HIGH ENERGY DETECTION

WE HAVE TAKEN OUR EXTENSIVE RANGE OF HIGH PERFORMANCE CAMERA PLATFORMS AND OPTIMIZED THEM TO SUIT THE DETECTION OF HIGH ENERGY PHOTONS, THUS MAINTAINING OUR LEAD IN THIS FIELD BY CONTINUALLY PUSHING THE BOUNDARIES OF DETECTION. OUR IN-DEPTH KNOWLEDGE BASE ENABLES US TO TAILOR SOLUTIONS FROM STANDARD FLANGES TO 'ONE OFF' BESPOKE SOLUTIONS, ALL DESIGNED AND BUILT WITH ANDOR QUALITY AND RELIABILITY TO DELIVER HIGH CAMERA PERFORMANCE AS STANDARD.

HIGH-ENERGY PHOTON DETECTION

ENHANCED SPATIAL & ENERGY RESOLUTION

S Direct Detection Cameras

In this configuration, the sensor is directly exposed to incoming radiation. This ensures the highest Quantum Efficiency with enhanced spatial and energy resolution compared to indirect detection or X-ray film detection methods.

SO 'Open Fronted' Systems

SY 'Stand Alone' Systems

H Indirect Detection Cameras

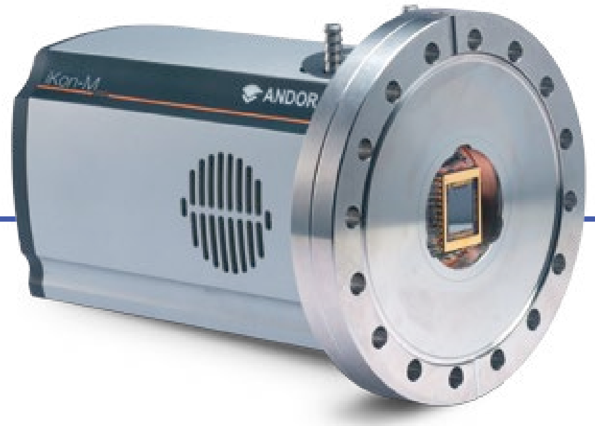
Suitable for High Energy Detection through fiber-optic coupling interface and use of scintillator screen.

HF 'Fiber Fronted' System

S Direct Detection Cameras

O ‘Open Front’ Systems

For interfacing directly to vacuum chambers



iKon SO Systems

High energy imaging cameras
Andor’s iKon-M SO 934 and 4 megapixel iKon-L SO 936 CCD are ideal systems to interface directly to vacuum chambers for X-ray detection. The systems incorporate high-QE back-illuminated sensor options, optimized for direct X-ray detection.

Features	
-100°C TE cooling	Cropped sensor mode for rapid data acquisition
Ultra low noise readout, multi-MHz readout platform	Enhanced baseline clamp
Large area 2048 x 2048 pixel sensor on iKon-L 936	O-ring or knife-edge sealing
High dynamic range and resolution	Deep Depletion option for enhanced hard X-ray detection
Dual output on iKon-L 936 (high sensitivity or high capacity mode)	Optional filter holder available
	USB 2.0 plug and play connectivity

Newton SO Systems

High energy Spectroscopy cameras
Andor’s spectroscopic Newton 920 and 940 CCD cameras are ideal systems to interface on to VUV spectrographs. The systems incorporate high-QE back-illuminated sensor options, optimized for direct X-ray detection.

Features	
-100°C TE cooling	Enhanced baseline clamp
Ultra low noise readout, multi-MHz readout platform	O-ring or knife-edge sealing
High dynamic range and resolution	Deep Depletion option for enhanced hard X-ray detection
Dual output on 940 model (high sensitivity or high capacity mode)	Optional filter holder available
Cropped sensor mode for rapid data acquisition	USB 2.0 plug and play connectivity

Y ‘Stand Alone’ Systems

Incorporate visible photon input filter

The ‘Stand Alone’ cameras offer our industry leading platforms in a visible light filtered Ultravac permanent vacuum package. These cameras have been designed to maximize the soft X-ray detection without compromise on our ground breaking platforms performance. A flexible range of cameras with direct USB 2.0 connectivity.

Features
Soft X-ray detection
High spatial resolution
200 μm Beryllium window to block visible and low energy photons
UltraVac™ Technology
Single photon energy resolution
Deep Cooling -100°C
Indirect variants available on request

H Indirect Detection Cameras

NEW

Suitable for High Energy Detection through fiber-optic coupling interface

Andor's fiber optic fronted cameras couple to scintillator screen modules for hard X-ray detection. The iKon-L HF allows access to a large field of view, while the new Zyla HF offers the highest resolution, fastest acquisition rate platform.

