LHRS Analysis for d_2^n

PID Analysis, Scintillator Calibration Study

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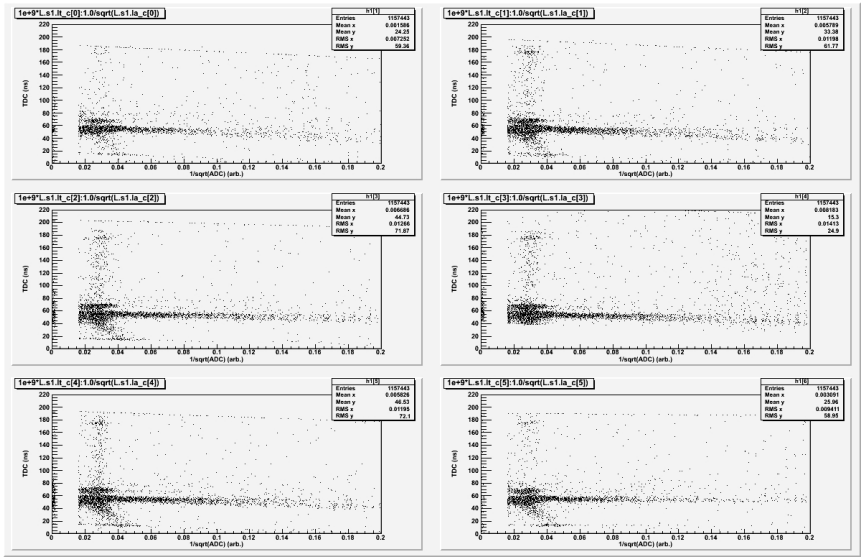
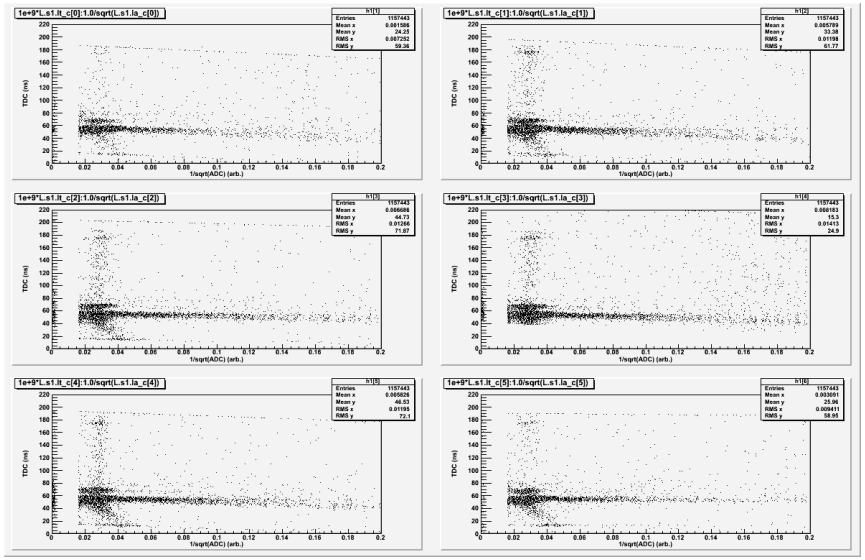
Outline

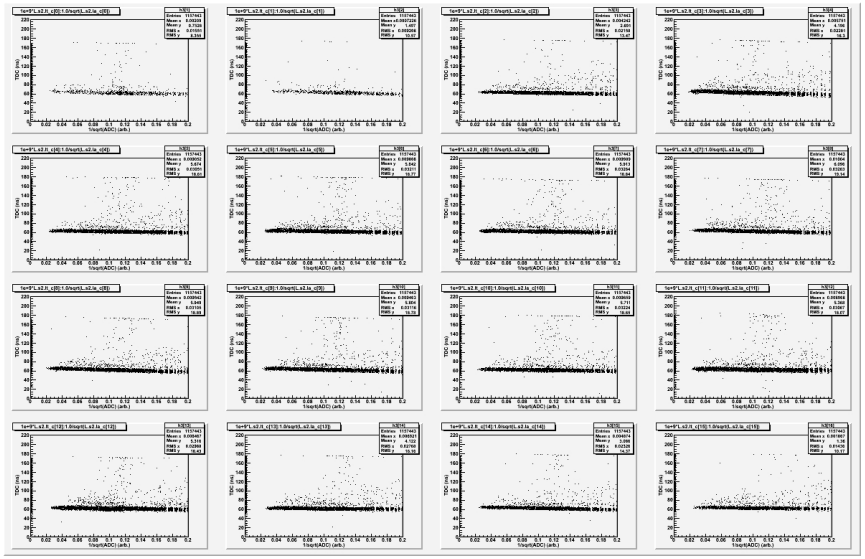
S1 Timewalk

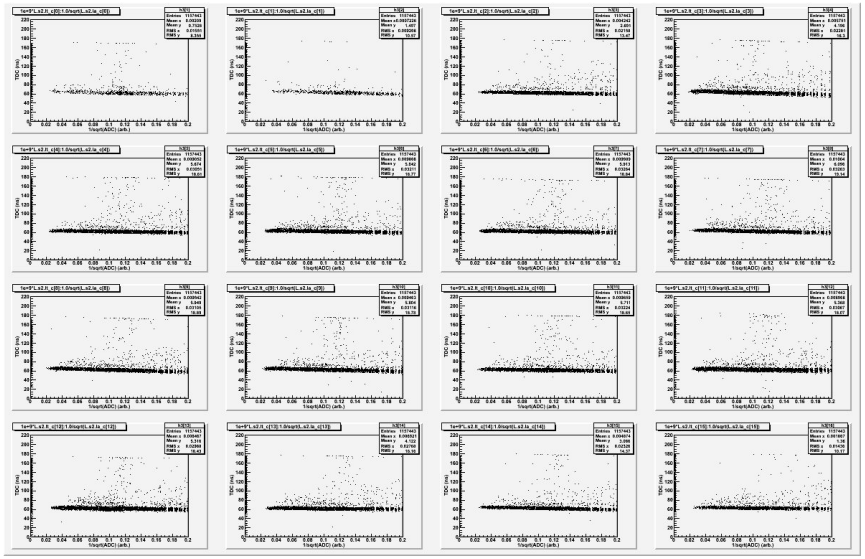




- Left → no correction factors implemented; Right → correction factors implemented
- There seems to be no difference here. . .

