AGIPD calibration status report

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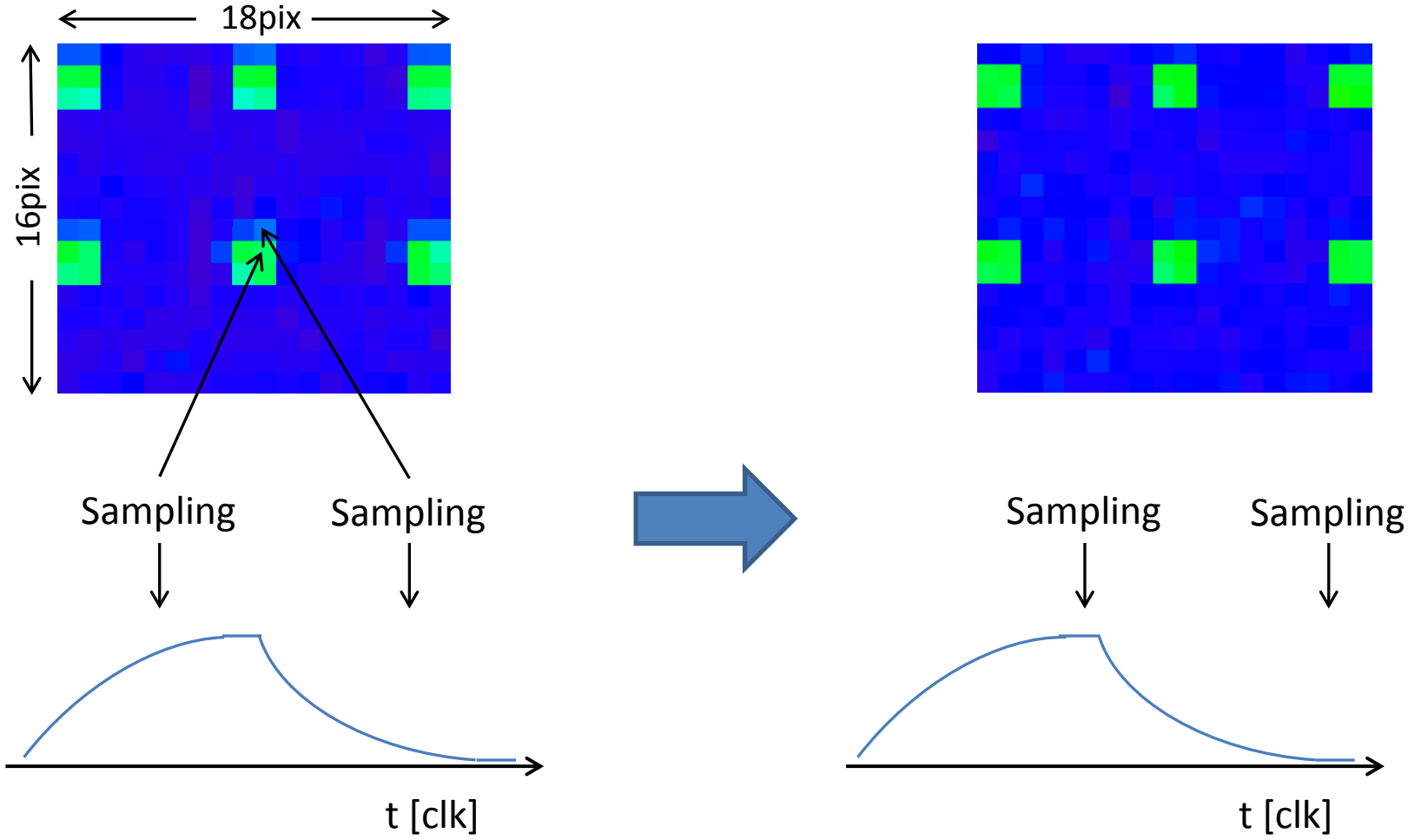
Overview

- Since last XDAC
  - New modules received (1 in April, 2 this week)
  - First module is being used to work out calibration procedure:
    - Optimized the sampling point of the read out signal
    - First X-ray transmission imaging (applied data correction)
    - Bad pixel identification for first module
  - Beam time schedule was worked out
  - Cross calibration between current source and Photons under discussion

- For the next months
  - Sensor module calibration and characterization for AGIPD 1M assembly.
  - Assembly of a second single module system (ongoing)
  - Single module delivery to XFEL in June 15

