LHRS Analysis for d_2^n

PR Calibration, PID Analysis, and Data Quality Check

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2/4/10

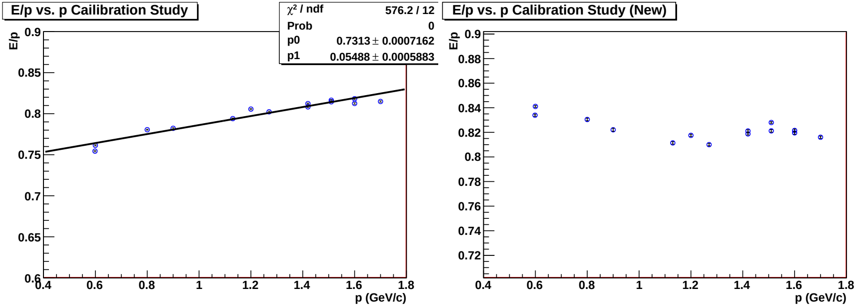
Outline

1. Calibration
   - Pion Rejector
2. Cut Definitions
   - Standard Cuts
3. PID: Gas Čerenkov
   - Electron Detection
   - Pion Rejection
4. PID: Pion Rejector
   - Electron Detection
   - Pion Rejection
5. Data Quality Check
   - First Steps
6. Summary

PR Energy Calibration (1)

E/p vs. p

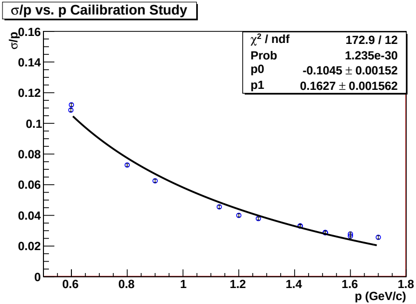
- Results of the new calibration – aligning the pion peaks in each block to 100 channels for all p:

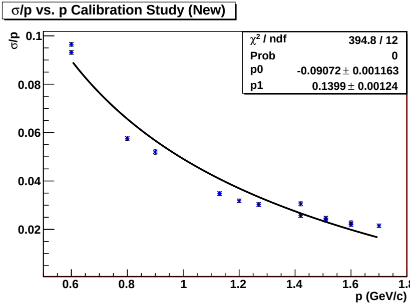


PR Energy Calibration (2)

σ/p vs. p

- Looking at the resolution:



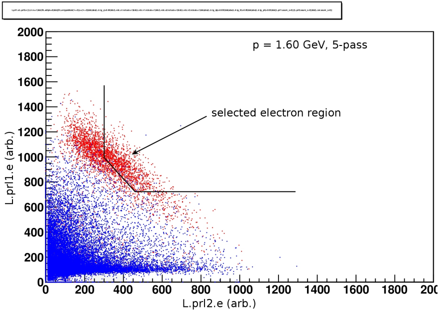


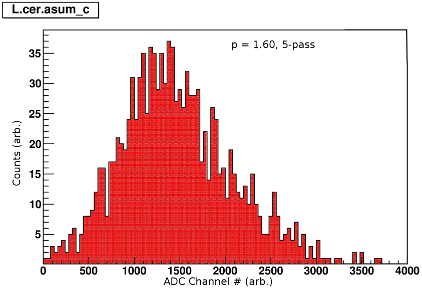
Definition of Cuts

- A review of what I call ‘standard cuts’ (*applied to all histos*):
  - *one track*:
    L.tr.n==1
  - *trigger cuts*:
    (DL.edtpl==0)&&((DL.evtypebits&(1<<3))==(1<<3))
  - *cuts on target y*:
    (abs(L.tr.tg_y)<0.04)
  - *VDC cuts*:
    (L.vdc.u1.nclust==1)&&(L.vdc.v1.nclust==1)
    (L.vdc.u2.nclust==1)&&(L.vdc.v2.nclust==1)
  - *cuts on acceptance*:
    (abs(L.tr.tg_dp)<0.035)
    (abs(L.tr.tg_th)<0.05)&&(abs(L.tr.tg_ph)<0.03)

