

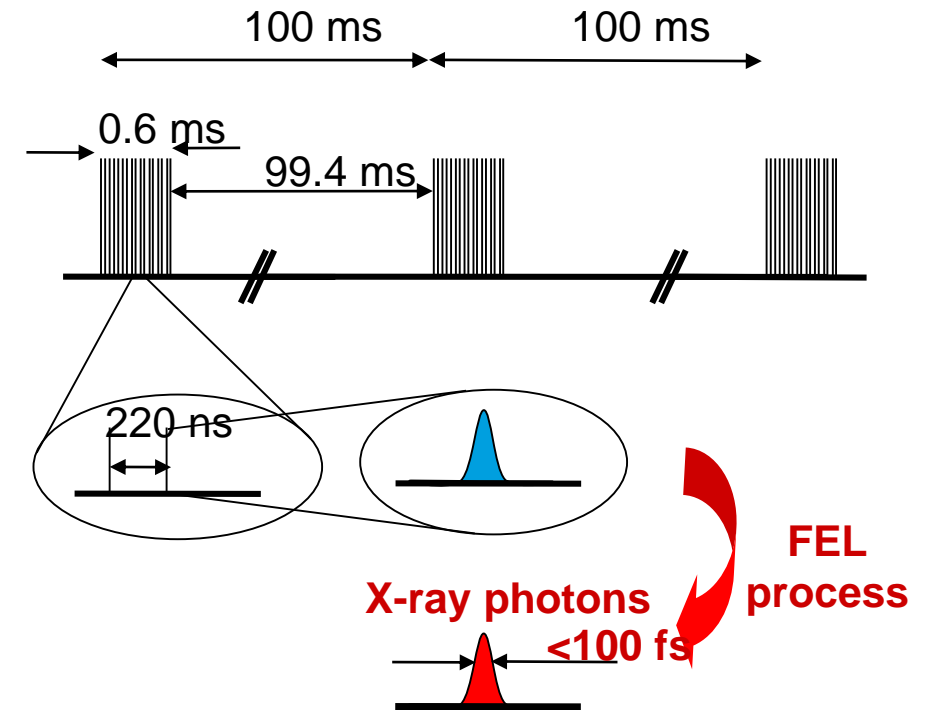
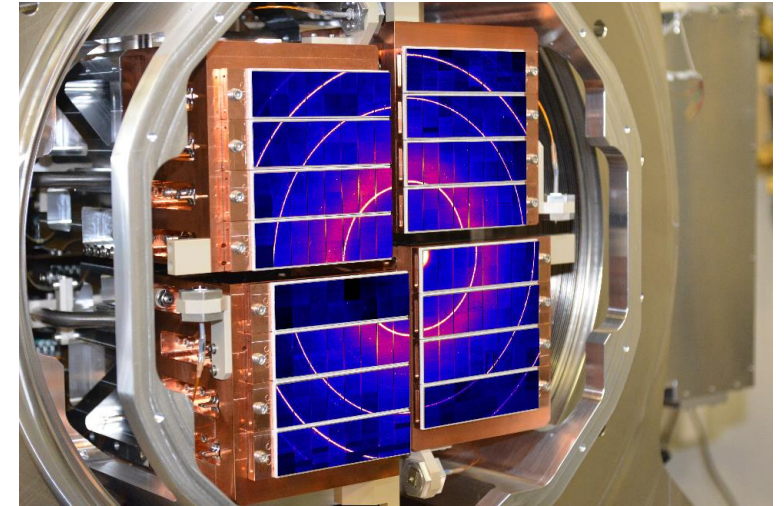
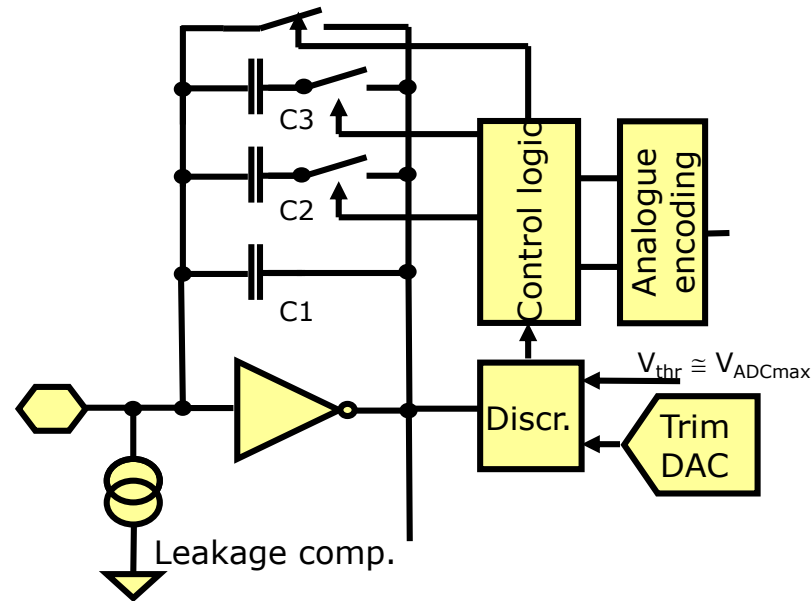
Commissioning of the AGIPD Mini-Half Prototype System at EuXFEL

