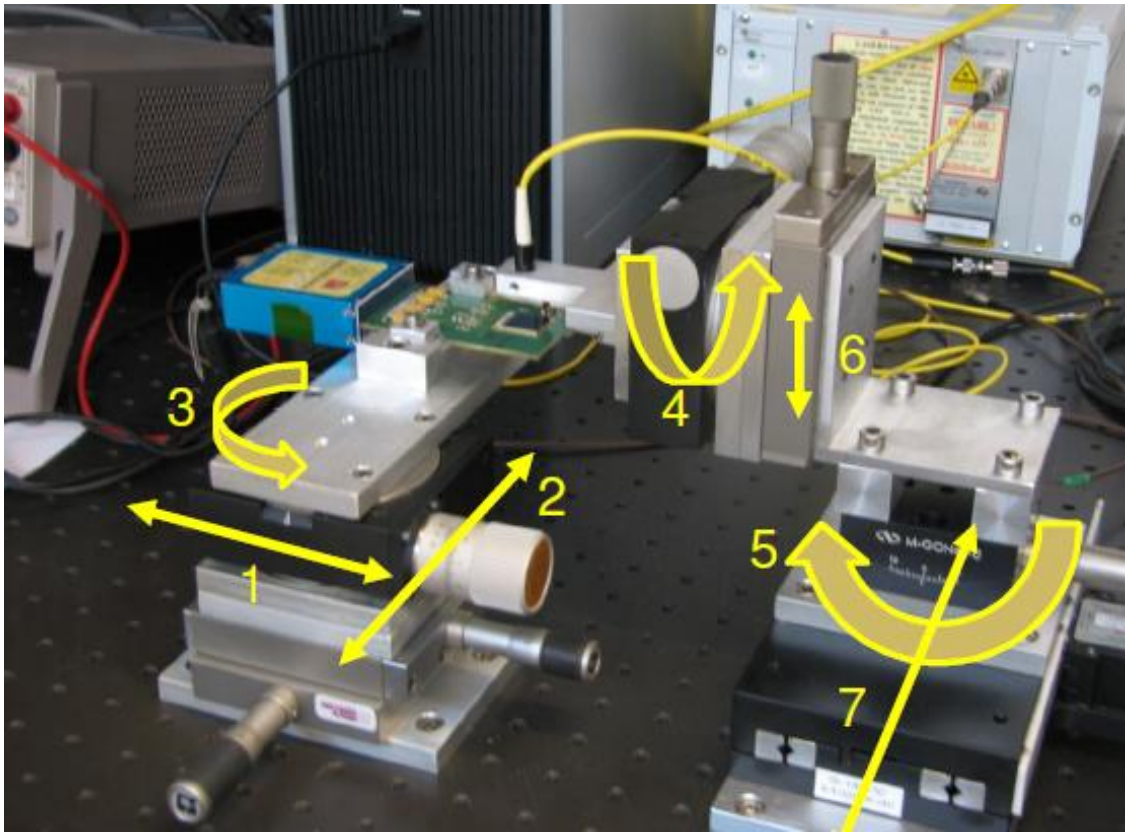
Laser + Timepix Studies at CERN

Alessandra Borgia
Marina Artuso
Syracuse University
With: Paula Collins, Jan Buytaert
And help from the Medipix Crew

Studies performed so far…

- Laser stability
- Pixel to pixel TOT
- Single cluster vs multiple cluster distributions
- Timewalk
- Test Pulse Reliability
- …etc!

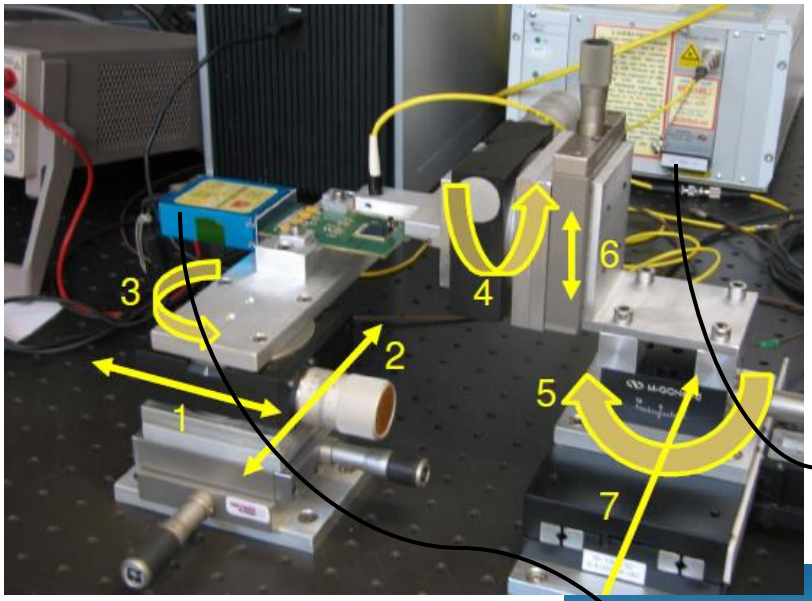
Setup v1r0



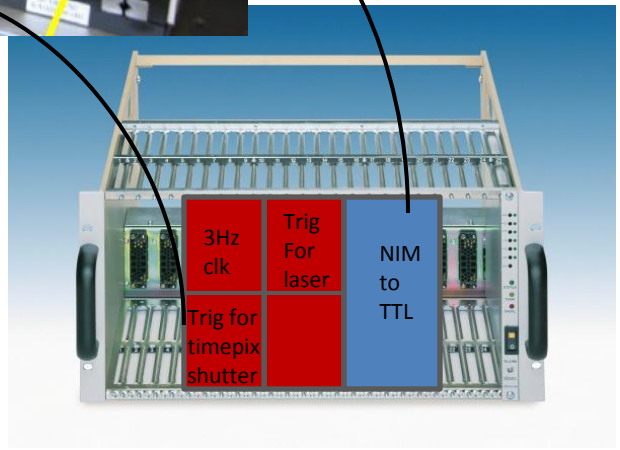
Thanks Jan!

