

DECTRIS®

detecting the future

EIGERX

DETECTOR SERIES



The Summit of Hybrid Photon Counting Detectors

Ultimate performance for the most demanding synchrotron applications

synchrotron

The Summit of Hybrid Photon Counting

Research is the continuous quest for excellence driven by curiosity and the desire to overcome limitations. It requires and results in the perfection of measurement protocols and setups. The tremendous progress in synchrotron instrumentation and science is a powerful manifestation of this endeavor. The new EIGER X detector family provides ultimate performance for the most demanding synchrotron applications. Frame rates in the kilohertz range in combination with continuous readout open new horizons in time-resolved experiments and XPCS. Hitherto prohibitively

slow scanning beam imaging techniques like ptychography become routinely possible. High-resolution and coherent diffraction experiments benefit from the small pixel size and an outstanding point-spread function enabled by direct conversion of X-rays. Highest count rates per unit area ideally match the ever-increasing beamline brightness.

Realize your scientific ambitions with EIGER X, the summit of Hybrid Photon Counting detectors.

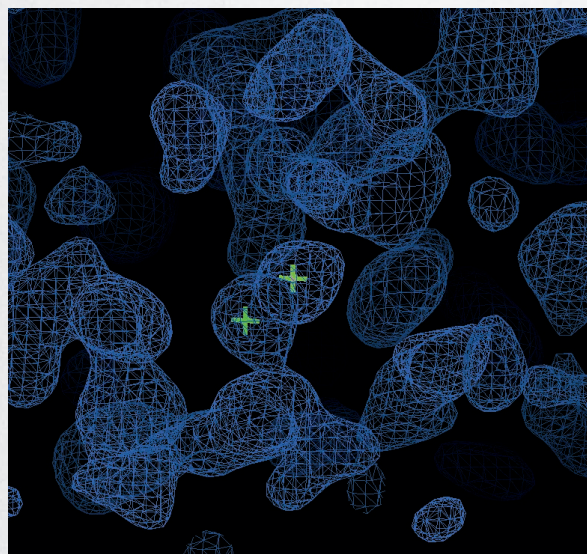
"Despite its slightly too large pixel size, EIGER is by far the best detector we have used for making XPCS measurements; both in quality of the data and the time resolution." Mark Sutton, McGill University

Key advantages

- Hybrid Photon Counting: Direct detection of X-rays in single-photon-counting mode
- Kilohertz frame rates with duty cycle > 99%
- Continuous readout with 3 μ s dead time
- High spatial resolution with 75 μ m pixel size
- Excellent point-spread function
- Count rates up to $5 \cdot 10^8$ phts/s/mm²
- No readout noise or dark current
- Extremely compact housings
- Room temperature operation of all components

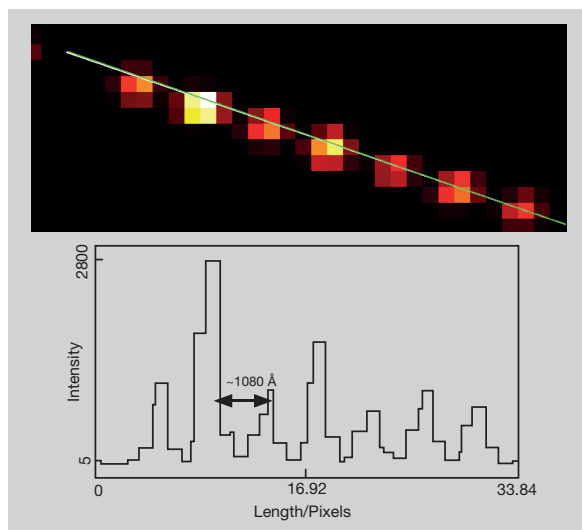
Applications

- X-ray photon correlation spectroscopy (XPCS)
- Ptychography
- Time-resolved experiments
- Macromolecular crystallography (MX)
- Single crystal diffraction (SCD)
- Powder diffraction (PD)
- Surface diffraction
- Small- and wide-angle X-ray scattering (SAXS/WAXS)
- X-ray imaging



Highly accurate data: EIGER detectors are capable of delivering outstanding data quality. Data were collected from an insulin crystal at 12 keV with an EIGER 1M prototype at a detector distance of 60 mm. Only 360° of data are sufficient for successful S-SAD phasing at 12 keV.

