Update on Quality Measurements in Erlangen

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ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS
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Quality assurance measurements

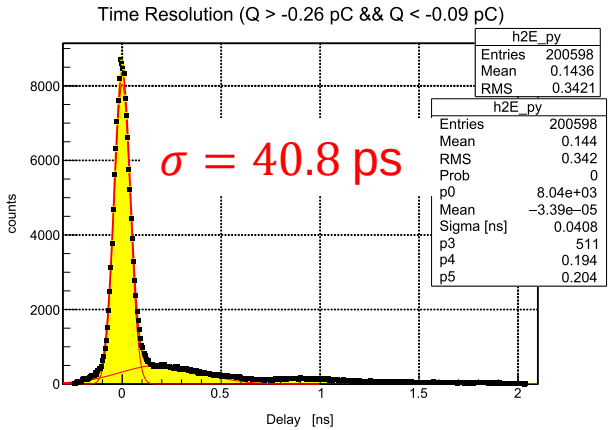
- QE:
  - Wavelength dependent
  - Position dependent
- Gain:
  - Voltage dependent
  - Position dependent
- TRB:
  - Afterpulsing
  - Dark counts
  - General pulse performance
- Time resolution (3 sensors)

Overview GSI sensors

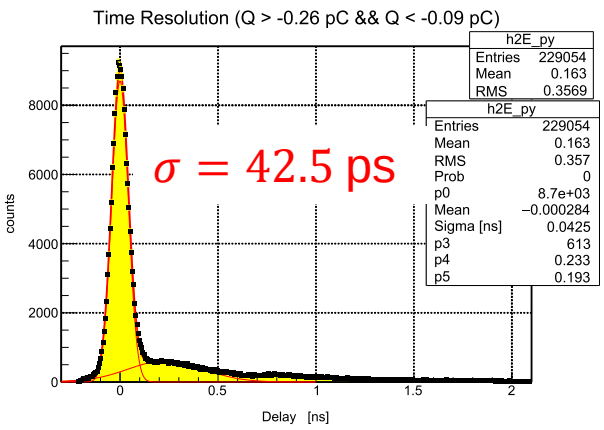
ID	QE-Scan	Gain-Scan	Gain 1E06	TRB Thres. offset	Darkcount [Hz]	Afterpulsing [%]	QE-Mess	Comments
9000411	Good	Good (noisy)	2420V	500	1x 12k, 90% ca 100	10	N/A	Maybe
9000412	Good	Good (noisy)	2300V	500	1x 14k 90% 20-200	6 +-4	6	Maybe
9000765	Good	Good (noisy)	2560V	500	1x 7k, 80% 100-200	28-50	13	No
9000766	Good	Bad	2560V	500	1x 400k, 90% 1-4k	30	5	No
9001336	Good	Good	1960V	500	1x 1k, 90% < 20	1,5-6	12	Yes
9001338	Good	Good	1710V	500	2x 5k, 80% <30	0,2-1	7	Yes
9001339	Good	Bad	1730V	2000	1x 9k, 80% <100	3-5	9	No
9001352	Good	Good	1720V	500	<300	2-4	11	Yes
9001353	Poor	Good	1720V	500	1x 350, 90% <50	0,3-0,7	14	Maybe
9001355	Good	Good	1700V	100	20-300	90% <1	4	Yes
9001356	Good	Good	1760V	500	1x 450, 80% <150	1-2	3	Yes
9001357	Good	Poor	1760V	200	2x12k, 80% <400	1-1,5	2	Yes
9001358	Poor	Horrific	1680V	500	1x 40k, 90% <100	1-1,5	15	Maybe
9001359	Good	Good	1730V	500	<600, 80% < 50	2-3	10	Yes
9001360	Poor	Good	1680V	500, 1825V	1x 600, 90% < 50	2	8	Maybe
9001392	Good	Horrific	1750V	500, 1850V, GSI	1x 140k, 90% <2k	< 0,7	1	Maybe
9001392	-	-	-	500, 1850V, ER	1x 130k, 90% <2k	< 0,5	-	-