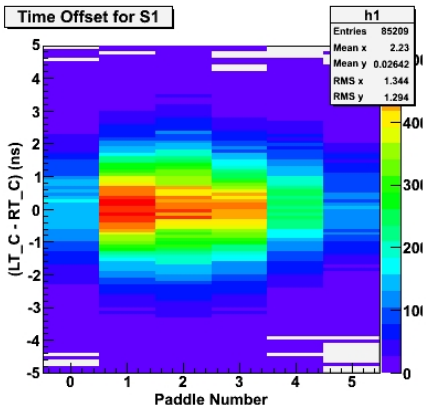
S2m Timewalk

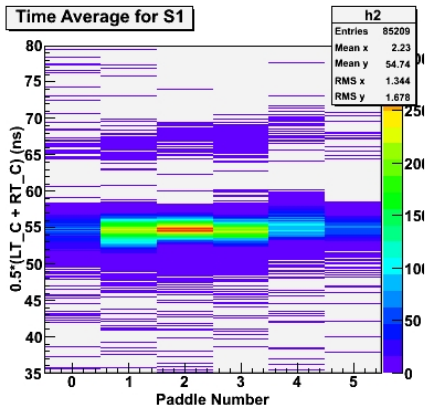


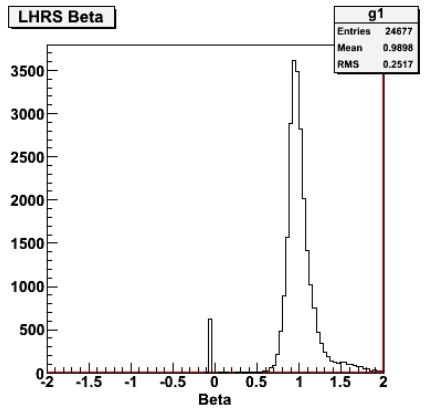


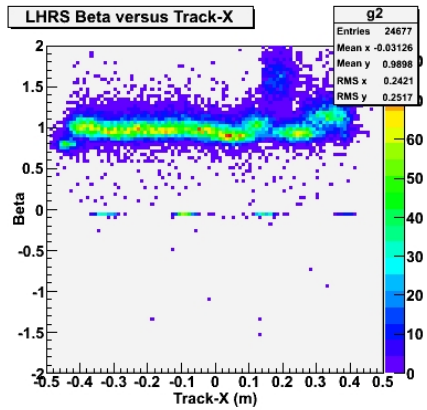
- Same issue for S2m

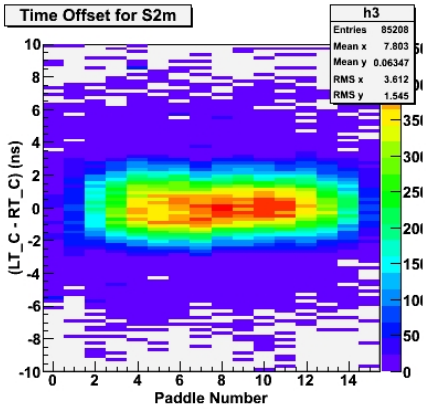
β vs. x

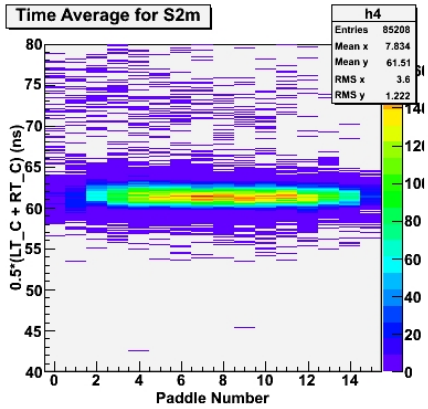

Time Offset for S1
h1
Entries 85209
Mean x 2.23
Mean y 0.02642
RMS x 1.344
RMS y 1.294
(LT_C - RT_C) (ns)
Paddle Number

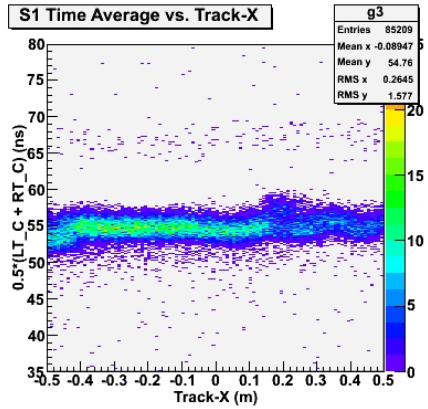

Time Average for S1
h2
Entries 85209
Mean x 2.23
Mean y 54.74
RMS x 1.344
RMS y 1.678
0.5*(LT_C + RT_C) (ns)
Paddle Number

