First look at the test-beam data of the ALICE investigator chip
- Results still very preliminary -

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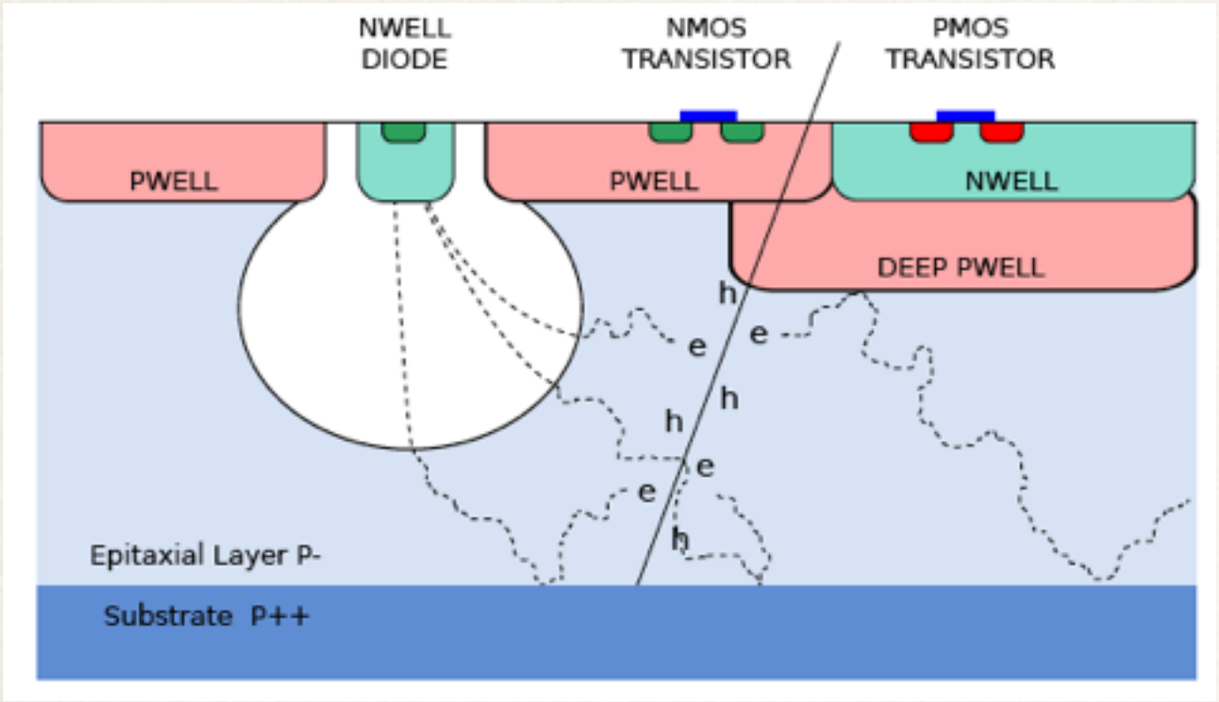
Introduction

Introduction



Investigator has been successfully integrated in the Timepix3-Telescope

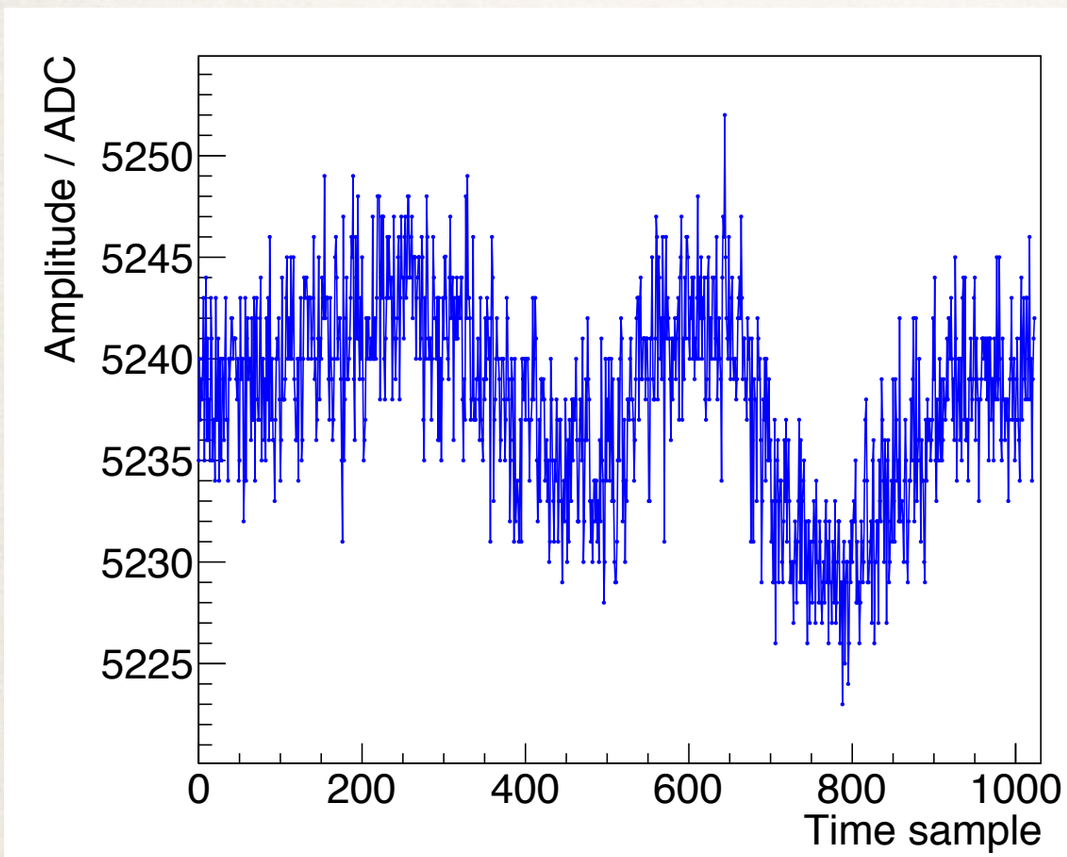
(https://indico.cern.ch/event/508332/contributions/2151098/attachments/1266140/1874329/investigator_munker_first_look.pdf)

- Investigator chip, TowerJazz technology
- 18 μm thick epi layer
- 134 matrices with different pitch (20 μm - 50 μm), implant width and spacing between collection diode and p-ring
- 64 ADC channels on readout board to measure amplitude
- Time sampling with 65 MHz clock