Time resolution of GSI sensors

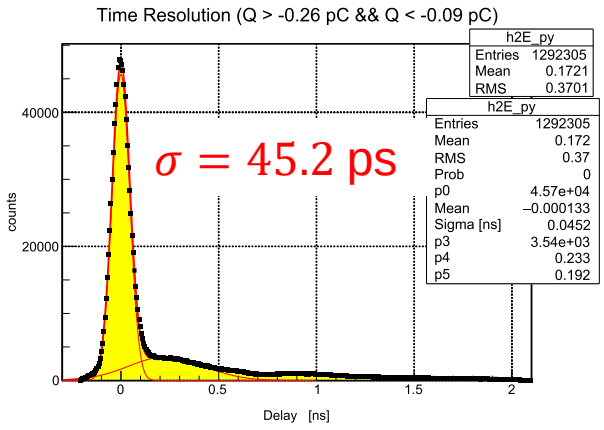
9001353



9001356

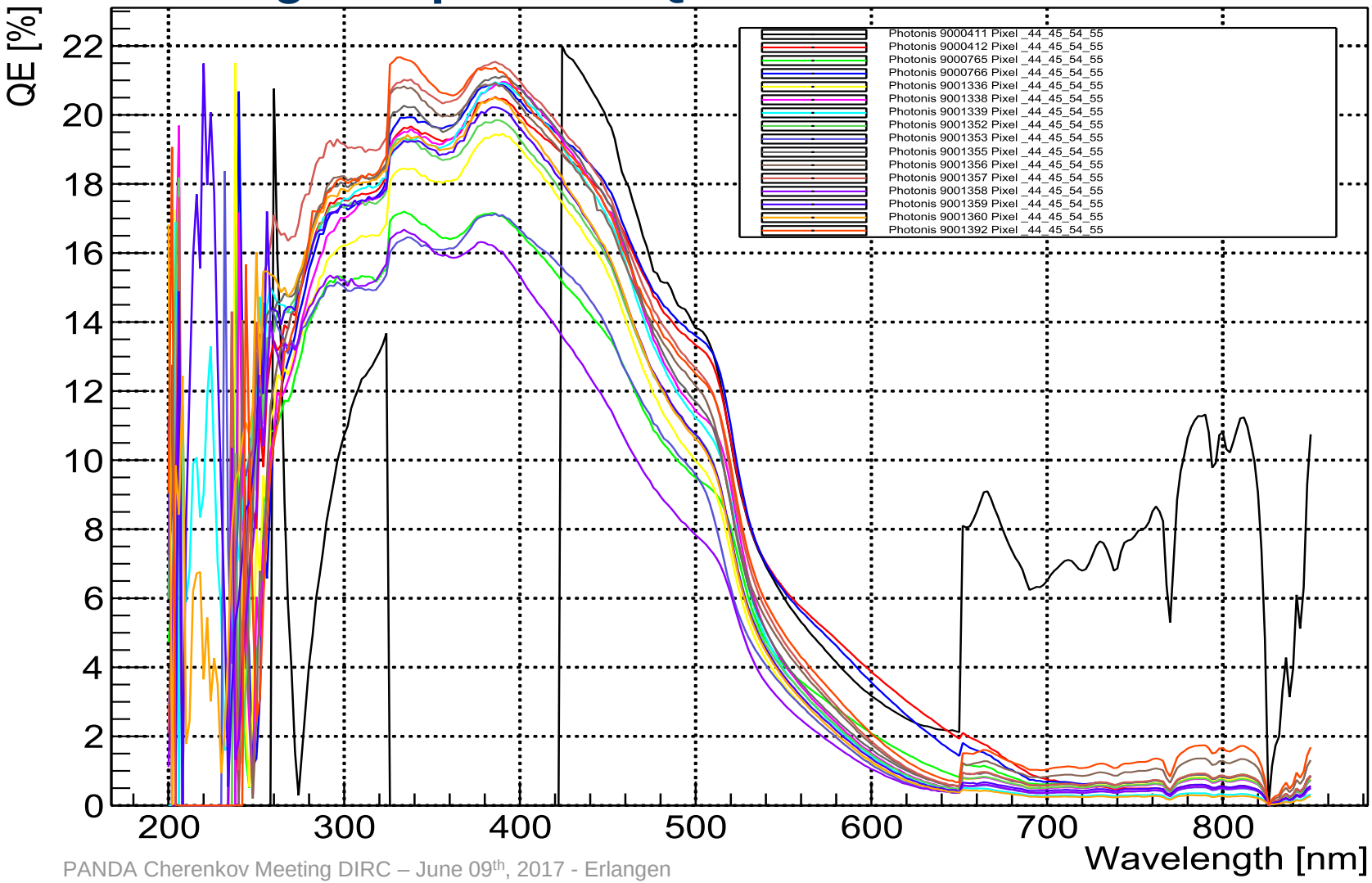


9001392



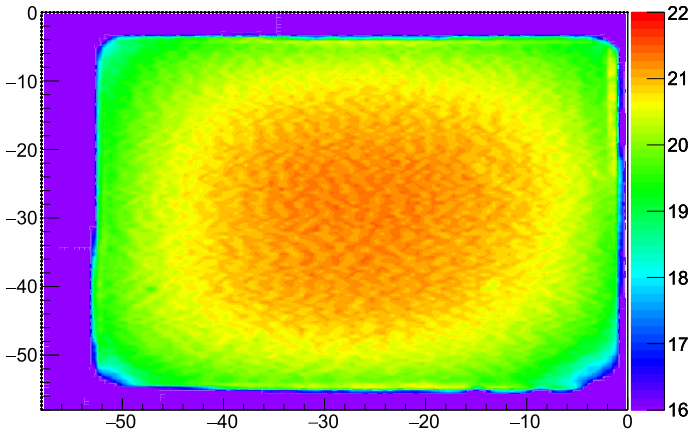
- Measured with scope, 200x Ortec fast amp and threshold of 50 mV
- Measurements are time walk corrected
- All time resolutions well below 50 ps

