Advanced and Customizable Camera Technology for Direct Detection of X-rays

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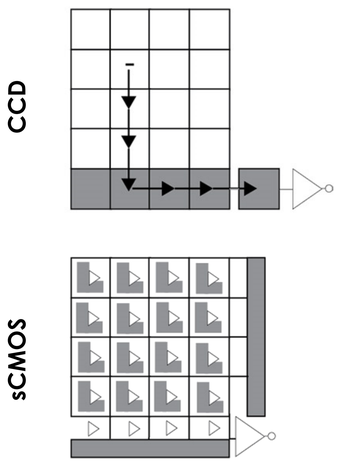
Abstract. Development of soft X-ray (20 eV to 10 keV) sources has led to an increasingly wide application of X-ray spectroscopy, microscopy, and tomography for studying material and biological systems. As experimental applications of these methods continue to grow, detection needs in the soft X-ray regime are becoming increasingly demanding and diverse. It is important that X-ray camera technology develops to accommodate these needs, whether they be complex experimental geometries, a desire for high-throughput capabilities, or large fields of view. Equally as important is that detector sensitivity and noise profiles are not compromised in this pursuit.

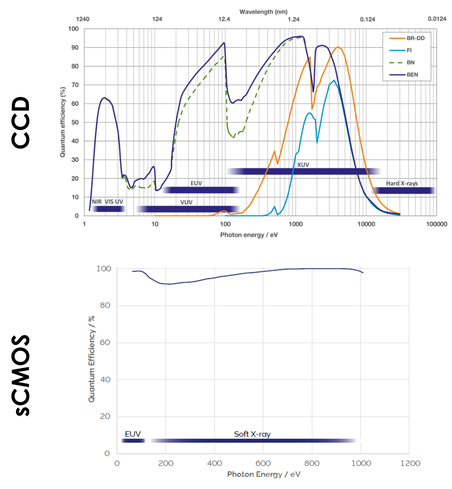
We present several detection solutions for complex and high-speed soft X-ray measurements. A back-illuminated X-ray sCMOS camera is shown, possessing full frame rates at least an order of magnitude faster than conventional CCD technology. Examples of custom CCD cameras will be shown to illustrate how X-ray detectors can be modified to accommodate unique experimental geometries. Further discussion will be framed around how camera technology can facilitate a continual evolution in soft X-ray methodologies housed in both small research group settings and larger beamline facilities.

Technical differentiation of soft X-ray CCD and sCMOS cameras.

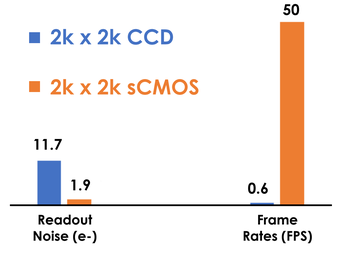
Read Out Architecture



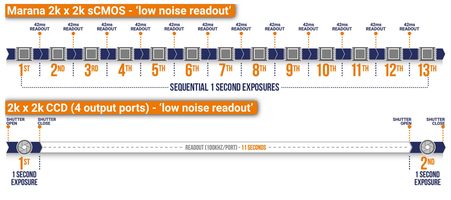
QE Profiles



Frame Rates and Readout Noise

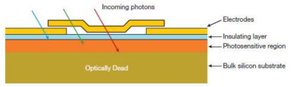


Read Out Speed

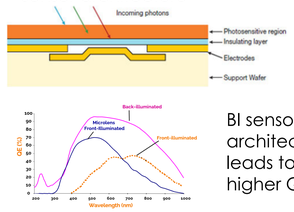


Marana-X: Back-Illuminated sCMOS for fast and direct soft X-ray measurements.

Front-Illuminated sensor architecture

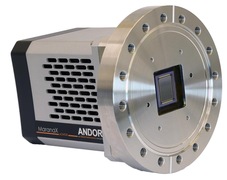


Back-Illuminated(BI) sensor architecture



BI sensor architecture leads to higher QE

As X-ray sources get brighter and faster, direct detection of soft X-rays at fast frame rates becomes possible with the Marana-X's back-illuminated sCMOS technology. Boasting **high QE** and **frame rates ranging from 10's Hz to 10's kHz**, the Marana-X is a unique camera solution for use in fast imaging and spectroscopy experiments utilizing soft X-ray light sources ranging from synchrotrons, free electron lasers, table-top HHG sources, and beyond.



Application Space:

- Absorption/Transmission Spectroscopy
- Ultrafast Spectroscopy
- Nonlinear Spectroscopy
- X-ray Scattering
- Coherent X-ray Imaging

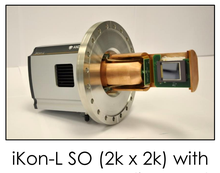
X-ray CCD cameras optimized for particular experimental configurations.

Range of Sensor Sizes

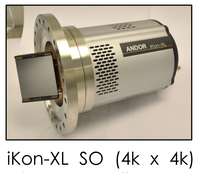
iKon-M SO (1k x 1k)

iKon-XL SO (4k x 4k)

Protruding and Tilted Sensors

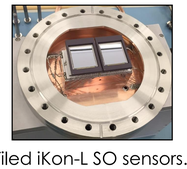


iKon-L SO (2k x 2k) with sensor protruding and sitting 90° to normal



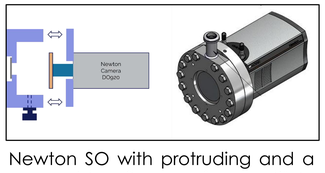
iKon-XL SO (4k x 4k) with sensor tilted 60° to normal.

Tiled Sensor Arrays



Tiled iKon-L SO sensors.

Custom Flanges



Newton SO with protruding and a removable flange for multiple applications.

Andor's **customer special request (CSR)** process can be utilized to optimize CCD camera form factors to optimize sensor positioning for unique experimental configurations – all based on Andor's HED camera models.

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