

LHRS Pion Rejector Calibration for d_2^n

Progress Report

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5/12/09



Outline

- 1 Introduction
 - The Pion Rejector
- 2 Calibration
 - E/p
 - δ -electrons
- 3 Summary
 - Pion Rejector
 - Cerenkov

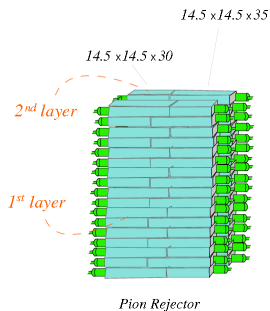


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Geometry of the Pion Rejector



- Two layers of thirty four blocks composed of SF-5 lead glass
- Dimensions: $14.5 \times 14.5 \times 30 \text{ cm}^3$ / $14.5 \times 14.5 \times 35 \text{ cm}^3$
- Radiation Length: $X_0 = 2.55 \text{ cm} \Rightarrow$ thickness of block: $5.7X_0$ (traversed by incident e^-)



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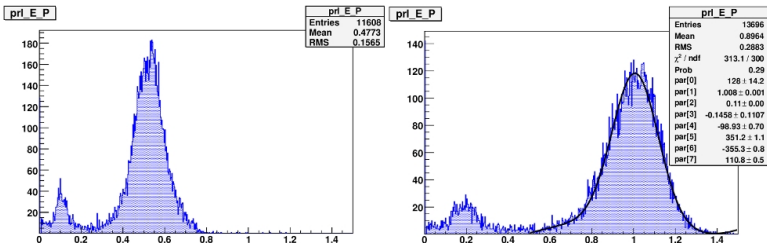


$E/p (1)$

- Alignment of electron peaks in ADC spectra for each block corresponding to the incident particle momentum p
- Overall effect – alignment of E_{dep}/p at 1. Two calibrations were used so far. One for $p = 0.6 \text{ GeV}/c$ and one for $p = 1.20 \text{ GeV}/c$, which was applied to all other kinematics



E/p (2)



→ plots obtained by Cerenkov cut above 3 p.e. (~ 600 channels in ADC)

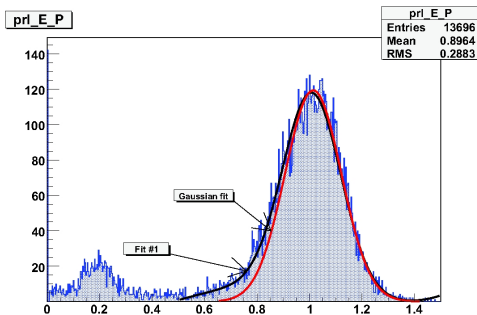
- Fit of E_{dep}/p according to (call this fit #1):

$$f_1(x) = a_1 e^{a_2} e^{-\frac{1}{2} \left(\frac{x-a_3}{a_4} \right)^2} + a_5 x + a_6 x^2 + a_7 x^3 + a_8 x^4$$

→ a_i are parameters

We see a smaller peak at low $E_{\text{dep}}/p \Rightarrow$ knock-on (δ^-) e^- ?



E/p (3)

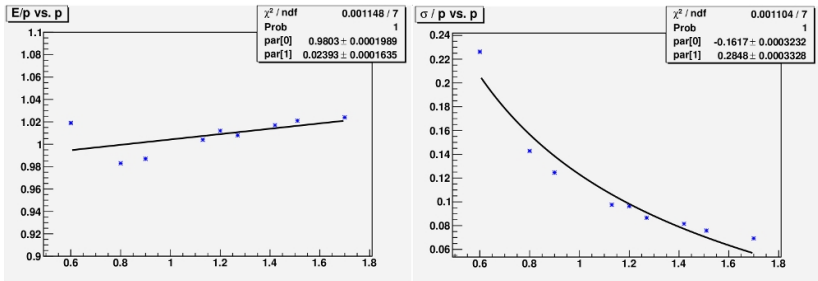
- We see from the plot that the peak at 1 is not a pure gaussian. Left edge seems to indicate leakage of energy in blocks (more on this later)
- Need to make better cuts in order to sharpen up this peak (reduce σ) \Rightarrow geometrical cuts, corresponding to better sums of blocks to recover lost energy?



