dE/dx Performance with TRIUMF Beam Test and Ageing Study Update

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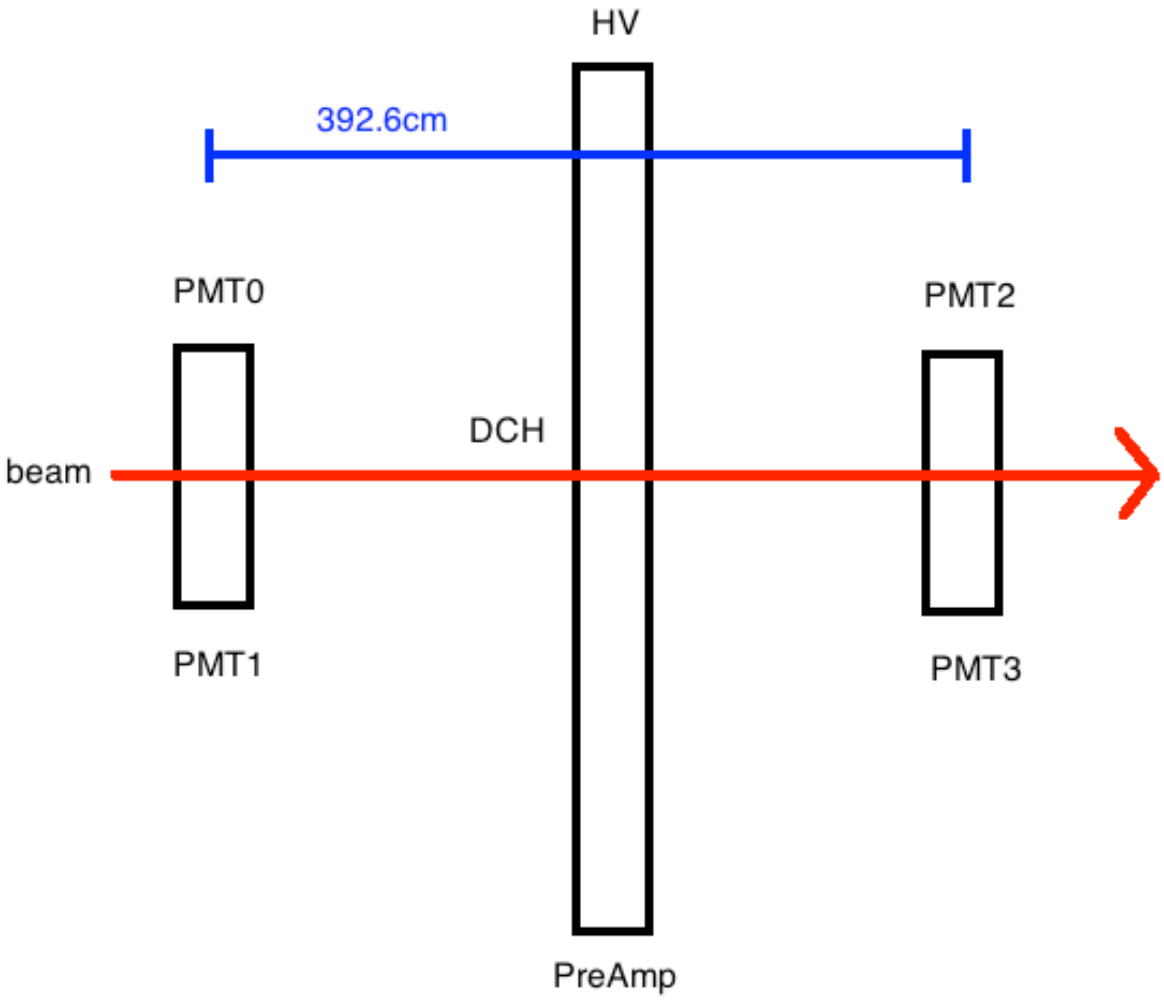
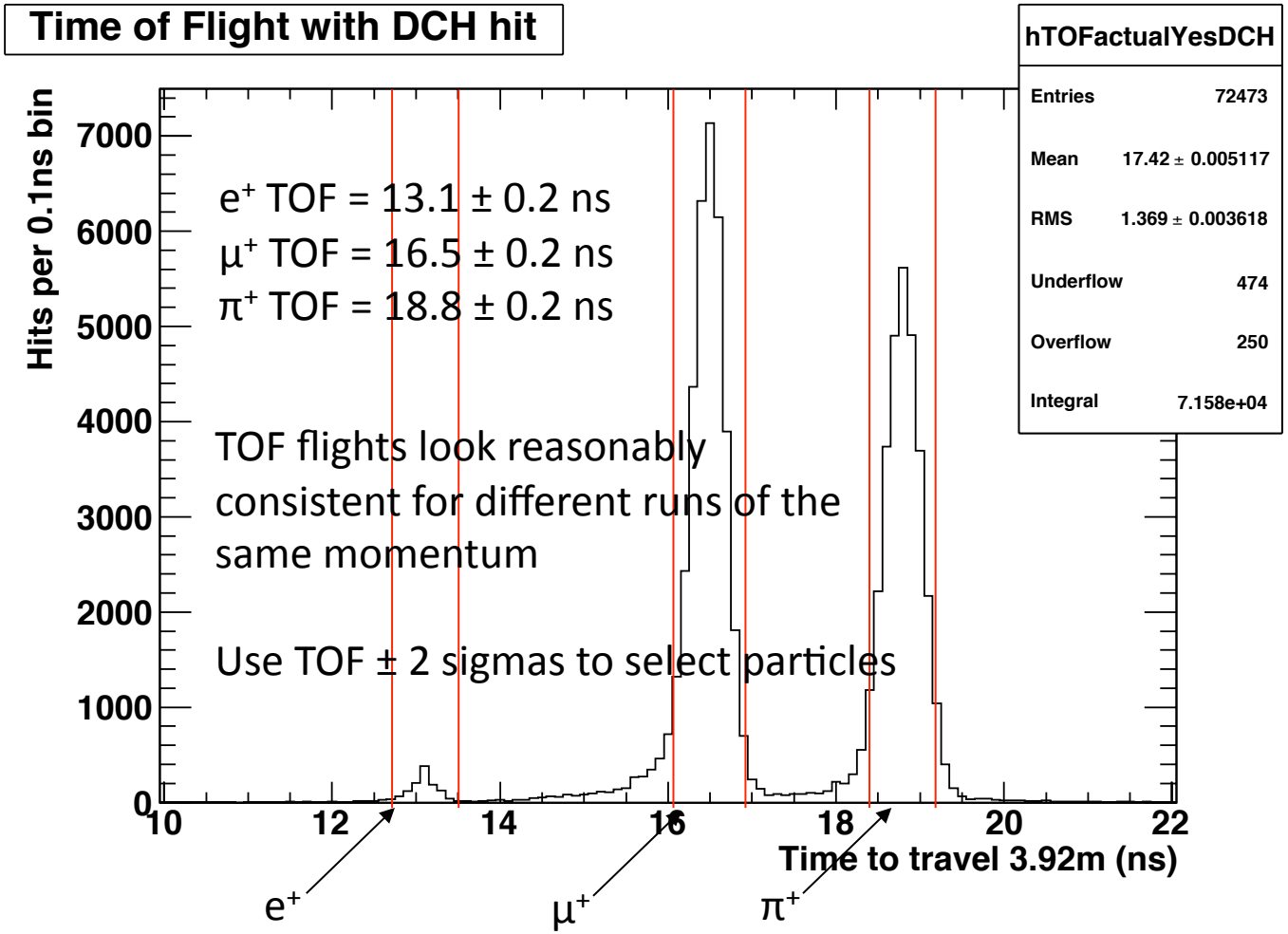
Top View Schematic