Read out synchronization



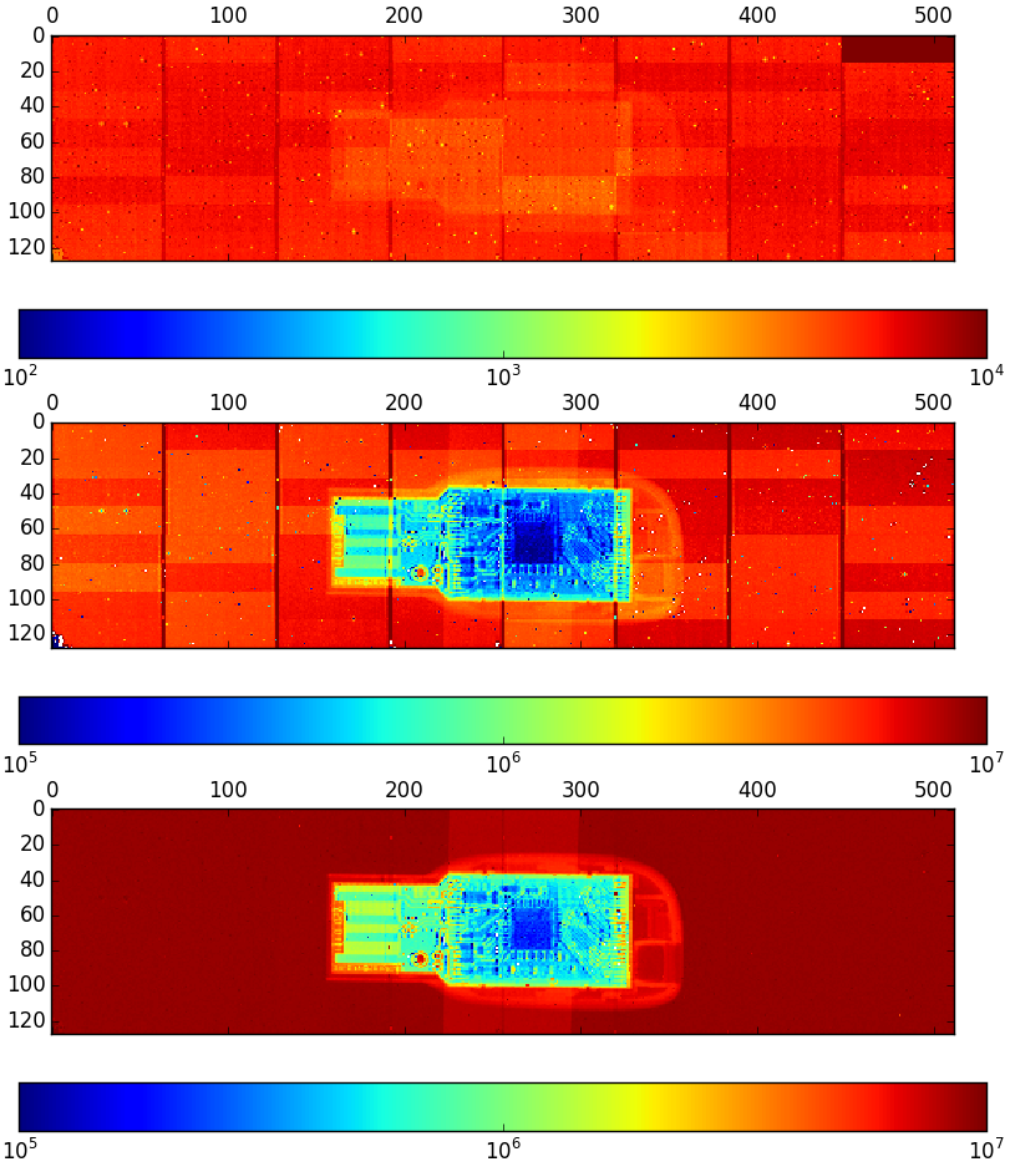
- A calibration precedure was worked out in order to find the right sampling point.
- The image quality could be improved dramatically by adjusting the data read out properly to the sampling point of the ADC.

