



DECTRIS – OVERVIEW

SFR Online-Conference, 15 July 2020

Stefan Brandstetter, Head of Product Management

Product Manager Synchrotron

What we do

DECTRIS develops and manufactures X-Ray detector-systems for worldwide customers in scientific, industrial and medical markets



More than 10 Years in Detection



DECTRIS AG
Founded 2006 as Spin-Off
from
Paul Scherrer Institut, PSI

DECTRIS AG in Baden CH
Production, Labs and Offices
>100 colleagues
Delivered >1500 detector systems
ISO9001:2015 certified

Leading supplier in the Synchrotron Market



PAUL SCHERRER INSTITUT



MYTHEN2 – 1D Detectors

Single-photon-counting strip detector

- 1280/640 strips
- 50 μm pitch and 4/8 mm length

Applications

- X-ray powder diffraction
- Residual-stress measurements
- Pair-Distribution Function analysis



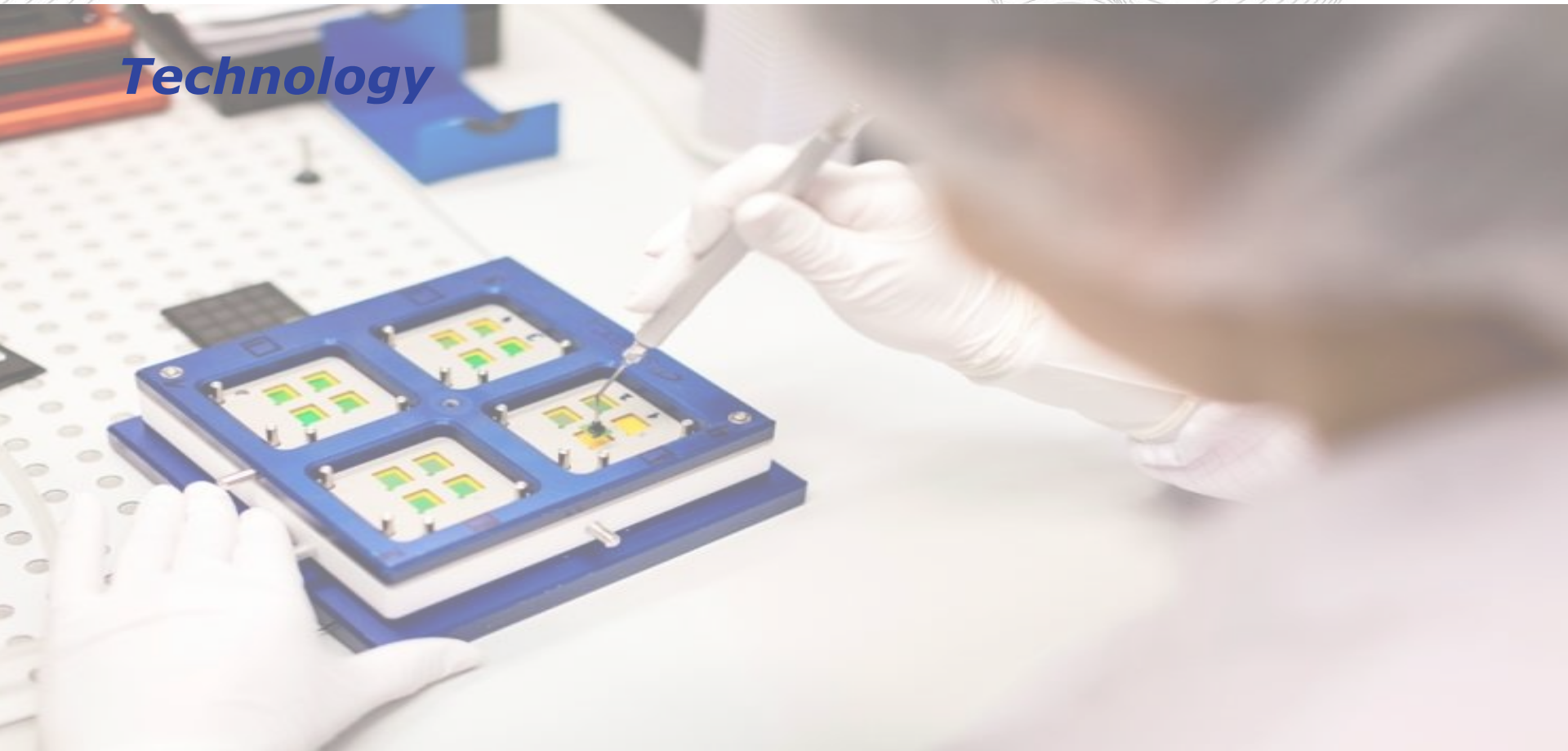
EIGER2 - 2D Detectors



EIGER2 Series

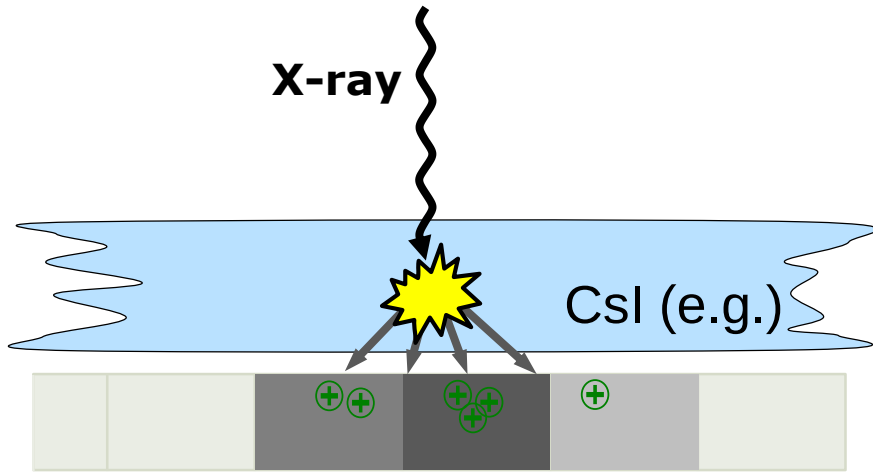
- Pixel size 75 μm
- 10^7 cps/pix
- Two Thresholds
- Si and CdTe Sensors

Technology



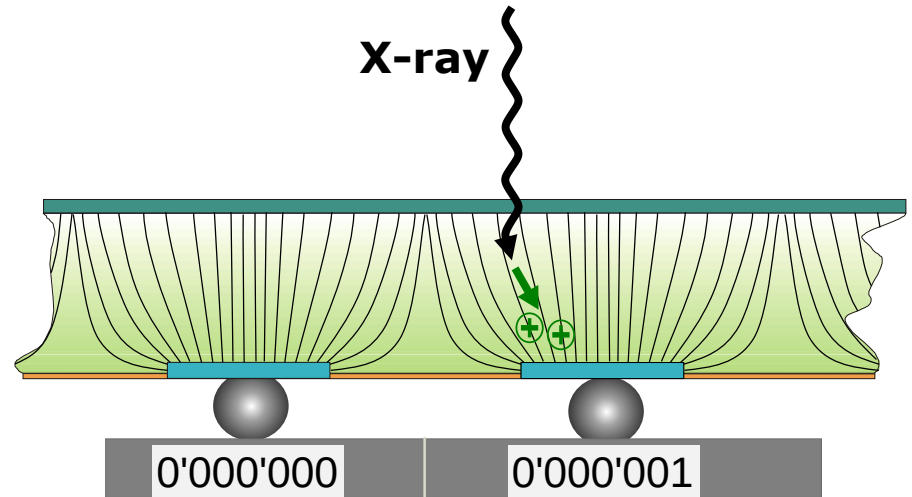
X-ray Detection

Indirect Detection
scintillator + CCD



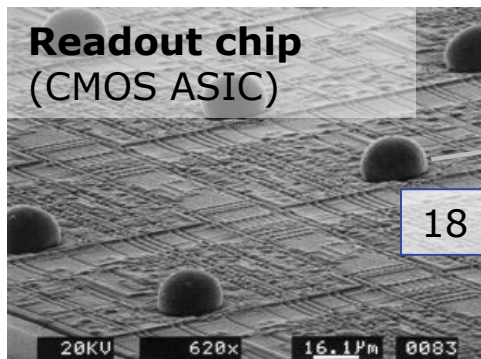
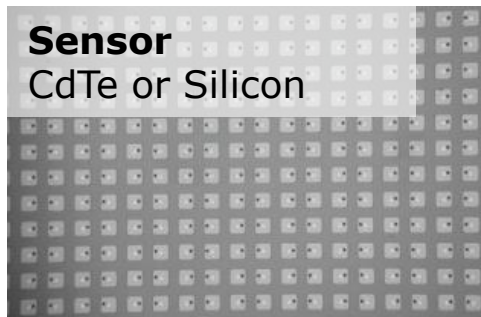
- blur over several pixels
- charge integration

Direct conversion
hybrid photon counting (HPC)