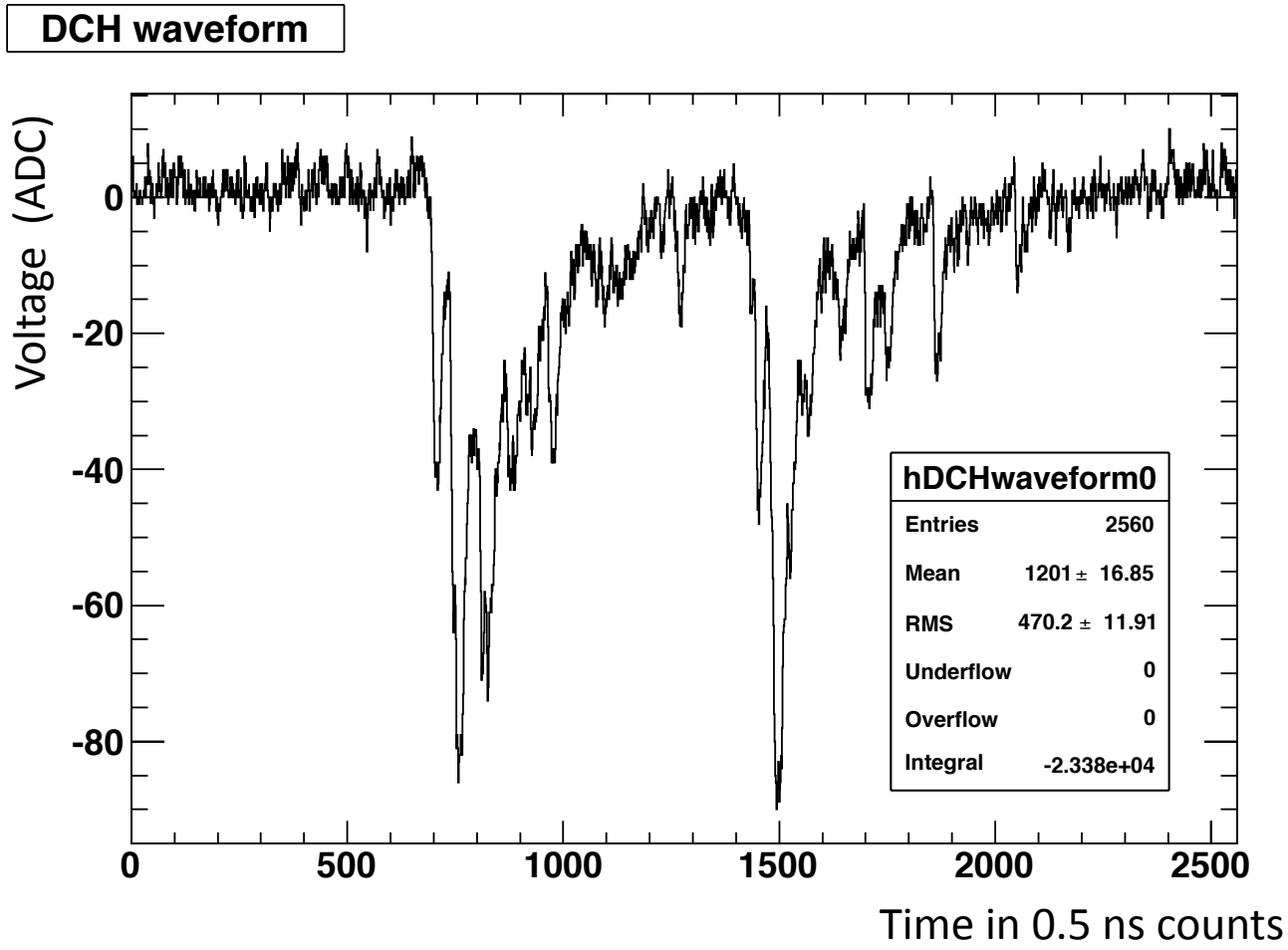


Time of Flight of 140MeV/c Particles



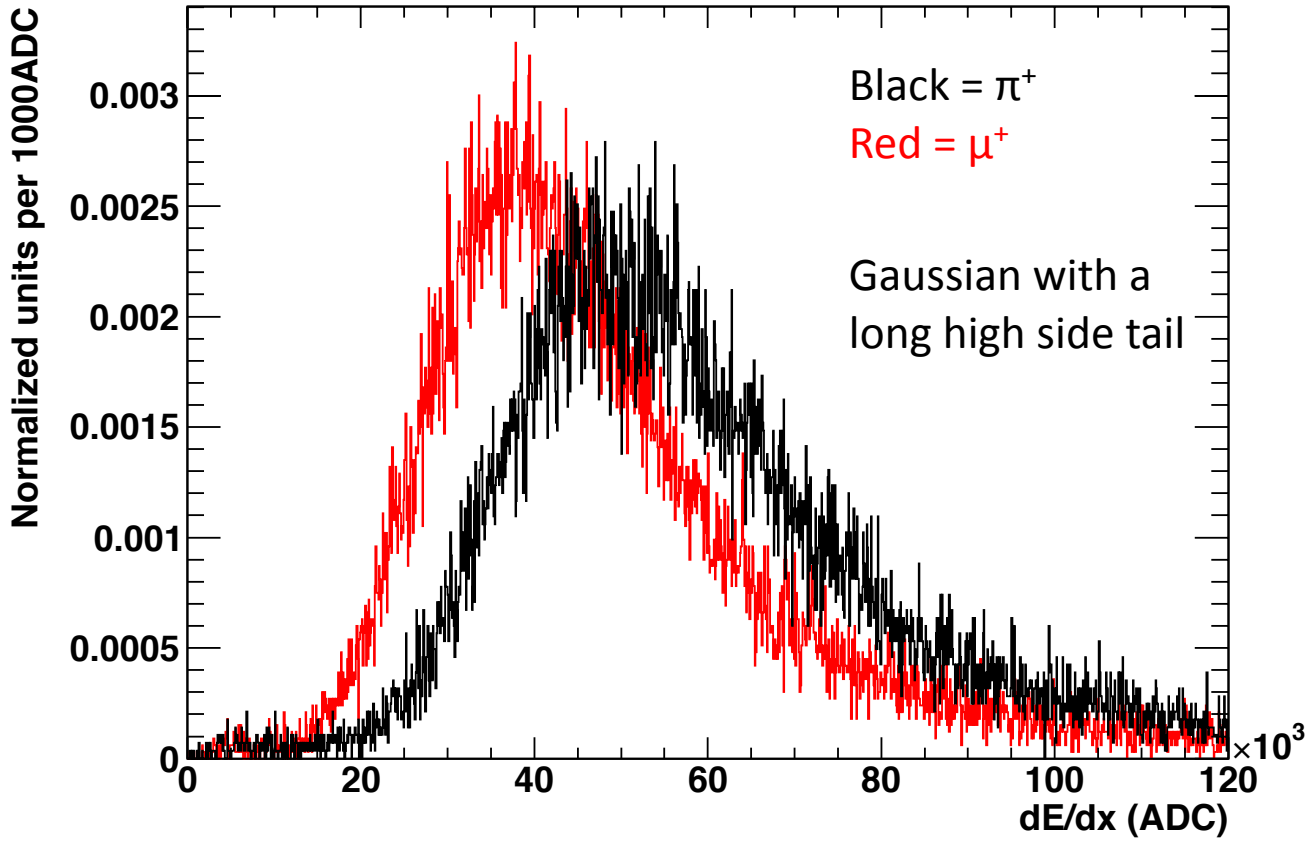
DCH Waveform

clusters!



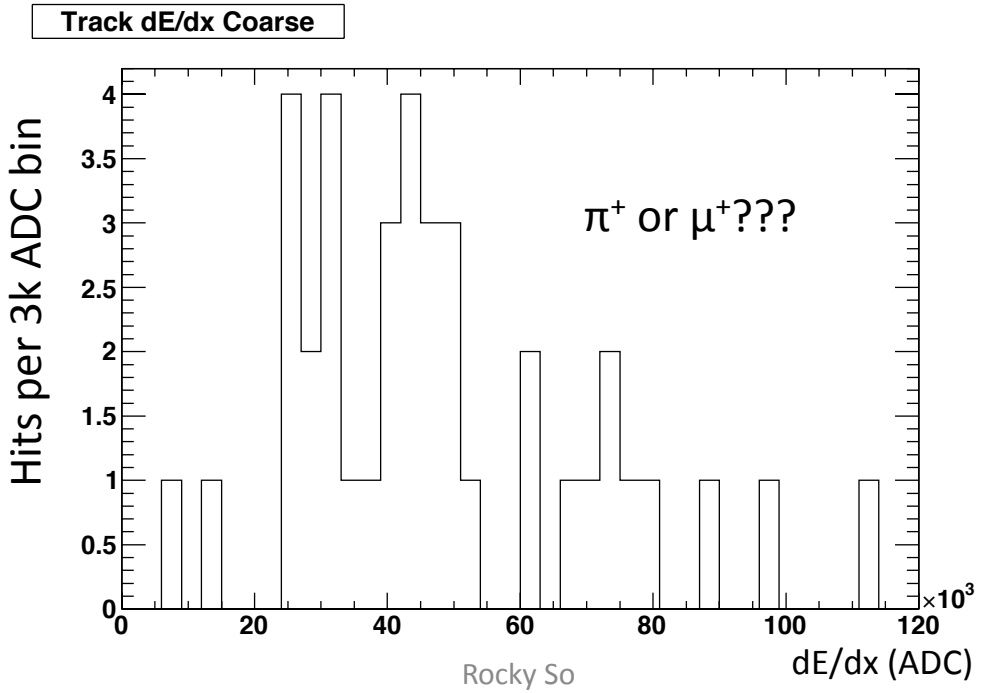
Energy Deposited per Hit

Run 144, centre of chamber, 45 degree, 90:10 gas, HV end terminated, Jean Pierre's preamp

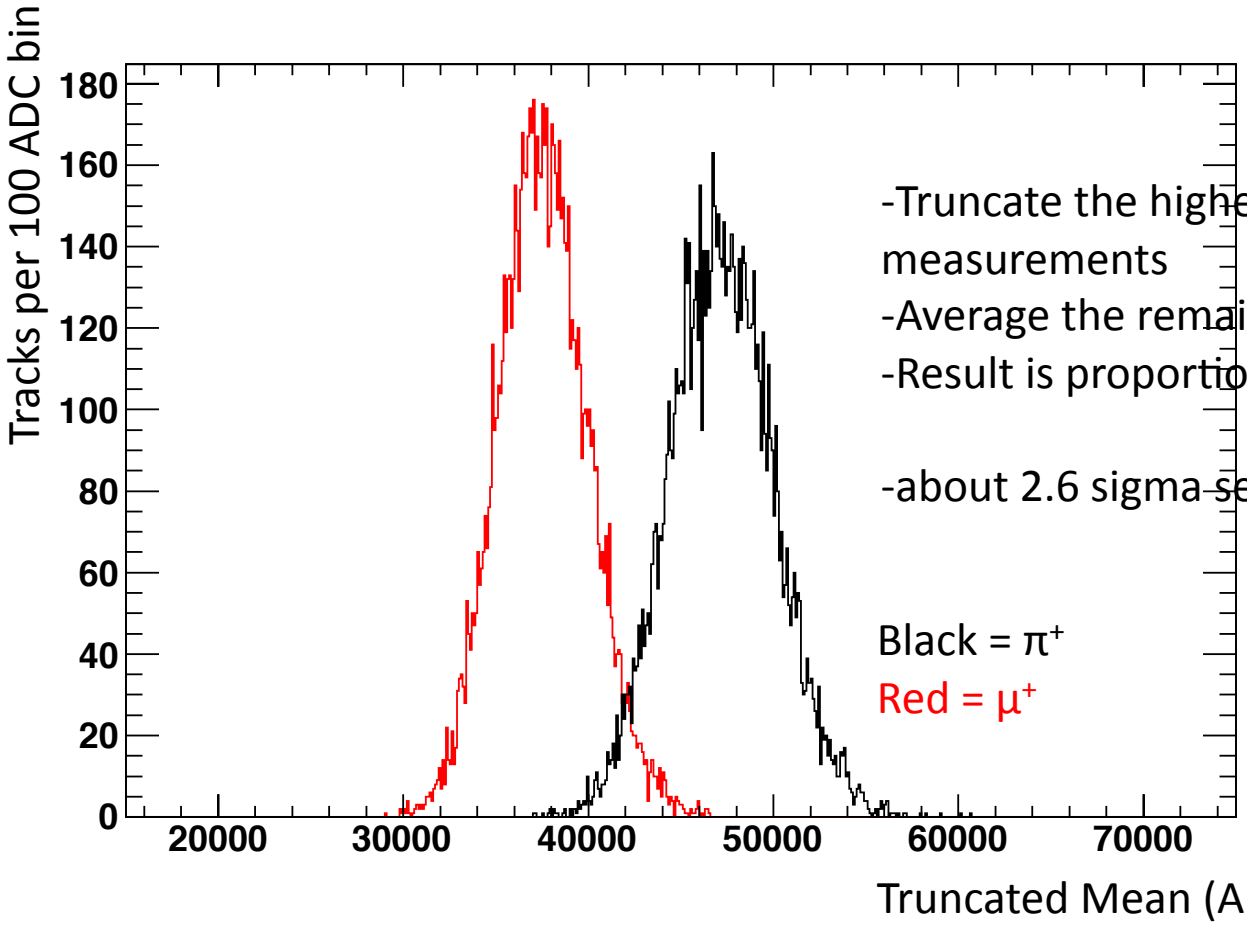


Bootstrap to Make Tracks

- Sample from the data 40 times to make a track
  - histogram.GetRandom()
- Calculate a truncated mean
- Calculate LH for both π^+ and μ^+ hypothesis
- Do KS test for both hypothesis



