35ton Sim/Reco/Analysis Meeting 11/18/2015

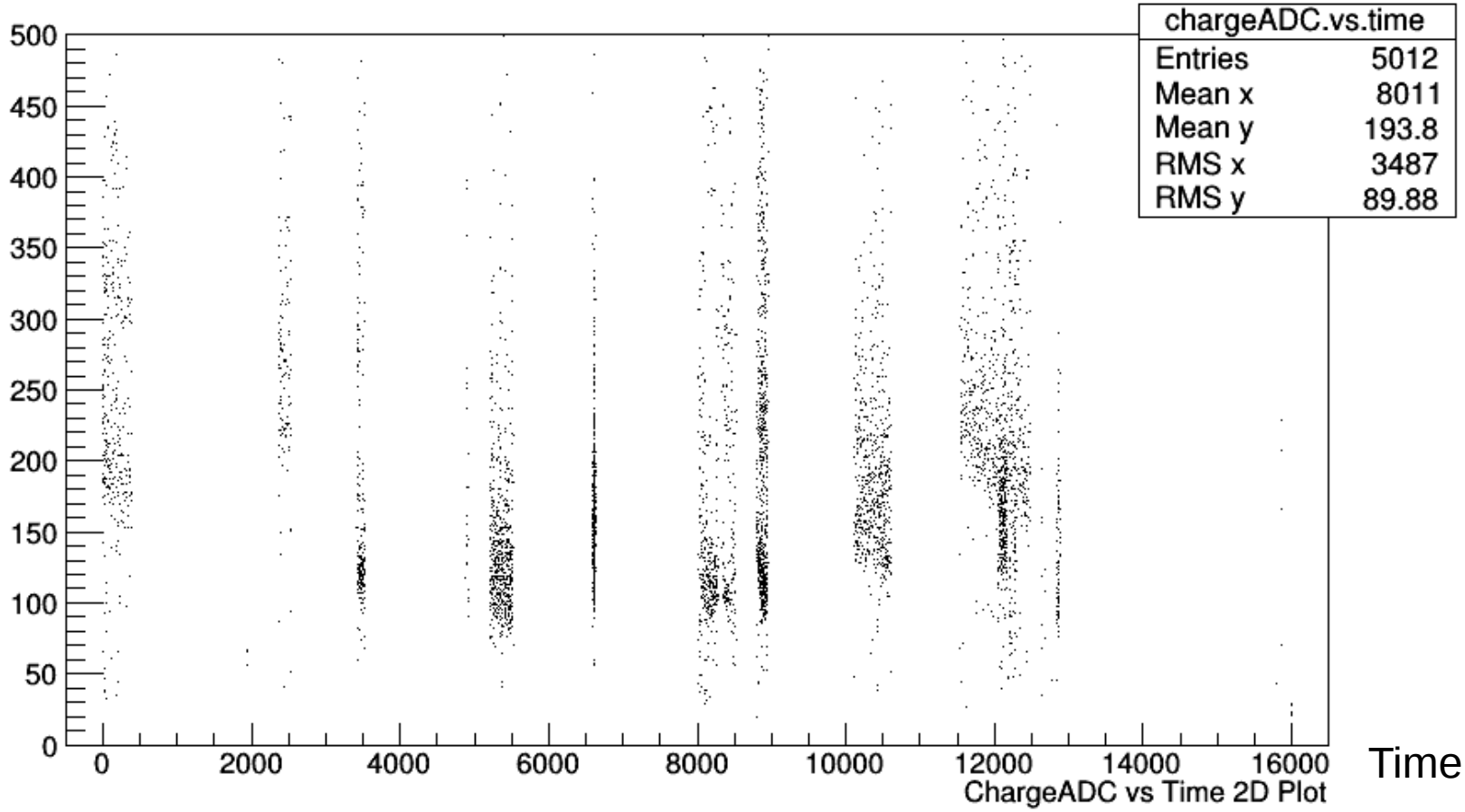
Celio Moura (UFABC)

Measuring Purity Offline
- Electron Lifetime
(*work in progress*)

Electron Lifetime

- The electron lifetime τ_{ele} is inversely proportional to the attenuation of the ionization charge signal produced by the particle energy deposition;
- The attenuation is a function of the drift distance from the wire planes;
- $Q = Q_0 \exp(-d/\lambda) = Q_0 \exp(-(t-t_0)v_{drift}/\lambda);$
- $lnQ = -(v_{drift}/\lambda)t + const.$
- $v_{drift}/\lambda = 1/\tau_{ele}$;
- $lnQ = t/\tau_{ele} + const.$

