LHRS Analysis for d_2^n

Scintillator Calibration Study

D. Flay


Hadronic & Nuclear Physics Group
Temple University Physics Department

4/15/10

Outline

1. Scintillator Calibration
   - S1 Timewalk Correction
   - S2m Timewalk Correction
2. Summary

S1 Timewalk Correction (1)

`THaScintillator` Class: Implementation of Timewalk Correction

- In order to understand how the timewalk corrections work, we examine the `THaScintillator` class:

```
fLT_c[i] = (fLT[i] - fLOff[i])*fTdc2T
           - TimeWalkCorrection(i,kLeft);
```

- `fTdc2T` is the resolution of the TDC – set by the DB (= 50 ps)
- `fLOff[i]` is the offset correction set by the DB
  - These offsets were obtained by using Vince's calibration code – minimizes the time difference between left (L) and right (R) TDCs
- The corrected variable is in units of seconds. Conversion to nanoseconds $\Rightarrow$ `fLT_c[i]` $\times 10^9$
- Same for the R TDCs

S1 Timewalk Correction (2)

THaScintillator Class: Implementation of Timewalk Correction

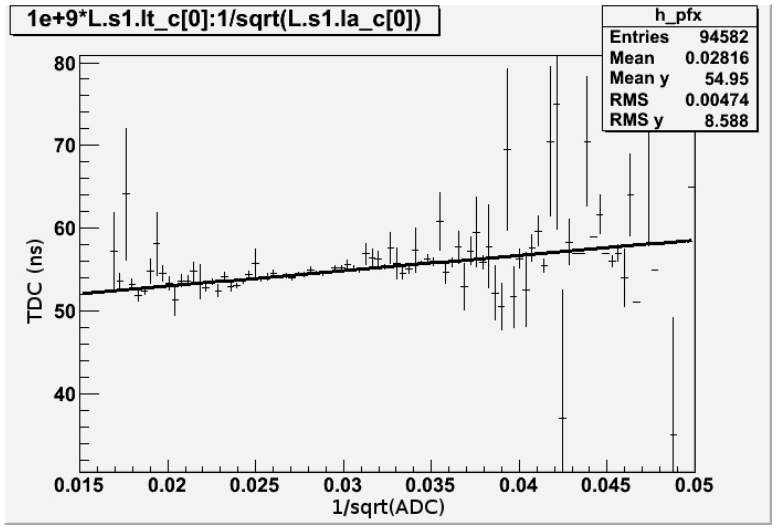
- The `TimeWalkCorrection()` member function gives:

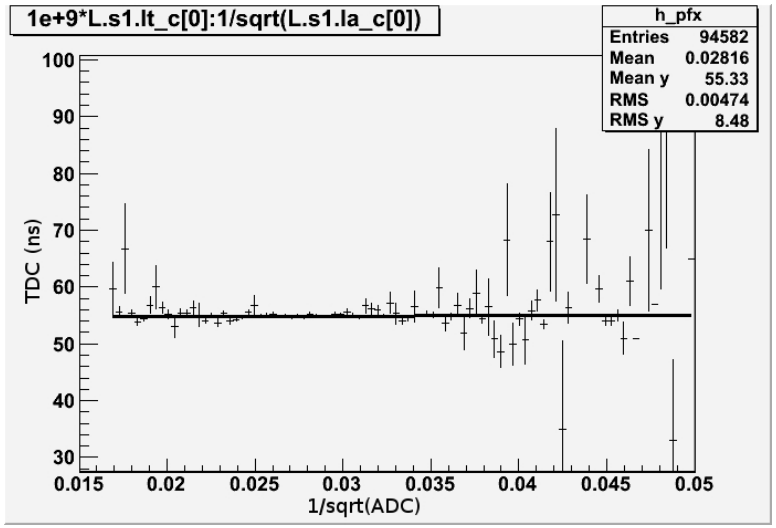
```
tw = par[0]*pow(adc,-.5);
tw_ref = par[0]*pow(ref,-.5);

return tw-tw_ref;
```

