Electron-Lifetime Determination using Long Tracks in ArgoNeuT

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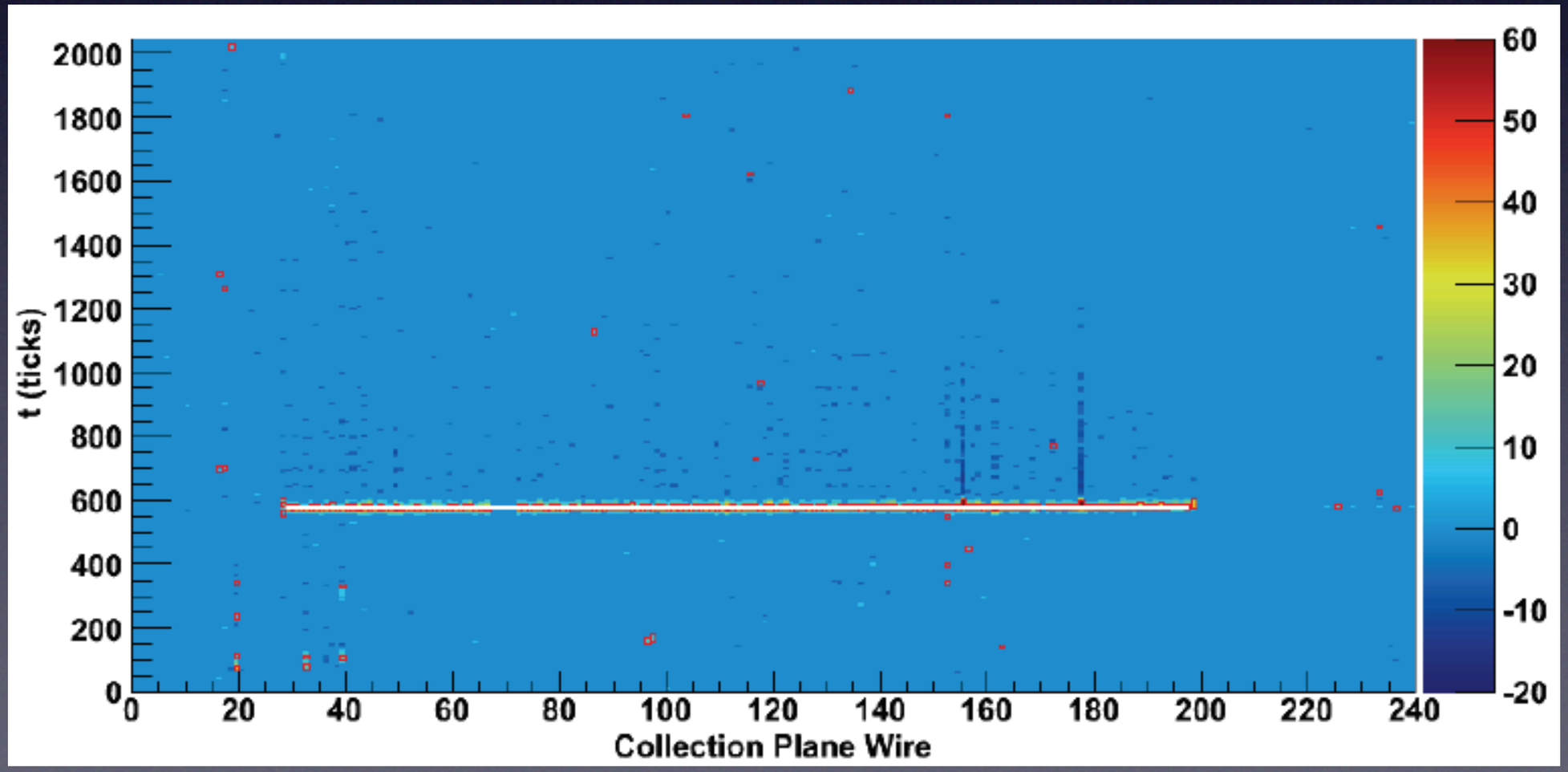
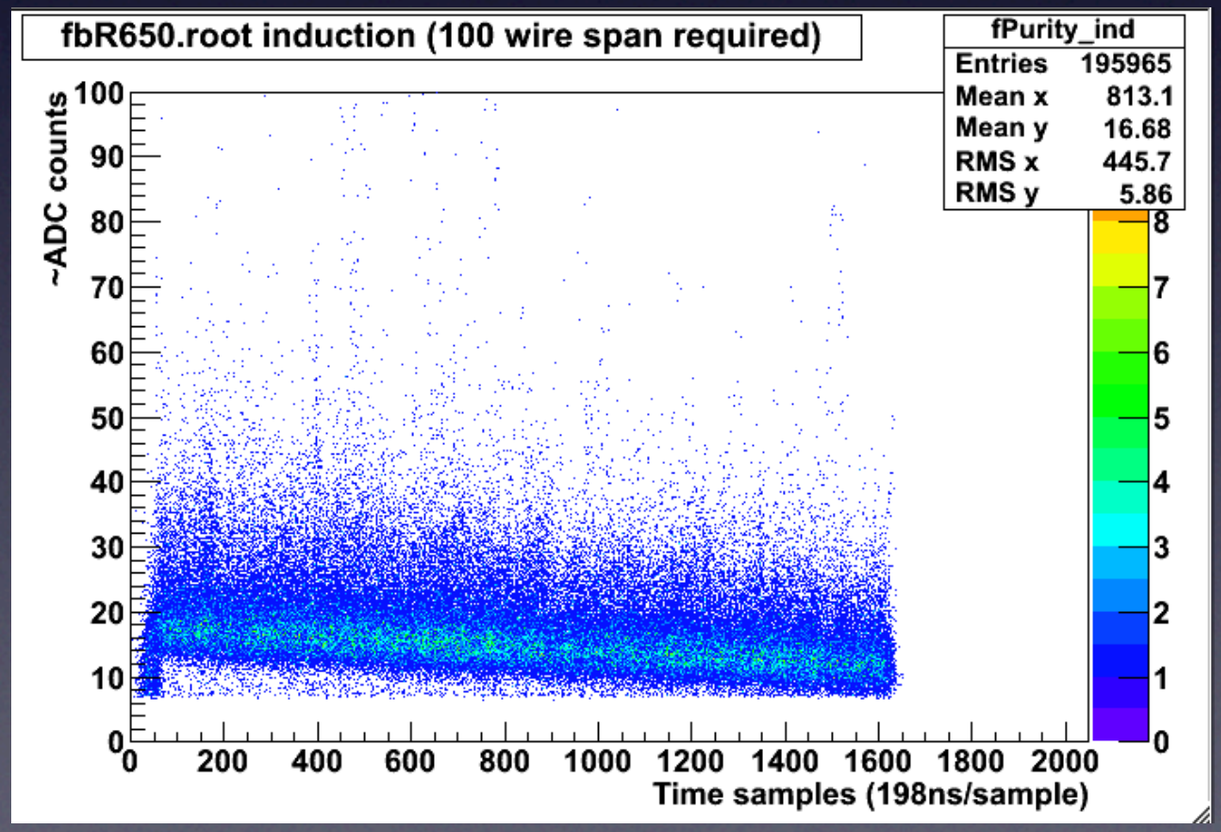
4/22/2010