Simulation – One event

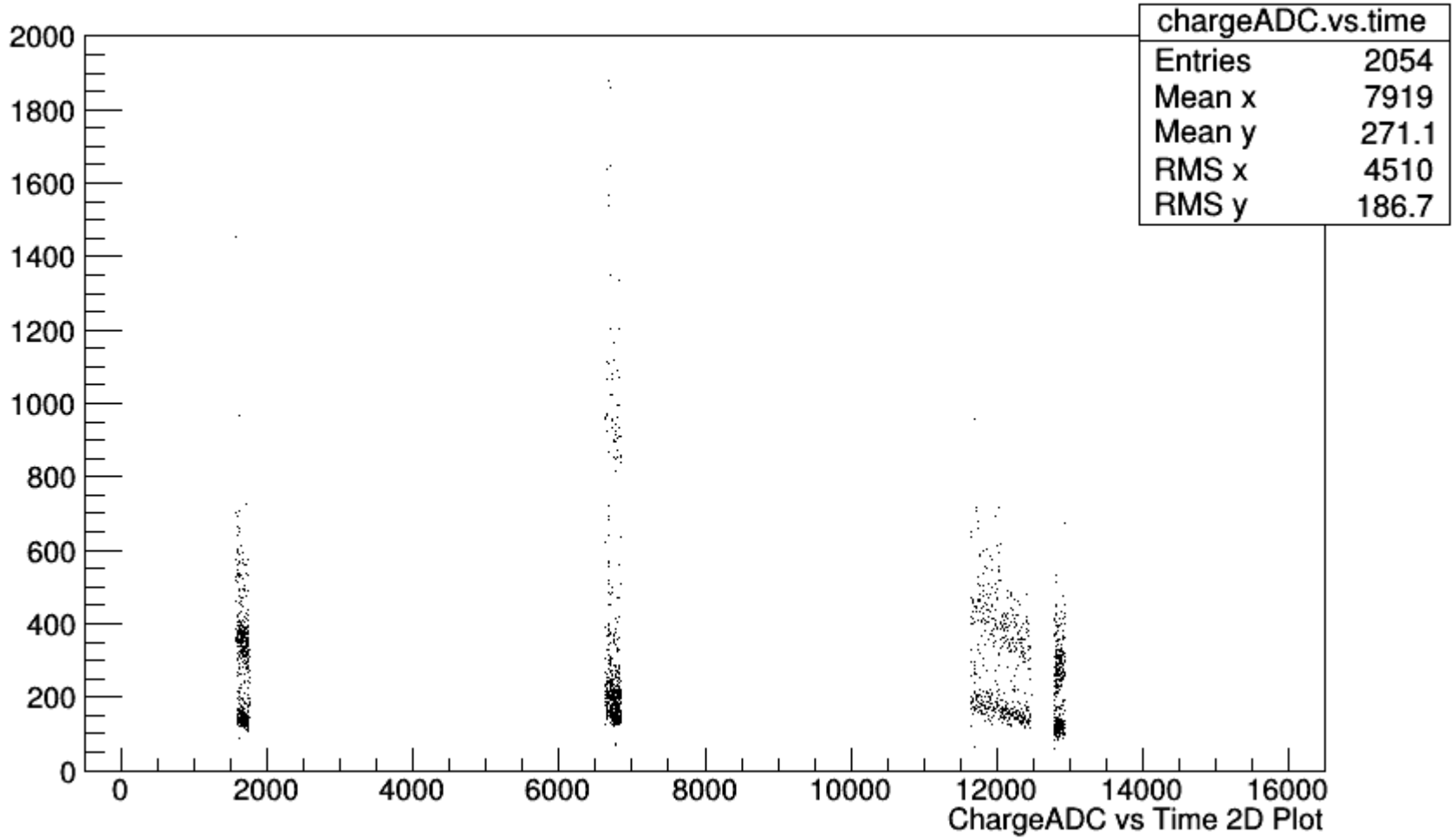


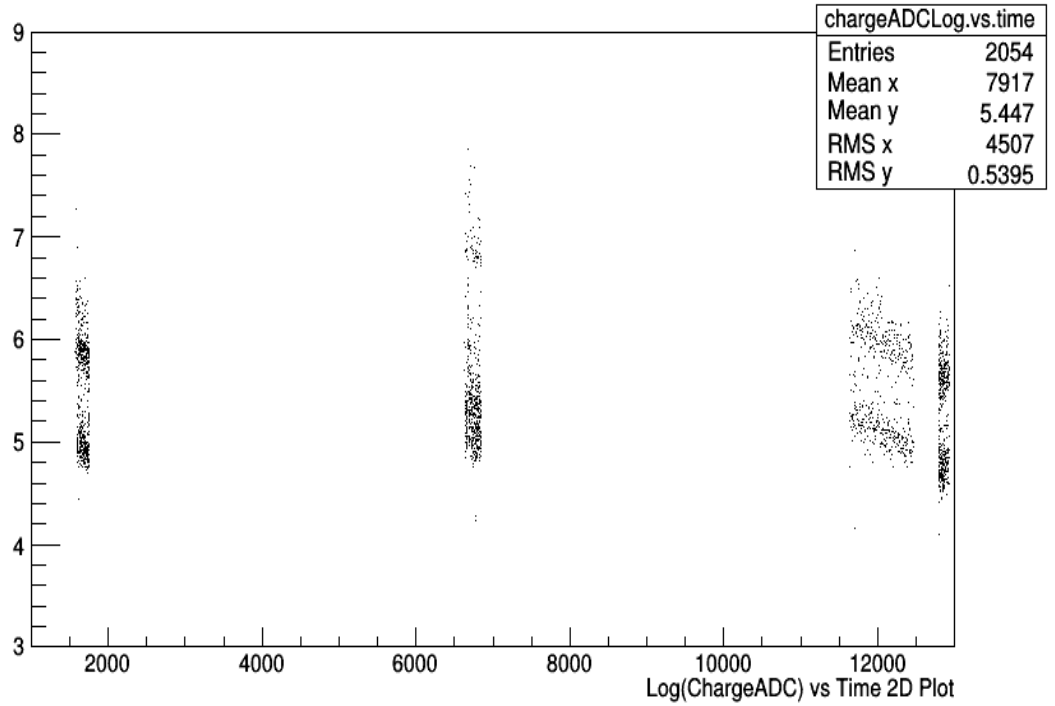
prodcosmics_dune35t_miliblock_0_20150827T232050_merged.root

Track selection

from 4 events

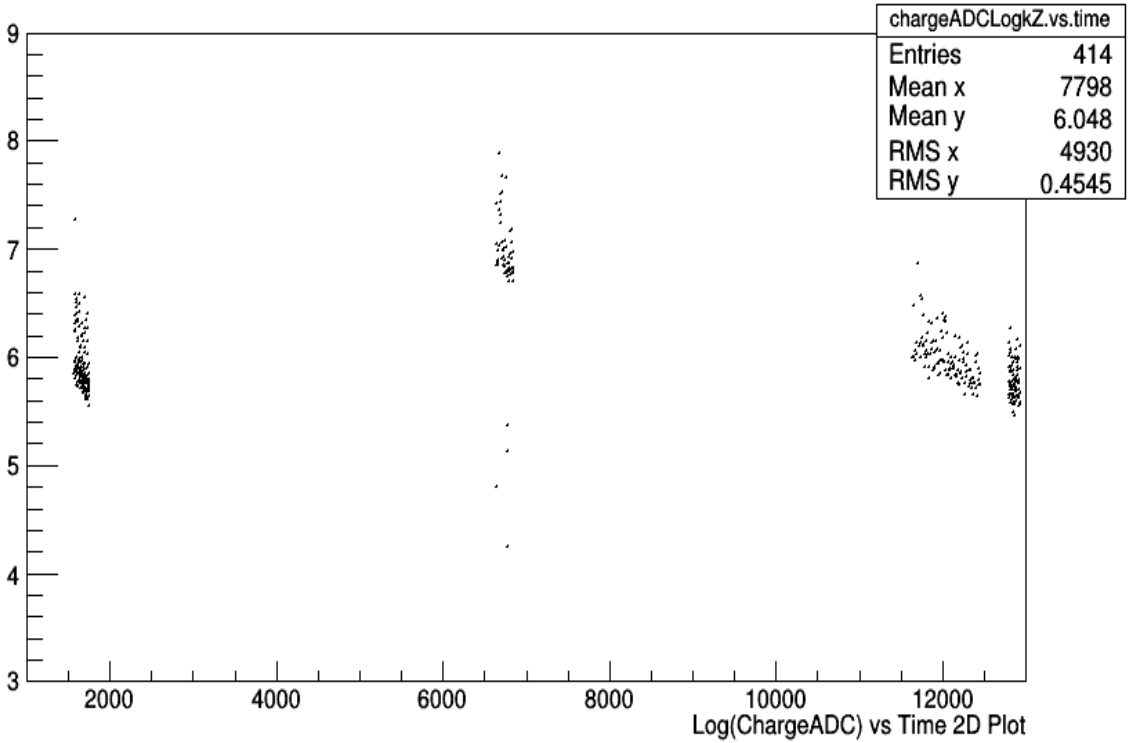
- Long tracks → number of wires with hits > 300;





