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Analytical®
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HPCD - 3415

Hybrid Photon Counting X-ray detectors

EPCC / PRODUCTS / APPLICATION / SOFTWARE / ACCESSORIES / CONSUMABLES / SERVICES

Analytical Technologies Limited

An ISO 9001 Certified Company

www.analyticalgroup.net

HPCD and HPCD CdTe

HPCD is ATLS' most advanced family of Hybrid Photon Counting (HPC) X-ray detectors. One of the key features of HPC technology is direct conversion from X-ray to charge in a solid state sensor enabling high sensitivity and well resolved signals.

The recently introduced HPCD detector series features a silicon sensor and is the ideal companion for Ga, Cu, or longer wavelength X-ray sources in the laboratory.

The detectors of the novel HPCD CdTe series are equipped with a CdTe sensor. The HPCD CdTe detectors maintain similar performance for Cu and Ga radiation compared to the HPCD series with Si sensor. Thanks to the high-Z sensor material, quantum efficiency, sensitivity and measurement speed are greatly improved when using high energy radiation compared to HPCD or other HPC detectors equipped with Si sensors. Choose HPCD CdTe as the perfect match for any dual-wavelength setup or high-energy laboratory source.

HPCD : The latest-generation HPC technology for your laboratory

HPCD incorporates every state-of-the-art feature of HPC technology. Small pixels, in combination with direct detection, enable a high spatial and angular resolution and give you the benefit of fine sampling of reciprocal space. A superior count-rate performance ensures accurate measurements of even the highest intensities. Take full advantage of this detector series' vast dynamic range, even during long exposures, using simultaneous read/write with zero dead time. Dual-energy discrimination allows for extensive background suppression and improves signal-to-noise, in particular for weak signals and long exposure times. Eliminate absorption and scatter from air and windows, thanks to optional vacuum compatibility. Choose from three different models to match your needs.

Key Advantages

- The highest possible dynamic range thanks to zero detector background, superior count rates, and simultaneous read/write
- Direct detection and a small pixel size for the best spot separation and minimal background overlap

Applications

- Macromolecular crystallography
- Chemical crystallography
- SAXS/WAXS
- X-ray powder diffraction
- X-ray reflectometry
- Diffuse scattering

- Dual-energy discrimination for suppression of low- and high-energy background
- ATL Instant Retrigger for a virtually linear response without limitations in the dynamic range

Technical specifications			
HPCD	500K	1M	4M
Number of detector modules	1	1 × 2	2 × 4
Active area, width × height [mm²]	77.3 × 38.6	77.1 × 79.7	155.1 × 162.2
Pixel size [µm²]		75 × 75	
Point-spread function		1 pixel (FWHM)	
Energy-discriminating thresholds		2	
Threshold range [keV]	4 - 11	3.5 - 30	3.5 - 30
Maximum count rate [cps/mm²]*	3.6×10^8	6.9×10^8	6.9×10^8
Counter depth [bit/threshold]		2 × 16	
Acquisition mode	simultaneous read/write with zero dead time		
Image bit depth [bit]		32	
Optional vacuum compatibility?		yes	
Cooling	Air-cooled	Water-cooled	Water-cooled
Dimensions (WHD) [mm³]	100 × 140 × 93	114 × 133 × 240	235 × 237 × 372
Weight [kg]	1.8	3.9	15

HPCD CdTe: All the advatages of HPC technology for high energy

HPCD CdTe X-ray detectors combine the latest developments in HPC technology with the high quantum efficiency of cadmium telluride sensors. This makes them indispensable for your laboratory when using high-energy sources or a dual-wavelength setup. Their unprecedentedly high count-rate capability, enabled by ATL' patented Instant Retrigger, allows for more accurate measurements of the highest intensities that can be achieved with laboratory sources. Equipped with two energydiscriminating thresholds, these detectors have lower dark counts from environmental background than their predecessors did. This significantly improves the signal-to-noise ratio for weak signals and long exposures, allowing for shorter measurement times and better data quality. Single-photon counting, in combination with continuous read/write, overcomes all saturation issues and the limited dynamic range of integrating detectors. In addition, direct detection and the small, 75-µm pixel size guarantee high spatial and angular resolution.