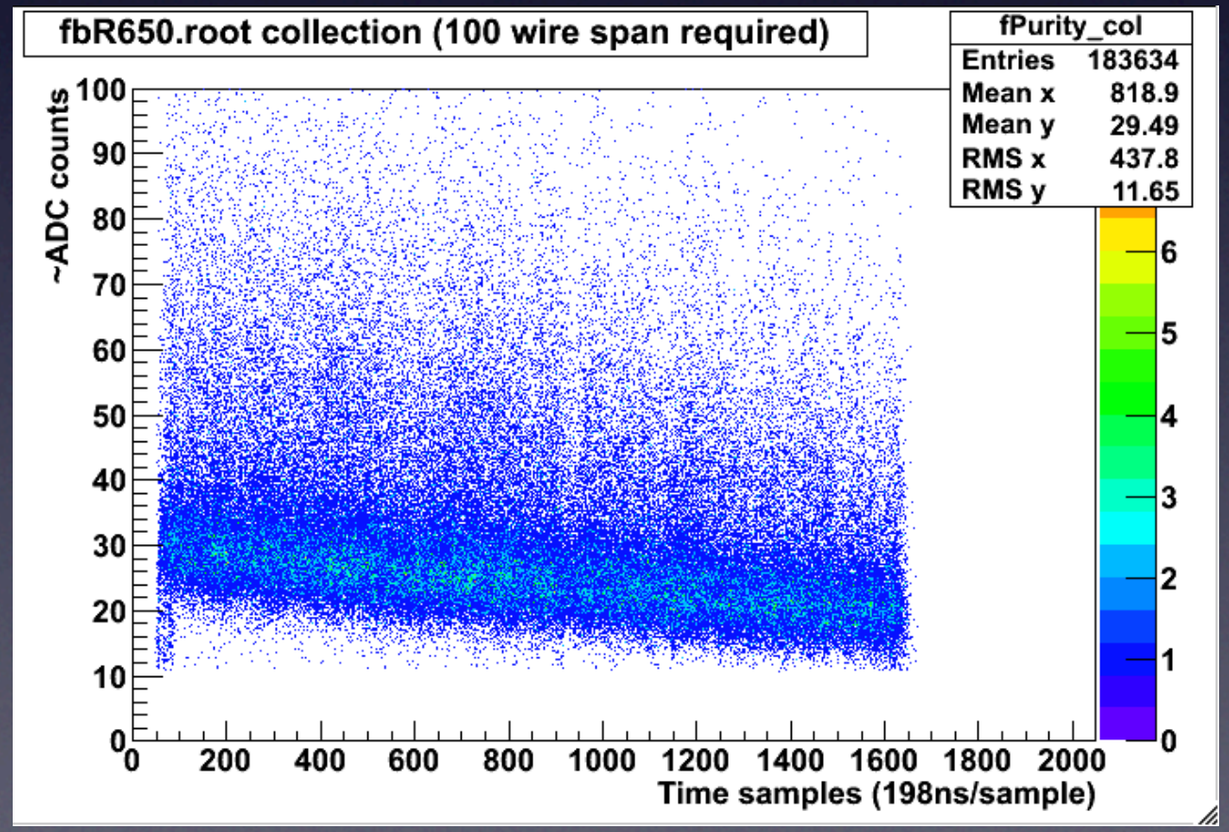
The procedure

- Run the reconstruction chain.
  - Event filter, Raw digits, Deconvolution, Hit finding, DBSCAN (optional), HoughLineFinder, Ana



