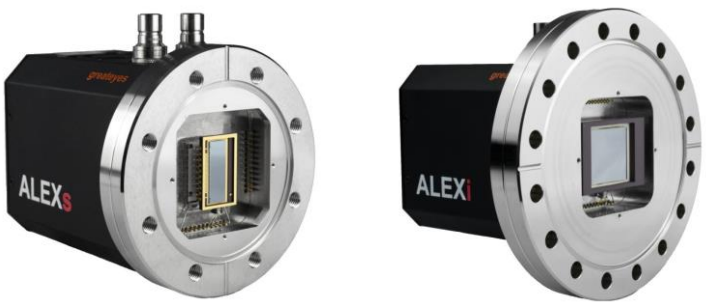
Scientific Full-Frame CCD Cameras for VUV EUV X-ray Imaging and Spectroscopy

ALEXs/ALEXi



2023 V1

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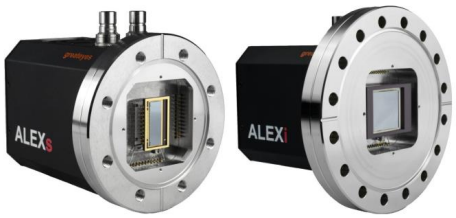
Scientific Full-Frame CCD Cameras for VUV EUV X-ray Imaging and Spectroscopy

These scientific full-frame CCD cameras for for VUV EUV X-ray imaging and spectroscopy are the ALEX series (including ALEXs and ALEXi). It is suitable for photon energy range 5 eV - 20 keV.



ALEX integrates cutting-edge low-noise electronics and ultra-deep cooling technology while keeping a compact camera design. Multiple readout speeds can be selected supporting pixel rates from 50 kHz up to 5 MHz. True 18-bit AD conversion allows to exploit the full dynamic range of the CCD sensor for highest performance and SNR. ALEX is ideally suited for detection of very weak signal intensities where a low-noise floor is paramount. ALEX offers unprecedented possibilities for your measurements of tomorrow.

Camera Feature

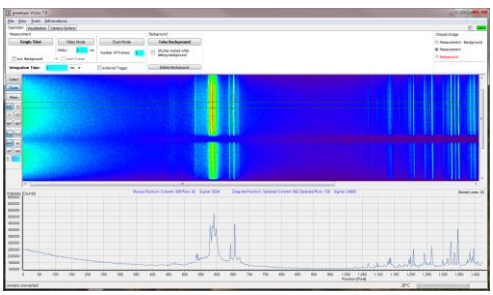
- Ultra deep TE cooling to -100 °C
  Lowest dark current for better detection limit
- GigE & USB 3.0 data interface
  Local or remote network operation – your choice
- Fast readout speeds up to 5 MHz
  Fast frame rates paired with low-noise electronics
- High QE up to 98%
  Very sensitive sensors for low light applications
- User selectable gain
  Balance your detector for best SNR and dynamic range
- Flexible software options
  Camera software and SDKs available

Vision Software

Vision software suite provides access to all camera functionalities. It includes comprehensive visualization, analysis and storage options and supports important features such as wavelength and geometric calibration, crop and burst modes and various file formats. The software runs on 32/64-bit Windows systems. For integration into other systems, a software development kit and drivers are available.

Software Features

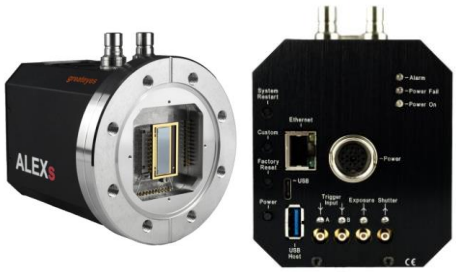
- Supports crop and burst readout modes for higher frame rates and precise time resolution
- Various file formats: JPG, BMP, TXT, TIFF (16-bit), DAT raw data
- Comprehensive visualization and image manipulation routines
- Supports flexible horizontal and vertical binning
- Many drivers available for integration into other systems
- Runs on 32/64-bit Windows systems
- Wavelength and geometric calibration
- Language support in English and German



Scientific Full-Frame CCD Cameras for VUV EUV X-ray for Spectroscopy-ALEXs Series