X-ray of a pendrive

Mean of 10000 frames
50µs integration time per frame

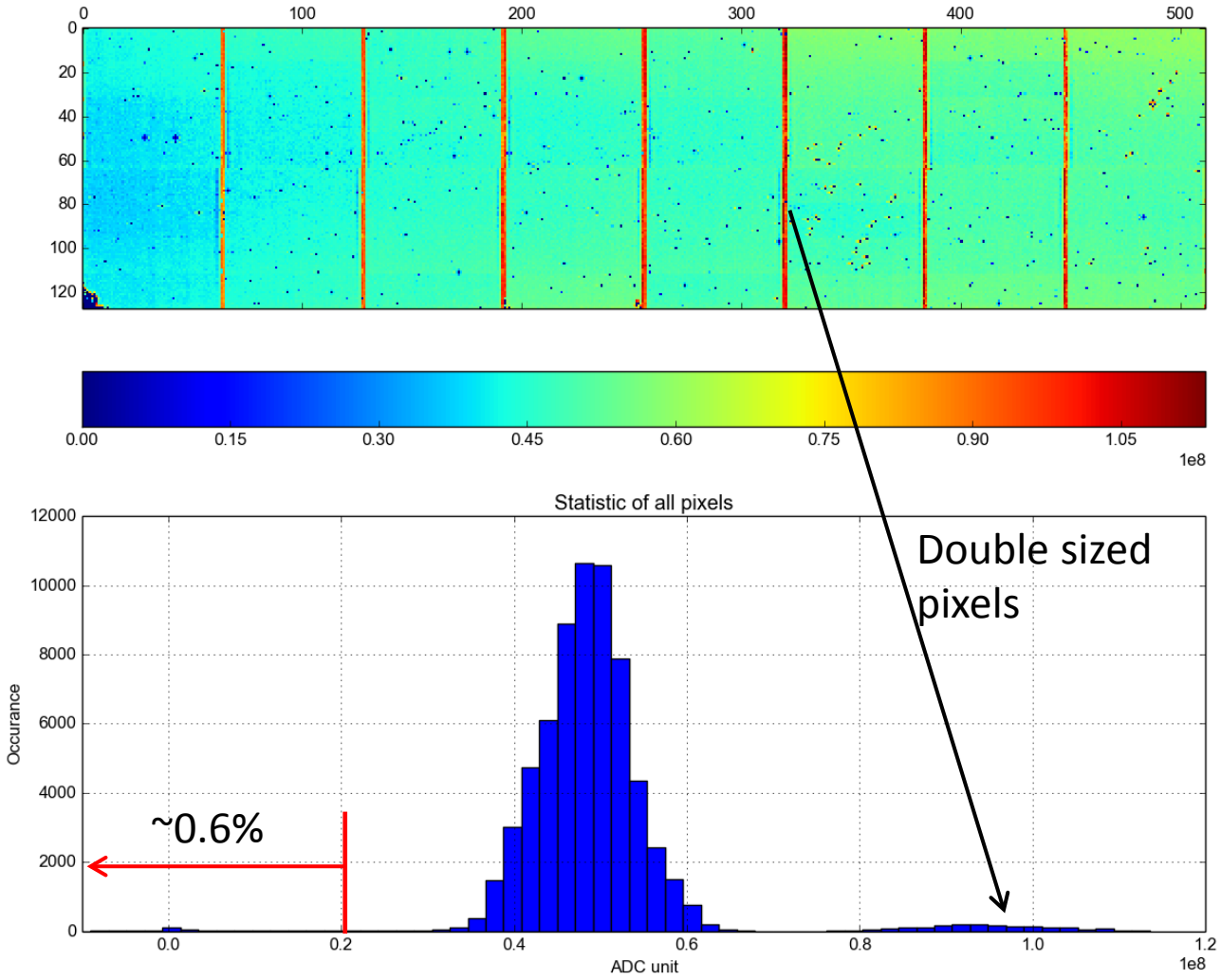
After dark field correction

After gain correction



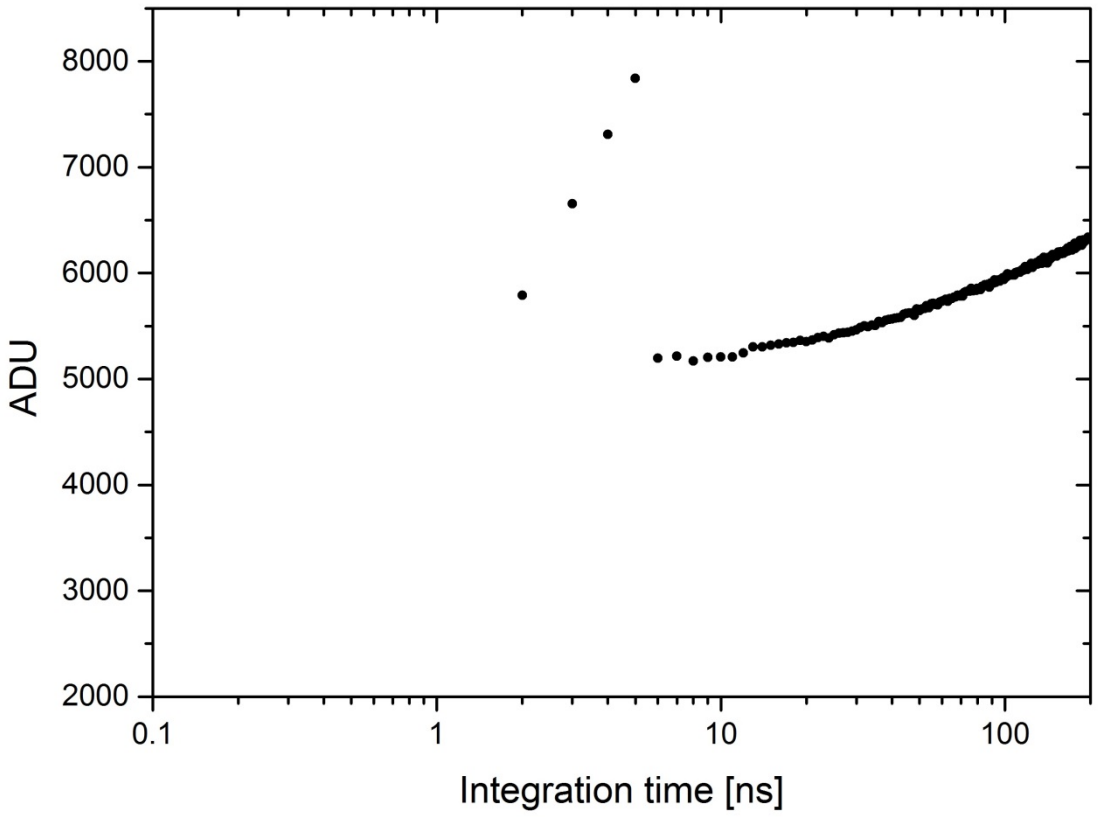
Bad pixel estimation

Sum of 30,000 dark field corrected flat field images (x-ray)



Cross calibration:
Current source/Photons

When scaning the dynamic range with the current injection, only the very end of the high gain region can be reached.



Cross calibration: Current source/Photons

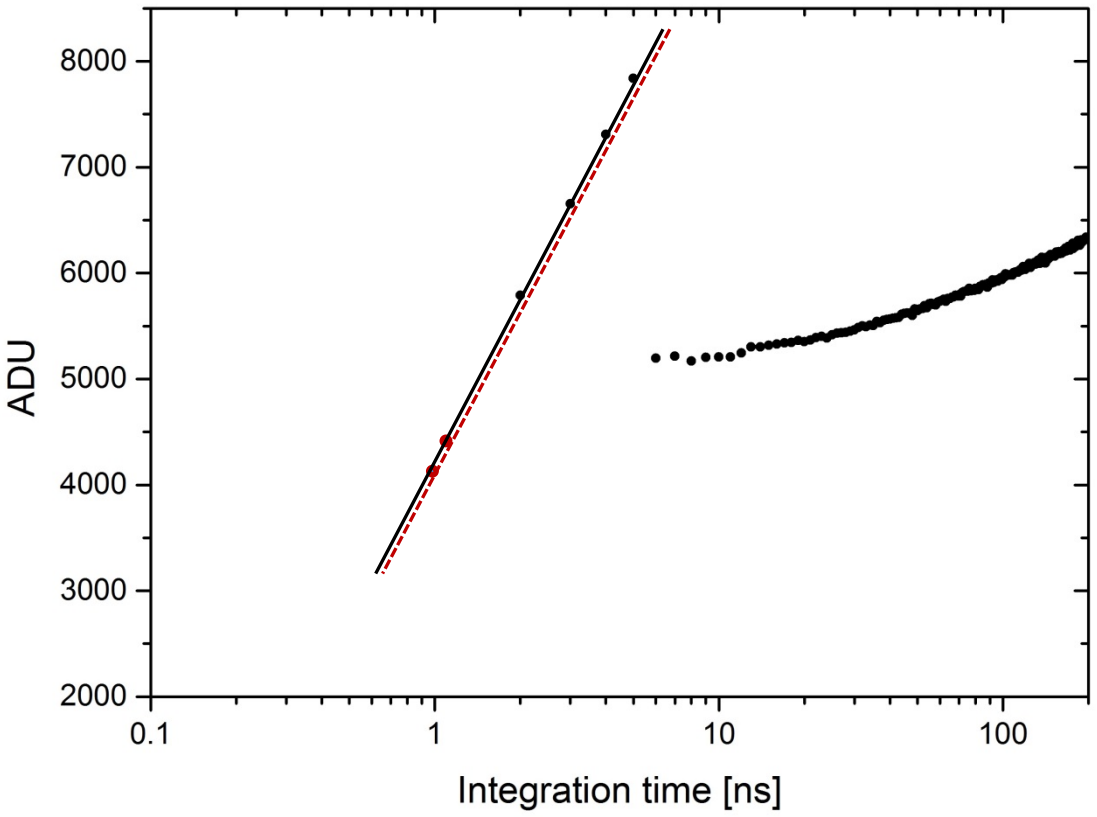
When scaning the dynamic range with the current injection, only the very end of the high gain region can be reached.