Wavelength dependent QE of GSI sensors

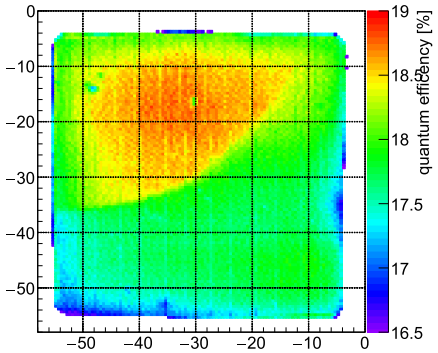


QE scans of GSI sensors

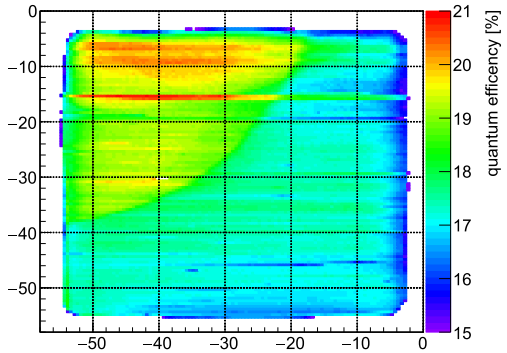
9001338



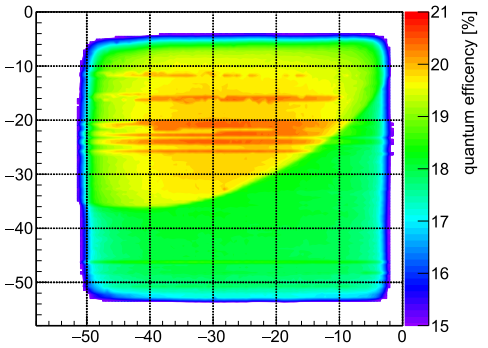
9001353



9001358



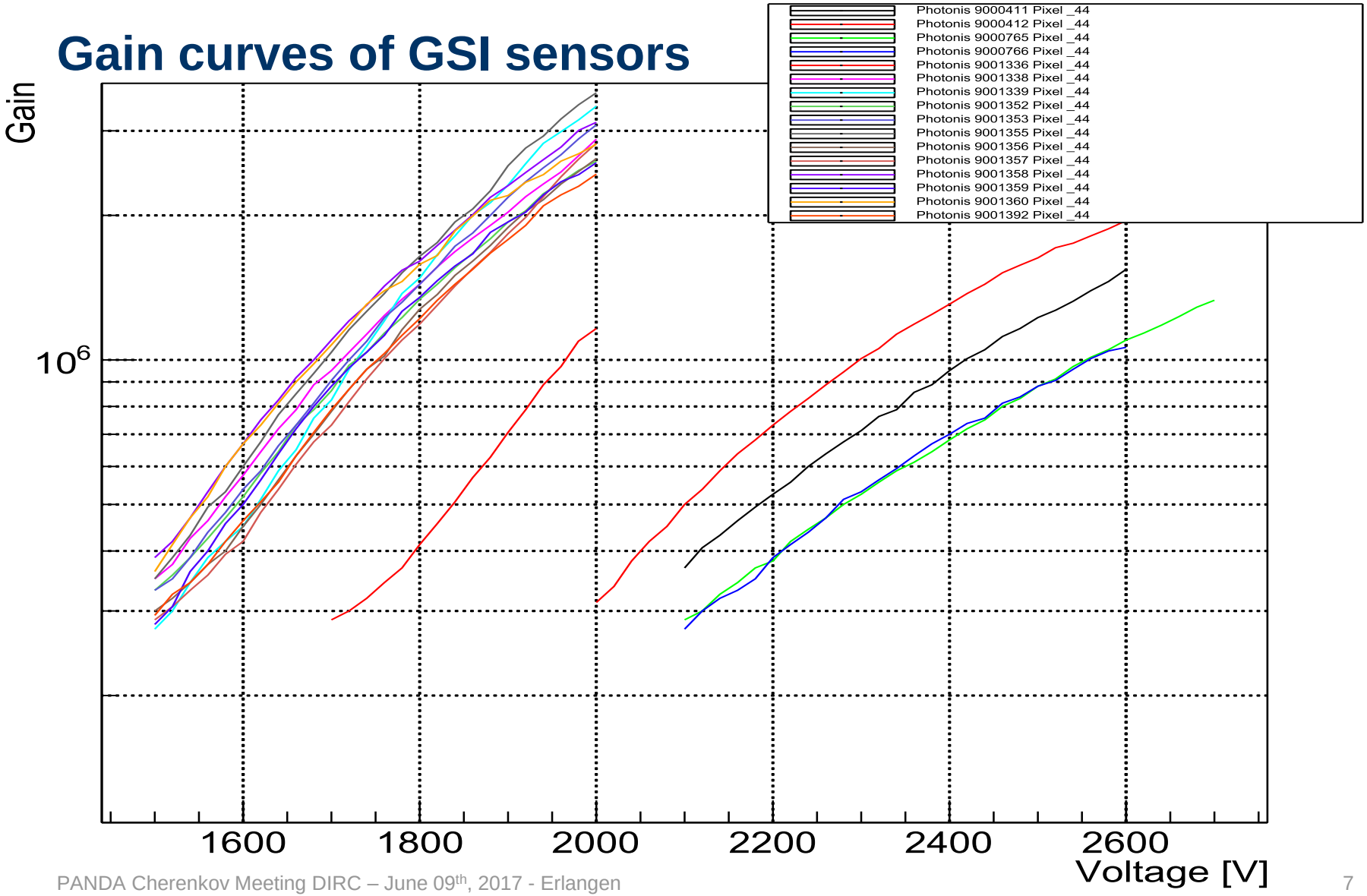