Torsten Laurus on behalf of the AGIPD consortium
Hamburg, 03. February 2021

AGIPD

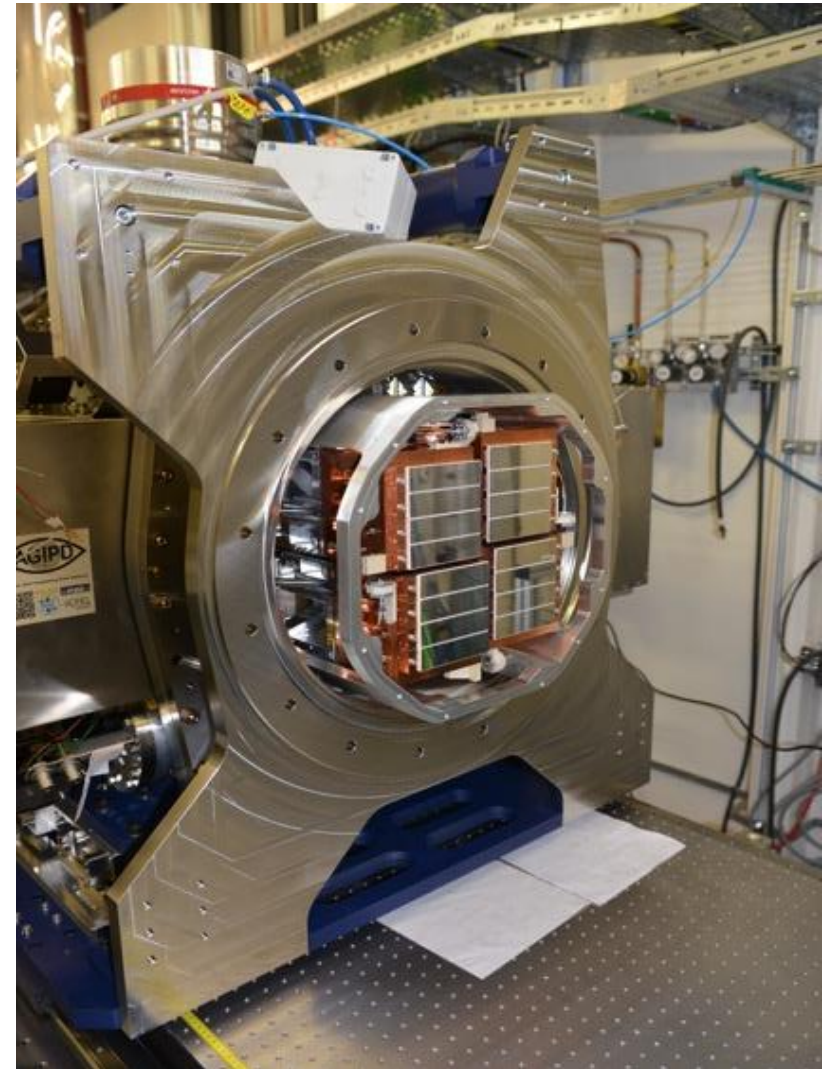
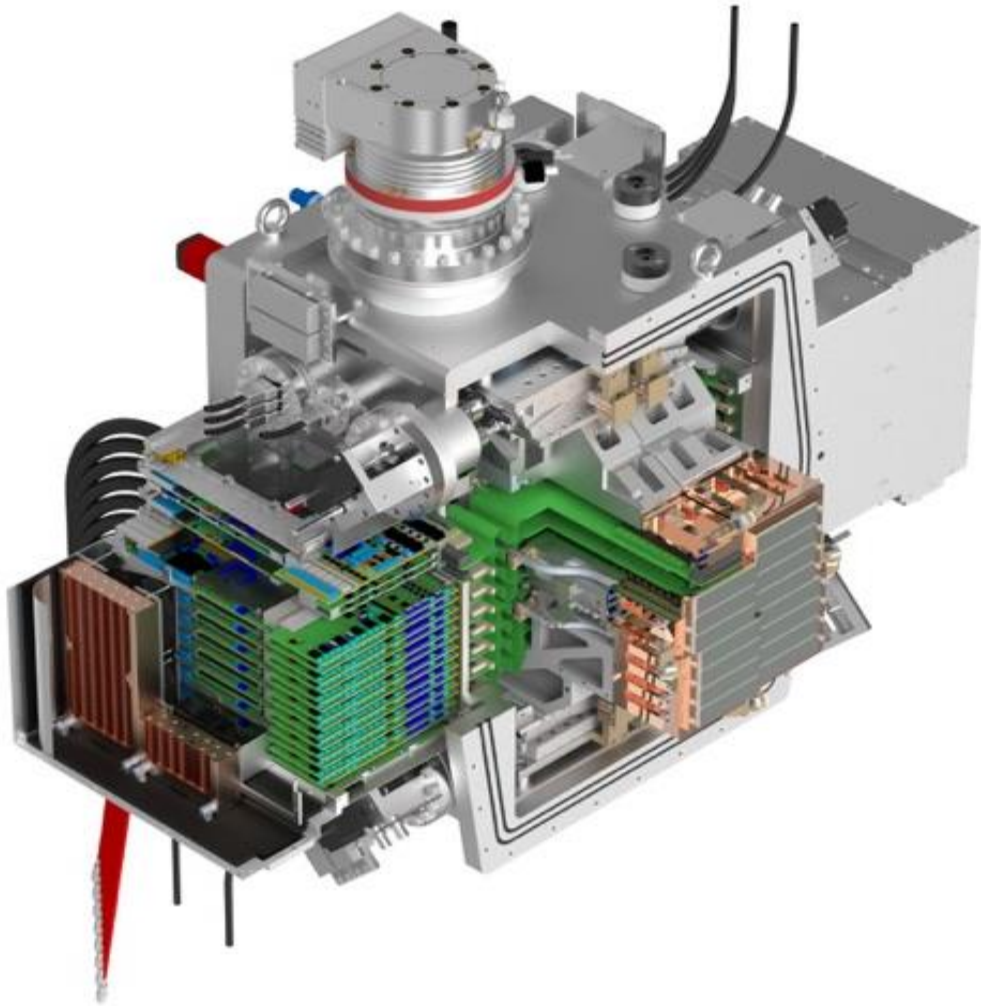
Adaptive Gain Integrating Pixel Detector

- Burst mode – 352 images at 4.5 MHz (6.5 MHz max)
- Single photon sensitivity at 7 keV
- 10^4 ph/pixel/image dynamic range (at 12.4 keV)
- 200 x 200 micron² pixels
- Noise below Poisson statistics
- 64 x 64 pixels per ASIC
- 2 x 8 ASICs per module



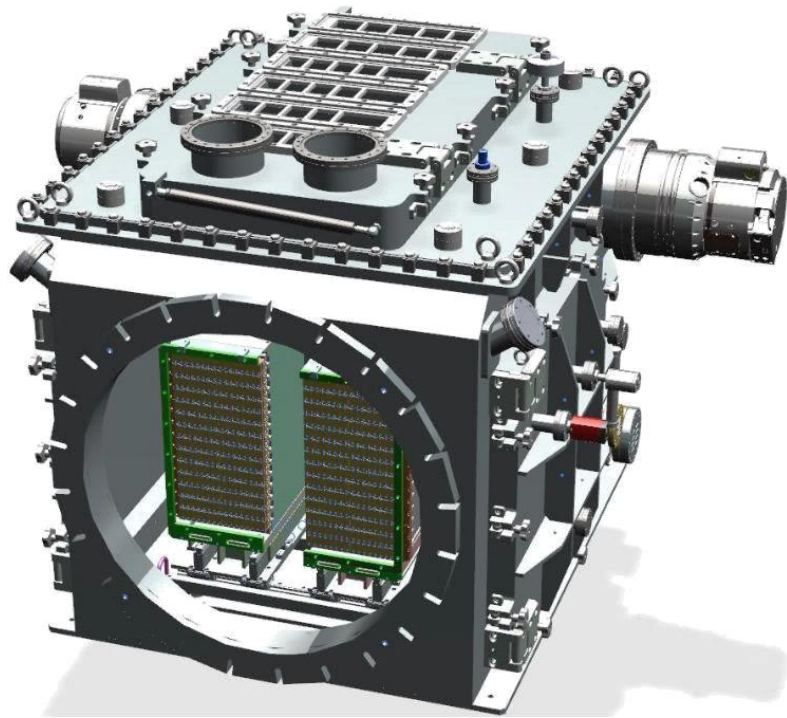
Operational AGIPD Systems at EuXFEL

1MPix Systems at SPB and MID

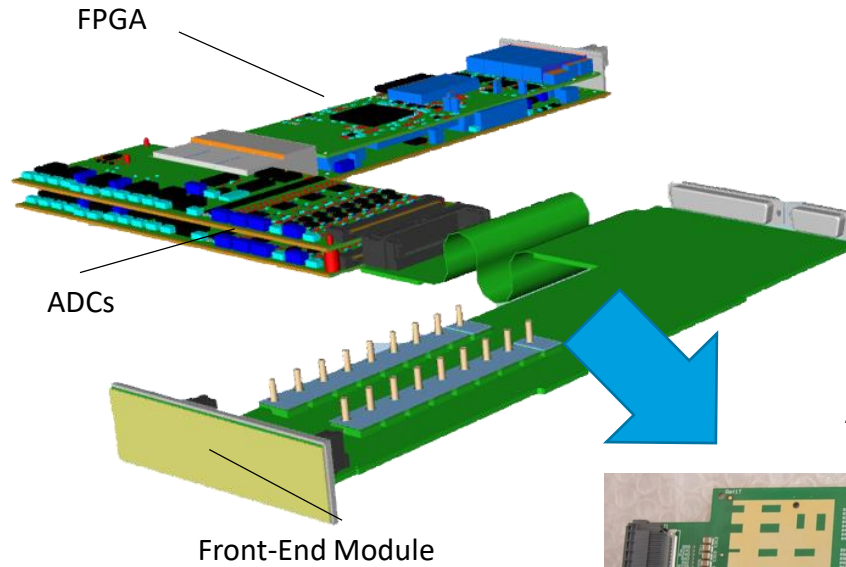


AGIPD Systems in Development

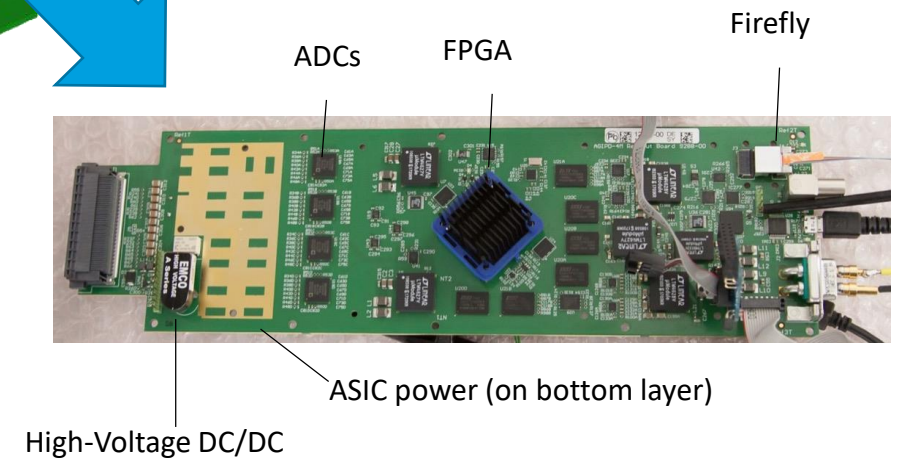
1MPix for HIBEF/HED and 4MPix for SFX/SPB



