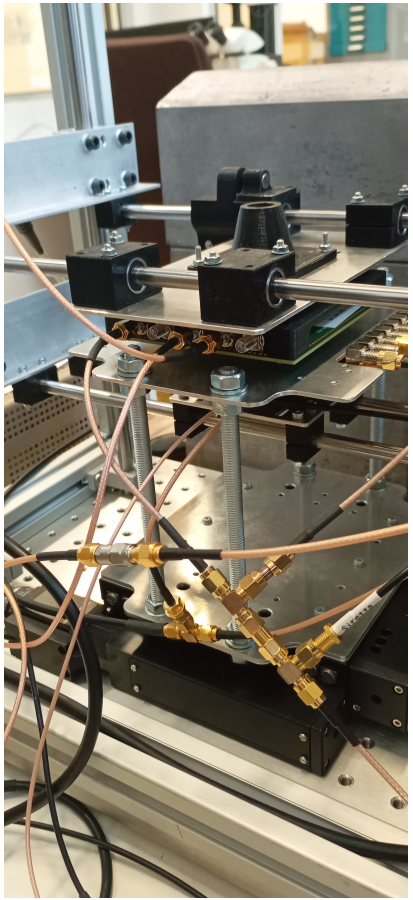
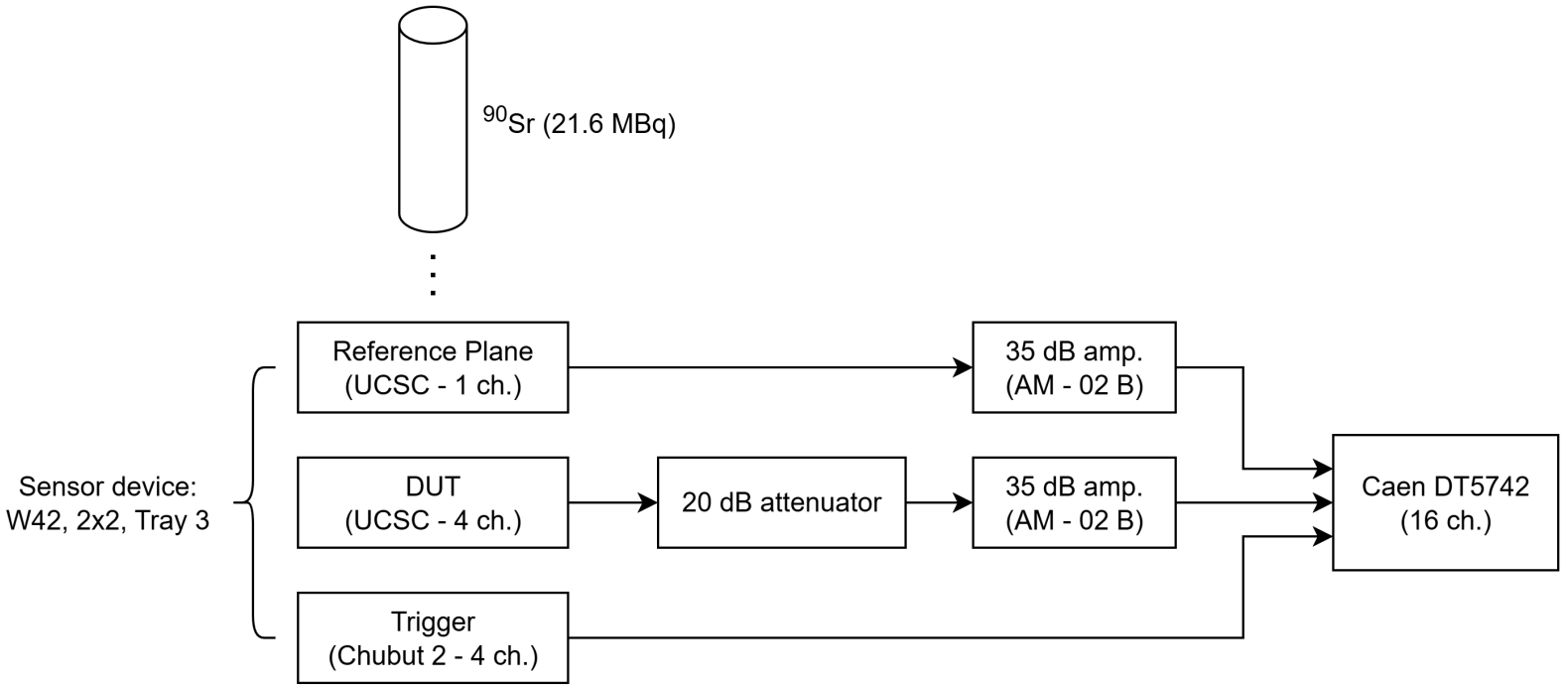
Measurement setup

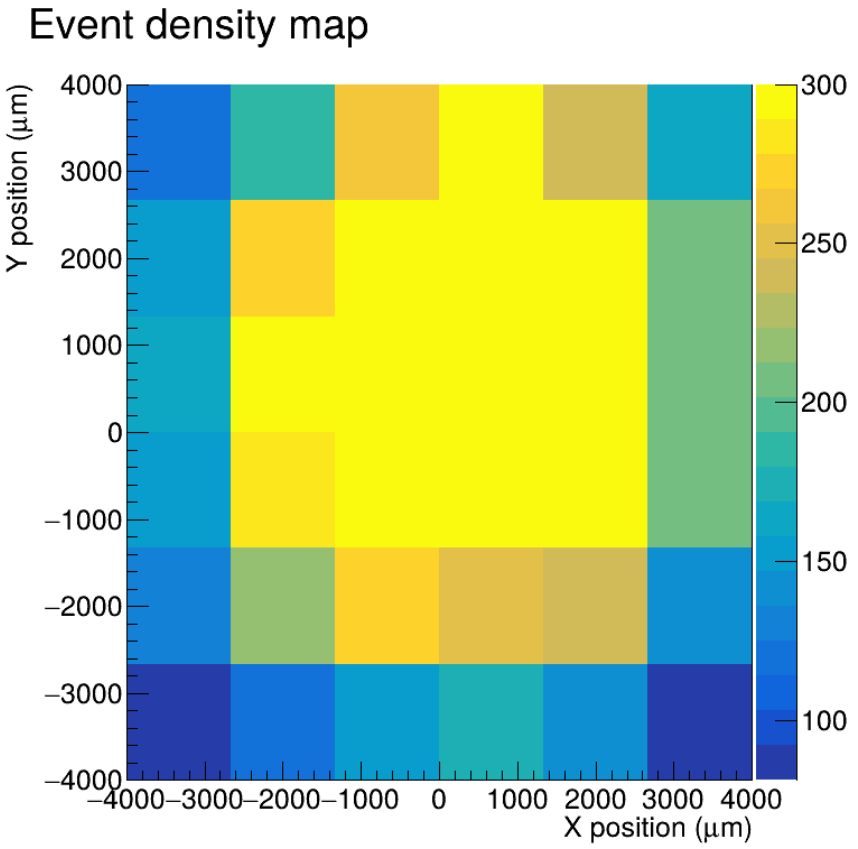




DUT alignment

XY scan

- Aproximate manual alignment (set zero)
- 6x6 grid (-4 to 4 mm in both directions), acquire up to 300 events or timeout at 60 s
- Plot event density (number of hits per scan step)

