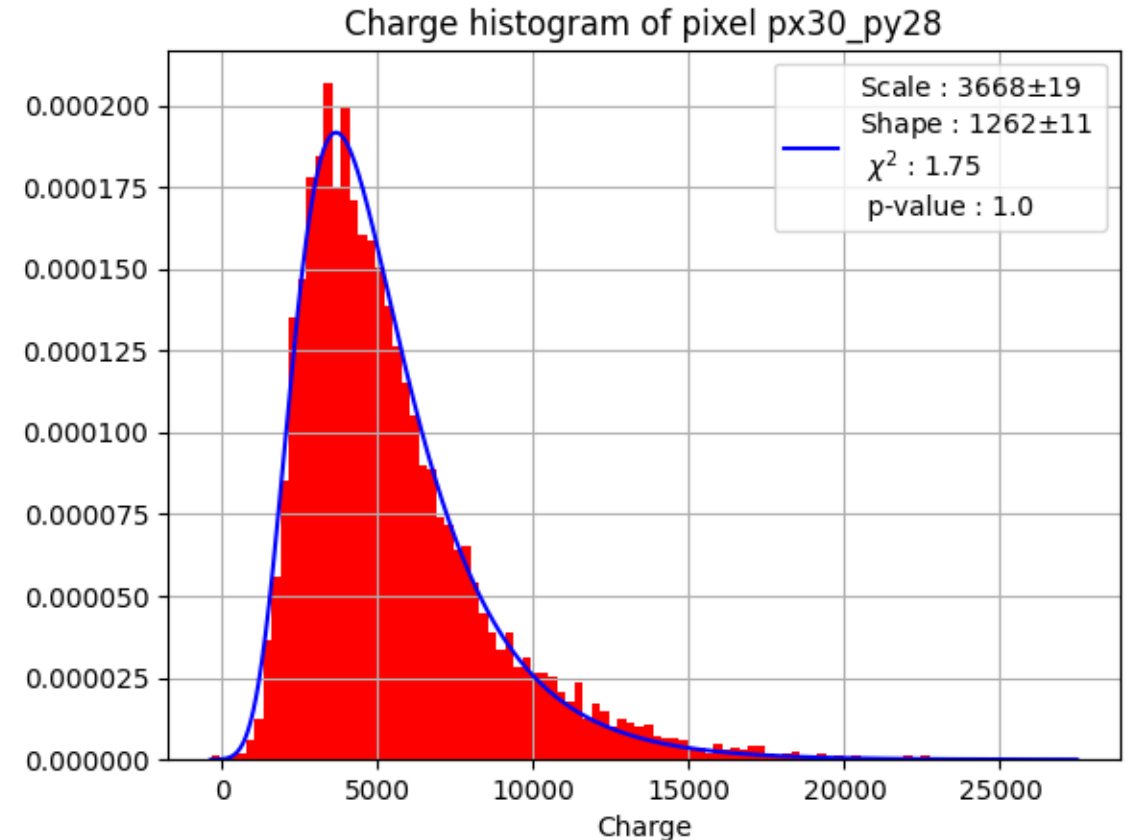


MPW4 depletion voltage and capacitance

- Sensor: **Topside biased MPW4 HV-CMOS**
- Depletion voltage of -200V
- In previous meeting it was requested that the experiments would be done with a threshold of 1.0V and that data would be compared with Allpix2 simulations

Incorrect Charge

- SR-90 Source, 10000 hits
- Minimum ionizing particle:
80 e-h pairs per micron
→ 22000 e-h pairs
- Assuming Capacitance of
2.8fF this would mean
~4000 electrons measured
from fit of Landau
distribution