1st generation AGIPD electronics

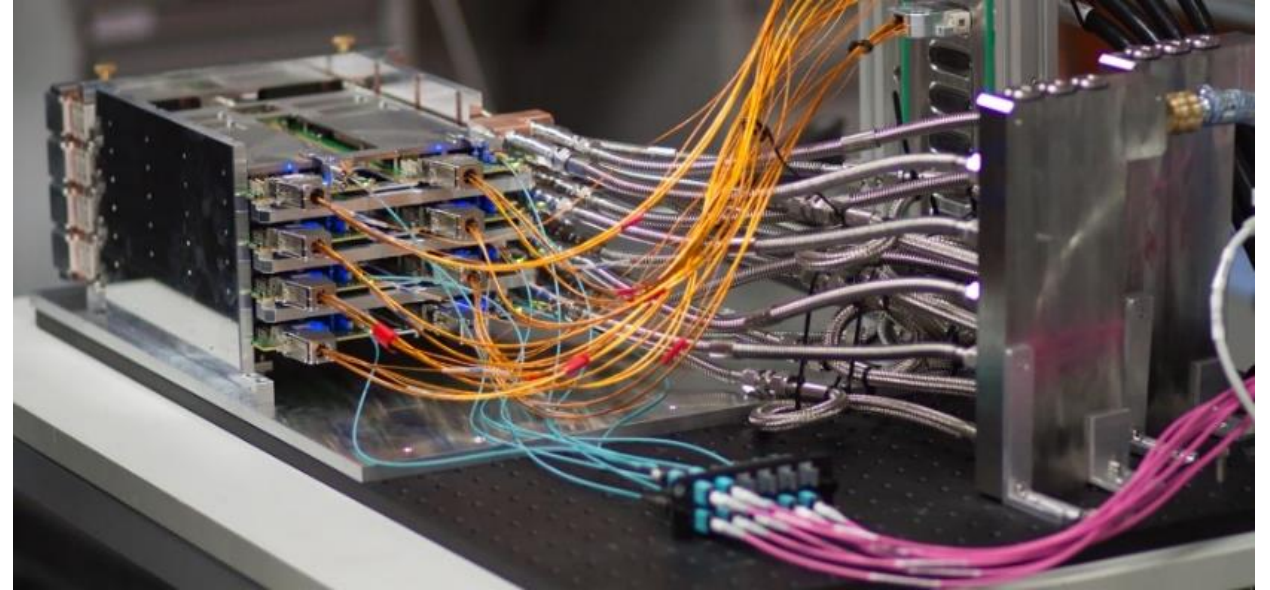


2nd generation AGIPD Electronics Readout Board

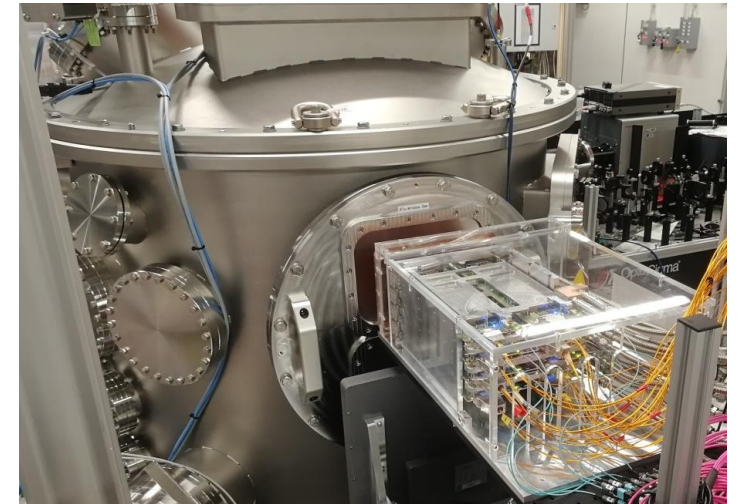


AGIPD Systems in Development

Mini-Half Prototype System



- 8 Readout Boards, 8 front-end modules = 500kpix
- 4x AGIPD1.1, 4x AGIPD 1.2 FEMs
- 1 Receiver Board – without interlock functionality, link to EuXFEL Clock&Control
- Operated in air, water cooled



Commissioning at HED instrument at EuXFEL

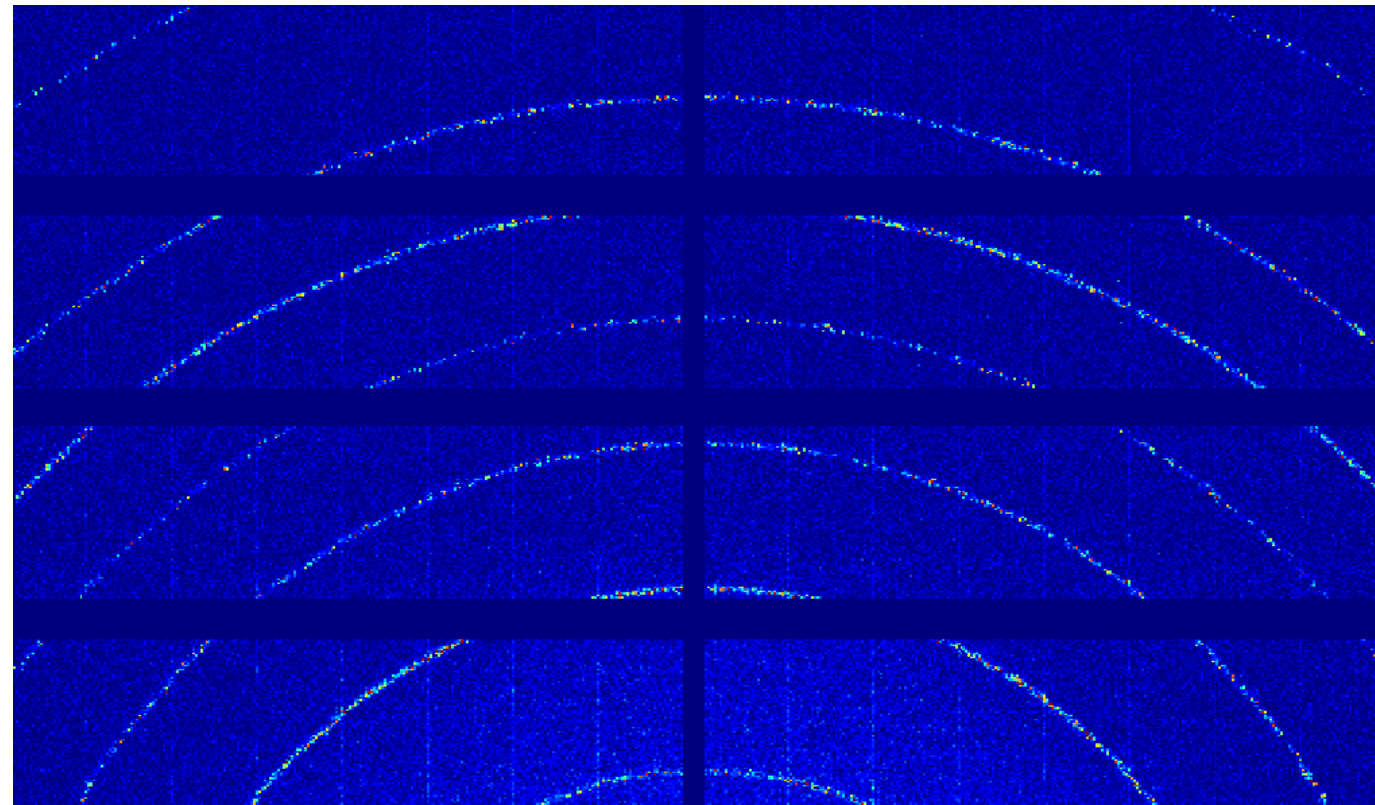
Objectives

- Integration into EuXFEL's controls environment
- Commissioning together with HED/HIBEF's dynamic DAC and pulsed laser setup
- Characterization of new readout electronics and AGIPD 1.2 ASICs