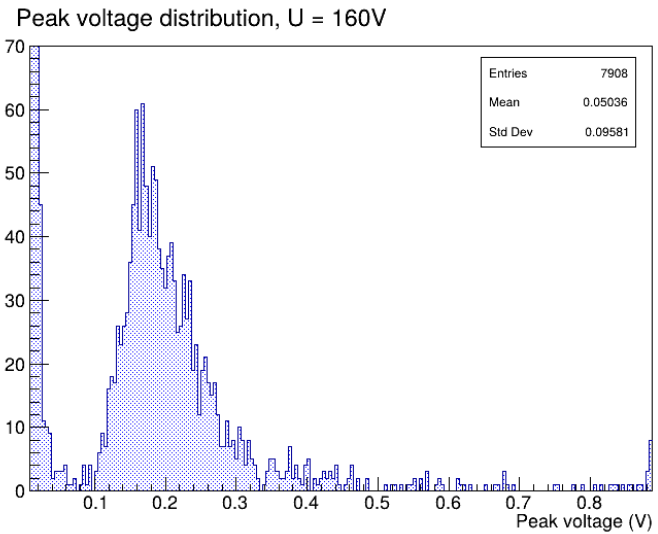


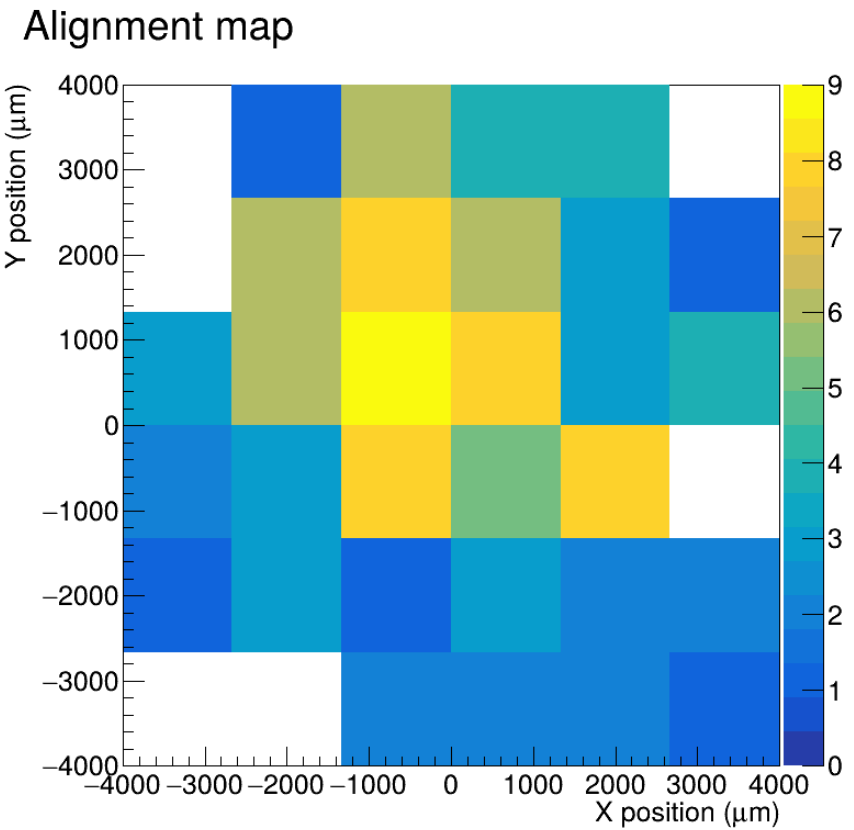
Alignment

From acquired XY data find which position has most events with both reference and DUT signal present.

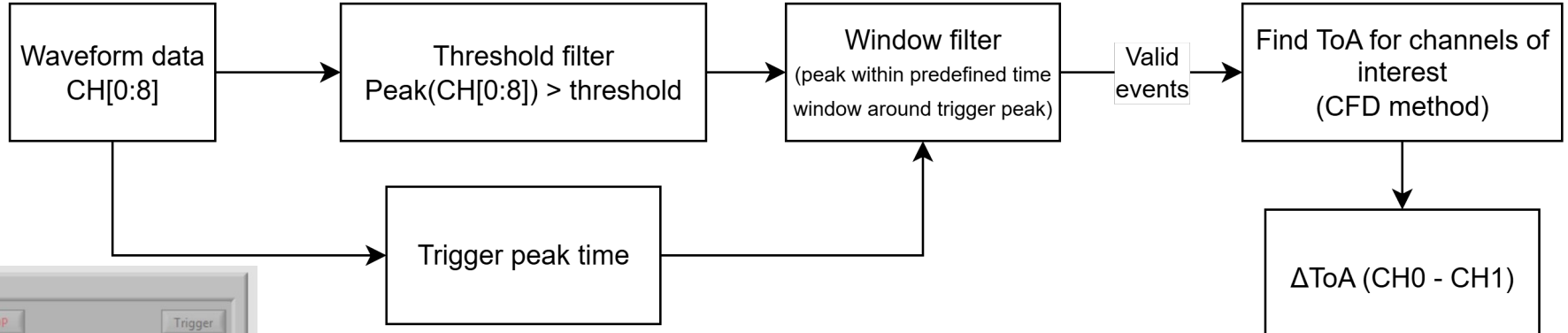
Threshold based filtering:
Peak(CH1) > 0.1 V AND Peak(CH2) > 0.1 V

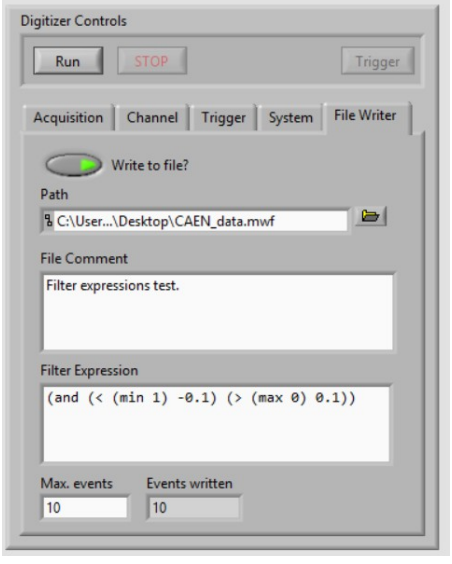
Threshold value based on peak voltage distribution.