9001360



- Most sensors tend to have higher QE in the middle
- Some QE-scans are a bit noisy

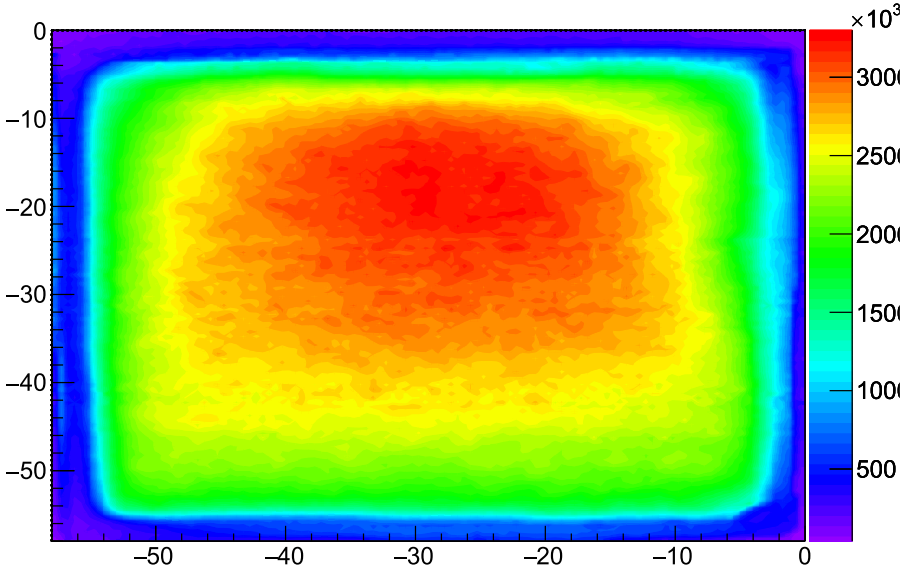
- Overall lower QE
- Bad homogeneity across surface
- One with very high dark current (9000411)