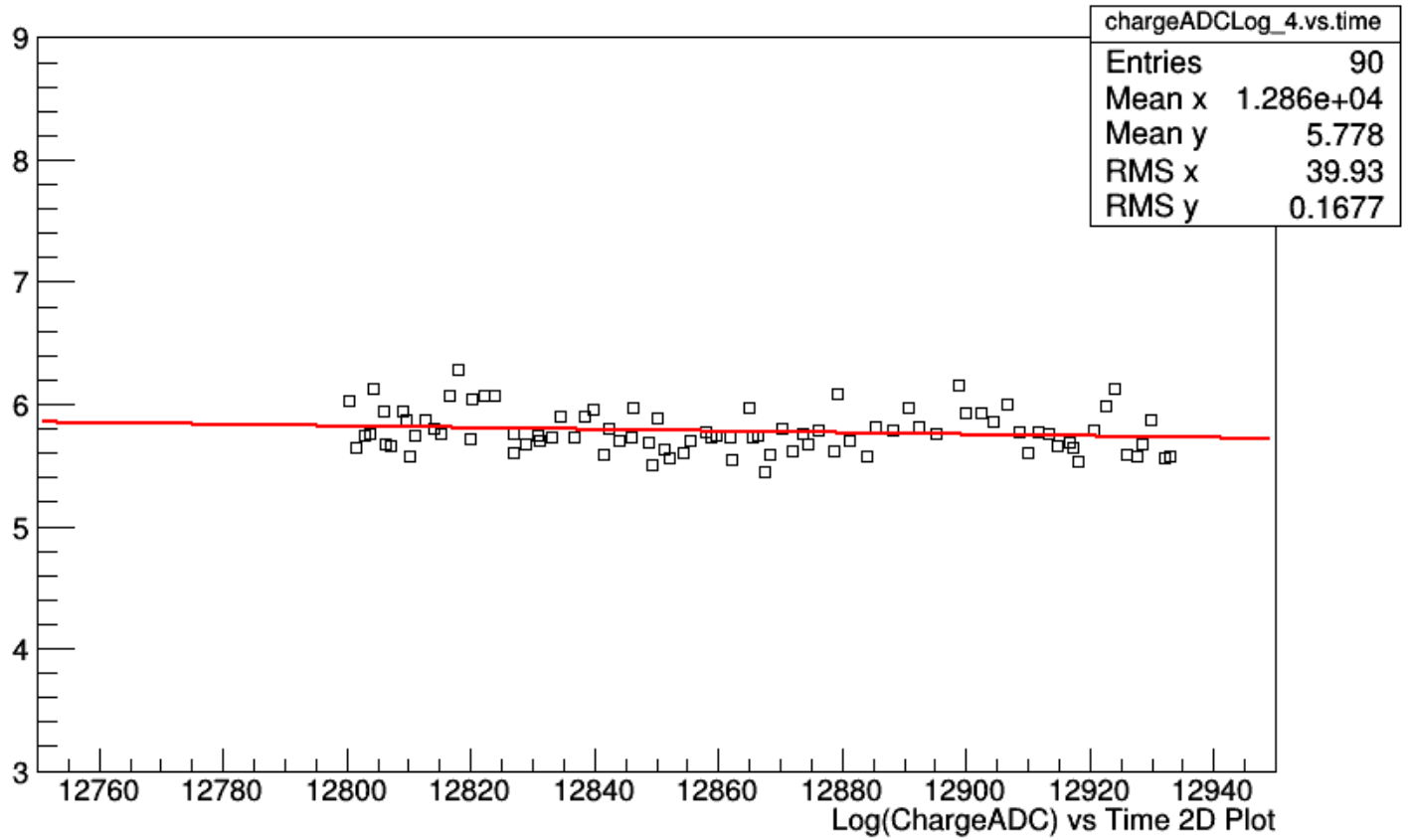
Hits selection

Logarithm of charge
All planes
vs
Only collection plane



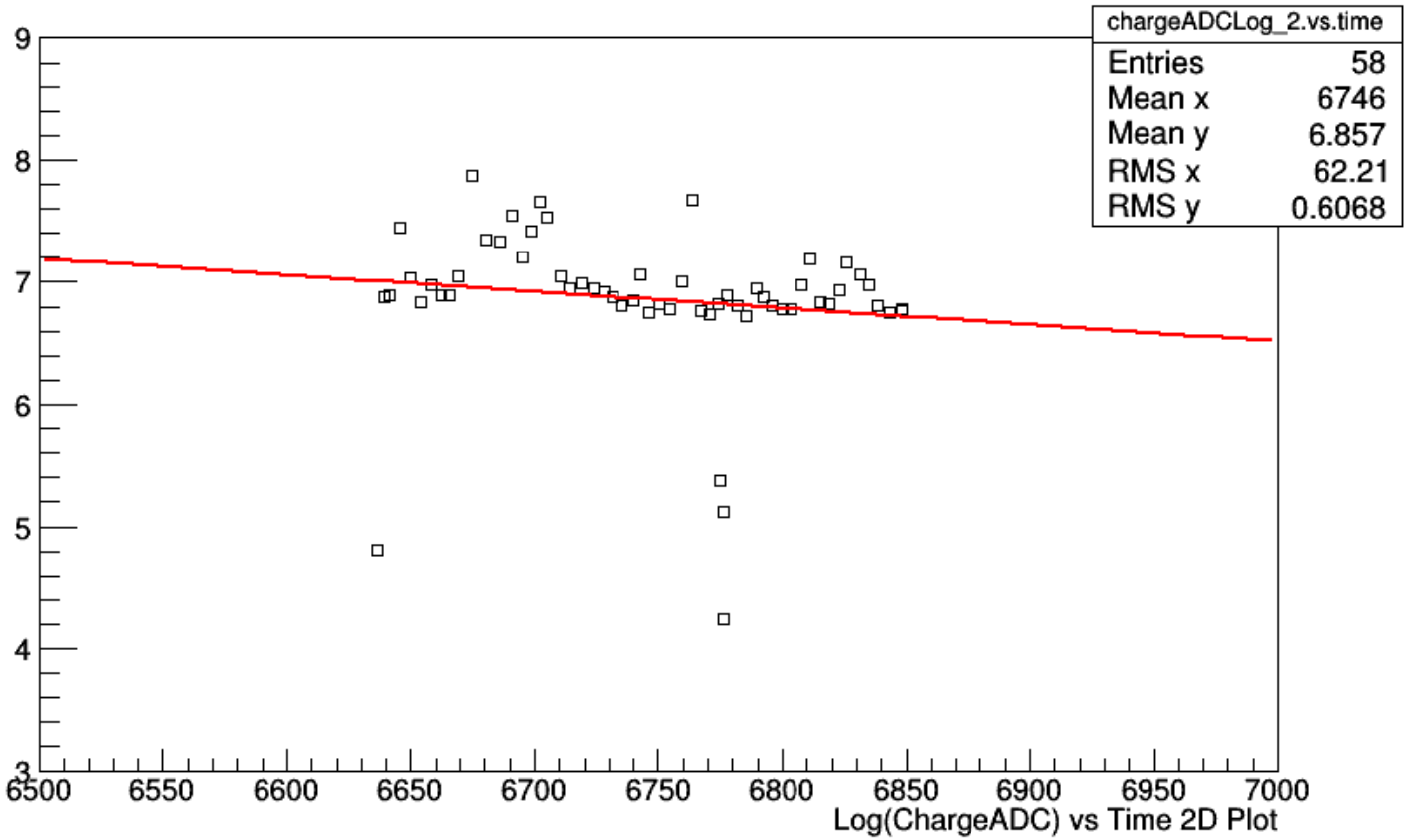
Linear fit for track 1 – no charge cut

$$lnQ = t/\tau_{ele} + const.$$



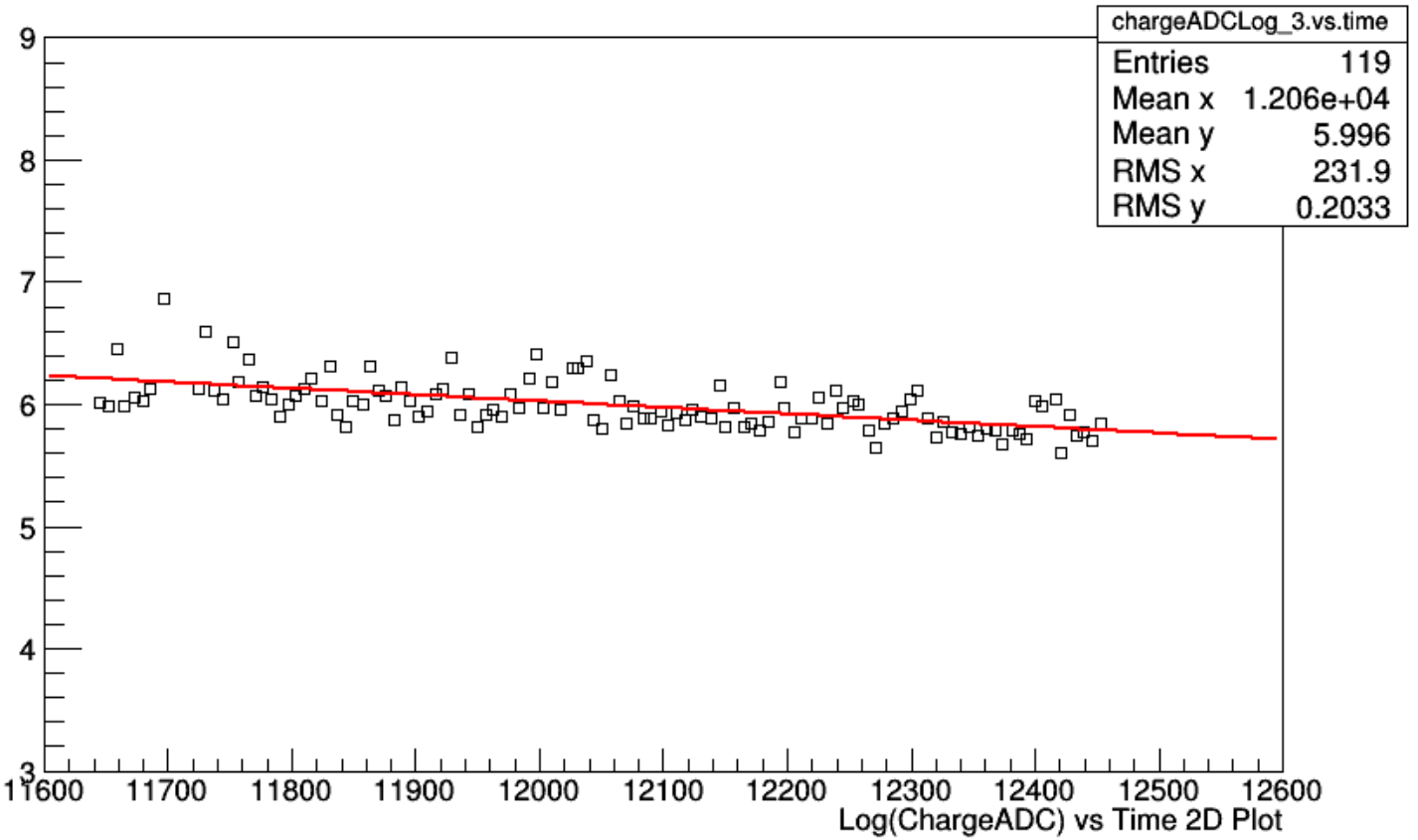
Linear fit for track 2 – no charge cut

$$lnQ = t/\tau_{ele} + const.$$



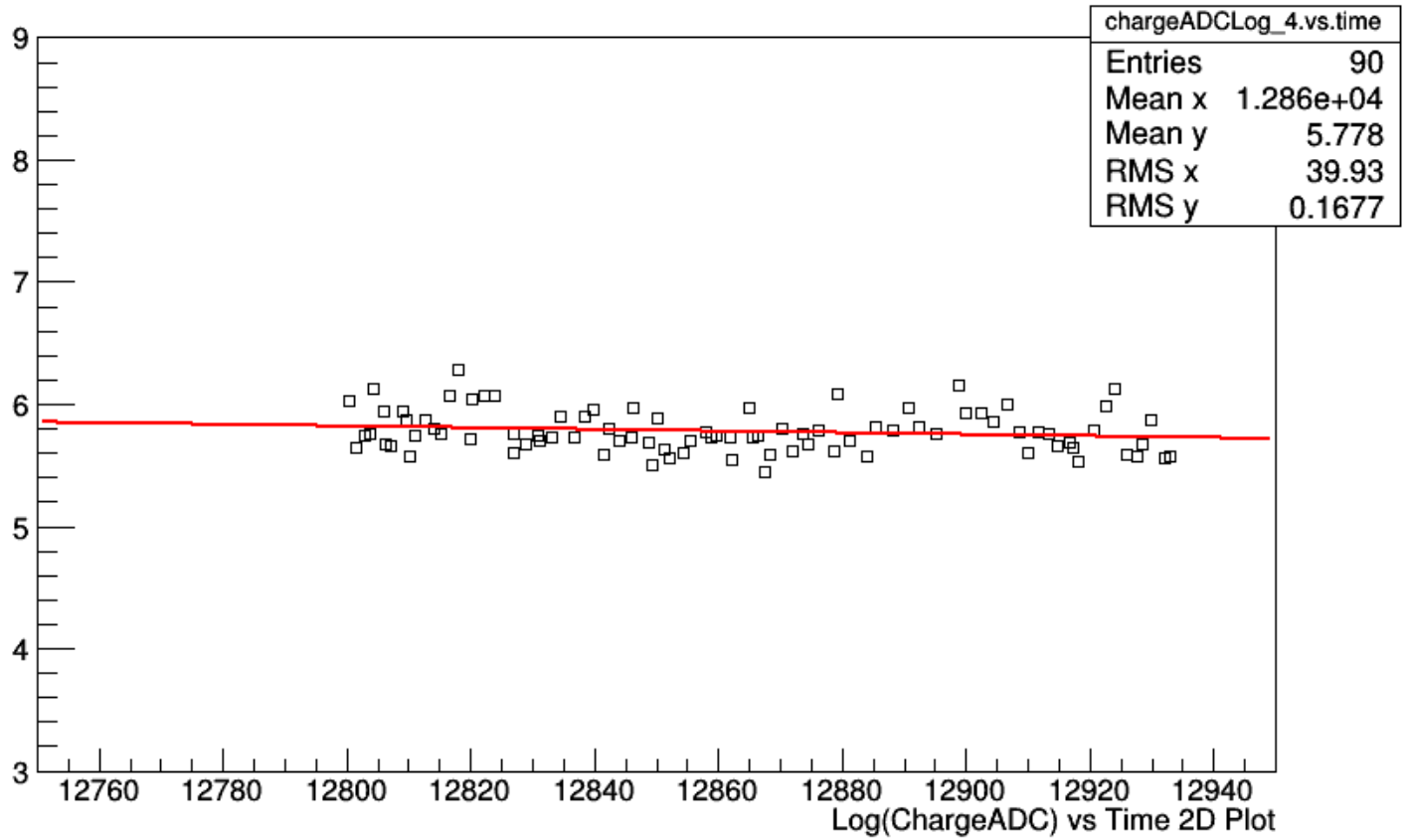