Timing data processing



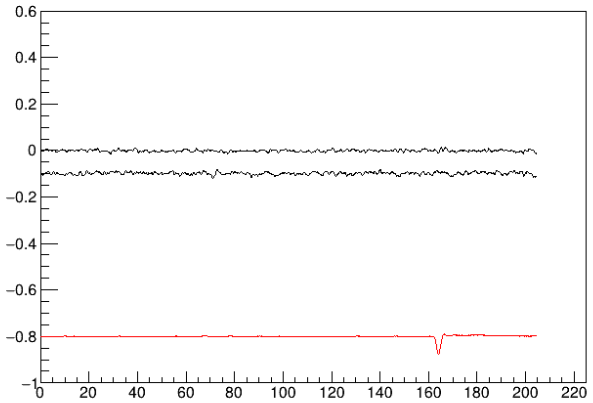


WIP: Real-time event filtering to reduce storage requirements.

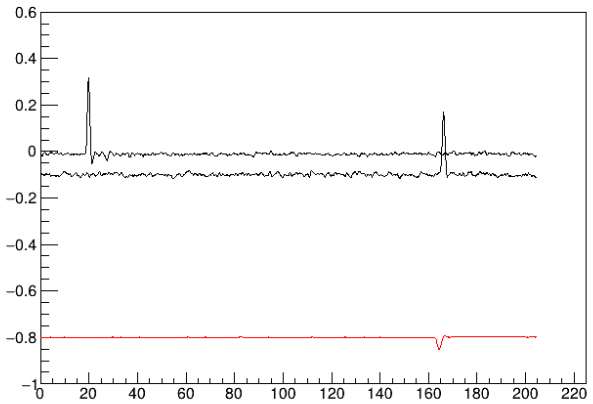
20K events requires 720 MB of storage space (8+1 channels). Out of 20K events ~700 (3.5%) are valid – signal above threshold on both planes and located within trigger time window.