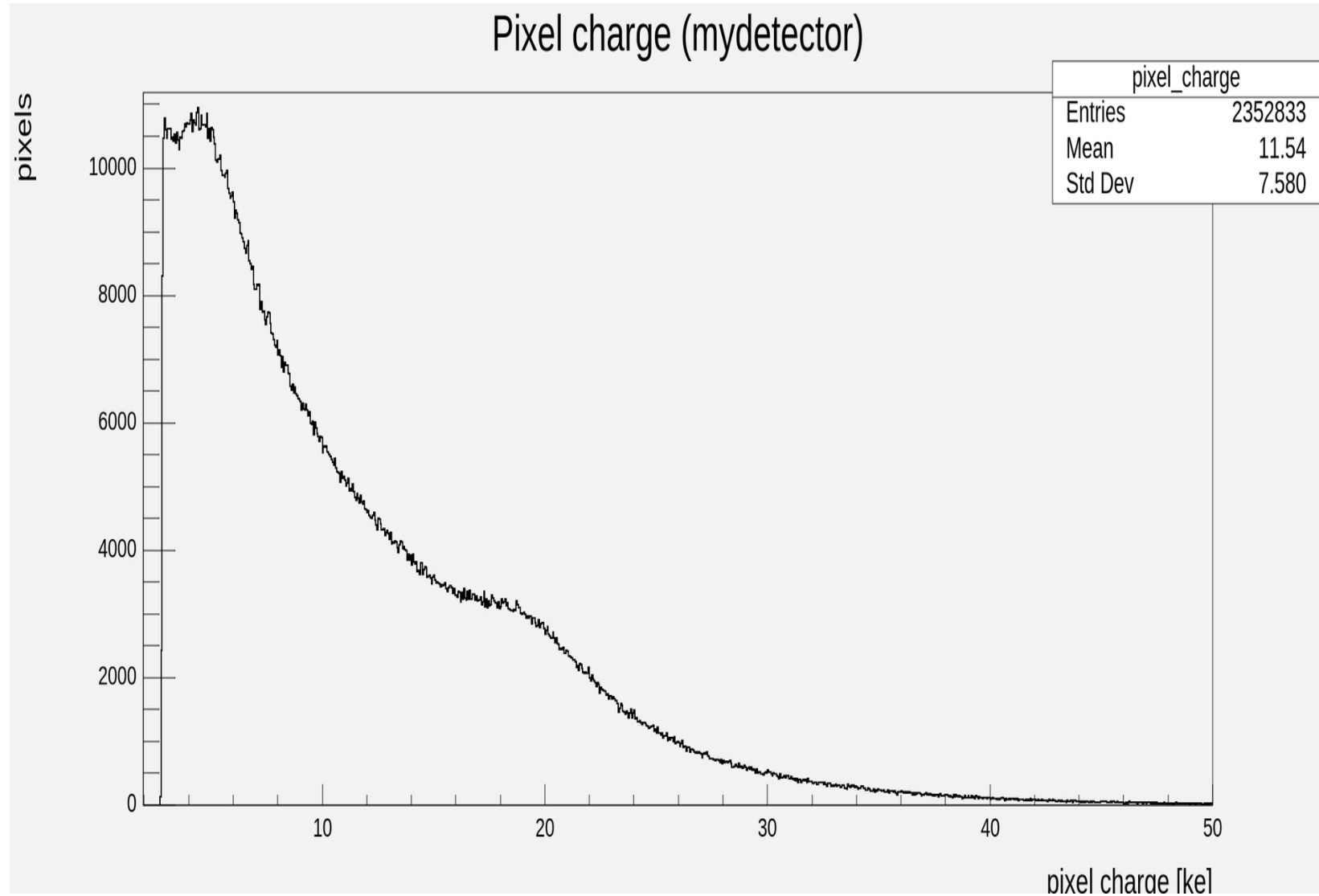


Allpix2

- 280x62x62 μm detector
- 64x64 pixelgrid
- -200V depletion and bias
- MIP electron for Y90 decay (2.1 MeV)
- Threshold of 2800e (corresponding to capacitance of 2.8fF)

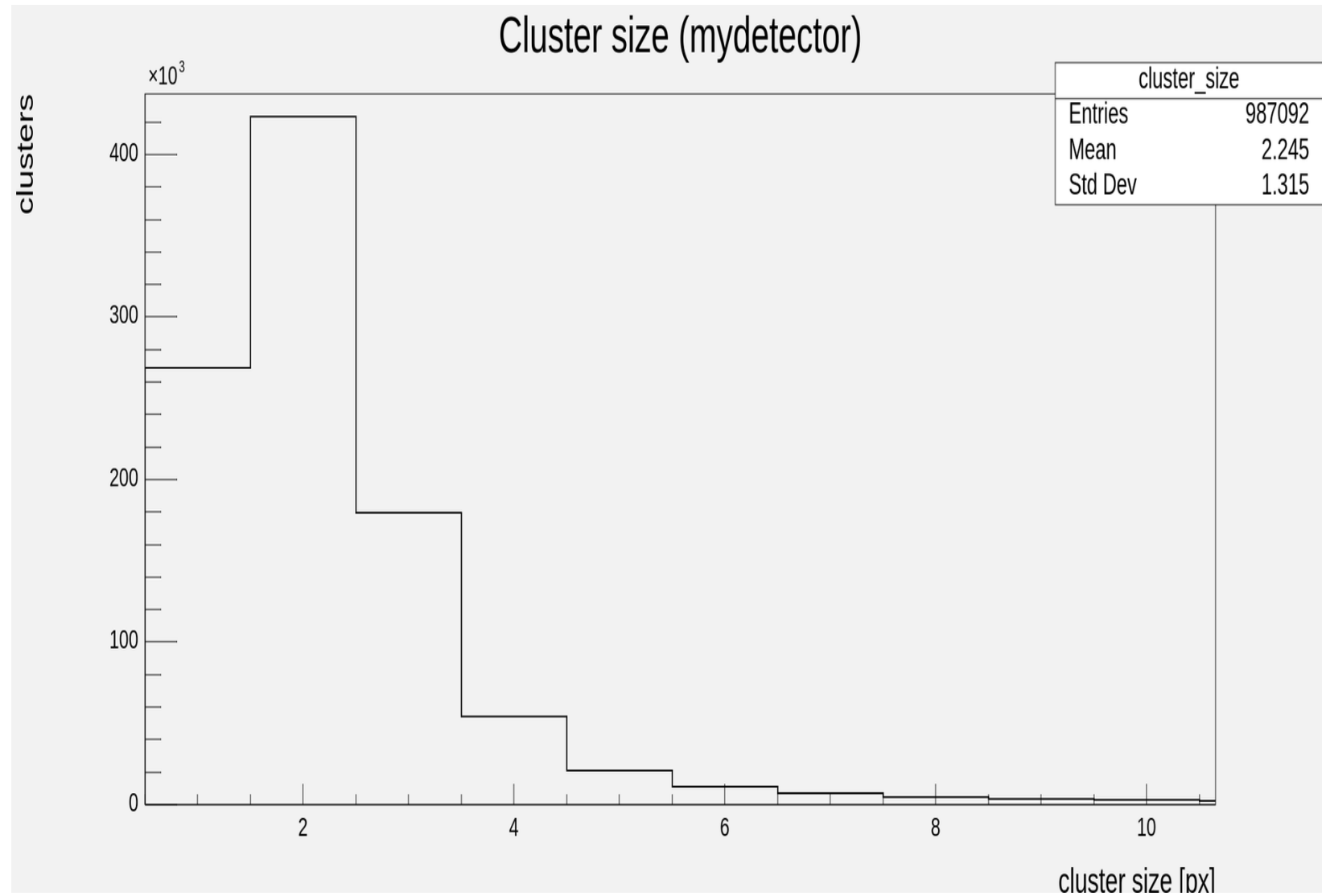
Allpix2

- MIP electron for Y90 decay (2.1 MeV)
- Threshold of 2800e (corresponding to capacitance of 2.8fF)



