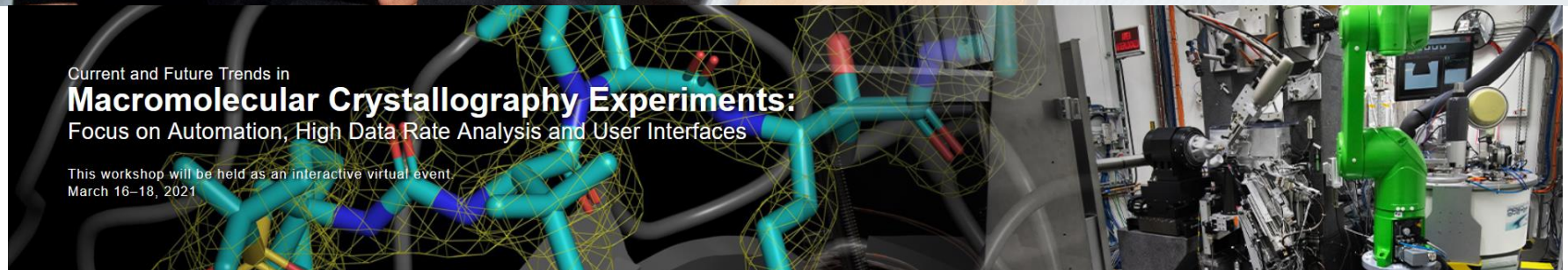
SPECTRUM
DETECTORS FOR SERIOUS SCIENCE

X-Spectrum detectors: Now and tomorrow

Julian Becker - March 17th, 2021



Company Introduction

Julian Becker
CEO

Julian Schmehr
VP PRODUCTION

Chieh-Hsuan Tsai
JUNIOR SALES MANAGER

Cyrill von Hehn
JUNIOR SALES MANAGER

Spin-off from DESY

Founded 2014

Photon counting detectors

Medipix3-RX based

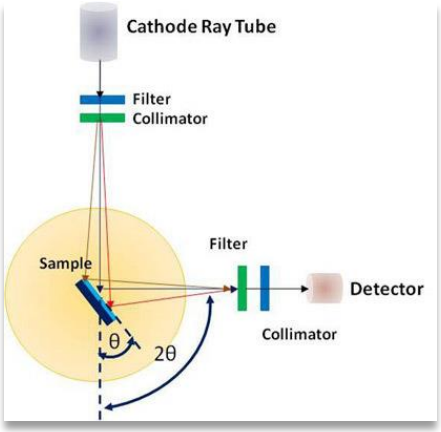
Full-service detector company

Custom systems

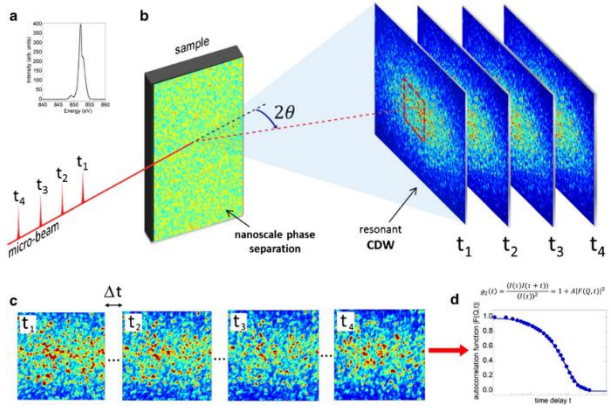
3 standard product lines

Our detectors are used for:

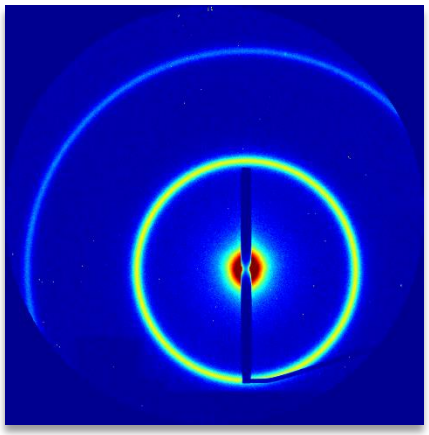
XRD



XPCS



SAXS/WAXS



BUT NO MX (YET!)….