Applications

- Soft X-Ray Spectroscopy
- Plasma Emission Spectroscopy
- High Harmonic Generation Spectroscopy
- NEXAFS Spectroscopy
- Resonant Inelastic X-Ray Scattering



Choose your camera model

ALEX-s series	ALEX-s 1k256			ALEX-s 2k512
Sensor code	FI FI DD BI UV1			FI BI BI UV1
Usable pixels (columns × rows)	1024 × 255			2048 × 515
Active image area	26.6 mm × 6.7 mm			27.6 mm × 6.9 mm
Pixel size	26 µm × 26 µm			13.5 µm × 13.5 µm
Full well capacity	500 ke^- / 700 ke^- (DD)			100 ke^-
Register well	1 000 ke^- / 1 400 ke^- (DD)			400 ke^-
Typ. read noise (e^-)	@ 50 kHz			
	FI:4.2	BI:6.0	DD:5.4	3.5
	@ 1 MHz			
	FI:12	BI:13.1	DD:12.3	6.8
	@ 3 MHz			
	FI:25	BI:26	DD:25	10.7
Typ. dark current (e^-/pixel/s)@ -100 °C	0.0004 e^-/pixel/s 0.005 e^-/pixel/s (DD)			0.00025 e^-/pixel/s
Gain (counts/e^-)	Standard mode			
	0.4			1
	High capacity mode			
	/			0.34
CCD sensor type	Front-illuminated (FI), back-illuminated (BI), deep depletion fringe suppression (DD),enhanced back-illuminated (BI UV1)			

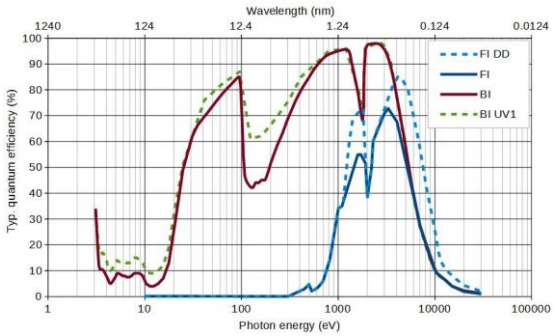
Select interface vacuum flange

Order code	Description
CF1	Knife-edge sealed CF DN63 flange with threaded holes
CF2	Knife-edge sealed CF DN100 flange with through holes
CF4	Rotatable, knife-edge sealed CF DN100 flange with through holes

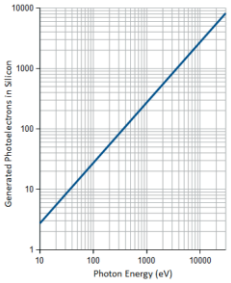
Choose your accessories and software

	Description
A) Accessories for imaging purposes	
GE-SR35	35mm shutter, including shutter driver module (compatible with CF DN100 or larger)
GE-AE01	Addittional CF DN63 flange with a window of Beryllium, MgF2, UVFS or other materials, can be sealed with the camera flange, with a port for external vacuum pump, enables ALEX to be used in air independently
B) Accessories for enhanced cooling performance	
GE-CR01	Compact liquid cooling, circulating the coolant at room temperature for deep camera cooling
GE-CR02	Recirculating water chiller, PID control with temp. from -5°C to 30°C for ultra-deep camera cooling
C) Soft ware development kit (SDK) and drivers	
GE-LX01	SDK for Linux (c/c++ based)
GE-PYT01	Python driver
GE-LAB01	LabVIEW driver
GE-EP	EPICS driver
GE-TAN	Tango driver

Quantum efficiency curves



QE of the ALEXs series



The mean energy of a photon to generate an electron-hole pair in silicon is 3.66 eV

