LHRS Pion Rejector Calibration for d_2^n

Progress Report

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Outline

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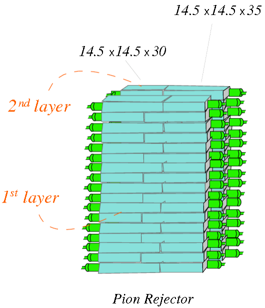
1. Introduction
   - The Pion Rejector
2. Calibration
   - E/p
   - δ-electrons
3. Summary
   - Pion Rejector
   - Cerenkov

Geometry of the Pion Rejector



- Two layers of thirty four blocks composed of SF-5 lead glass

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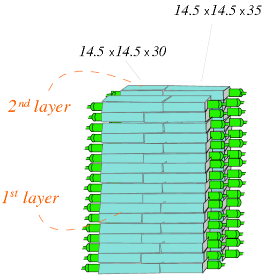

Pion Rejector

- Two layers of thirty four blocks composed of SF-5 lead glass
- Dimensions: $14.5 \times 14.5 \times 30\ \mathrm{cm}^3$ / $14.5 \times 14.5 \times 35\ \mathrm{cm}^3$

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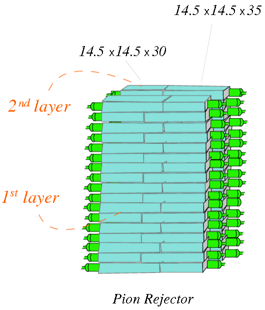

- Two layers of thirty four blocks composed of SF-5 lead glass
- Dimensions: $14.5 \times 14.5 \times 30 \text{ cm}^3$ / $14.5 \times 14.5 \times 35 \text{ cm}^3$
- Radiation Length: $X_0 = 2.55 \text{ cm} \Rightarrow$ thickness of block: $5.7X_0$ (traversed by incident e^-)

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E/p (1)

- Alignment of electron peaks in ADC spectra for each block corresponding to the incident particle momentum p

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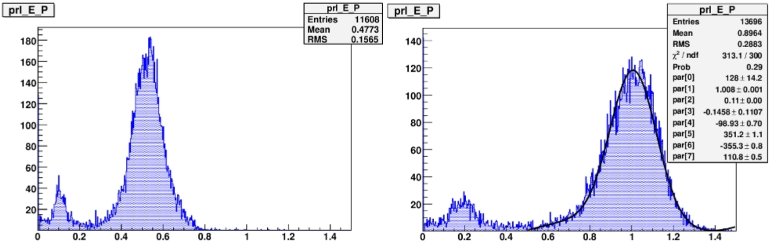
- Overall effect – alignment of $E_{\rm dep}/p$ at 1. Two calibrations were used so far. One for $p = 0.6$ GeV/c and one for $p = 1.20$ GeV/c, which was applied to all other kinematics

E/p (2)



$\rightarrow$ plots obtained by Cerenkov cut above 3 p.e. ($\sim$ 600 channels in ADC)

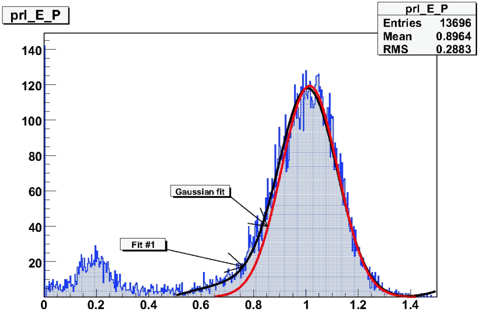
- Fit of E_{dep}/p according to (call this fit $\#1$):

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

$\rightarrow$ 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)

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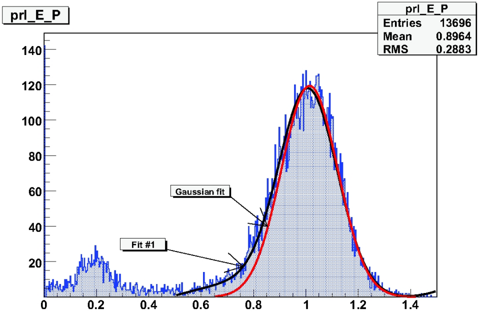