Linear fit for track 3 – no charge cut

$$lnQ = t/\tau_{ele} + const.$$



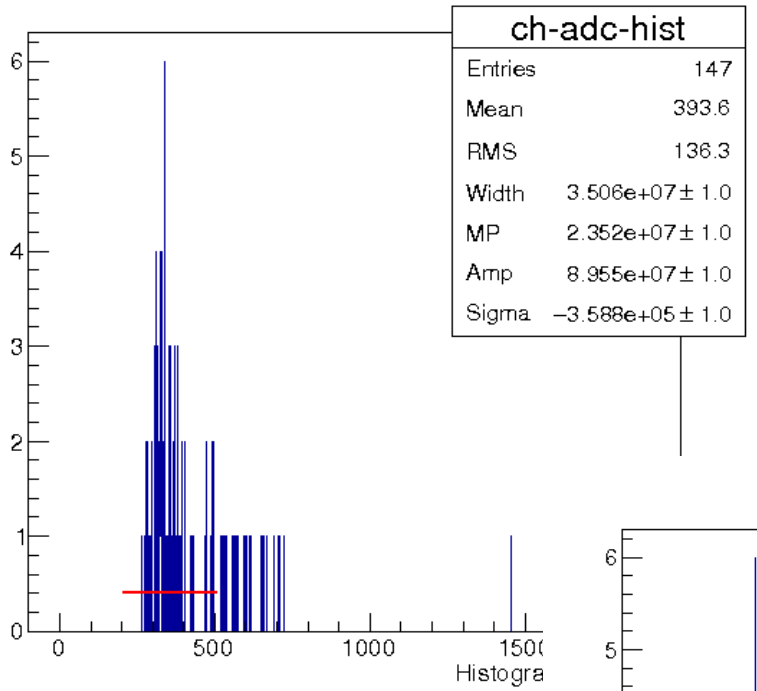
Linear fit for track 4 – no charge cut

$$lnQ = t/\tau_{ele} + const.$$

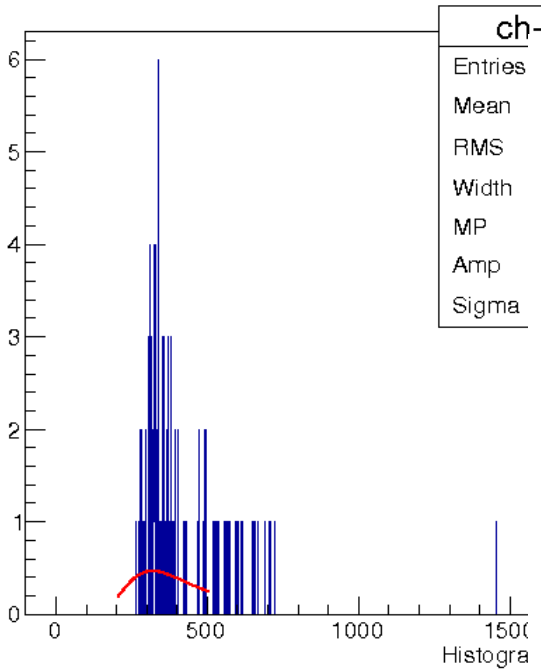


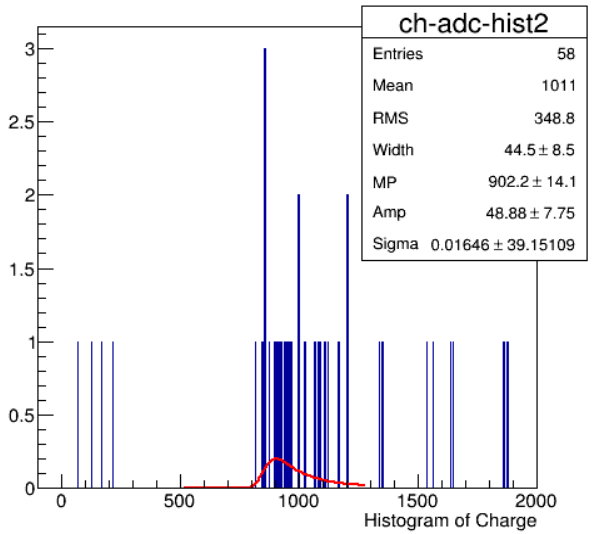
Summary of (preliminary) results

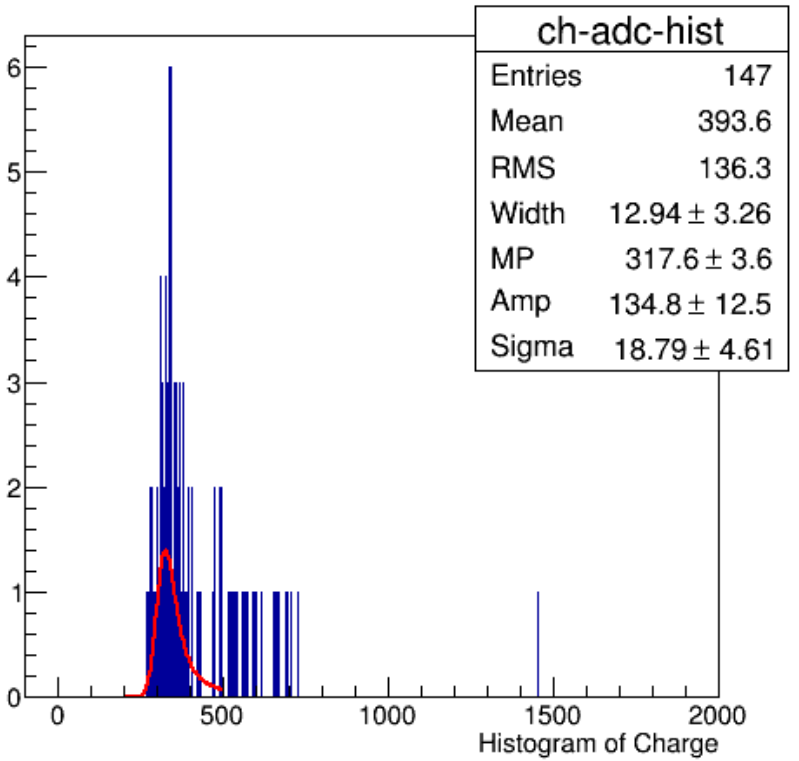
- $\tau_{ele}1$ = (0.447423 +/- 7.6e-05) ms
- Fit = -0.00224 +/- 0.00038; 9.6596 +/- 0.635646
- $\tau_{ele}2$ = (0.73816 +/- 0.00071) ms
- Fit = -0.00135473 +/- 0.00130362; 15.9988 +/- 8.7949
- $\tau_{ele}3$ = (1.91423 +/- 0.00024) ms
- Fit = -0.000522404 +/- 6.62997e-05; 12.2945 +/- 0.799502
- $\tau_{ele}4$ = (1.47890 +/- 0.00098) ms
- Fit = -0.00067618 +/- 0.000445878; 14.4752 +/- 5.73445

