

## *LHRS Analysis for $d_2^n$ : PID Analysis*

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12/1/09

# Outline

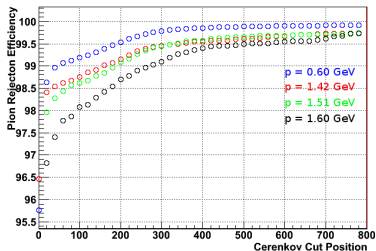
- 1 Pion Rejection Efficiency
  - Gas Čerenkov
  - Pion Rejector
- 2 Electron Detection
  - Pion Rejector
- 3 Summary
- 4 Appendix
  - Data Tables

# Pion Rejection (1)

Gas Čerenkov:  $\pi$ -rejection via Čerenkov Cut

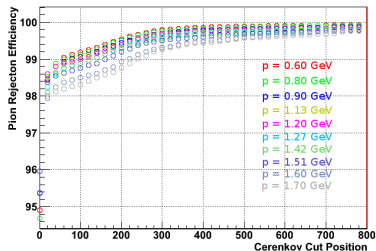
● 4-pass data:

Cerenkov Pion Rejection Efficiency Study (4-pass Data)



● 5-pass data:

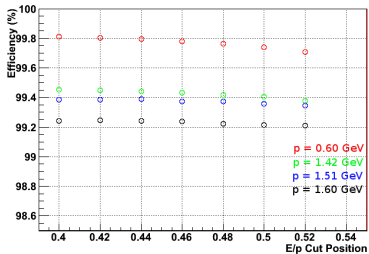
Cerenkov Pion Rejection Efficiency Study (5-pass Data)



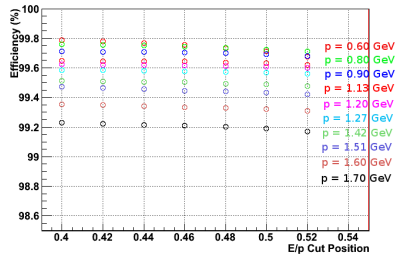
# Pion Rejection (2)

Pion Rejection:  $\pi$ -rejection via  $E/p + \checkmark$ Čerenkov Cut

PR E/p+GC Cut Pion Rejection Efficiency Study (4-pass Data, GC > 500)



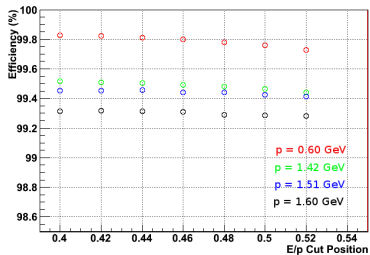
PR E/p+GC Cut Pion Rejection Efficiency Study (5-pass Data, GC > 500)



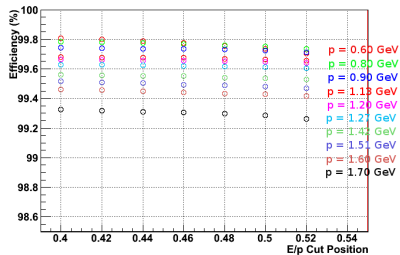
# Pion Rejection (3)

Pion Rejection:  $\pi$ -rejection via  $E/p + \checkmark$ Čerenkov Cut

PR E/p+GC Cut Pion Rejection Efficiency Study (4-pass Data, GC > 600)



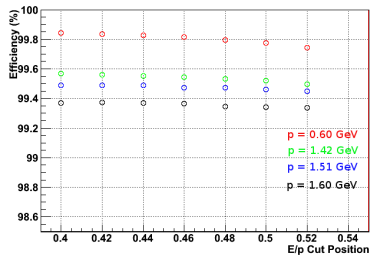
PR E/p+GC Cut Pion Rejection Efficiency Study (5-pass Data, GC > 600)