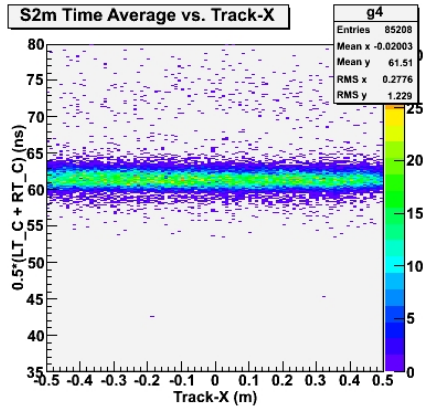

LHRS Beta
g1
Entries 24677
Mean 0.9898
RMS 0.2517
Beta


LHRS Beta versus Track-X
g2
Entries 24677
Mean x -0.03126
Mean y 0.9898
RMS x 0.2421
RMS y 0.2517
Beta
Track-X (m)


Time Offset for S2m
h3
Entries 85208
Mean x 7.803
Mean y 0.06347
RMS x 3.612
RMS y 1.545
(LT_C - RT_C) (ns)
Paddle Number


Time Average for S2m
h4
Entries 85208
Mean x 7.834
Mean y 61.51
RMS x 3.6
RMS y 1.222
0.5*(LT_C + RT_C) (ns)
Paddle Number


S1 Time Average vs. Track-X
g3
Entries 85209
Mean x -0.08947
Mean y 54.76
RMS x 0.2645
RMS y 1.577
0.5*(LT_C + RT_C) (ns)
Track-X (m)

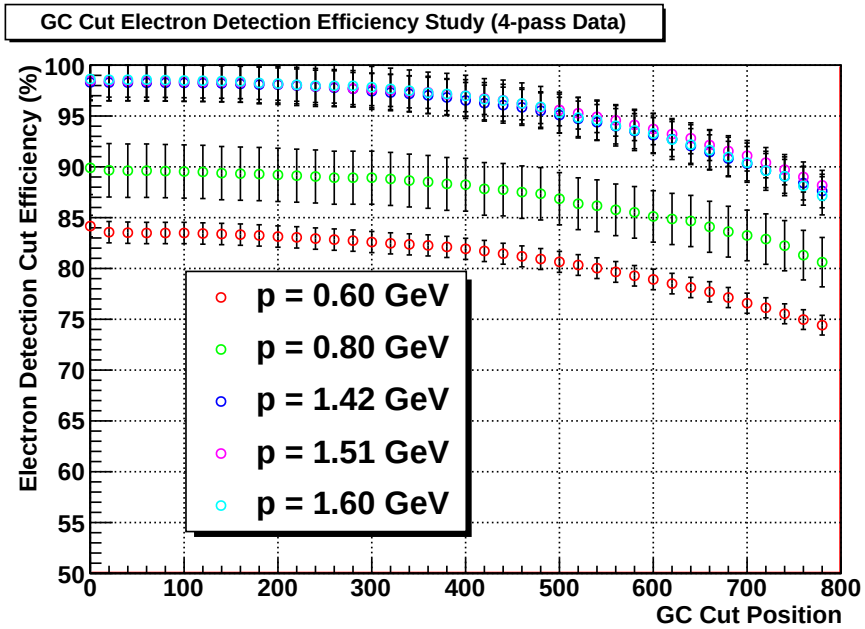

S2m Time Average vs. Track-X
g4
Entries 85208
Mean x -0.02003
Mean y 61.51
RMS x 0.2776
RMS y 1.229
0.5*(LT_C + RT_C) (ns)
Track-X (m)

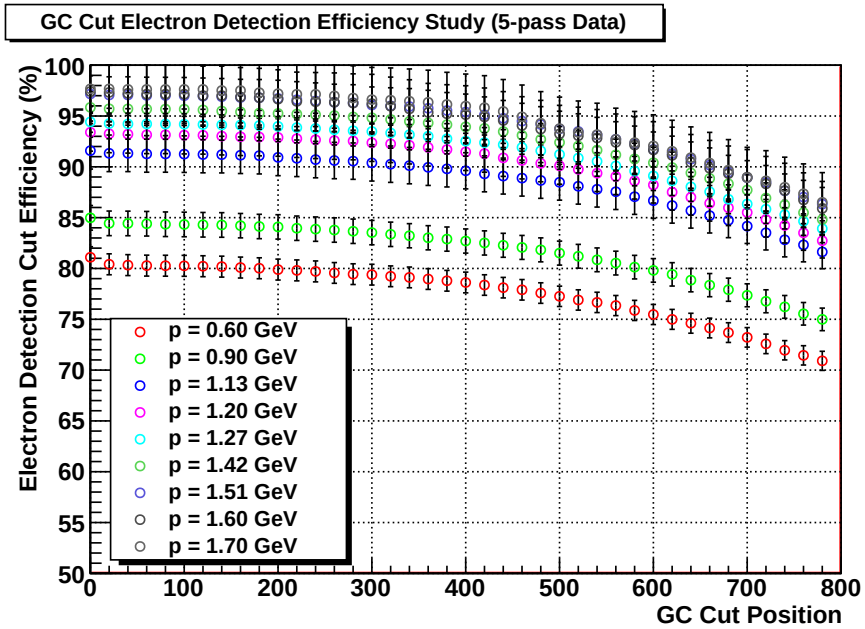
β vs. x

- It seems that the blip in β is due to the time average in S1, as the S2m time average looks good across the tracking x variable
  - How much more can be done to the time offsets and averages in S1?