Procedure

- Assembly and testing at CFEL lab
- Commissioning at EuXFEL's detector laboratory without beam
- Commissioning beamtime at HED instrument

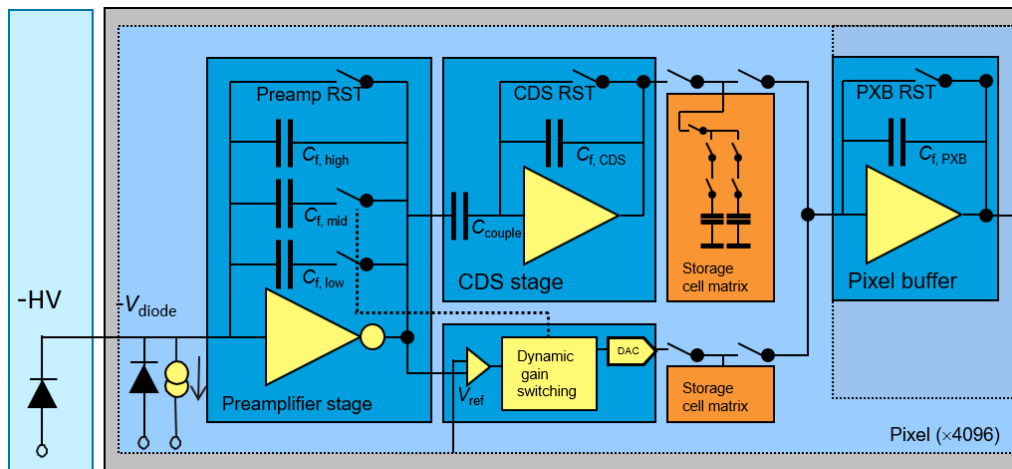
First light on AGIPD Mini-Half – LaB₆ at 17.8keV



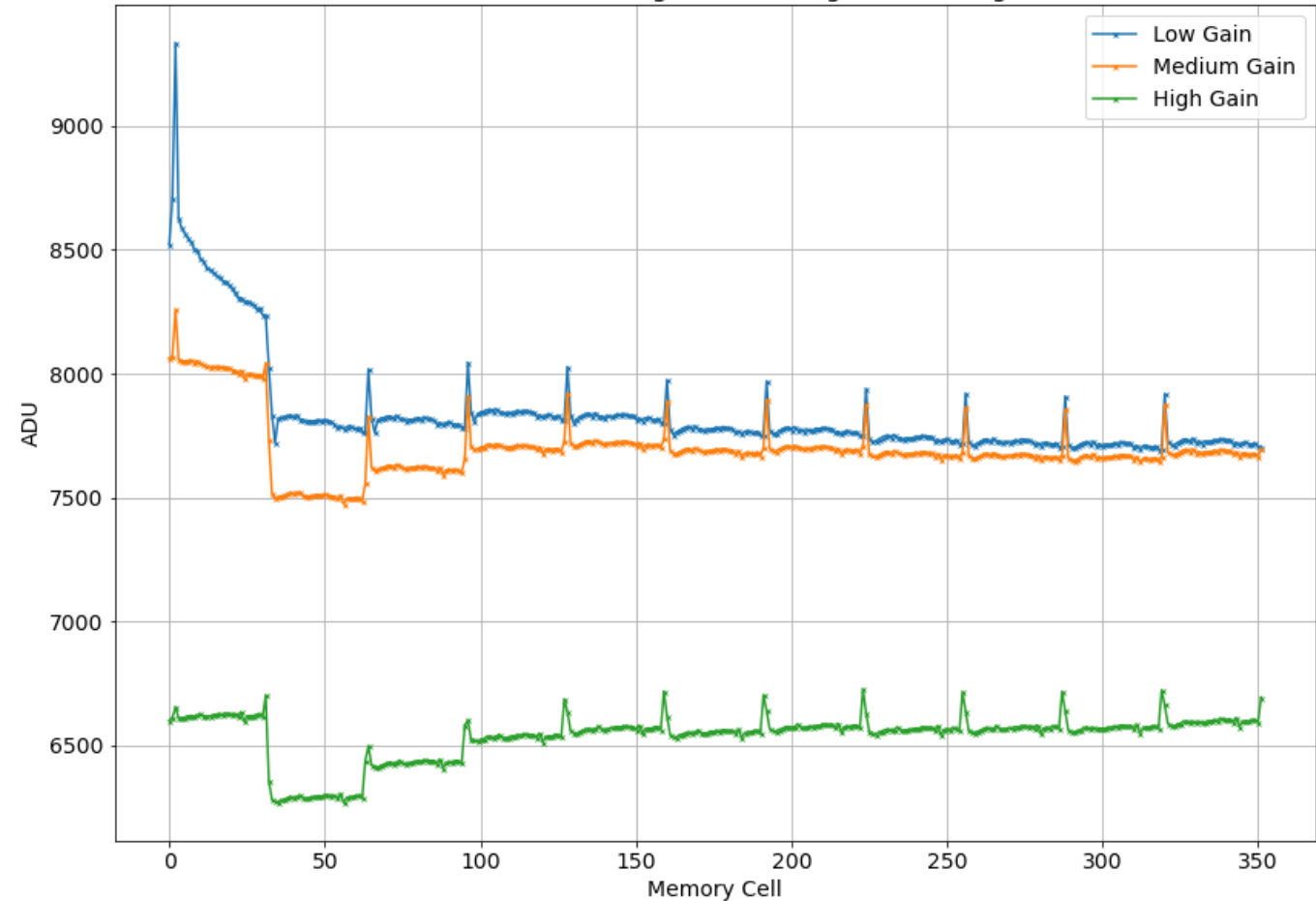
AGIPD 1.2

ASIC for improved gain encoding

- Each pixel encodes the used gain analogue in a storage cell matrix
- AGIPD 1.1: During readout, the analogue level of the low gain drops, making the two gains indistinguishable