On the other hand for photons (Cu fluoresence) one get only values for the beginning of the high gain region.

Cross calibration by „downwards“ extrapolation of current source values.

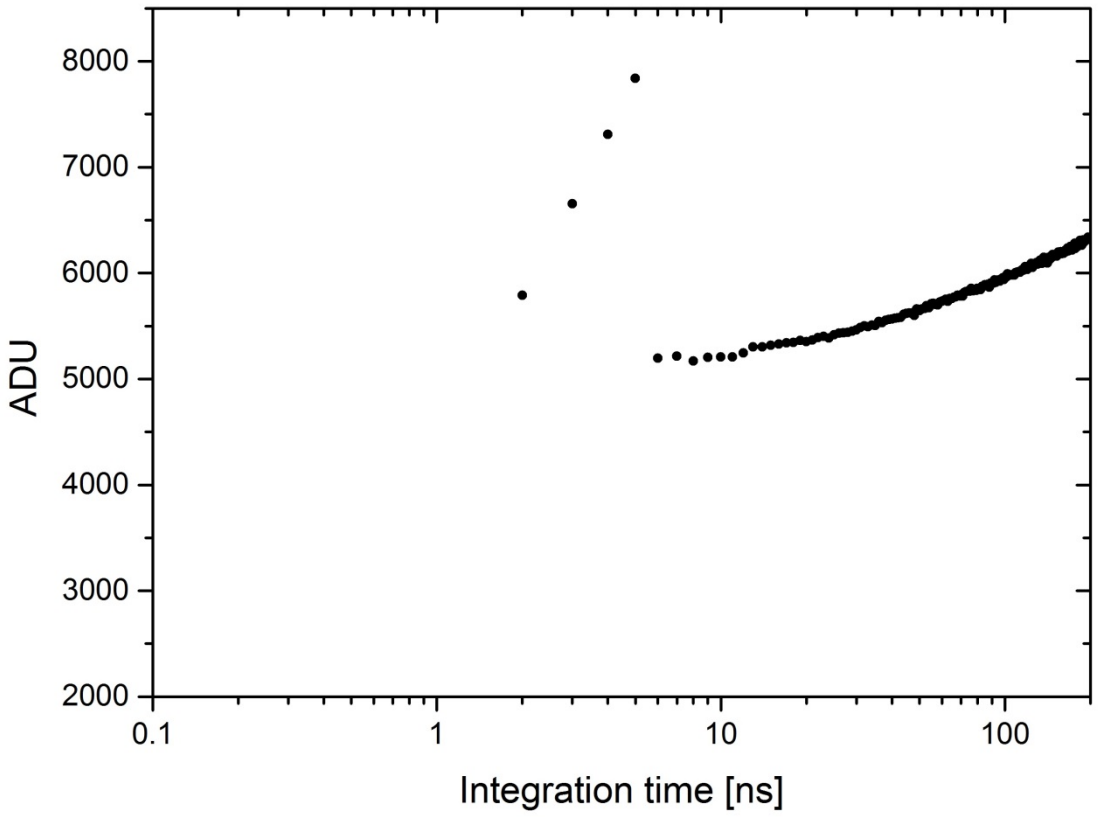
and „upwards“ extrapolation of current source values.

Note: Linear fit in case of linear x-axis



New current source for AGIPD 1.1

Why does the current source of AGIPD 1.0 cover only a few points of the high gain region?



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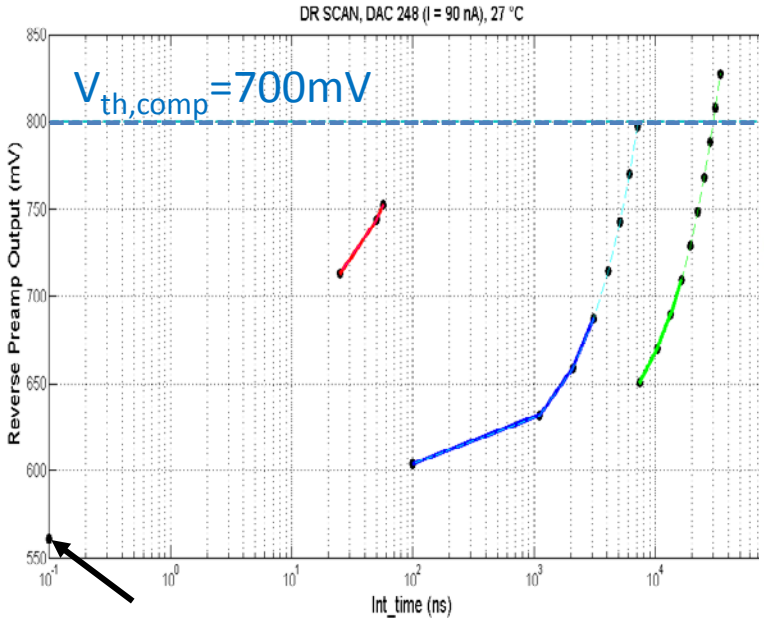