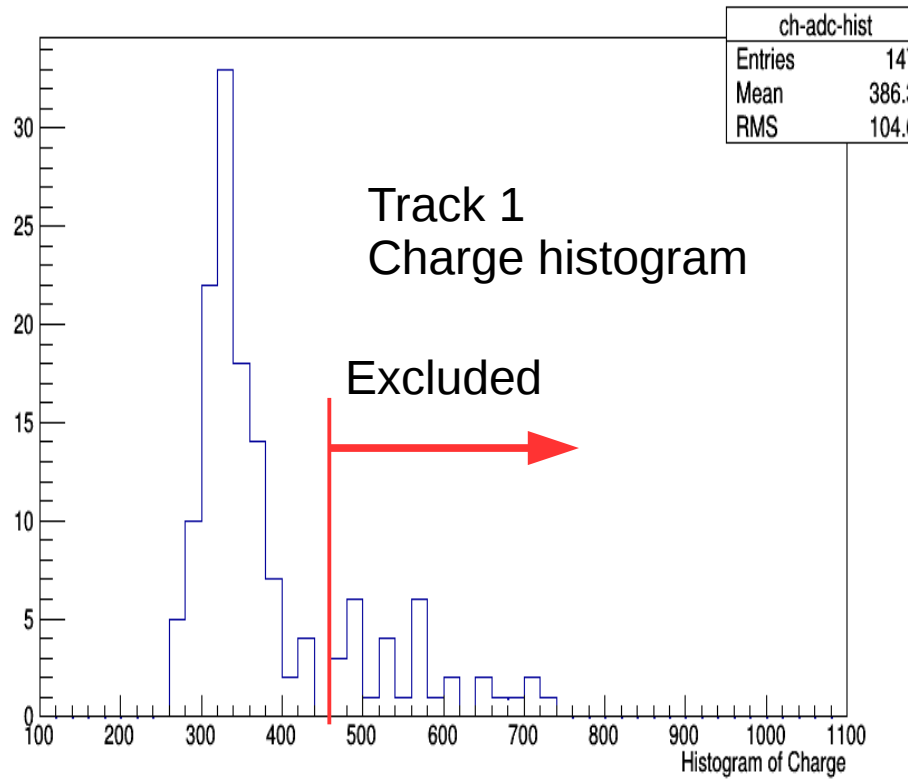


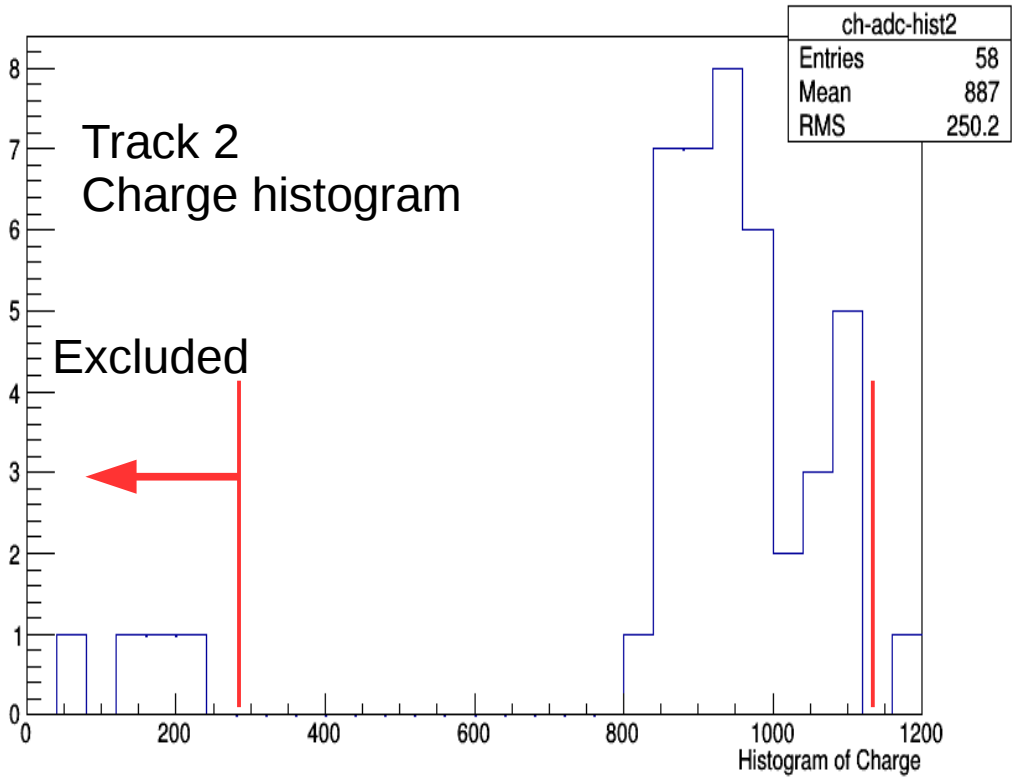
- Obtain Gauss-like distribution of charges cutting the Landau tail of the dE/dx depositions. (30% upper and 1% lower)

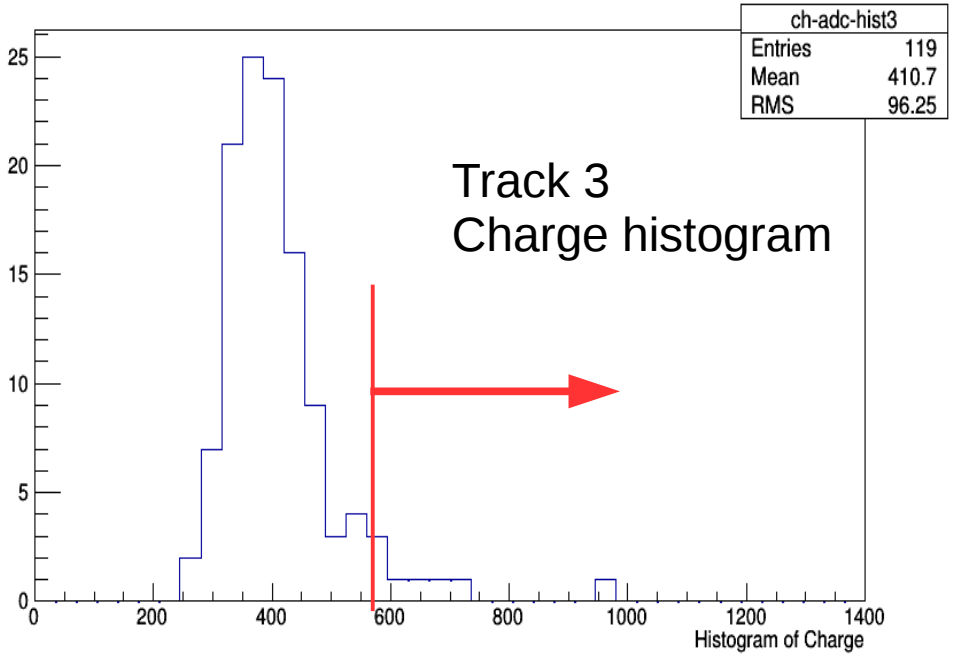


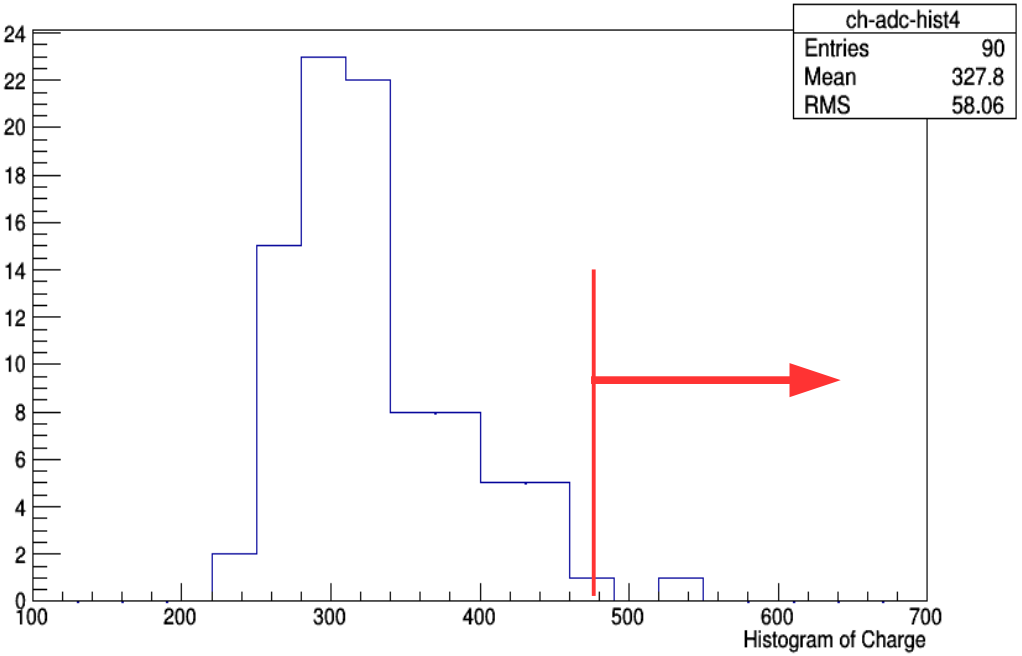





ch-adc-hist
Entries 14
Mean 386.
RMS 104.
Track 1
Charge histogram
Excluded
Histogram of Charge

