# LHRS Analysis for $d_2^n$

## Scintillators and Data Quality

D. Flay

12/16/10

# Outline

1. Skim
   - Skim Level 1
   - Checking the Beam Helicity Asymmetry
2. Scintillator Calibration
   - A New Method
3. Summary

# Skim (1)
## Update: Skim Level 1

- Skim Level 1 takes an input ROOTfile and analyzes the beam trips
  - Output is a skim ROOTfile, with a new variable (*in addition to the ones already there*)
    - `skim_beam_trip` (boolean quantity)
  - On an event-by-event basis, the beam trips are tagged
  - Cutting on beam trips is simple now: `skim_beam_trip==0` (no trips) or `skim_beam_trip==1` to look at beam trip events
- Working from a new run list (will post to Wiki tomorrow)

# Skim (2)
## Skim Level 1

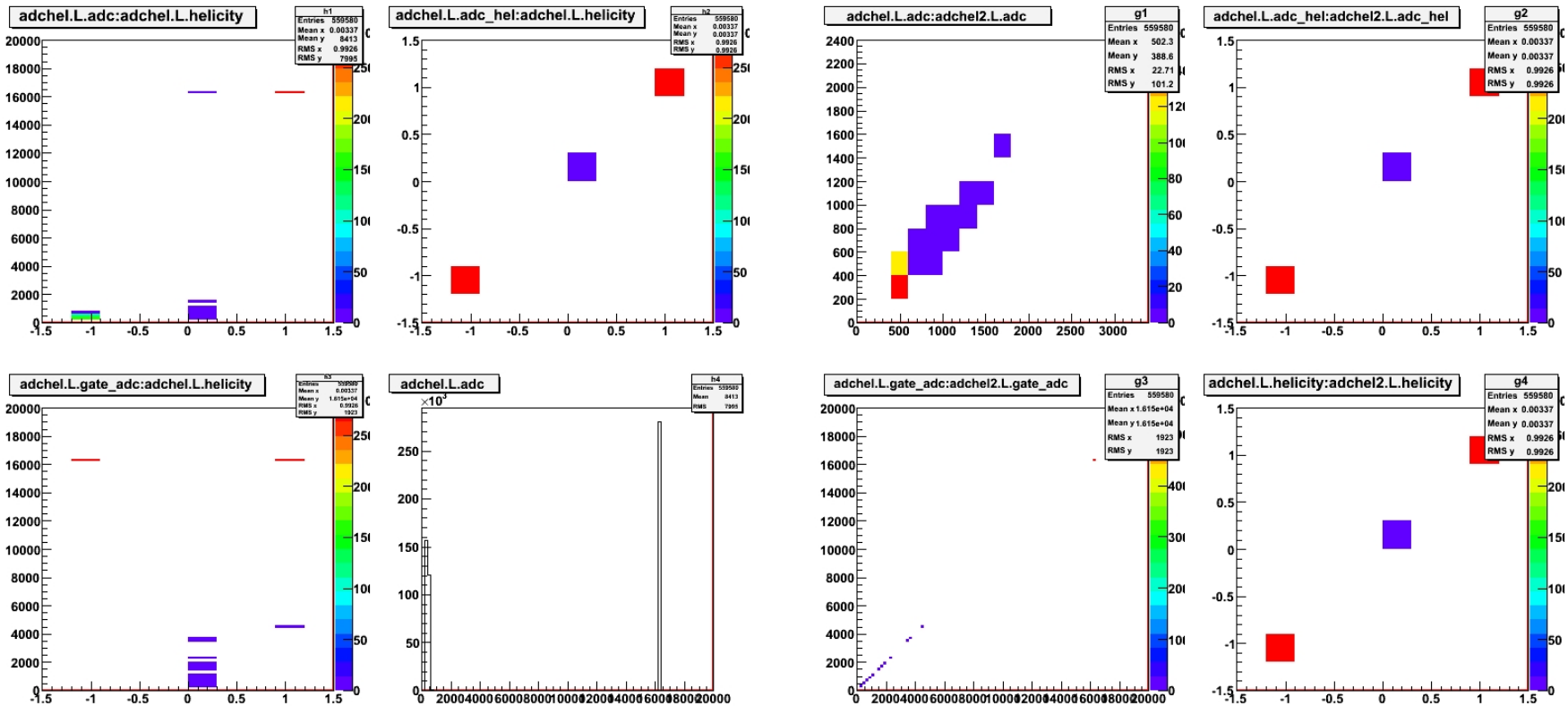
- Some statistics so far (with respect to beam trips):

| $p = 0.60$ GeV, 4-pass Kinematic | | | |
|---|---|---|---|
| Run | Total Events | Good Events (%) | Bad Events (%) |
| 20675 | 1291073 | 94.96 | 5.04 |
| 20676 | 1408648 | 97.64 | 2.36 |
| 20677 | 1272021 | 97.65 | 2.35 |
| 20678 | 1273606 | 97.32 | 2.68 |
| 20679 | 1297077 | 93.06 | 6.94 |
| 20680 | 1300432 | 96.35 | 3.65 |
| 20682 | 161221 | 97.71 | 2.29 |
| 20718 | 1686830 | 95.32 | 4.68 |
| 20719 | 1689692 | 95.28 | 4.72 |
| 20720 | 392720 | 99.72 | 0.28 |

- A new condition on good runs: require the percentage of good events to be above some value – maybe 70–80%?