Sources: XRD | XPCS | SAXS/WAXS

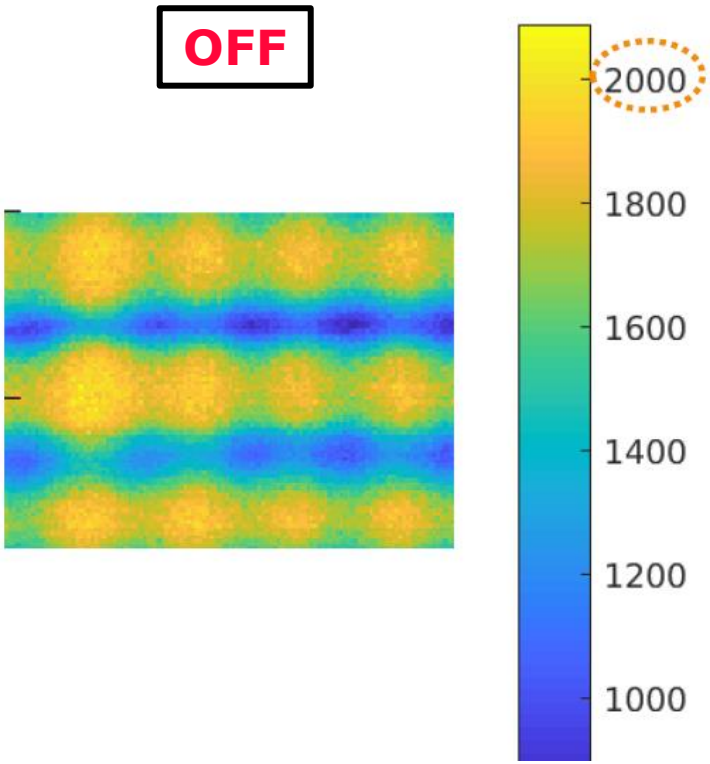
Some highlights of our current detectors

High speed

Bit Depth	Max frame rate	Gap between frames
24-bit	**1 kHz**	1 ms
12-bit	**2 kHz**	0 ms
6-bit	**4 kHz**	0 ms
1-bit	**> 23 kHz**	0 ms

Charge summing mode

- Charge sharing correction in Medipix3-RX ASIC
- Pencil beam scan shows hits consistently once and only once