70% Truncated Mean

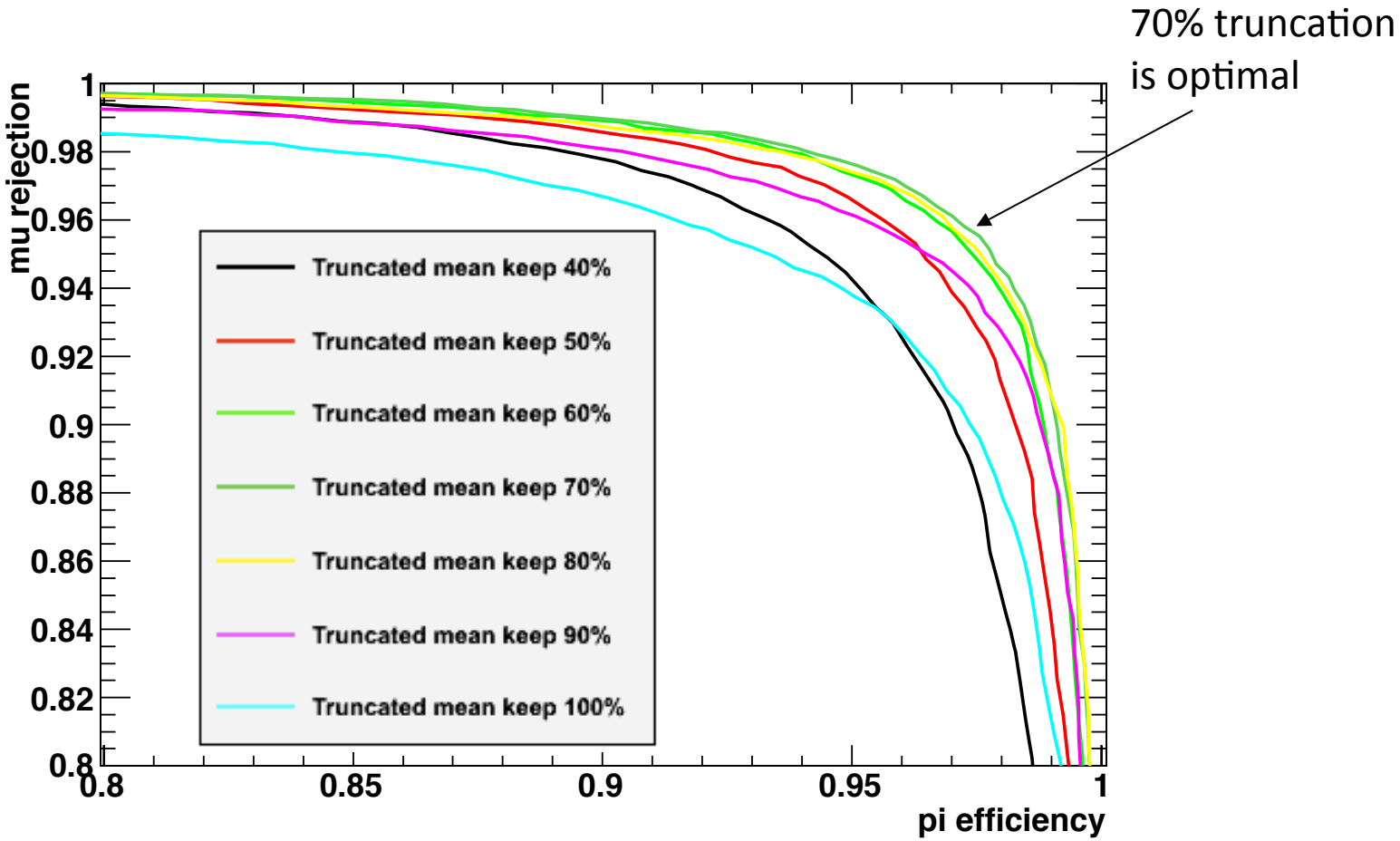


-Truncate the highest 30% energy measurements
-Average the remaining 70%
-Result is proportional to dE/dx