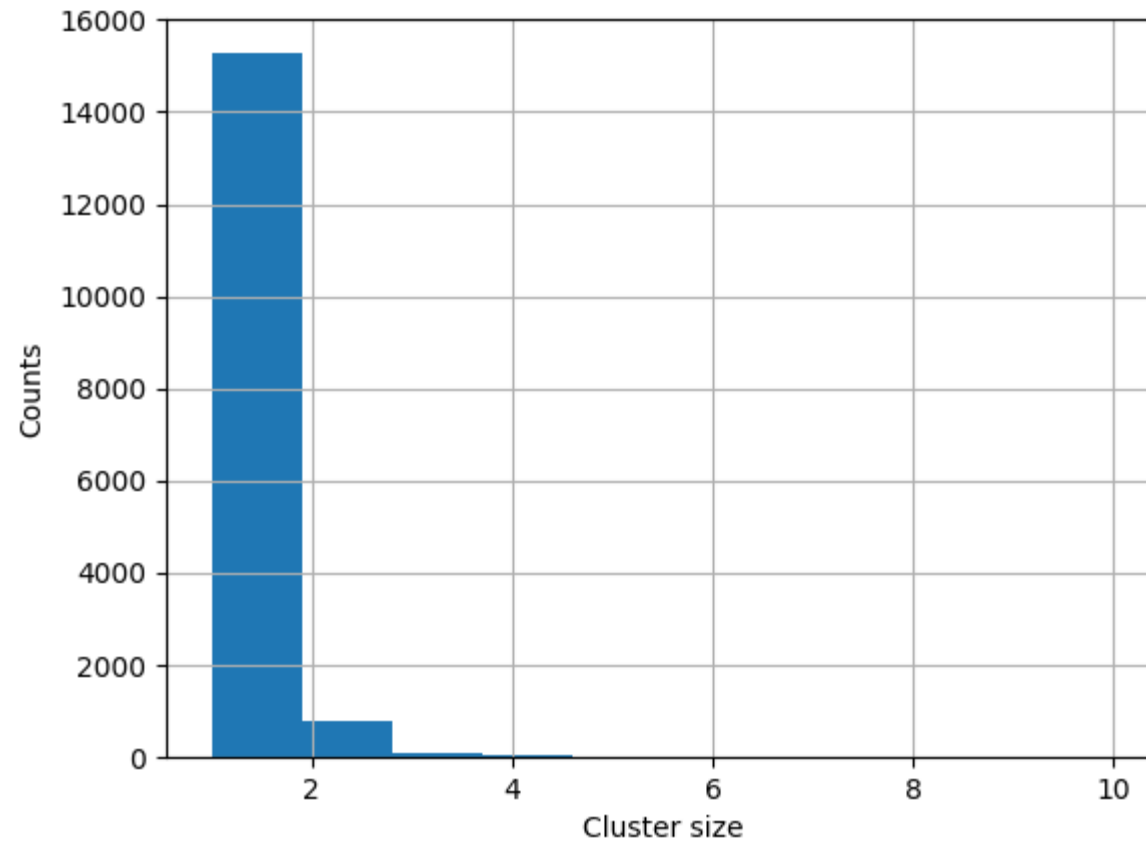
Allpix2

- MIP electron for Y90 decay (2.1 MeV)
- Threshold of 2800e (corresponding to capacitance of 2.8fF)



