Electron Lifetime Measurement

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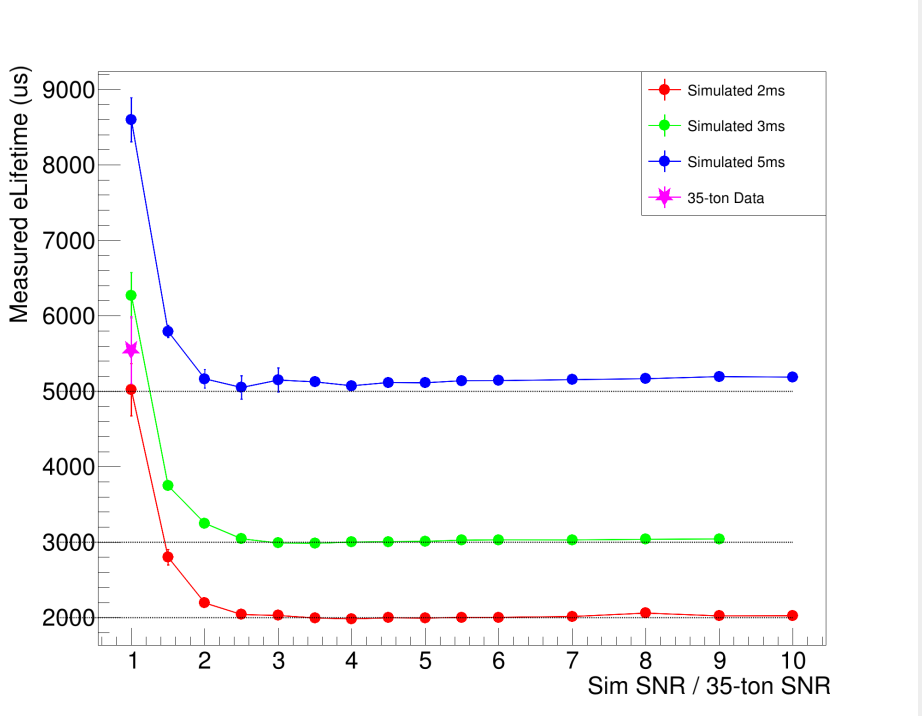
22 February 2017

35-ton Sim/Reco/Ana Meeting

Previously...

- See my collaboration meeting talk
- Gist:
  - Measured 5.48 +/- 0.26 ms e- lifetime for data
  - Measured similar lifetime for simulation (using DataOverlay and input lifetime of 3ms)
  - IF simulation == data:
    - Data measurement is consistent with 2.5 +/- 0.5 ms lifetime
  - Poor reconstruction efficiency for small charge hits skews Landau MPV upwards, and hence, the lifetime is biased upwards
  - How much bias???



What's new...

- Several changes after talking with Mark and Tom:
  - Use fixed hit width for both "found" and "assumed" hits
    - Pre-peak ticks = 50, Post-peak ticks = 100
  - Use David's updated bad channel list
  - Use better run selection, 29 Feb – 3 March && 14 March – 18 March
  - Investigate effects of non-constant wire-by-wire gains
  - Fix ratio LandWidth/LandMPV in LxG fits

- Tidbit: (was asked a while ago)
  - Track finding efficiency with Robust Hit Finder: 95%
    - Out of 65213 EW triggered events, 61989 were reconstructed successfully