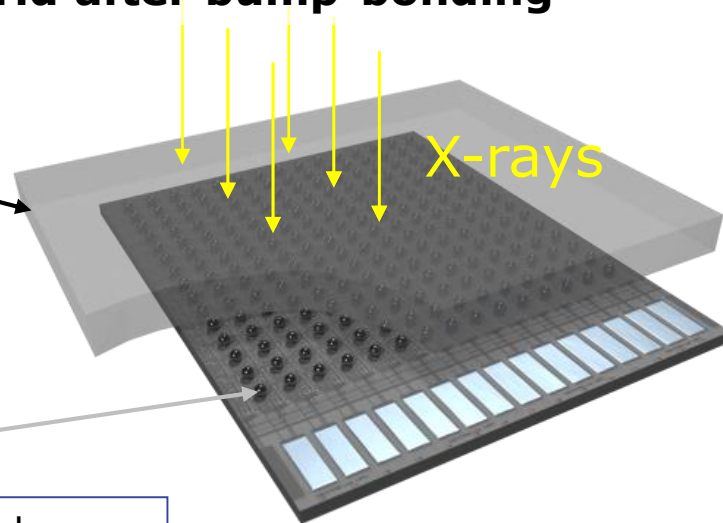


- 1 pixel spread, sharp image
- digital counting

Hybrid Photon Counting (HPC) - Technology

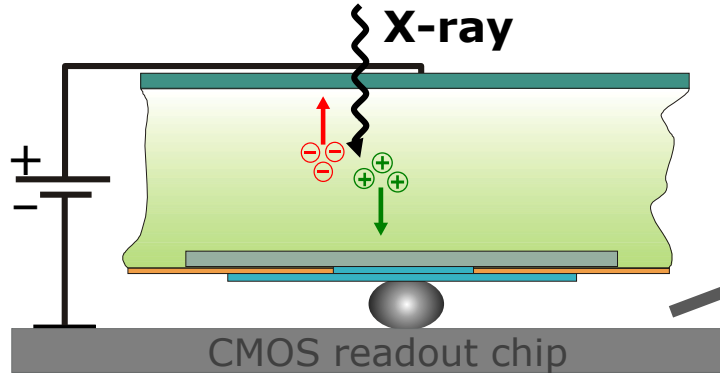


Hybrid after bump-bonding



HPC Technology

Sensor pixel

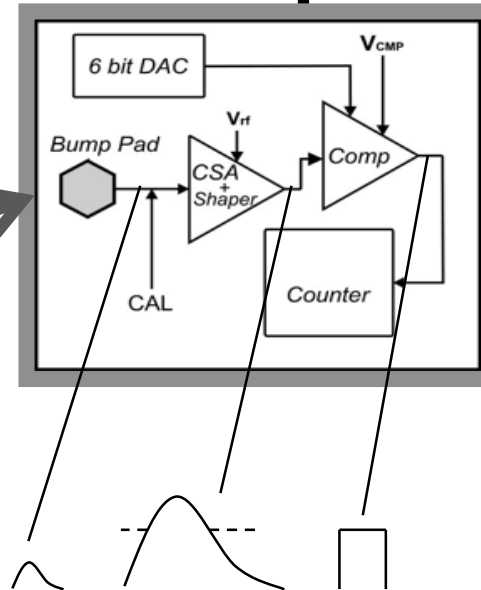


**Direct conversion of X-rays
in semiconductor sensor**

→ Point-spread function: ~ 1 Pixel

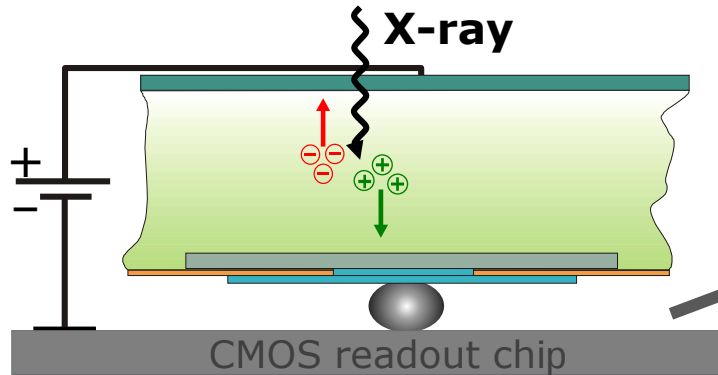
3.62 eV to create one e/h pair in silicon sensor
(e.g. ~ 3300 e/h-pairs created by a 12 keV photon)