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Key Advantages

- The highest possible quantum efficiency for shorter measurement times and better data
- Integrated ATL Instant Retrigger technology for a higher count rate
- Two energy-discriminating thresholds for suppression of low and high background
- Lack of readout noise or dark current ensures the best signal-to-noise ratio
- A simultaneous read/write functionality for a high dynamic range and saturation-free images

Applications

- Macromolecular crystallography
- Chemical crystallography
- SAXS/WAXS
- µCT

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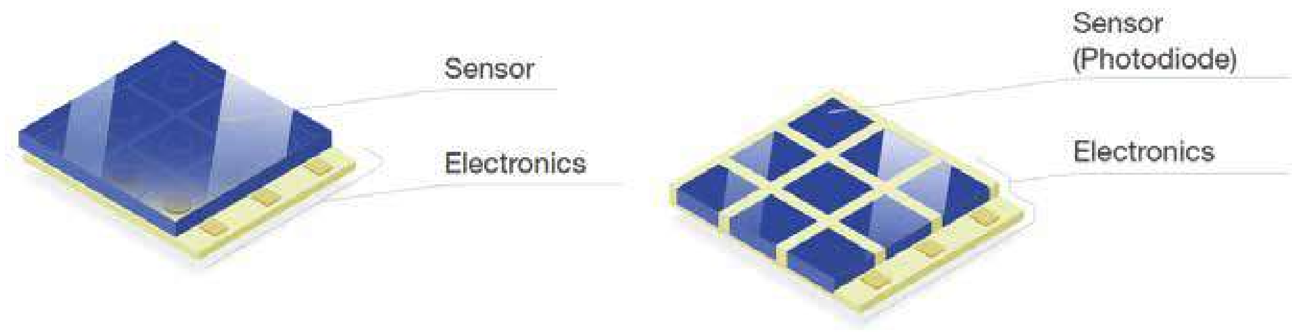
Technical specifications			
HPCD CdTe	500K	1M	4M
Number of detector modules	1	1 × 2	2 × 4
Active area, width × height [mm^2]	77.1 × 38.4	77.1 × 79.7	155.1 × 162.2
Pixel size [μm^2]		75 × 75	
Point-spread function		1 pixel (FWHM)	
Energy-discriminating thresholds		2	
Photon energy [keV]	8 - 24.2	8 - 24.2	8 - 24.2
Threshold energy [keV]	4 - 30	4 - 30	4 - 30
Maximum count rate [cps/mm^2]	9.8×10^8	9.8×10^8	9.8×10^8
Counter depth [bit/threshold]		2 x 16	
Acquisition mode	simultaneous read/write with zero dead time		
Image bit depth [bit]		32	
Optional vacuum compatibility?		yes	
Cooling	Water-cooled	Water-cooled	Water-cooled
Dimensions (WHD) [mm^3]	114× 92 × 242	114 × 133 × 242	235 × 237 × 372
Weight [kg]	3.7	3.9	15

Direct conversion in hybrid pixel technology

Characteristically, Hybrid Photon Counting (HPC) incorporates the method of single-photon counting as well as hybrid pixel technology. This technology enables direct conversion of X-rays to electric charge and is the state of the art in X-ray detection because it offers several advantages over indirect detection. In the sensor layer of a hybrid pixel, the charge generated by X-ray absorption is captured in an electric field, along which it moves rapidly, going towards the electronics layer for processing and counting. Both loss and spreading of the signal are minimized. Therefore, hybrid pixel detectors achieve a sharp pointspread function and quantum efficiencies that are close to the sensor's absorption efficiency. Hybrid pixel technology also makes it unnecessary to use a large fraction of the electronics layer's pixel area for a photodiode because the electric signal is generated in a separate layer that covers the full pixel area. This way, thousands of transistors for advanced detector features can be implemented in every pixel without reducing the area that is available for signal detection and compromising quantum efficiency.