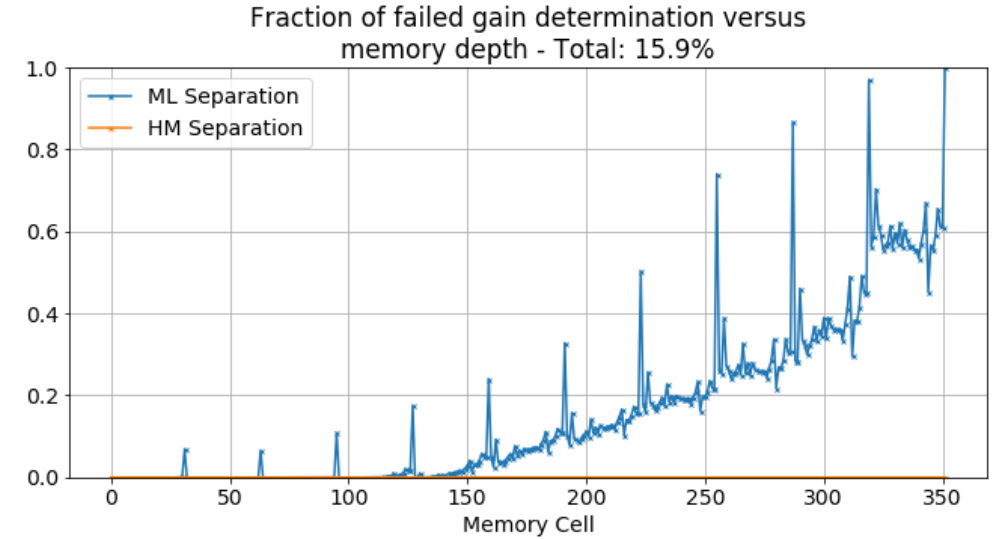
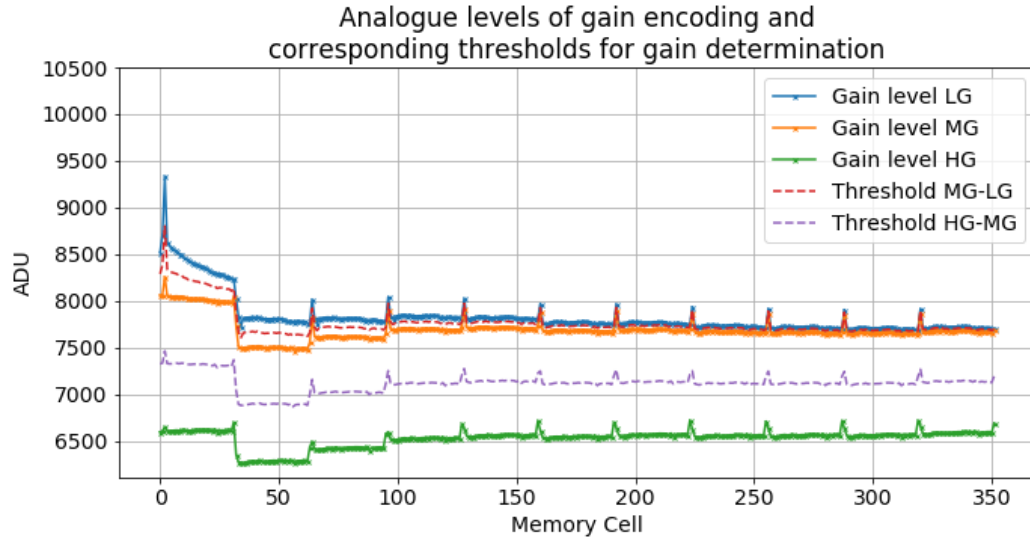
AGIPD 1.1 - Analogue levels of gain encoding



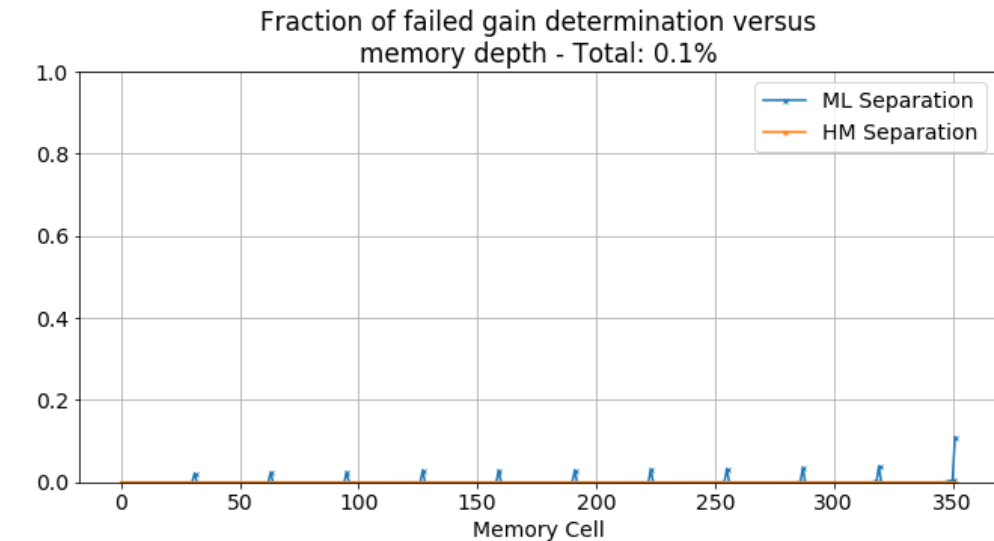
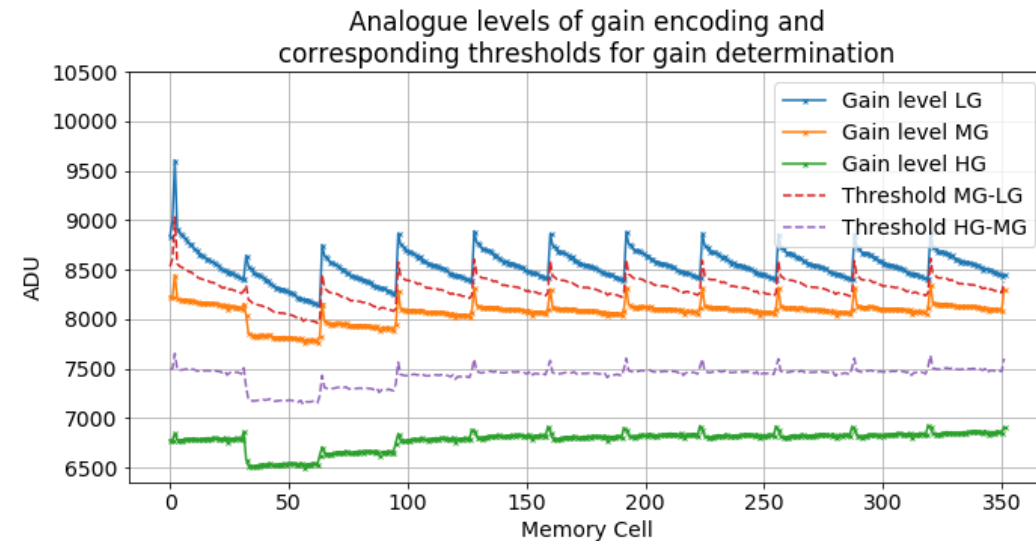
AGIPD 1.2