Gain curves of GSI sensors



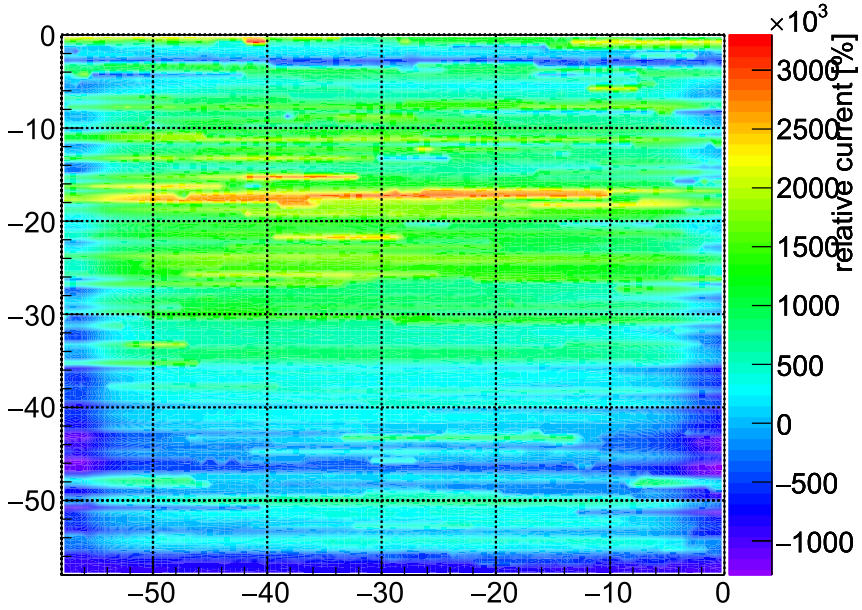
Gain scans of GSI sensors

9001338



- Current of shortened anodes
- Gain scan folded with QE
- Example for a good looking scan

9001358



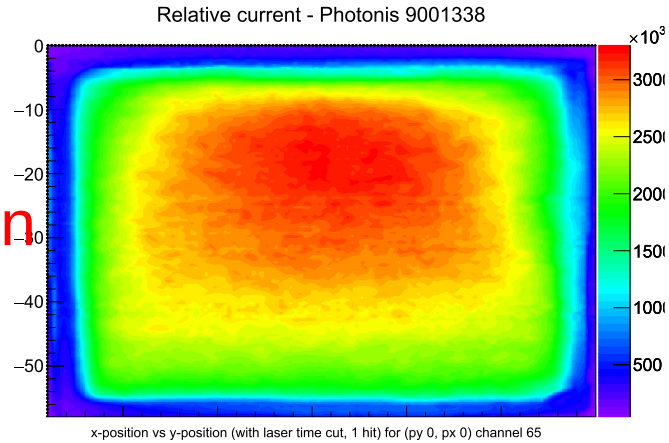
- Scan failed because of high and unstable dark current
- All failed scans tend to have same behavior

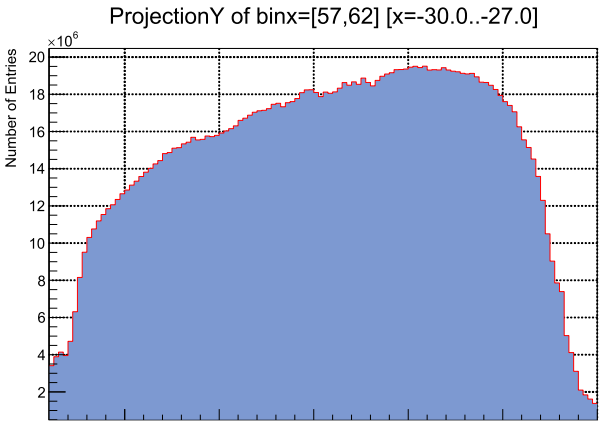
Comparison of Gain and TRB scan (9001338)

Whole scan

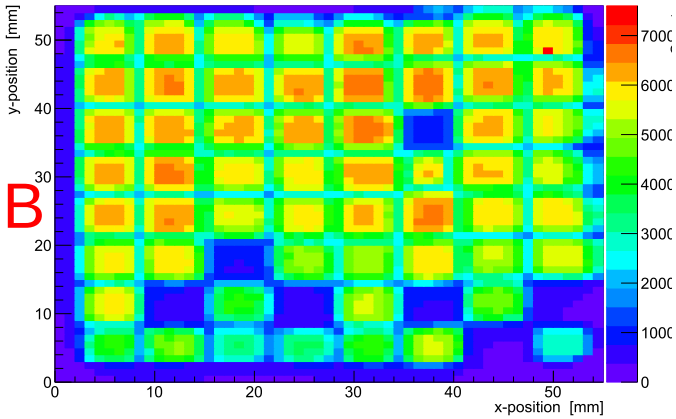
Projection y (middle)