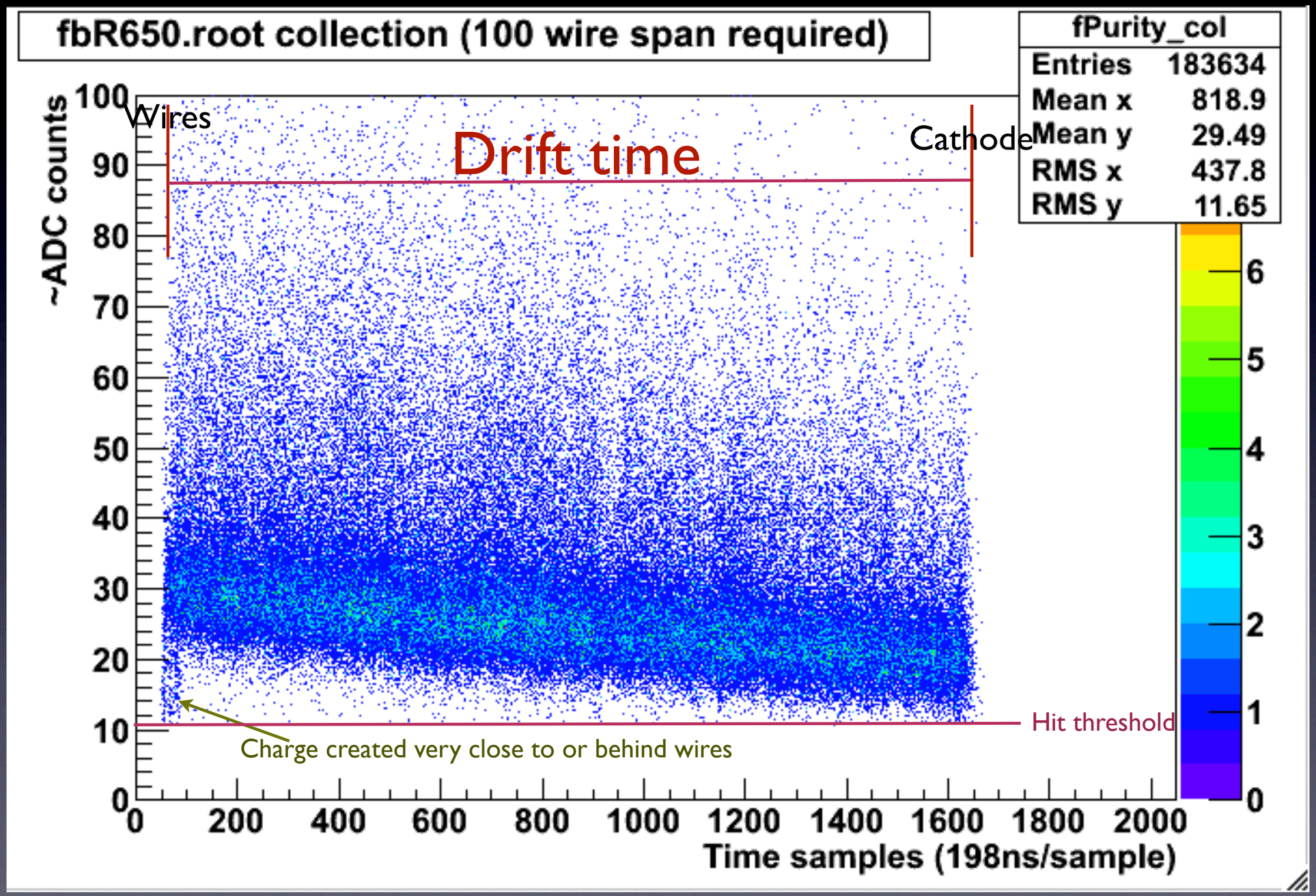
- Record ADC counts (peak height or integrated area) vs drift time for the hits on a Hough line with length spanning at least X wires.
- The e-lifetime measurement module (Muon_elifetime) can now be found in the Utilities package.



