

IMBL imaging detectors

Chris Hall

Two (broad) types

- Indirect detection
 - Optical phosphor converter
 - Optical sensor

- Direct detection
 - Semiconductor converter
 - Electron sensor

Indirect or Direct

- Indirect
 - Can more easily reach better spatial resolutions
 - Standard interfaces
 - Lens coupling allows for easy ‘zoom’
 - Can cope with full IMBL flux
 - Inefficient (=>low DQE)
- Direct
 - Much more sensitive
 - Can count the x-rays
 - Can discriminate against noise photons of lower energy
 - Potentially spectroscopic (Hyperspectral imaging)
 - More complex interface
 - Cannot cope with high fluxes

Ruby

- Sensor: PCO.edge scientific CMOS
- Coupling: Nikon macro lenses
- Converter: Gadox, CsI(Tl), CdWO₄

- Zoomable field-of-view
- Interchangeable converter
- Moderate pixellation (5.5 Mpix)
- **Inefficient**



Field of view (mm)	Pixelation/size (μm)	Full frame rate (fps)
16.2 x 13.7	2560 x 2160 / 6.3	35
110 x 93	2560 x 2160 / 43	35

Diamond (Optique Peter)

- Sensor: PCO.edge scientific CMOS
- Coupling: Microscope objective lenses
- Converter: LSO, YAG
- Microscopic level resolution
- Single crystal scintillators
- **Very inefficient**



Field of view (mm)	Pixelation/size (μm)	Full frame rate (fps)
1.66 x 1.40	2560 x 2160 / 0.64	35
13.5 x 11.4	2560 x 2160 / 5.3	35

Quartz Hamamatsu C9252DK

- Sensor: a-Si photodiode array
- Coupling: Proximity
- Converter: CsI(Tl)
- Large area
- Sensitive
- Coarse resolution
- Easily damaged by radiation



Field of view (mm)	Pixelation/size (μm)	Full frame rate (fps)
243 x 123	1216 x 616 / 200	30
243 x 100	2432 x 100 / 100	146

Hamamatsu C10900D

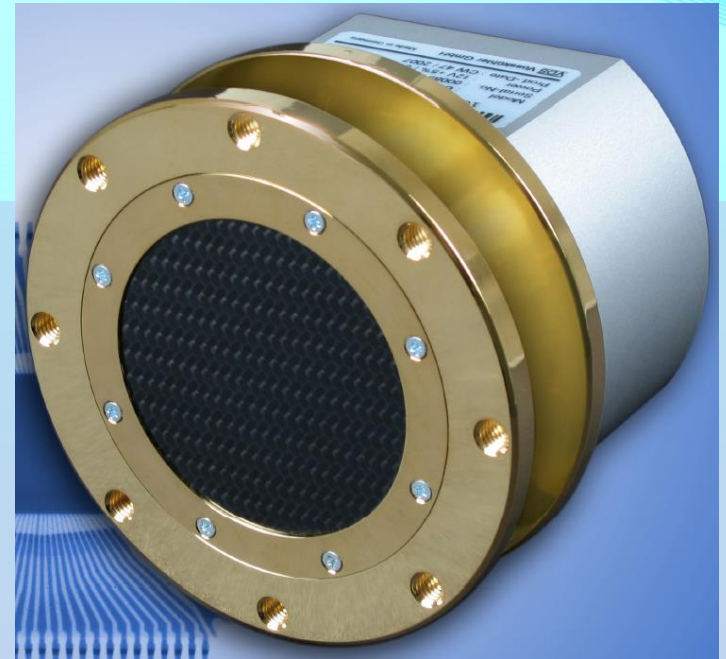
- Sensor: a-Si photodiode array
- Coupling: Proximity
- Converter: CsI(Tl)
- Large area
- Sensitive
- **Coarse resolution**
- **Easily damaged by radiation**



Field of view (mm)	Pixelation/size (μm)	Frame rate (fps)
122 × 123	1216 × 1232 / 100	35
122 × 7	1216 × 72 / 100	70
122 × 123	608 × 618 / 200	17
122 × 62	608 × 310 / 200	280