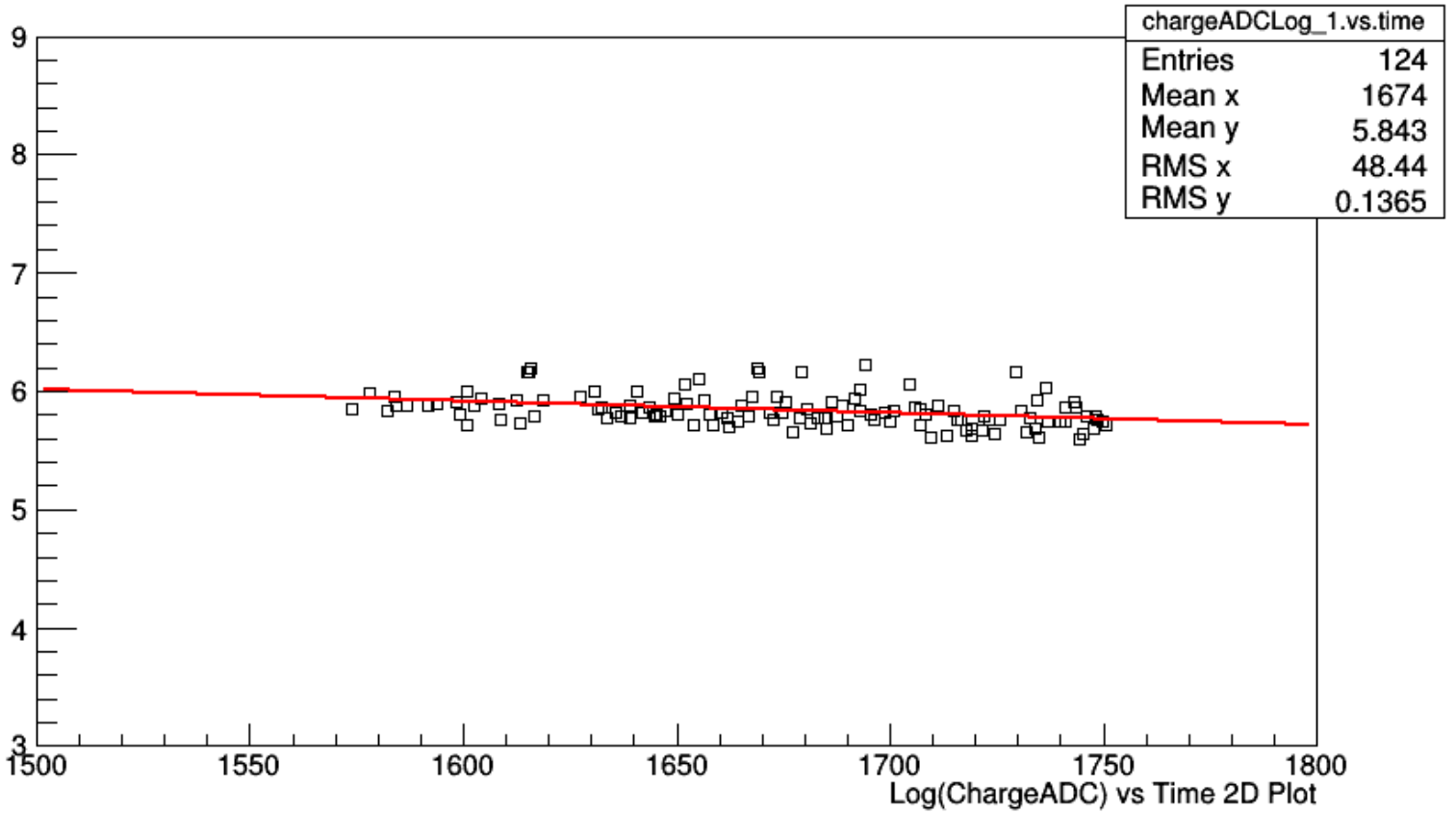

ch-adc-hist2
Entries 58
Mean 887
RMS 250.2
Track 2
Charge histogram
Excluded
Histogram of Charge


ch-adc-hist3
Entries 119
Mean 410.7
RMS 96.25
Track 3
Charge histogram
Histogram of Charge


ch-adc-hist4
Entries 90
Mean 327.8
RMS 58.06
Histogram of Charge

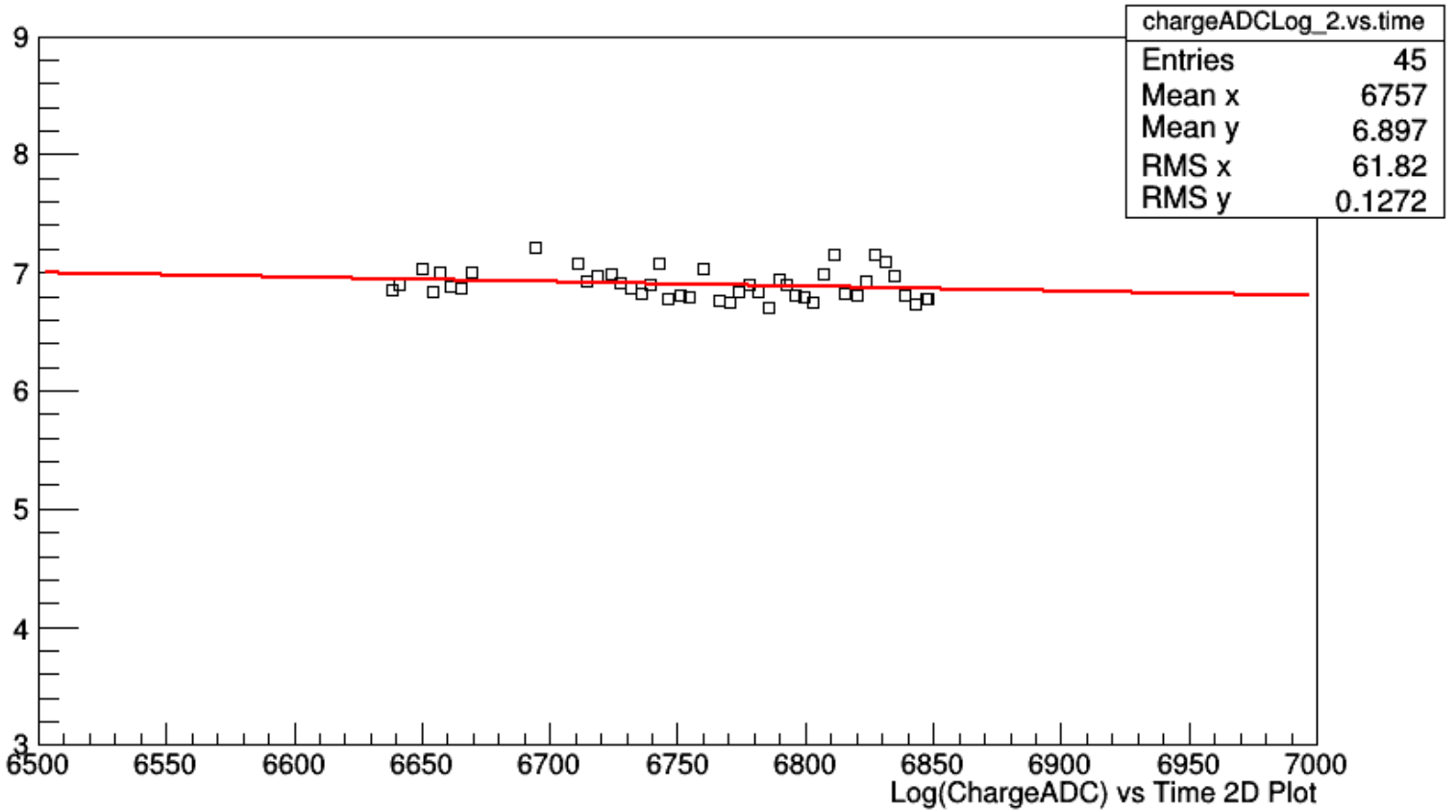
Linear fit for track 1 – with charge selection