Gas Čerenkov (1)

e^- Cut Efficiency (No Correction)

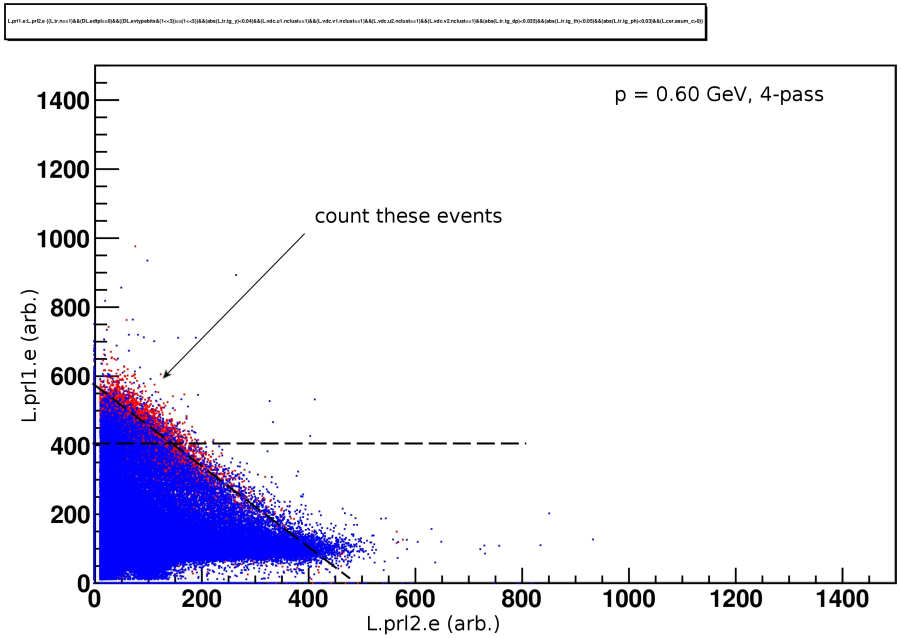


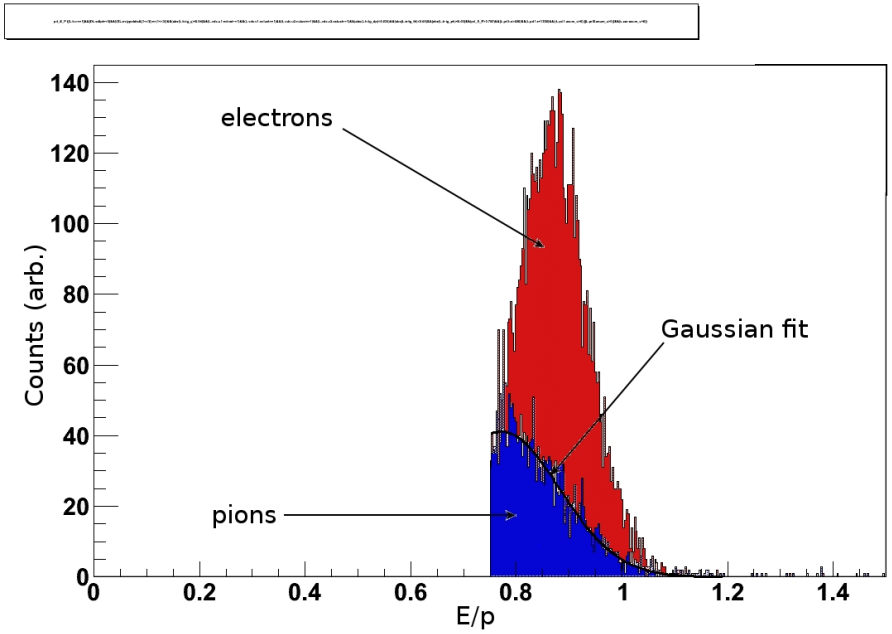


Gas Čerenkov (2)

Background Subtraction Method

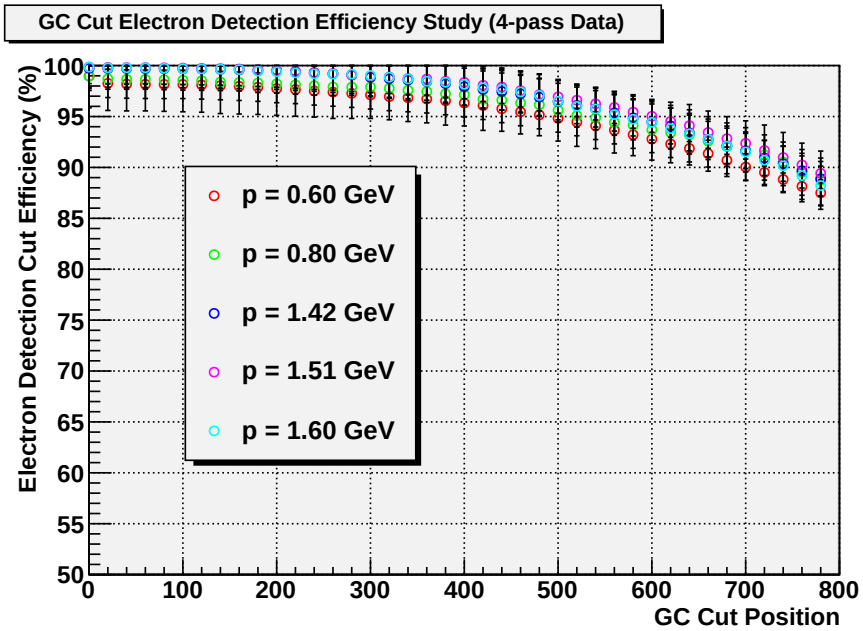
- Review of method
  - Fit pion curve to Gaussian in E/p, subtract off from selected sample