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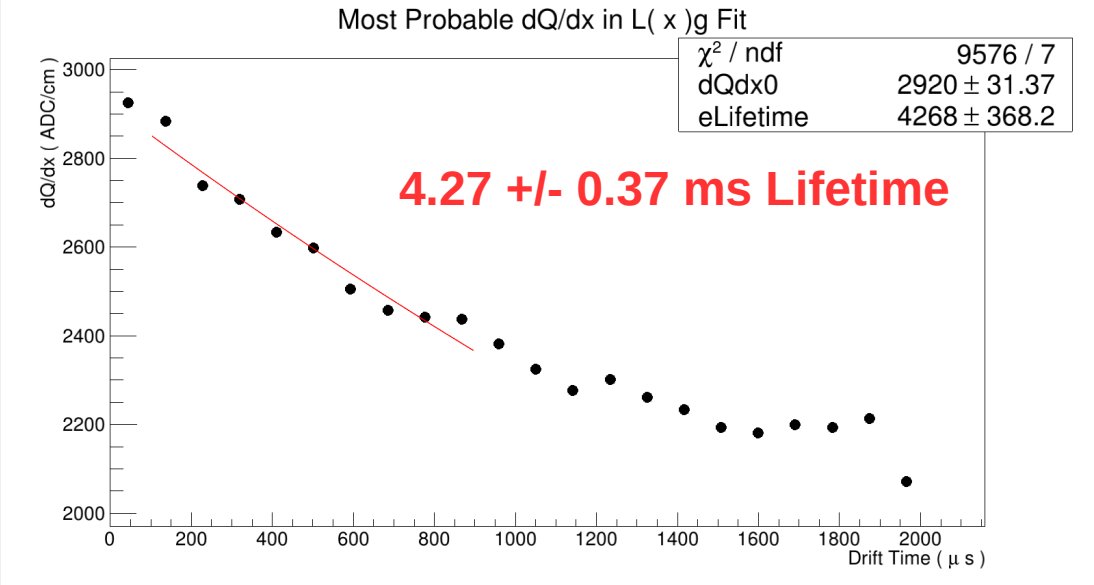
