LHRS Analysis for d_2^n

Scintillators and E/p

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1/7/11

Outline

1. Scintillator Variables
   - Paddle Number Index
2. Pion Rejector: $E/p = 0$ Events
   - Elastic Data
   - Inelastic Data
3. Summary

Scintillator Variables (1)
Analyzer Code for *.t_pads[i]

- The `*.t_pads[]` variable is typically used as a paddle index when considering how the TDC time of either of the scintillator planes changes with paddle number
- Used in the form: `L.s1.t_pads[0]` – but why 0 as the argument?
    - Looking at the code:

```
fNhit = 0;
for(int i=0;i<fNelem;i++){
   if(fLT[i]>0 && fRT[i]>0) {
      fHitPad[fNhit++] = i;
      fTime[i] = .5*(fLT_c[i]+fRT_c[i])-fSize[1]/fCn;
      fdTime[i] = fResolution/sqrt2;
      fYt[i] = .5*fCn*(fRT_c[i]-fLT_c[i]);
   }
}
```

Scintillator Variables (2)

The Particulars on *.t_pads[i]

- The *.t_pads[fNhit] variable is not utilized in the calculation of the TDC times
- fHitPad ⇒ *.t_pads[fNhit]
- The index of the array—fNhit—is the hit number for a given event
- The value of *.t_pads[i] is the paddle that took the i^{th} hit
  - Example: L.s1.t_pads[1] gives the plot of those paddles that took the first hit

SCINTILLATOR VARIABLES (3)

THE PARTICULARS ON *.T_PADS[I]

- Considering the fact that `*.t_pads` is filled starting at `fNhit==1`, it seems that `*.t_pads[0]` looks at 'all hits'
- Printing out `*.t_pads[0]` event-by-event, it is clear that this variable reports the first hit recorded, and not necessarily the correct one (i.e., the TDC value for the first hit may be ~ 150 ns – see next slide...)

Scintillator Variables (4)

*.t_pads[i]: Insight From My Code

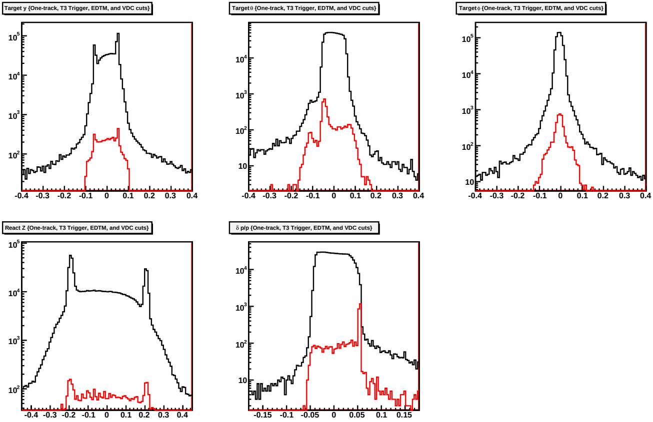
- Setting my cuts to match the analyzer and printing out what my code does event-by-event:

```
===================== Event 23456 =====================
Hit found in S2m paddle 13
S2m[cor]: 61.369
  No hit found in S1 paddle 0
  No hit found in S1 paddle 1
  No hit found in S1 paddle 2
  Hit found in S1 paddle 3
   S1[cor]: 181.75 fTrigOff[3][13]: 0
   L.s1.t_pads: 3
   L_s1_my_t_pads: 3
  Hit found in S1 paddle 4
   S1[cor]: 55.75 fTrigOff[4][13]: 0
   L.s1.t_pads: 3
   L_s1_my_t_pads: 4
  No hit found in S1 paddle 5
Accepted times:
S2m: Paddle: 13 time: 61.369
S1: Paddle: 4 time: 55.75
S2m - S1 Time Difference: 5.619
```

PION REJECTOR: $E/p = 0$ EVENTS (1)

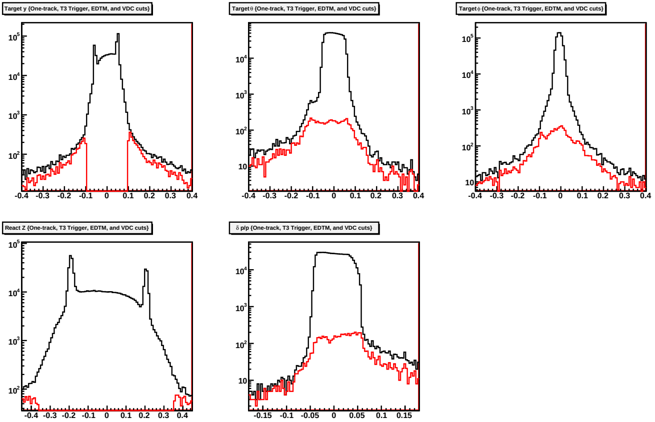
ELASTIC DATA: TARGET VARIABLES

- What do the target variables look like?
- Zero energy:



Pion Rejector: $E/p = 0$ Events (2)
Elastic Data: Target Variables

- Large momentum:

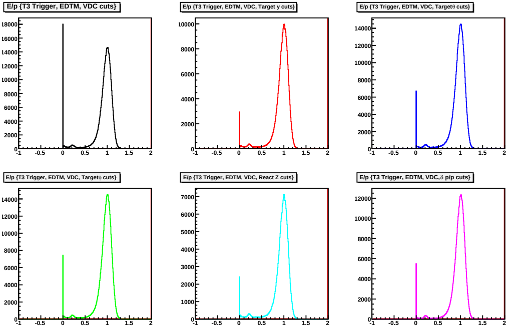


Pion Rejector: $E/p = 0$ Events (3)

Elastic Data: Cutting on Target Variables

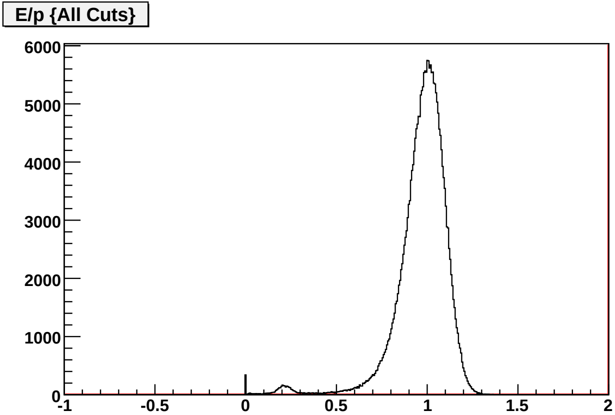
- Modest cuts:

```
abs(L.tr.tg_y)<0.05
abs(L.tr.tg_th)<0.05
abs(L.tr.tg_ph)<0.04
abs(L.tr.tg_dp)<0.035
abs(ReactPt_L.z)<0.15
```



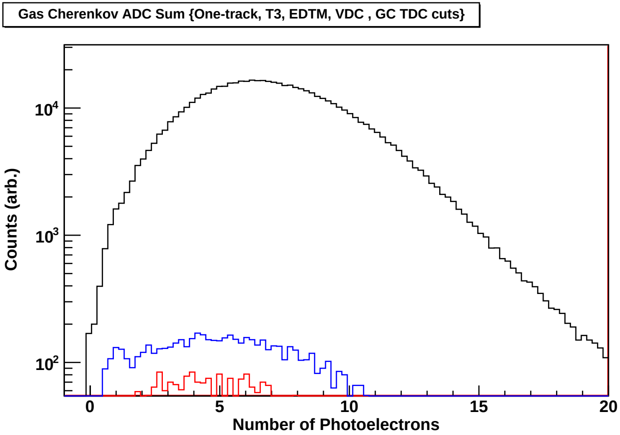
Pion Rejector: $E/p = 0$ Events (4)

Elastic E/p: All Target Cuts



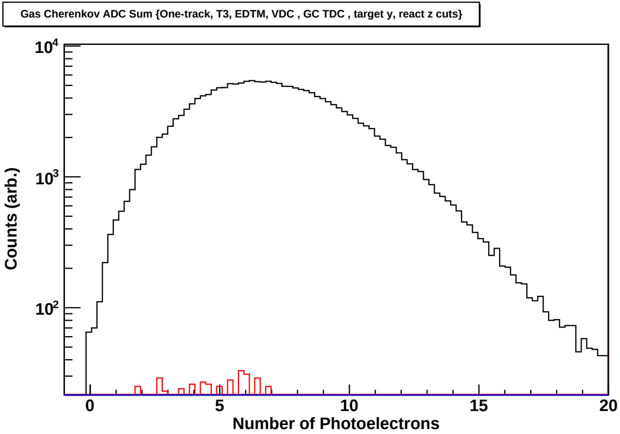
Pion Rejector: $E/p = 0$ Events (5)

Elastic Data: Gas Čerenkov Spectrum



Pion Rejector: $E/p = 0$ Events (6)