Readout pixel



HPC Technology

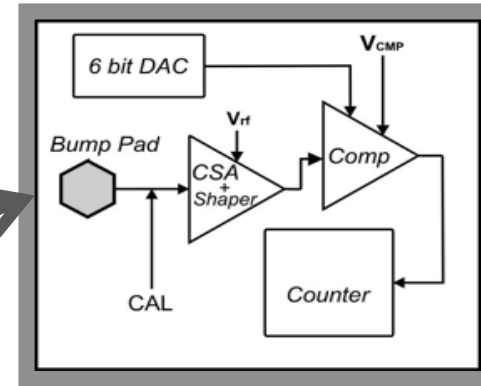
Sensor pixel



**Direct conversion of X-rays
in semiconductor sensor**

→ Point-spread function: ~ 1 Pixel

Readout pixel



**Single-photon counting
with adjustable energy threshold**

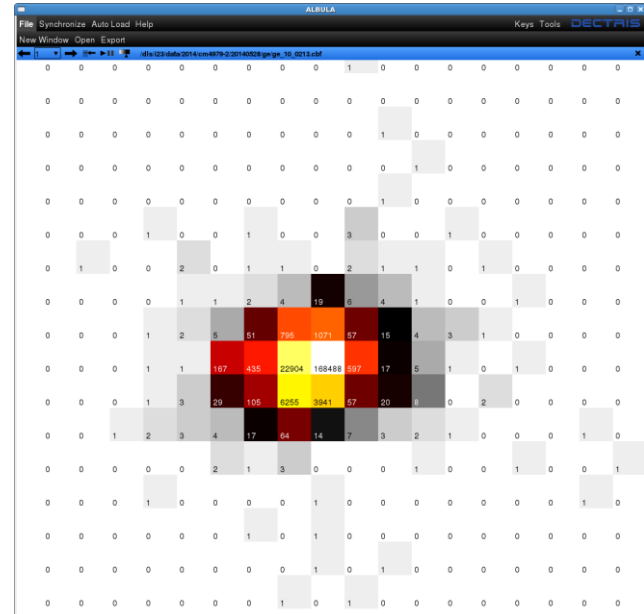
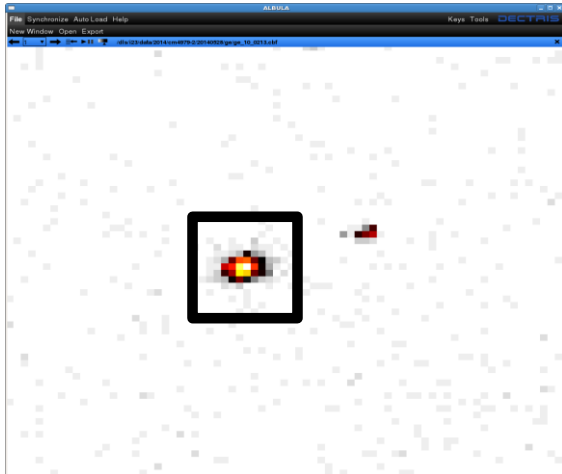
→ Noise free / no dark signal

→ high dynamic range, fast readout

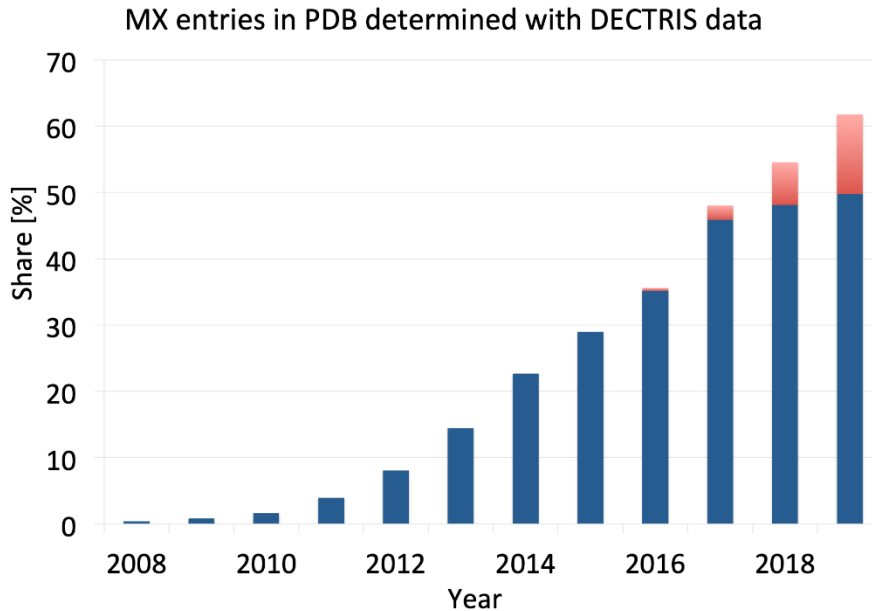
Negligible X-ray background

In-vacuum setup not only eliminates air absorption, but also scattering, yielding perfect background of zero counts!