- 1060nm laser - MG
- 2 attenuators
- Many degrees of freedom for motion
  - Adding more s

Setup v1r1

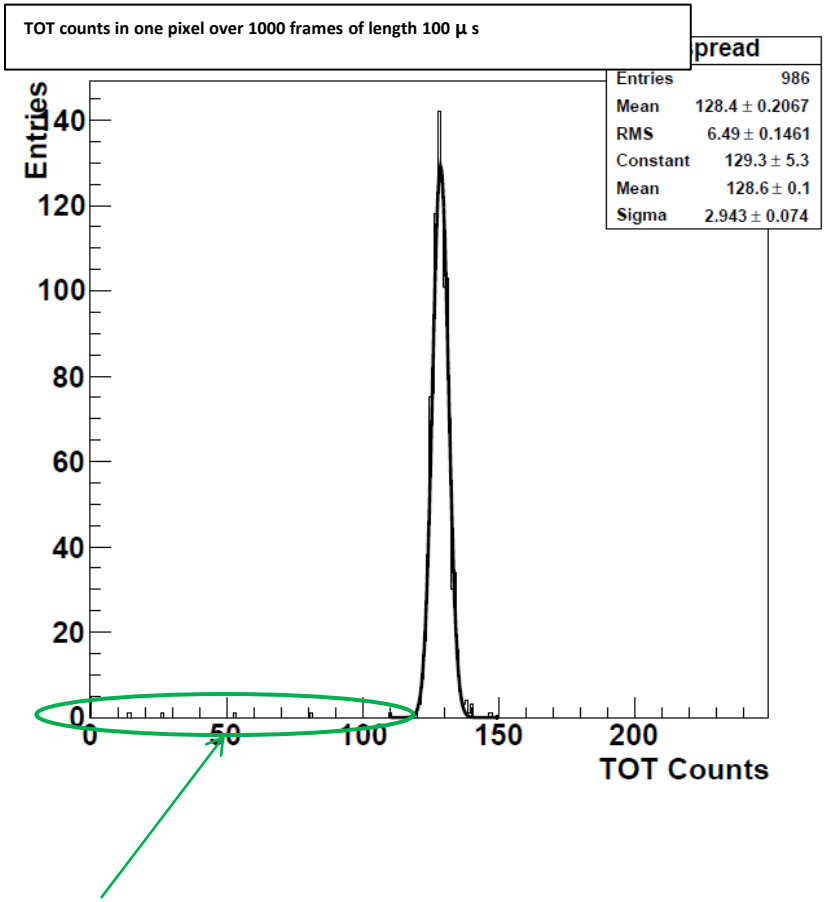


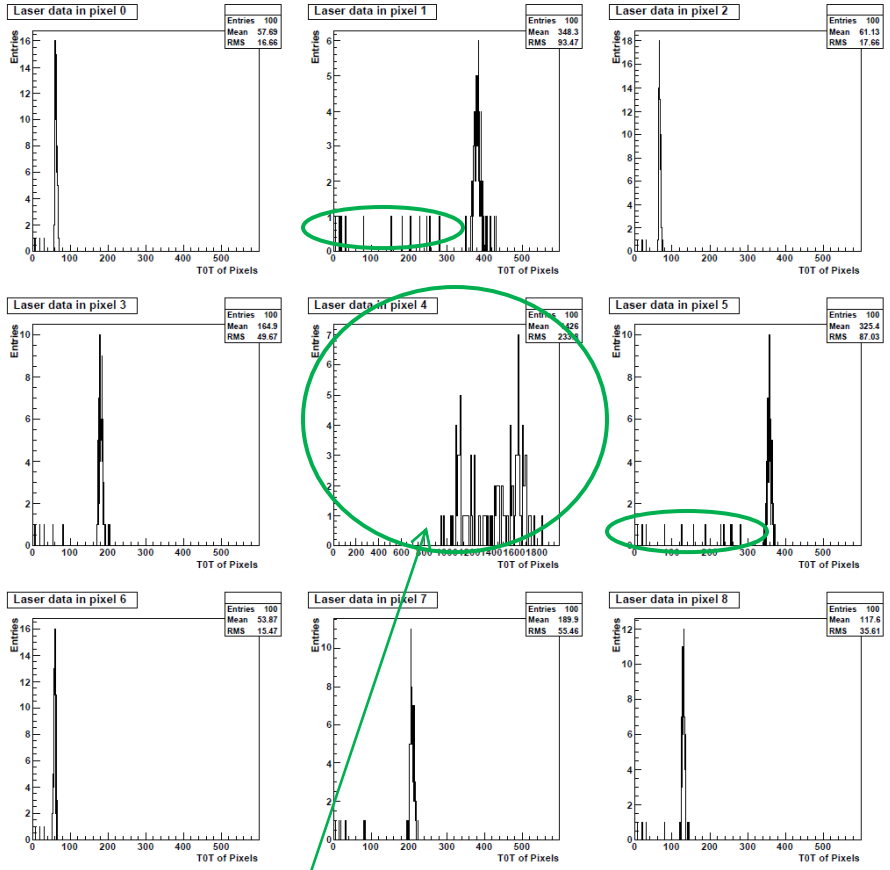
Thanks Richard!



- New and improved thanks to Richard!
- 3Hz laser pulse
- Laser width = 20ns
- Rising edge of Timepix shutter triggers the start of the delay for the laser pulse.
  - ~6.5µs delay