Event filter

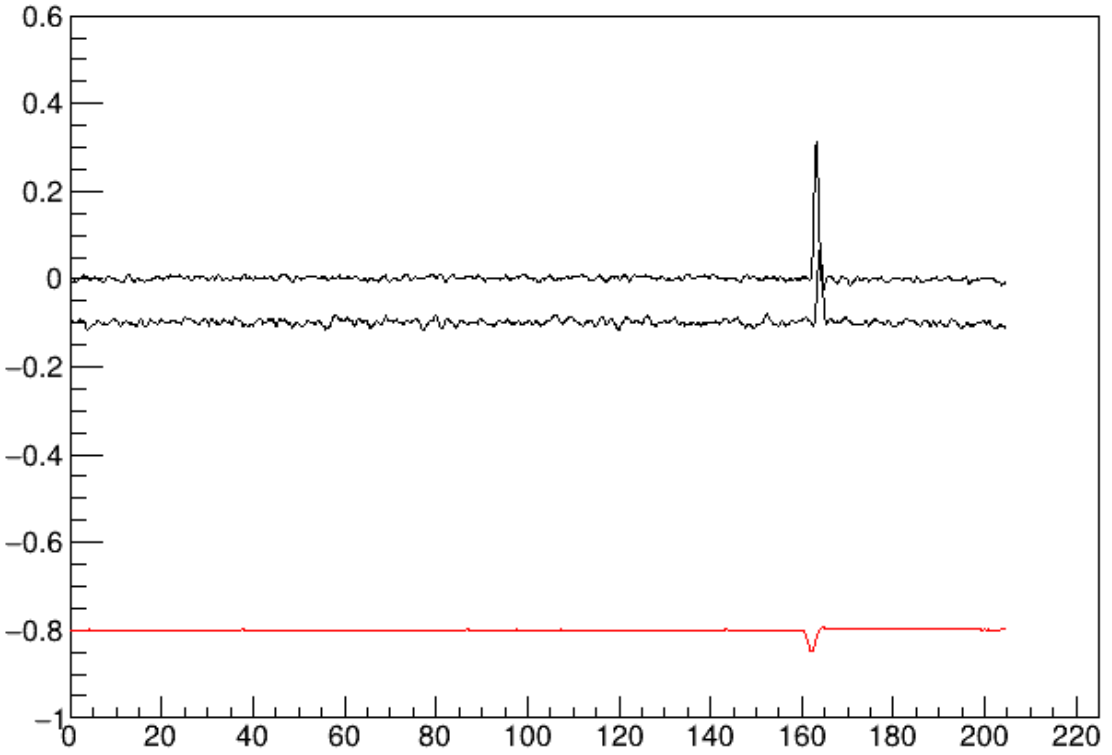
Empty event



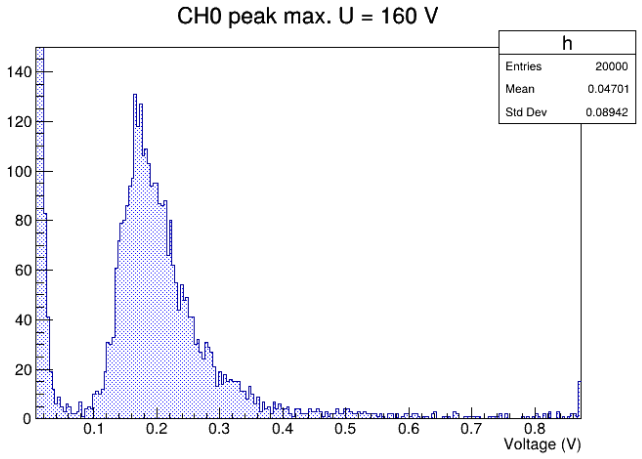
Invalid event - window

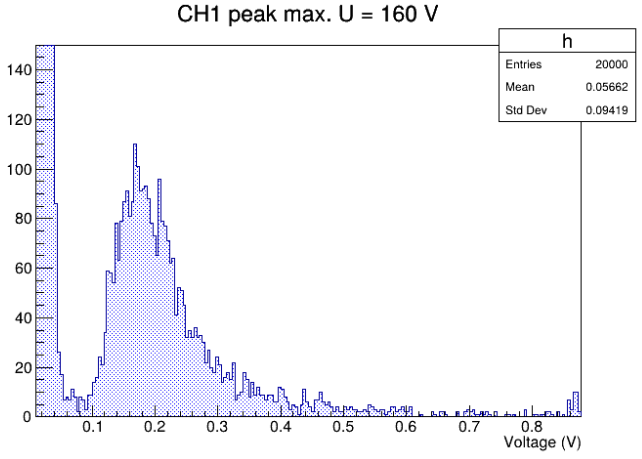


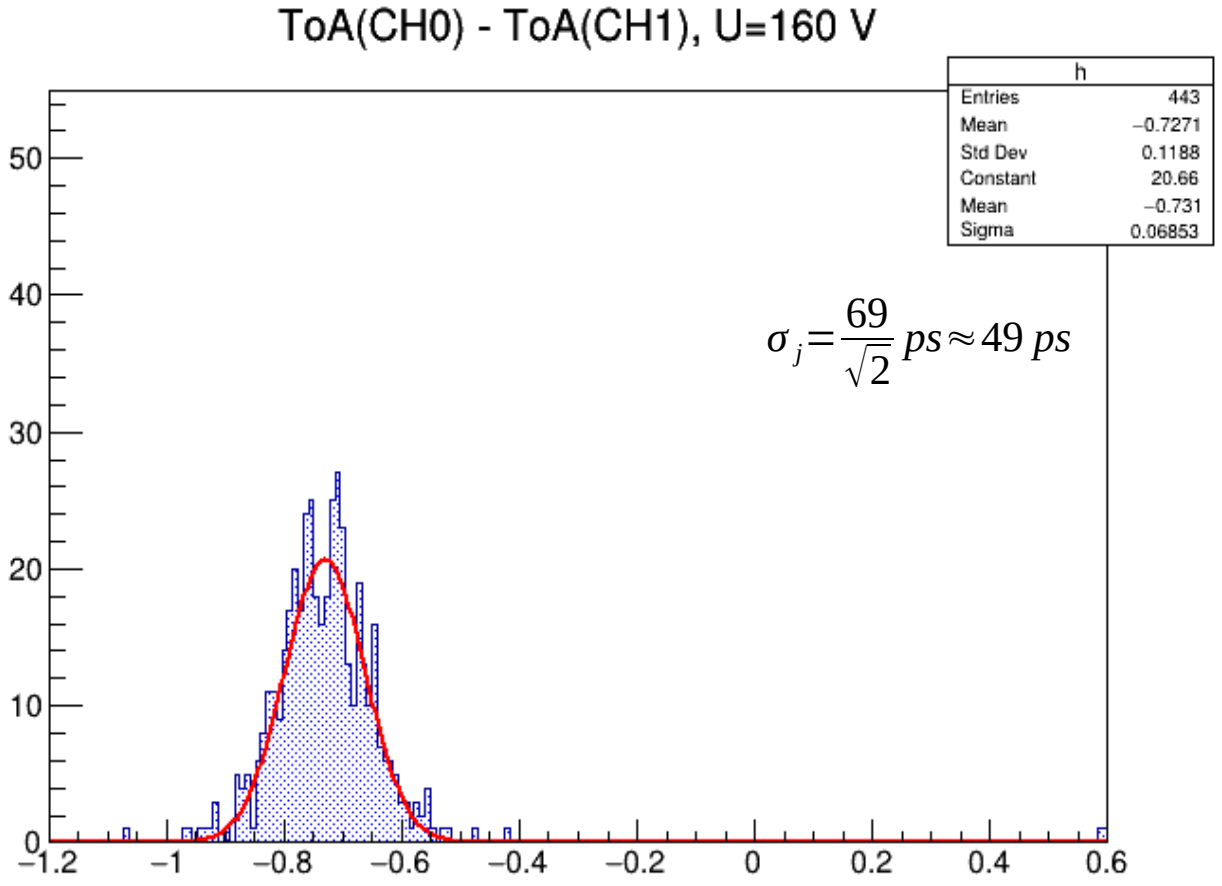
Valid event



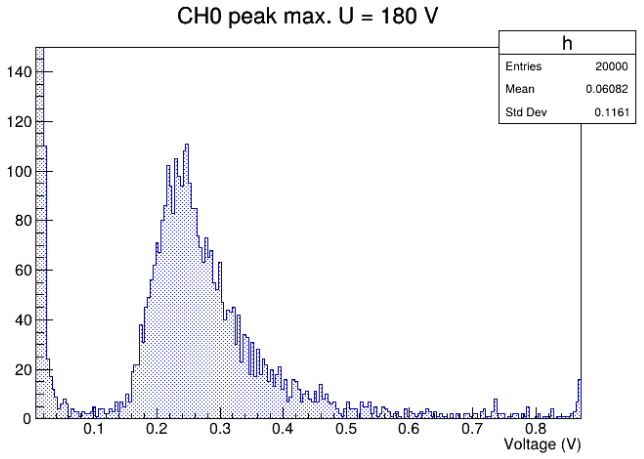
Run 1

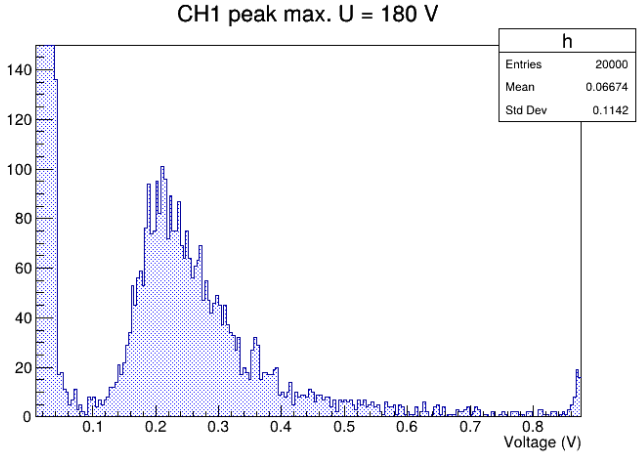

CH0 peak max. U = 160 V
h
Entries 20000
Mean 0.04701
Std Dev 0.08942
Voltage (V)