ASIC for improved gain encoding

AGIPD1.1



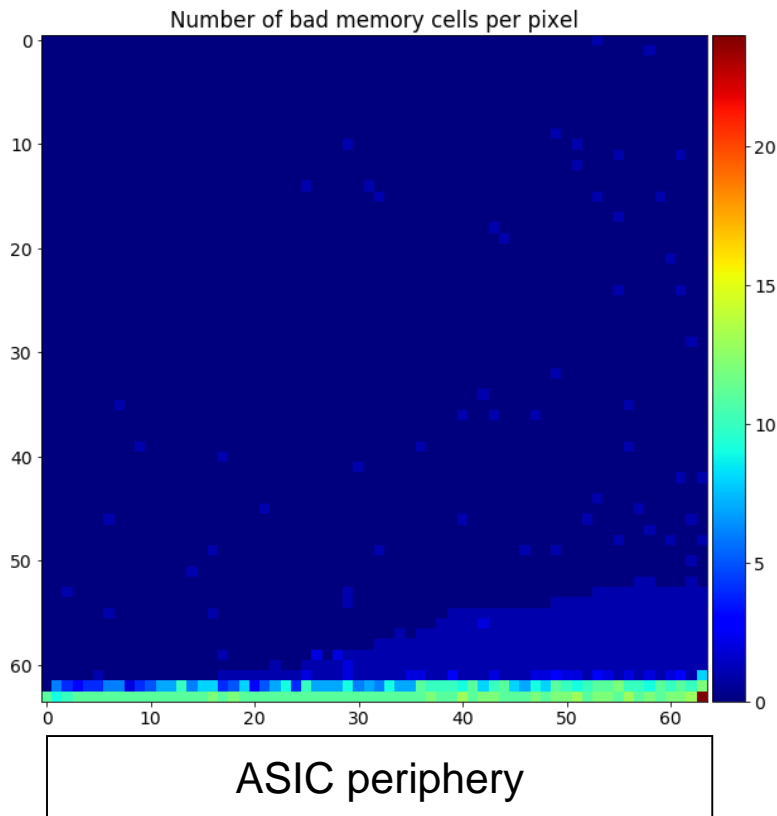
AGIPD1.2



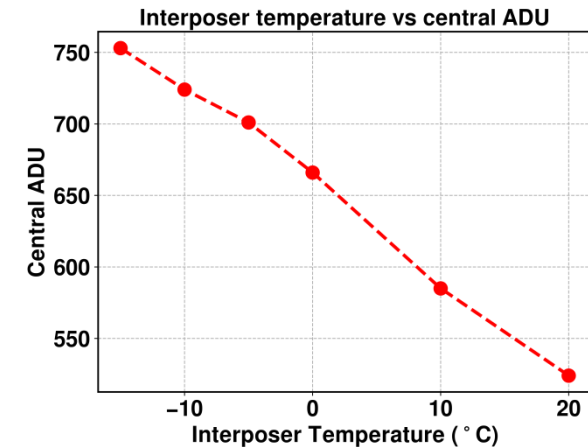
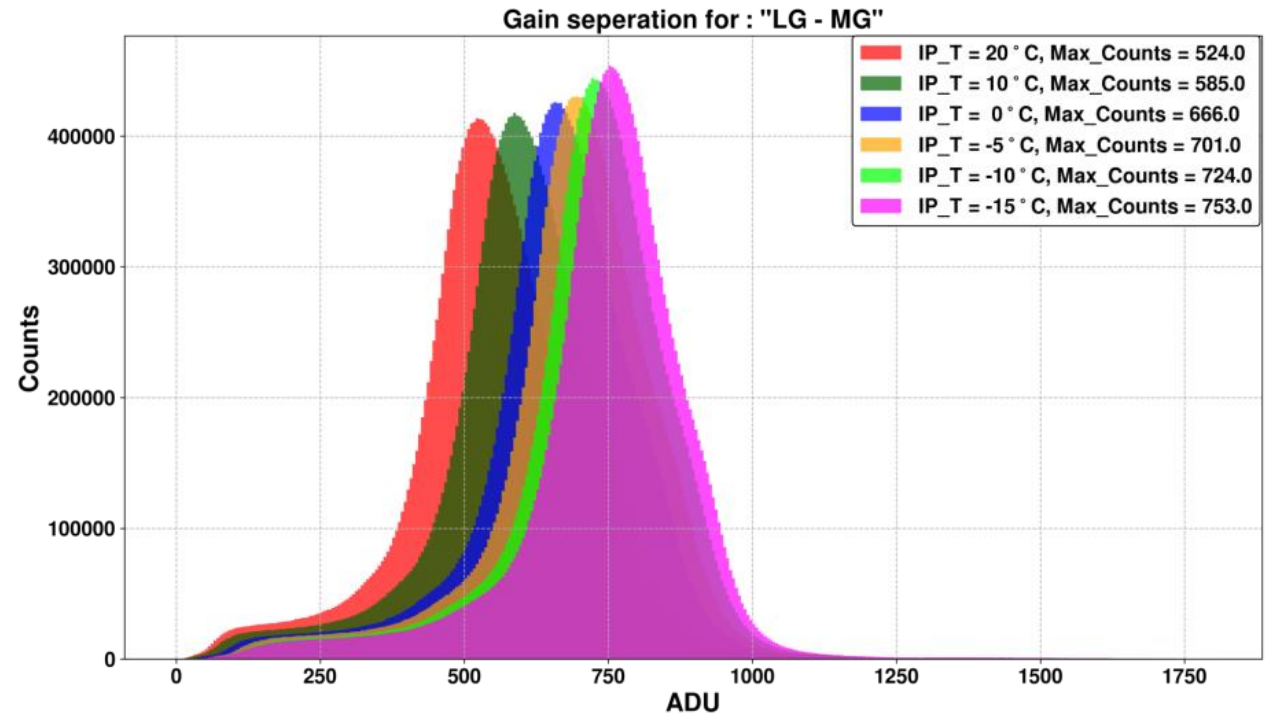
AGIPD 1.2

ASIC for improved gain encoding

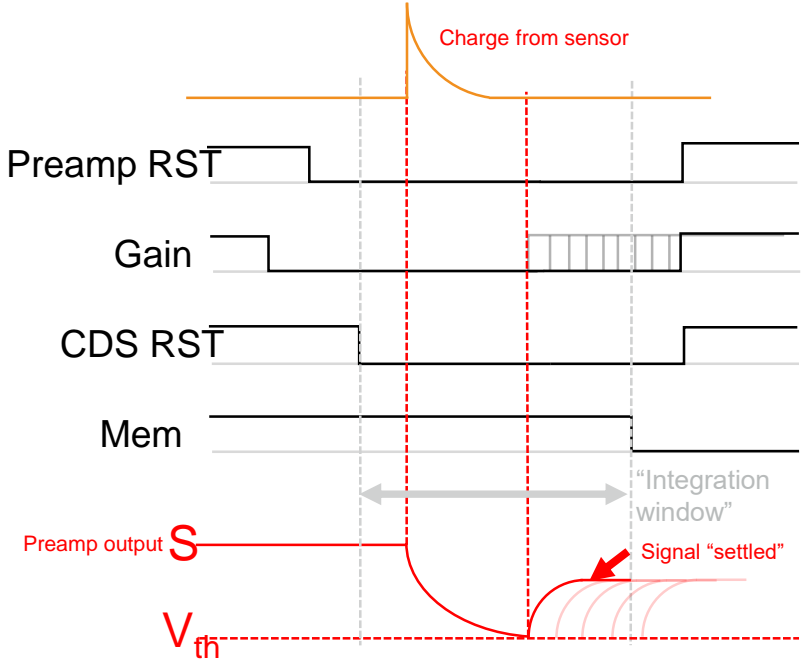
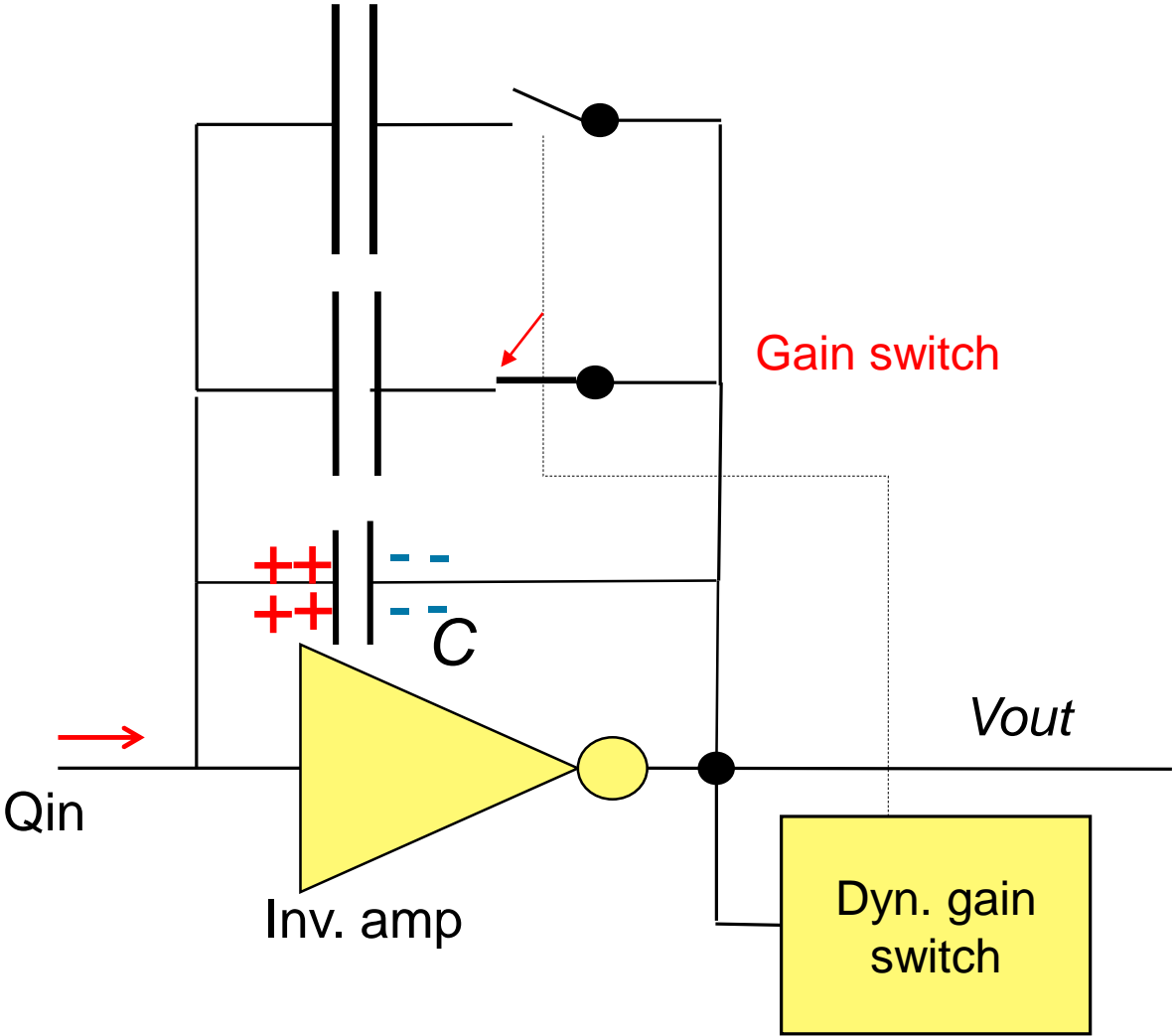
Gradient towards ASIC periphery