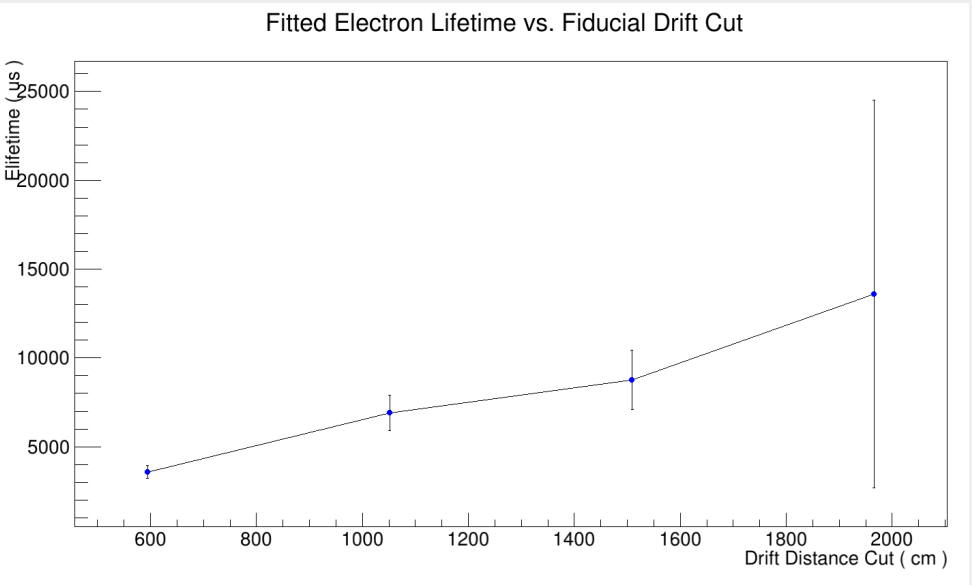
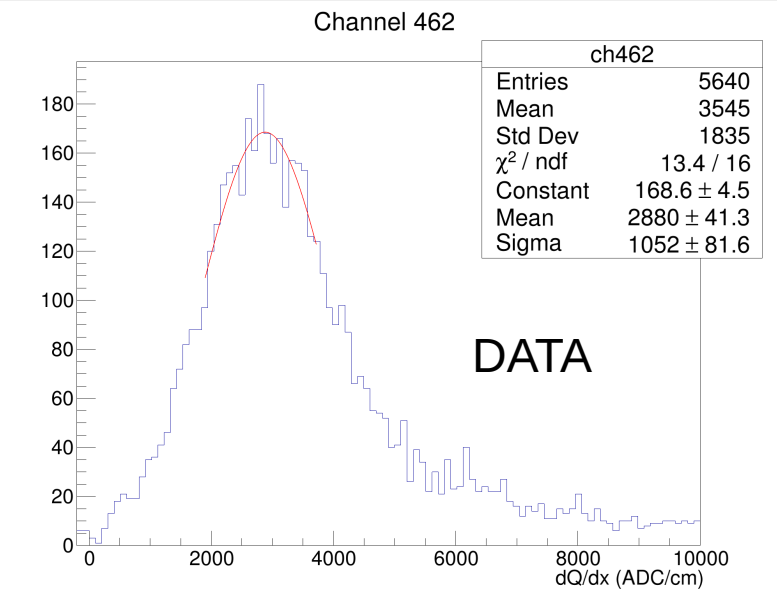
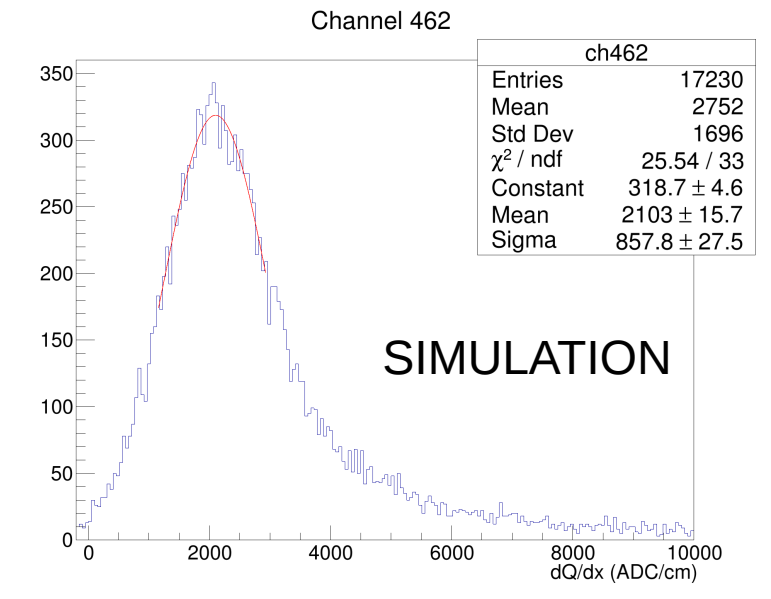