Features	
High frame rate, high resolution sCMOS options (Zyla sCMOS)	Large area coverage (via magnifying taper)
Single photon sensitivity even with highly demanding tapers (iXon Ultra technology available)	High dynamic range at high energy levels
Custom relay tapers available on request	Interfaces with imaging relay devices, e.g. streak modules
Range of scintillators / phosphors available	
Detection coverage beyond the Hard X-ray region	

Specifications Overview

	iKon-M 934 [SO]	iKon-L 936 [SO]	Newton 920 [SO]	Newton 940 [SO]	Zyla 5.5 [HF]
Active pixels (H x V)	1024 x 1024	2048 x 2048	1024 x 255	2048 x 512	2560 x 2160
Pixel size (W x H; µm)	13 x 13	13.5 x 13.5	26 x 26	13.5 x 13.5	6.5 x 6.5
Sensor area (mm)	13.3 x 13.3	27.6 x 27.6	26.6 x 6.7	27.6 x 6.9	16.6 x 14
Pixel well depth (e-, typical)	100,000	100,000	500,000	100,000	30,000
Maximum full frame rate (fps)	4.4	0.95	10	2.5	100
Read noise (e-, typical*)	2.9 @ 50 kHz	2.9 @ 50 kHz	4 @ 50 kHz	3.5 @ 50 kHz	1.2 @ 200 MHz
Dark current (e-, typical)	0.00012	0.00059	0.0001	0.0009	0.14
Vertical clock speeds (µs)	11 to 44	38 to 76	12.9 to 154	14.5 to 58	-
Minimum sensor temperature (°C)	-100	-100	-100	-100	0
Digitization	16-bit	16-bit	16-bit	16-bit	12- and 16-bit
Pixel readout rates (MHz)	5, 3, 1, 0.05	5, 3, 1, 0.05	3, 1, 0.05	3, 1, 0.05	200, 560 MHz
PC interface	USB 2.0	USB 2.0	USB 2.0	USB 2.0	Camera Link
Sensor options	BN, BR-DD	BN, BR-DD, FI	BN, BR-DD, FI	BN, FI	FI

* All values based on BN variation of sensor

Typical Applications Matrix

	DIRECT DETECTION (S)			INDIRECT DETECTION (H)
	'Open Front' (O)		'Stand Alone' (Y)	'Fiber-Optic' (F)
	iKon-M and L	Newton	SY Series	HF Series
Soft X-ray Imaging	•	•	•	
Hard X-ray Imaging				•
X-ray Diffraction (XRD)	•	•	•	
X-ray Fluorescence (XRF)	•	•		
Plasma Diagnostics	•	•	•	
Lithography EUV [UHV]	•	•	•	
Crystallography				•
X-ray Tomography / Tomography				•
Image Relay Systems (e.g. slit scanners, streak tubes)				•
Laser X Development	•	•	•	

Scientific User's References

Optical control of hard X-ray polarization by electron injection in a laser wakefield accelerator 2013
M Schnell, A Sävert et al – (2013) Nat Commun Vol 4 Article number:2421

Tabletop Nanometer Extreme Ultraviolet Imaging in an Extended Reflection Mode using Coherent Fresnel Ptychography 2013
Seaberg, M. D., Zhang, B., Gardner, D. F., Shanblatt, E. R., Murnane, M. M., Kapteyn, H. C., et al. (2013). Tabletop Nanometer Extreme Ultraviolet Imaging in an Extended Reflection Mode using Coherent Fresnel Ptychography. arXiv preprint arXiv:1312.2049.
arXiv preprint arXiv:1312.2049, 2013, Seaberg, Zhang, Gardner, Shanblatt, Murnane, Kapteyn, Adams