Specifications

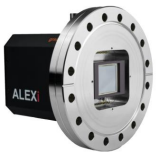
Pixel readout frequency	50 kHz, 250 kHz, 1 MHz, 3 MHz (5 MHz for visualization mode)
AD converter resolution	18-bit
Linearity	Better than 99%
CCD epitaxial thickness	15 µm standard, 40 µm for deep depletion (FIDD) models
Flange types	ISO-F DN63, knife-edge sealed CF DN63, CF DN100, CF DN160
Vacuum compatibility	With CF fl ange: 10-10 mbar (UHV capability)
Bakeout temperature	Max. +80 °C
Distance flange - focal plane	6 mm for CF DN63, 8 mm for CF DN100 (can be customised)
CCD sensor cooling	-100°C to 20°C, forced air or liquid cooling
Temperature monitoring	Two thermistors at CCD sensor and thermoelectric cooler (hot side)
Data link	Gigabit Ethernet, USB 3.0
Software	Vision software for Windows 7 / 10
SDK and drivers	DLL for Windows; LabVIEW, EPICS, Linux, Python, Tango driver (optional)
TTL interface signals	Sync out, shutter out, 2 external trigger in
Operating conditions	Temperature: 0°C to 35°C ambient, relative humidity <80% (non-condensing)
Power supply	80-264 VAC (115/230 typical), 47-63 Hz (50/60 typical), max. 1.1 A (230 VAC), 1.9 A (115 VAC)
Certification	CE
Dimensions	8.3 cm (3.27") × 10.0 cm (3.94") × 10.9 cm (4.29") (W × H × L, camera body)
Weight	2.9 Kg (with CF DN63 flange)
Blemish specifications	Grade 0 or grade 1 (standard) as specified by sensor manufacturer

Scientific Full-Frame CCD Cameras for VUV EUV X-ray for Imaging Applications - ALEXi Series

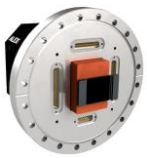
Applications

- EUV Lithography
- X-Ray Tomography
- Fourier Transform Holography
- X-Ray Fluoroscopy
- Coherent Diffraction Imaging
- Ptychographic Spectromicroscopy
- Grazing-Incidence Small-Angle X-Ray Scattering

Images of ELESi series



ALEX-i 1k1k/ALEX-i 2k2k



ALEX-i 2k2k plus

AALEX-i 4k4k

Choose your camera mode

ALEX-i Series	ALEX-i 1k1k		ALEX-i 2k2k		ALEX-i 2k2k plus	ALEX-i 4k4k	
Sensor code	FI BI BI UV1	BI DD	FI BI	BI DD BI UV1	BI	BI	BI DD BI UV1
Usable pixels (columns × rows)	1024 × 1024 (FI) 1056 × 1027 (others)		2048 × 2052		2048 × 2064	4096 × 4096	
Active image area	13.3 mm × 13.3 mm		27.6 mm × 27.6 mm		30.7 mm × 30.7 mm	61.4 mm × 61.7 mm	
Pixel size	13 µm × 13 µm		13.5 µm × 13.5 µm		15 µm × 15 µm	15 µm × 15 µm	
CCD sensor cooling	-100 °C to 20 °C		-90°C to 20 °C				
Full well capacity	100 ke¯	120 ke¯	100 ke¯	150 ke¯	150 ke¯	150 ke¯	350 ke¯
Register well	400 ke¯		400 ke¯	600 ke¯	/	/	/
Output node	/		/	/	900 ke¯	900 ke¯	600 ke¯
Typ. read noise (e¯)	@ 50 kHz						
	2.8		3.4		4.6	4.6	2.8
	@ 1 MHz						
	6.4		7		8.5	8.5	5.8
	@ 3 MHz						
	10.9		13.6		17	17	10.4
	@ -100 °C		@ -90 °C				
Typ. dark current (e¯/pixel/s)	0.00015	0.0005	0.0001	0.001	0.00008	0.00008	0.0006
Gain (counts/e¯)	Standard mode						
	1		1		0.6	0.6	1
	High capacity mode						
	/		0.34		0.2	0.2	0.34
CCD sensor type	Front-illuminated (FI), back-illuminated (BI), deep depletion fringe suppression (DD), enhanced back-illuminated (BI UV1)						

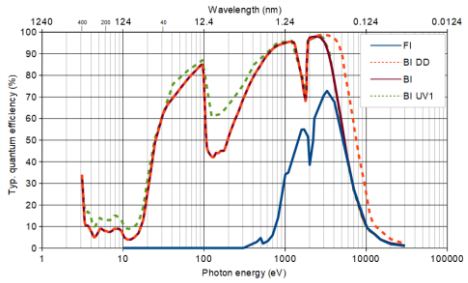
Select interface vacuum flange

Order code	Description
CF1	Knife-edge sealed CF DN63 flange with threaded holes (only for 1k1k or 2k2k)
CF2	Knife-edge sealed CF DN100 flange with through holes (only for 1k1k or 2k2k)
CF3	Knife-edge sealed CF DN160 flange with through holes
CF4	Rotatable, knife-edge sealed CF DN100 flange with through holes (only for 1k1k or 2k2k)