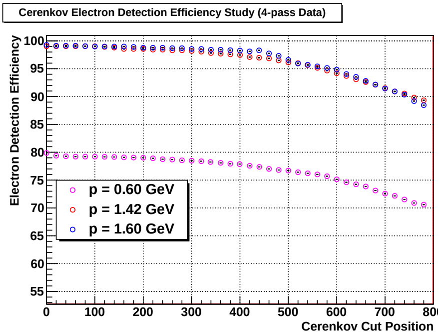
Electron Detection (1)

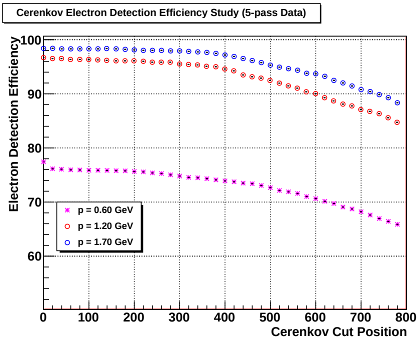
- Review of the method: We select an e^- sample in the PR, and see how those events populate the GC
- It is important that this sample is very clean





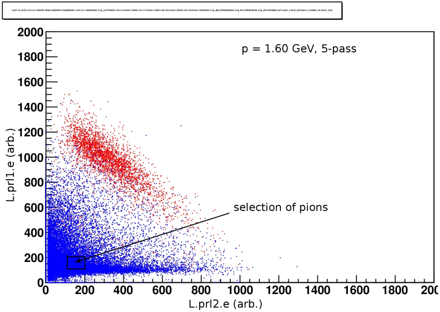
Electron Detection (2)

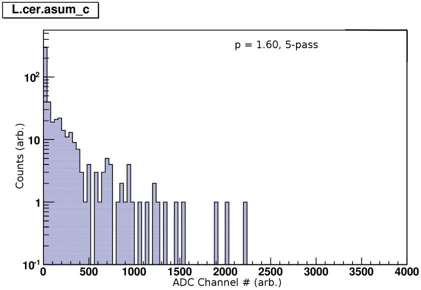




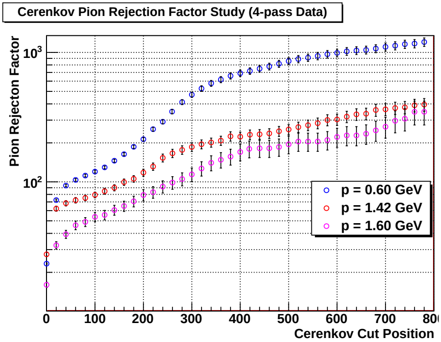
Pion Rejection (1)

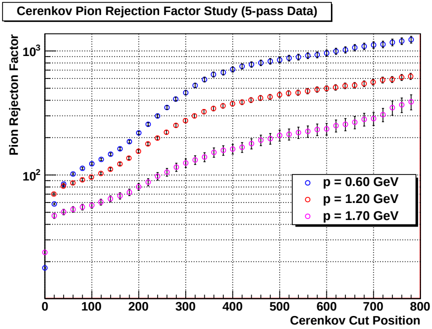
- Review of the method: We select an π^- sample in the PR, and see how those events populate the GC





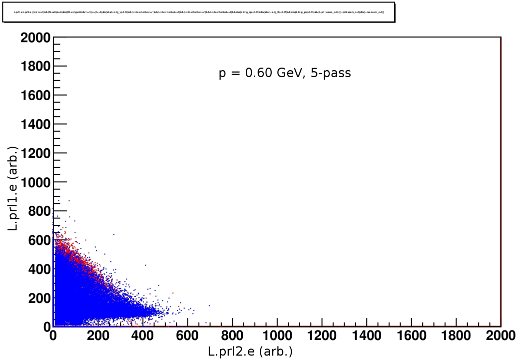
Pion Rejection (2)





Contamination at Low p

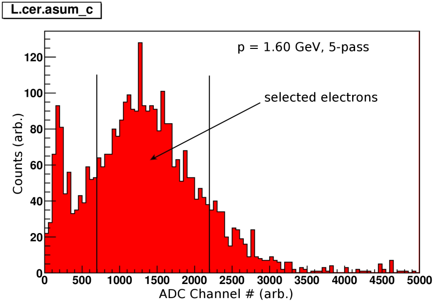
- The poor efficiency at $p = 0.60\ \mathrm{GeV}$ is most likely due to the large contamination in the PR (e^- in red, π^- in blue):

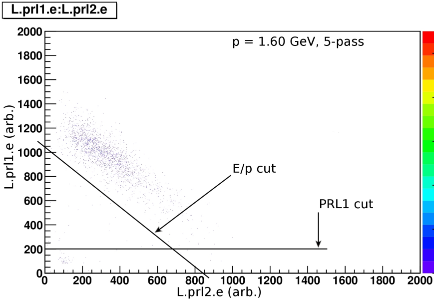


- It appears we may be handcuffed here. . .