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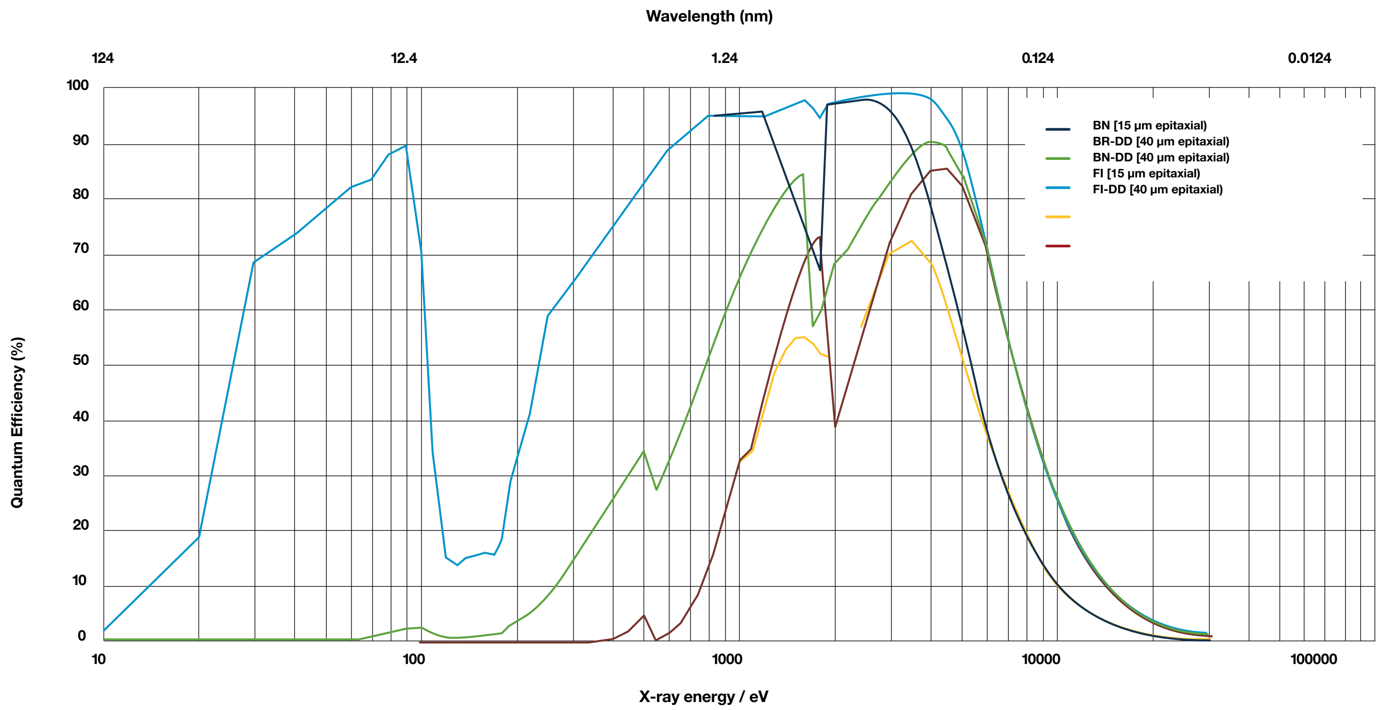
Zhang, B., Seaberg, M. D., Adams, D. E., Gardner, D. F., Shanblatt, E. R., Shaw, J. M., et al. (2013) Optics express, 21(19), 21970-21980

Compressive x-ray phase tomography based on the transport of intensity equation 2013
L Tian, JC Petruccelli, Q Miao, H Kudrolli et al Optics Letters, Vol. 38, Issue 17, pp. 3418-3421

L-Edge X-ray Absorption Spectroscopy of Dilute Systems Relevant to Metalloproteins Using an X-rayFree-Electron Laser 2013
R Mitzner, J Rehanek, J Kern, et al - (2013) J. Phys. Chem. Lett., 2013, 4 (21)pp 3641–3647

Quantum Efficiency Curves

Quantum Efficiency (QE) curves for high energy cameras

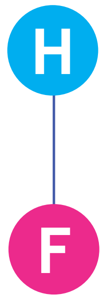


High Energy Camera Capabilities

The following diagram can be used as a guide to Andor's broad capabilities in the area of high energy photon detection, demonstrating our ability to adapt our various high-performance camera platforms to meet a broad gamut of specific application and set-up requirements.

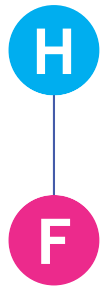
Many of the camera types represented are available as standard products but please use Andor's Customer Special Request (CSR) service to discuss other options within this diagram.

Zyla sCMOS

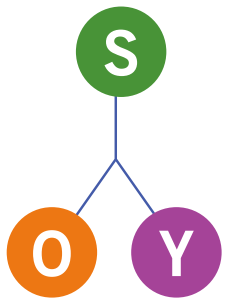


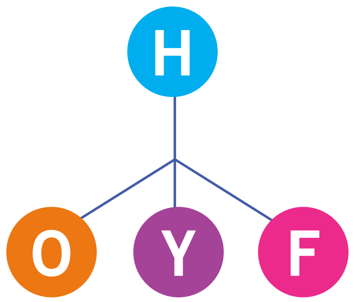
iStar ICCD

iXon EMCCD



iKon-L CCD





S Direct Detection Cameras

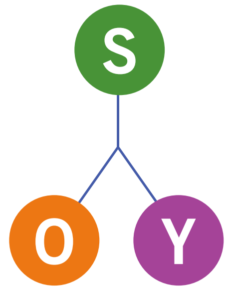
H Indirect Detection Cameras

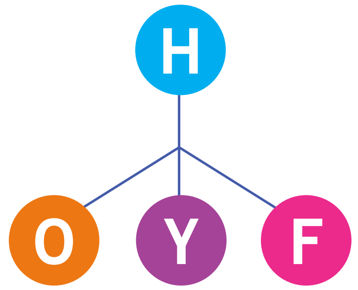
O Open Front Systems

Y Stand Alone Systems

F Fiber Optic Interface

iKon-M CCD





Newton CCD