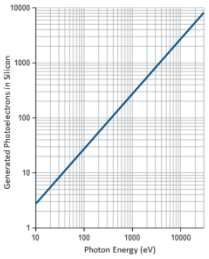
Choose your accessories and software

Order code	Description
	A) Accessories for imaging purposes
GE-SR25	25mm shutter for 1k1k camera, including shutter driver module
GE-SR45	45mm shutter for 2k2k & 2k2k plus cameras, including shutter driver module
GE-AE01	Additional CF DN63 flange with a window of Beryllium, MgF2, UVFS or other materials, can be sealed with the camera flange, with a port for external vacuum pump, enables ALEX to be used in air independently
	B) Accessories for enhanced cooling performance
GE-CR01	Compact liquid cooling, circulating the coolant at room temperature for deep camera cooling
GE-CR02	Recirculating water chiller, PID control with temp. from -5°C to 30°C for ultra-deep camera cooling
	C) Soft ware development kit (SDK) and drivers
GE-LX01	SDK for Linux (C/C++ based)
GE-PYT01	Python driver
GE-LAB01	LabVIEW driver
GE-EP	EPICS driver
GE-TAN	Tango driver

Quantum efficiency curves



QE of the ALEXi series



The mean energy of a photon to generate an electron-hole pair in silicon is 3.66 eV

Specifications

Pixel readout frequency	50 kHz, 250 kHz, 1 MHz, 3 MHz (5 MHz for visualization mode; up to 20 MHz with multi-output)
Readout modes	2 output nodes for 1k1k & 2k2k cameras, 4 output nodes for 2k2k plus & 4k4k cameras
AD converter resolution	18-bit
Linearity	Better than 99%
CCD epitaxial thickness	15 µm standard, 40 µm for deep depletion (BI DD) models
Flange types	ISO-F DN63, knife-edge sealed CF DN63, CF DN100, CF DN160
Vacuum compatibility	With CF flange: 10-10 mbar (UHV capability)
Bakeout temperature	Max. +80 °C
Flange - focal plane	1k1k camera with CF DN63: 6 mm; 2k2k with CF DN63: 5 mm; 2k2k plus & 4k4k cameras with CF DN160: -27 mm (all disctance can be customised)
CCD sensor cooling	-100 °C to 20 °C(1k1k camera), '-90°C to 20 °C(2k2k,2k2k plus and 4k4k camera)
Temperature monitoring	Two thermistors at CCD sensor and thermoelectric cooler (hot side)
Data link	Gigabit Ethernet, USB 3.
Software	Vision software for Windows 7 / 10
SDK and drivers	DLL for Windows; LabVIEW, EPICS, Linux, Python, Tango driver (optional)
TTL interface signals	Sync out, shutter out, 2 external trigger in
Operating conditions	Temperature: 0°C to 35°C ambient, relative humidity <80% (non-condensing)
Power supply	1k1k & 2k2k: 80-264 VAC (typ. 115/230), 47-63 Hz (typ. 50/60), max. 1.1 A (230 V) / 1.9 A (115 V) 2k2k plus & 4k4k: 85-264 VAC (typ. 115/230), 47-63 Hz (typ. 50/60), max. 1.9 A (230 V) / 3.8 A (115 V)
Certification	CE
Dimensions	8.3 cm (3.27") × 10.0 cm (3.94") × 10.9 cm (4.29") (W × H × L, 1k1k & 2k2k camera body) 13.7 cm (5.39") × 13.7 cm (5.39") × 13.3 cm (5.24") (W × H × L, 2k2k plus & 4k4k camera body)
Weight	2.9 kg (1k1k & 2k2k, CF DN63) / 4.3 kg (1k1k & 2k2k, CF DN 100) / 12.5kg (4k4k, CF DN160)
Blemish specifications	Grade 0 or grade 1 (standard) as specified by sensor manufacturer

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