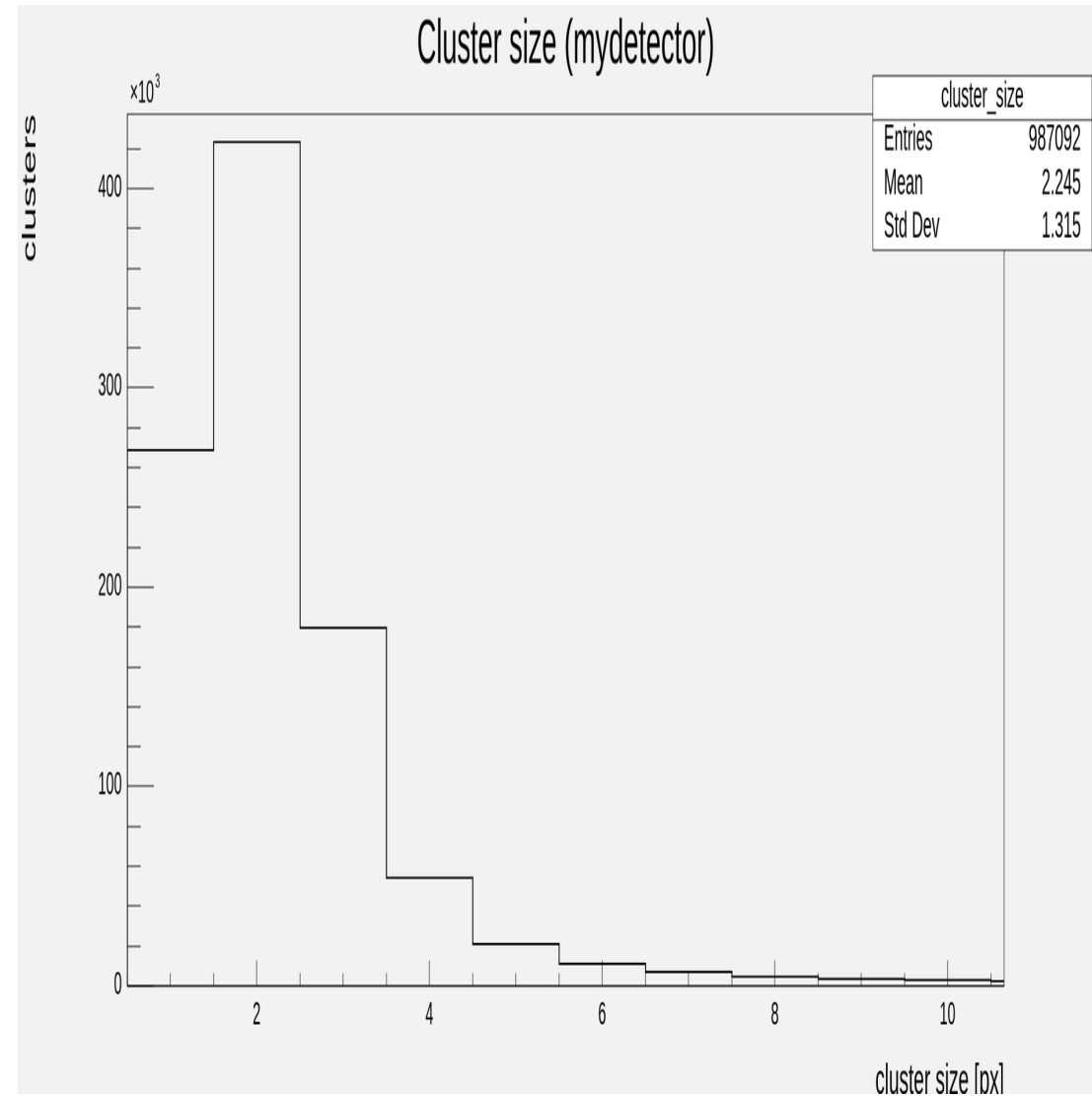
Clustering

- Threshold = 1.0V