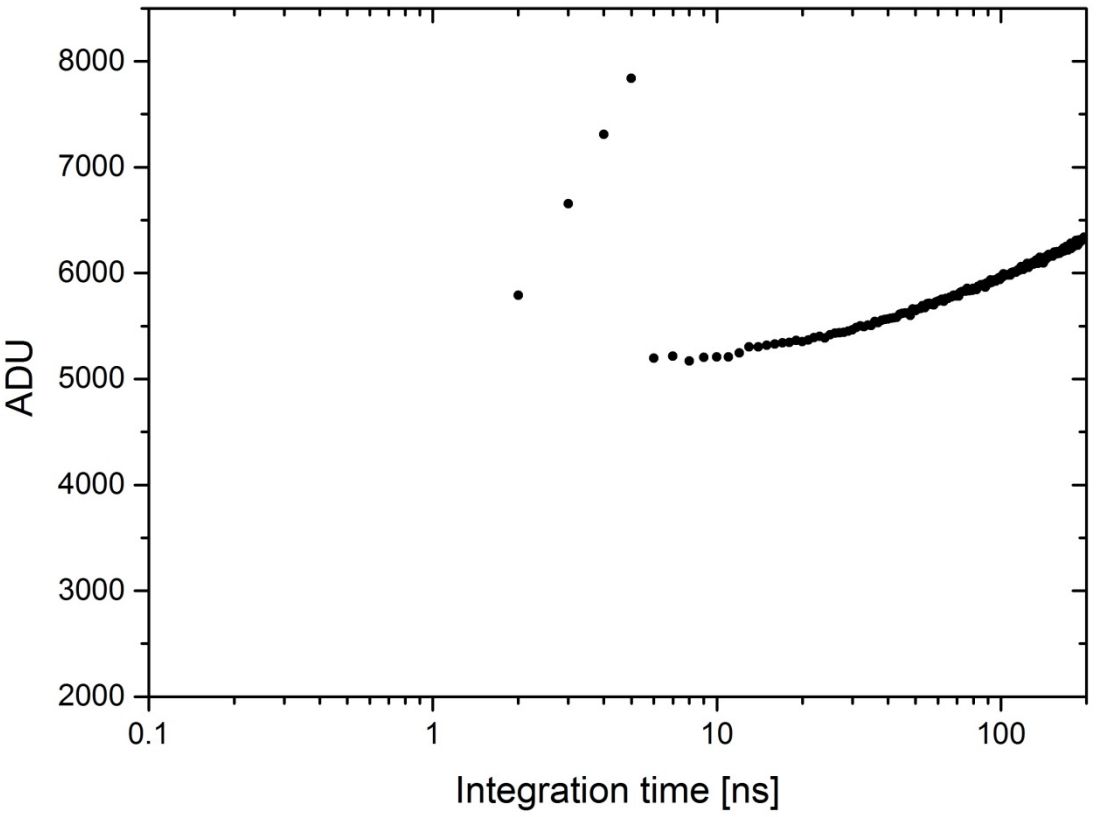

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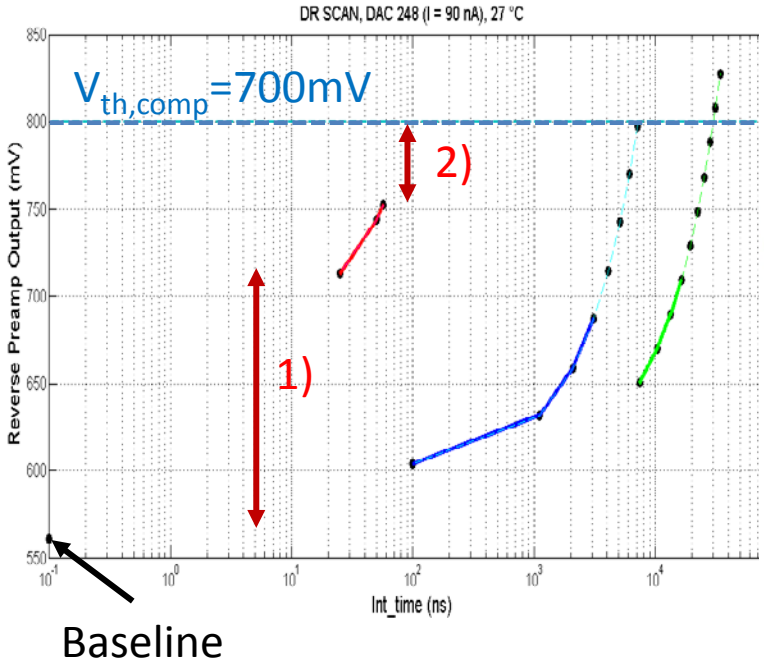