Reason for Timing Fix



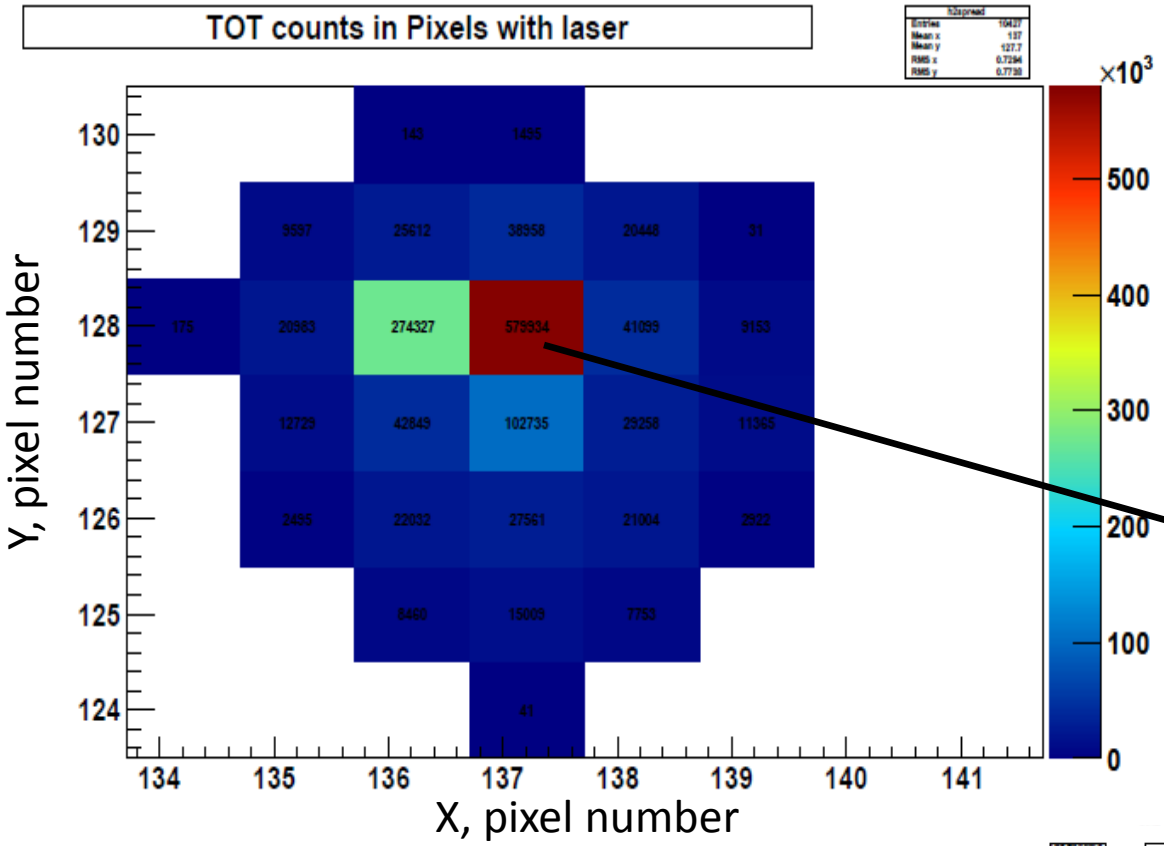


Double peak structure on central pixel?

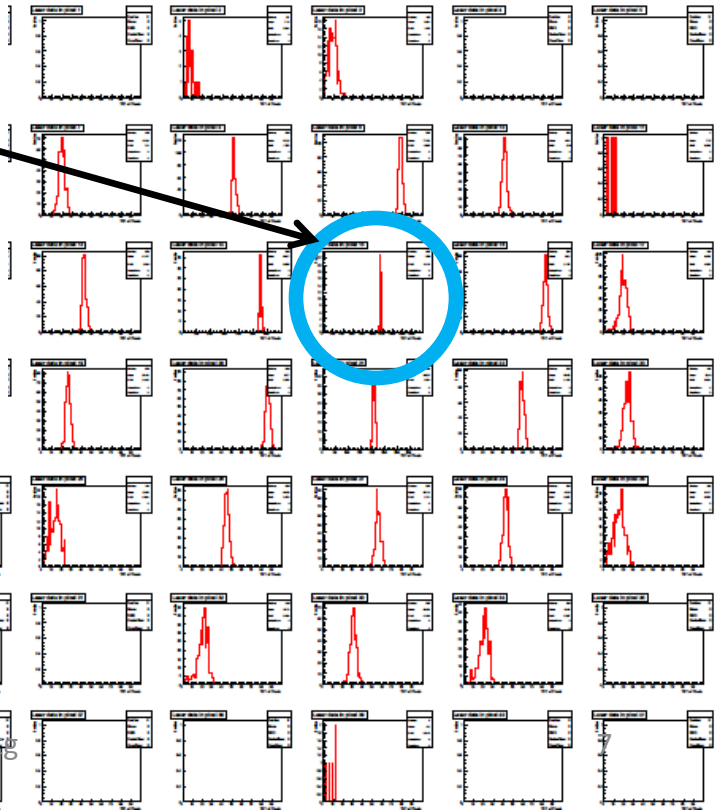
A Quick Note

- All plots/results are **not** final, they are preliminary.
- Bugs may exist. And most likely do!
- These are fresh data taken in the last 2 days, however based on data taking methods since I began.

Laser Stability

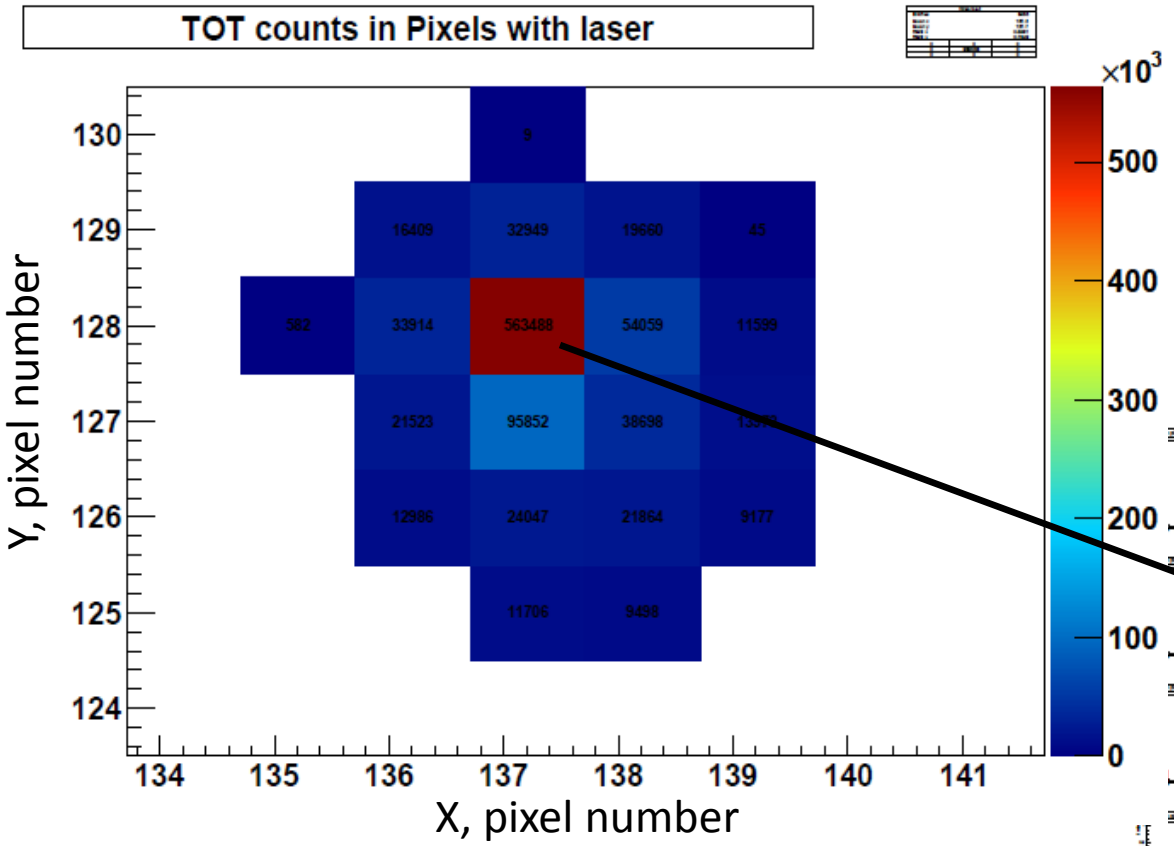


*Laser at 770mV and centered mainly on pixel (137, 128), but sharing with (136, 128)

