LHRS Analysis for d_2^n

Trigger Efficiency, Data Quality, & Scintillator Studies

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Outline

Trigger Efficiency (1)

Review of Method

- To calculate the trigger efficiency, we first determine good events:
  - *Trigger Cuts – remove pulser, require either a T3 or T4:* (DL.edtpl==0)&&(((DL.evtypebits&(1<<3))==(1<<3)) ||((DL.evtypebits&(1<<4)))==(1<<4)))
  - *VDC Cuts – reconstruction of one cluster in each plane:* (L.vdc.u1.nclust==1)&&(L.vdc.v1.nclust==1) (L.vdc.u2.nclust==1)&&(L.vdc.v2.nclust==1)
  - *PID Cuts:* (L.cer.asum_c> 300)&&(prl_E_P> 0.54) &&(TDC Cuts on the Gas Čerenkov)

Trigger Efficiency (2)

Review of Method

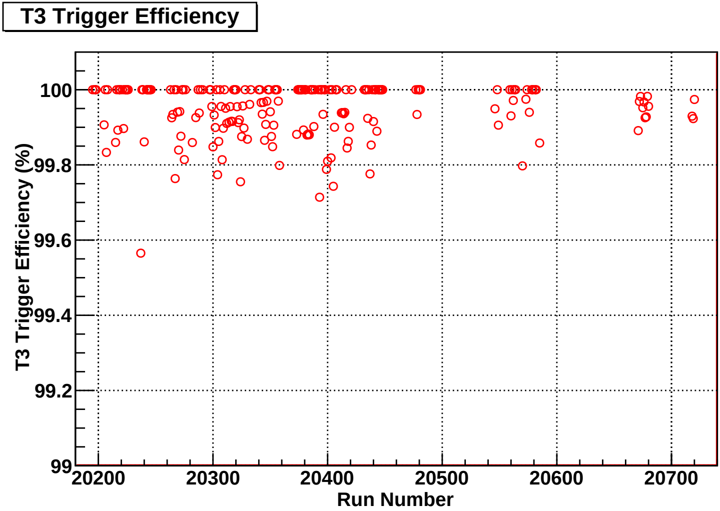
- The efficiency is given as:

$$\varepsilon_{T3} = \frac{N_{T3}}{N_{T3} + N_{T4}}$$

  - $N_j = ps_j \times \text{bit}_j$ for $j = T3, T4$
  - $ps_j =$ prescale for trigger j
  - $\text{bit}_j =$ bit pattern for trigger j (from the variable DL.bitj)
- We include the prescales here so as to keep the calculation honest
  - For instance, if all the $T4$'s were prescaled away, this calculation would yield a T3 efficiency of 1, while the $T3$ may only be 50% efficient

Trigger Efficiency (3)

Results



Trigger Efficiency (4)

Results: Averages

- The large number of $\varepsilon = 100\%$ is most likely due to statistics
  - See the PID cut-by-cut study I showed in previous e-mails
- The general trend of the plot (previous page) is a little more spread out as compared to Patricia's (page 8)
- The total average (all runs): $\varepsilon_{T3} = 99.95\%$
- To the right the average for each momentum bin is shown

T3 Trigger Efficiency		
p (GeV)	E (GeV)	ε_{T3} (%)
1.23	1.23	99.99
0.60	4.73	99.95
0.60	5.89	99.96
0.80	4.73	99.93
0.90	5.89	99.95
1.13	5.89	99.93
1.20	5.89	99.98
1.27	5.89	99.94
1.42	4.73	99.95
1.42	5.89	99.93
1.51	4.73	99.92
1.51	5.89	99.96
1.60	4.73	99.96
1.60	5.89	99.96
1.70	5.89	99.96

Data Quality (1)

LHRS Production Run List

- Based on the HALOG entries, I've re-examined my initial run list and it's been revised
  - All runs listed on the wiki are now in fact production runs
  - Previously, some runs listed were 'test' runs, or mislabeled (i.e., listed as production, but had an N_2 target, etc.)

Data Quality (2)

LHRS Data Quality Check: Diagnostic Quantities – First Steps

- I've been working on a script that will check the LHRS (production) data:
  1. Gas Čerenkov 1 p.e. peak position
  2. Gas Čerenkov main p.e. peak position
  3. Gas Čerenkov number of p.e. (sanity check on items 1 and 2)
  4. Pion Rejector E/p
  5. S1, S2m TDCs
  6. VDC t_0 for each plane
  7. VDC one-track efficiency
  8. Similar plots for positive polarity runs

  - Items in red have not been implemented yet
  - Scintillator TDCs aren't finished yet. . .
- Eventually, will add another script that will look at beam trips for each run
- This project will be a 'background' activity as I work on other topics. . . any suggestions for other things to check?