# Skim (3)
## Skim Level 1 – Checking the Beam Helicity Asymmetry

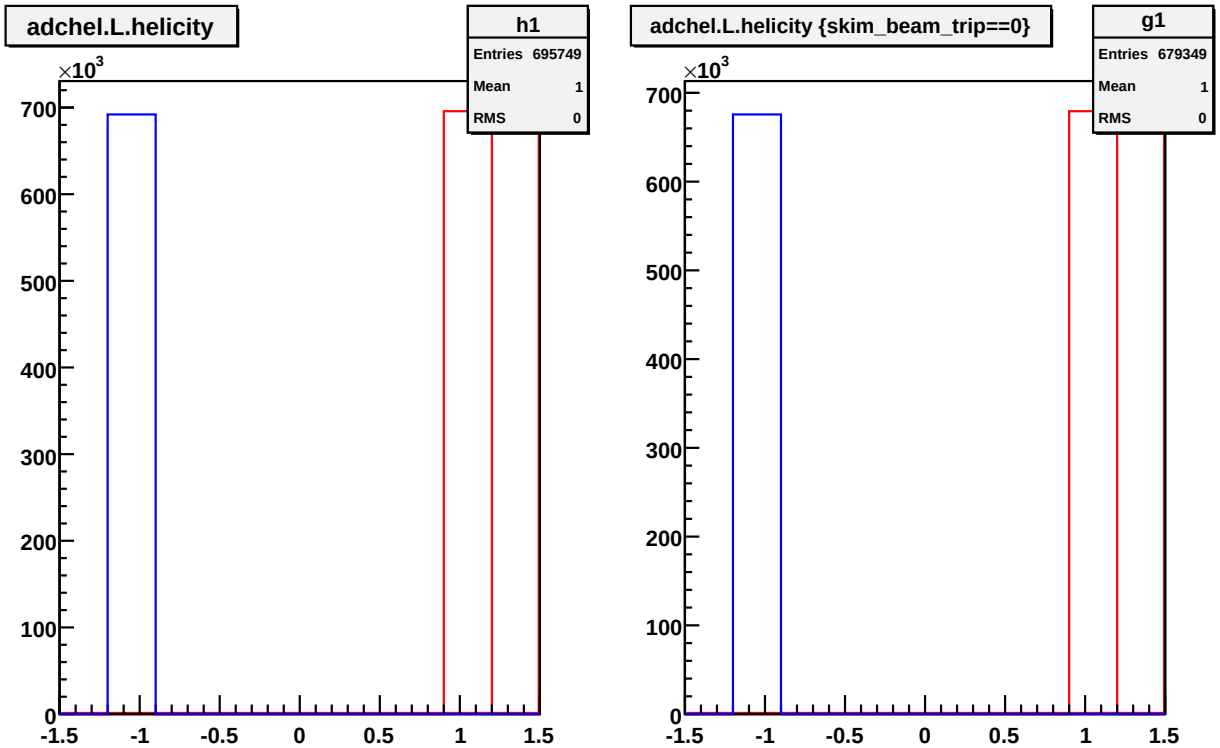
- First, some plots to make sure our beam helicity variables are behaving as expected:



# SKIM (4)
## SKIM LEVEL 1 – CHECKING THE BEAM HELICITY ASYMMETRY

- The beam helicity asymmetry is:

$$A_{hel} = \frac{N_+ - N_-}{N_+ + N_-}$$



# Skim (5)
## Skim Level 1 – Checking the Beam Helicity Asymmetry

- Beam helicity asymmetries with and without beam trip (BT) cuts:

| $p = 0.60$ GeV, 4-pass Beam Helicity Asymmetries | | | |
|---|---|---|---|
| Run | $A_{hel}$ (w/o BT cut) | $A_{hel}$ (with BT cut) | Percent Difference (%) |
| 20675 | 1.11E-03 | 9.19E-04 | 9.45 |
| 20676 | 2.69E-03 | 2.69E-03 | 0.00 |
| 20677 | -1.30E-03 | 1.37E-03 | 2.18 |
| 20678 | -1.32E-04 | -1.16E-04 | 6.14 |
| 20679 | -1.70E-03 | -1.55E-03 | 4.75 |
| 20680 | 1.90E-04 | 1.63E-04 | 7.82 |
| 20682 | -1.96E-03 | -1.21E-03 | 23.56 |
| 20718 | -9.51E-04 | -8.28E-04 | 6.92 |
| 20719 | -1.02E-03 | -1.06E-03 | 1.88 |
| 20720 | -2.25E-03 | -2.08E-03 | 3.80 |