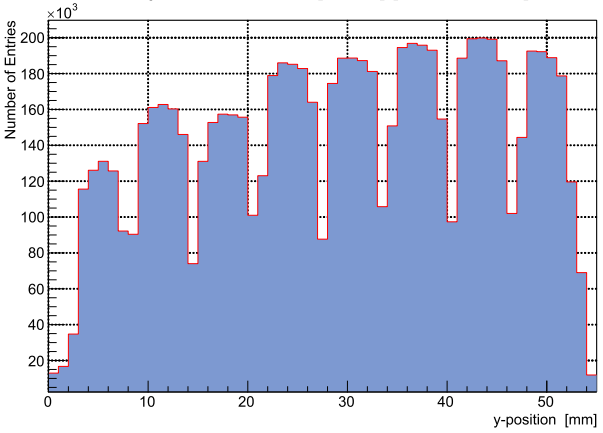
Gain





TRB





- TRB measures counts over certain threshold
- TRB scans also folded with QE
- Pixel structure visible because of cut on one hit per Trigger
- Some dead channels
- Comparable surface information

TRB scans of GSI sensors

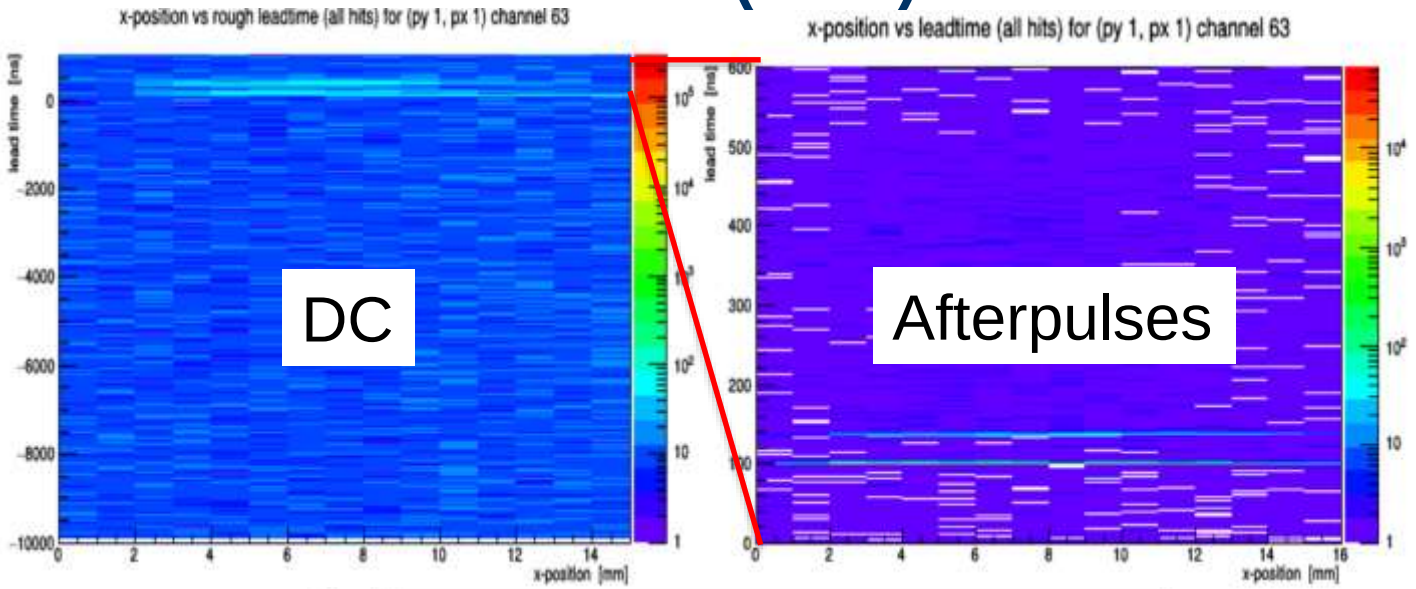
- Using Voltage of 10^6 Gain
- Setting lowest possible threshold
  - High thresholds indicate noise problems
- Trigger window -10 µs to 1 µs around the lasertrigger
- Events from -10 µs to 0 µs are Darkcounts
- Main peak shifted to 100 ns
- Events from 115 ns to 999 ns (with subtracted Darkcounts in this area) are Afterpulsing