Bragg scattering from germanate crystal.



DECTRIS accelerates crystallography



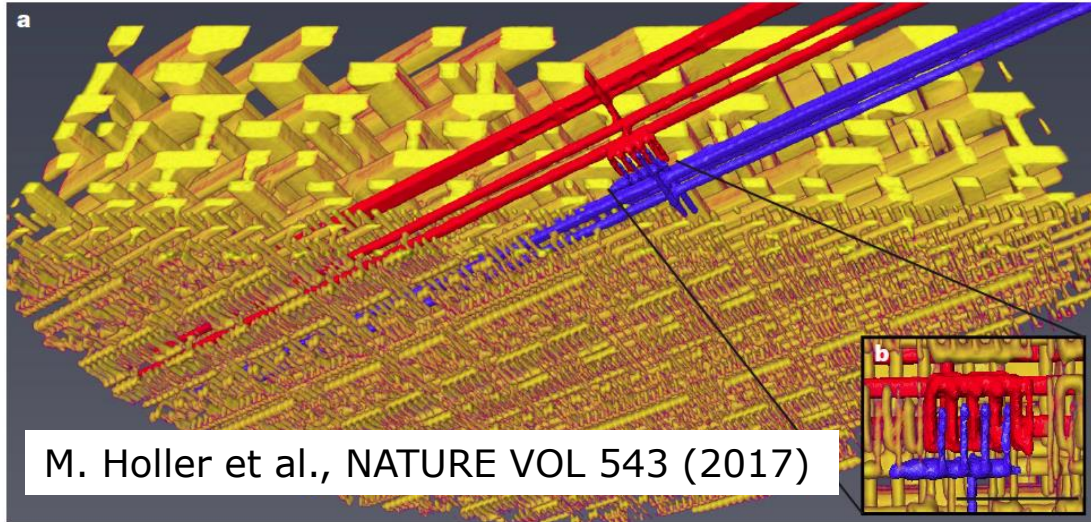
Ge et al., Nature
580:658 (Apr
2020)



Zhou et al. Nature
548:420 (Aug 2017)

PDB releases based on
PILATUS and **EIGER**
data

Chip Imaging with Ptychography

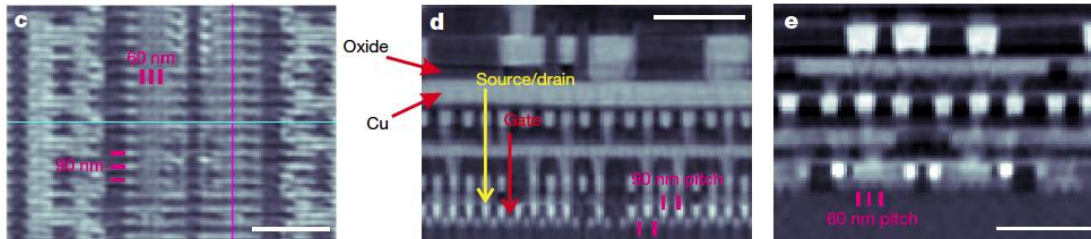


Requirements

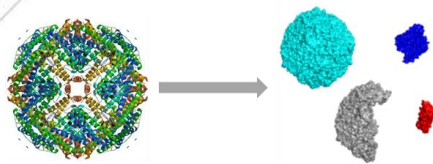
- High frame rates
- Small pixel size and large area

Object

- Intel Pentium G3260 processor 22 nm tech.
- Sample diameter 10 μm
- 3D resolution 14.6 nm

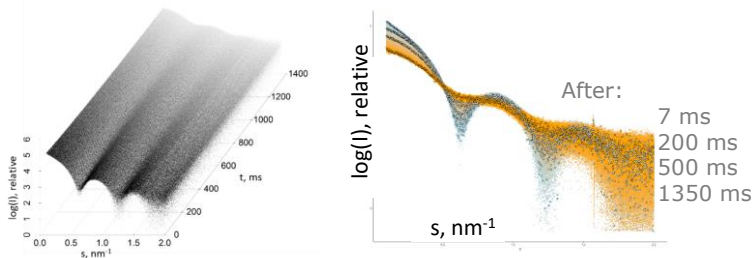


Hybrid photon counting detectors for kinetics and high flux SAXS



Time resolved SAXS:
Apoferritin following pH-jump trigger using a stopped-flow pH-jump and monitored by SAXS.