- Includes: David's bad channel list, Full good run list, Fixed hit widths
- Ignoring first and last bins
- Impose cut on fitting the exponential to half the drift distance
  - Kind of an arbitrary choice. The measurement is much closer to 3ms than by using the full volume, but I don't really have a good justification aside from "reconstruction efficiency gets worse with longer drift times"
  - Looking at hit finding efficiency vs. drift distance, I could claim it is because efficiency is greater than 50%... (I know this is weak)

Relative Wire Gains

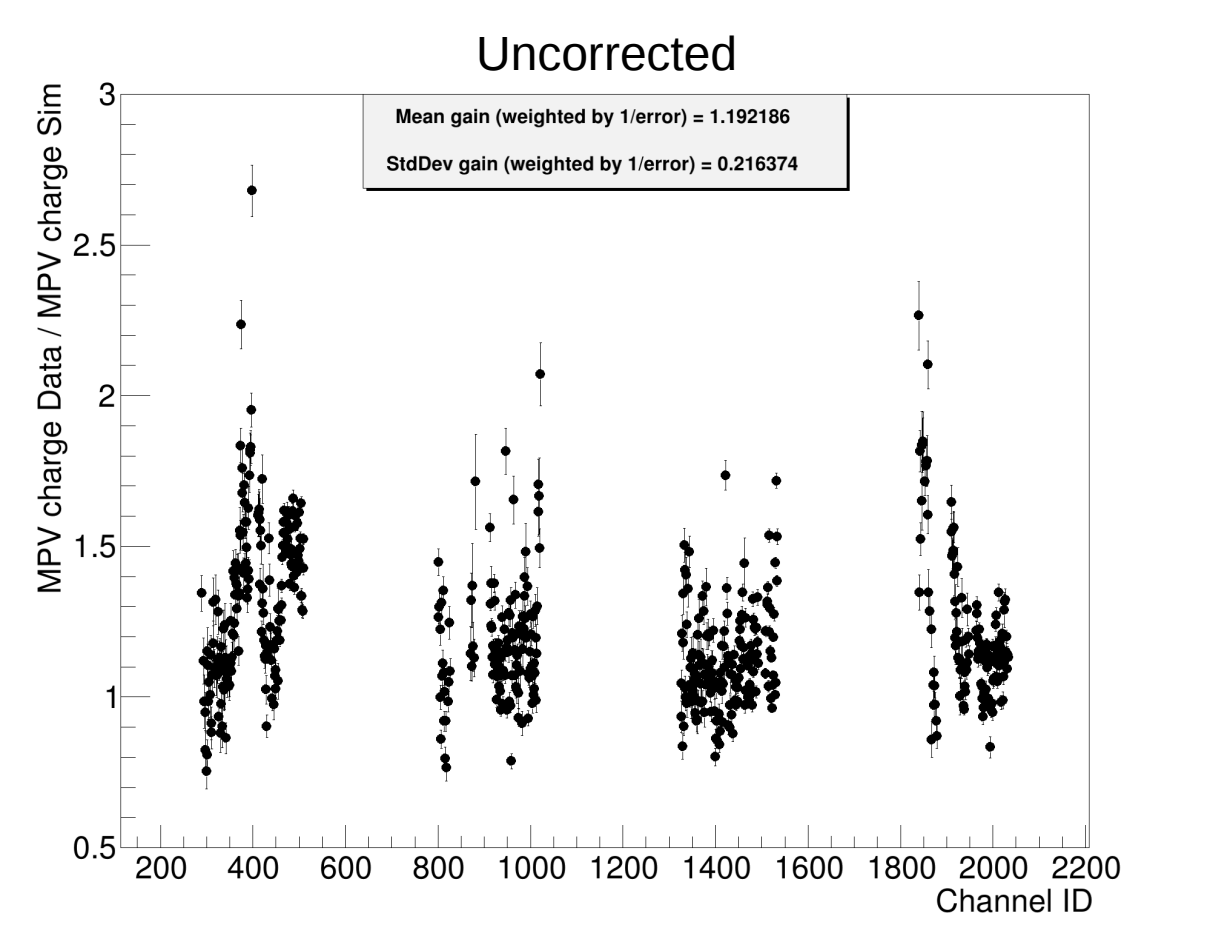




- We expect differences in wire gains to look like the charge is scaled
  - i.e. landau distributions on each wire will look stretched or compressed in the horizontal direction
- Compare MPV of dQ/dx on each wire between data and simulation (DataOverlay)
- MPV found by gaussian fit to peak