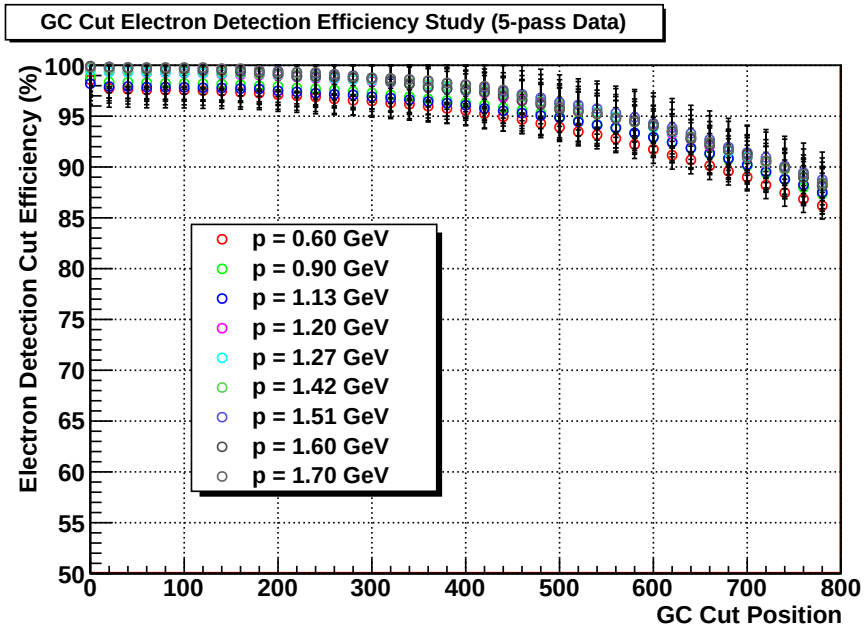




Gas Čerenkov (3)

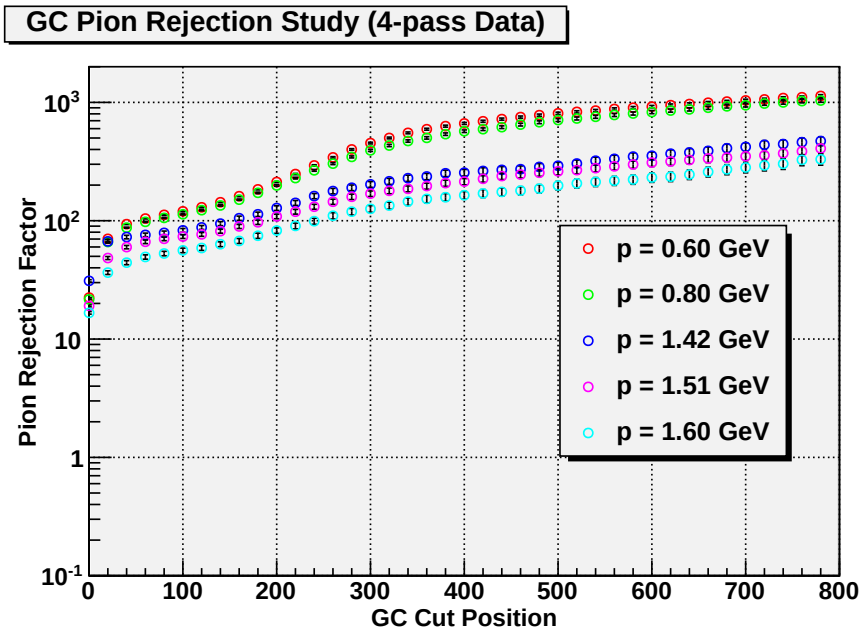
e^- Cut Efficiency (Background Corrected)

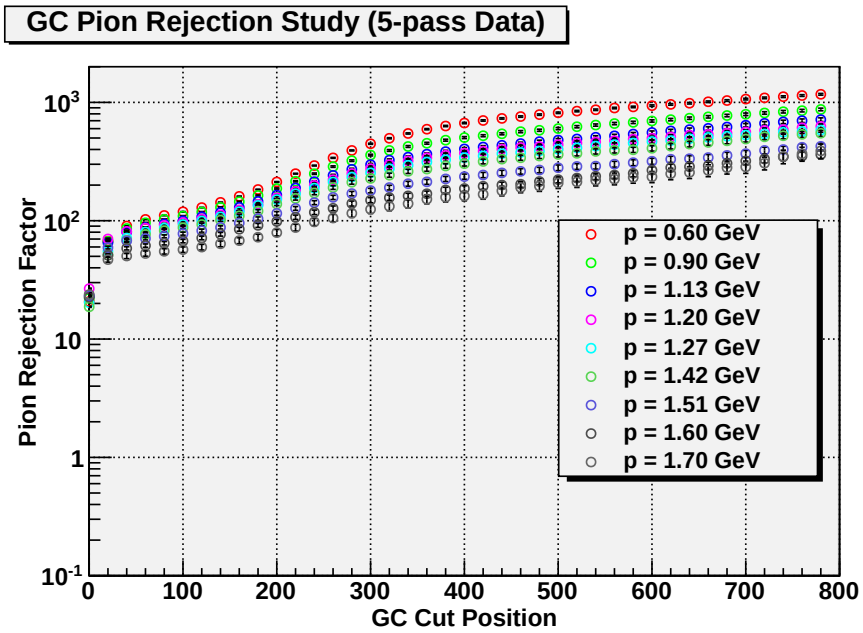




Gas Čerenkov (4)

Pion Rejection Factors (Not Normalized)