Elastic Data: Gas Čerenkov Spectrum (with Target Cuts)



Pion Rejector: $E/p = 0$ Events (7)

Elastic Data: Statistics

- How much of the spike at zero is due to each condition:
  1. $p \sim \infty$ (only)
  2. $E = 0$ (only)
  3. $p \sim \infty$ and $E = 0$
- Count how many tracks remain for each condition (above) after:
  - No cuts
  - Good event cuts (T3, EDTM, VDC, one-track)
  - Good event and target cuts (from previous slides)
  - Each percentage is formed w.r.t. the ‘no cut’ condition

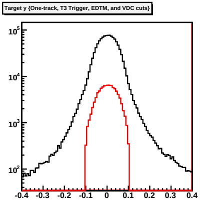
Percentage of Events for Various Cases

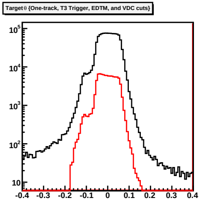
Condition \ Base Cut	None	Good events	Good events + target
$p \sim \infty$	6.60	1.26	0.00
$E = 0$	0.77	0.68	0.14
$p \sim \infty$ and $E = 0$	4.44	0.71	0.00

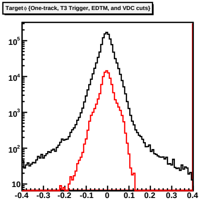
Pion Rejector: $E/p = 0$ Events (8)

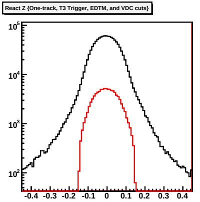
Inelastic Data: Target Variables

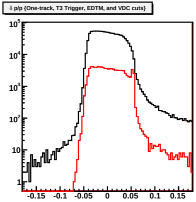
- How does this work on inelastic data?
- Zero energy:







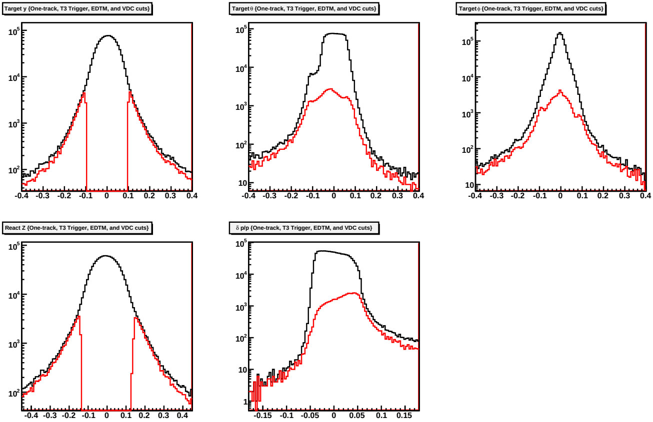




Pion Rejector: $E/p = 0$ Events (9)

Inelastic Data: Target Variables

- Large Momentum:

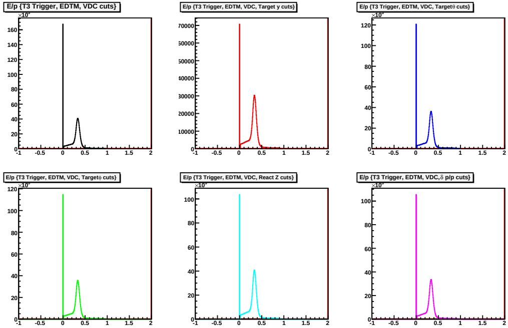


Pion Rejector: $E/p = 0$ Events (10)

Inelastic Data: Cutting on Target Variables

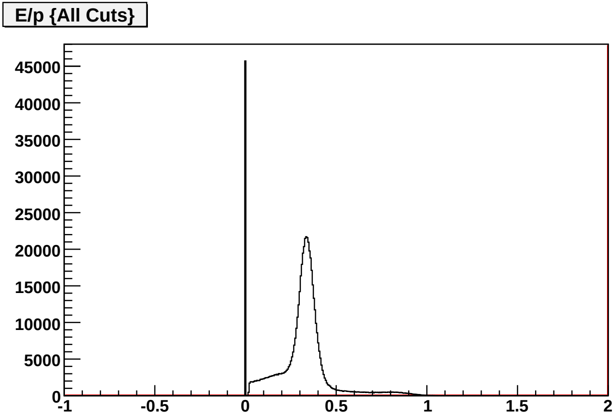
- Modest cuts:

```
abs(L.tr.tg_y)<0.10
abs(L.tr.tg_th)<0.05
abs(L.tr.tg_ph)<0.04
abs(L.tr.tg_dp)<0.035
abs(ReactPt_L.z)<0.10
```