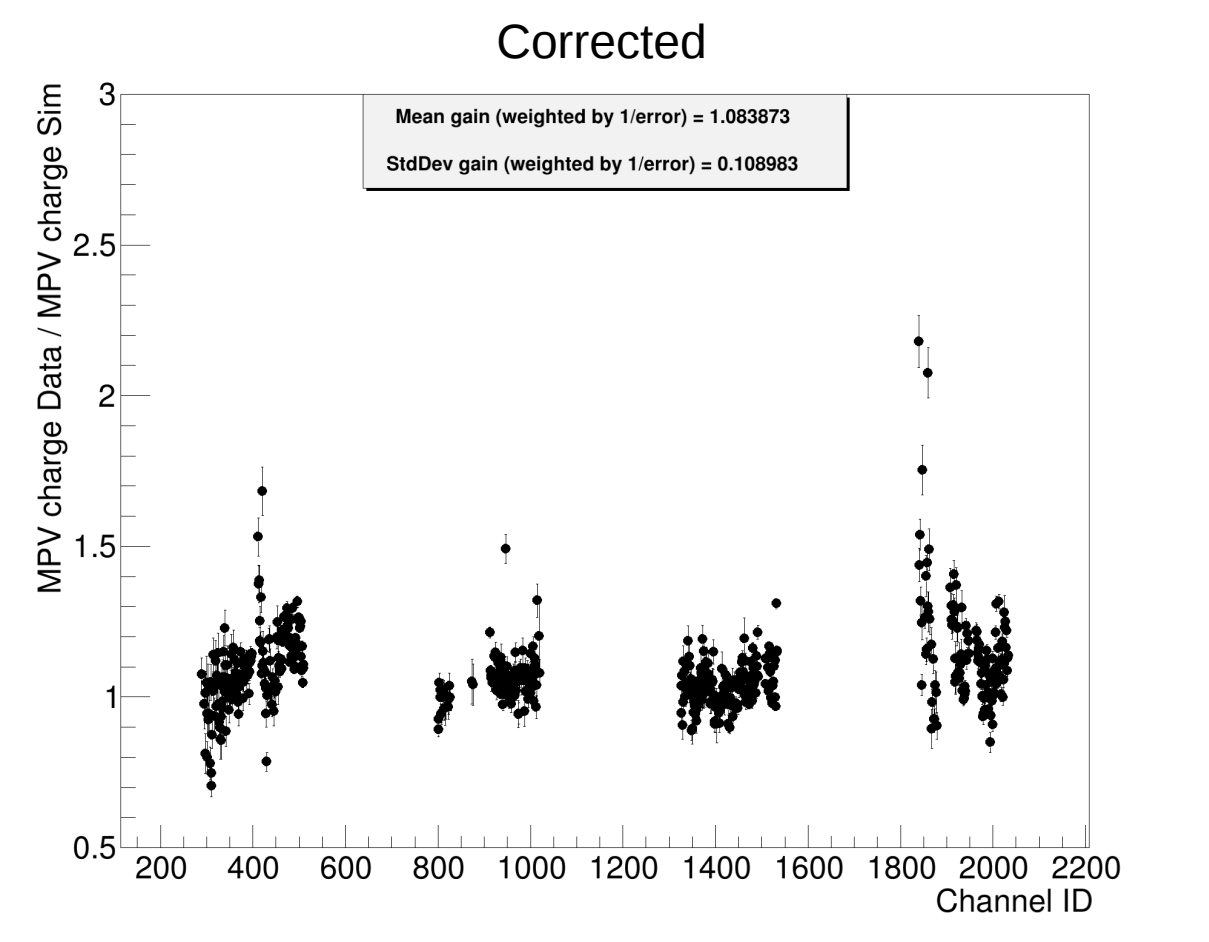
Relative Wire Gains

- Relative gains across all collection wires calculated
  - Errors bars calculated from the errors on the MPV fits
- Average wire gain of data is 1.2x that of simulation
- Standard deviation of 22% across all wires