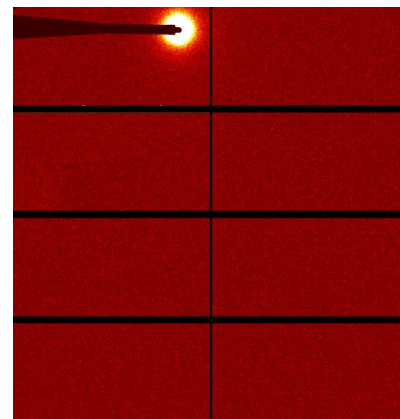
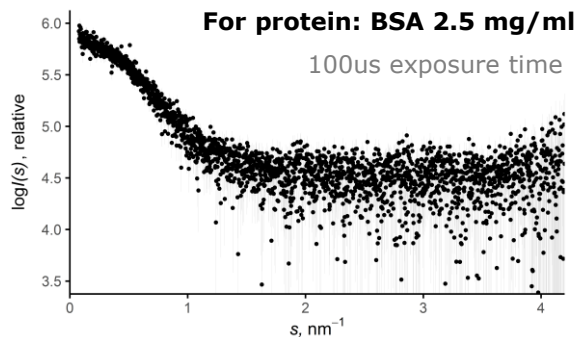
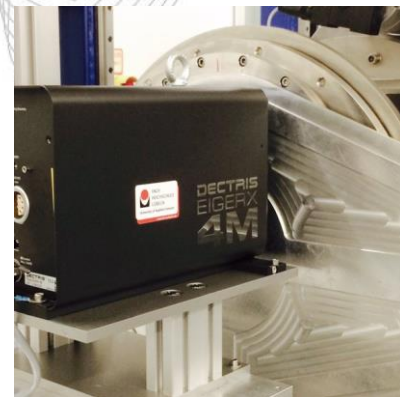
1000 frames collected in 1350 ms



Courtesy of C. Blanchet



High flux beam:
Using multilayer monochromator (5×10^{14} ph/sec)