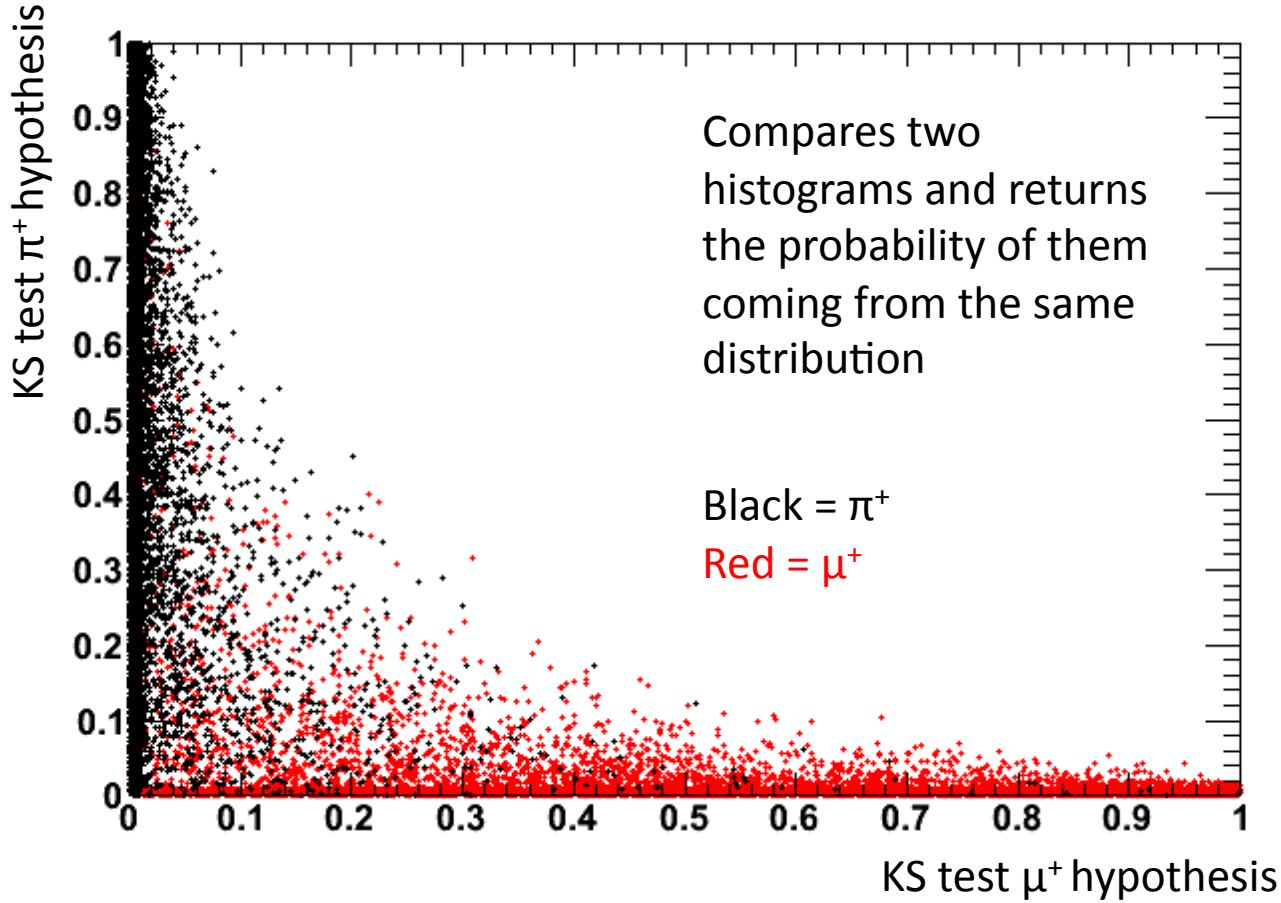
-about 2.6 sigma separation

Black = π^+
Red = μ^+

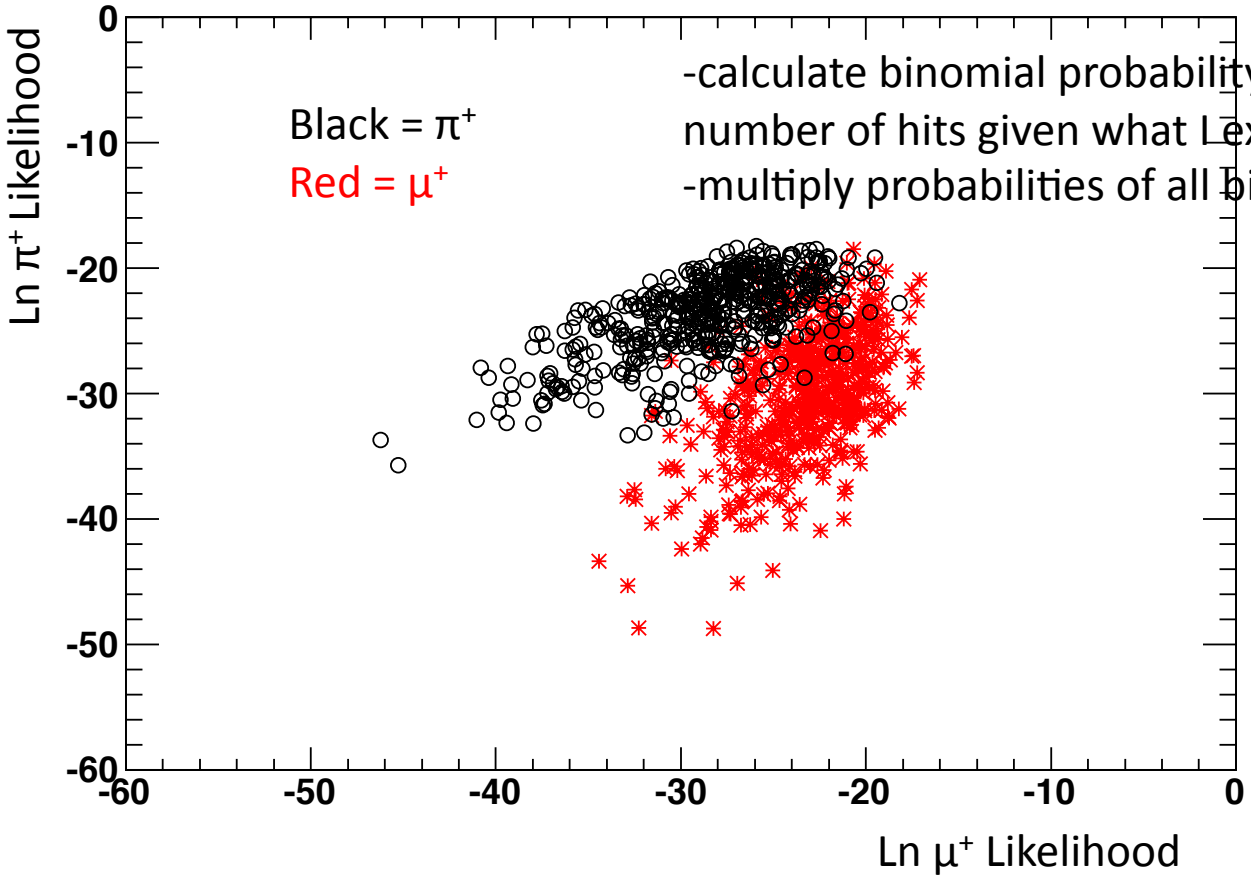
Compare Levels of Truncation



Kolmogorov-Smirnov Test of Track Being a π^+ or μ^+ Using All 40 Hits



Likelihood of Track Being a π^+ or μ^+ Using All 40 Hits

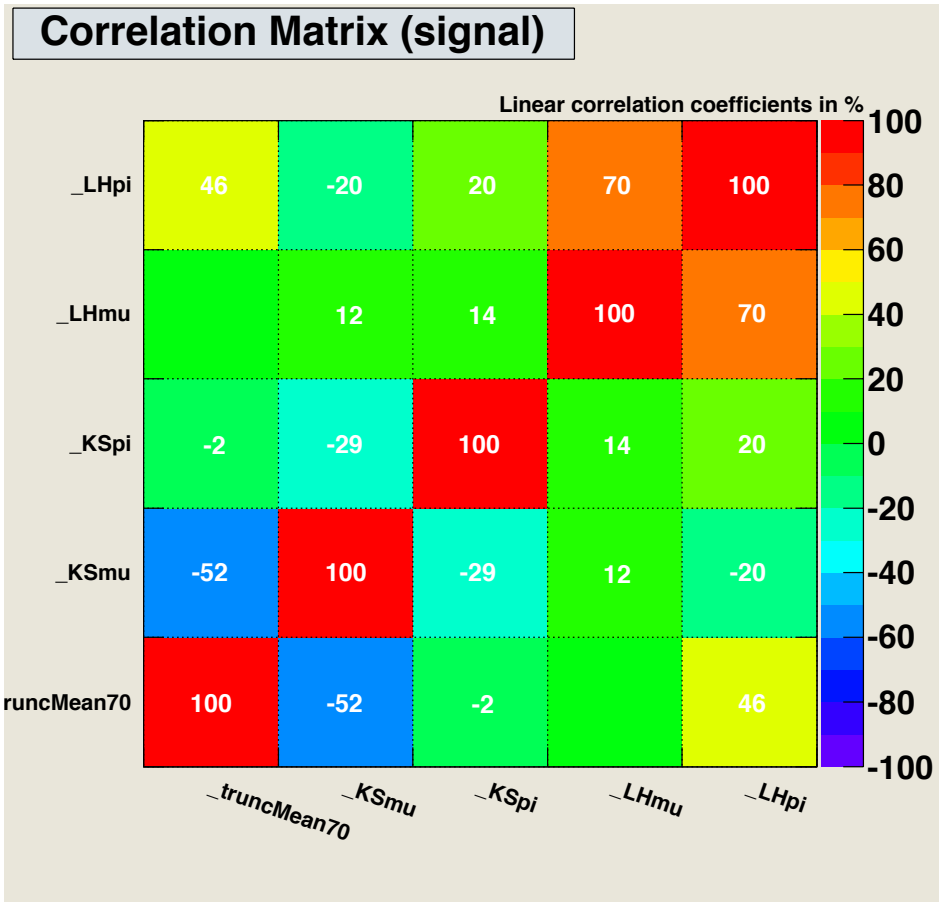


-calculate binomial probability of observing the number of hits given what I expect in each bin