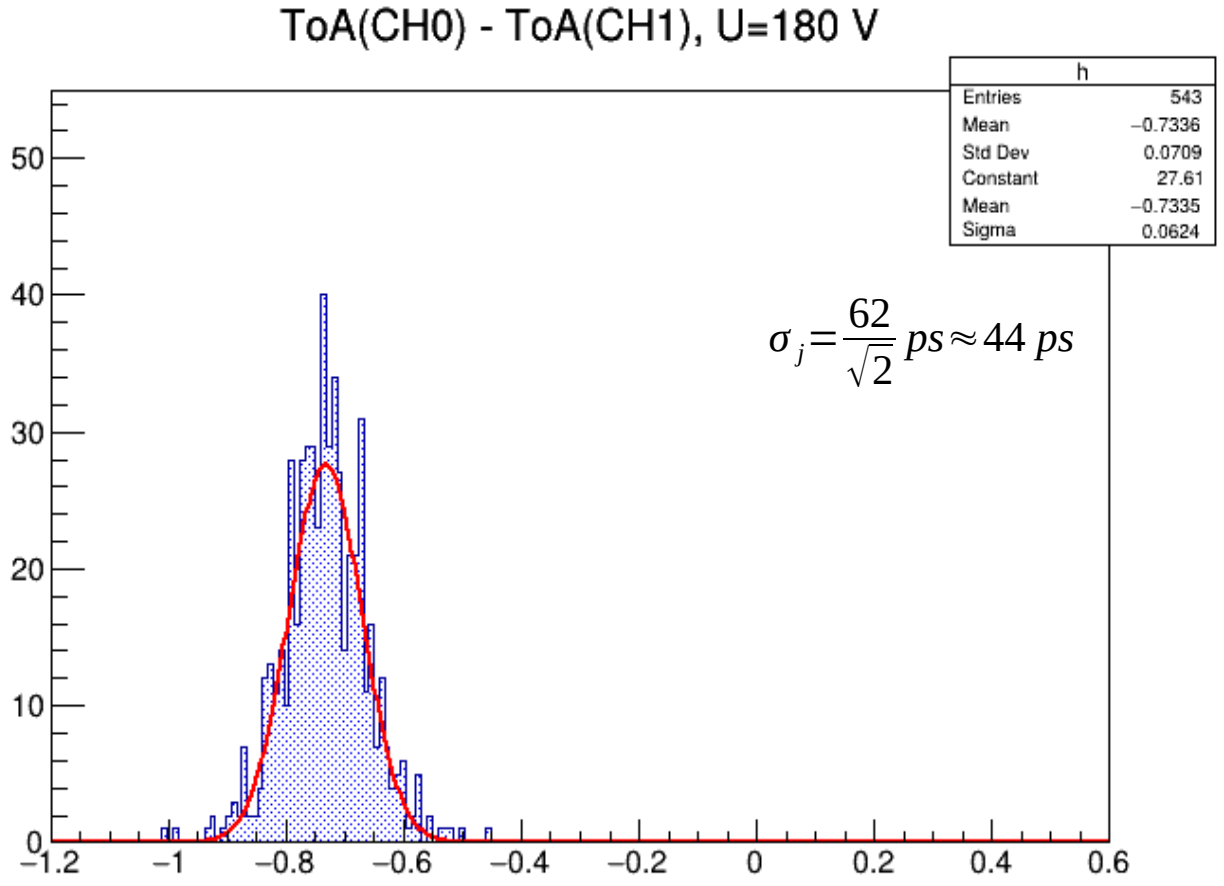

CH1 peak max. U = 160 V
h
Entries 20000
Mean 0.05662
Std Dev 0.09419
Voltage (V)


ToA(CH0) - ToA(CH1), U=160 V
h
Entries 443
Mean −0.7271
Std Dev 0.1188
Constant 20.66
Mean −0.731
Sigma 0.06853
$\sigma_j = \frac{69}{\sqrt{2}}\,ps \approx 49\,ps$

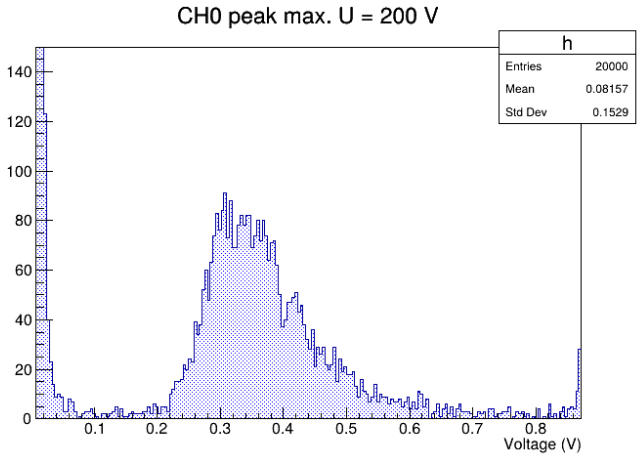
Run 2

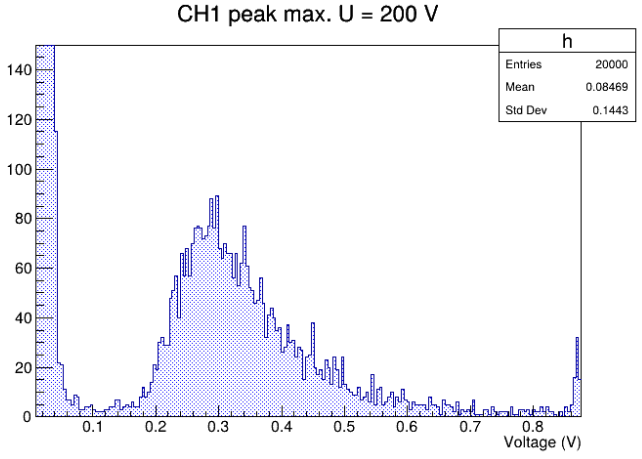

CH0 peak max. U = 180 V
h
Entries 20000
Mean 0.06082
Std Dev 0.1161
Voltage (V)