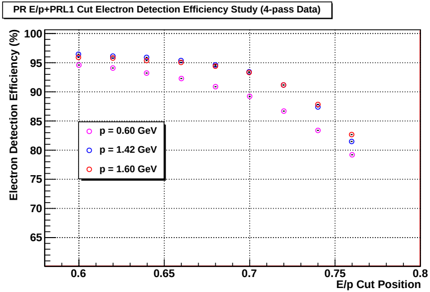
Electron Detection (1)

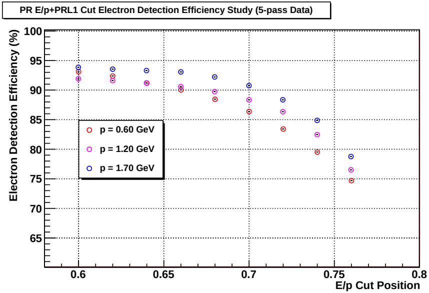
- Review of the method: We select an e^- sample in the GC, and see how those events populate the PR
- Cut used: E/p+PRL1> 200 – PRL1 cut removes δ's





Electron Detection (2)



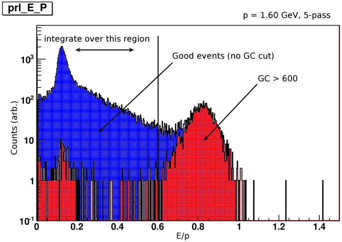


- Low ϵ most likely due to the PRL1 cut $\Rightarrow$ good amount of δ's

Pion Rejection (1)

Method

- The process for rejecting pions is somewhat tricky in the PR (ironically)
  - This is due to the inability to select pions in the GC
- Adapted from Karl's work:
  - First, plot E/p as is (using standard cuts) (N_i)
  - Second, plot E/p subject to standard+GC cut (N_f)
  - The N_j ($j = i, f$) are determined through the integral of E/p in the specified region



Pion Rejection (2)

Definitions

- What are the N_j?
  - $N_i = \pi_i + e_i$
    $\pi_i =$ initial π^- excluded by E/p
    $e_i = \varepsilon \cdot \pi_i$ initial e^- excluded by E/p
  - $N_f = \pi_f + e_f$
    $\pi_f =$ remaining π^- excluded by E/p
    $e_f = \delta \cdot \pi_f =$ final e^- excluded by E/p
- Now, $e_i = e_f$, since the GC cut doesn't affect the electrons:

$$\varepsilon \cdot \pi_i = \delta \cdot \pi_f$$

$$\Rightarrow \frac{\varepsilon}{\delta} = \frac{\pi_f}{\pi_i} \leq 1$$

- Define the pion rejection factor

$$\gamma_{\text{cer}} \equiv \frac{N_i}{N_f} = \frac{\pi_i}{\pi_f} \cdot \frac{1+\varepsilon}{1+\delta}$$

Pion Rejection (3)

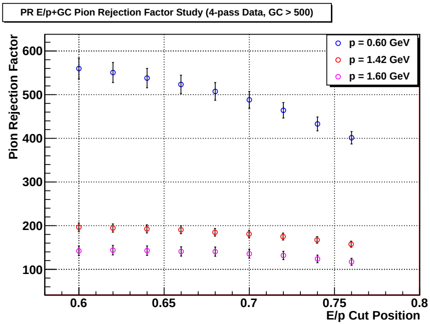
Definitions

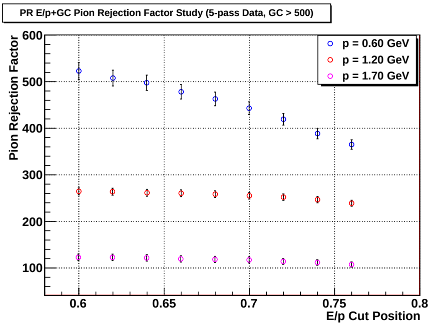
- Now, the true pion rejection factor is written as: $\gamma_{\text{true}} = \pi_i / \pi_f$
- Therefore, $\gamma_{\text{cer}} \leq \gamma_{\text{true}}$
  - If π^- production is large, $\gamma_{\text{cer}} \to \gamma_{\text{true}}$, since ε / δ is a small correction
  - For our kinematics, this is a very good approximation

