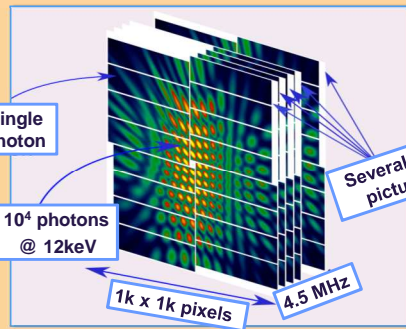
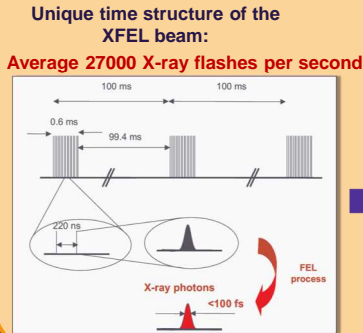


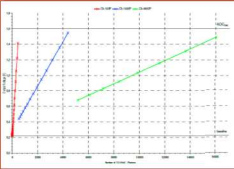
European XFEL – Detector Requirements & Challenges...



- Energy 0.3 - 25keV (depends on experimental station)
- Quantum efficiency (>0.8)
- Sufficiently rad. hard for operation at XFEL
- Low noise
- High dynamic range
- XFEL timing compliant (2700 images per train)
- Low dead area
- Vacuum compatible
- Central hole

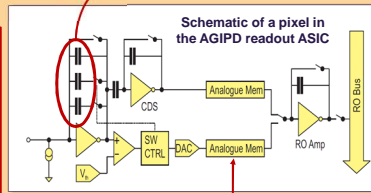
Possible solution for $E > 3\text{ keV}$ → AGIPD Detector

AGIPD Design

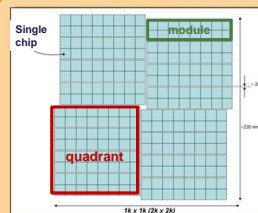


- Dynamic gain → switching for high dynamic range
- Gain factors: 1, ~4, ~25

- Analog memory for very fast imaging
- Storage cell capacity: 350 memory cells/pixel
- Random access operation of the analogue memory for 350 images → veto & trigger capabilities by overwriting unfit/obsolete images

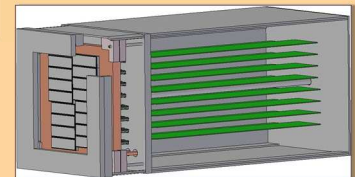


AGIPD Detector Layout and Mechanics



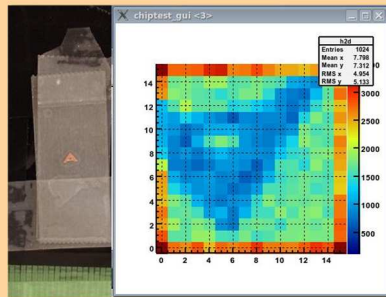
- 64x64 pixels/chip
- 2x8 chips/module
- 4 modules/quadrant
- 4 quadrants/detector → 1Mpix
- Pixel size: 200 μm x 200 μm
- Sensor: 500 μm thick silicon

- Hole for direct beam
- Active cooling
- Back-end electronics easily accessible
- Full in vacuum design



Testing of Structures

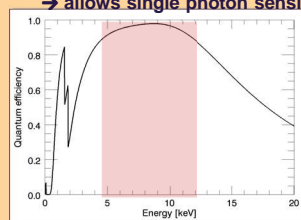
- To understand the behavior of the detector the test structures were:
 - Irradiated
 - Heated up/cooled down
 - Measured:
 - linearity of the gain,
 - noise
 - storage cell variation
 - pixel-to pixel variation
 - and much more...



Imaging with the first 16x16 pixel detector prototype - AGIPD0.2

Expected Performance

- Sensitive energy range 3-13 keV
 - Max. frame rate 4.5MHz
 - Dynamic range > 10⁴ photons/pixel @ 12keV
 - Radiation tolerance > 10¹⁴ photons/pixel @ 12 keV
 - Expected noise ~350 e- r.m.s.
- allows single photon sensitivity down to 5 keV

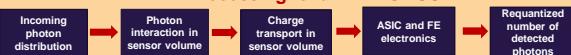


Expected Quantum Efficiency $QE > 0.9$ for $4 < E < 12\text{ keV}$

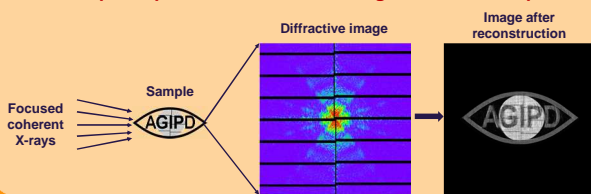
Science Simulation with HORUS - CDI

HORUS - Hpad Output Response fUncion Simulator
Designed to evaluate influences of certain design choices for AGIPD

Processing chain in HORUS:



Example of phase retrieval: scattering on a small sample



Facts and Plans

- Participating institutes: DESY, PSI, Uni Bonn, Uni Hamburg → ~ 20 people work on it
- More information at the AGIPD web page: http://hasylab.desy.de/instrumentation/detectors/projects/agipd/index_eng.html



Major milestones:

- First full-scale (64x64 pixels) prototype submission in 2012
- First working module in 2014
- Full working system available in 2015

AGIPD Detector will be ready for the 1st beam at the XFEL