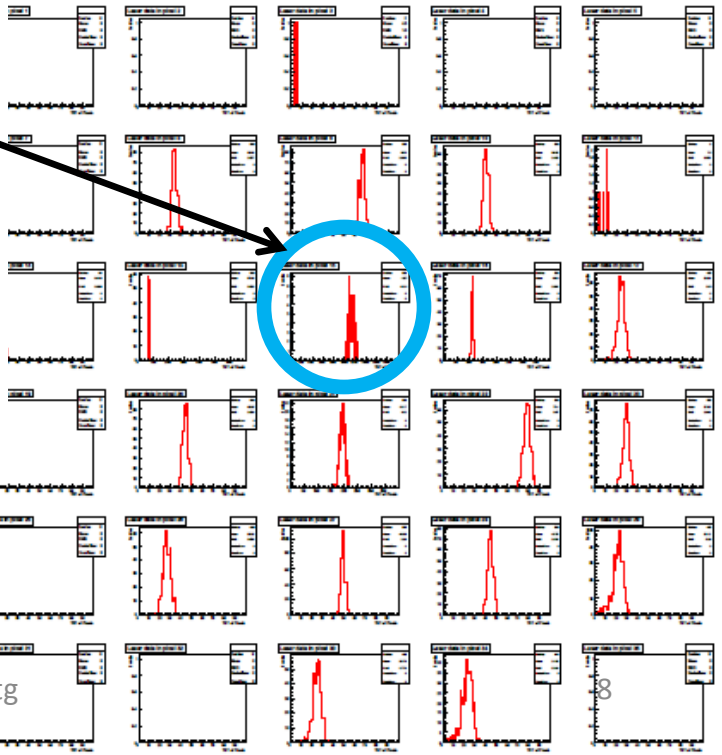


Beautiful and clean!

Laser Stability

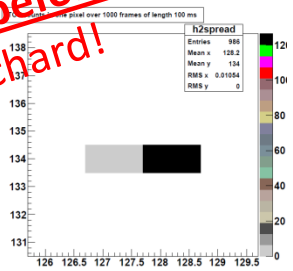


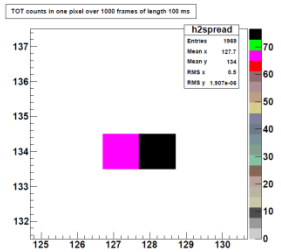
*Laser at 700mV and centered mainly on pixel (137, 128).

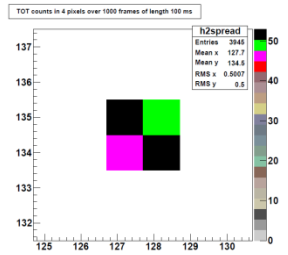


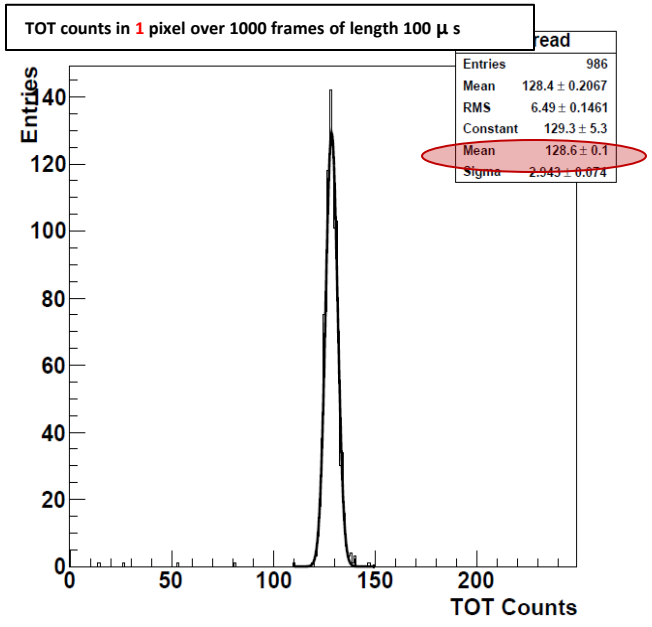
Single pixel vs. Multi-pixel clusters

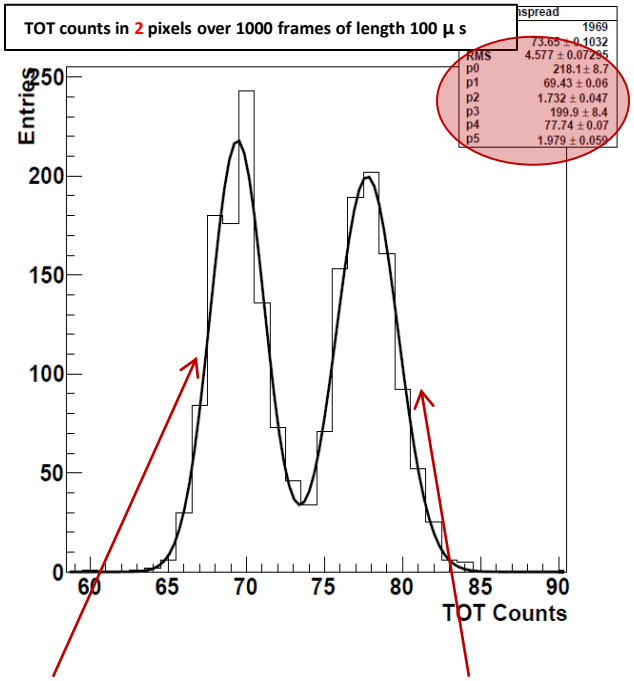
This data taken **before** the timing fix by Richard!