Data Quality (3)

LHRS Data Quality Check: Method – Cuts & Plotting Procedures

- Cuts utilized:
  - Baseline cuts: one-track, T3 events, Čerenkov TDC cuts
  - Gas Čerenkov:
    - One p.e. and main p.e. peak are determined by cuts on those respective peaks in addition to the appropriate PR cuts
    - One p.e. peak $\Rightarrow$ cut on π^- in PR
    - Main p.e. peak $\Rightarrow$ cut on e^- in PR
  - Pion Rejector:
    - Cut on main peak of E/p
    - GC > 300 (e^-)
  - Such cuts let us isolate the peaks of interest
- Grab the mean value for each quantity $\Rightarrow$ plot against run number

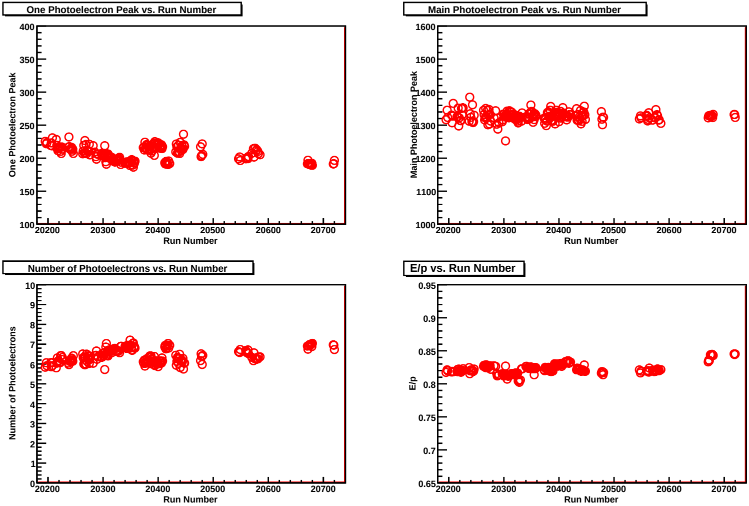
Data Quality (4)

LHRS Data Quality Check: Expected Trends

- On average, we should see a level (i.e., constant) value of:
  1. Gas Čereknov one p.e. peak
  2. Gas Čerenkov main p.e. peak
  3. $\#$ of p.e. (for Gas Čerenkov)
  4. Pion Rejector E/p (for a given p) – should see some ‘jaggedness,’ or ‘plateau regions’ overall

Data Quality (5)

LHRS Data Quality Check: Some Preliminary Plots



Data Quality (6)

LHRS Data Quality Check: Some Preliminary Plots – Results

- There's some fine-tuning needed here
- The one p.e. peak isn't as constant as expected
- The main p.e. peak is (surprisingly) consistent – given the behavior of the one p.e. peak
- The $\#$ of photoelectrons mimics the structure of the one p.e. peak, which is expected
- E/p has hints of the 'jaggedness' (or plateau regions) that I was expecting on the whole
  - The lowest run numbers $\Rightarrow p = 1.70$ GeV (through 20216)
  - The highest run numbers $\Rightarrow p = 0.60$ GeV (20632 - 20720)
  - E/p should be higher for lower p – so this makes sense

Data Quality (7)

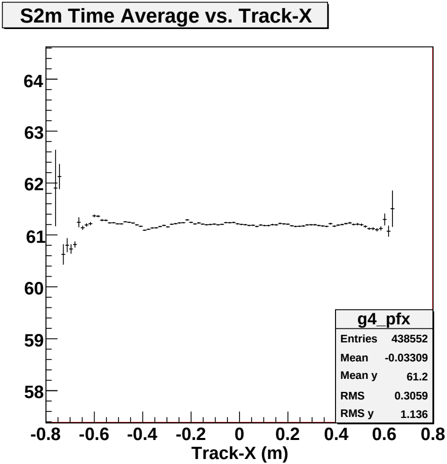
LHRS Data Quality Check: Some Preliminary Plots – Thoughts & Possible Explanations

- Is the strange behavior due to the calibration being incorrect, or because the method is wrong?
  - The one p.e. peak position is very touchy
  - I have a feeling it's largely a statistical problem – some runs have ~ 300, and even as low as ~ 75 events after all cuts have been applied
  - Of course, as p increases, we have less and less π^- $\Rightarrow$ not as many events from cuts
- Ideas for a more accurate look:
  1. Abandon the run-by-run study, and bin by momentum instead? We could get better statistics, but we would lose the ability to see which runs are giving some funny behavior that needs to be examined
  2. Utilize fits – determine fits for all runs. This could be quite exhausting however. . .

Scintillator Study (1)

S2m - S1 Time Difference

- Haven't had too much time to look at it this week
- Double-checked the code that I was using to determine the S2m - S1 time difference, and everything looked fine
- A projection of the S2m time vs. track-x plot shows some small jitter in S2m
    - Previous plots I've shown didn't reveal this too well
    - Maybe try to fix this? How well can this be done, however?



Summary

- Trigger Study
  - The trigger efficiency looks good – 99.95% on average over all runs
  - Consistent with Patricia's work
- Data Quality Study
  - Just got going, but looks decent so far
- Scintillator Study
  - Haven't taken too close of a look this week
  - A quick plot of the projection of S2m time average vs. track-x shows some jitter that I didn't notice until making this plot – the other plots I've shown previously covers this up

What's Next?

- Trigger Study
  - Start writing the technical note
- Data Quality Study
  - Work on the accuracy of the one p.e. peak vs. run number plot
  - Make sure we like the overall results of the presented plots before adding more diagnostic quantities/expanding the check
  - Will be a 'back burner' topic
- Scintillator Study
  - Try to minimize as much as possible the noted jitter in S2m
  - Back to S2m - S1 time difference once this is satisfactory
- Start working on the acceptance
  - I have Huan's SAMC code, so I can start looking at it and understanding how it works