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Technical Specifications

Rayonix MX 340 HS C2

Customized 340 mm High Speed CCD Detector System for X-ray Science Applications

(Specifications subject to change)

1. MX340-HS C2 CCD X-ray Detector System – with through-hole to allow direct beam to pass through, or to facilitate simultaneous wide and small angle data collection

1.1. 340 mm High Speed Mosaic Frame Transfer CCD Detector

- Sixteen element mosaic frame-transfer CCD X-ray detector — optimized for highest possible speed and dynamic range, with uncompromised sensitivity, accuracy and stability.
- Frame rates as high as 120 frames/sec. Typical rate is 10 frames/sec for operation at standard resolution and speed.
- Deadtime between frames of 1 msec facilitates high duty cycle shutterless data collection.
- Sixteen custom designed 2k x 2k (1920 x 1920 pixels) Split Frame Transfer Charge Coupled Device (SFT-CCD) image sensors with 16 readout channels per chip (256 channels total).
- Customization: An unobstructed beam tunnel at center of imaging area, normal to detector face, and exiting at the rear of detector. Attachment of the front X-ray window to the beam tunnel is via a flange. A disk-shaped area surrounding the tunnel entrance will be masked due to the attachment of the tunnel to the X-ray window. The non-imaging disk region will have a diameter of approximately 15-20mm. The pipe passing through the detector is 5mm inner diameter, with threads on each end.
- Produces seamless, fully corrected images with permanent geometric and flat-field calibrations. Maximum physical gap (< 50 µm) between adjacent fiber optic taper elements is smaller than 1 binned pixel. (Unbinned images only may have up to a 2 pixel (89 µm) gap between modules.)
- Active imaging surface : 340 mm x 340 mm square (115,600 mm^2).
- Software-selectable on-chip binning yields the following supported resolutions (standard mode is highlighted):

On-Chip Binning	Resolution	Pixel Size (µm)
1 x 1	7680 x 7680	44
2 x 2	**3840 x 3840**	**89**
3 x 3	2560 x 2560	133
4 x 4	1920 x 1920	177
5 x 5	1536 x 1536	221
6 x 6	1280 x 1280	266
8 x 8	960 x 960	354
10 x 10	768 x 768	443

- **Readout Modes** – Two software selectable readout modes: **Normal (High Speed)** and **Low Noise (Low Speed)**

Speed and Noise vs. Mode and Binning

	Normal (High Speed) Read Noise = 8 e^-/pixel		Low Noise (Low Speed) Read Noise = 4.5 e^-/pixel	
On-Chip Binning	**Max Frame Rate (sec^{-1})**	**Duty Cycle (%)**	**Max Frame Rate (sec^{-1})**	**Duty Cycle (%)**
1 x 1	2.5	> 99	1.5	> 99
2 x 2	**10**	**99**	6	99
3 x 3	20	98	12	99
4 x 4	35	96	20	98
5 x 5	50	95	30	97
6 x 6	70	93	40	96
8 x 8	100	90	65	93
10 x 10	120	86	90	91

- **Low Demagnification FOT** - Each frame-transfer CCD is coupled to the X-ray sensitive phosphor by 2.92:1 Fiber-Optic Taper
- **Electro-optical Gain** (electrons/X-ray photon) - 7 e^-/12keV X-ray photon
- **DQE** (Detective Quantum Efficiency) - DQE up to 0.8 for 8 keV - 12 keV
- **PSF** (Point Spread Function) - FWHM ~ 100µm *(with standard 40um thick phosphor)*
- **Dark current** (unbinned, at standard operating temperature of -75°C) - ~0.003 e^-/pixel /second or ~0.0005 12 keV photon /pixel /second
- **Full well capacity** - Depends on binning and gain.
  At 3840 x 3840 resolution, high speed and low gain : 360 ke^-/pixel = 51,000 12 keV photons/pixel
- **Dynamic Range** (~ Full Well / Noise) 16 bits
  Depends on photon energy, binning, A/D converters, readout rate, and data format, but in most cases the dynamic range will be limited by the choice of readout mode and data format.
  For 3840 x 3840 resolution, High Speed, 16 bit data format mode ➔ 360 ke^-/8 e^- ➔ 45,000
  Low Speed, 18 bit data format mode ➔ 360 ke^-/4 e^- ➔ 80,000
- **Phosphor** - Gd_2O_2S ~40µm thick
  Replaceable, but not routinely changeable. High accuracy data requires careful factory calibration after phosphor change. Other phosphor options are available, including thin phosphor for higher resolution or thick phosphor for higher X-ray energy.
- **Defects** - Frame-transfer CCD sensors are selected for low noise and low number of cosmetic blemishes. All defects and spatial distortion are correctable and permanently mapped, and corrected by our factory calibration procedure. Fiber Optic tapers are low thorium glass with extra mural absorption (EMA) selected for minimal geometric and shear distortions.
- **Physical**

Detector Head	
Dimensions	H x W x D = 81 cm x 54 cm x 47 cm
Weight	approx. 190 kg
Power Supply/Cooling assembly	Rolling cabinet (2 required)
Dimensions	H x W x D = 180 cm x 64 cm x 64 cm ea.
Weight	approx. 215 kg

Vacuum Pump

Dimensions	H x W x D = 36 cm x 33 cm x 30 cm
Weight	approx. 17 kg

- **Locations**

Between Detector Head and:

Computer	Standard = 10 meters (Max 100 meters with fiber optic cable extension)
PS/Cooling	Standard = 7.5 meters Max 30 meters
Vacuum Pump	Standard = 1.8 meters Max 5.5 meters

Non-standard distances require specification at time of order.

1.2. Computer Workstation, Including Control and Data Acquisition Hardware

- Dedicated data acquisition and processing hardware provides real-time correction and storage of frames.
- Computer Server/Frame Buffer/Frame Processor:
  - Rack-mounted Linux Server
  - Solid State Drive Frame Storage
  - 10 Gigabit Ethernet Network Interface
  - Dedicated GPU for frame corrections
  - Camera-Link data interface (Detector to Server)
- Two TTL or optically isolated digital inputs for external trigger of readout, or bulb mode acquisition, or gating function
- Two TTL or optically isolated digital outputs to indicate detector state (armed for trigger, reading out, or integrating), or for external shutter controller or other device synchronization

1.3. Control and Data Acquisition Software Package

- User control
  - Separate client computer connects to computer server over Ethernet TCP/IP connection
  - Rayonix function library DLL is installed on client computer for use by client application
  - Example menu-driven client application provided
  - Alternative control method with simple text commands over Ethernet TCP/IP also available
- Server performs dark current, flat-field and geometric distortion correction in real-time
- Graphical data display and inspection software included
- Function library includes “zinger”" removal routines
- Software selectable Stability mode to process overscan to reduce baseline drift
- Complete Documentation