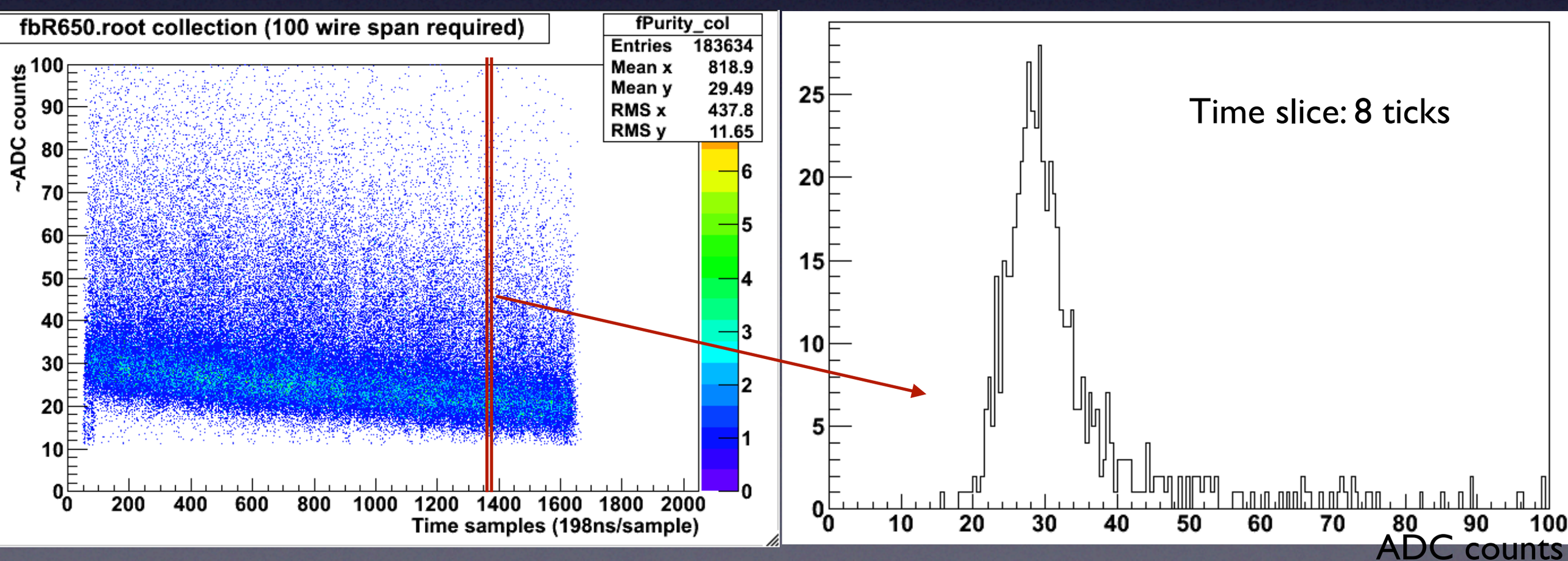


Note that there is an ADC count offset between induction and collection. This can be adjusted (but it doesn't matter for the e-lifetime measurement). Planes are treated separately.

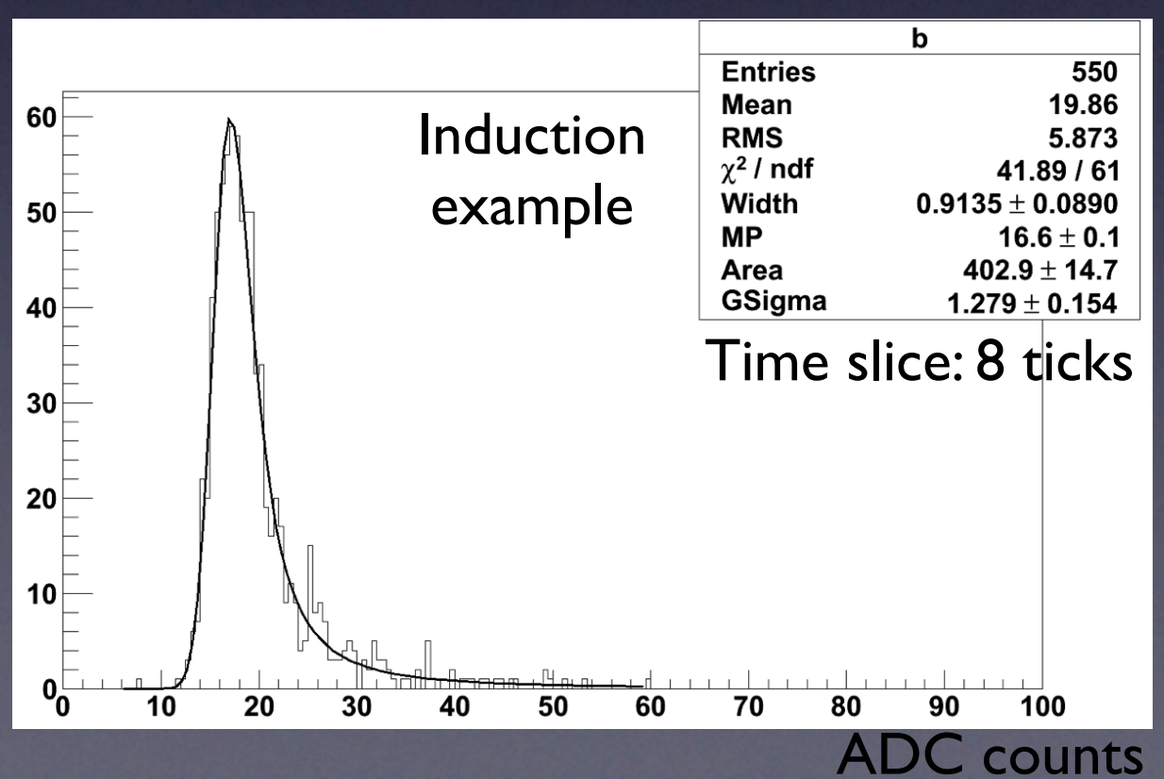
A closer look at the plot:

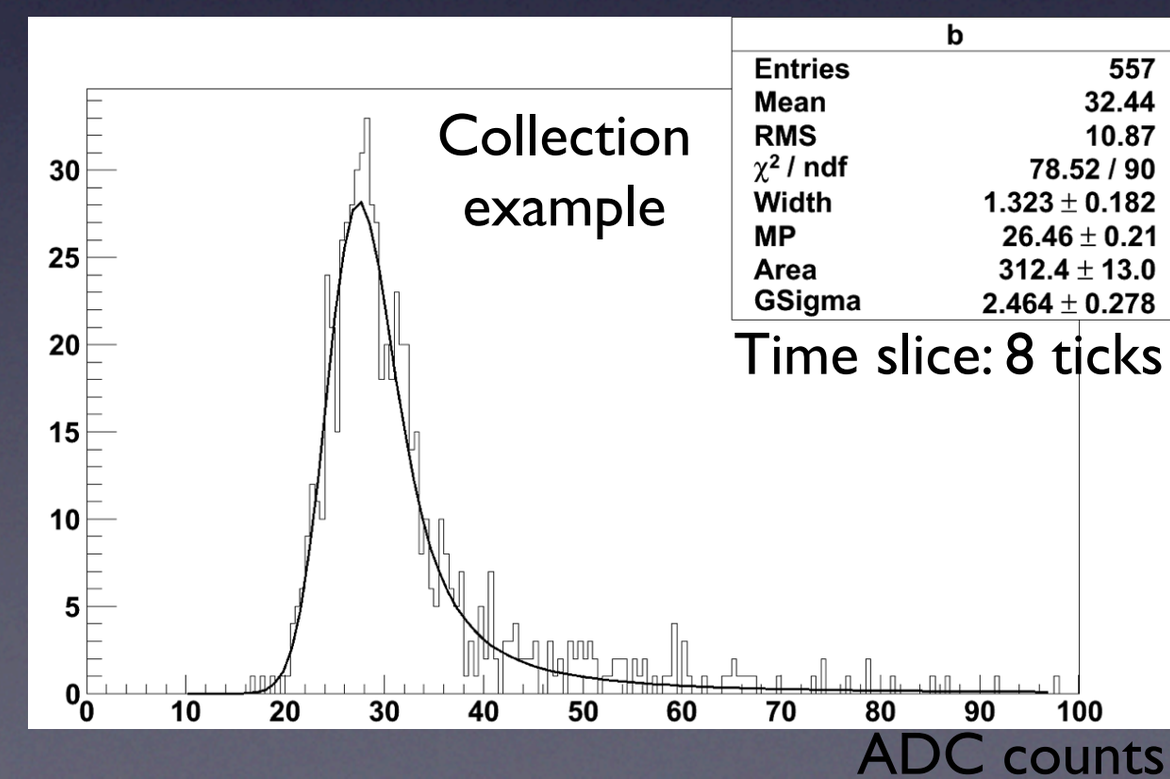


- Take a drift time slice and plot ADC counts in a 1D histogram.
- The time slice should be as small as possible (but needs to have enough stats to do a reasonable fit).

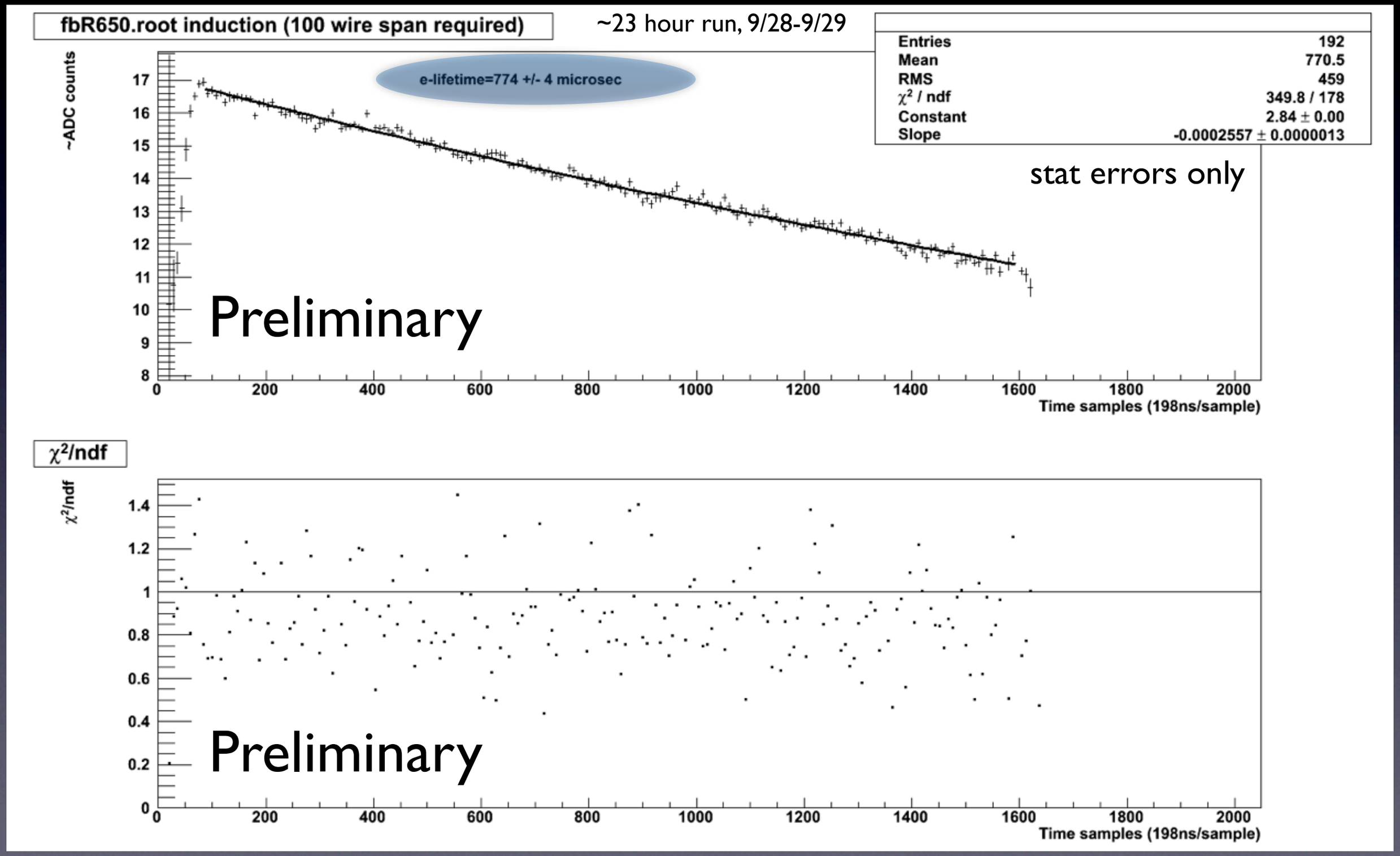


- Fit a convoluted Landau+Gaussian.
  - The Landau distribution describes the energy losses as a particle travels through matter.
  - The Gaussian distribution describes charge fluctuations from electronic noise, electron diffusion, particle energy spectrum, track orientation wrt wires, etc.
- The fit has 4 parameters
  - Most Probable Value (MPV), scale parameter of Landau distribution (Width), sigma of Gaussian distribution (GSigma), and area (Area).





- Fit an exponential curve to a plot of MPV (w/ MPV error) vs. drift time. The fit range avoids the detector thresholds.