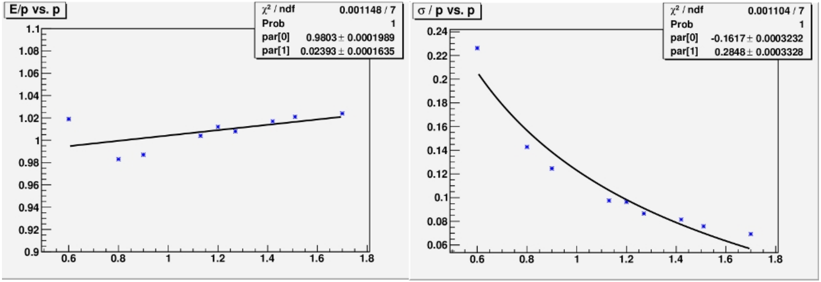
- We see from the plot that the peak at 1 is not a pure gaussian. Left edge seems to indicate leakage of energy in blocks (more on this later)
- Need to make better cuts in order to sharpen up this peak (reduce σ) $\Rightarrow$ geometrical cuts, corresponding to better sums of blocks to recover lost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

E/p (4)

Table: E/p Calibration Results (Preliminary)

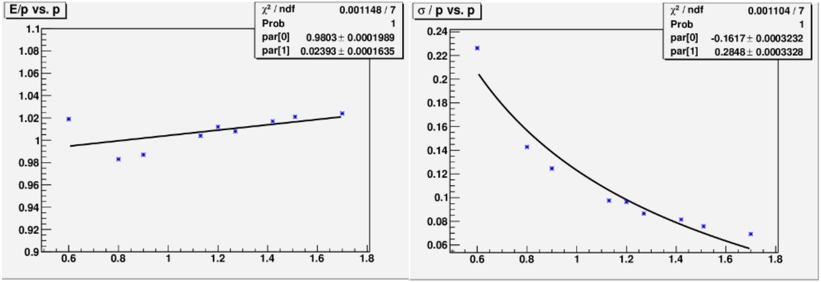
p [GeV/c]	E_{beam} [GeV]	E_{dep}/p	σ	σ/p	χ^2/ndf
0.60	4.73	1.019	0.1357	0.2262	1.04
0.80	4.73	0.983	0.1142	0.1428	1.52
0.90	5.89	0.987	0.1121	0.1246	1.25
1.13	5.89	1.004	0.1102	0.0975	1.09
1.20	5.89	1.012	0.1157	0.0964	1.05
1.27	5.89	1.008	0.1099	0.0866	1.04
1.42	5.89	1.017	0.1158	0.0815	1.15
1.51	4.73	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 $f(x) = a_1 + a_2/\sqrt{x}$

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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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

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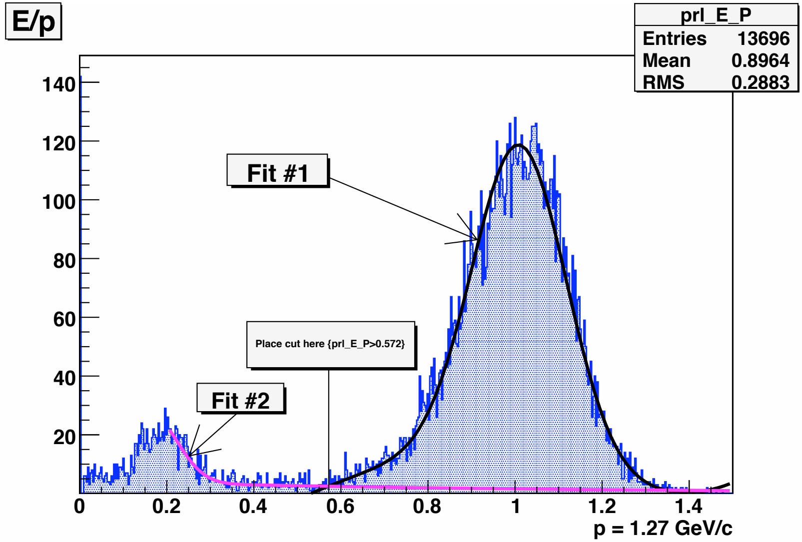
Loss & Contamination

- 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:

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

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- Need to do this for each kinematic

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What's Next? (1)

Pion Rejector

- Still need calibration of:
  $p = 0.60$ GeV/c, $E_{\text{beam}} = 5.89$ GeV
  $p = 1.42$ GeV/c, $E_{\text{beam}} = 4.73$ GeV
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- 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)

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- Efficiencies