E/p (4)Table: E/p Calibration Results (Preliminary)

p [GeV/c]	E_{beam} [GeV]	E_{dep}/p	σ	σ/p	χ^2/ndf
0.60	4.73	1.019	0.1357	0.2262	1.04
0.80	4.73	0.983	0.1142	0.1428	1.52
0.90	5.89	0.987	0.1121	0.1246	1.25
1.13	5.89	1.004	0.1102	0.0975	1.09
1.20	5.89	1.012	0.1157	0.0964	1.05
1.27	5.89	1.008	0.1099	0.0866	1.04
1.42	5.89	1.017	0.1158	0.0815	1.15
1.51	4.73	1.021	0.1145	0.0758	1.23
1.70	5.89	1.024	0.1178	0.0693	1.08



E/p (5)

- Fit of σ/p vs. p according to $f(x) = a_1 + a_2/\sqrt{x}$
- a_2 is a measure of how good the calibration is \Rightarrow resolution of the calorimeter. Here, we see that the resolution is $\sim 28\%$. It should be $\sim 8 - 10\%$. Hence, we need to go back and properly sum the blocks through (geometrical) cuts



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δ -electrons(1)

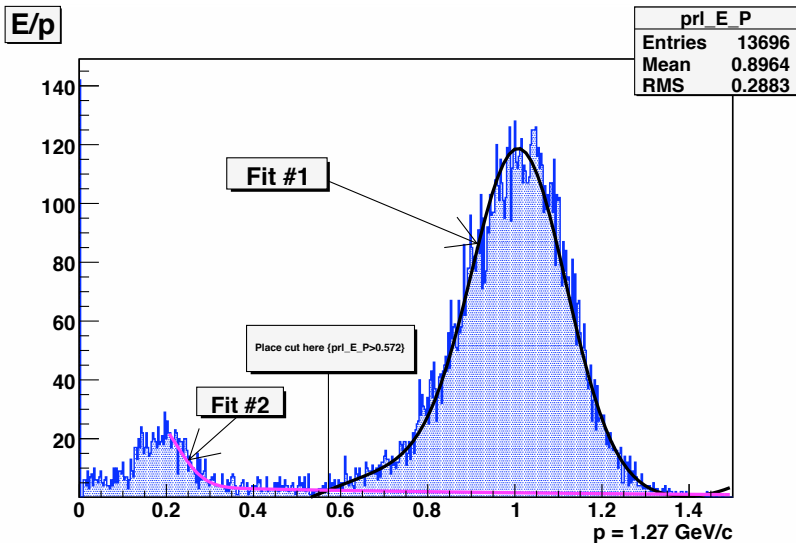
Loss & Contamination

- We see at low E/p we have a smaller peak – this must be due to δ -electrons which cannot be removed by the cut on the Cerenkov
- To see the **loss** and **contamination** to our peak of interest, we try various fits to the data:



δ -electrons (2)

Loss & Contamination



δ -electrons (3)

Loss & Contamination

- Fit # 2 according to:

$$f_2(x) = a_1 e^{-a_2} e^{-\frac{1}{2} \left(\frac{x-a_2}{a_3} \right)^2} + a_4 e^{-x}$$

- This shows us the optimal place to put our cut on E/p to select good electrons with the **least** amount of loss
- Need to do this for each kinematic



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What's Next? (1)

Pion Rejector

- Still need calibration of:

$$p = 0.60 \text{ GeV}/c, E_{\text{beam}} = 5.89 \text{ GeV}$$

$$p = 1.42 \text{ GeV}/c, E_{\text{beam}} = 4.73 \text{ GeV}$$

$$p = 1.51 \text{ GeV}/c, E_{\text{beam}} = 5.89 \text{ GeV}$$

- Need better fit to E_{dep}/p vs. p data / multiple calibrations?
- Determine geometrical cut in PR to recover energy loss
- Need more statistics for E_{dep}/p vs. p , σ/p vs. p plots?
- Calculate efficiency of electron selection/pion rejection for PR \Rightarrow placement of/efficiency of E/p cut for all kinematics



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What's Next? (2)

Cerenkov

- Check calibration from Transversity (1 p.e. at ADC channel 200)
- Number of p.e.'s for each mirror
- Efficiencies