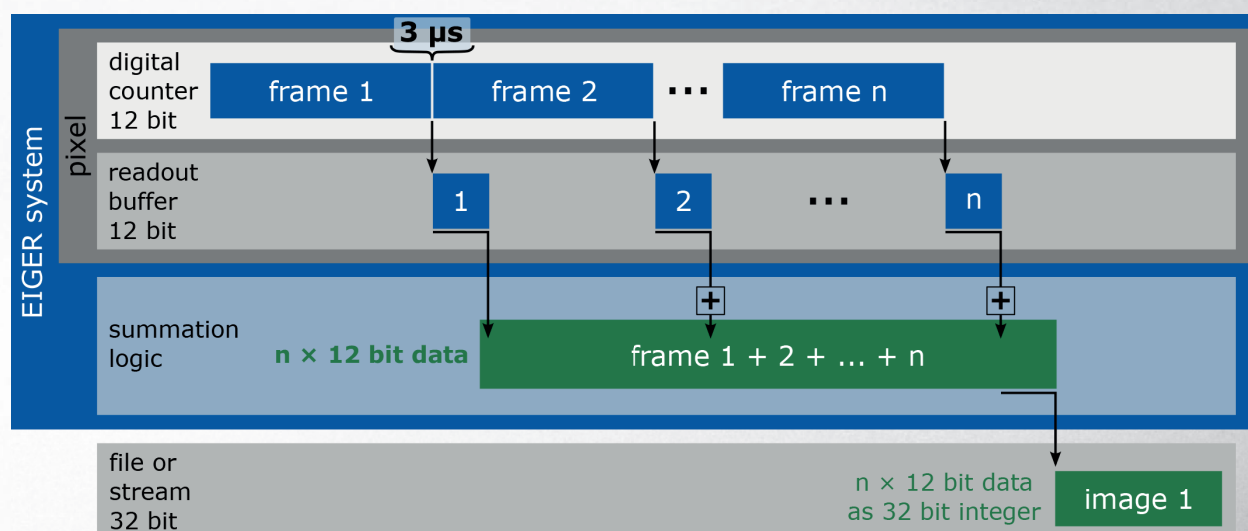
Ultimate spatial resolution: EIGER combines the advantageous, sharp point-spread function of a hybrid pixel detector with a small pixel size of $75\ \mu\text{m}$. This enables high spatial resolution and allows for separation of the closely spaced reflections along a long unit cell axis. In the example shown, the reflections of a cell axis longer than $1000\ \text{\AA}$ are well separated at a detector distance of $340\ \text{mm}$ using $12.4\ \text{keV}$ X-rays (upper panel: detail of detector image; lower panel: intensity along unit cell axis). At this distance and wavelength, an EIGER X 16M centered on the beam achieves a resolution of $2.3\ \text{\AA}$ at the detector edge.



Continuous readout and auto-summation

One of the hallmark features of EIGER is its continuous readout that enables kilohertz frame rates with duty cycles greater than 99%. Every pixel of an EIGER ASIC features a digital counter for noise-free counting of the observed photons. A readout buffer accompanies this digital counter in each pixel. After acquisition of a frame, the state of the counter is transferred to the readout buffer virtually instantly. A subsequent frame can start after only 3 microseconds while the previous frame is being read out from the readout buffer. The global, continuous readout of EIGER with counter and buffer in every pixel maximizes duty cycle and data collection efficiency without requiring a rolling shutter. EIGER's auto-summation mode is a further benefit of continuous readout with high duty cycle. While a single

frame is limited to the 12 bits of the digital counter, auto-summation extends the data depth up to 32 bits, or more than 4.2 billion counts per pixel, depending on the number of summed frames in an image. At short exposure times and frame rates in the kilohertz range, all counts are captured in the digital counter of a pixel and directly read out as an image. If long exposure times are requested, frames are still acquired at high rates on the pixel level, effectively avoiding any overflows. The detector system sums the frames to images on the fly, extending the bit depth of the data by the number of summed frames. EIGER's auto-summation mode maintains a duty cycle greater than 99.7% at all times thanks to continuous readout with $3\ \mu\text{s}$ dead time.



EIGER X



Technical specifications

EIGER X	500K	1M	4M	9M	16M
Number of detector modules	1	1 × 2	2 × 4	3 × 6	4 × 8
Sensitive area, width × height [mm²]	77.2 × 38.6	77.2 × 79.9	155.2 × 162.5	233.2 × 245.2	311.2 × 327.8
Pixel size [µm²]	75 × 75				
Total number of pixels	1030 × 514 = 529,420	1030 × 1065 = 1,096,950	2070 × 2167 = 4,485,690	3110 × 3269 = 10,166,590	4150 × 4371 = 18,139,650
Gap width, hor. / ver. [pixel]	- / -	- / 37	10 / 37	10 / 37	10 / 37
Inactive area [%]	0	3.5	5.6	6.3	6.6
Defective pixels [%]	< 0.03				
Maximum frame rate* [Hz]	3000, 4500**, 9000**	3000	750	238	133
Counter bit depth [bit]	12, 8, 4	12	12	12	12
Readout time	continuous readout, 3 µs dead time, duty cycle > 99 %***				
Point-spread function [pixel]	1				
Sensor thickness [µm]	450				
Threshold energy [keV]	2.7 - 18				
Maximum count rate [phts/s/mm²]	5 · 10 ⁸				
Image bit depth [bit]	16 or 32				
Data format	HDF5 / NeXus				
Dimensions (WHD) [mm³]	114 × 92 × 242	114 × 133 × 240	235 × 237 × 372	340 × 370 × 500	400 × 430 × 500
Weight [kg]	3.3	3.9	15	41	55
Power consumption [W]	70	75	300	750	1200

* Theoretical limit at maximum bandwidth, ** 30 s burst, *** at 3000 Hz

All specifications are subject to change without notice.