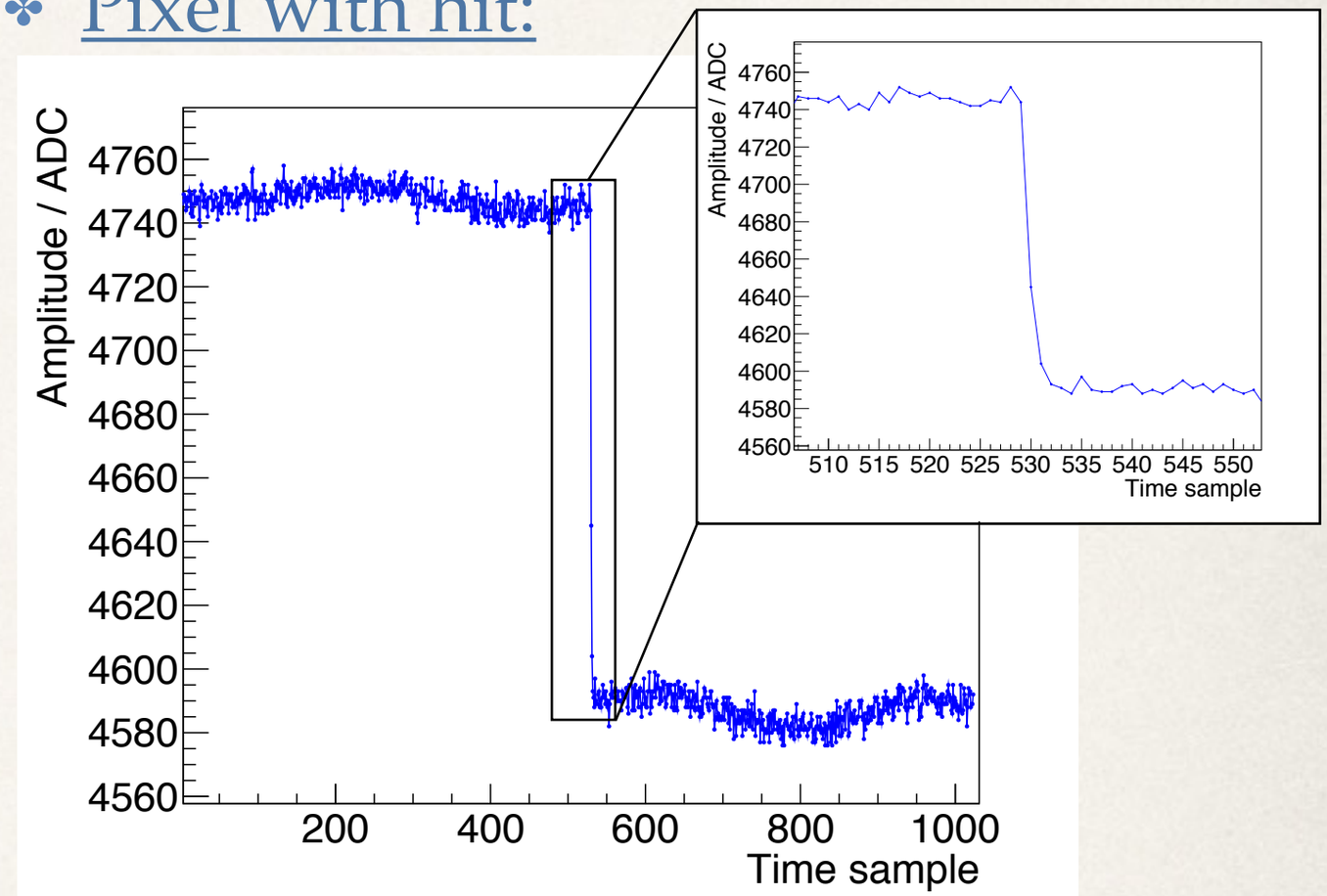
First approach for the analysis

Event display

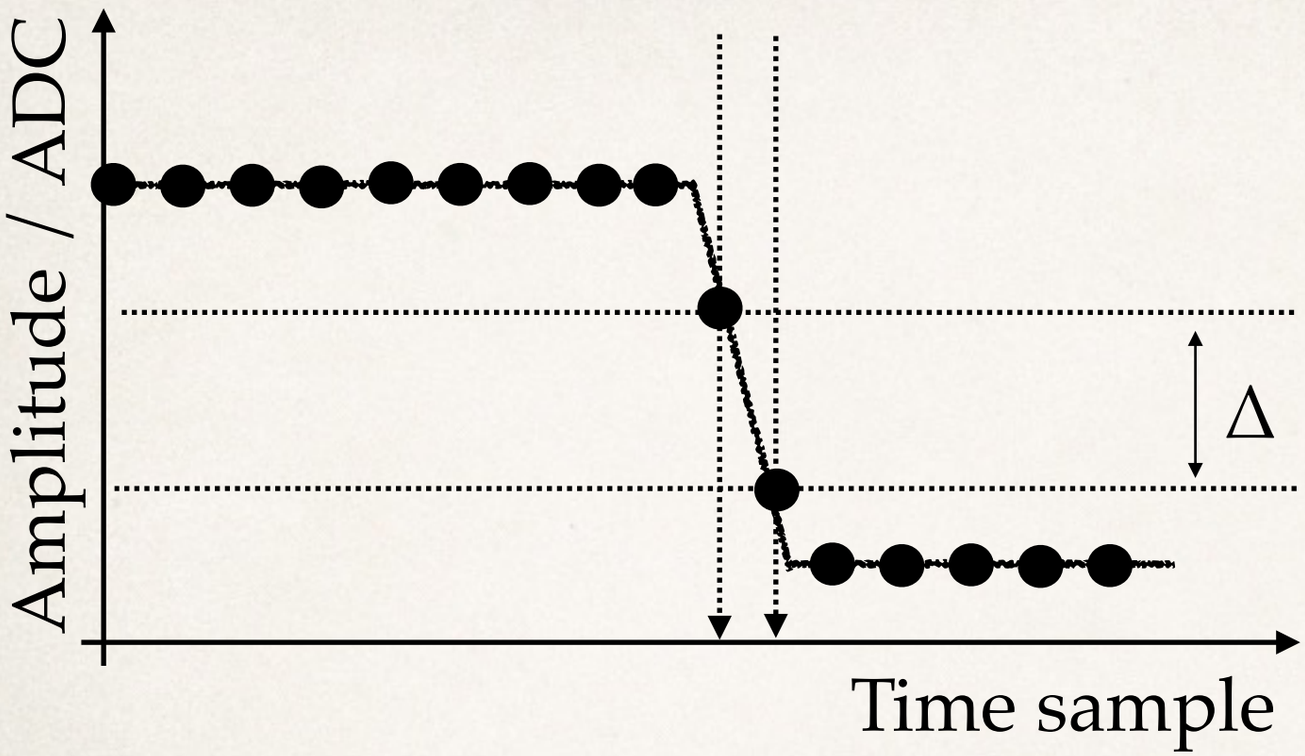
- Pixel with no hit:



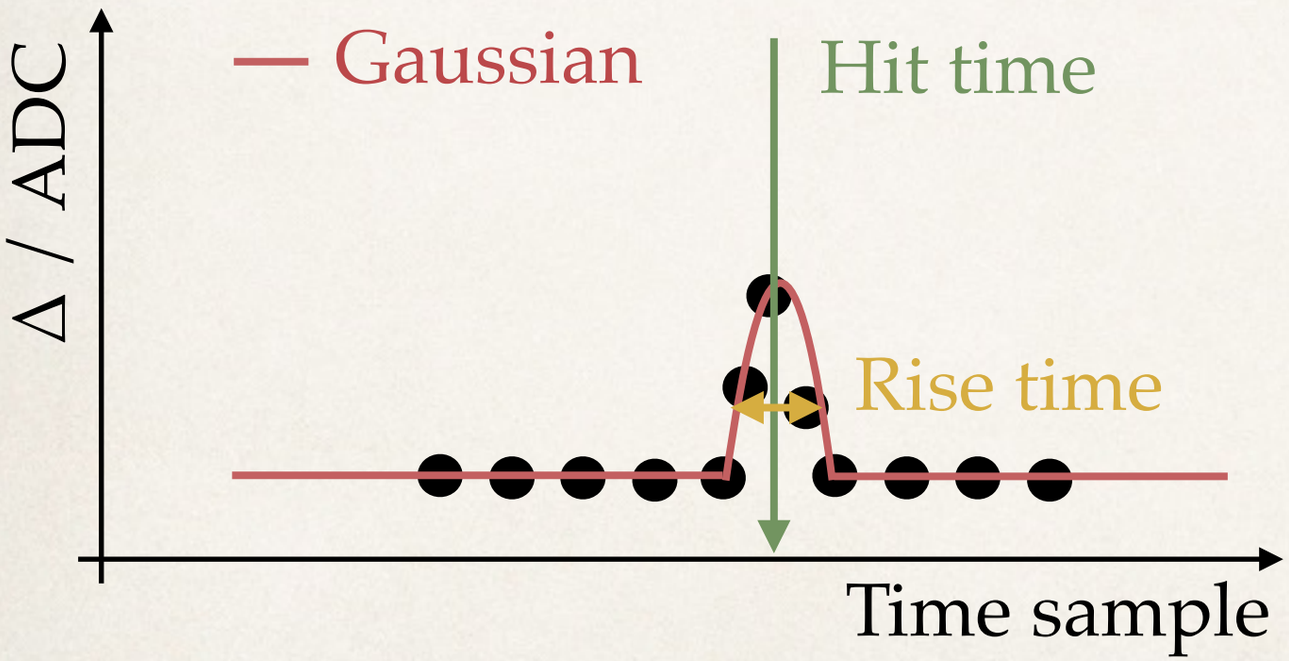
- Pixel with hit:



Observables for timing analysis

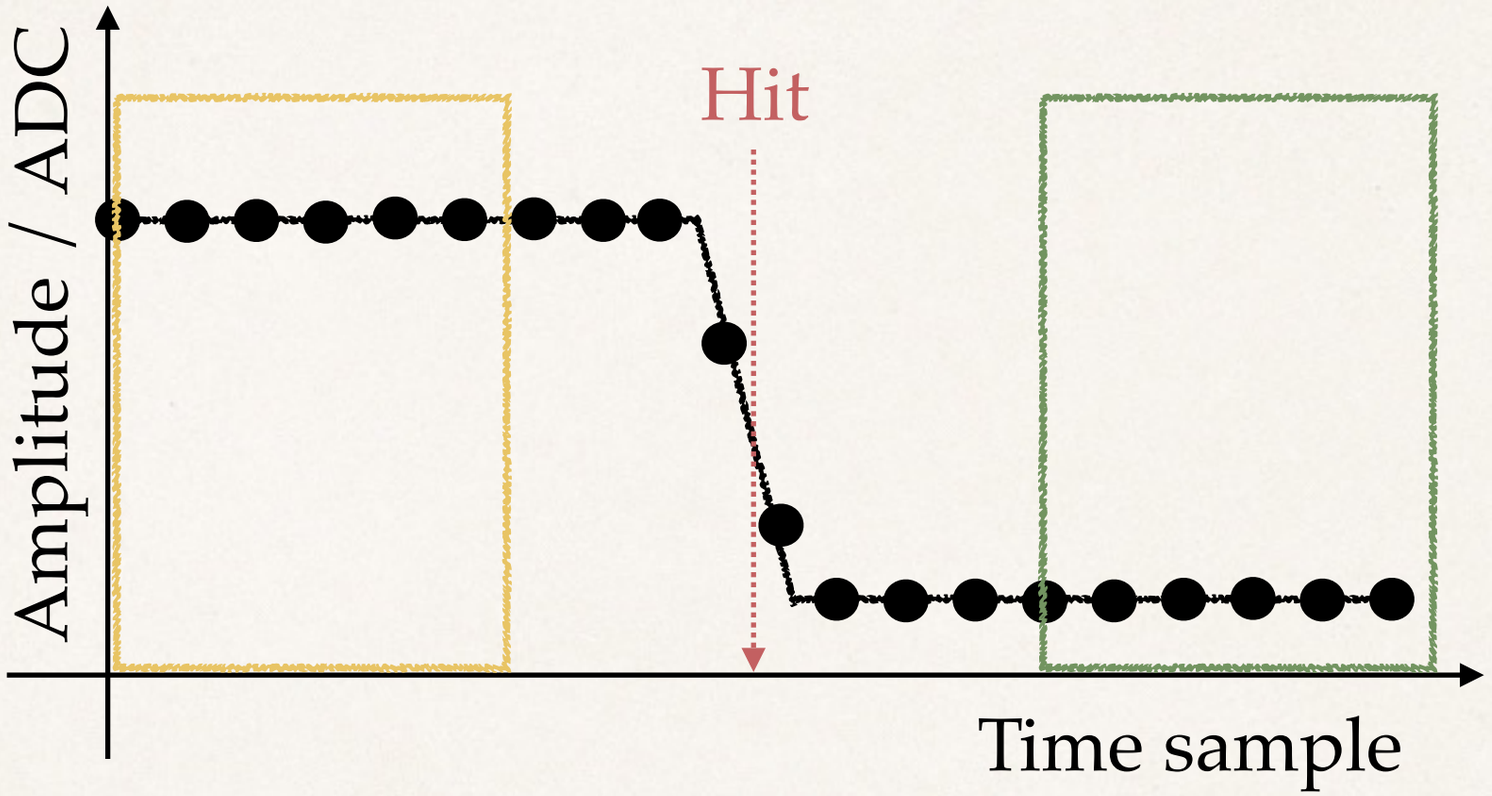


- Loop through time samples
- Calculate difference in amplitude Δ to previous time sample
- Plot Δ for each time sample



- Fit Gaussian to distribution
- Define Hit time as the mean of the Gaussian
- Define Rise time as the with of the Gaussian

Signal definition

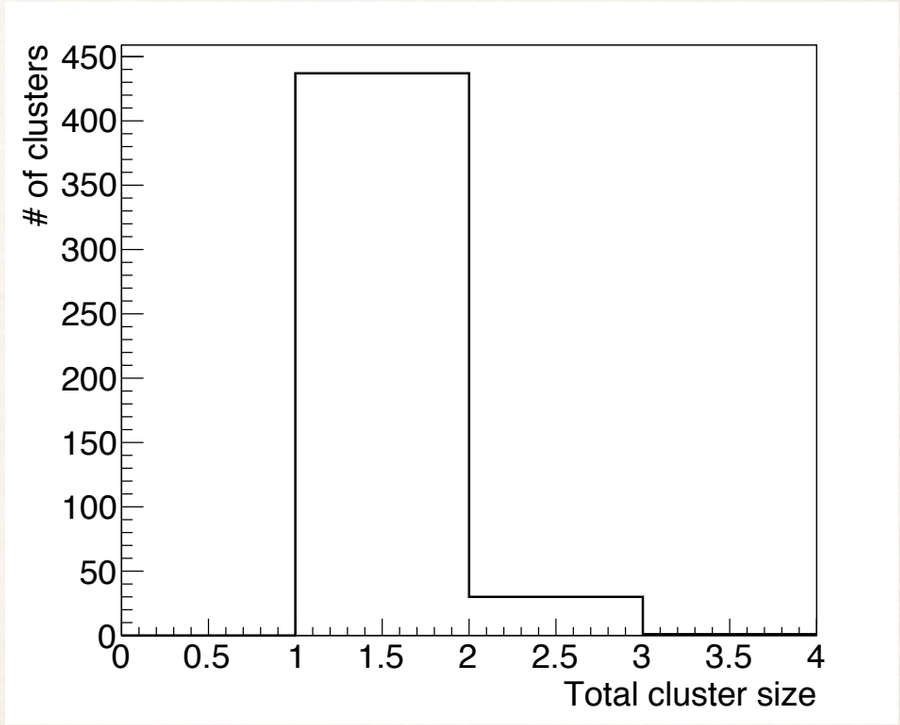


- Average amplitude for samples before hit A(before hit)
- Average amplitude in samples after hit A(after hit)

- Signal = | A(after hit) - A(before hit) |

Cuts in the analysis

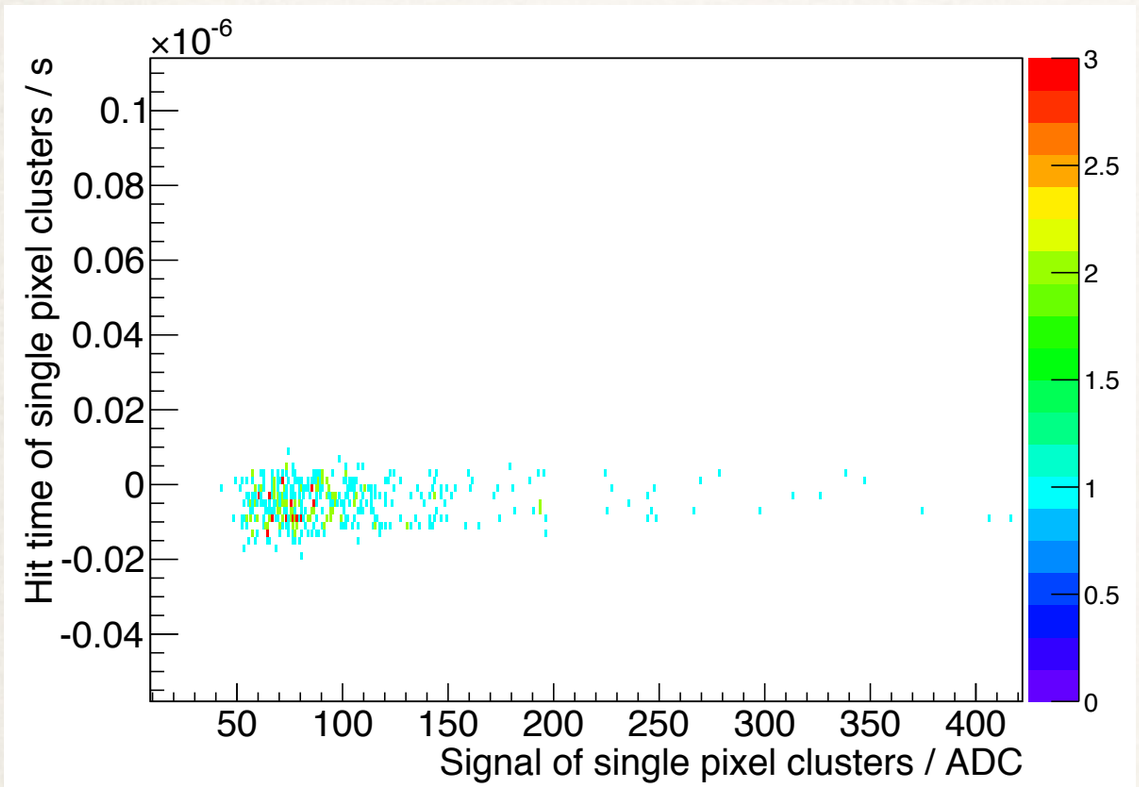
- Spacial residual:
  - Spacial residual $< 100\ \mu$m
- Signal:
  - Signal > 20 ADC
- Cluster-size:
  - Only single pixel clusters for first look
  - Easier to define timing for single pixel clusters
  - Cluster size dominated by single pixel clusters