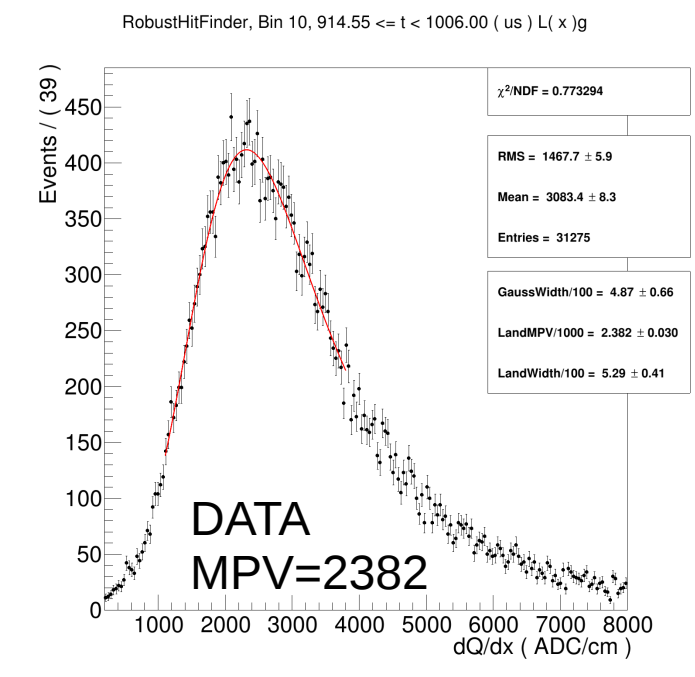


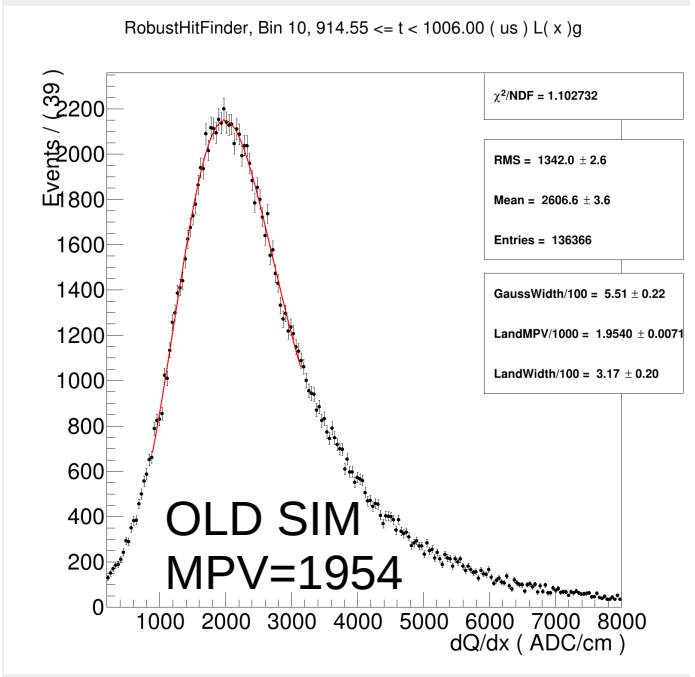
Relative Wire Gains

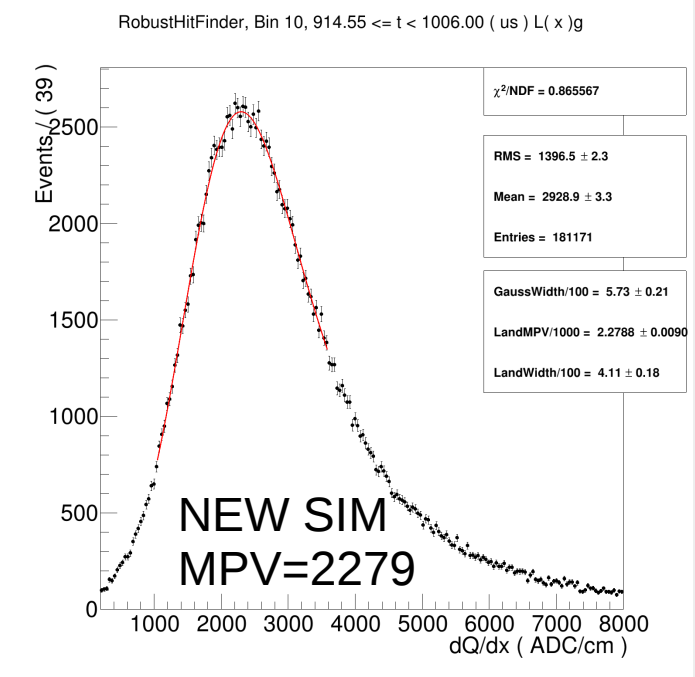
- Results fed back into DataOverlay step
  - Adjusted signal = (gain)*signal
  - IMPORTANT: “gains” with large errors remain uncorrected as they usually correspond with low statistics on the wire
- New gain map has smaller StdDev (0.11) and mean closer to ideal (1.08)
- Not a perfect technique, but probably some of the more significant differences are accounted for