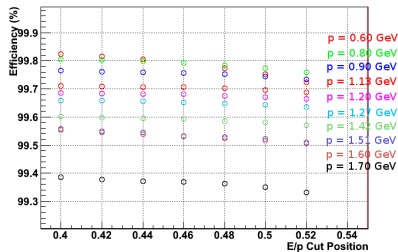
# Pion Rejection (4)

Pion Rejection:  $\pi$ -rejection via  $E/p + \checkmark$ Čerenkov Cut

PR E/p+GC Cut Pion Rejection Efficiency Study (4-pass Data, GC > 700)



PR E/p+GC Cut Pion Rejection Efficiency Study (5-pass Data, GC > 700)



## Pion Rejection (5)

Pion Rejector:  $\pi$ -rejection via  $E/p$ +PRL1 Cut

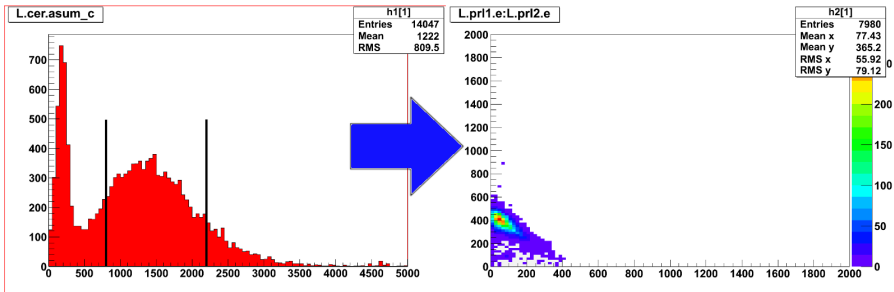
$p$ (GeV)	$E$ (GeV)	$E/p$	PRL1	$\epsilon_{\pi\text{-rej}}^{\text{PR}}$ (%)
0.60	4.73	0.40	300	99.9841
		0.42		99.9256
		0.44		99.8510
		0.46		99.7877
		0.48		99.7137
		0.50		99.6466
		0.52		99.5678
1.20	5.89	0.40	520	99.7211
		0.42		99.6076
		0.44		99.4920
		0.46		99.4056
		0.48		99.3025
		0.50		99.2095
		0.52		99.1135
1.70	5.89	0.40	740	99.8464
		0.42		99.7776
		0.44		99.6885
		0.46		99.6228
		0.48		99.5323
		0.50		99.4740
		0.52		99.4114

- Best cut combinations<sup>†</sup> (of  $E/p$ +PRL1) shown for lowest, mid-range, and highest kinematic settings
- All other kinematics may be found in the Appendix section.
- <sup>†</sup> For each kinematic setting, 4 PRL1 cut positions are chosen, for which (total) cut efficiencies are calculated corresponding to each of the 7  $E/p$  cut positions. All of this data will eventually be compiled into the corresponding technical note on efficiencies of the LHRS Detectors.

# Electron Detection (1)

*Pion Rejector*

- Choose a clean sample of  $e^-$  in the Čerenkov, and see how many **fire either layer** of the PR
  - Example of  $p = 0.60$  GeV, 4-pass kinematic:





## Electron Detection (2)

Pion Rejector

$p$ (GeV)	$E$ (GeV)	$\epsilon_{\text{PR eff}}$ (%)
0.60	4.73	99.7126
0.60	5.89	99.5882
0.80	5.89	99.6157
0.90	5.89	99.3003
1.13	5.89	99.2859
1.20	5.89	99.2370
1.27	5.89	99.5062
1.42	4.73	99.7529
1.42	5.89	99.2238
1.51	4.73	99.7225
1.51	5.89	99.7135
1.60	4.73	99.4611
1.60	5.89	99.2395
1.70	5.89	99.4294

- Decent amount of fluctuation in  $\epsilon_{\text{PR eff}}$  as  $p$  changes
  - Is there an issue here?
  - What to do about it?