  - `tw_ref` refers to the MIP value (a large value in general, ~ 2000 ADC unts) – from reading the code, it looks to be some arbitrary offset value for which the timewalk correction is zero
  - The check of the timewalk was not being done properly as shown last time – what we should do:
    - First, set all DB coefficients to zero
    - We need to plot TDC vs. $1/\sqrt{\text{ADC}}$
    - Do a linear fit, extract the slope m
    - Check by plotting $\left(\text{TDC} - m/\sqrt{\text{ADC}}\right)$ vs. $1/\sqrt{\text{ADC}}$

S1 Timewalk Correction (3)

Results: Before & After





S1 Timewalk Correction (4)

Results: Before & After

S1 Left PMTs		
Paddle	Slope Before	Slope After
1	185.66	4.39
2	168.12	−1.39
3	157.34	−6.61
4	138.43	−0.71
5	112.85	0.41
6	144.41	−1.05

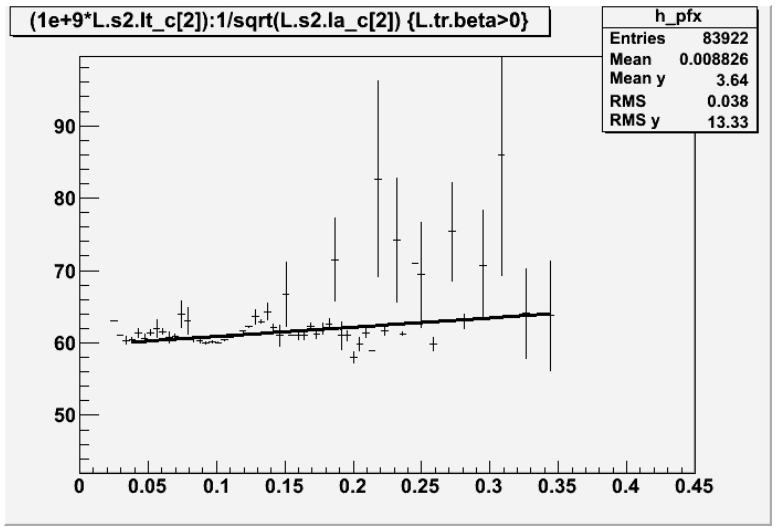
S1 Right PMTs		
Paddle	Slope Before	Slope After
1	24.12	4.05
2	33.74	1.65
3	16.89	5.61
4	3.49	5.31
5	−11.15	1.94
6	28.81	4.47

- Correction brings the slope of TDC vs. $1/\sqrt{\text{ADC}}$ to be consistent with zero
  - Slope units are: $\text{ns}\cdot\sqrt{\text{ADC units}}$
  - The fitting is very touchy – very easy to obtain 'overcorrections' as we see for some values
  - A few iterations of the procedure were necessary

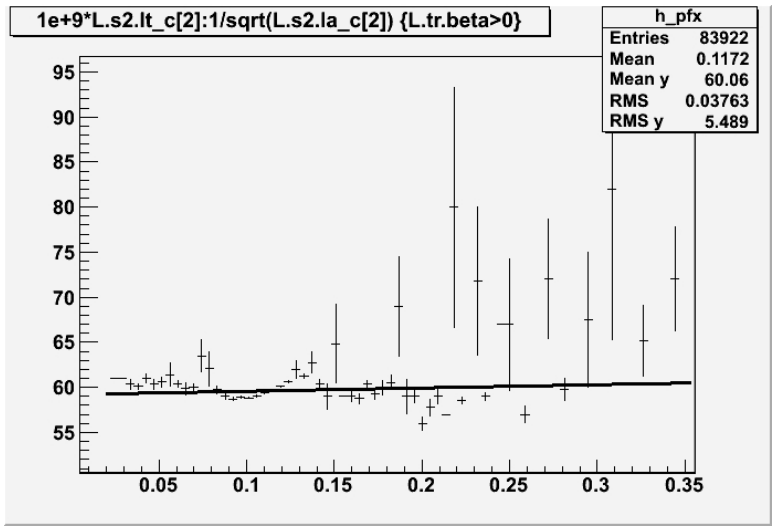
S2m Timewalk Correction (1)