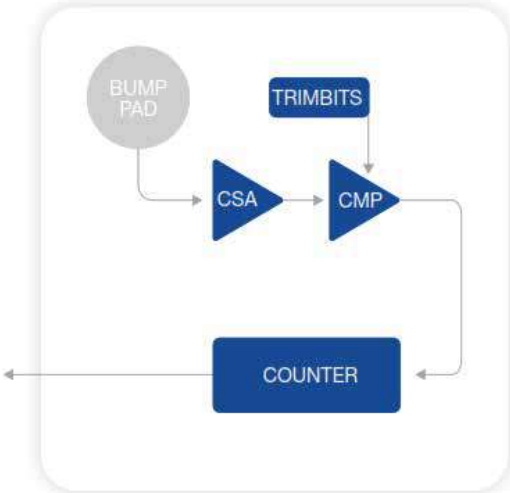


Hybrid Pixel Detector

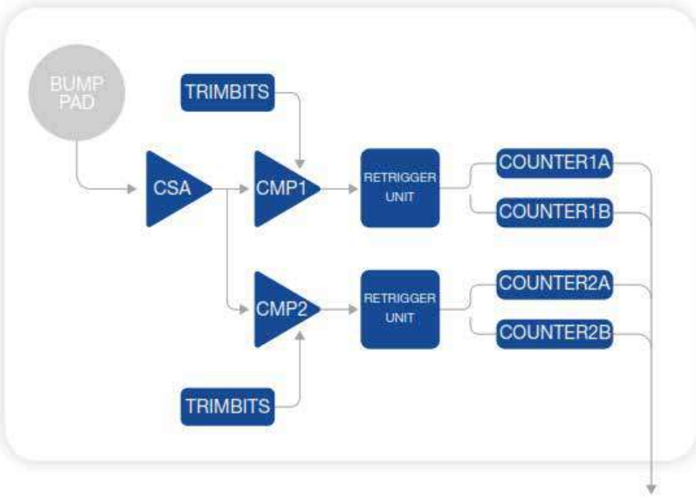
CMOS Active Pixel Sensor

Highly advanced HPC chip

HPCD features one of the most advanced application-specific integrated circuits (ASIC) for HPC, with more than 150 million transistors per chip. As in a CPU or GPU, more transistors mean more features, and that means advantages over previous generations or competing products. Every pixel in an HPCD detector features not one, but two comparators per charge-sensitive amplifier (CSA). This enables high-energy discrimination, in addition to lowenergy discrimination of a single comparator (CMP). A retrigger unit for each of the comparators complements the fast CSA, further boosting the count rate performance. This makes HPCD compatible with the requirements of latest-generation synchrotrons and provides a virtually linear response for count rates that can be achieved in typical laboratory experiments. At the same time, two digital counters for each comparator allow to take advantage of dual-energy discrimination and simultaneous read/write with zero dead time at the same time. Thanks to the combination of zero detector background, superior count rates, and simultaneous read/write, HPCD detectors achieve a dynamic range of more than 10 orders of magnitude.



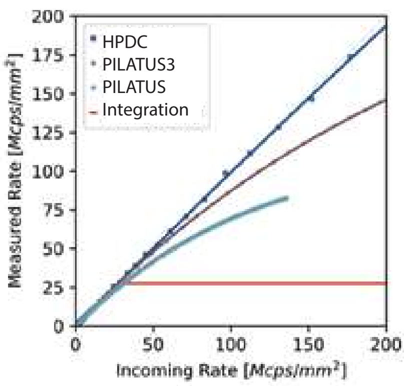
Schematics of single pixel in a basic HPC ASIC



Schematics of single pixel in an HPCD ASIC

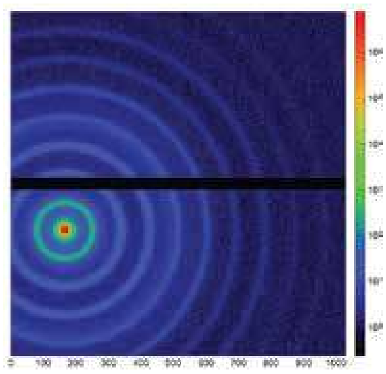
Superior count-rate performance

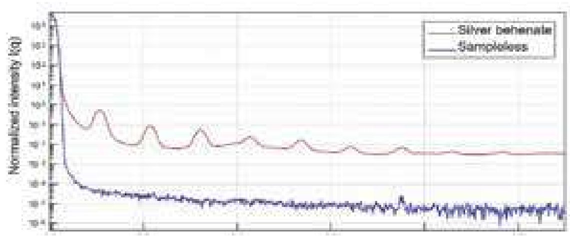
ATL HPC detectors are designed to match the high count-rate requirements of synchrotron sources, but on the other hand, even the most advanced laboratory sources offer lower flux and brightness than a typical synchrotron beamline does. Therefore, HPCD detectors far exceed the count-rate requirements of any laboratory setup and experiment. At the same time, HPCD overcomes the saturation issues and limited dynamic range that are typical of integrating detectors, even modern ones. Thanks to its superior count-rate performance, HPCD is the best match for state-of-the-art laboratory sources. It provides high accuracy for strong intensities, without saturation issues, and even allows for measurement of a direct beam.