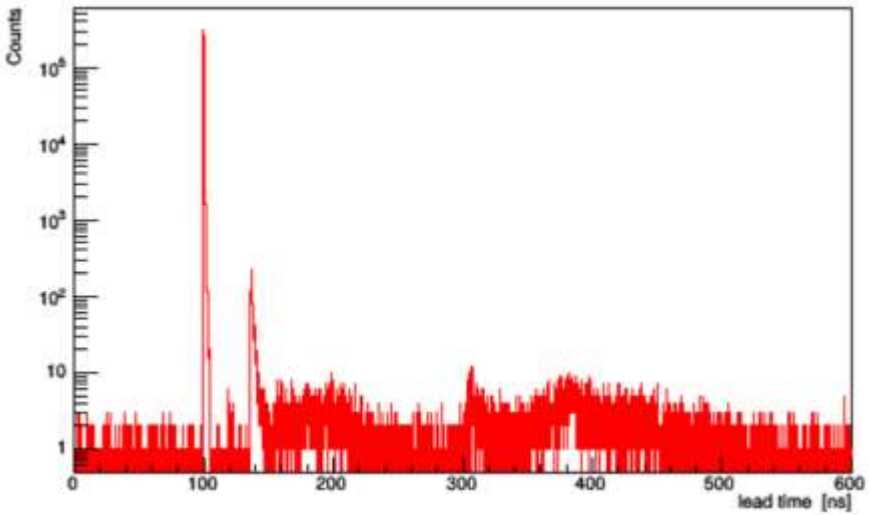
- Measuring in 1 mm steps on 54x54 mm^2 active area, collecting 100k events with 10 kHz laser rate -> 55x55x11s/3600s/h -> ~10 h per Sensor

TRB scans of GSI sensors

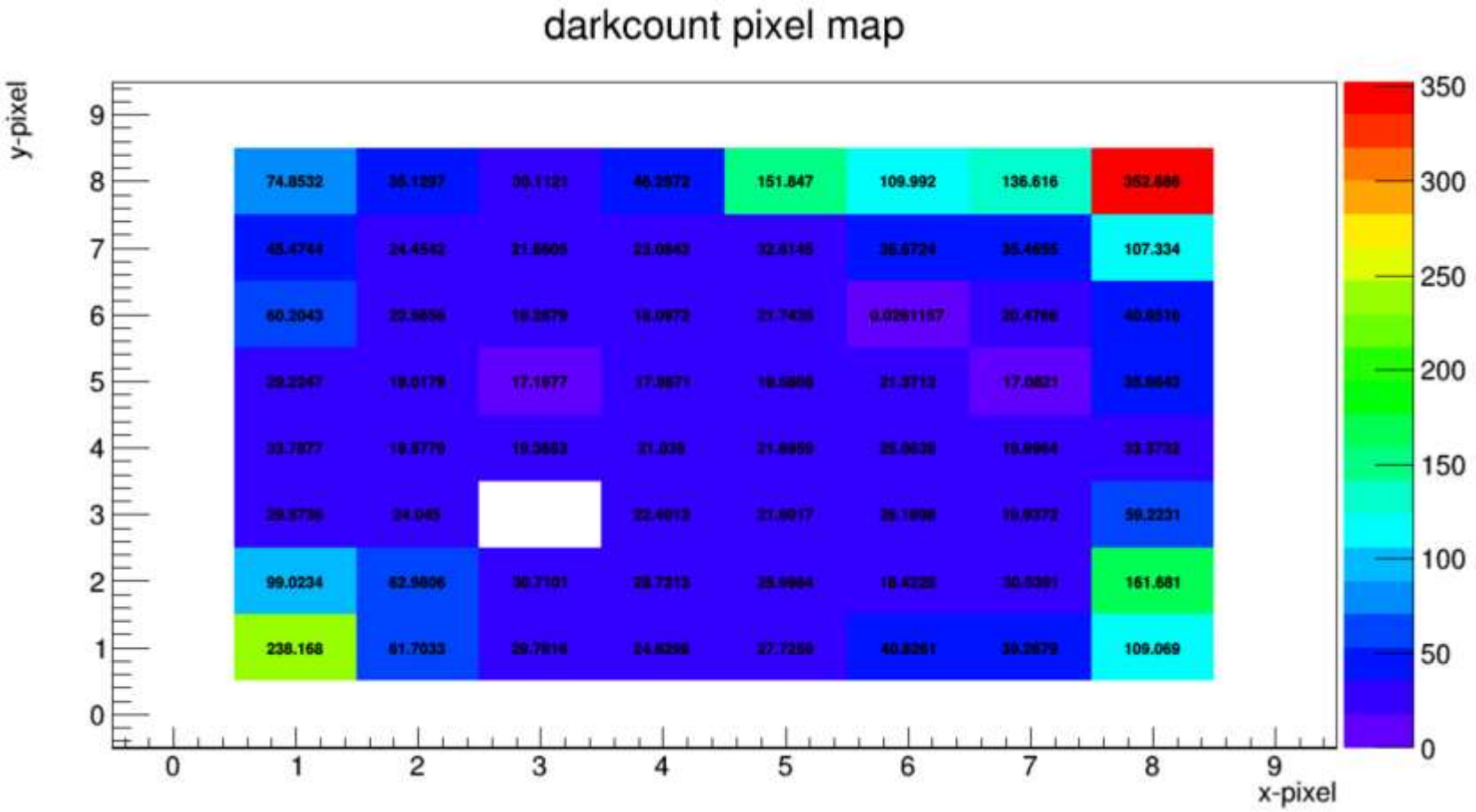
- Analysis software still under development
- Processing and calibrating events online and produce directly root files with Go4/Stream framework
- Problems when high dark count rate (>100 kHz) online calibration and writing ROOT files cant keep up
  - need to write hld files
  - more disk space needed (5-10x)