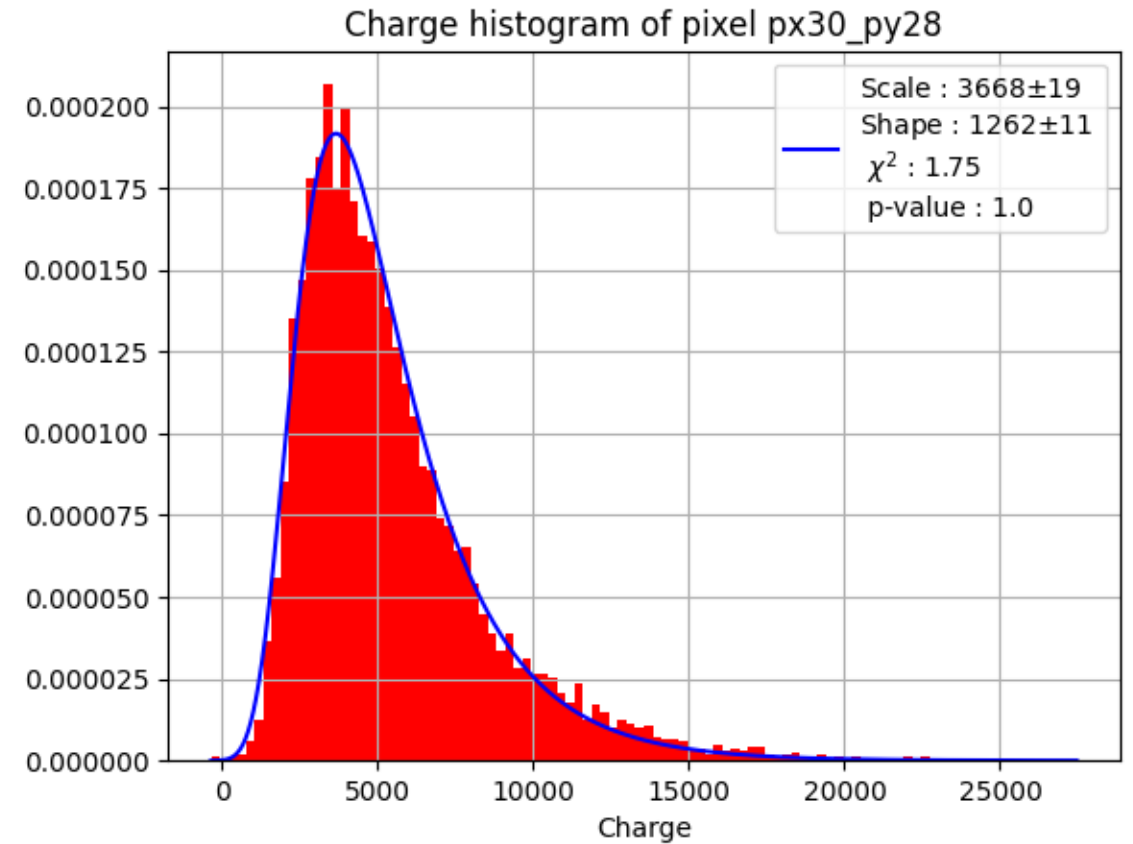
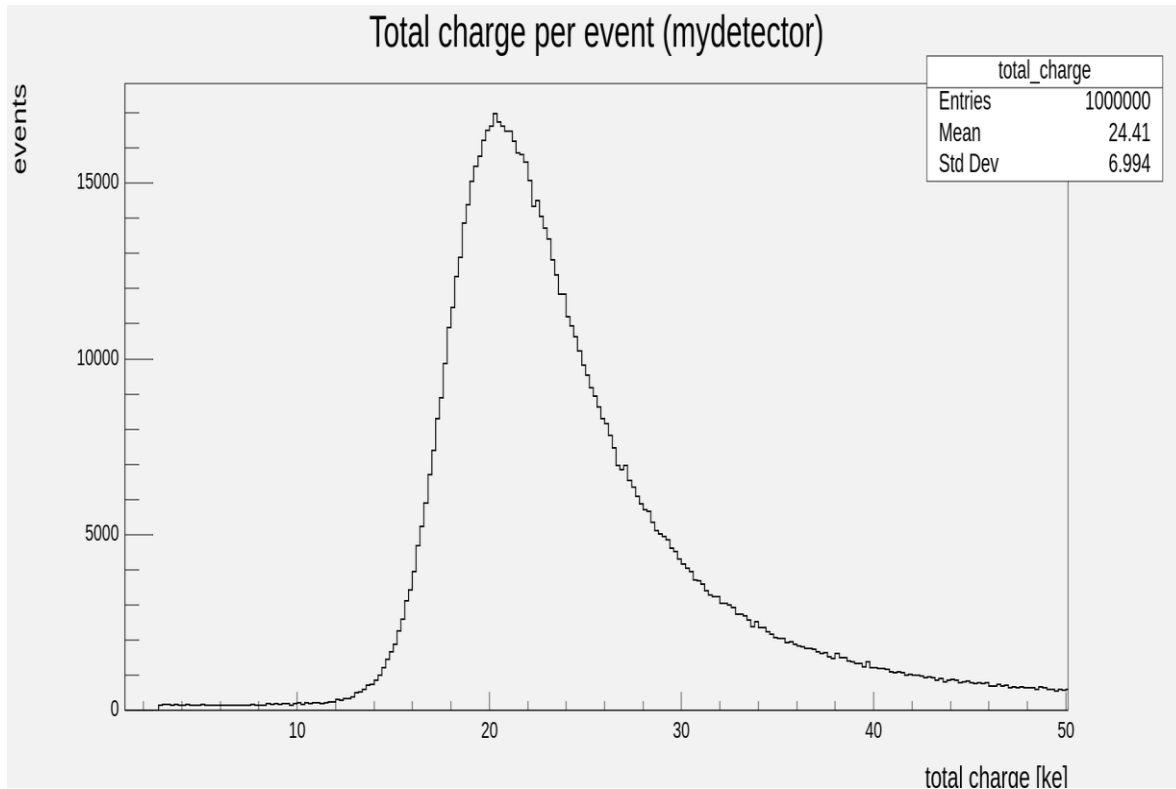