Relative Wire Gains Effects

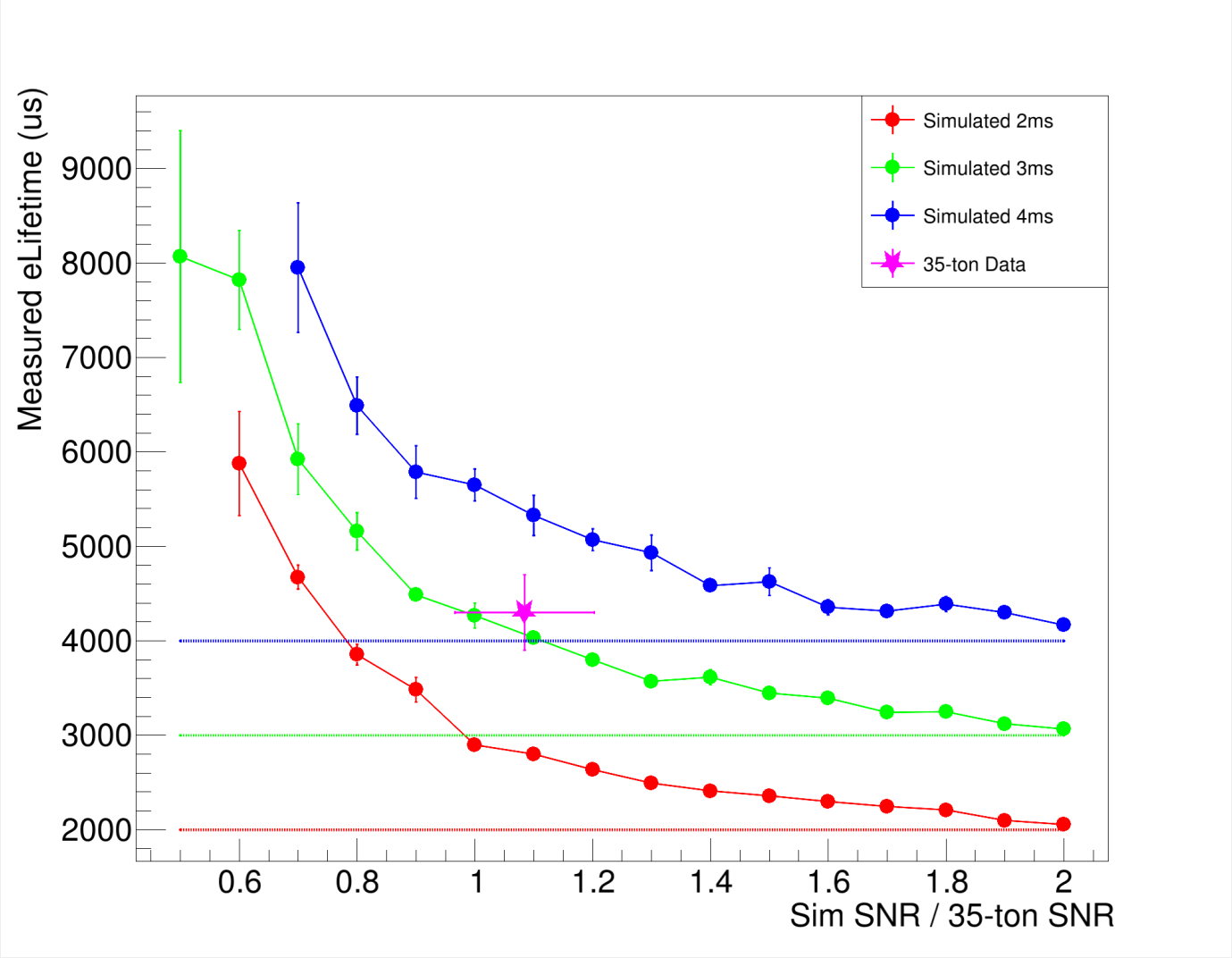






- Simulated LxG bin MPVs are more consistent with data

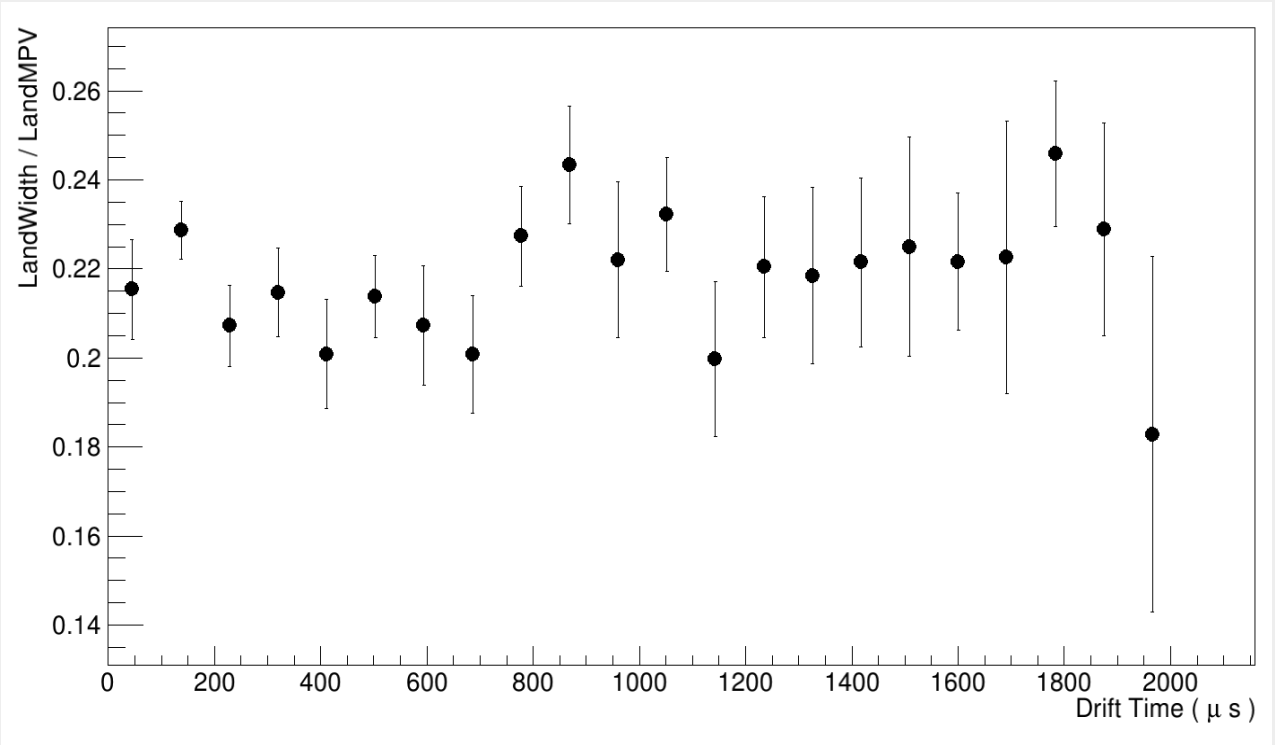
Estimating the bias

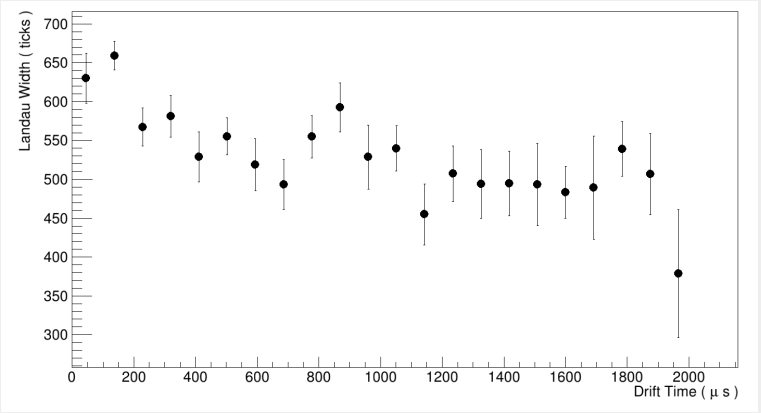


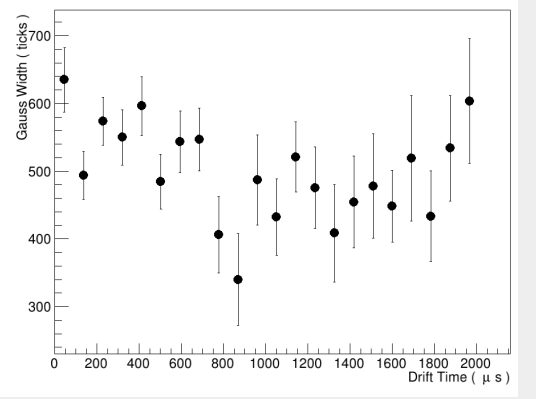
- Data point:
  - y = 4.27 +/- 0.37 ms
  - x = 1.08 +/- 0.12 gain
- SAME analysis on both data and simulation
- If simulation and data are biased the same:
  - Real data e- lifetime → about 3.2 +/- 0.4 ms
- Definitely consistent with purity monitors

Fixing LandWidth/LandMPV

- The idea is to remove any possible linear dependence between the two parameters during fit
- Essentially, this takes away the freedom of the landau width to increase over drift time (which should be accounted for in the gauss width anyway)
- Haven't yet figured out how to (successfully) constrain the ratio during fitting…
  - Trying ExternalConstraints in the fitTo method
- Fairly constant anyway, maybe fixing it would make the fits worse?
- In general, the fact that the landau width does not stay constant and gauss width does not increase over drift time, shows there is something wrong in the analysis and/or data







Remarks

- There's not much else I can do with this analysis – the data is too noisy to get anything meaningful
- I'm happy to finish it here, unless there are major pressing issues
- As for the 35-ton TPC paper, how much of this analysis is desired?
  - Do you believe my bias estimation technique enough for it to be included?
  - Or should I just show the results for data and say that it is biased? (and not show any simulations)
  - Is there a happy medium?