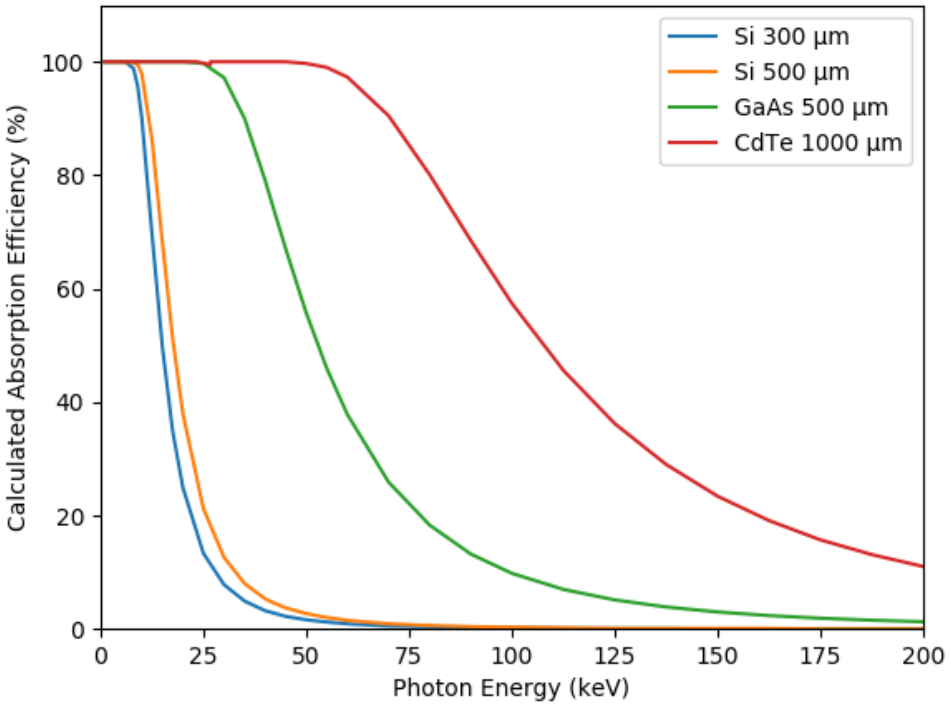


High-Z sensors

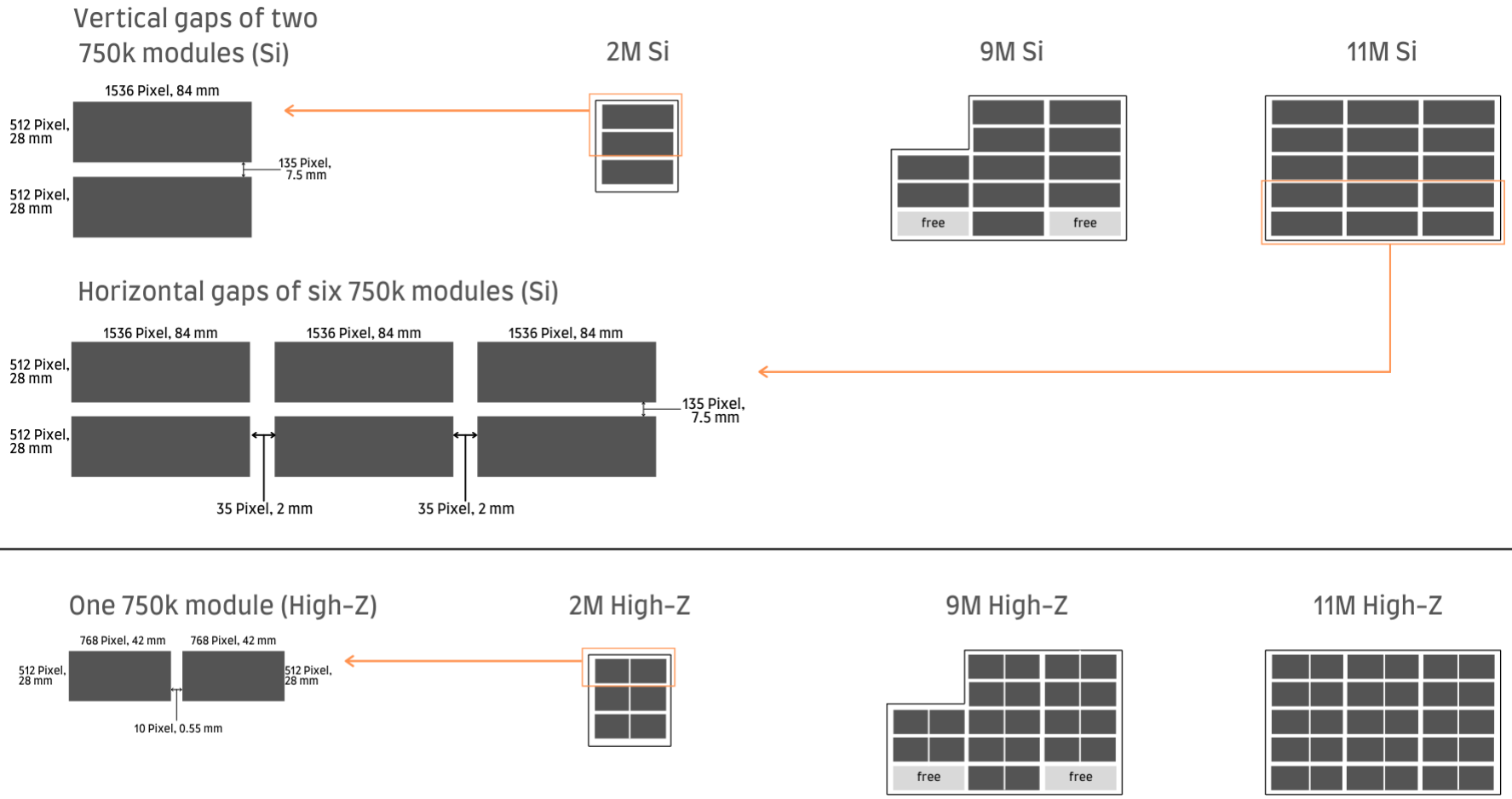
Sensor choice depends on application

- **Si** up to ~15 keV
- **GaAs** up to ~40 keV
- **CdTe** even higher Energies

Any system is available with any sensor!

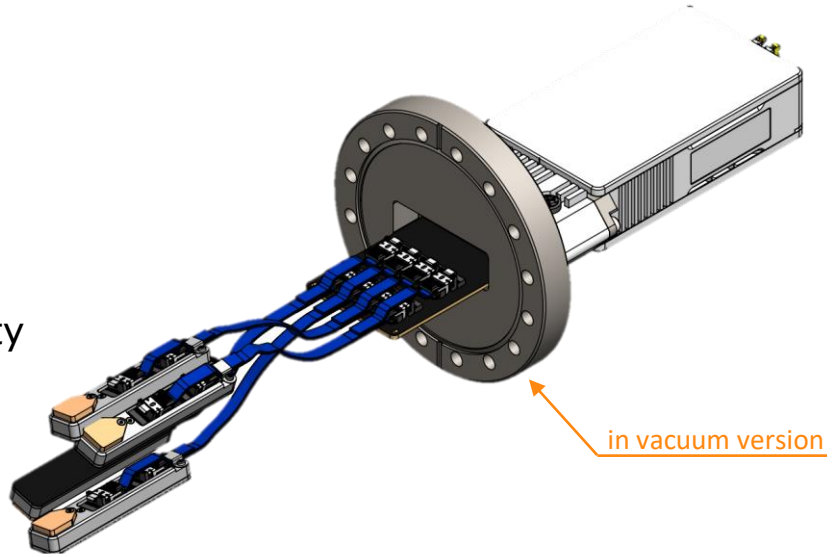


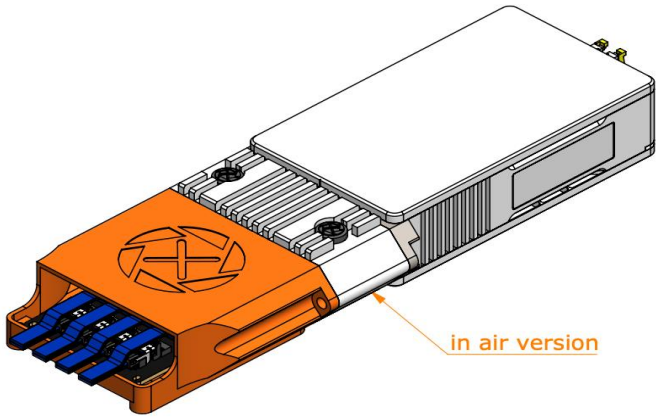
Sensor layouts of our large systems

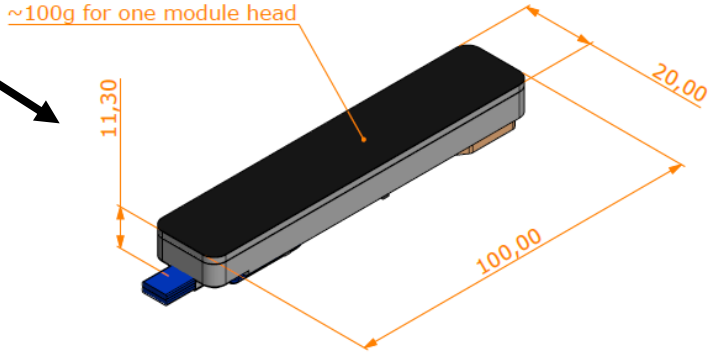


Hydra 60k, 250k

- Examples: NRS, RIXS
- Up to four individual 60k modules
- connected via cables for maximum flexibility
- Can be used in-vacuum
- Full capabilities of standard detectors
- Small detector head – ideally suited for applications with tight space constraints
- Up to 1 m cable length