Allpix2

- Increase in threshold reduces clustering but not so drastically (threshold of $\sim 15000e$ needed to get the measured results)
- Something wrong with the simulation model

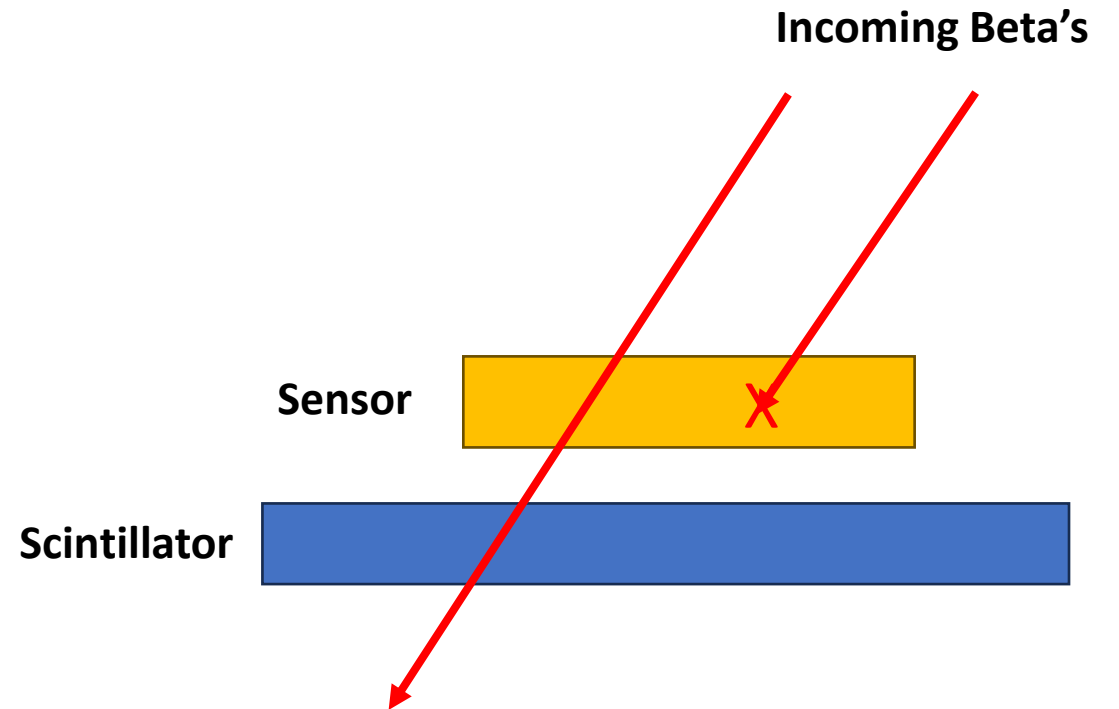


Allpix comparisson



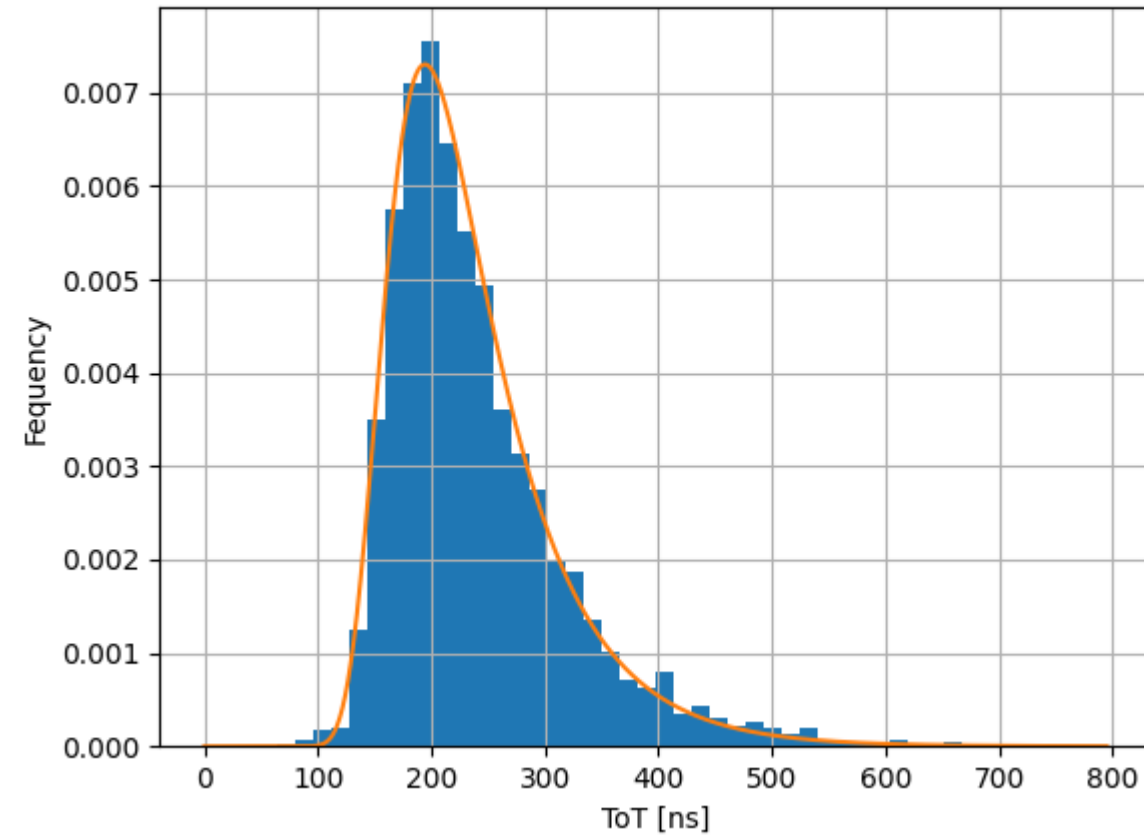
MIP behaviour

- Scintillator underneath the Sensor, to make sure all particles are MIP