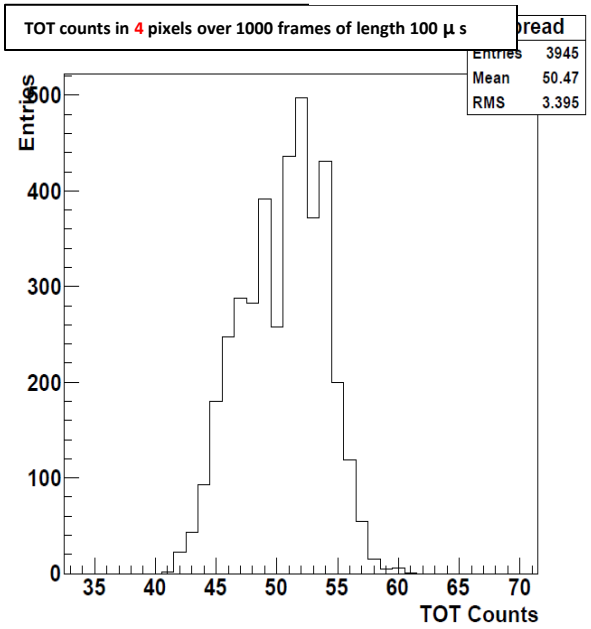












Mean = 69.43 ± 0.06

Mean 77.74 ± 0.07

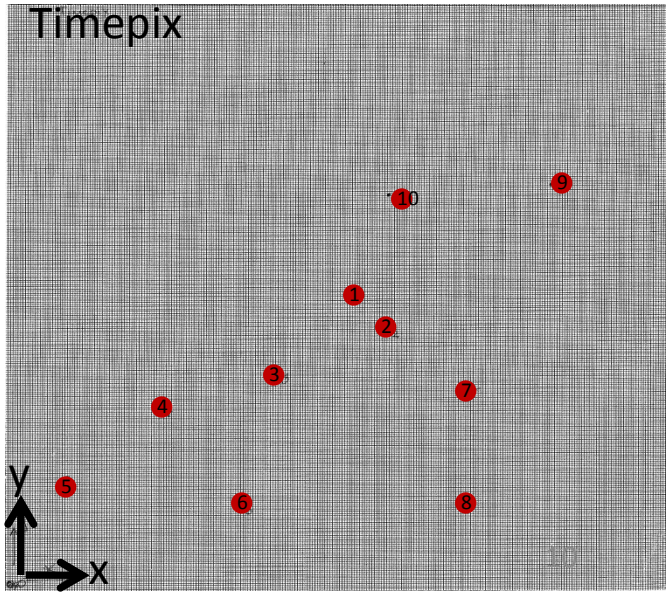
*Have not yet disentangled the 4 peaks!

Pixel to Pixel TOT: Method (not precise!)

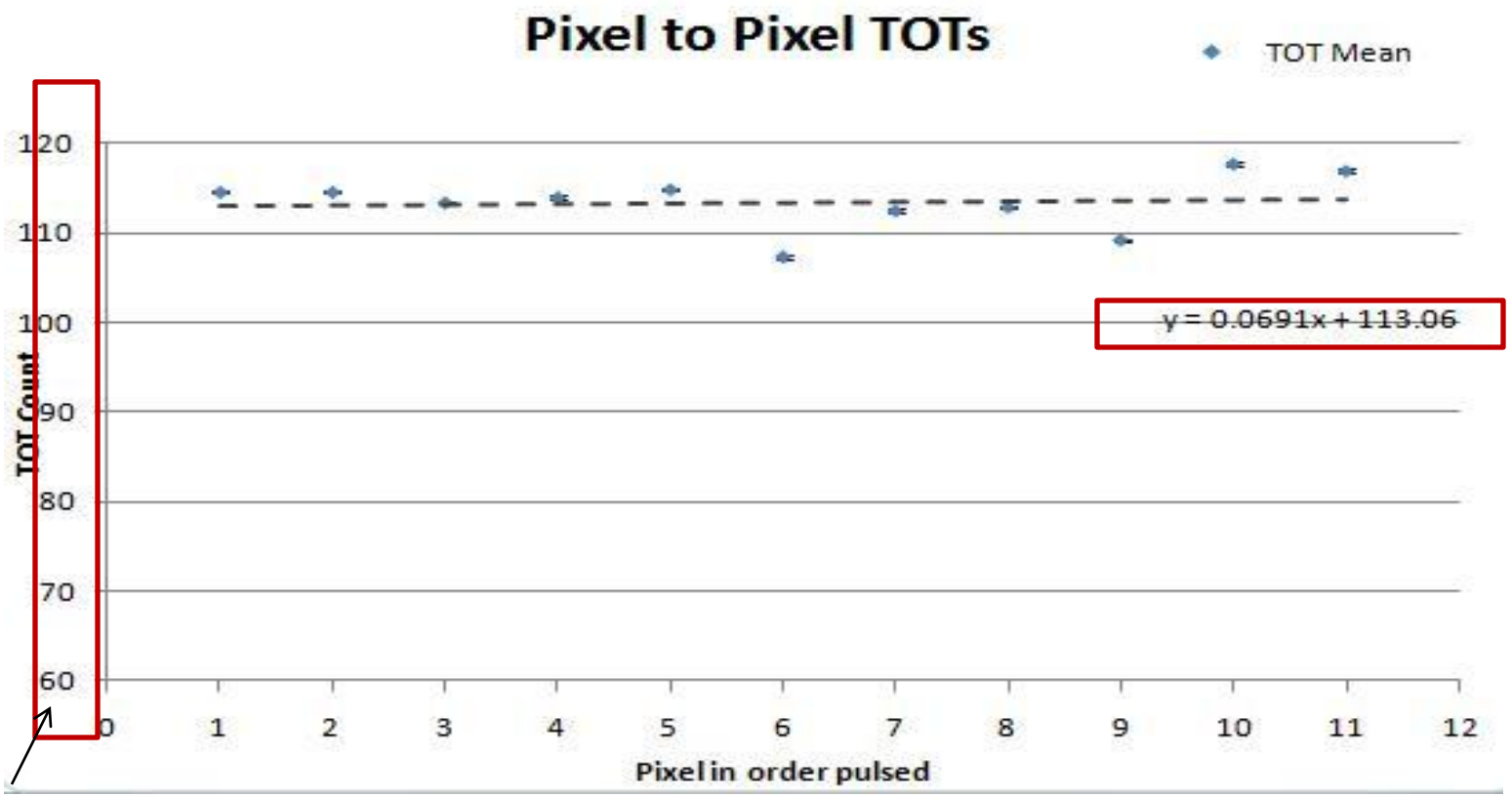
1. Choose central pixel (known)
2. Run Pixelman program over ~1k frames and move laser in x & y manually.
   - Ensure that laser is shooting in 1 pixel only
3. Take 1k frames in TOA and TOT modes.
4. Move to another randomly chosen pixel.
5. Repeat steps 2→4 until satisfied.