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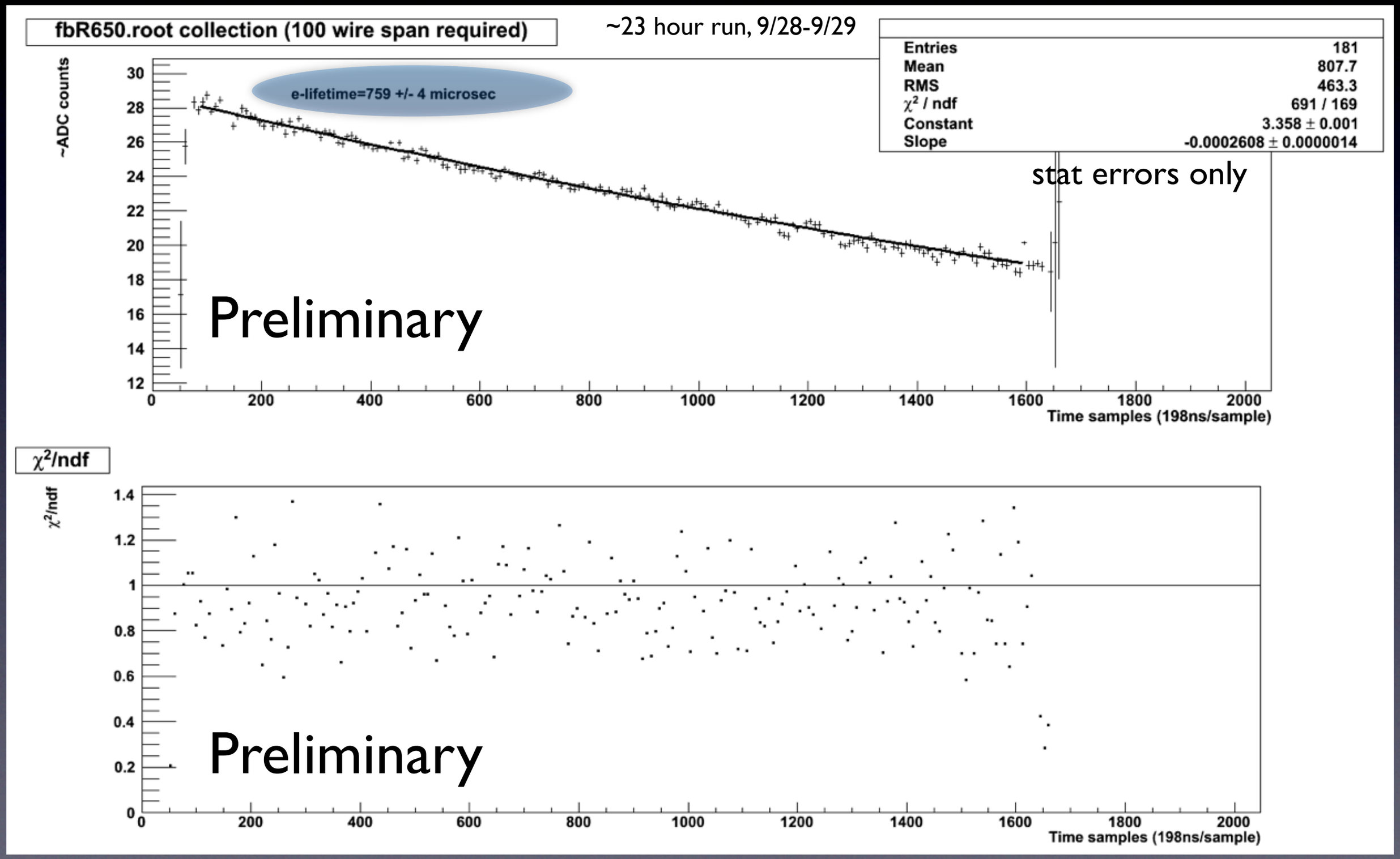
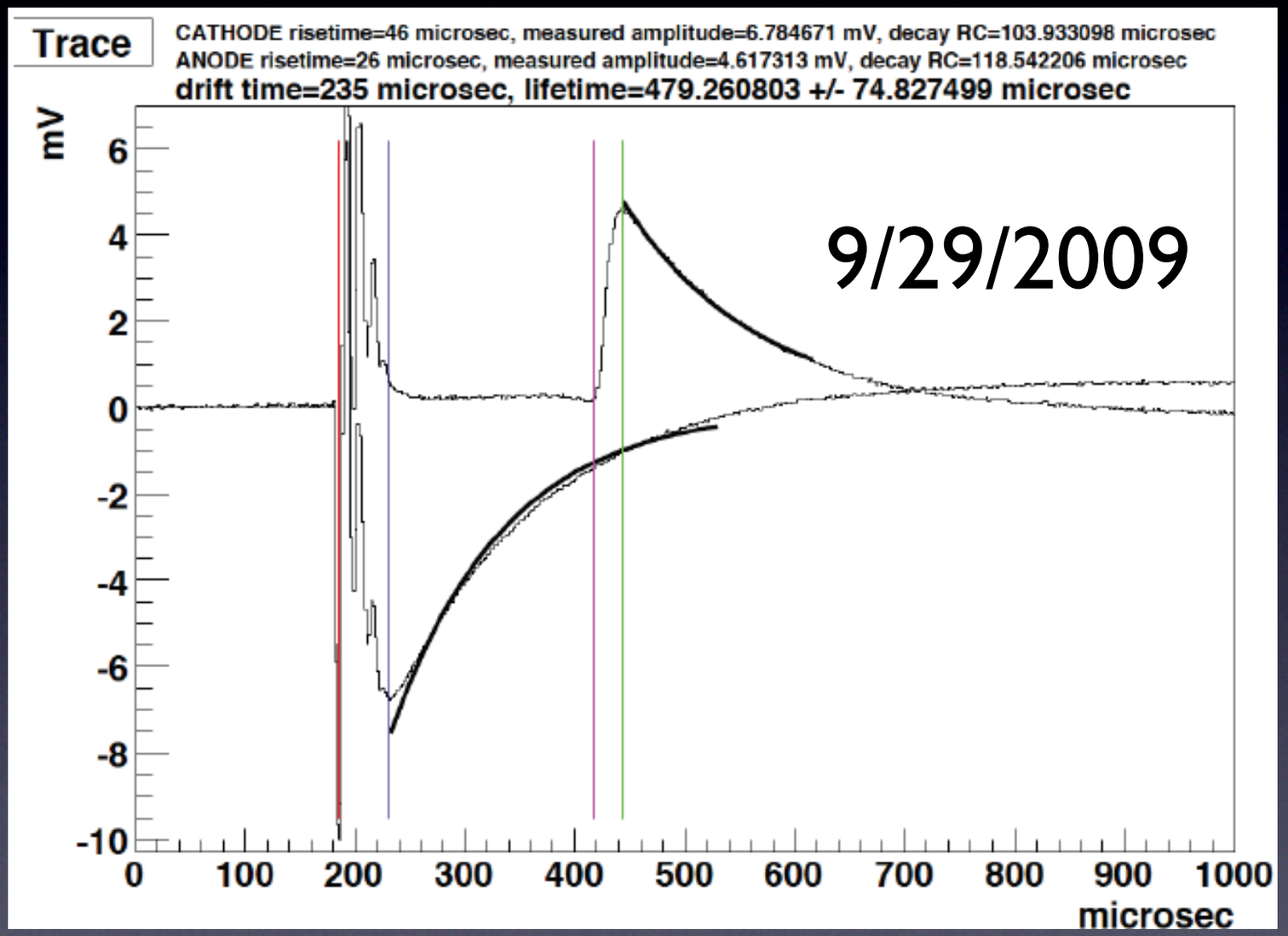
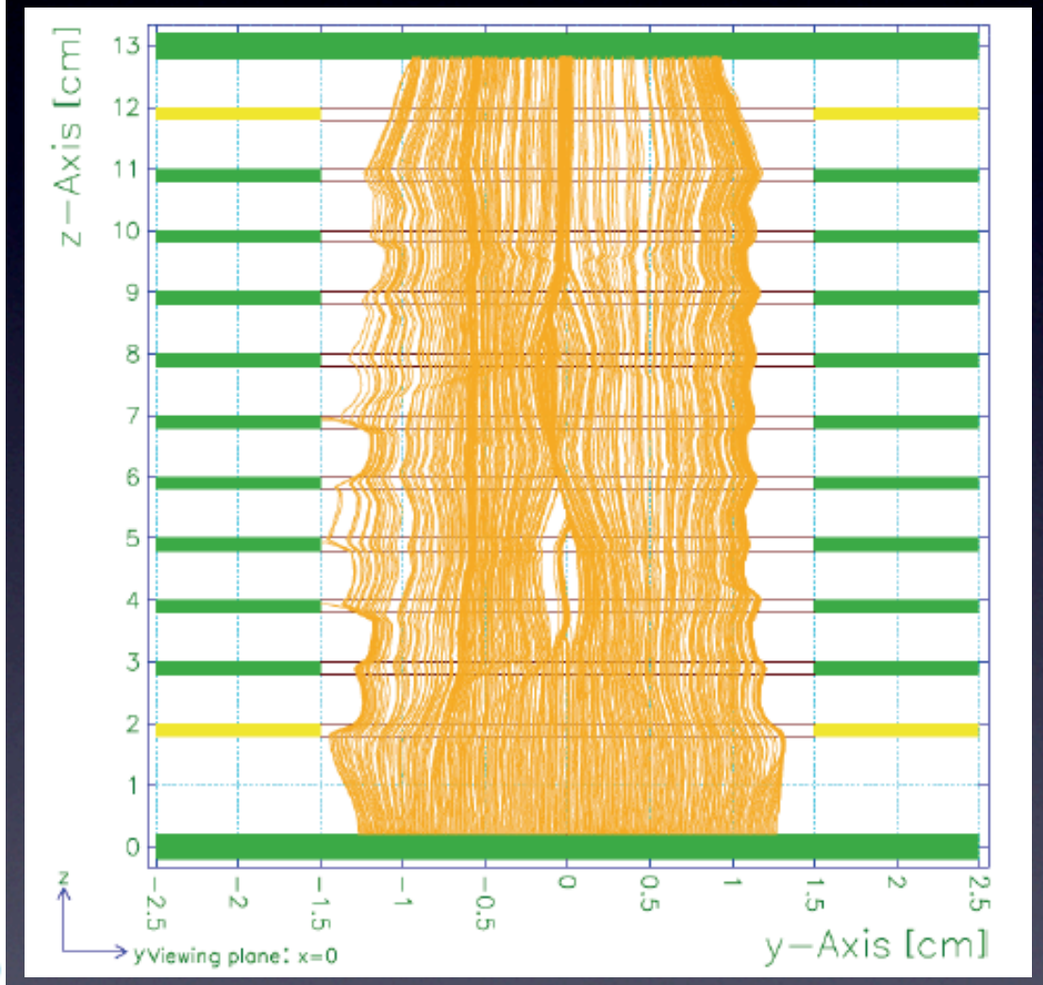


e-lifetime program parameters

- Parameters specific to each reco step.
- Use hit peak height or integrated area?
- Track wire span required.
- Number of drift time slices.
- Time of run/sub-run start and end.
- Various Landau+Gaussian fit seed parameters.
- Landau-Gaussian fit chi2/ndf required to be included in e-lifetime plot.

How does this compare to the purity monitor measurement?





- This confirms what we already knew: the purity monitor underestimates the e-lifetime.
- We found evidence of electron leakage multiple times during the run (see projects docDB #798).

To do

- Combine induction and collection plane e-lifetime measurements somehow.
  - Should I just take the arithmetic mean? I think this might be better than combining the induction and collection information before doing the fit.
- Choose parameters for a frozen release and run over all data.
- Estimate systematic errors(?).
- Put "official" e-lifetime measurements in a database, to be used for calorimetry calibration.