Strong temperature dependency



Gain Switching Transition Region

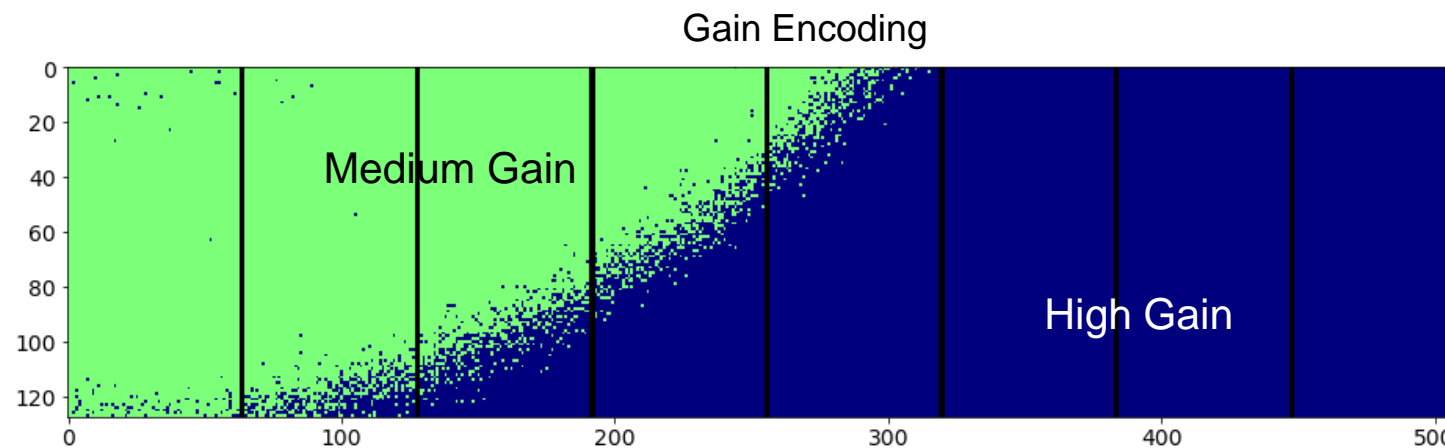
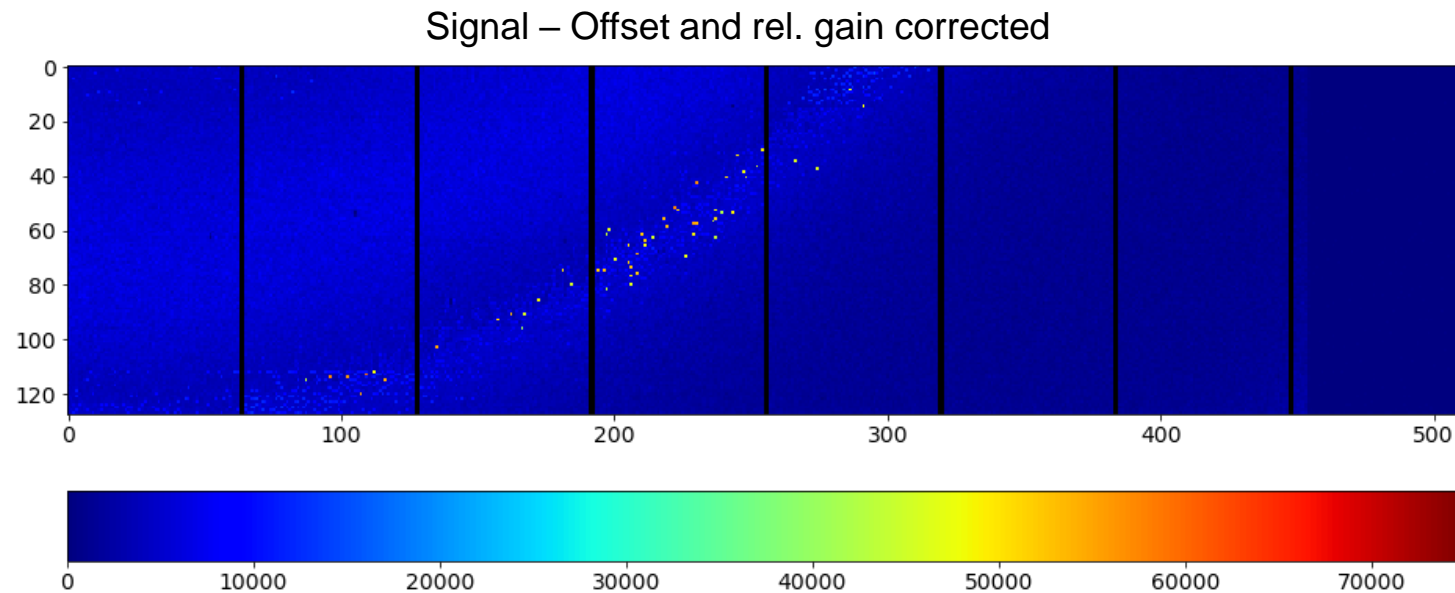


- Late gain switching leads to incorrect intensities
- Longer Integration time should reduce probability