$$lnQ = t/\tau_{ele} + const.$$



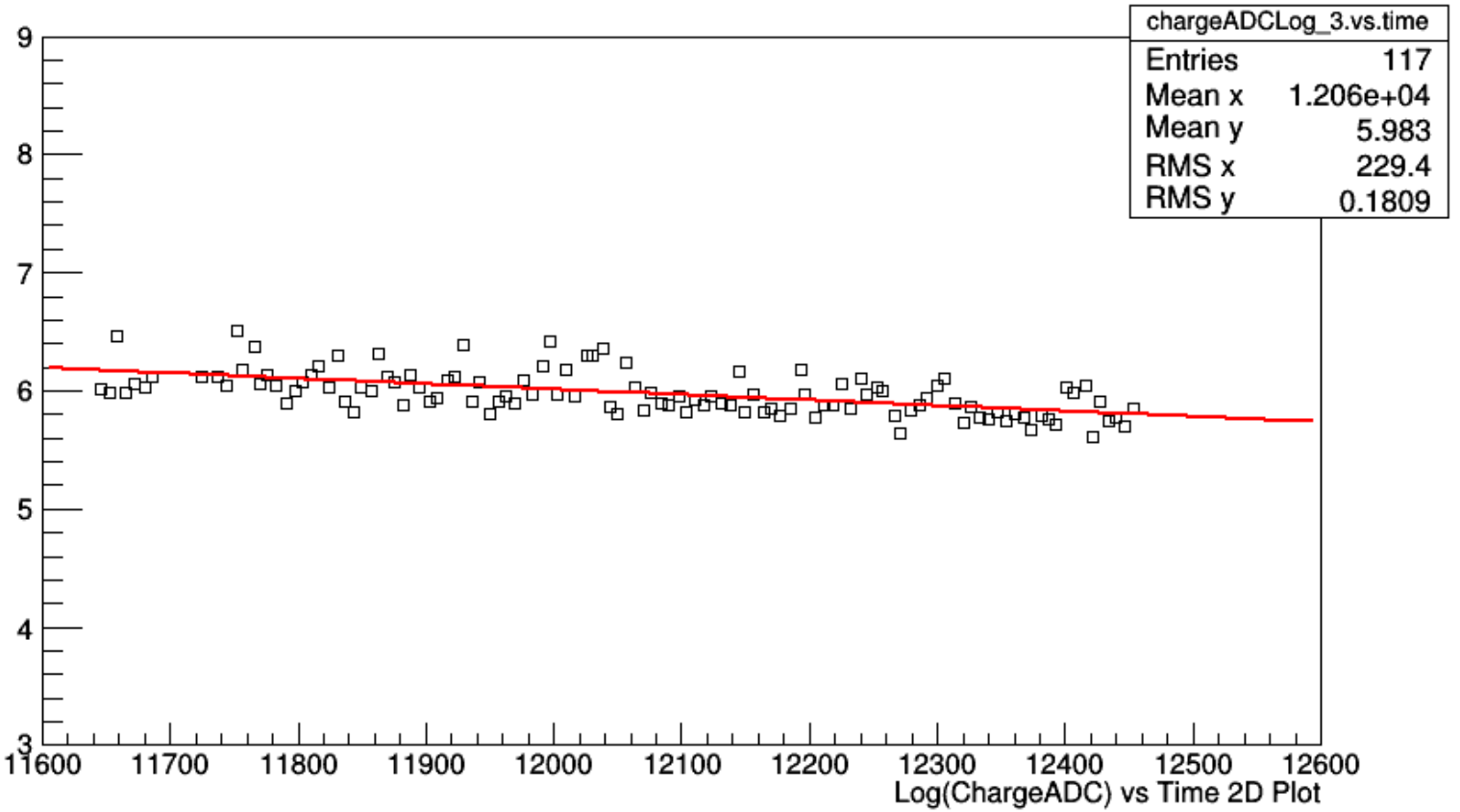
Linear fit for track 2 – with charge selection

$$lnQ = t/\tau_{ele} + const.$$



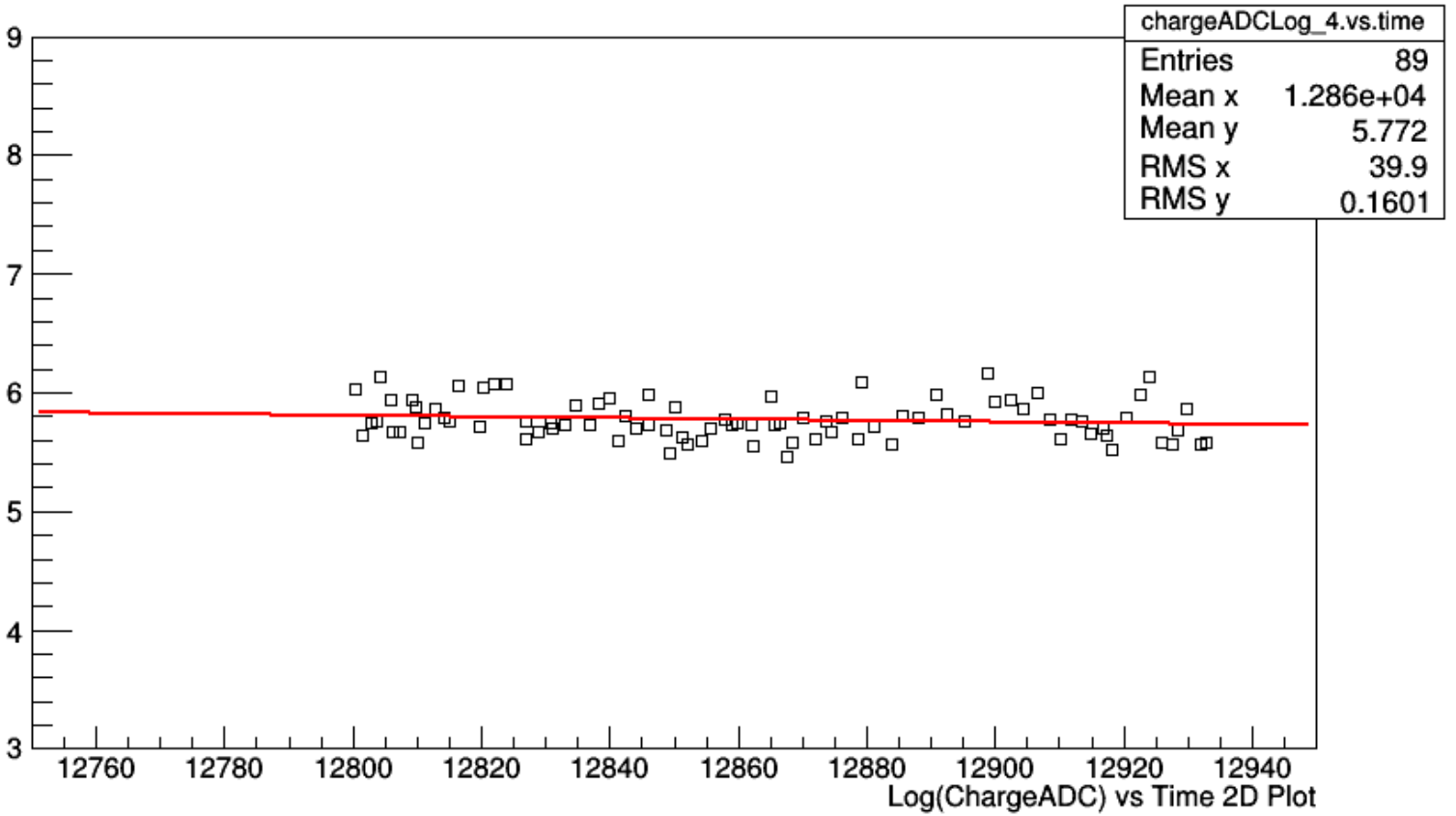
Linear fit for track 3 – with charge selection

$$lnQ = t/\tau_{ele} + const.$$



Linear fit for track 4 – with charge selection

$$lnQ = t/\tau_{ele} + const.$$



Summary of results

- $\tau_{ele}1$ = (1.00102 +/- 0.00024) ms
- Fit = -0.00100 +/- 0.00024; 7.51484 +/- 0.407439
- $\tau_{ele}2$ = (2.5530 +/- 0.0020) ms | (0.73816 +/- 0.00071) ms
- Fit = -0.000391 +/- 0.00030; 9.54612 +/- 2.036
- $\tau_{ele}3$ = (2.17705 +/- 0.00029) ms | (1.91423 +/- 0.00024) ms
- Fit = -0.000459337 +/- 6.06575e-05; 11.5243 +/- 0.731817
- $\tau_{ele}4$ = (1.8702 +/- 0.0015) ms
- Fit = -0.000534701 +/- 0.000430523; 12.6503 +/- 5.53718

Final result from the average of fits:

τ_{ele} = 1.90 ± 0.66 ms

Conclusion

- τ_{ele} obtained through charge attenuation is close to the simulated value of 3 ms;
- Many factors may influence the different, such as reconstruction and not considering diffusion;
- Refinement of the track and hit selection still have to be done: select tracks
  - not vertical (parallel to collection wires) and not perpendicular to the wire plane;
  - with long time spread;
  - Exclude tracks with associated electromagnetic showers and large number of delta-rays;
  - Etc.