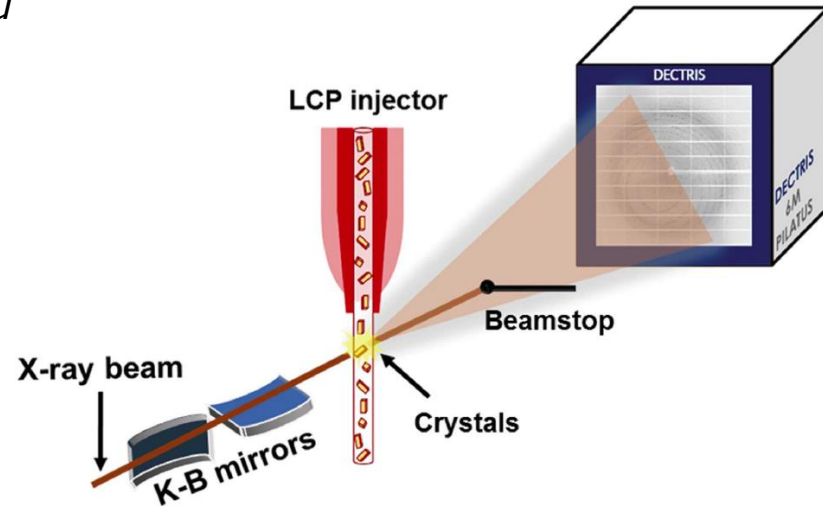


Serial Synchrotron Crystallography

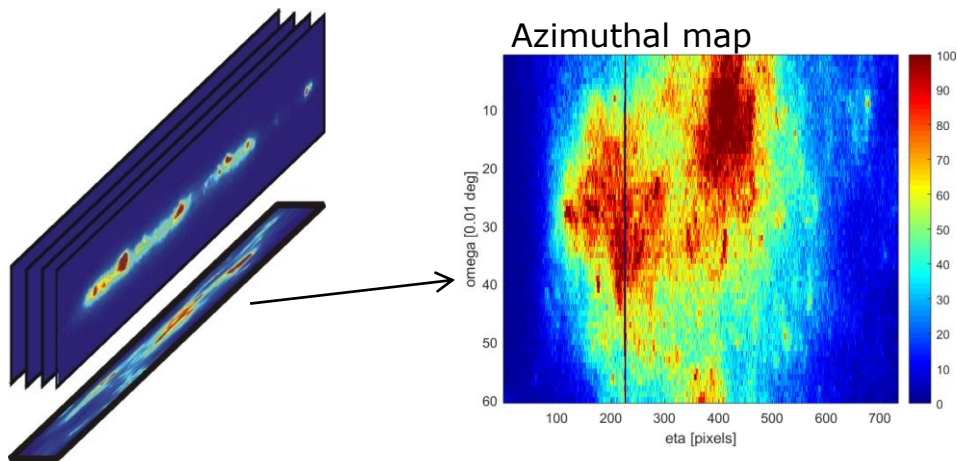
- High throughput, short exposures of small crystals (GPCRs, etc.) using injectors and in-situ in-meso data collection
- Time-resolved studies (in-crystallo enzymatic reactions by diffusion (small Xtals!))
- Acoustic levitation

Detector requirements

- Highest count-rate for optimal statistics
- High-frame rates and large area
- Zero dead-time for perfect duty cycle
- Gateable for dynamic studies

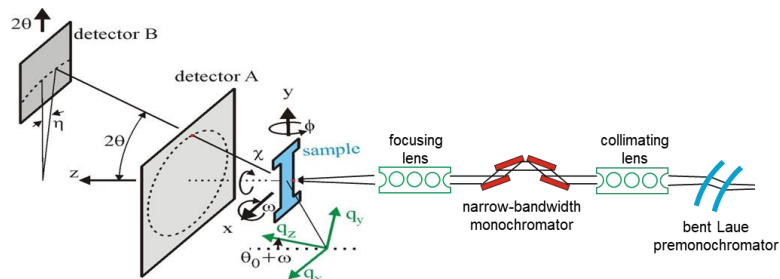


Single-grain mapping with *EIGER2* CdTe



PETRA III P21.2 test in June 2019
 Detector: *EIGER2* CdTe 1M (prototype)
 Energy: 52 keV (narrow BW)
 Rocking interval: 0.01 deg
 Exposure time: 0.1 s

Courtesy: Ulrich Lienert, PETRA3 P21.2, DESY



Electron Microscopy Product Line

Hybrid pixel technology is optimal for detecting high energy electrons
30keV – 300keV



QUADRO



ELA



CRISTALLINA

Materials Science
Research

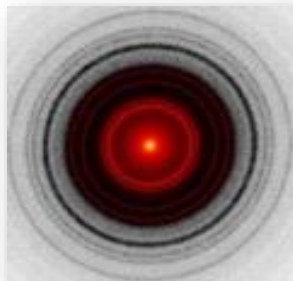
Life Science Research

Semiconductor Industry

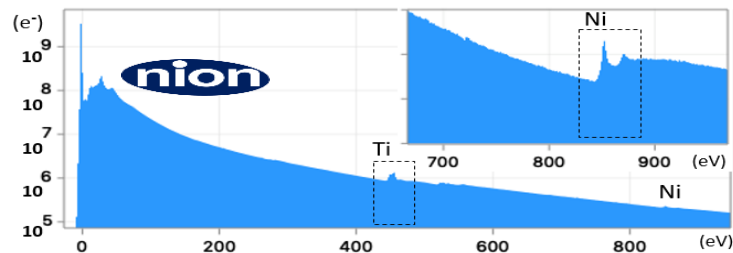
Pharma

Electron Microscopy – Applications

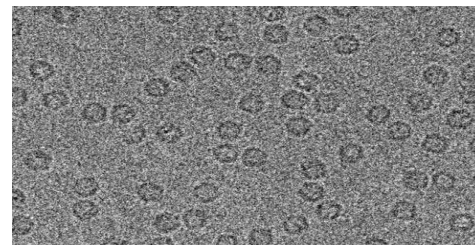
Electron Diffraction - Al



Electron Energy Loss Spectroscopy – SrTiO_3



Cryo-EM - Apoferritin

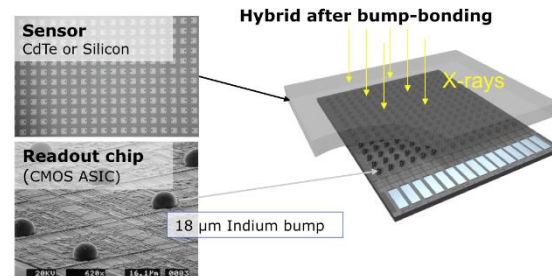


MRC | Laboratory of
Molecular Biology

Summary

Hybrid Photon Counting (HPC) Technology

- *sharp PSF (1 pixel)*
- *direct detection of photons*
- *no dark current*
- *fast readout*



