European XFEL facility overview



Monica Turcato Detector group European XFEL

IFDEPS, Port Jefferson March 18, 2024







Timeline for the EuXFEL development



Monica Turcato, March 18, 2024

Detector development program approved end of 2022

Goal: next generation of Large Area Pixel Detectors 2030+

1st Generation AGIPD, LPD and DSSC fully operational since at least 2019

- Providing good scientific data to users
- Need to ensure operation until new generation is available \rightarrow spares, maintenance

Facility demand for Higher Photon Energy > 25 keV up to more than 50 keV

Silicon sensors suffer from critically low quantum efficiency above 25keV

Increased pixel density desired by scientific instruments < 100µm

LPD 500 μm, AGIPD 200 μm, and DSSC ~ 230μm

Areas of investigation

- System integration, backend electronics
- System integration, mechanics and cooling
- High-Z materials
- Sensor and ASIC

Start with small module implementations of existing technologies



One of the first goals: single modules

- For system tests, we would like to rebuild single-module systems in house and start learning from them. This implies also the investigation of new portable mechanics and cooling solutions.
 - Basically all the beamlines have expressed the interest in small single module systems and we would like EuXFEL to be able to set them up and maintain them





Inside of DSSC ladder test stand

XFEL.EU 08-2022-XXX

REPORT

2nd Generation of AGIPD Detector -Requirements for Small Detector Systems at EuXFEL

September 2022

prepared by J. Sztuk-Dambietz based on information provided by the instruments

	FXE	HED	HED- HiBEF	MID	SPB/SFX
# of detectors/ # of pixels	1/ 256x512	1/ 128x512	1/ 1 28x512	FEL 128x256	1/ 256x512
Operation	In air	vacuum	In air	In air and vacuum	vacuum
Location of auxiliary infrastructure	hutch	hutch	hutch	Rack room	Rack Room

DSSC single module standalone detector system development













R&D of small scale DSSC detector is actively ongoing in house:

- Semiconductor based cooling system.
- Mechanics and vacuum system.
- Refactoring (scaling down) PP PCB.
- Concept design including 3D modelling and production drawings.
- Simulations and prototype tests.

Complete integration of 1MPix Camera first time in house:

- QA check and documentation.
- FPM integration.
- Electronics integration.
- Complete system test after assembly.
- Expand interlock concept

Dedicated large clean room area:

- Complete IT infrastructure (Karabo, DAQ, Online correction)
- Cooling, vacuum, power systems 1:1 as at instruments
- X-ray sources, high resolution tools (microscopes, oscilloscopes, etc) and reference detectors.

Work on single module AGIPD to start soon



Photons

Electronics, ASICs and new sensors for hard X-rays

In common: hiring new personnel to actively increase resources on these topics

Electronics

Improvements / design updates on existing systems
Incremental modifications from existing technologies
Work with experienced external partners

ASICs

Feasibility studies on pixel sizes, memory cells...

New sensors for harder X-ray detection

Perform tests at high fluxes and rates at the EuXFEL

Data analysis

Lessons learnt from present systems

- Detector self-protection is a must
- Easy operability has high priority
- Calibration must be easily repeatable and reliable
- Reliability!



Thank you for your attention