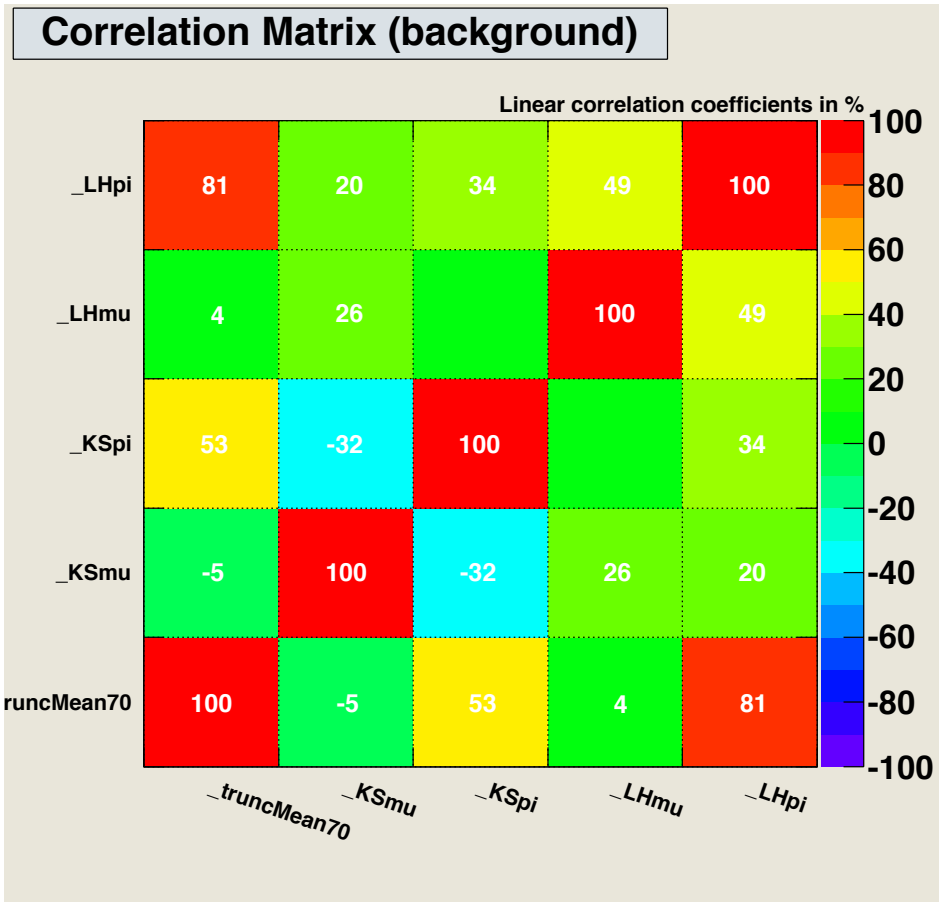
-multiply probabilities of all bins

Correlation Matrices

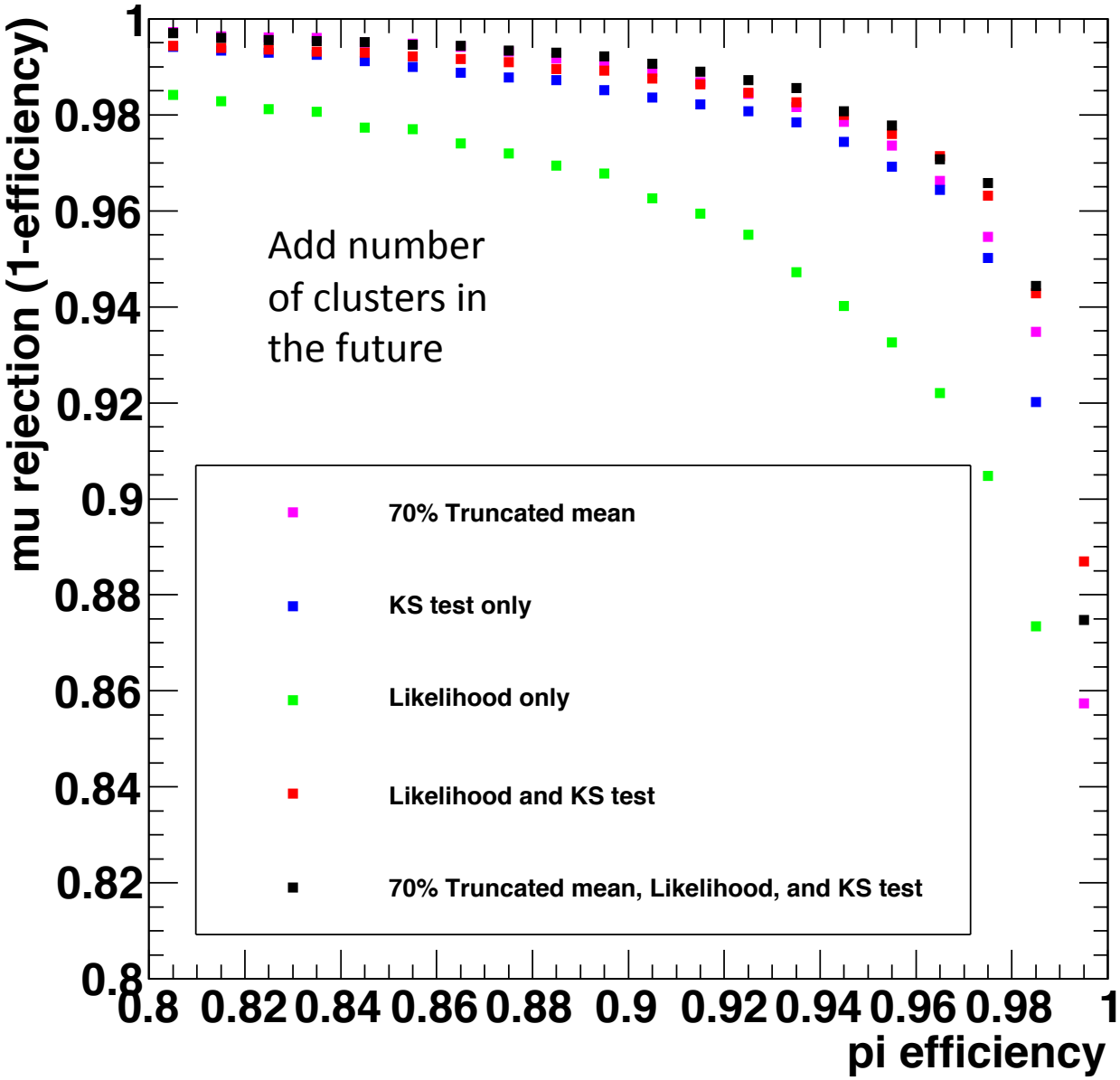
π^+



μ^+



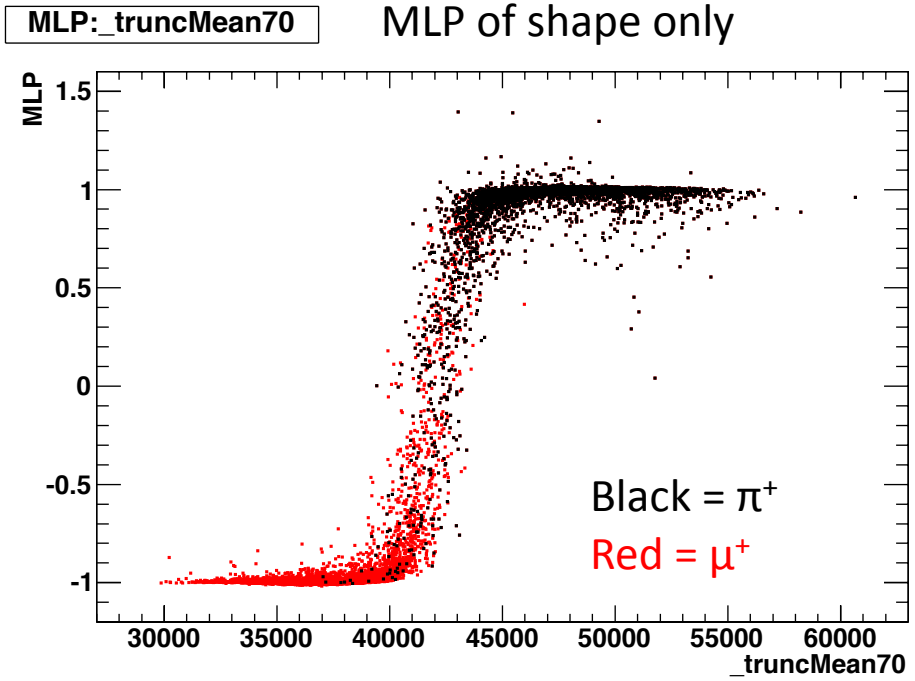
140MeV/c pi+ mu+ separation



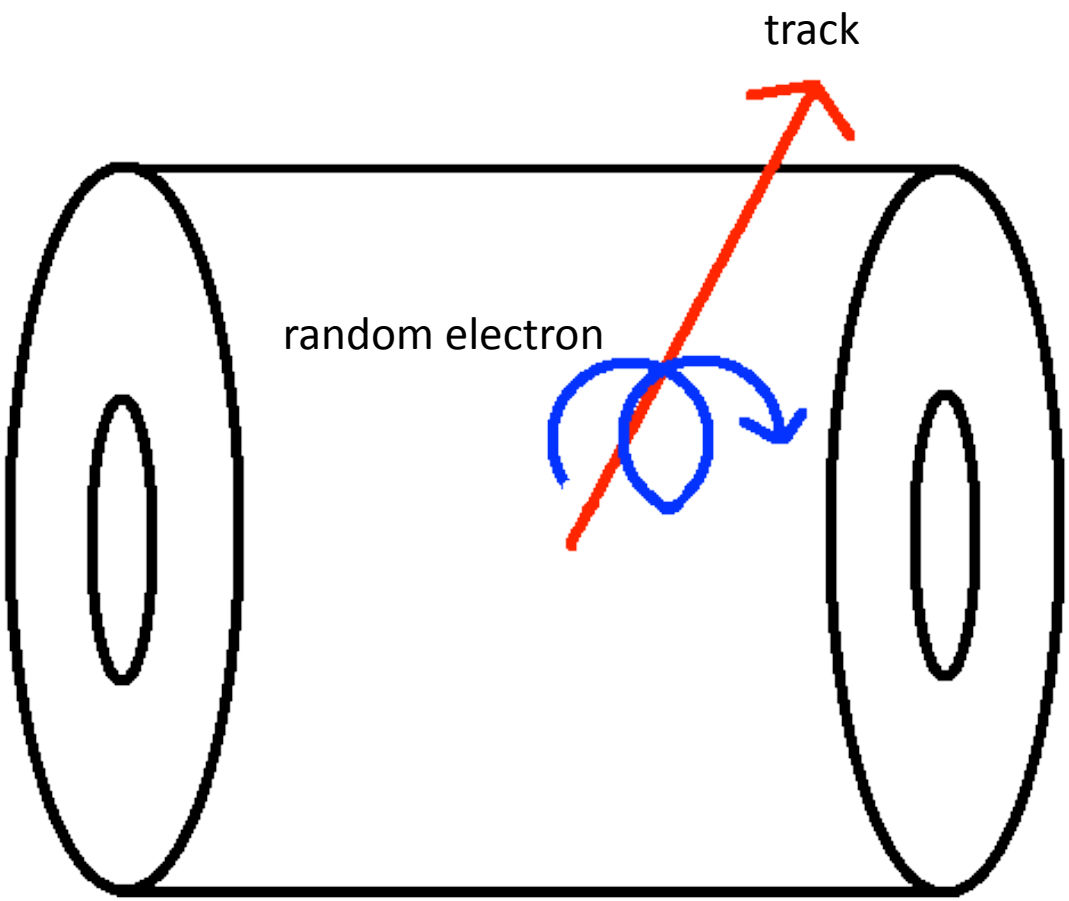
95 % pi ε	mu ε
Truncated mean	2.6 %
LH	3.1 %
KS test	6.7 %
LH and KS test	2.4 %
All combined	2.2 %

Choosing an Algorithm

- Using all 5 is the best
- Seems just a little better than just using truncated mean
- MVA output of shape variables correlate with truncated mean