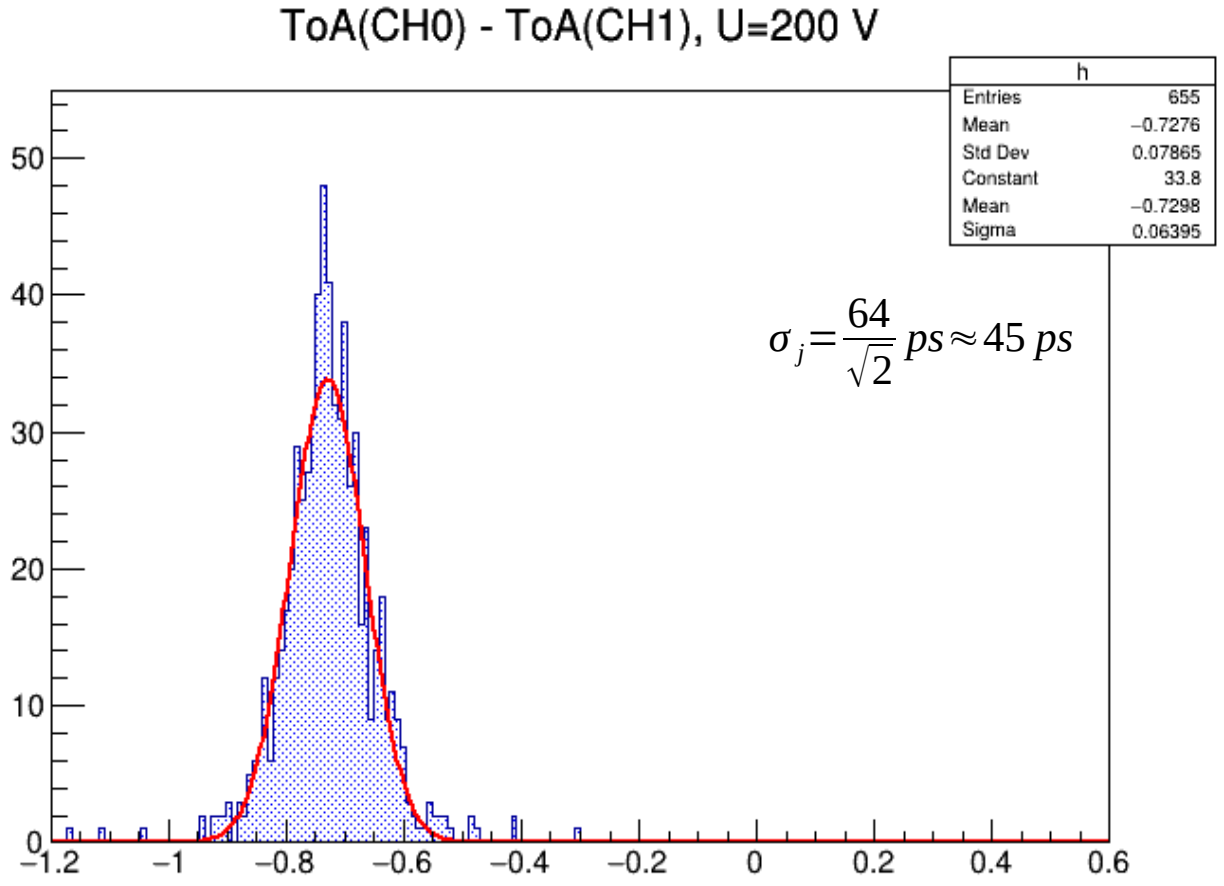

CH1 peak max. U = 180 V
h
Entries 20000
Mean 0.06674
Std Dev 0.1142
Voltage (V)


ToA(CH0) - ToA(CH1), U=180 V
h
Entries 543
Mean −0.7336
Std Dev 0.0709
Constant 27.61
Mean −0.7335
Sigma 0.0624
$\sigma_j = \frac{62}{\sqrt{2}}\,ps \approx 44\,ps$

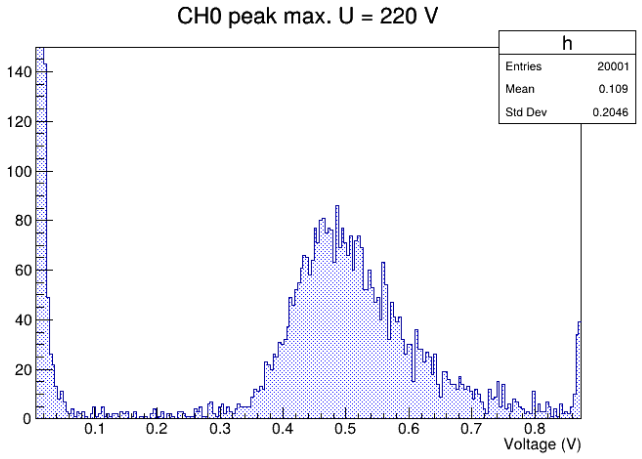
Run 3

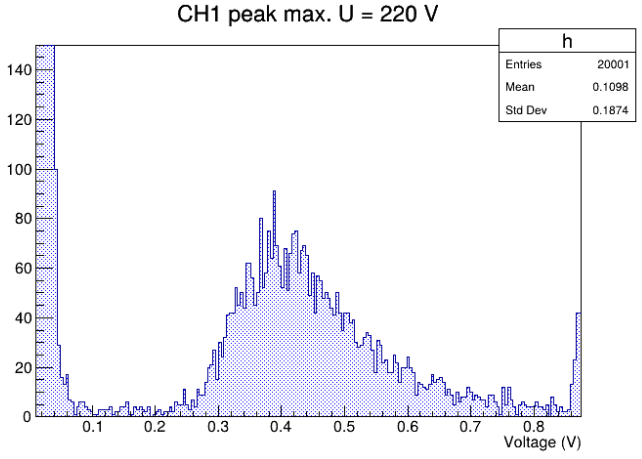

CH0 peak max. U = 200 V
h
Entries 20000
Mean 0.08157
Std Dev 0.1529
Voltage (V)