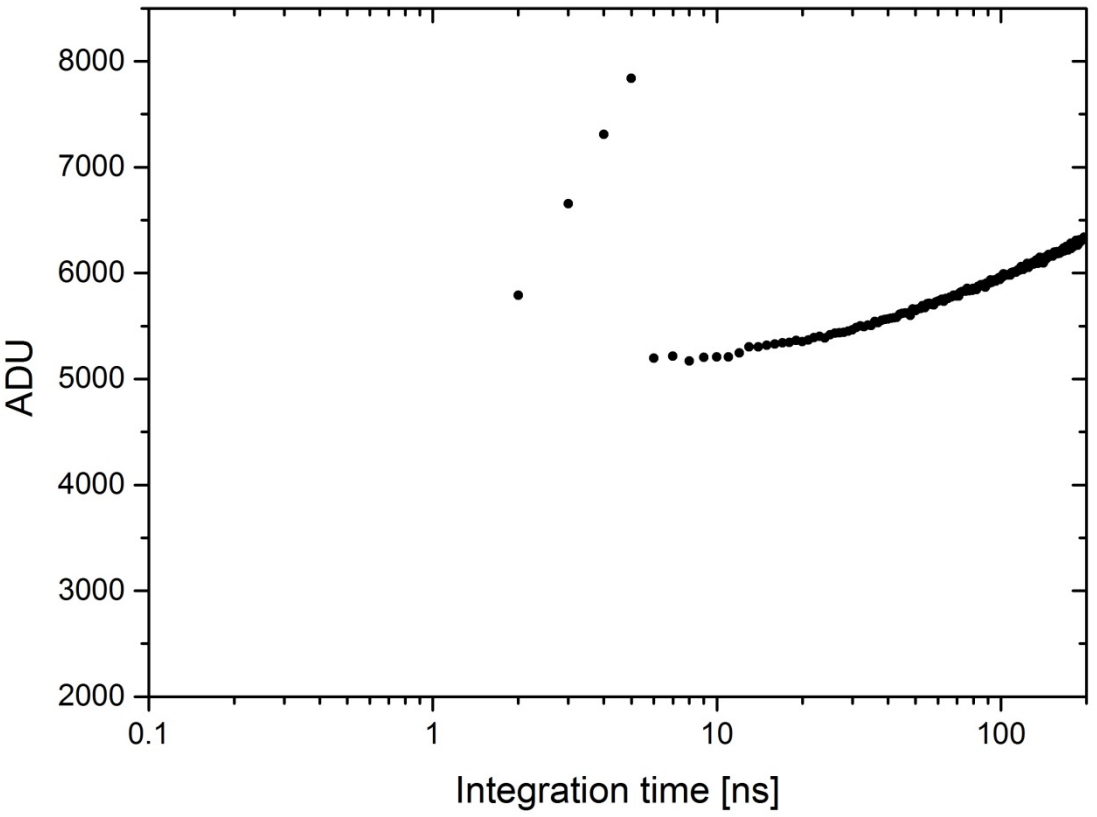

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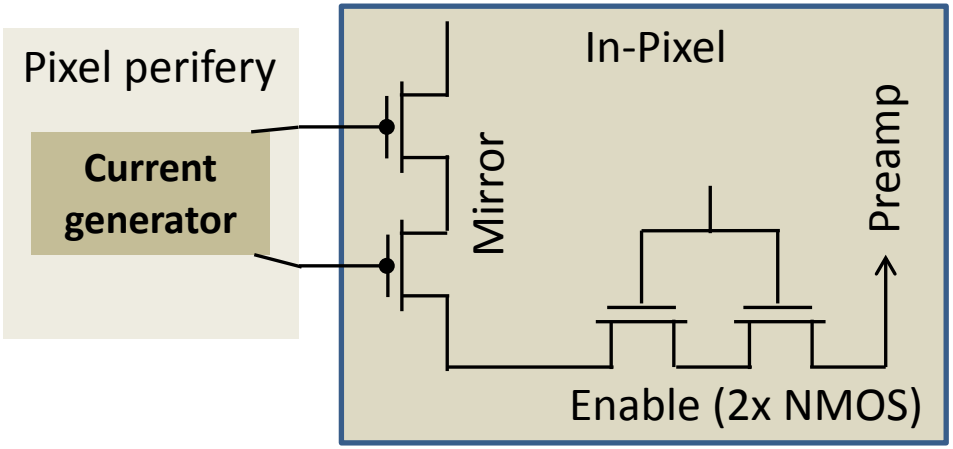

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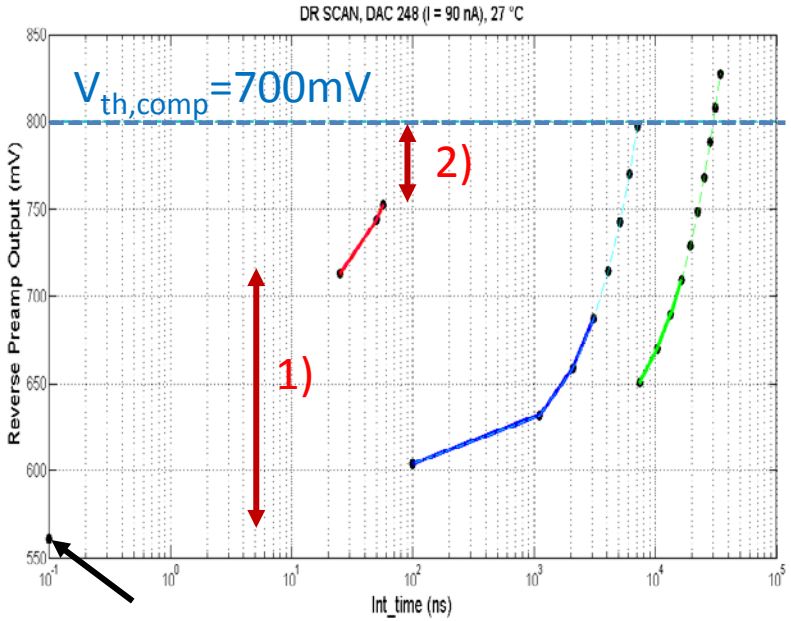


1) During the first 5ns of activation, additional charge proportional to the capacitance of the nodes between the enable transistors and the p-transitor of the mirror.

2) The final level is lower than $V_{th,comp}$ since charge is injected due to switching off „Enable“

Reducing the dimensions of the Enable transistors.