Highest dynamic range

HPCD 's zero detector background, superior count rates, and simultaneous read/write provide the highest dynamic range. Determine the highest and lowest intensities accurately and in a single image, whether you are measuring strong and weak reflections or diffuse scattering, or facing a challenging SAXS/WAXS measurement

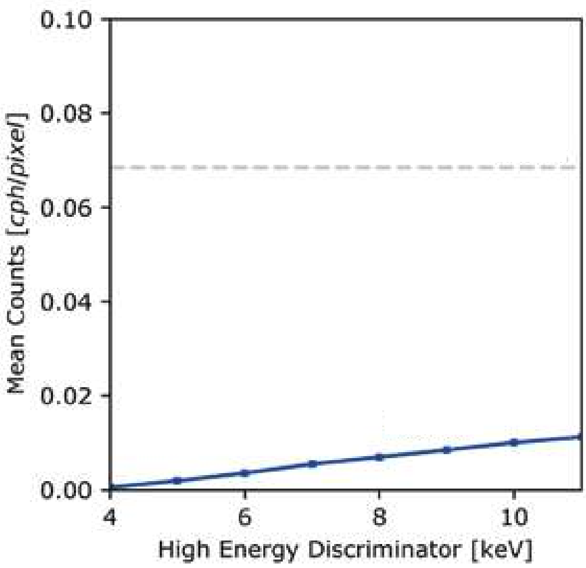


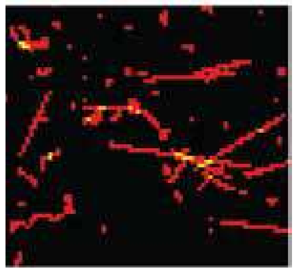


WAXS signal of Silver behenate (AgBH). Top: Raw data acquired with an HPCD 1M in a Xeuss3.0 SAXS/WAXS instrument from Xenocs. Bottom: This dual plot of AgBH's signal and a negative control shows that the dynamic range of HPCD detectors easily covers the more than ten orders of magnitude that are needed for weakly scattering samples.

Background suppression

The dual-energy discrimination of HPCD enables suppression of both low- and high-energy background. A single energy-discriminating threshold, as implemented in any HPC detector, allows for the suppression of low-energy background. This is a tremendous advantage when dealing with X-ray fluorescence from the sample or low-energy contamination in the spectrum of the X-ray beam. However, with a second energy-discriminating threshold, as implemented in HPCD , it is possible to suppress high-energy background as well. Cosmic radiation is a source of high-energy background that compromises data quality when measuring very weak signals with long exposure times. HPCD achieves a fivefold reduction of high-energy background from cosmic radiation, which ensures better data quality. If there is high-energy contamination of the X-ray beam, such as higher-order harmonics, dual-energy discrimination becomes even more critical. Thanks to their lack of detector background and their extensive capabilities for suppression of experimental background with dual-energy discrimination, HPCD detectors are your best choice for measuring weak intensities with high accuracy.



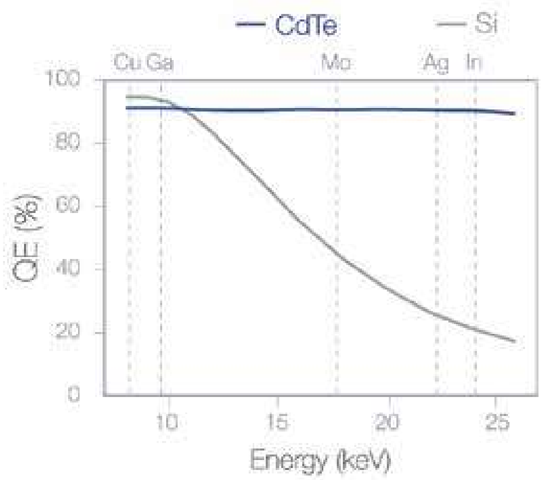


Background counts per pixel in 1 hour dark images. Grey dotted line: Dark counts for HPCD with a single energy discriminator set at 4 keV. Blue solid line: Dark counts for HPCD with a low-energy discriminator at 4 keV as a function of a high-energy discriminator setting.