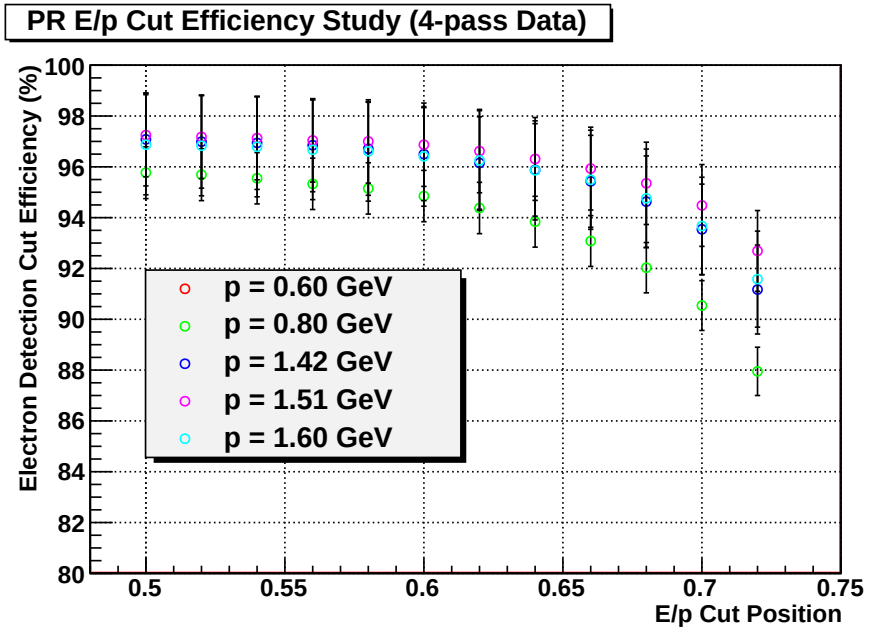


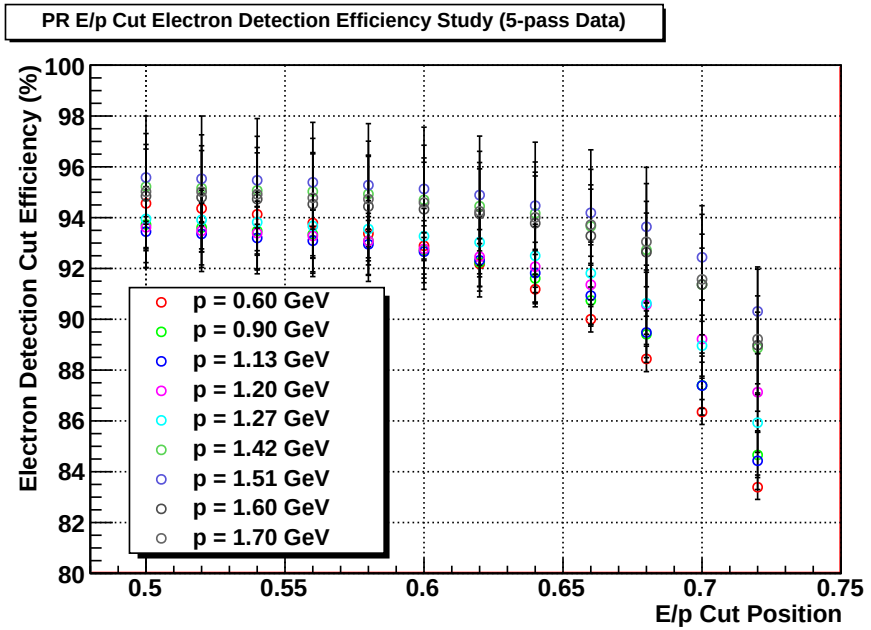


- Need to figure out how to select the same # of π^- for each p
  - How do we normalize these?

Pion Rejector (1)

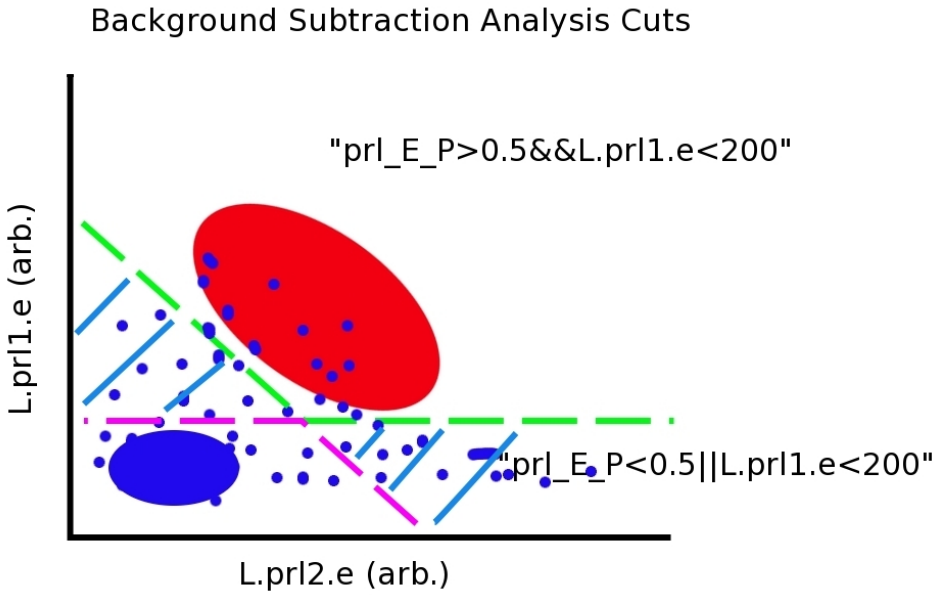
e^- Cut Efficiency (No Correction)





Pion Rejector (2)