Pion Rejector: $E/p = 0$ Events (11)

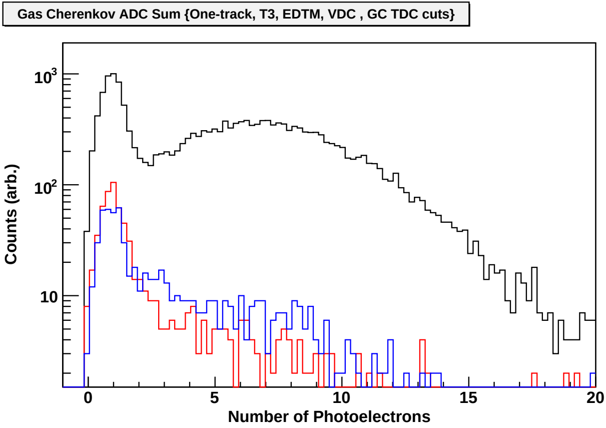
Inelastic Data: All Target Cuts



Pion Rejector: $E/p = 0$ Events (12)

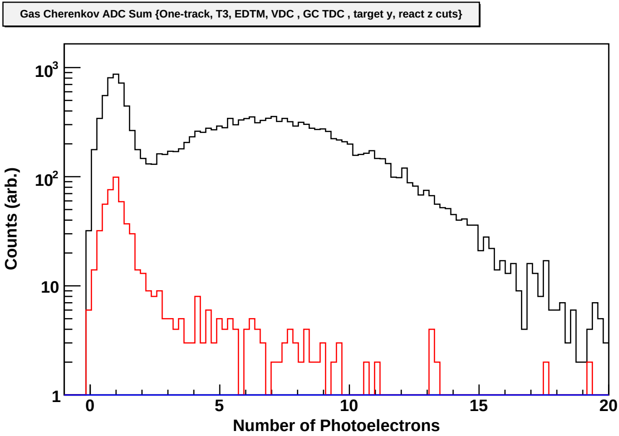
Inelastic Data: Gas Čerenkov Spectrum

- Run 20676 ($p = 0.60$ GeV, 4-pass)
- Red $\Rightarrow E = 0$; blue $\Rightarrow p \sim \infty$



Pion Rejector: $E/p = 0$ Events (13)

Inelastic Data: Gas Čerenkov Spectrum (With Target Cuts)



Pion Rejector: $E/p = 0$ Events (14)

Inelastic Data: Statistics

- Calculating the same quantities as before:

Percentage of Events for Various Cases ($p = 0.60$ GeV, 4-pass)			
Condition \ Base Cut	None	Good events	Good events + target
$p \sim \infty$	8.26	5.05	0.00
$E = 0$	7.13	8.00	7.90
$p \sim \infty$ and $E = 0$	8.16	1.02	0.00

Percentage of Events for Various Cases ($p = 1.20$ GeV, 5-pass)			
Condition \ Base Cut	None	Good events	Good events + target
$p \sim \infty$	9.16	6.99	0.00
$E = 0$	0.46	6.69	6.98
$p \sim \infty$ and $E = 0$	54.74	3.87	0.00

Pion Rejector: $E/p = 0$ Events (15)

Inelastic Data: Statistics

Percentage of Events for Various Cases ($p = 1.70$ GeV, 5-pass)			
Condition \ Base Cut	None	Good events	Good events + target
$p \sim \infty$	10.42	28.16	0.00
$E = 0$	0.46	4.17	6.16
$p \sim \infty$ and $E = 0$	84.27	20.91	0.00

SUMMARY

- Scintillators:
  - `*.t_pads[0]` reports the first hit, not necessarily the correct one
  - `*.t_pads[0]` does not play a role in the calculation of the TDC times
- Pion Rejector:
  - For the elastic data, it seems that the majority of the $E/p = 0$ (in particular, $p \sim \infty$) events come from the target endcaps (in y and z)
  - Inelastic data has some of this behavoir, but there is still 6–8% of the events with $E = 0\dots$

What's Next?

- Pion Rejector E/p
  - Track down issue with $E = 0$ events
- Data Quality:
  - Develop plots of magnet currents, p_0, and other important quantities vs. run number
  - Continue to re-replay all production data and process it (skim procedure, cut performance history, etc.)
    - Should this wait until after the issue with the `PriKineL` class is settled (elastic protons – W)?