# Summary

- Pion Rejection (for GC & PR) just about finished (?)
- Electron detection looks OK in PR
  - Do we need to worry about the fluctuations (are they as bad as they look)?

## What's Next?

- PID:
  - Continue calculating electron detection efficiencies (in GC)
    - How do we select a **clean**  $e^-$  sample in the PR?
  - Start investigation of cut efficiencies in PR, GC
- Calibrations:
  - Investigate  $E/p$  momentum dependence  
( $\Rightarrow$  Geant4 Simulation...)
- $d_2^n$  Status Report:
  - *Physics Motivation & Experiment* sections are **complete**
  - *LHRS & Compton* sections mostly done – **need to add final plots**
  - Shooting to finish report and send to you by Dec. 4 (Friday)
- Hall A Collaboration Talk
  - I'll start work on this probably this week(end)  
 $\Rightarrow$  **send me plots soon!**

# Appendix (1)

Data Tables for Pion Rejection Efficiencies ( $E/p$ +PRL1 Cut)

$p$ (GeV)	$E$ (GeV)	$E/p$	PRL1	$\epsilon_{\pi\text{-rej}}^{\text{PR}}$ (%)
0.60	5.89	0.40	300	99.9866
		0.42		99.9313
		0.44		99.8646
		0.46		99.8017
		0.48		99.7285
		0.50		99.6626
		0.52		99.5824
0.80	5.89	0.40	400	99.9882
		0.42		99.9496
		0.44		99.8805
		0.46		99.8202
		0.48		99.7540
		0.50		99.6918
		0.52		99.6188
0.90	5.89	0.40	440	99.9669
		0.42		99.9045
		0.44		99.8319
		0.46		99.7631
		0.48		99.6719
		0.50		99.6021
		0.52		99.5265

$p$ (GeV)	$E$ (GeV)	$E/p$	PRL1	$\epsilon_{\pi\text{-rej}}^{\text{PR}}$ (%)
1.13	5.89	0.40	540	99.9474
		0.42		99.8830
		0.44		99.8169
		0.46		99.7431
		0.48		99.6697
		0.50		99.5963
		0.52		99.5174
1.27	5.89	0.40	600	99.9530
		0.42		99.8958
		0.44		99.8300
		0.46		99.7805
		0.48		99.7097
		0.50		99.6562
		0.52		99.5802
1.42	4.73	0.40	620	99.8281
		0.42		99.7674
		0.44		99.6688
		0.46		99.5840
		0.48		99.4925
		0.50		99.4084
		0.52		99.3192

## Appendix (2)

Data Tables for Pion Rejection Efficiencies ( $E/p$ +PRL1 Cut)

$p$ (GeV)	$E$ (GeV)	$E/p$	PRL1	$\epsilon_{\pi\text{-rej}}^{\text{PR}}$ (%)
1.42	5.89	0.40	660	99.9332
		0.42		99.8779
		0.44		99.8230
		0.46		99.7657
		0.48		99.6951
		0.50		99.6320
1.51	4.73	0.40	700	99.9419
		0.42		99.8771
		0.44		99.8201
		0.46		99.7490
		0.48		99.6712
		0.50		99.6291
1.51	5.89	0.40	700	99.9579
		0.42		99.9162
		0.44		99.8539
		0.46		99.7873
		0.48		99.7122
		0.50		99.6600
		0.52		99.6149

$p$ (GeV)	$E$ (GeV)	$E/p$	PRL1	$\epsilon_{\pi\text{-rej}}^{\text{PR}}$ (%)
1.60	4.73	0.40	740	99.9473
		0.42		99.8878
		0.44		99.8287
		0.46		99.7846
		0.48		99.7556
		0.50		99.7047
1.60	5.89	0.40	740	99.9557
		0.42		99.9307
		0.44		99.8840
		0.46		99.8374
		0.48		99.7630
		0.50		99.6736
		0.52		99.6185