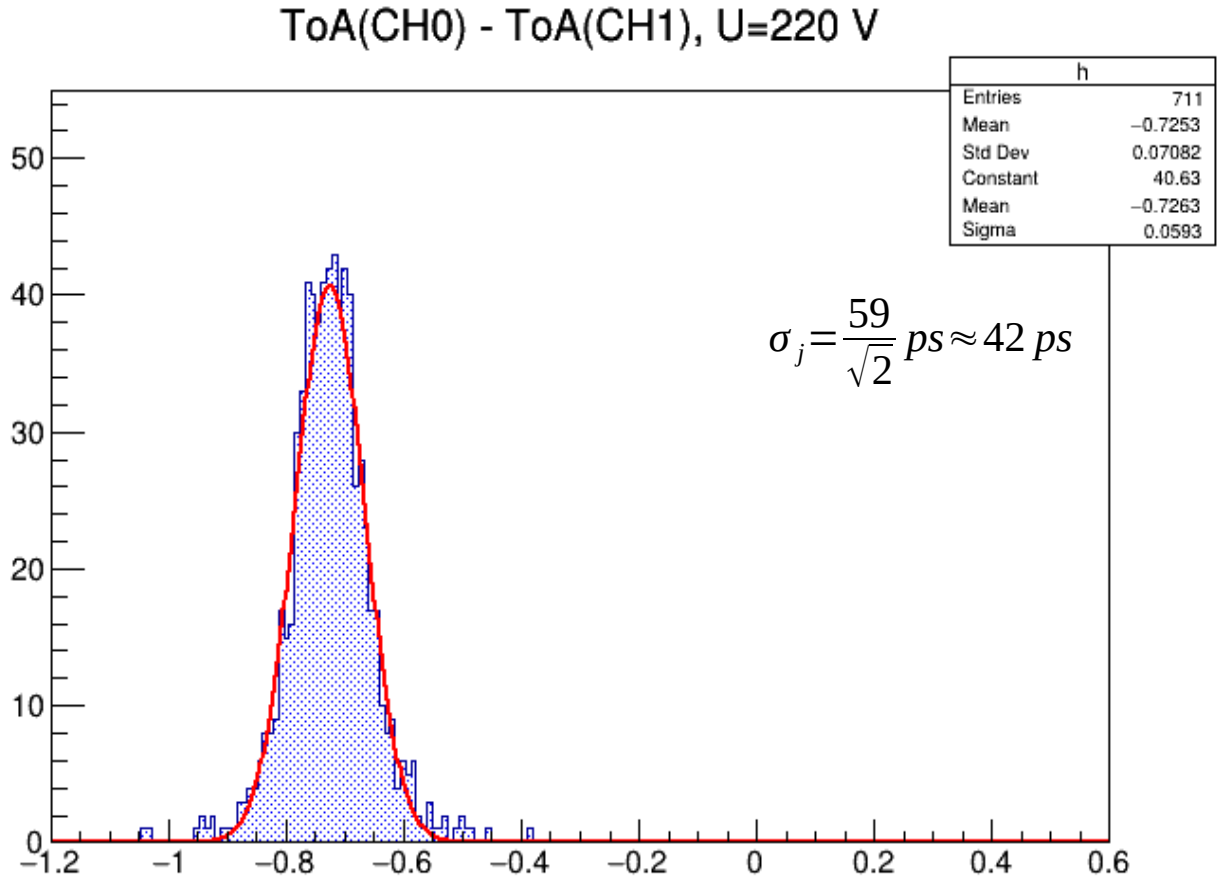

CH1 peak max. U = 200 V
h
Entries 20000
Mean 0.08469
Std Dev 0.1443
Voltage (V)


ToA(CH0) - ToA(CH1), U=200 V
h
Entries 655
Mean −0.7276
Std Dev 0.07865
Constant 33.8
Mean −0.7298
Sigma 0.06395
$\sigma_j = \frac{64}{\sqrt{2}}\,ps \approx 45\,ps$

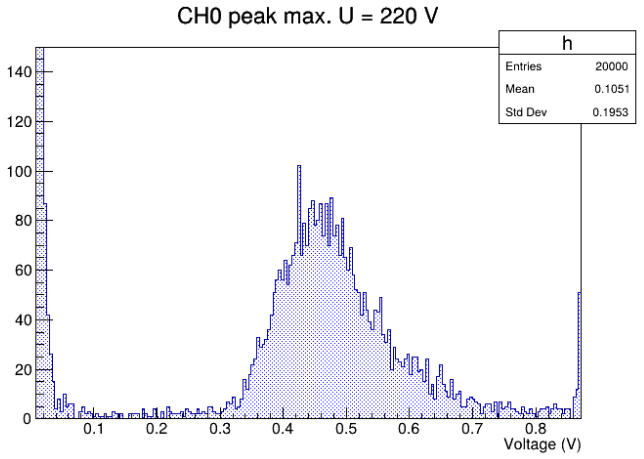
Run 4

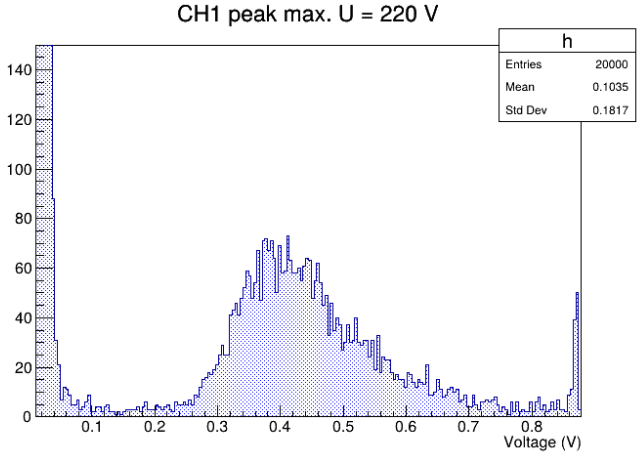

CH0 peak max. U = 220 V
h
Entries 20001
Mean 0.109
Std Dev 0.2046
Voltage (V)

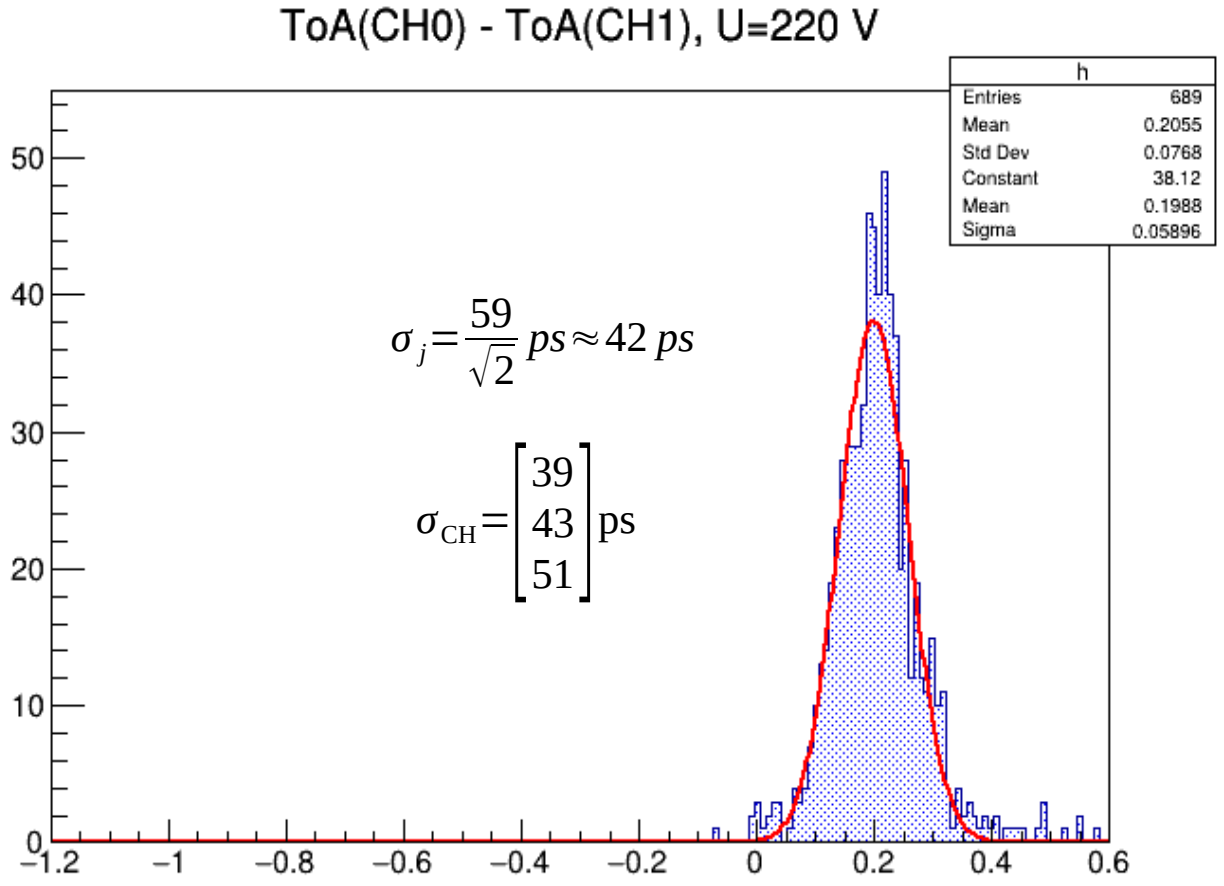

CH1 peak max. U = 220 V
h
Entries 20001
Mean 0.1098
Std Dev 0.1874
Voltage (V)