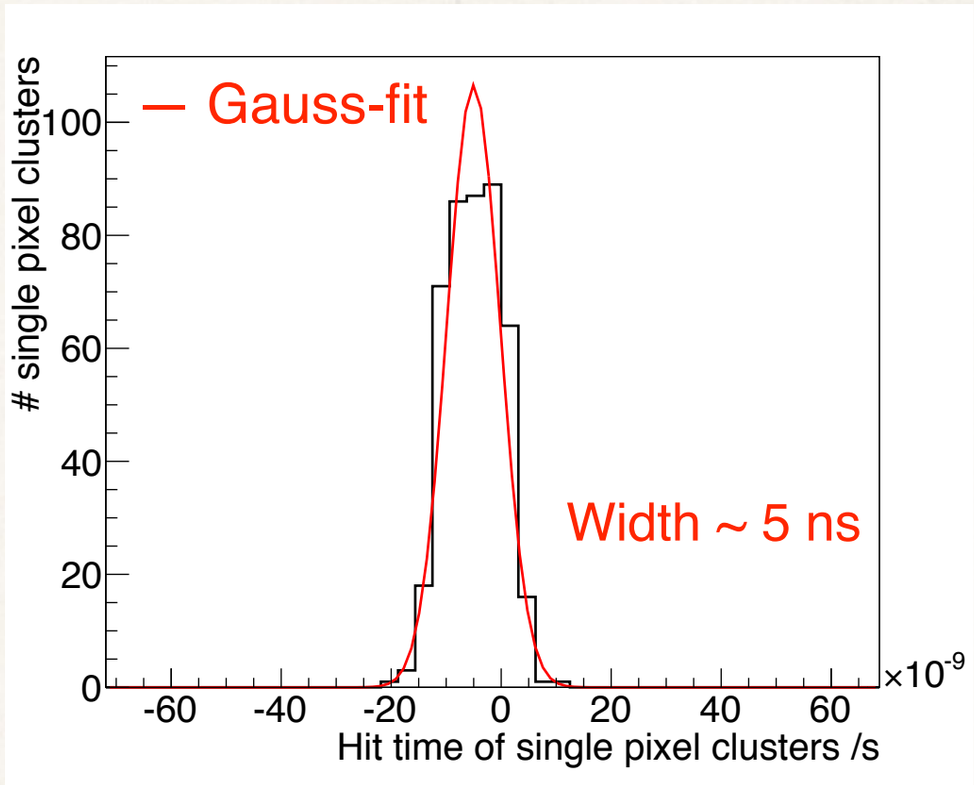
Timing results, pitch = 50 µm, $V_{Bias} = 6\,V$

Results for the hit time

- Hit time versus signal of single pixel clusters:



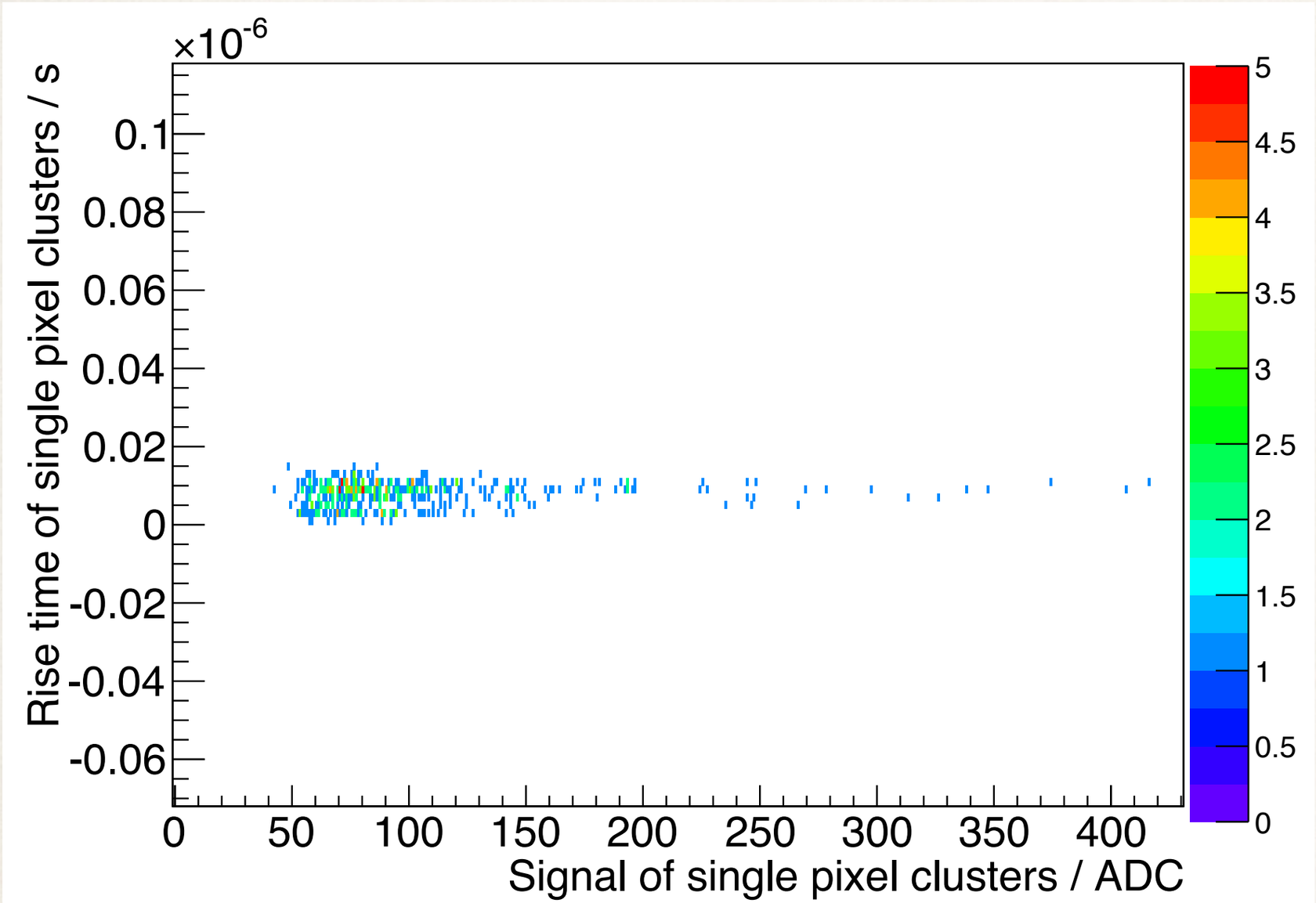
- Hit time versus signal of single pixel clusters:



- No time walk because no threshold has been applied
- Not centred around 0 because of manual offset correction

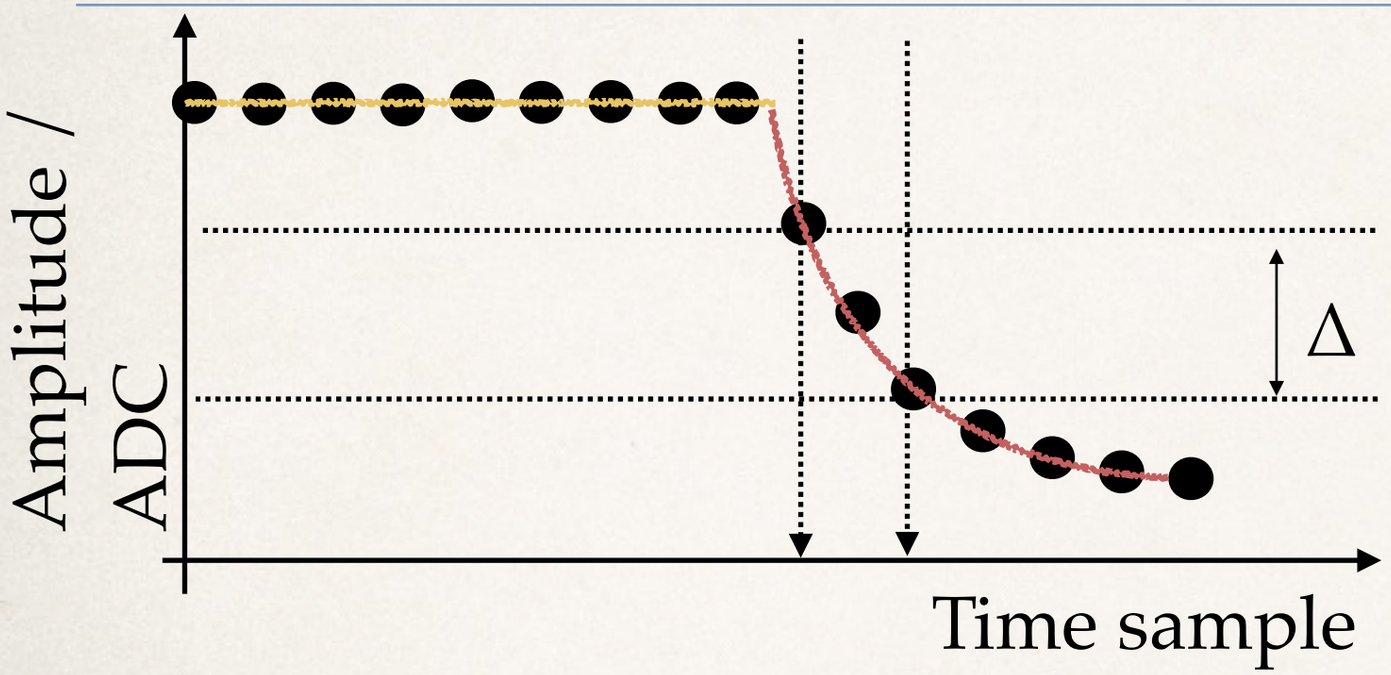
Results for the rise time

- Rise time versus signal of single pixel clusters:

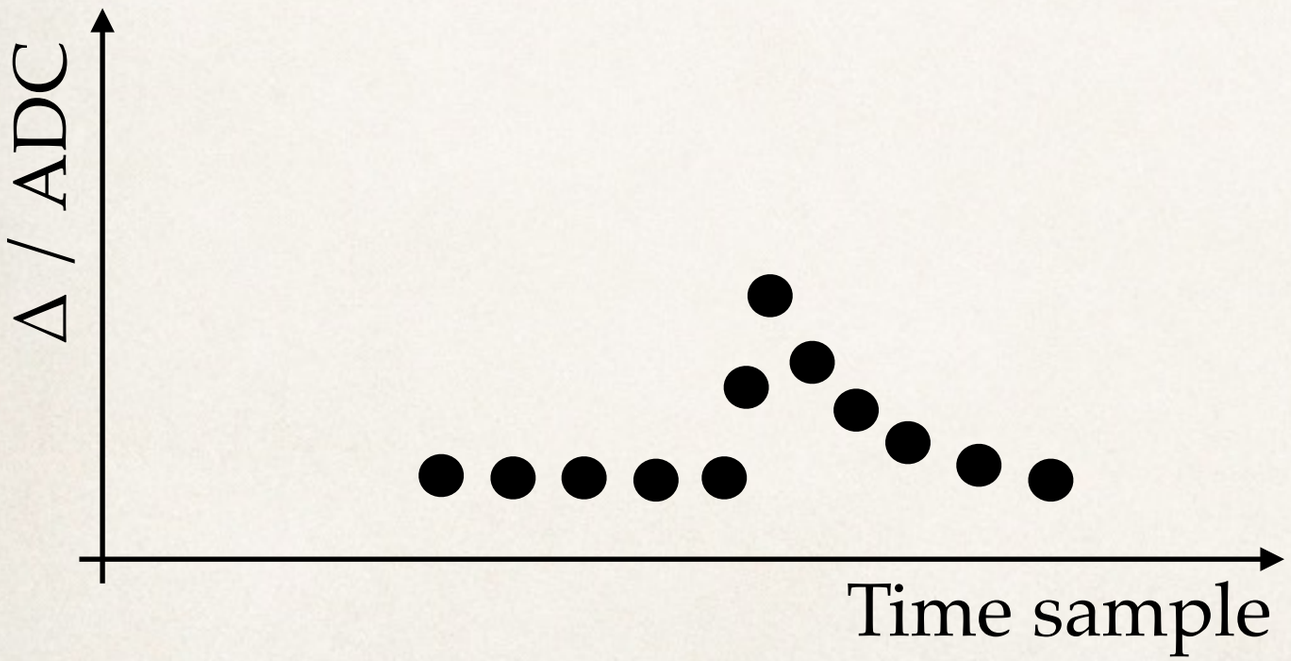


↳ Rise time of single pixel clusters in the order of 10^{-8} s

Limits of the Gaussian method to define timing observables



- Derivative of the waveform does not have to be symmetric
- Especially important for slow signals