Amethyst ScintX DXI-11000

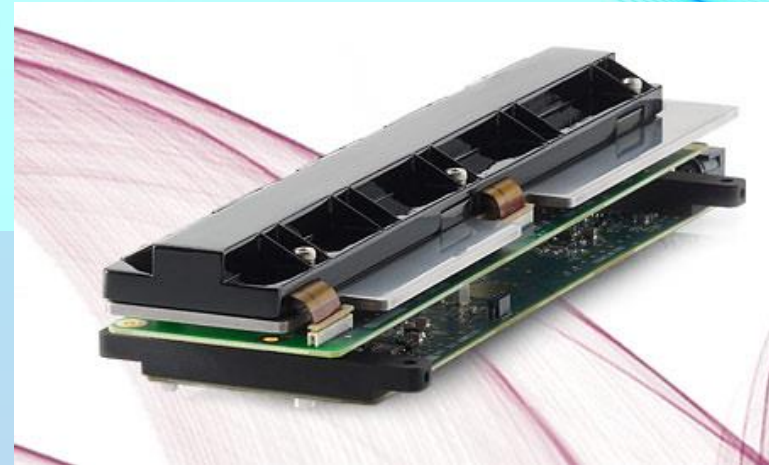
- Sensor: Cooled CCD
 - Coupling: Proximity
 - Converter: CsI(Tl)
-
- Fine resolution
 - Efficient
 - Small FOV
 - Slow readout



Field of view (mm)	Pixelation/size (μm)	Full frame rate (fps)
36 x 24	4024 x 2680 / 9	3

Argus Ceph

- Sensor: Photodiode array
- Coupling: Proximity
- Converter: CsI(Tl)
- High efficiency
- High aspect ratio
- Time Domain Integration for large objects
- **Slow readout**



Field of view (mm)	Pixelation/size (μm)	Full frame rate (fps)
220 x 7	8160 x 256 / 27	< 1

CPro

- Sensor: Large area CMOS
 - Coupling: Schneider macro lens
 - Converter: Gadox
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- Very large area
 - Good resolution
 - Low efficiency



Field of view (mm)	Pixelation/size (μm)	Full frame rate (fps)
204 x 85	12000 x 5000 / 17	10
504 x 210	12000 x 5000 / 42	10

Widepix 1X5

- Sensor: Timepix APS, 1X5 butted chip array
 - Coupling: Direct
 - Converter: CdTe (1.0 mm)
- High efficiency
 - Potential hyperspectral imager
 - Small active area



Field of view (mm)	Pixelation/size (μm)	Full frame rate (fps)
70 x 14	1280 x 256 / 55	40

XCounter Actaeon

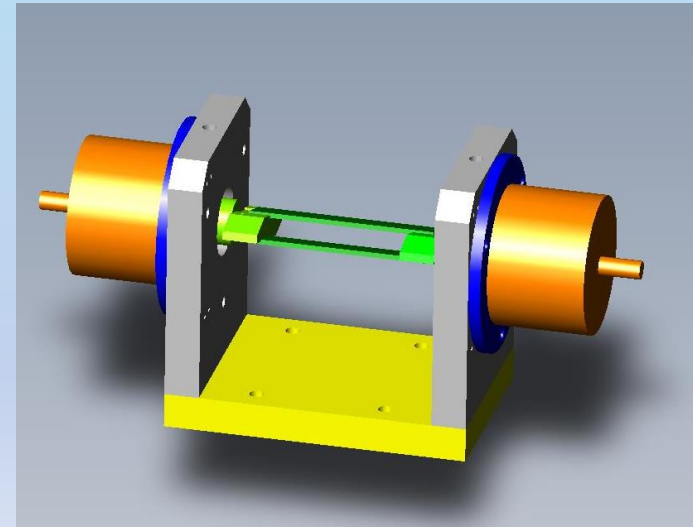
- Sensor: Proprietary APS
- Coupling: Direct
- Converter: CdTe (0.75 mm)
- High efficiency
- Potential for large width
- Good frame rate
- **Lower resolution**



Field of view (mm)	Pixelation/size (μm)	Full frame rate (fps)
51 x 25	512 x 256 / 100	200

The Imaging Shutter

- Located in the beamline air gap in 2A
- Shuttters the monochromatic beam
- Fastest cycle time is 65 ms.
- Synchronised via software or hardware



Unified readout system

- Abstracted through the EPICS AreaDetector system.
- All detectors look the same (or very similar) to the User
- Unified real-time display during image capture
- Various plugins allow in-line processing

Synchronisation

- Image capture sync'd to:
 - Imaging shutter
 - Motor positions
 - External sources
- Quantum Detectors Zebra logic and timing unit:

