can see dark current values that are inconsistent with reported temperature of the camera.

Should I buy a colour or monochrome CCD?

For most scientific applications, a monochrome CCD is the best choice for several reasons. First of all, you have control over the filter sets used. You may want to change from RGB to CMY to photometry filters or narrow band filters. A colour CCD has a fixed set of filters, typically in a Bayer pattern (red-green-green-blue). If you use a blue filter in front of a colour CCD, only one of 4 pixels will see any significant amount of light. Color CCDs can deliver a colour image in a single shot, but they compromise spatial sampling. A 10 megapixel color sensor is not delivering 10 megapixels of red, and 10 megapixels of green, and 10 megapixels of blue. A monochrome sensor acquiring a red, green, and blue image using a filter wheel acquires 10 megapixels of each. Typically you cannot bin colour CCDs (you can, but the results will have limited utility).