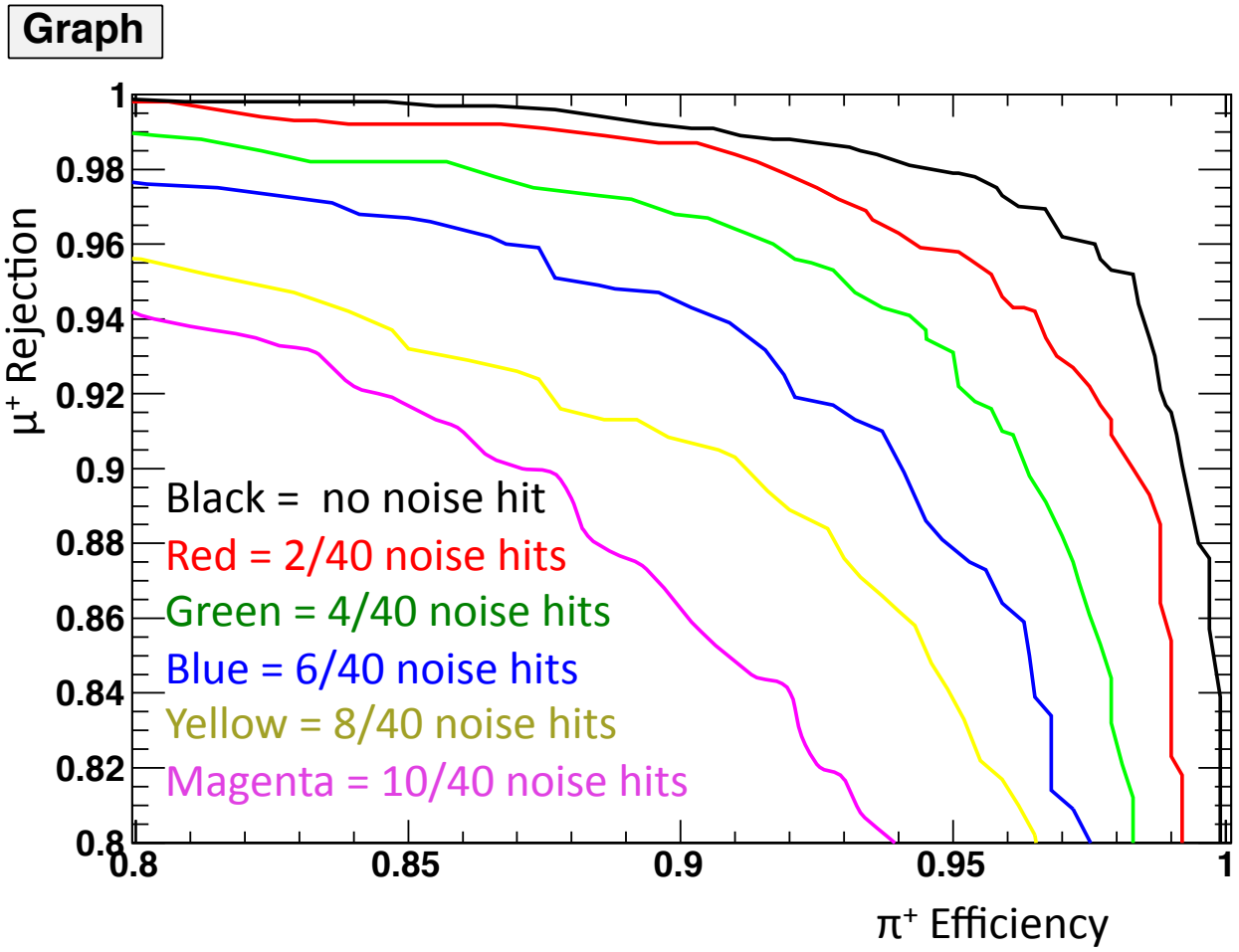
Noise Hits



Noise Hits

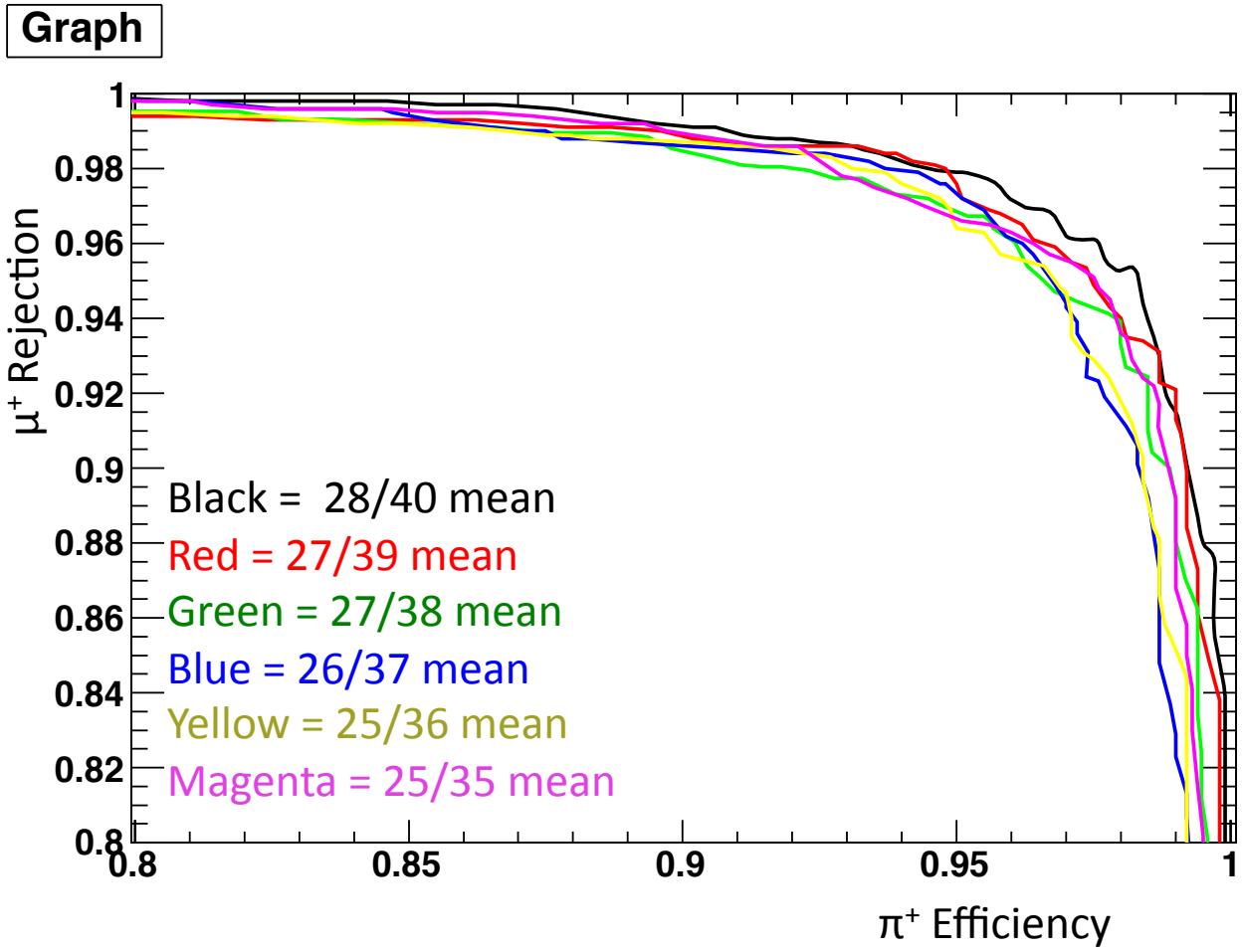
- Estimate how robust the truncated mean is
- Generate a hit with dE/dx uniformly distributed [0,120k ADC]
- Form tracks by replacing 0,2,4,6,8,10 normal hits with noise hits and compare π^+ μ^+ separation
- Form tracks with 35,36,37,38,39,40 normal hits to see the how performance gets worse if we can toss out noise hits

Effect of Random Noise Hits



Even with 10 noise hits, we still have ~88/88 efficiency and rejection as opposed to ~97/97 with no noise hits