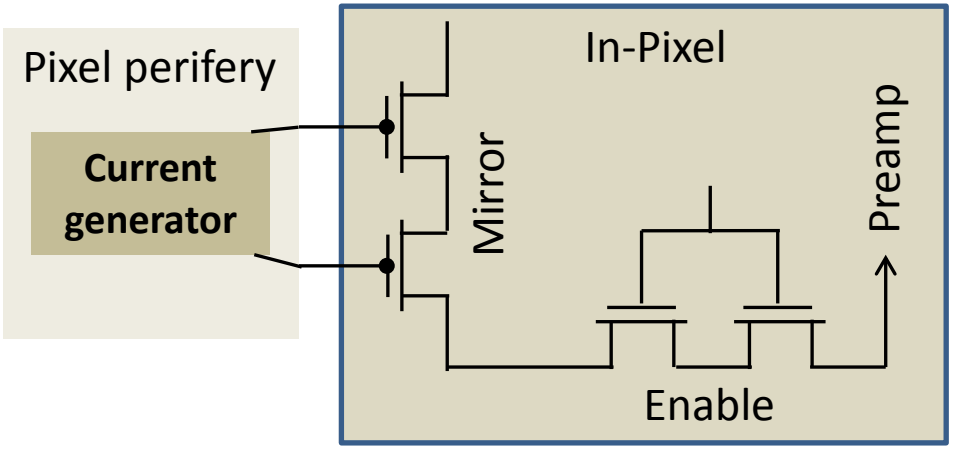
New current source for AGIPD 1.1

Transistors should be as small as possible but still radiation hard.

$W_n\big|_{min} = 800\ nm$

$W_p\big|_{min} = 400\ nm$

} Minimum W to be still Radiation Hard



- Small NMOS could stay in „switch ON“ when demaged.
- Two PMOS not possible due to possible forward bias of the drain junction for big input signal

Solution:
1 PMOS and 1 NMOS (in front of preamp)
+ In-Pixel inverter.

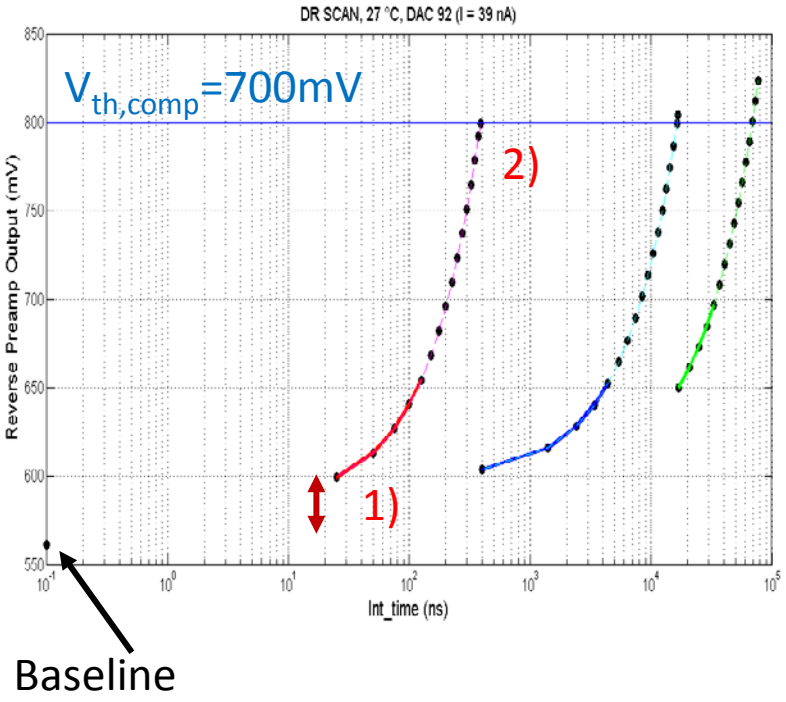
CHANGES:

(W/L) from 3.16um/350nm Enclosed Gate nmos to…

Linear Transistors $(W/L)_n$ =800nm/150nm and $(W/L)_p$ = 400nm/150nm

New current source for AGIPD 1.1

New simulation based on changes:



1) Dynamic Range loss in the high gain regime reduced.

2) Threshold of the comparator reached in the high gain.

For AGIPD 1.1 the entire dynamic range can be reached with the current source.

Better overlap with external sources.

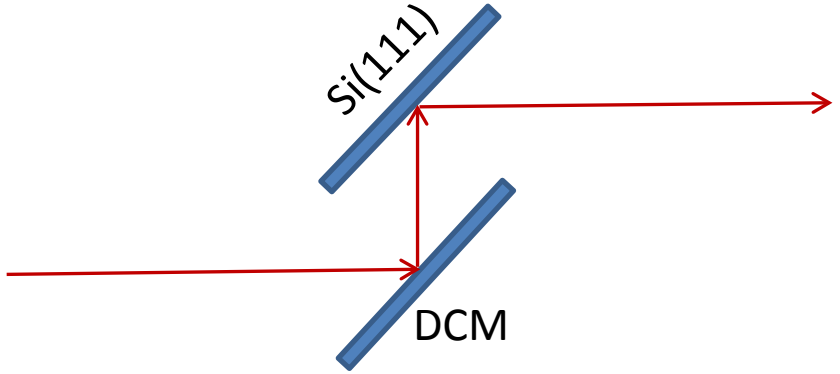
CHANGES:

(W/L) from 3.16um/350nm Enclosed Gate nmos to…

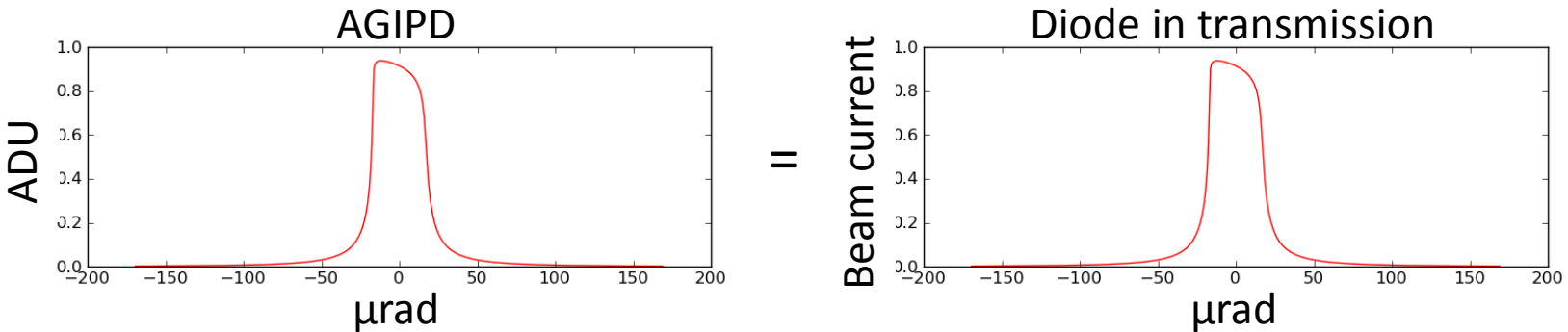
Linear Transistors $(W/L)_n$ =800nm/150nm and $(W/L)_p$ = 400nm/150nm

Cross check with synchrotron radiation: An experiment

- Beam (10^{13} Photons/s) focused into one Pixel
- DCM of beam line usually parallel to each other to maximize intensity.
- By scanning the detuning angle of the 2nd Mono, the intensity can be varied.
- Plotting the intensity measured by AGIPD should exhibit the rocking curve.

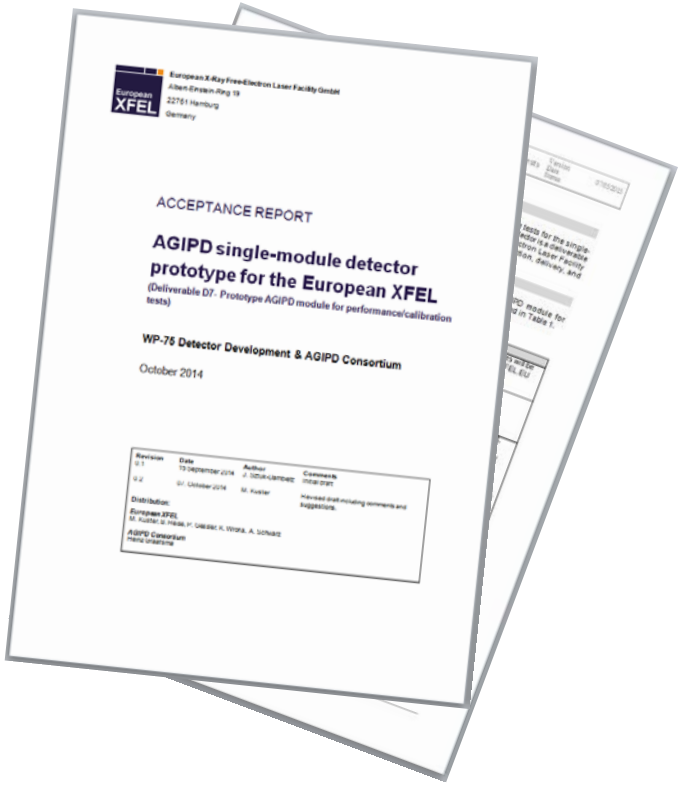


„Imaging“ of the darwin width



Calibration plan

Based on the acceptance report received from the European XFEL…



…a document about calibration plan is in preperation…

First steps of the calibration plan: Time estimation

Set of scans needed for calibration and characterization of one single module:

Scan	Number of files	Time needed for DAQ	Purpose
Gain bit calibration	7.0 million	1.5h	To know when gain switching happens
Gain map	70 million	20h	Gain map
Dark field	704,000	0.25h	Mem cell dependent base line/noise
Droop scan	5.0 million	1.5h	Mem cell dependent droop behaviour
Total	**82.7 million**	**~ 24h**	

Data aquisition with 10GE connection takes ~24h per module (1M system = 16 days)

10GE link is currently being integrated into the system and will be ready by end of June!!
With the 1GE link used at the moment the DAQ takes 5 days per module.

First steps of the calibration plan: Beam time Schedule

Where?	When?	days	What?	Why?
PETRAIII/P11	5.4.-6.4.15	2	Irradiation of single chips at different doses.	Radiation hardness
PETRAIII/P11	Regularly from 15.4.15		Permanent setup at P11 starting from 20.4.2015	
PETRAIII/P01	16.6.-21.6.15	5	Diffuse scattering during XAS and XES experiments.	Dynamic range Pilatus is used in parallel
PETRAIII/P03	n.A.	1	GISAXS during sputter deposition of Au Nanoparticles	Radiation hardness, dynamic range
PETRAIII/P01	13.8.-23.8.15	10	Diffuse scattering during XAS and XES experiments.	Dynamic range Pilatus is used in parallel
APS/1-BM	7.10.-12.10.15	5	Detector characterization & calibration.	Detector tests/large BM beam
APS/32-ID	14.10.-19.10.15	5	Simultaneous x-ray diffraction and phase-contrast during material deformation.	6.5MHz dynamic imaging
XFEL/Big Amber	November	n.A.	Big Amber for test of full 1M system	Read out synchronization, etc.

Note: Almost all calibration measurements will be done in FS-DS labs.

Summary

- Calibration infrastructure under construction and almost finished.
  - Time for calibration could be reduced from 16 days to 2 days.
  - Regular access to PETRA III beam line for detector studies granted.
  - Tests with first module are very promising (Pendrive, Dead pixels…)

- ASIC Resubmission: AGIPD 1.1
  - Optimization of „Enable“ Transisitors will allow the current source to access the high gain region. This will make the cross calibration to Photons much easier.
  - For AGIPD 1.0 additional extrapolation is needed for calibration.

Questions?