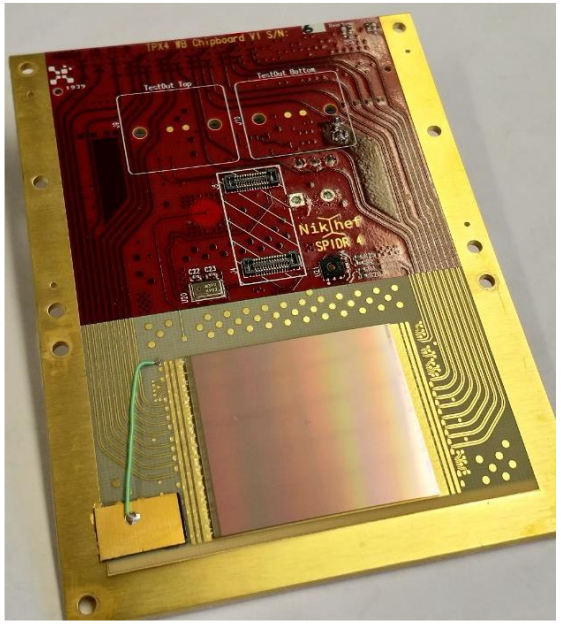




SPARTA Specifications - Soon

Pixel size	200 µm x 200µm
Sensor material	500 µm thick Silicon, high-Z version in development
Sensor size	128 x 512 pixels 25.6 mm x 105.2 mm sensitive area
Maximum frame rate	up to 6.5 MHz in a burst of 352 images
Average frame rate	≥ 3.5 kHz, exact value tba.
Dynamic range	0 to 10^4 photons at 12 keV per frame
Equivalent count rate	$>10^{10}$ cts/pix/s ($>2.5 \times 10^{11}$ cts/mm²/s)
Noise	~ 1 keV (0.75 keV at reduced dynamic range)
External trigger	tba., likely 3.3 V TTL

TimePix4 Specifications – Next Generation



Pixel size	55 µm x 55 µm
Sensor material	Si and High-Z
ASIC size	448 x 512 pixels, 4 side buttable
Maximum frame rate	up to 40 kHz, CRW
Timing resolution	Better than 0.2 ns
Dynamic range	16 bit
Equivalent count rate	~ 5 Gcts/mm²/s
Noise	Photon counting
Data driven mode	TOT and TOA @ >10 kHz/pixel

Off chip developments

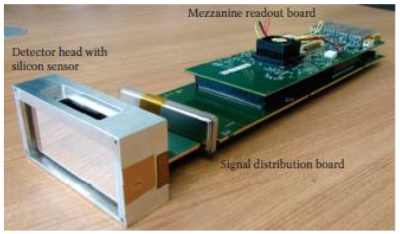
- **On board configuration & calibration data**
  -> enables true plug & play functionality

- **Scalable, self-configuring backend node(s)**
  -> reduce number of servers

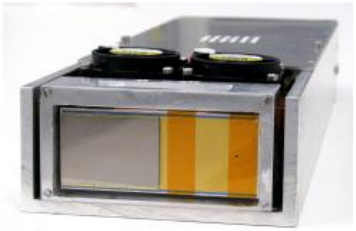
- **100 Gbit readout**
  -> reduces number of optical fibers
  -> enables high data throughput

- **On board data processing/compression**
  -> machine learning for data reduction?
  -> reduces computing requirements (time & servers)
  -> reduces bandwidth requirement between detector and backend

One decade of the LAMBDA 750k



2011



2014

2016

2020

Your questions