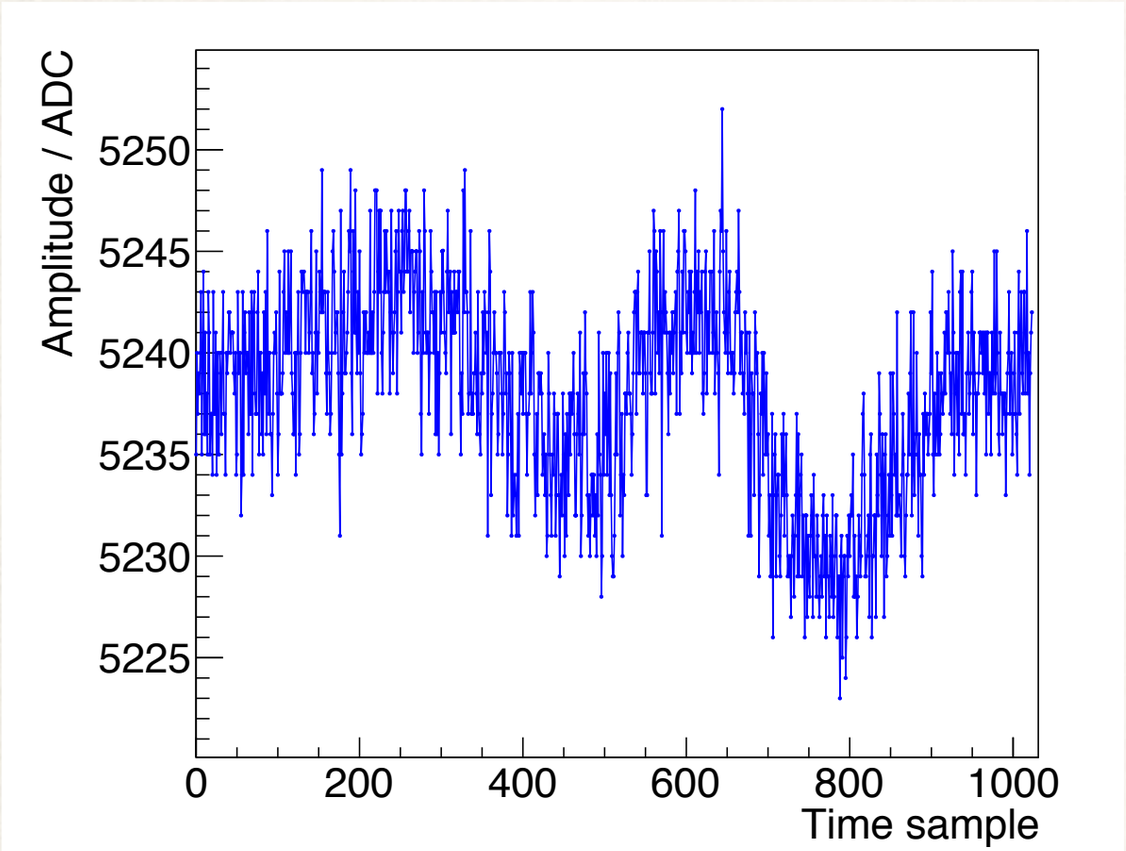


- Use fit straight line and exponential decay instead of Gaussian method

= ongoing work

Further improvements for the timing analysis

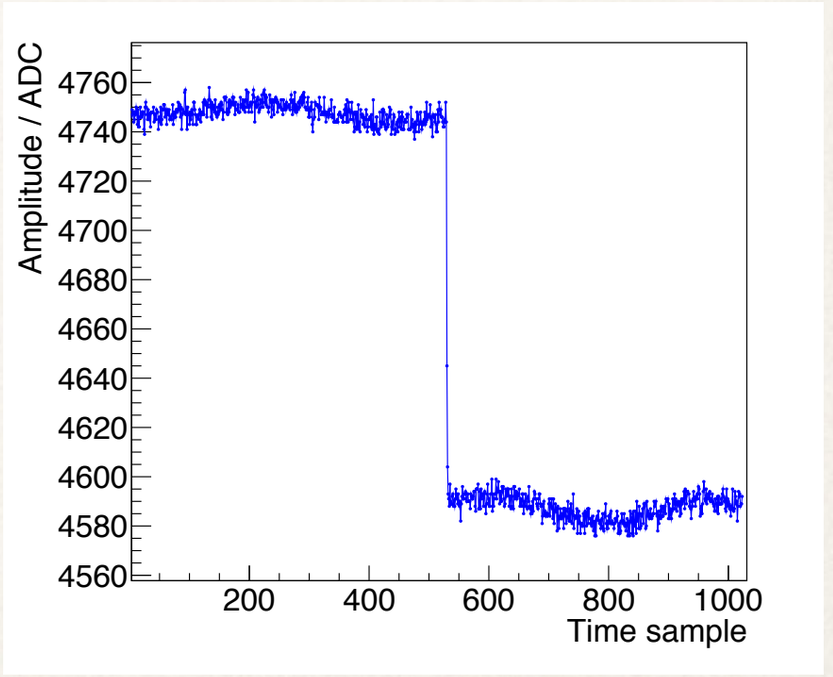
- See common mode in all pixels:



↳ Need to apply common mode filter

= ongoing work

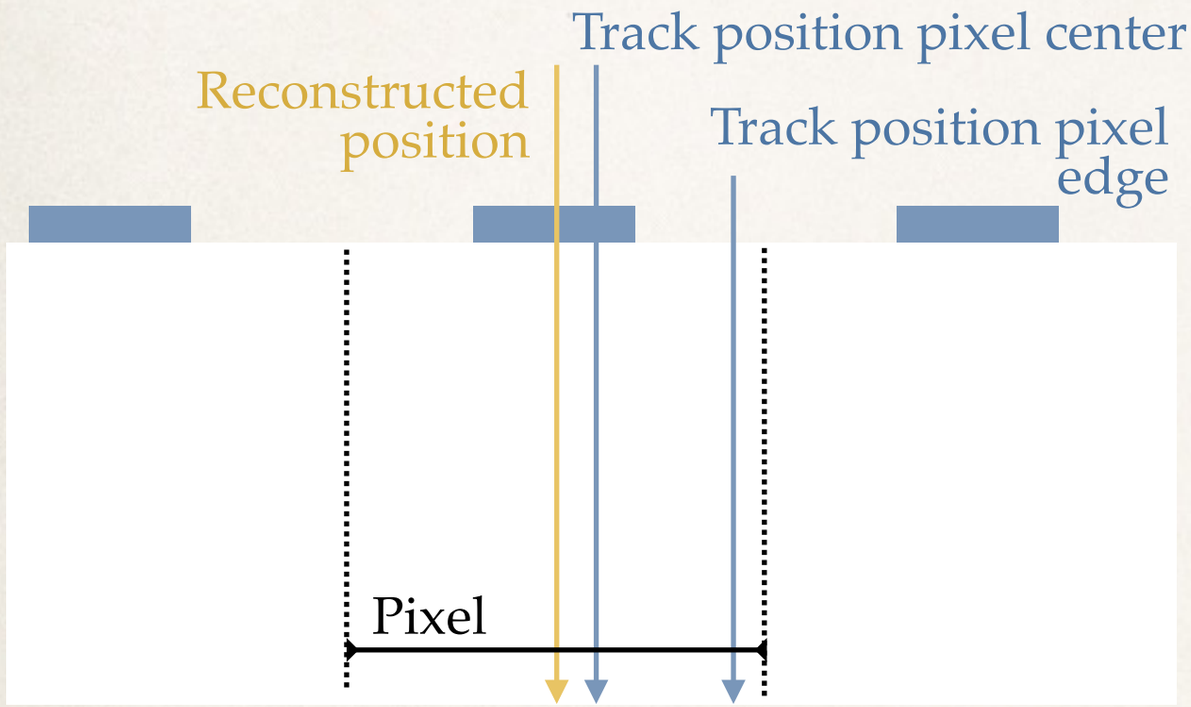
- Note:
  - Plots presented before are only for single pixel clusters
  - Single pixel clusters have large single pixel signal
  - Common mode negligible with respect to signal height



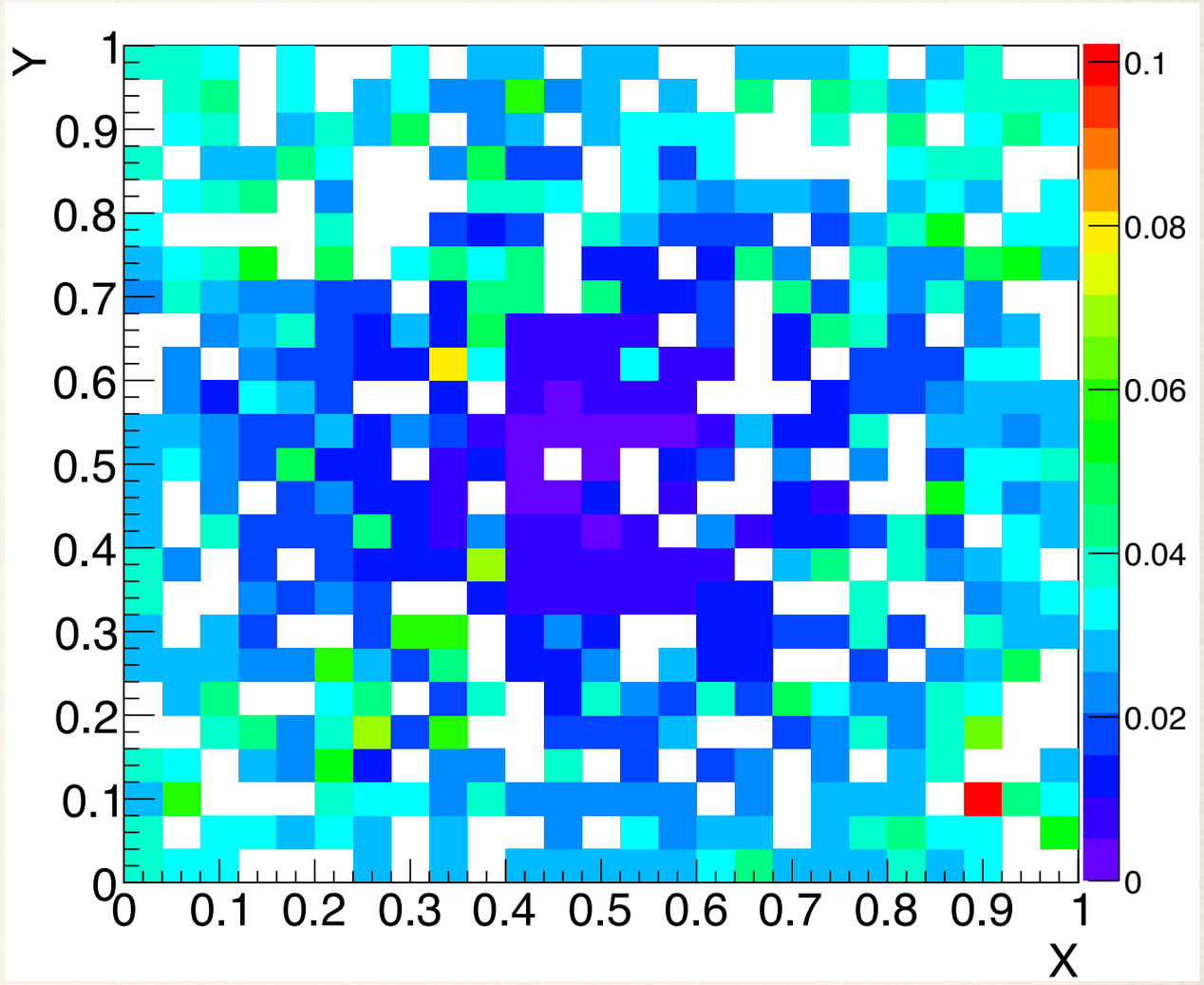
First look at in-pixel resolution

In-pixel resolution

- Expectation:
  - Mainly single pixel clusters
  - Expect better resolution in pixel center



- Results:



- Results match expectations
- Track reconstruction with good precision!

Summary & outlook

Summary & outlook

- First look at timing of the investigator chip:
  - First results seems to be promising
  - Next steps for improvement are defined
- In-pixel resolution:
  - Shows expected pattern
  - Proofs that track reconstruction is working to a precision of in-pixel level
  - Seem to gain from additional telescope plane close to investigator
- Next steps:
  - Improve timing analysis
  - Systematic study of timing, spacial resolution, …

Backup