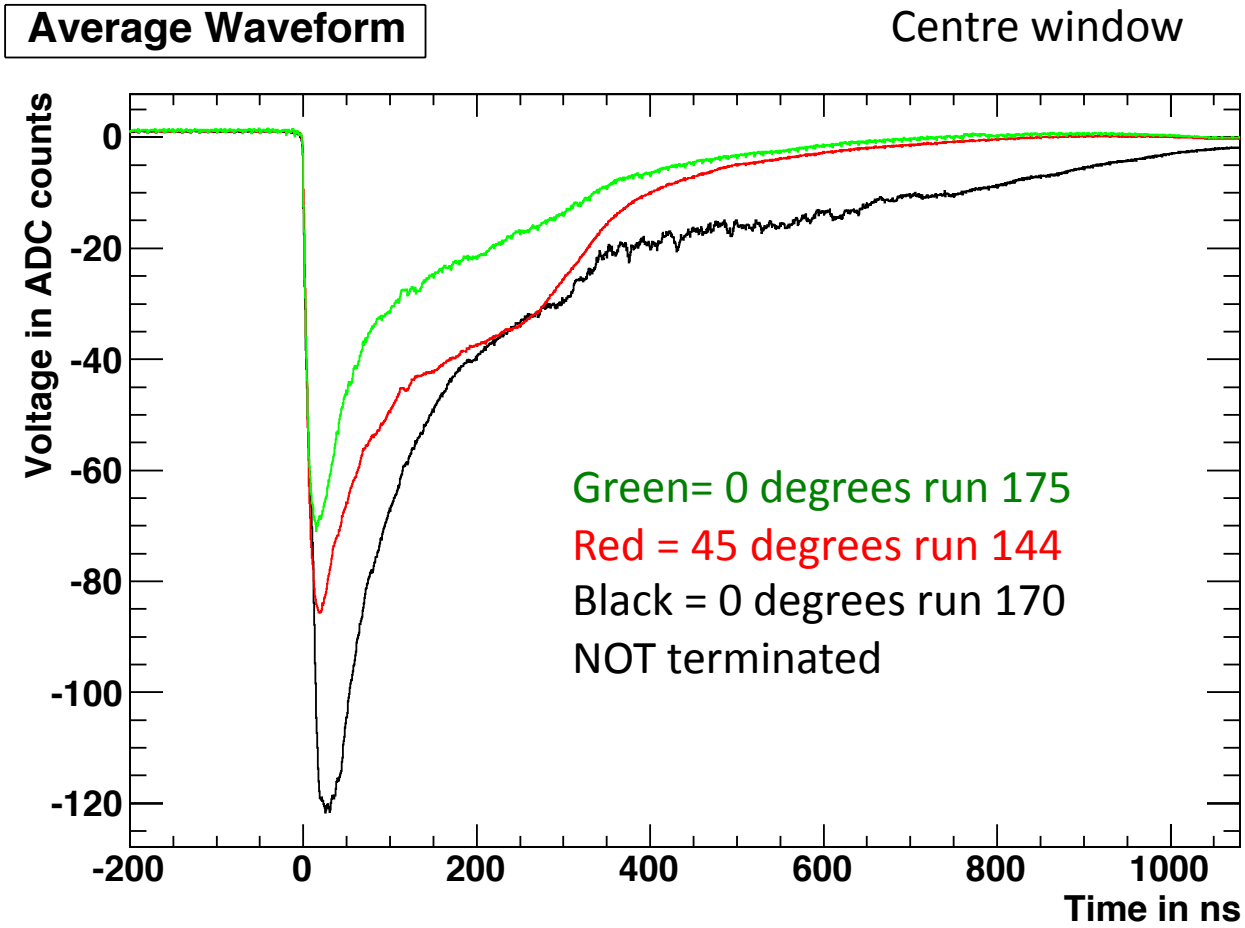
Effect of Using Fewer than 40 Hits

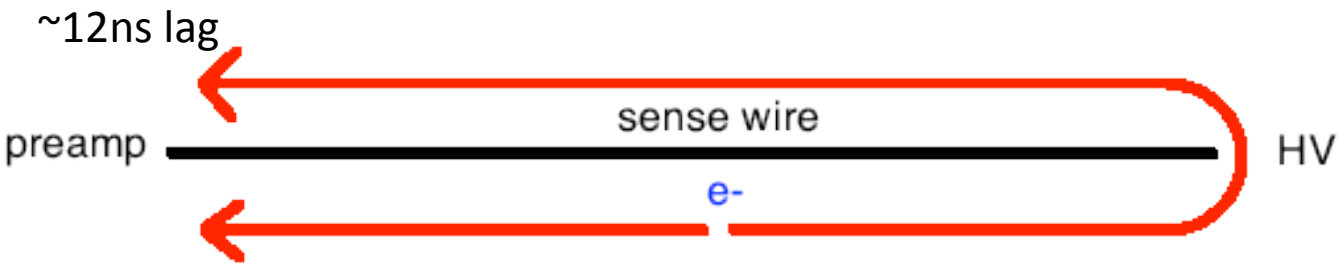


We can recover performance reasonably well if we can reject noise hits

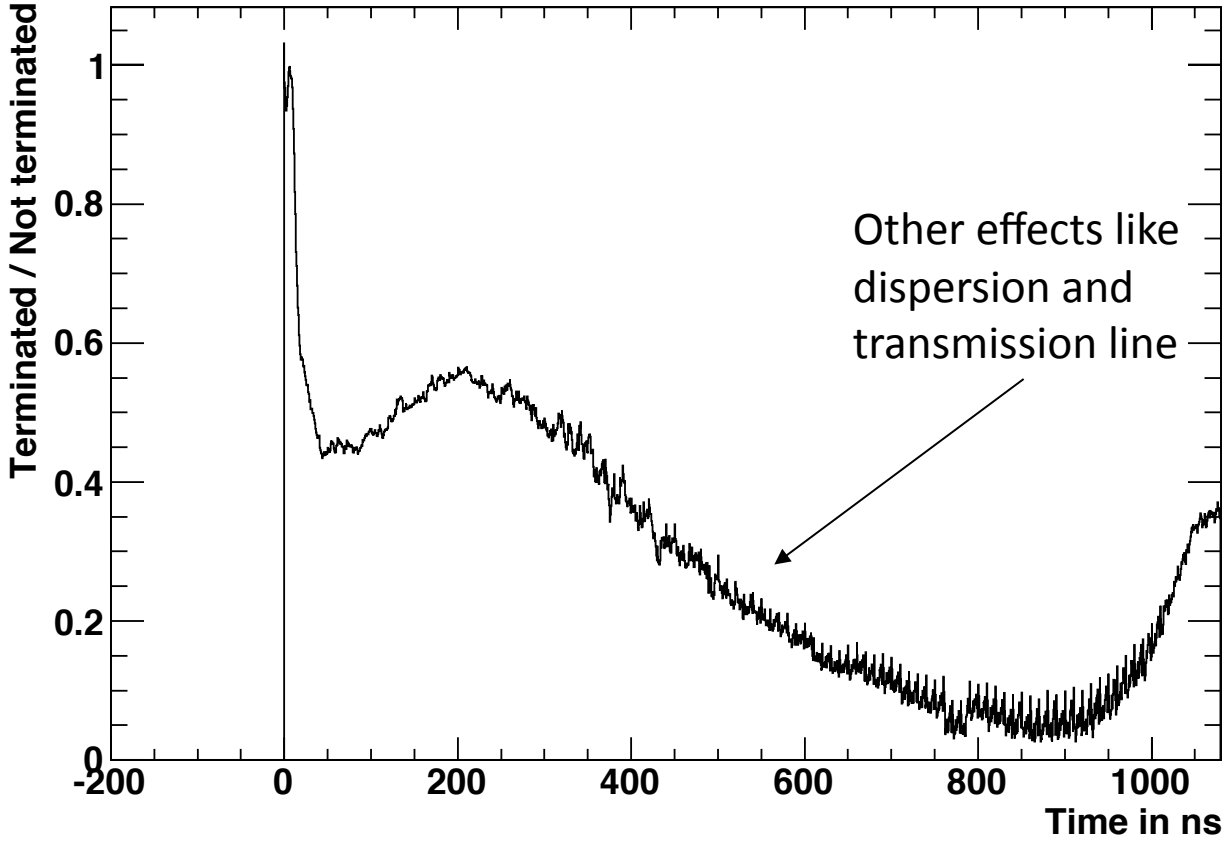
Work in progress

Average Waveform Aligned for μ^+ Normalized to Traversed Length

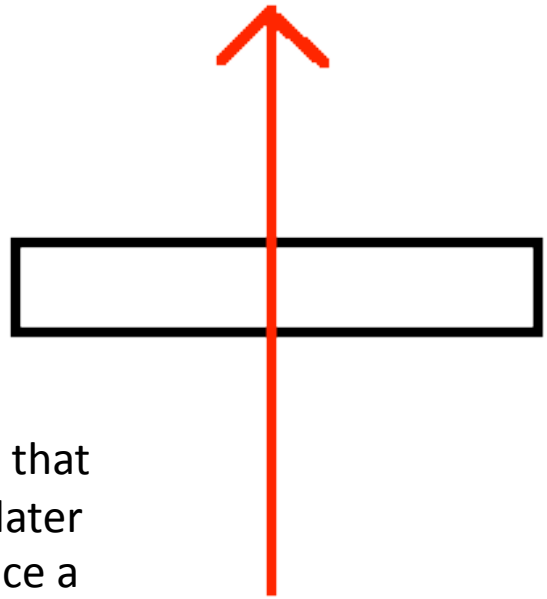




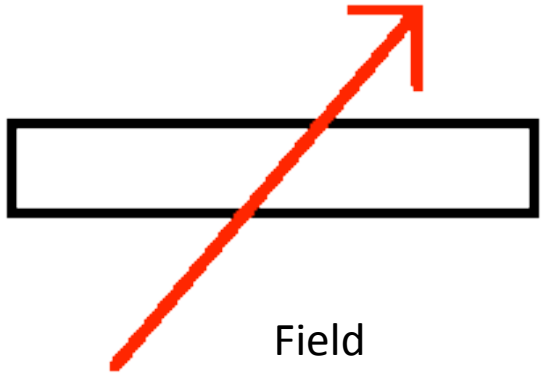
Ratio of terminated and not terminated waveform



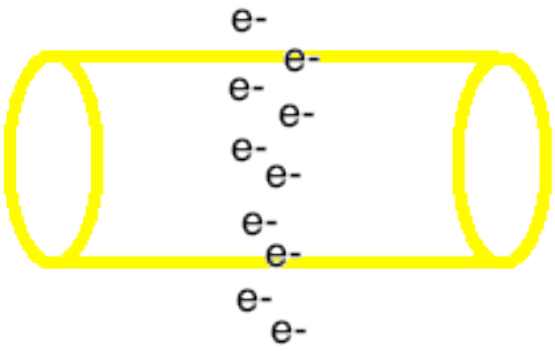
Cloud Effect Theory



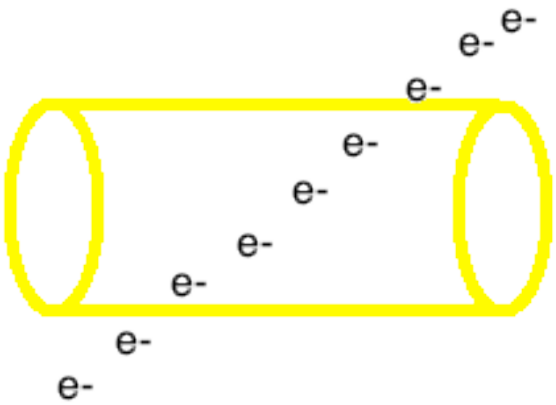
Electrons that come in later experience a smaller field