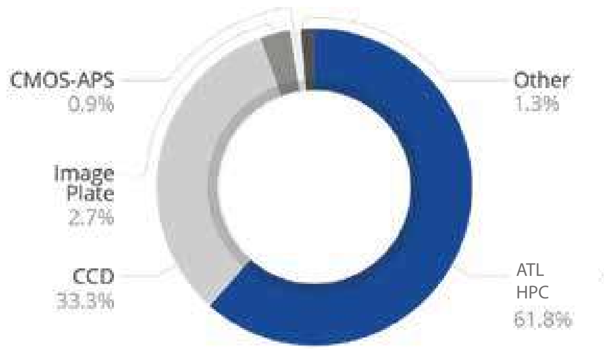
Identical regions obtained through a 1 hour dark exposure of an HPCD detector. Top: Counts obtained with a low-energy discriminator at 4 keV. Bottom: The difference between the counts with a high-energy discriminator at 10 keV and the counts with a low-energy discriminator at 4 keV

High quantum efficiency

Direct detection enables high quantum efficiency close to the absorption efficiency of the sensor material. High quantum efficiency gives you better data in less time. HPCD CdTe offers high quantum efficiency of more than 90% for any wavelength from copper to indium. Measurement times with short wavelengths can be reduced by a factor of 2 to 4, thanks to the efficiency advantage of cadmium telluride over silicon. The performance of HPCD CdTe detectors with copper and gallium radiation is similar to that of their silicon counterparts. Choose HPCD CdTe for the shortest measurement times with high-energy sources or dual-wavelength setups. HPCD detectors with silicon sensors achieve 94% quantum efficiency for copper and gallium radiation. They are the perfect companion for any such laboratory source. The decreasing quantum efficiency for shorter wavelengths of this sensor material can be effectively compensated by increasing exposure times. Thanks to the absence of detector background as well as the background suppression features of HPC technology, this strategy allows for excellent data quality also for high X-ray energies.



Quantum efficiency (QE) of HPCD R CdTe (blue) and HPCD (grey) with silicon sensors.



X-ray detector technologies used in 2019

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HPLC Servicing, Validation, Trainings and Preventive Maintenance :

HPLC Servicing :HPLC Servicing : We have team of service engineers who can attend to any make of HPLC promptly @the most affordable cost.

Trainings :We also take up preventive Maintenace to reduce downtime of HPLC's Trainings.

AMC's/CMC :AMC's/CMC :We offer user training both in-House and at customer sites on HPLC principles, operations, trouble-shooting.

Validations :Validations :We have protocols for carrying out periodic Validations as per GLP/GMP/USFDA norms.

Instruments :Instruments :We offer instruments/Renting Services Modules like pumps,detector etc. on Rent.

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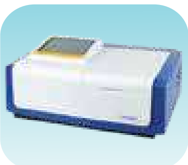
Our Products & Technologies



UV/VIS Spectro 2080+ Double Beam

Infra FTIR

Optima Gas Chromatograph 3007

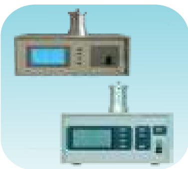
Optima Gas Chromatograph 2979 Plus

Flash Chromatograph

Atomic Absorption Spectrophotometer

Liquid Partical Counter

Optical Emission Spectrophotometer



DSC/TGA

Semi Auto Bio Chemistry Analyzer

HEMA 2062 Hematology Analyzer

Micro Plate Reader/Washer

URINOVA 2800 Urine Analyzer

Total Organic Carbon 3800

Fully Automated CLIA

NOVA-2100 Chemistry Analyzer

PCR/Gradient PCR/ RTPCR

TOC Analyzer

Laser Particle Size Analyzer

Ion Chromatograph

Water purification system

Regulatory compliances

Corporate Social Responsibility

Analytical Foundation is a nonprofit organization (NGO) found for the purpose of:

1.Research & Innovation Scientist's awards/QC Professional Award : Quality life is possible by innovation only and the innovation is possible by research only, hence ANALYTICAL FOUNDATION is committed to identify such personallities for their contributions across various field of Science and Technology and awarding them yearly. To participate for award, send us your details of research / testing / publication at Info@analyticalfoundation.org

2. Improving quality of life by offering YOGA Training courses, Work shops/Seminars etc.

3. ANALYTICAL FOUNDATION aims to DETOXIFY human minds,souls and body by means of yoga, Meditation, Ayurveda, Health Care, Awards, Media, Events, Camps etc.

Analytical® Technologies Limited

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