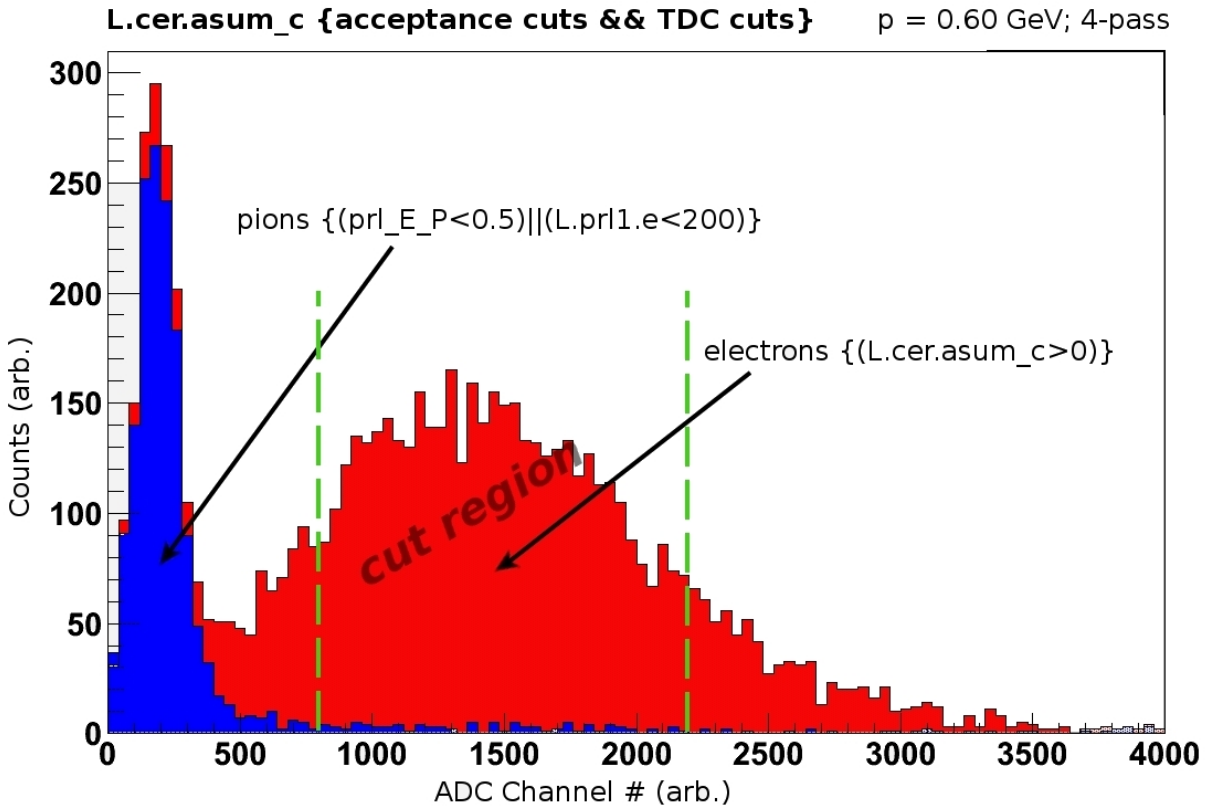
Background Subtraction Method



- Determine the background from L.prl1.e vs. L.prl2.e (2D energy plot)
- Plot its Čerenkov ADC spectrum
- Fit to an exponential, subtract off from original sample

Pion Rejector (3)