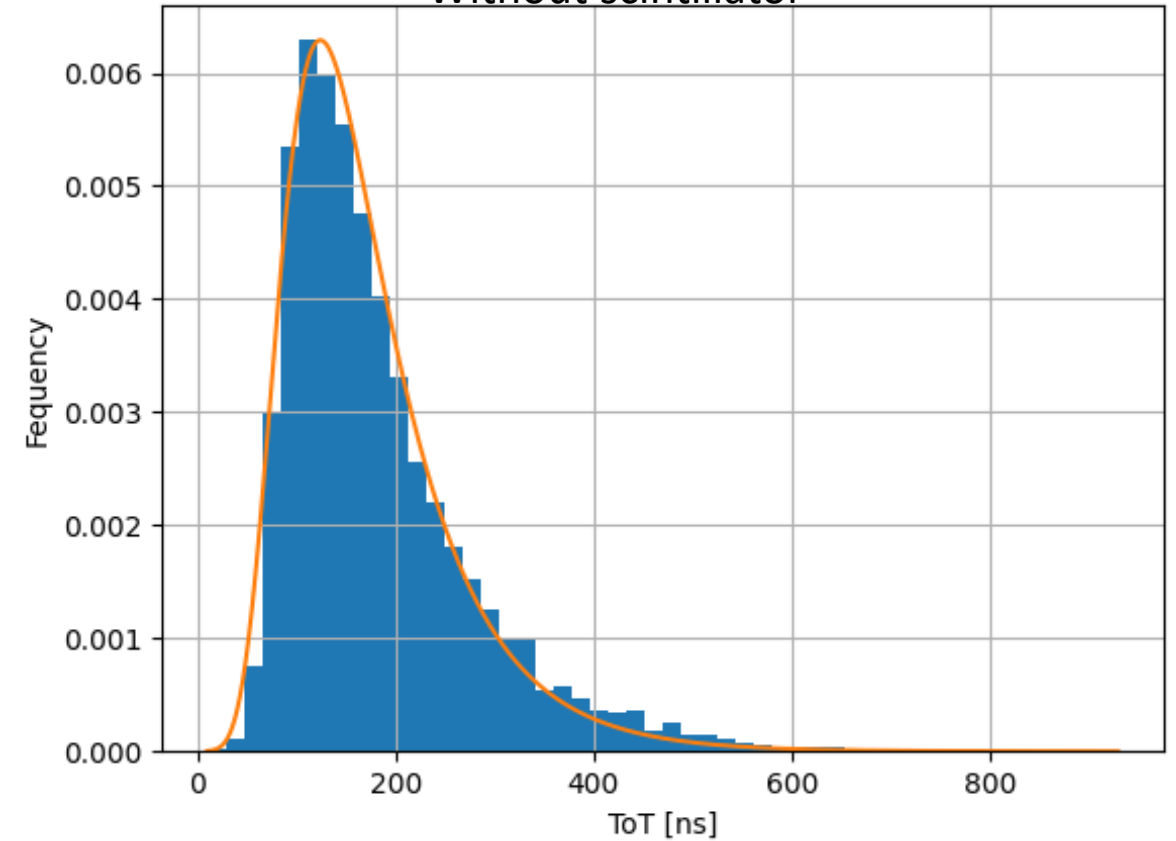


Comparison with Scintillator

With scintillator

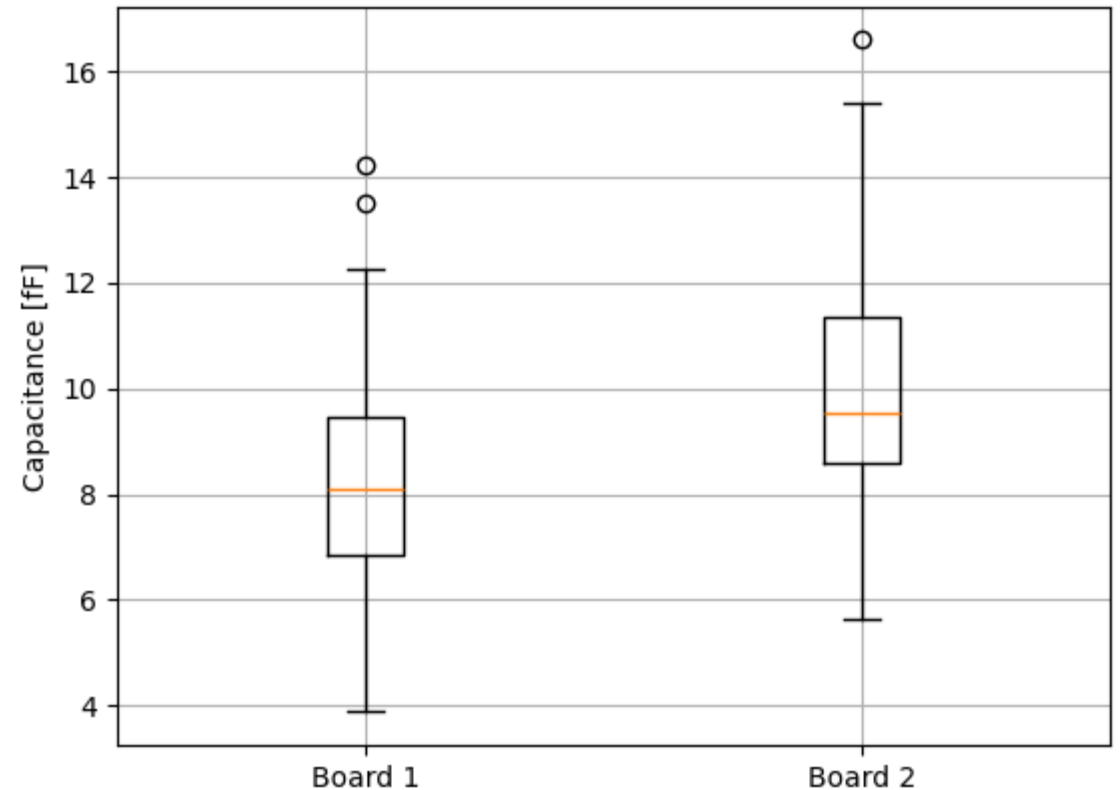


Without scintillator



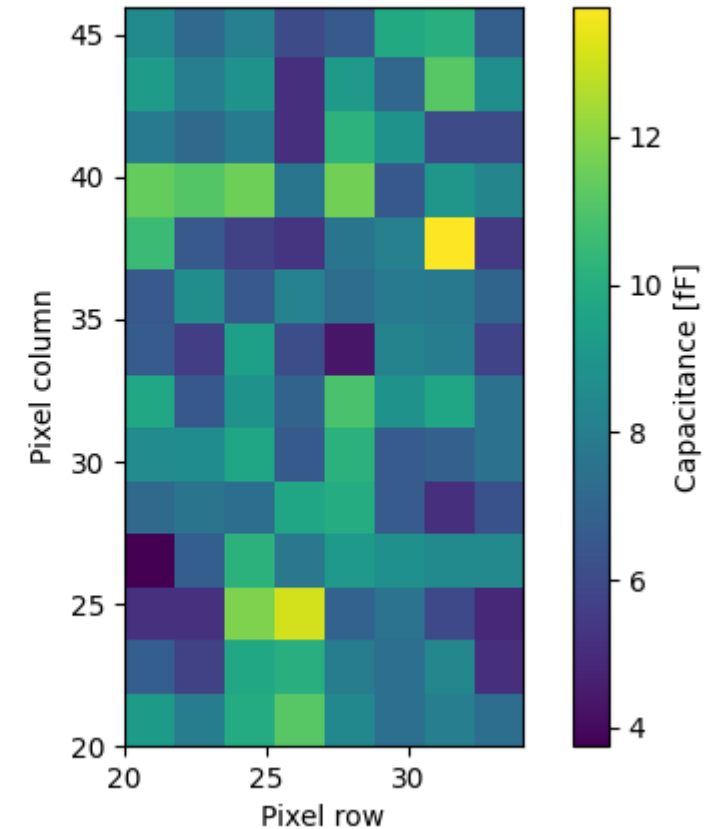
Capacitance

- Threshold = 1.0V
- Assuming MIP = 22.000 e-
- Mean voltage of histogram converted to capacitance
- N = 112 pixels
- Board1: 8.2 +/- 2.0 fF
- Board2: 9.7 +/- 2.4 fF