# Scintillator Calibration (1)

## An Event-by-Event Approach: Points to Keep in Mind

- In order to correct the jitter we see in S1, we consider a few things:
  1. The raw S2m times are not aligned. The $\delta_j$ needed to align the TDC time for each paddle of index $j$ should be (essentially) applied to the S1 paddles (as a starting point)
  2. For a given S2m paddle (of index $j$) that takes the trigger timing, there should be a correlated event for one of the S1 paddles (of index $i$)
  3. For a given S1 paddle, there should be a certain time difference $\Delta t_{ij}$ for the $j^{\text{th}}$ paddle in S2m that took the timing. Ideally, for a given $i$, these times would be virutally the same; however, they are not.

# SCINTILLATOR CALIBRATION (2)

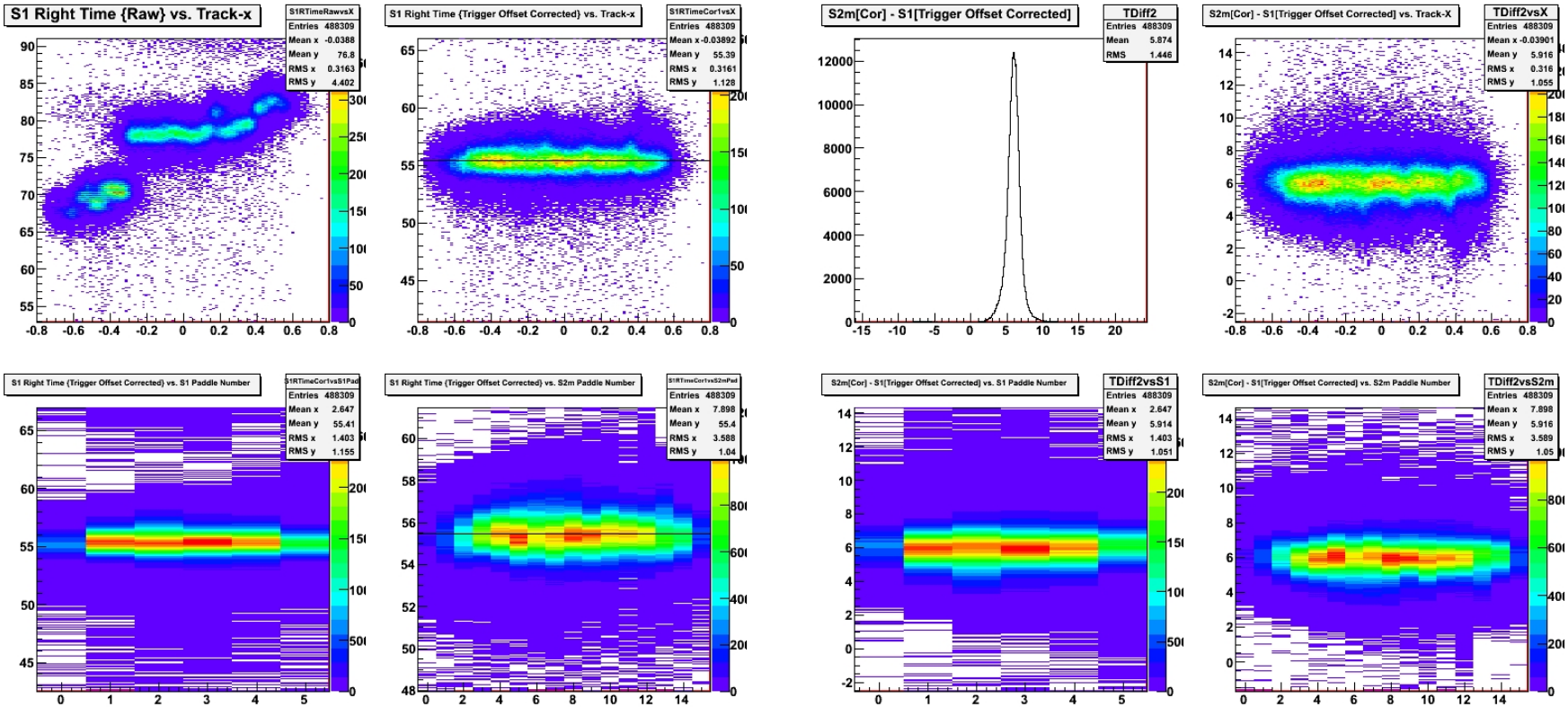
## AN EVENT-BY-EVENT APPROACH: PROCEDURE