ToA(CH0) - ToA(CH1), U=220 V
h
Entries 711
Mean −0.7253
Std Dev 0.07082
Constant 40.63
Mean −0.7263
Sigma 0.0593
$\sigma_j = \frac{59}{\sqrt{2}}\,ps \approx 42\,ps$

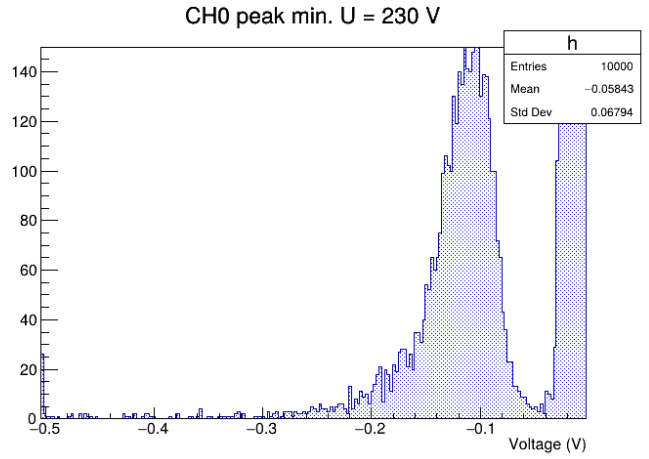
Run 5, ~0.5 ns added delay to CH0

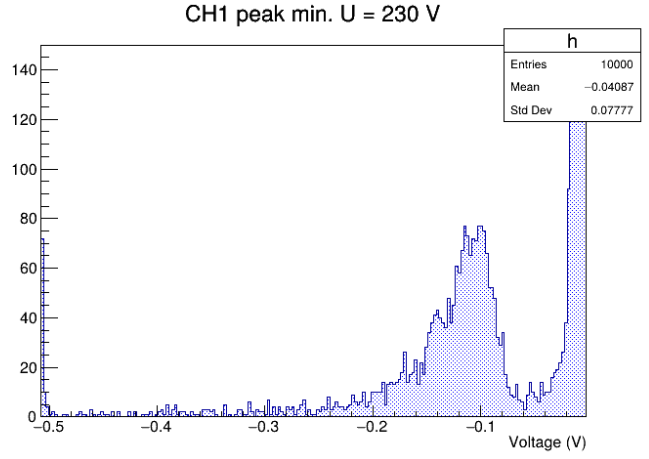


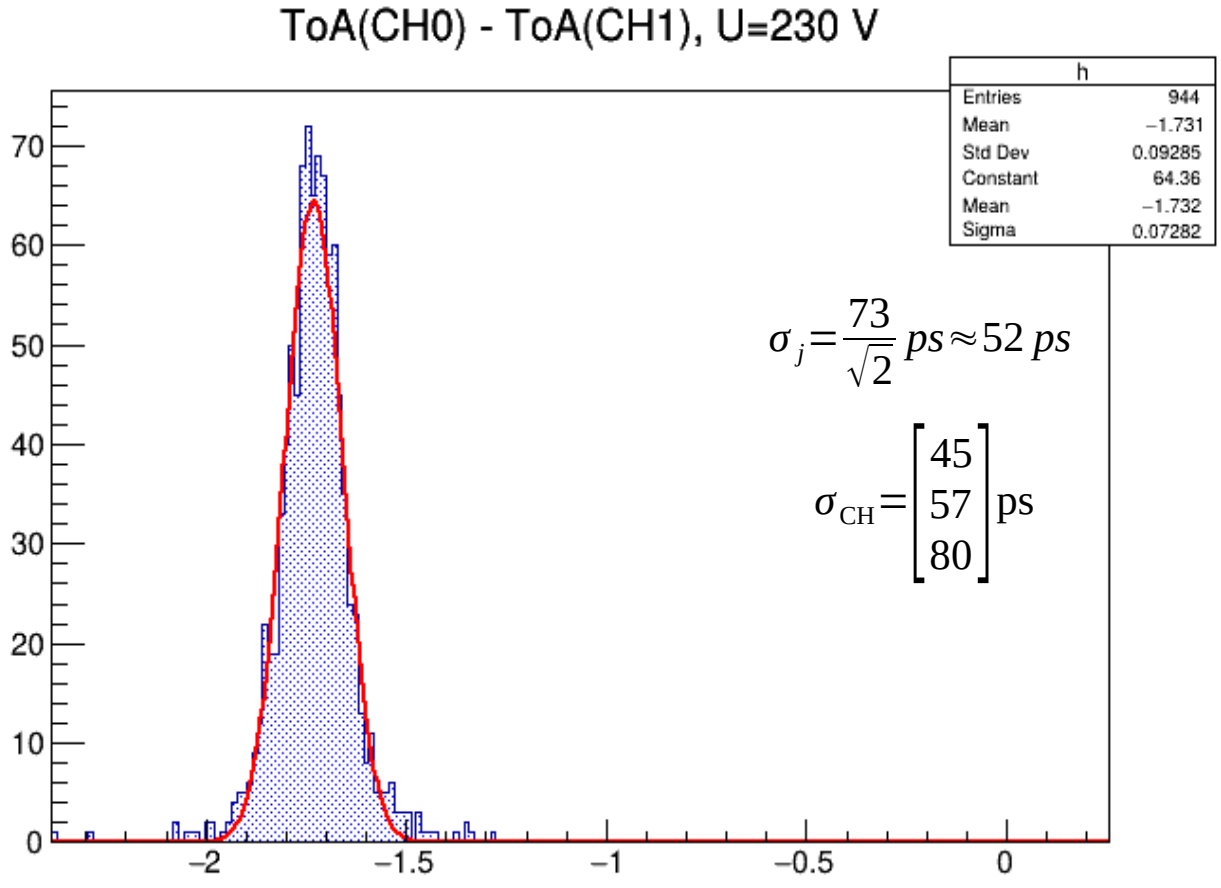




Run 6 (all Chubut boards)







$$\sigma_j = \frac{73}{\sqrt{2}}\,ps \approx 52\,ps$$

$$\sigma_{CH} = \begin{bmatrix} 45 \\ 57 \\ 80 \end{bmatrix} \text{ps}$$