TRB scans of GSI sensors (1353)

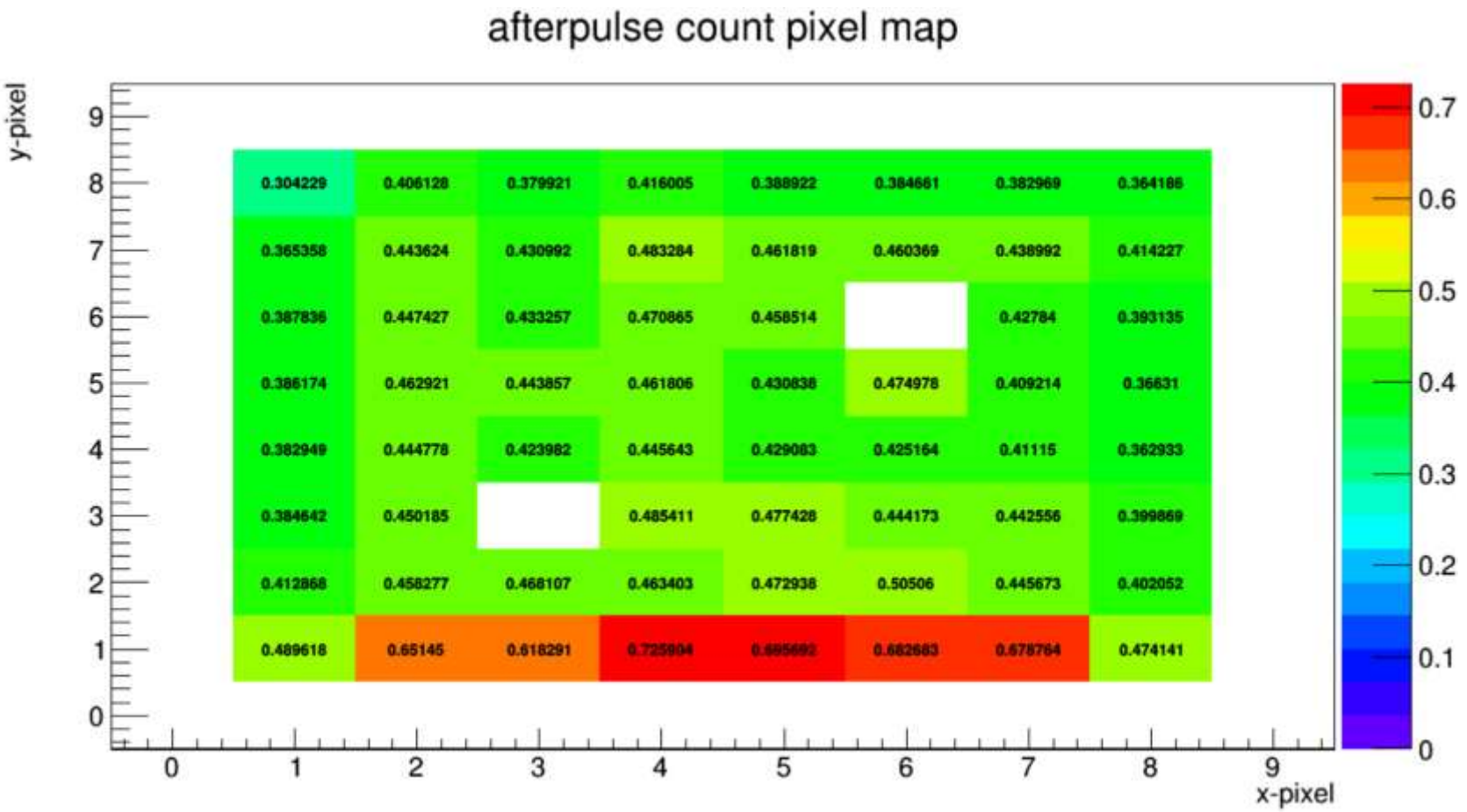




Dark counts of GSI sensors (1353)



After pulses of GSI sensors (1353)



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Thank you for your attention!

ERLANGEN CENTRE FOR ASTROPARTICLE PHYSICS

GEFORDERT VOM

Bundesministerium für Bildung und Forschung

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