Pion Rejection (4)

GC > 500

- For GC $>$ 500:

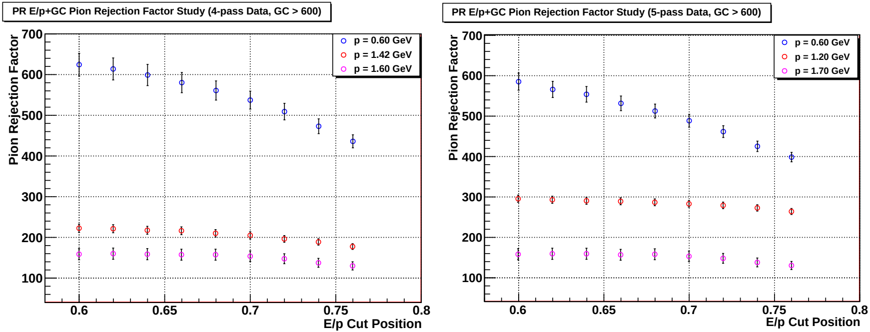




Pion Rejection (5)

GC > 600

- For GC $>$ 600:



Data Quality Check

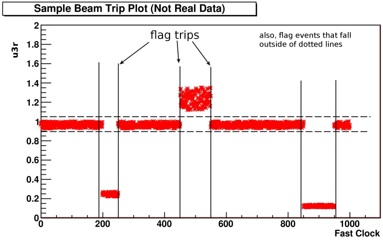
Preliminary Procedure

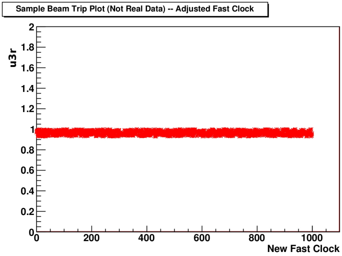
- We've been talking with Xin – start small, and build up
- Matt and I will start with removing beam trips from production data
  - Full replay of runs will be required
  - Plot beam current (u3r) vs. fast clock – determine beam trips for each run
  - Based on this plot, we will have to adjust the scalars to 'skip over' the bad sections of runs
    - Need a database for each run
- A similar process will need development for wire chamber trips, magnet trips, etc.
  - Need a database for each sub-detector

Data Quality Check

Beam Trip Script

- How does the beam trip script work?
- The script loads in the ROOTfiles for a given run, then:
  - Checks the beam current value for each entry
  - If it falls well outside of the mean current, it is flagged as $f = \pm 1$. If not, flag is set to $f = 0$. For those events that have $f = \pm 1$, the fast clock value is stored to an array
  - Based on these fast clock values, which determine the cut positions, a new fast clock is created to remove the trips





Summary

- PID: Čerenkov
  - Electron detection in GC looks pretty good at high p ($\geq 98\%$)
    - How to take a closer look at $p = 0.60$ GeV?
    - Can this be improved at low values of p?
  - Pion rejection factors look good (corresponds to $> 99\%$)
- PID: Pion Rejector
  - Electron detection in GC looks decent ($\geq 95\%$)
    - It seems the low ϵ is due to δ-e^- being excluded by the PRL1 cut in the 2D shower plot
  - Pion rejection factors look good (corresponds to $> 99\%$)
- Data quality check is getting underway
  - Quoting Xin: "It will be a long and tedious process. . ."

What's Next?

- Investigation of low p kinematics
  - I don't know how clean we can get this...
- Tie up loose ends on efficiencies
  - Are we just about finished?
- Get things rolling with the data quality check
  - Matt and I will do this exclusively on the d_2^n machine
- Put final touches on APS poster
- Debug Geant4 simulation (there's a memory leak *somewhere*...)