EIGER2

- *HPC technology*
- *up to 16M pixels*
- *up to 9000 Hz*
- *up to 100 keV*



Summary

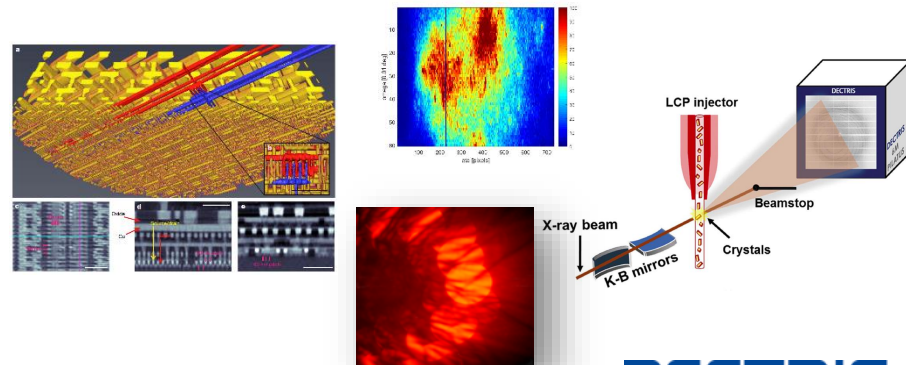
MYTHEN and Electrons

- 50 μm pitch
 - 1280 / 640 strips
- & the same technology for electrons*



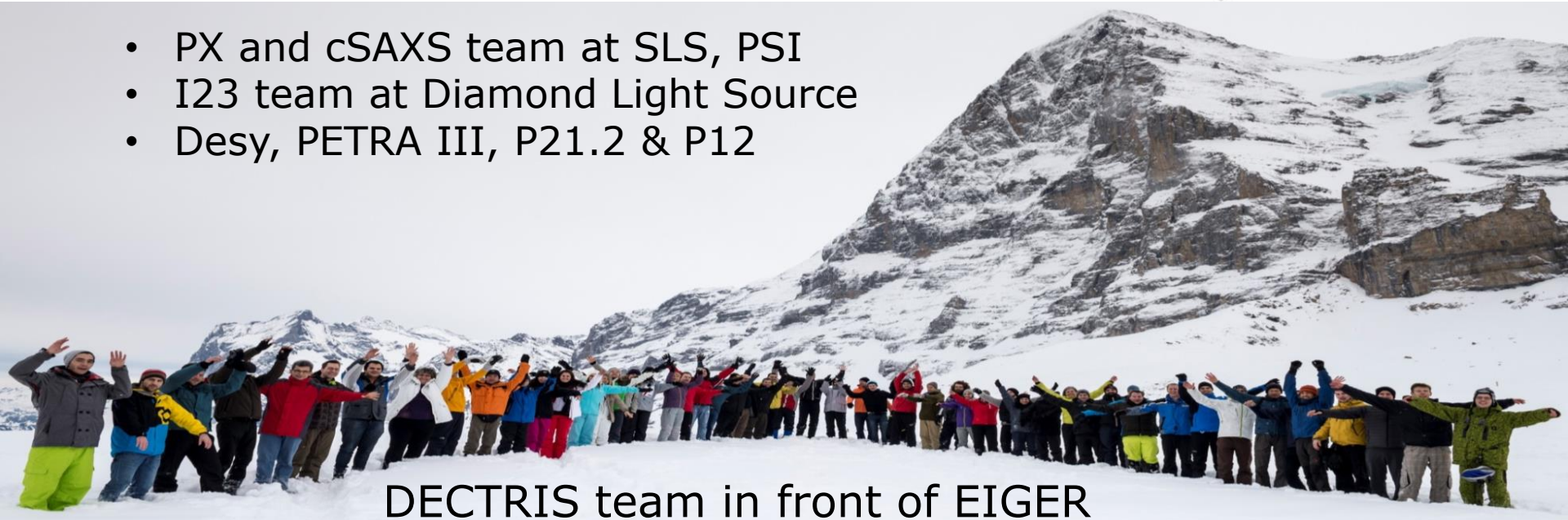
Many applications

- Serial crystallography
- Single-grain mapping
- SAXS, Ptychography, ...



Acknowledgment

- PX and cSAXS team at SLS, PSI
- I23 team at Diamond Light Source
- Desy, PETRA III, P21.2 & P12



DECTRIS team in front of EIGER