*Chose 10 random pixels →

*Re-measured the first one after 10th pixel.



Pixel to Pixel TOT



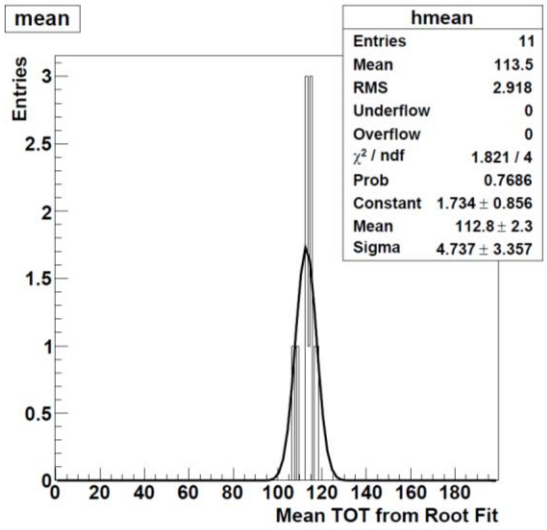
* Note: scale set from 60 to 120 to show small difference in each point

*1st and 11th pixels are the SAME pixel

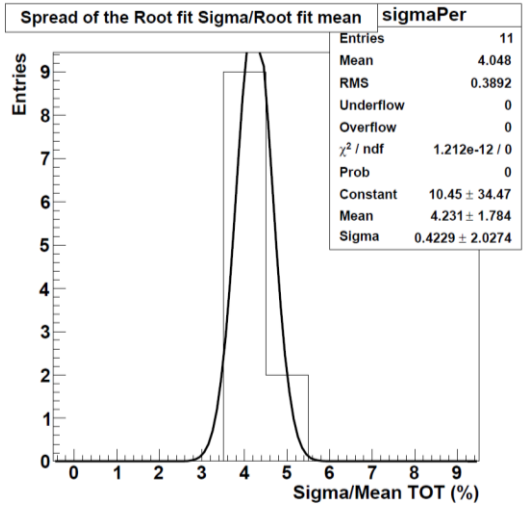
*There is a small change in the TOT which gives a handle on the measurement accuracy

*Fit indicates any drift - more linear than expected.

In other words…

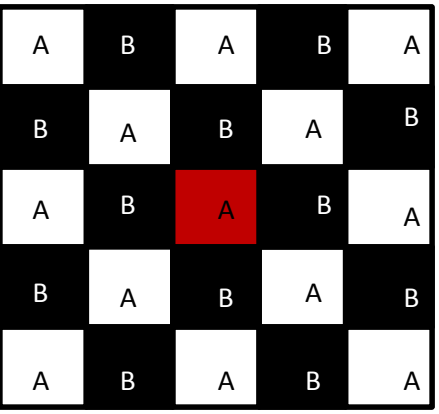


Over 10 pixels, there is a variation in the mean TOT, which can be fitted with a sigma of 4.7 counts, and never exceeds 5.5 counts.
This is a much smaller pixel to pixel variation than we were expecting!



Each individual measurement shows a spread of about 5%. This comes from a combination of variation in laser power, and variation in pixel response
Mean % = 4.23%

Timewalk



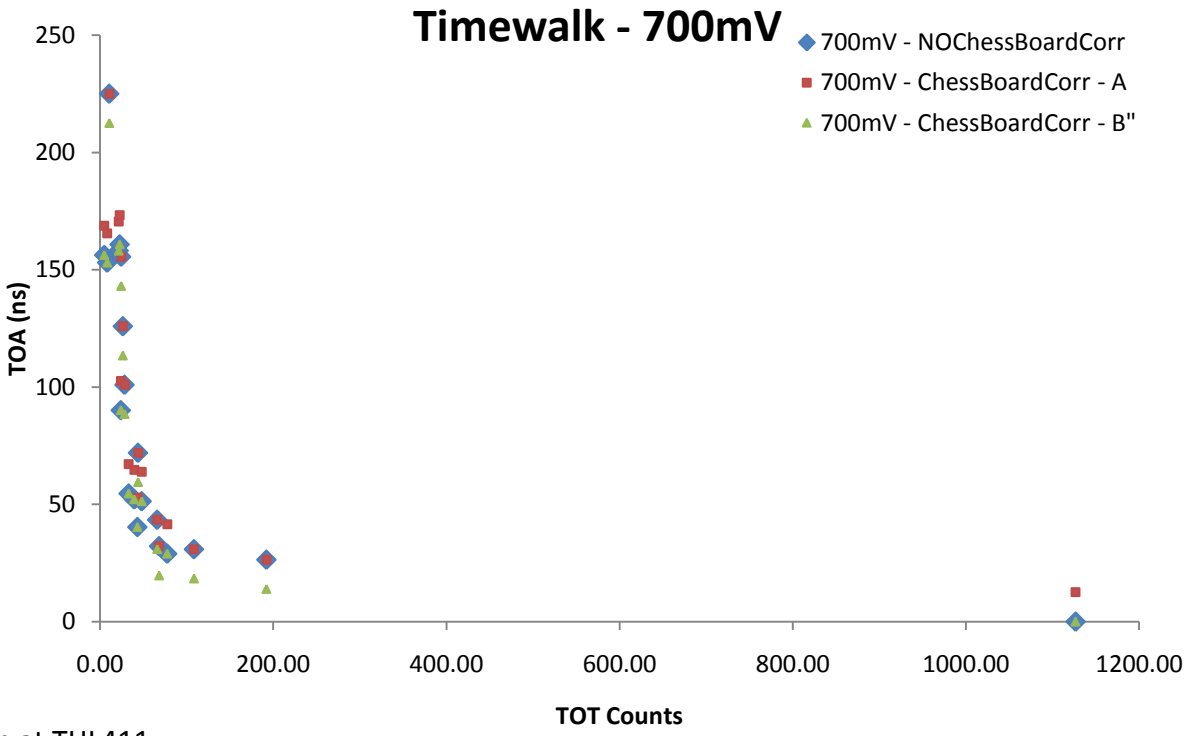
Chess board correction

700mV run:
Taken with laser central on one pixel to get TOT count ~1100

770mV run:
Taken with laser central on one pixel to get TOT count ~1100 but also sharing with adjacent pixel.

900mV run:
Taken with laser central on one pixel to get TOT count ~1100 but also sharing ***more*** with adjacent pixel.