- Given the points on the previous slide, we first align the S2m right raw times (yielding `L.s2.rt_c[j]`)
- From here we proceed as follows:
  1. Going event by event, we see which S2m paddle took the trigger time (i.e., the event has a time in the self-timing peak in S2m paddle $j$)
  2. For this event, we then scan through the S1 paddles to see which paddle it fired (call this paddle $i$)
  3. Form the time difference $t_{ij} = t_j^{s2m} - t_i^{s1}$. In total, there are 96 possible combinations, forming a matrix $T_{ij}$. We only consider 18 of the $t_{ij}$ (based on the paddle mapping of S2m to S1); all other entries are set to zero.
  4. The new S1 time is formed as ($f = 0.05$ ns/ch.):

$$t_{i,cor} = f \times t_{i,raw} + t_{ij}$$

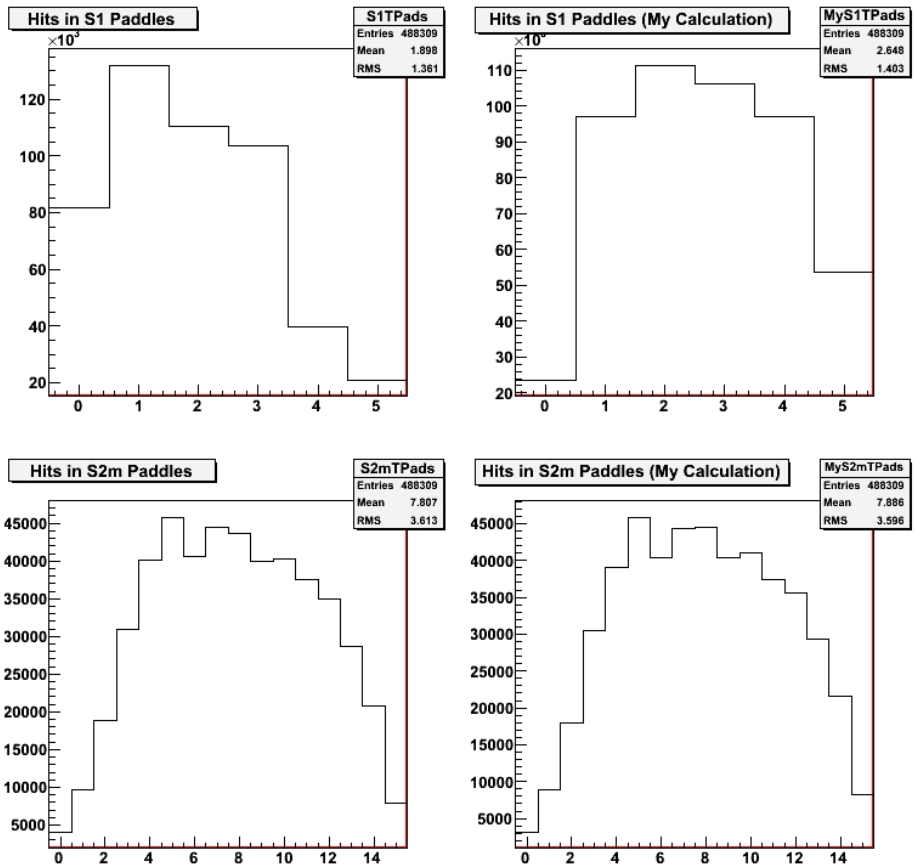
# Scintillator Calibration (3)

## An Event-by-Event Approach: Results



# Scintillator Calibration (4)

## An Event-by-Event Approach: The Smoking Gun (?)




- It's clear that the variables `*.t_pads` may not be working correctly – my calculations show a much more unform distribution of hits in S1 as opposed to that seen by `L.s1.t_pads`
- `L.s2.t_pads` seems to agree quite well with my calculations
- This may be (one of, at least) the issue here

# Summary

- Data Quality:
  - Skim stage 1 analysis underway
    - Run into an issue with segmentation faults – can't seem to close the newly generated ROOTfile (for runs with high event counts. . . )
- Scintillators:
  - A nice approach to a solution – but how to implement it?
- SAMC:
  - Playing with the simulation, understanding the subtleties of the variables and their respective distributions

# What's Next?

- Data Quality:
  - Continue to re-replay all production data
  - Clean up code, continue to carry out skim stage 1
- Scintillators:
  - What do we think of this latest analysis?
- SAMC:
  - Continue work on simulation, understanding why $\delta p/p, \phi, \theta$, etc. behave the way they do