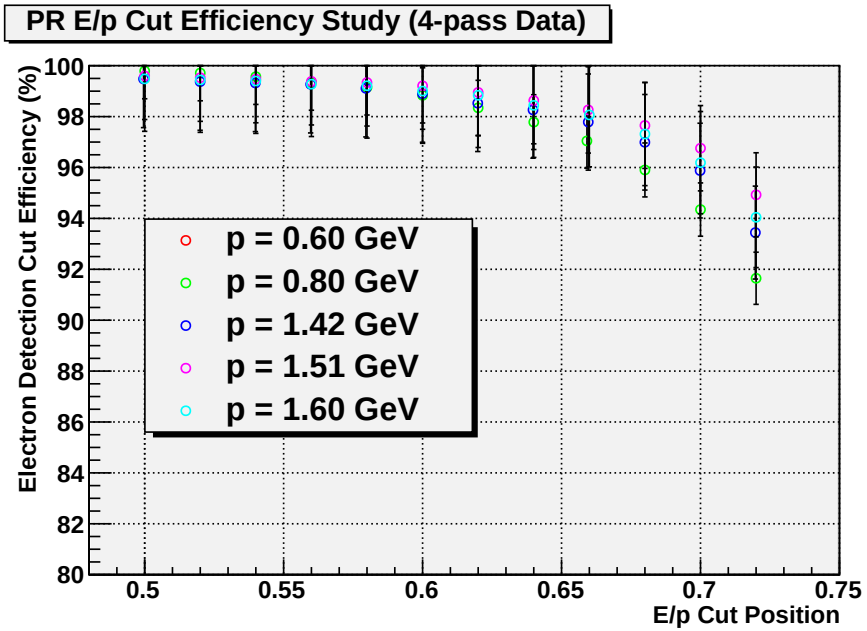
Background Subtraction Method

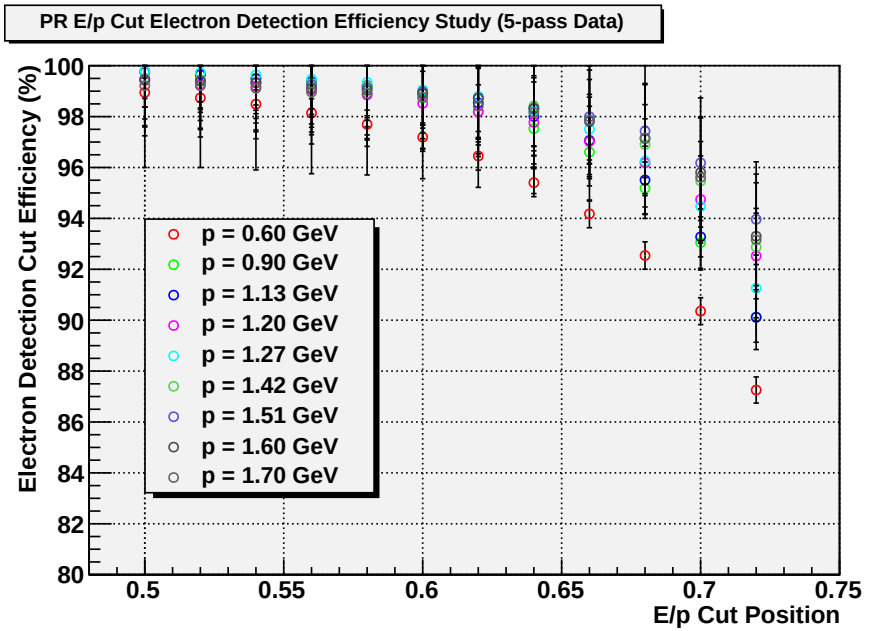


- Blue histo is fitted and subtracted from red histo in the cut window

Pion Rejector (4)

e^- Cut Efficiency (Background Corrected)

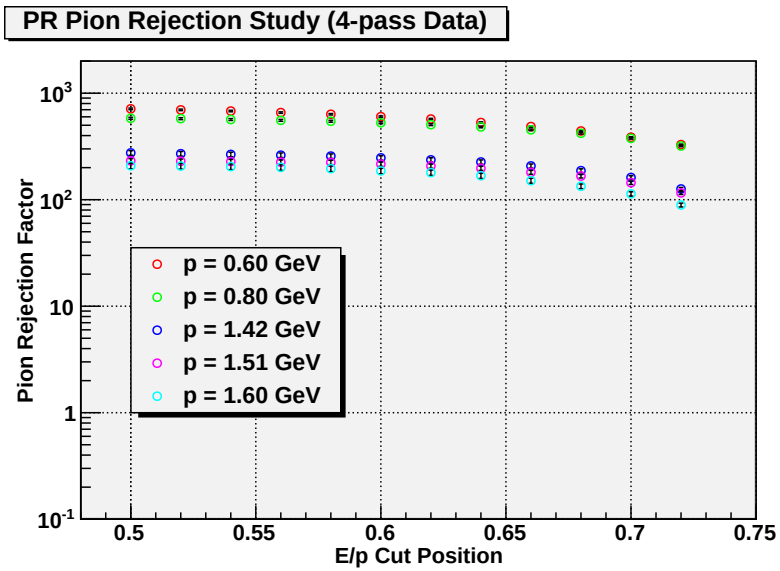


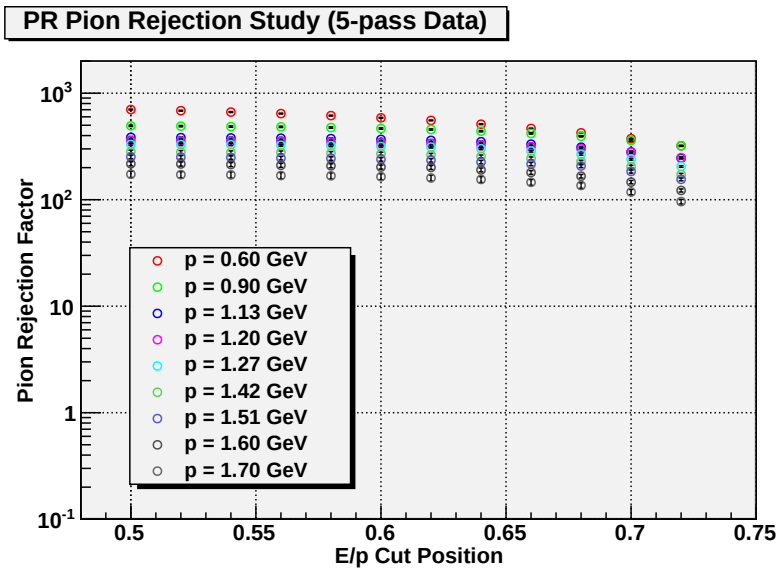


- The $p = 0.60$ GeV kinematic differs here between the 4- and 5-pass settings
  - Their e^- peak positions in E/p are similar, but do not overlap (differ by $\sim 1\%$)
  - Their respective width/p differ by $\sim 5\%$ (This seems large. . .)

Pion Rejector (5)

Pion Rejection Factors (Not Normalized)





- This trend doesn't seem right – shouldn't the pion rejection get *better* with increasing the cut in E/p?

Summary

- Scintillator Calibration Check:
  - Timewalk coefficients do not seem to be doing anything. . .
  - It seems that the blip in β is confined to a few paddles in S1
  - S2m looks good across track-x
- PID:
  - After correction, ε is consistent across all p to $\sim 1\%$ for GC and most of PR
  - e^- cut $\varepsilon > 97\%$ for all p above 1.5 photoelectrons in GC
  - Similar case in PR: $\varepsilon > 98\%$ in targeted plateau region $(0.5, 0.6)$
  - Combined pion rejection factor $\sim 10^4$ at lowest p
    - Expected rejection from proposal is $\sim 10^4$ – This looks to be the case with these initial results

What's Next?

- Scintillator Calibration Check:
  - Figure out timewalk factors – get those working
  - Blip in β still an issue. . .
- PID:
  - Iron out issues with PR e^- cut efficiency
  - Need to normalize the pion rejection factors – to show that the rejection is consistent across all p
  - Settle on cut positions for GC, PR
    - Maybe different cuts for each p?