Gain Switching Transition Region

Late gain switching leads to incorrect intensities

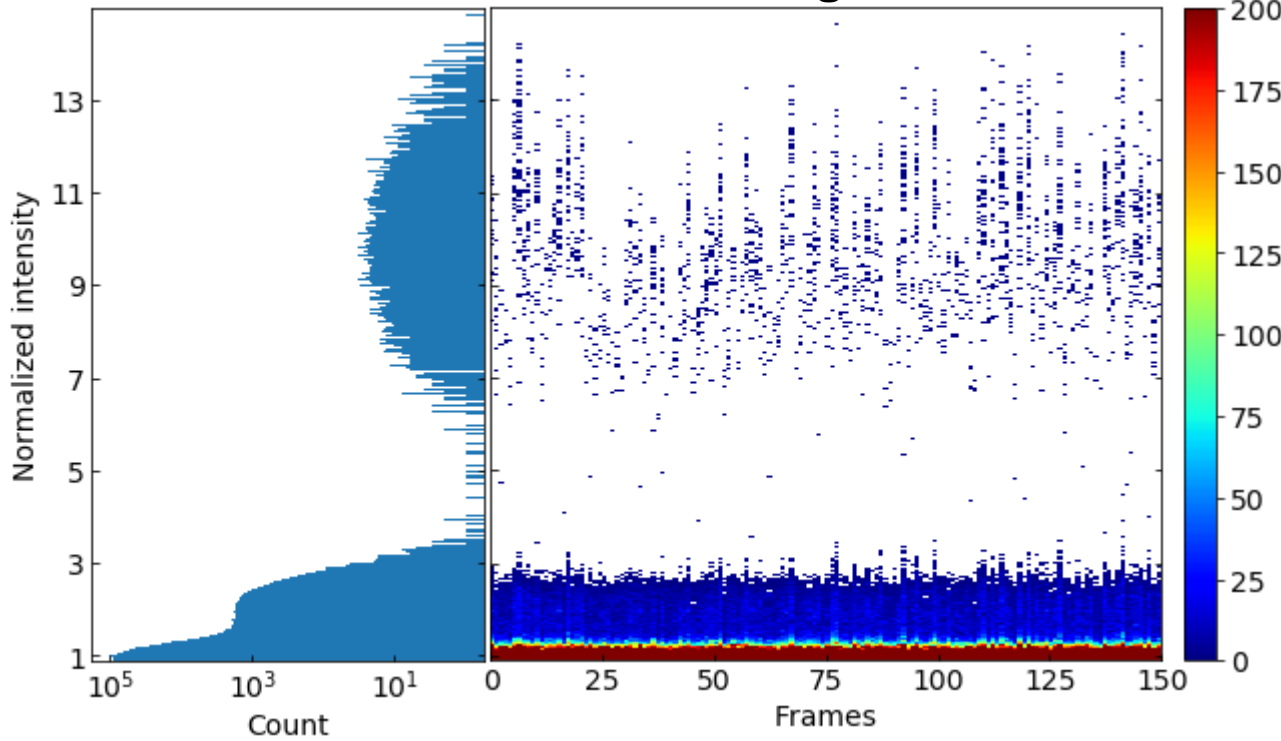
Yttrium K α
Fluorescence



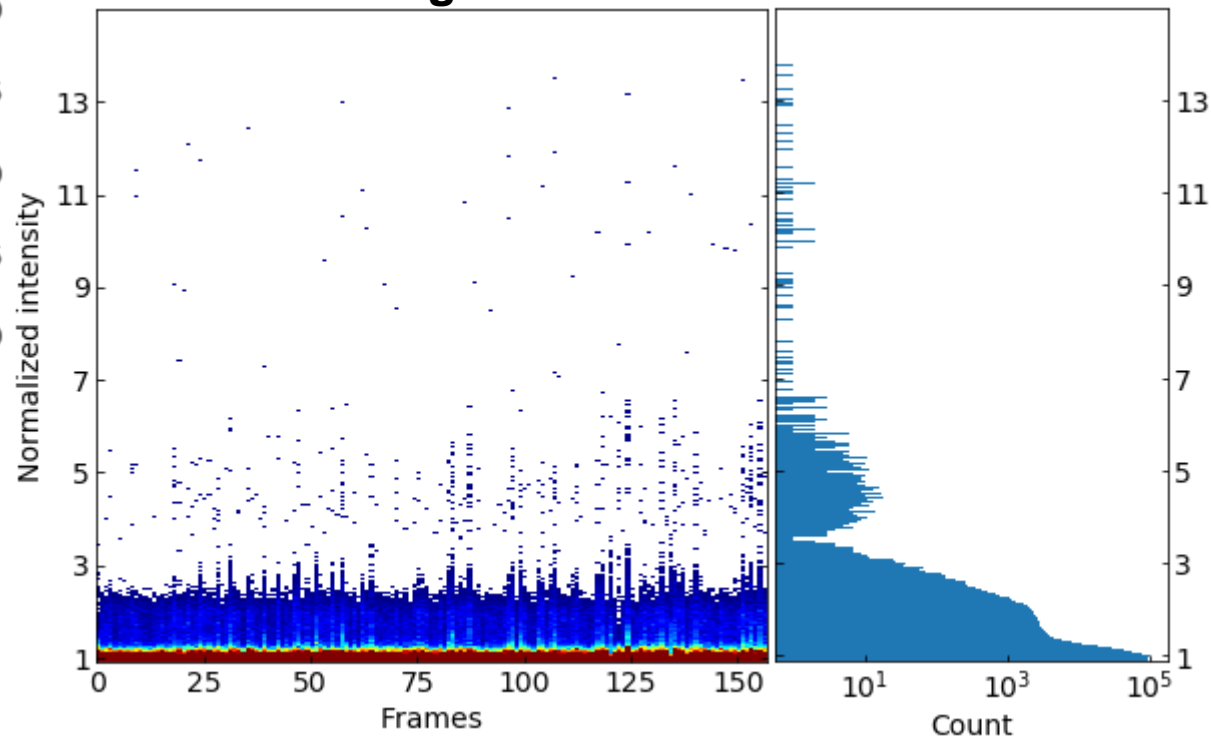
Integration Time

Impact on snowy pixels

120 ns Integration Time



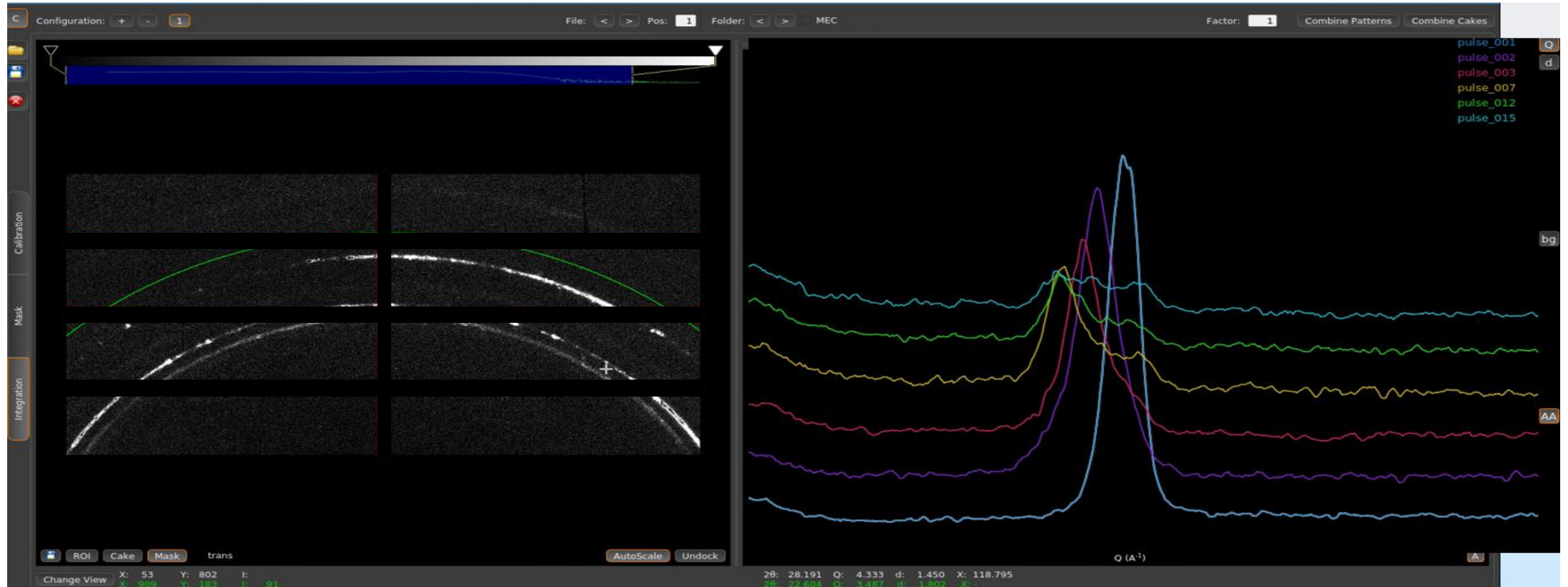
230 ns Integration Time



Increasing the integration time reduces late gain switching pixels' probability and intensity

Single-Train MHz-pulse-resolved diffraction

X-ray (and laser-) heated Platinum in diamond-anvil cells



intra-train thermal peak shift and melting

Summary and Outlook

Summary

- AGIPD Mini-Half successfully integrated into EuXFEL's control and DAQ system
- Characterization
 - AGIPD 1.2 shows a significantly improved gain level encoding
 - Integration time has influence on late gain switching effect
- First scientific experiments with HED/HIBEF's dynamic DAC and pulsed laser setup performed



Outlook

- More commissioning beamtime to characterize system
- First “friendly user” experiments planned for 2021