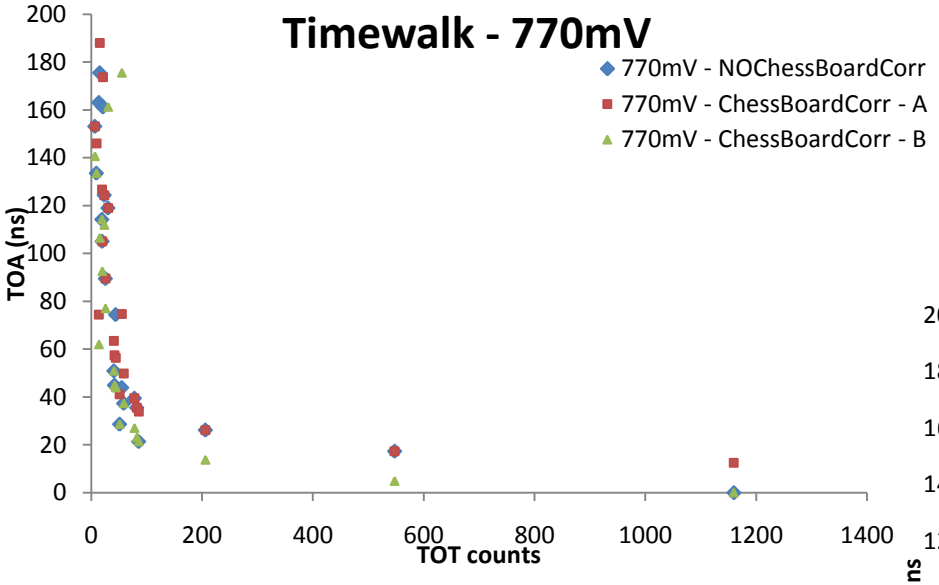
*Similar to Testbeam!
*This is good since I used the same DAC settings!!



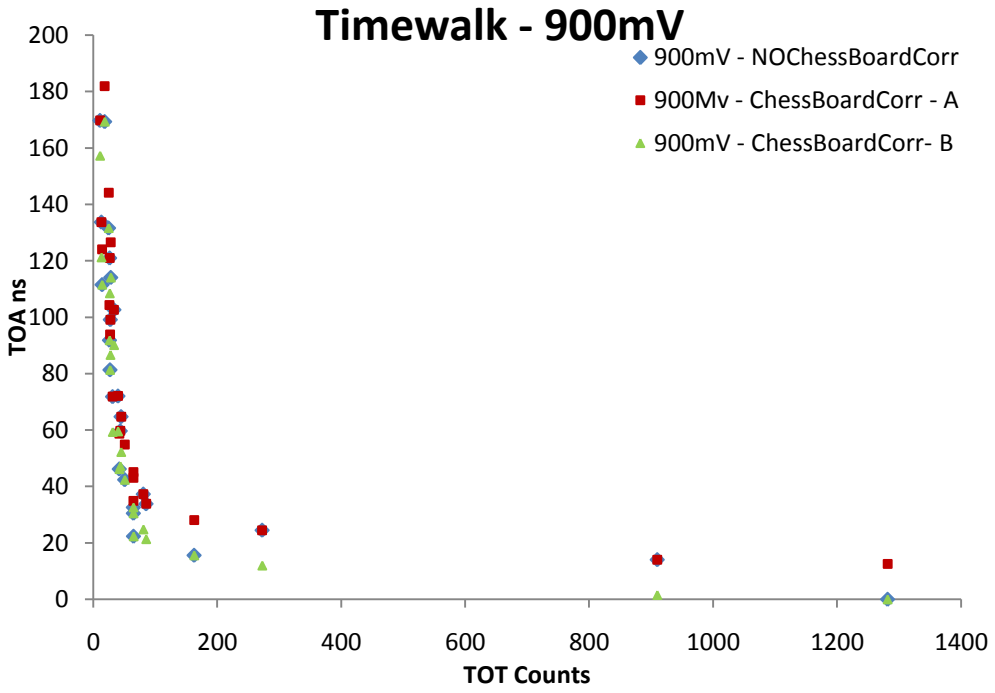
Both taken at THL411
→59 DACs above noise
→1475 e⁻s above noise

Timewalk:

770 and 900 mV

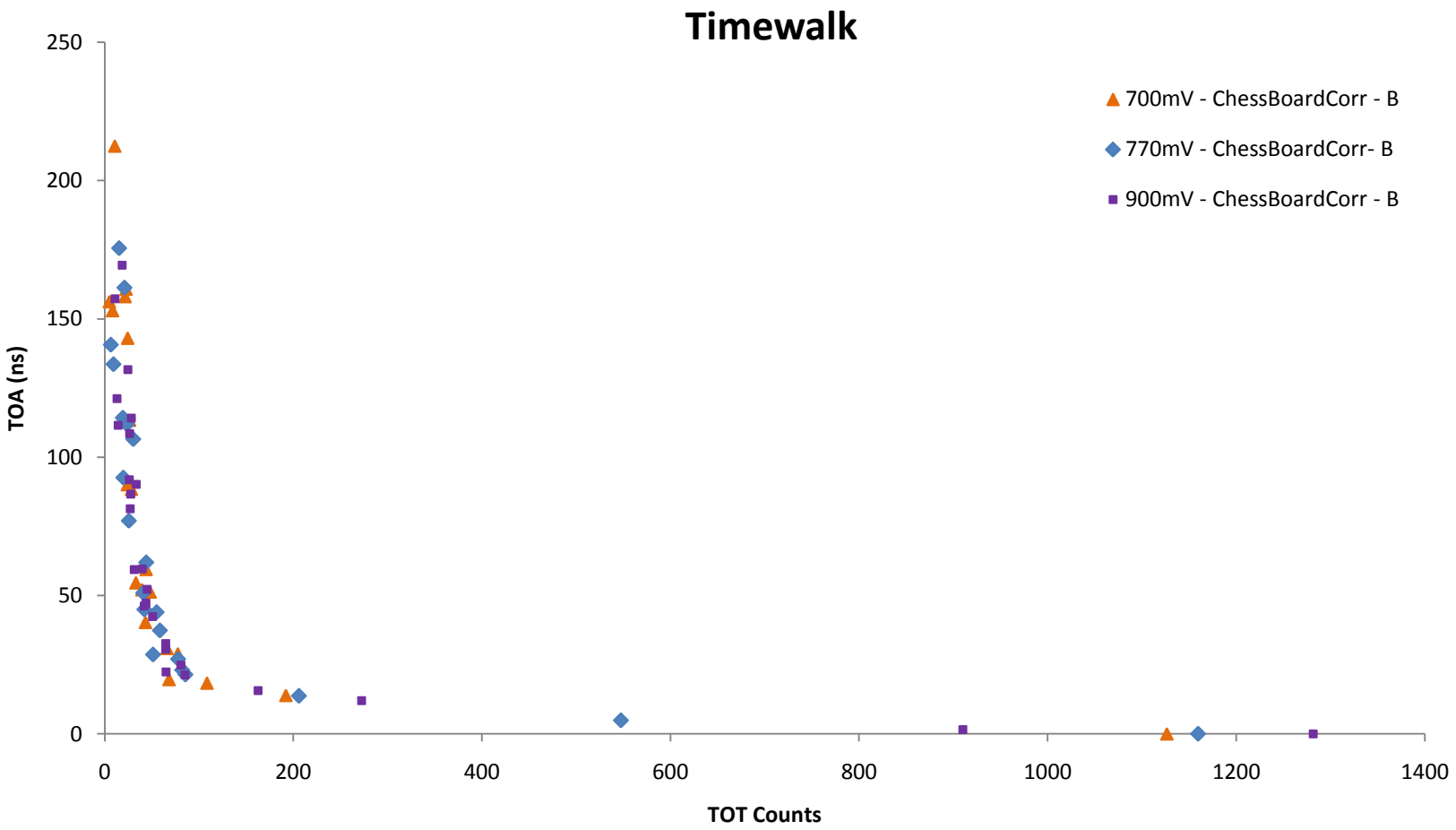


Newest data at 900 mV taken today, thanks to Atreyi!

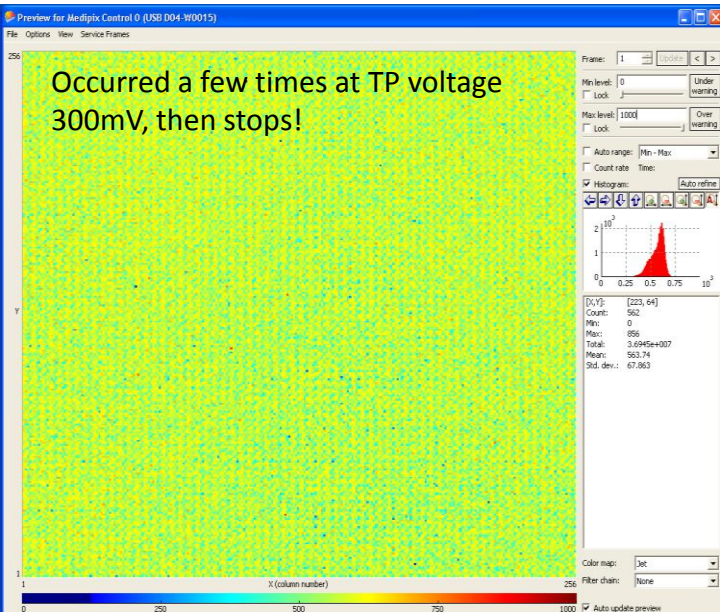


Timewalk:

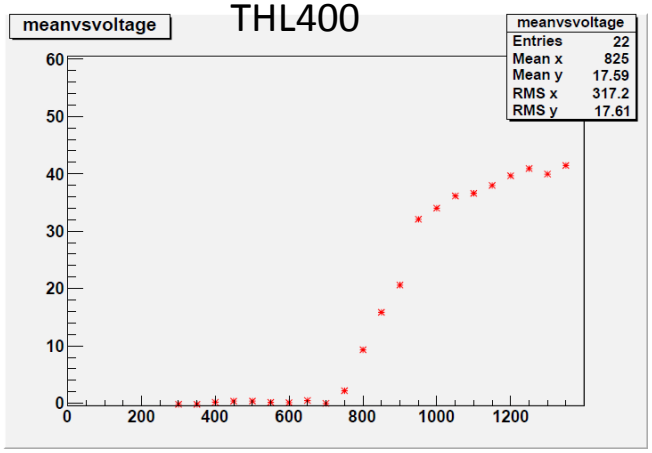
All Voltages together with proper chess board correction

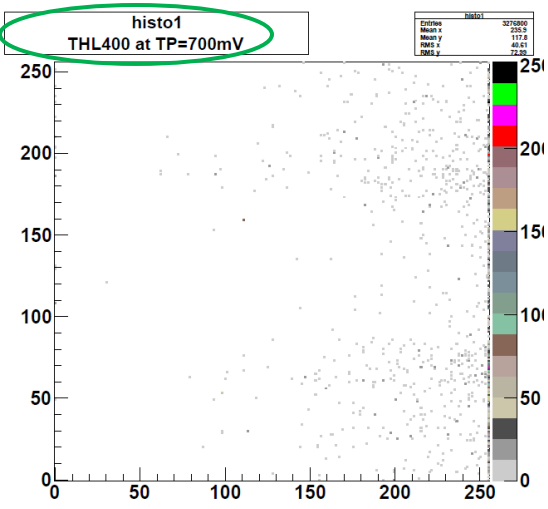


Test Pulse



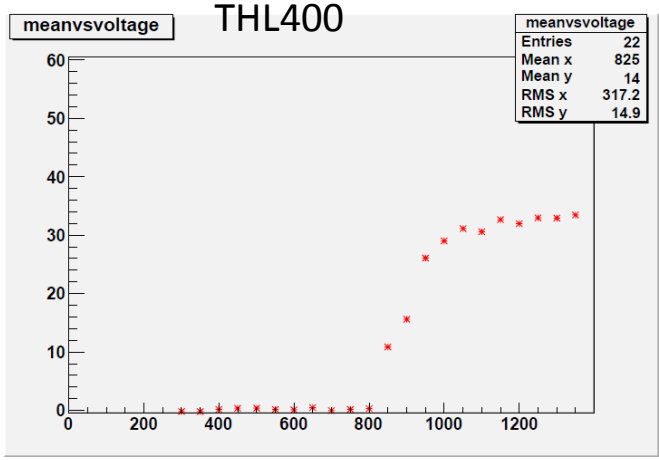
Pixel (0,0)
THL400





TP voltage @ ~490mV is equivalent to 1 MIP!!

Pixel (135,129)
THL400



**THL400 = 70 DACs above noise
➔1750e⁻s above noise

Current and Future studies

- ~900nm laser to be tested soon.
- More on single pixel cluster vs multiple pixel cluster effects.
- Linearity measurement of charge in a pixel.
- Ikrum setting studies for upcoming Testbeam.
- Source data needed for calibration.
- Cosmics with the Timepix at an angle.
- A lot more I can't think of right now!