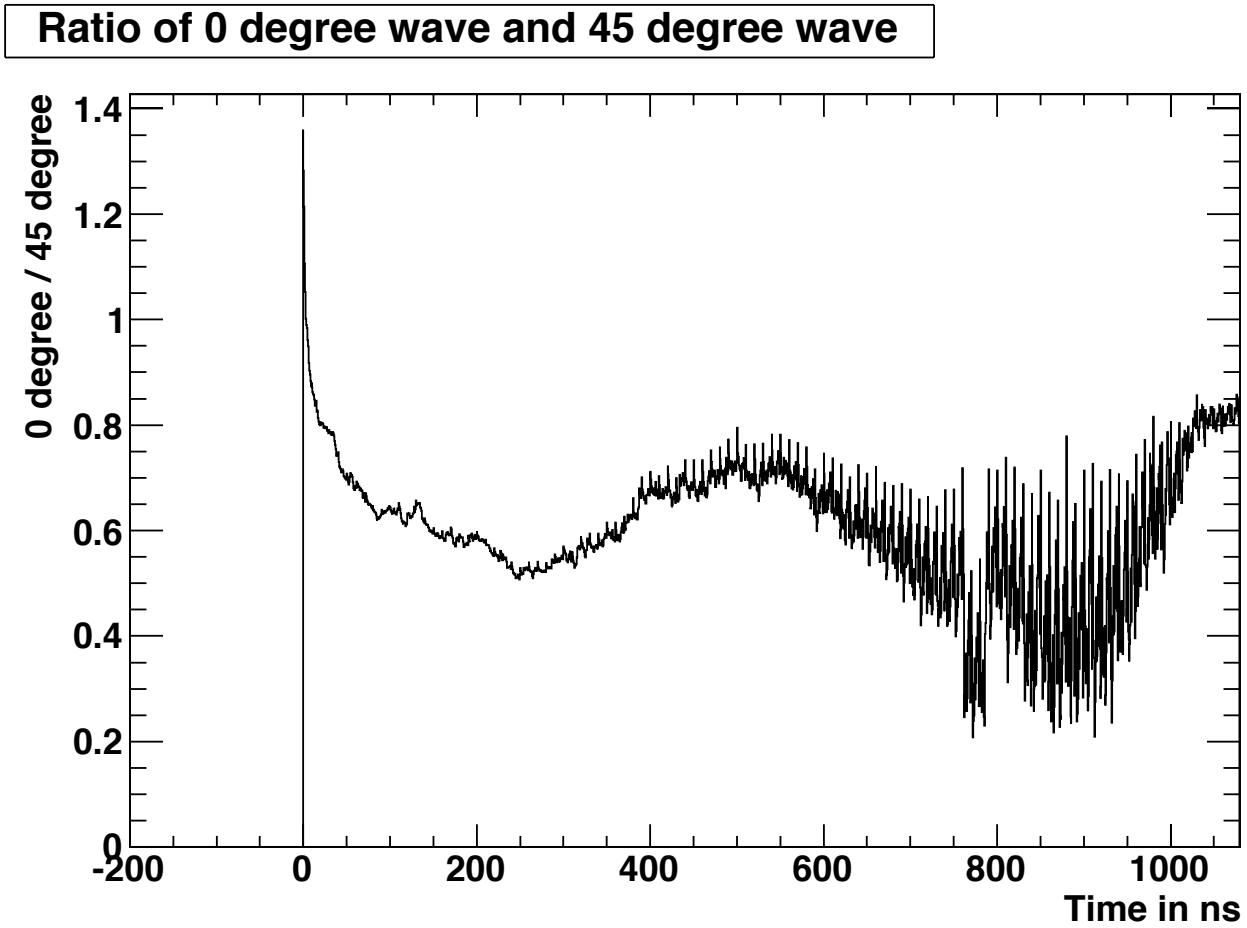
Field doesn't get clouded as much



sense wire

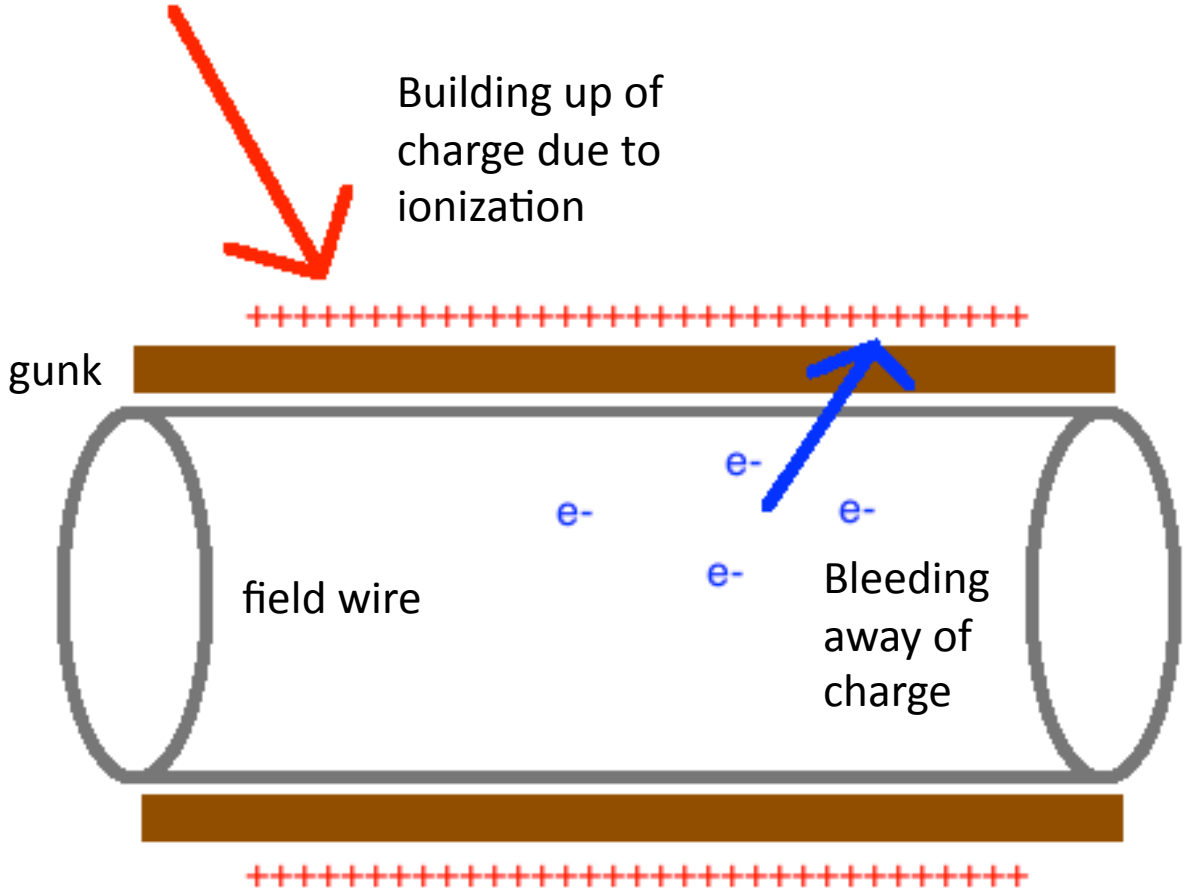


0 and 45 Degrees Dip Angle

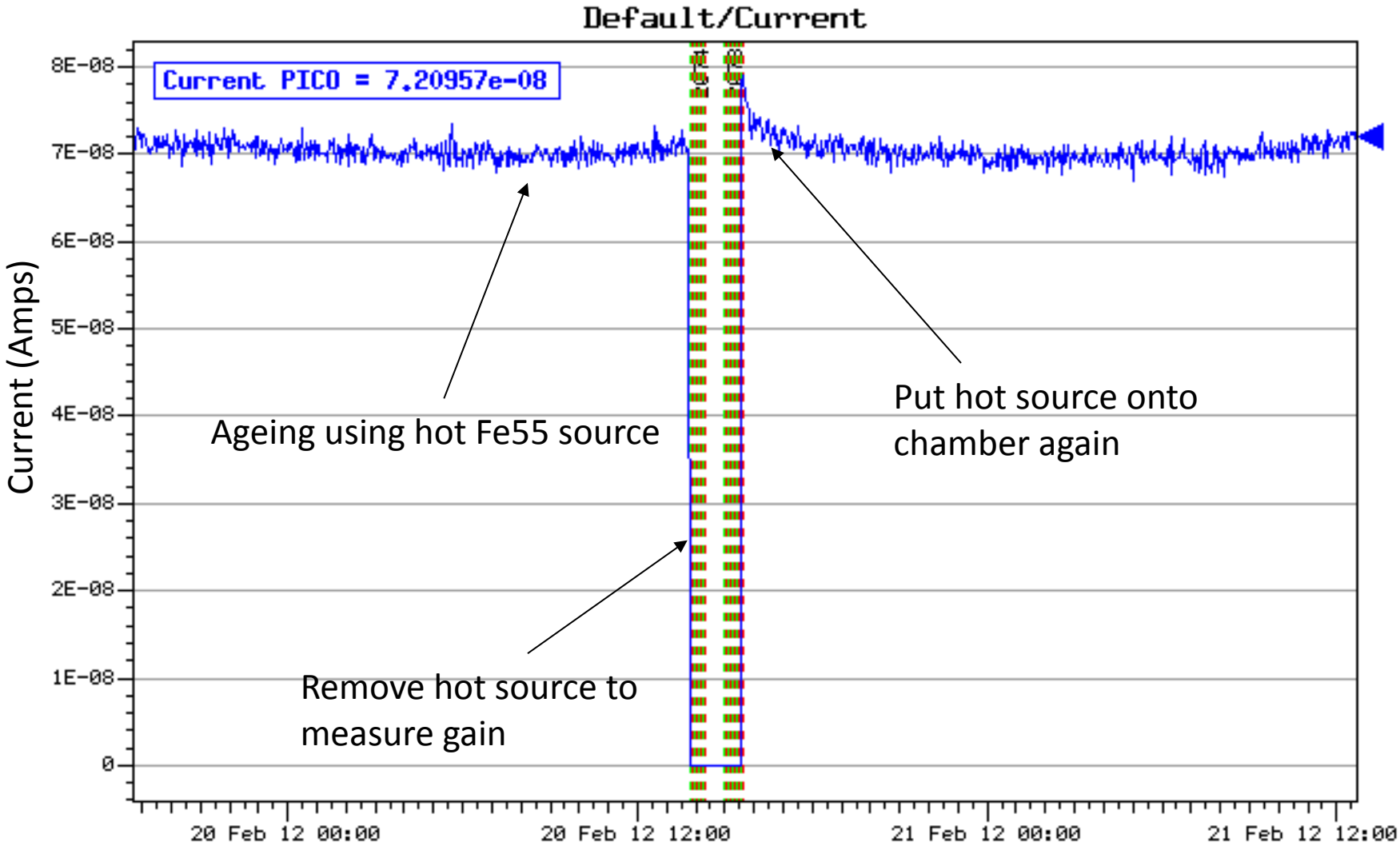


Ageing Chamber

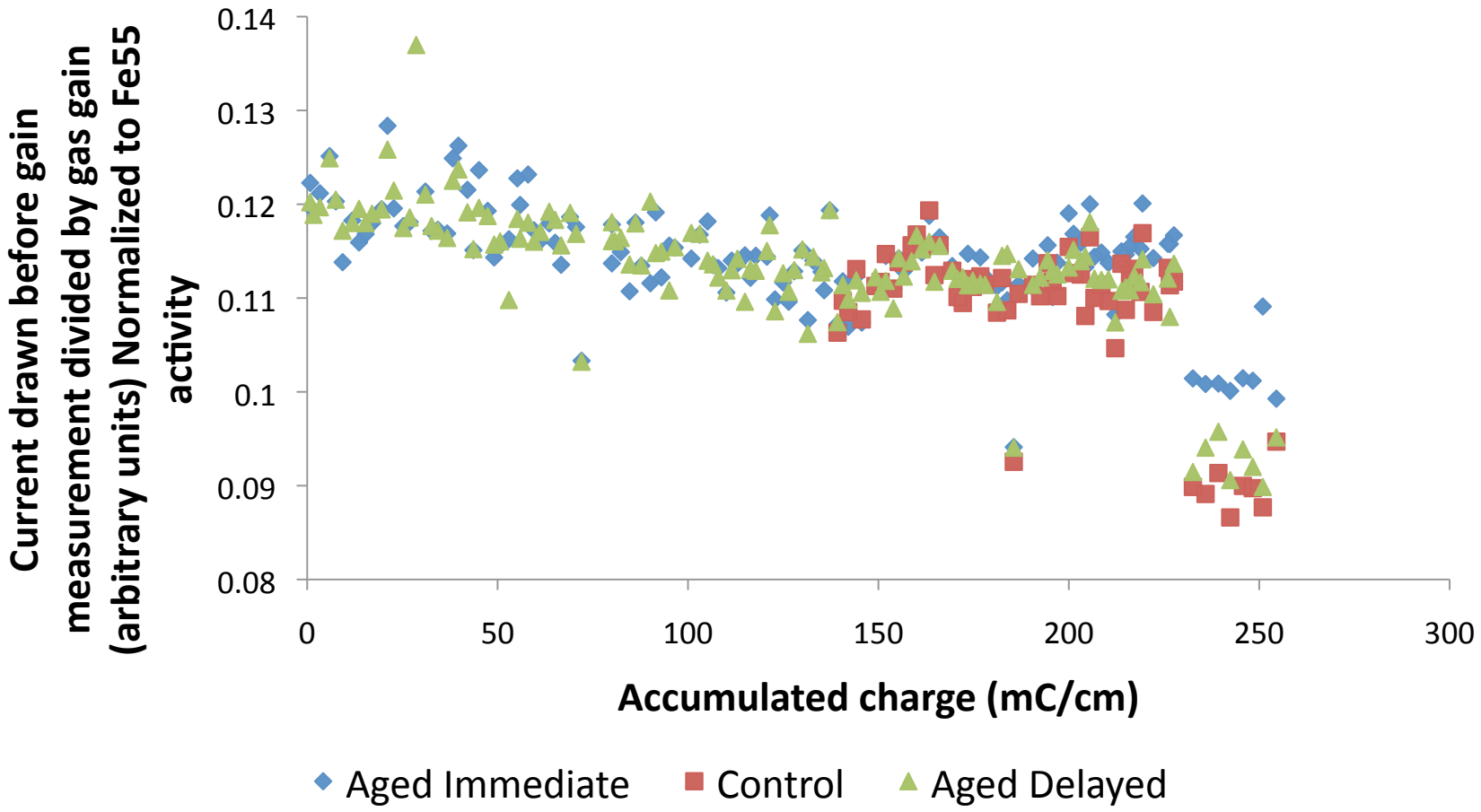
Field Around Ageing Field Wires



Transient Effects



Current and Gain Ratio



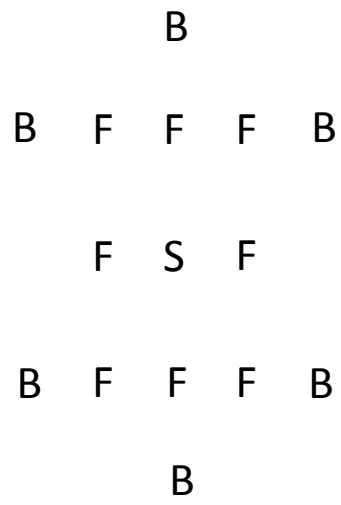
Outlook

- More beam test analysis to understand z and other momenta performance
- Ageing chamber 250mC/cm and alive
- Will age carbon fiber chamber as soon as we get it and build it

Extra Slides

TRIUMF Beam Test

- TRIUMF beam data taken Nov 25th to Dec 5th, 2011
- e^+ μ^+ π^+ of various momenta from 120 to 330MeV/c
- Square cell with wires 0.75cm apart
- Full length of 270cm with data taken at 4 distances from preamp
- 3 gases of He:Isobutane
  - 80:20
  - 90:10
  - 95:5
- HV side terminated and not
- Wentek preamp and prototype from McGill designed by Jean-Pierre



S = 20um gold plated Mo
B = F = 80um gold plated Al

Setup

- Use a time of flight system to measure particle velocity with a known momentum
- Record waveforms at 4 PhotoMultiplierTubes and DriftCHamber
- Trigger on the coincidence of all 4 PMTs
- Delay PMT for 80ns to account for drift time

MVA Algorithms Using All 5 Variables