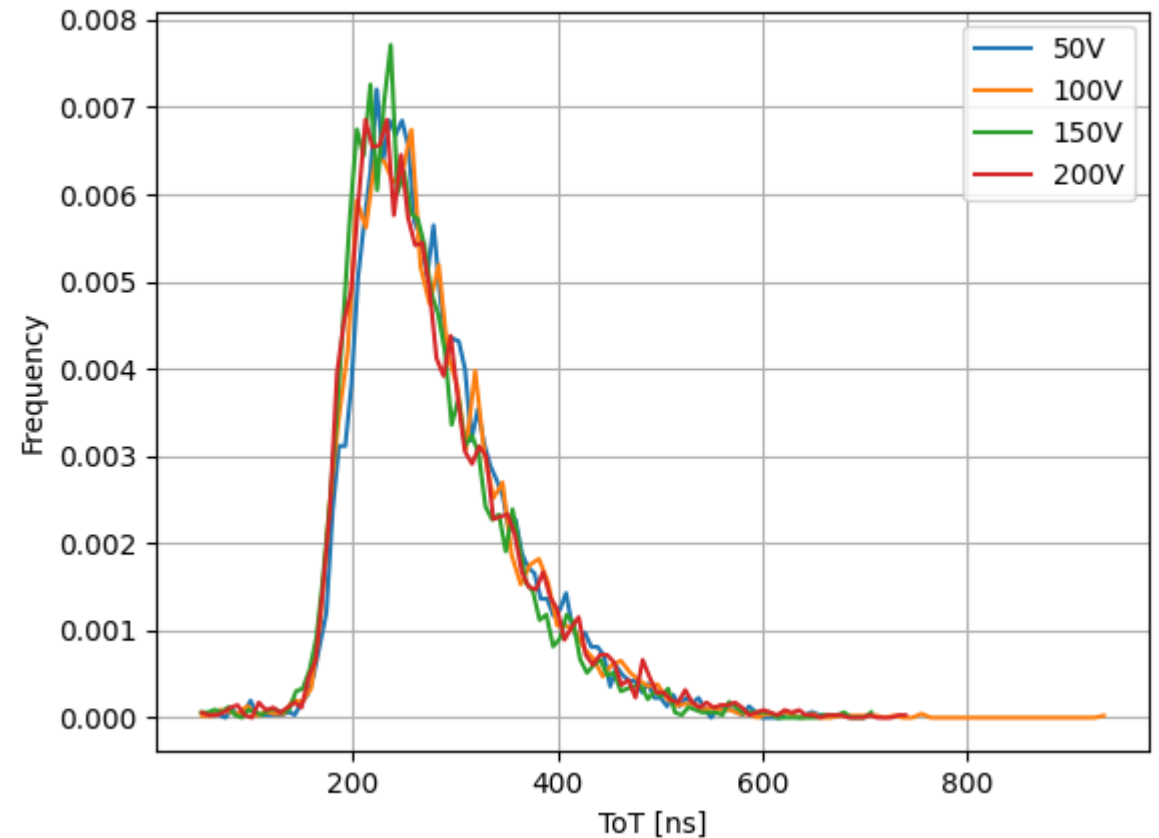
Capacitance

- No spatial dependency
- Measurements take a long time



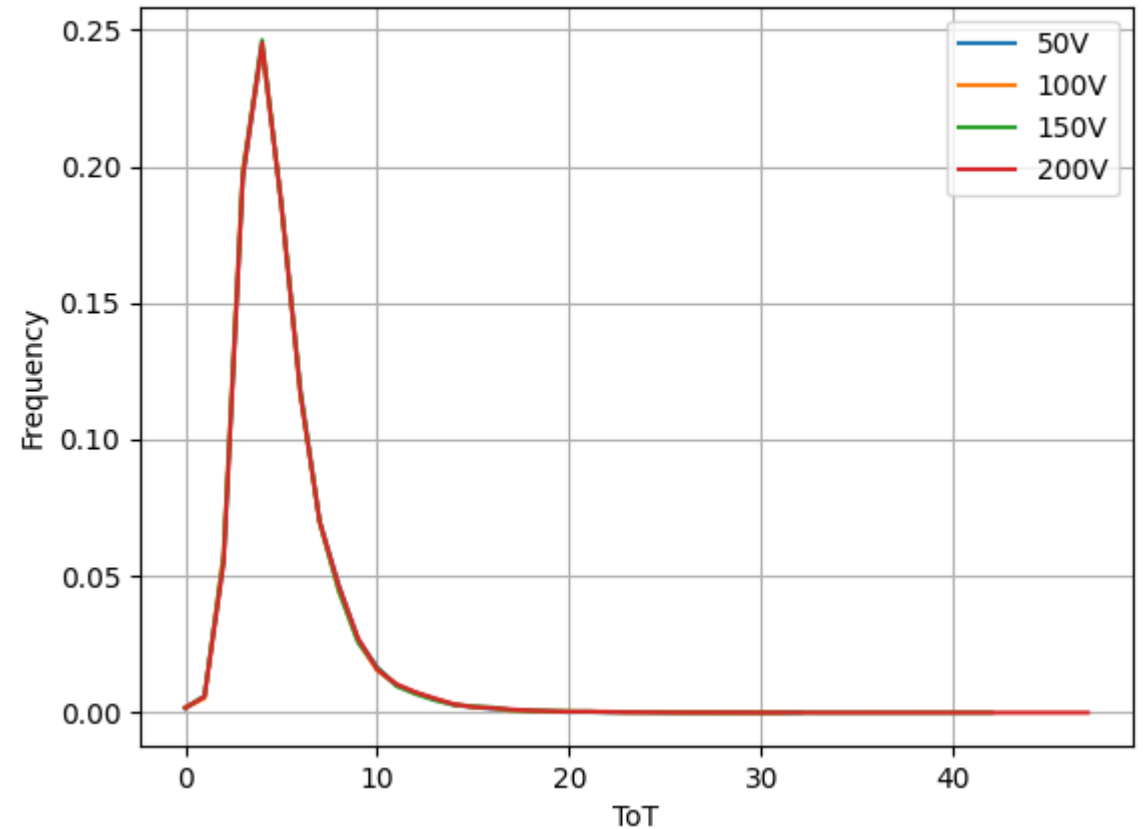
Depletion voltage – in pixel

- Threshold = 1.0V
- Changed depletion voltage and measured TOT with scintillator
- Same histogram for different depletion voltages



Depletion voltage – sensor wide

- Threshold = 1.0V
- Same measurement with hitmap
- Not corrected for pixel fluctuation
- Same histogram for different depletion voltages



Requests

- TCAD Electric field simulation (currently linear model)

Calibration

Insert voltage, measure ToT

Threshold voltage $\sim 0.15\text{V}$

Fit given by:

$$f(x, p_0, p_1, p_2, p_3) = p_0 + p_1x - \frac{p_2}{p_3 - x}$$