- We follow the same procedure here:

without correction:



with correction:



S2m Timewalk Correction (2)

Slopes of Linear Fits: L and R

S2m Timewalk Slopes		
Paddle	Left	Right
1	36.095	3.711
2	189.353	1.481
3	13.087	0.034
4	42.149	3.422
5	25.458	0.335
6	21.882	0.514
7	27.338	−0.157
8	26.899	0.870
9	24.059	0.033
10	24.608	−0.189
11	24.252	−0.742
12	20.072	1.039
13	11.451	−0.089
14	19.934	2.382
15	21.601	−0.416
16	24.777	3.226

- These slopes become the coefficients for the DB
- Right side slopes are consistent with $0 \Rightarrow$ no correction needed there?

S2m Timewalk Correction (3)

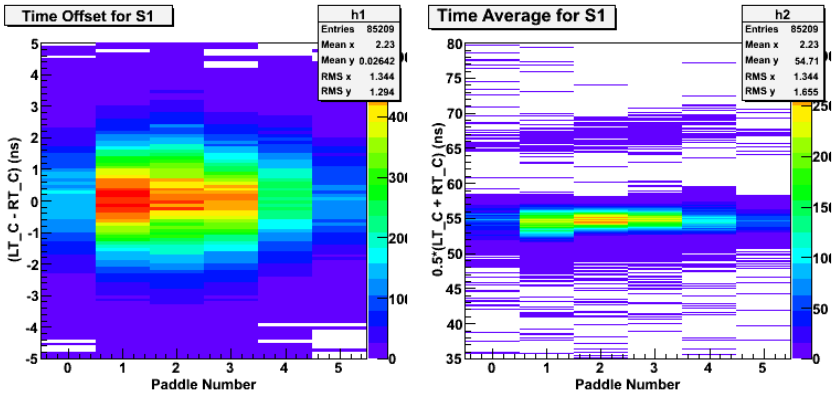
Database Problem

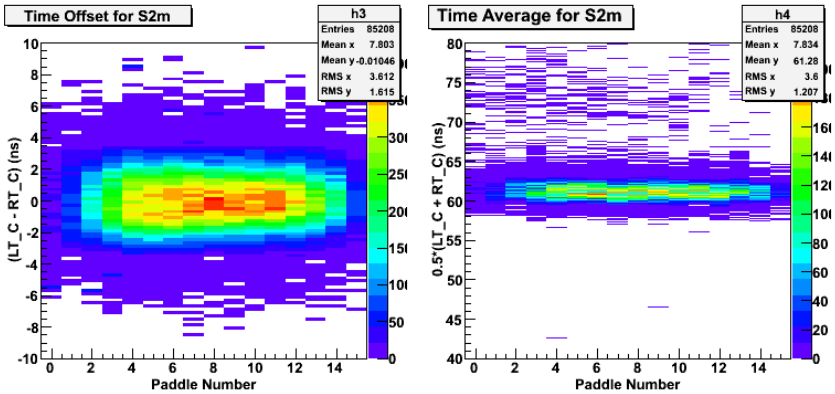
- I have the coefficients for S2m; however, the DB is not implementing them properly, despite the Analyzer picking up my timewalk coefficients and calculating a timewalk correction factor
  - Placed `printf()` statements throughout the `THaScintillator` class $\Rightarrow$ works fine
  - Problem seems to be in the MIP value
    - Was set to 50 $\Rightarrow$ following the procedure done for S1 will not work
    - Set S2m's MIP to match the value of S1's MIP: ~ 1300
    - Affects the time offset and time average of S2m to a noticable degree $\Rightarrow$ re-optimization needed for these quantities
    - I'd like to first get my timewalk corrections ironed out then do a minimization of the time offsets and time average

S2m Timewalk Correction (4)

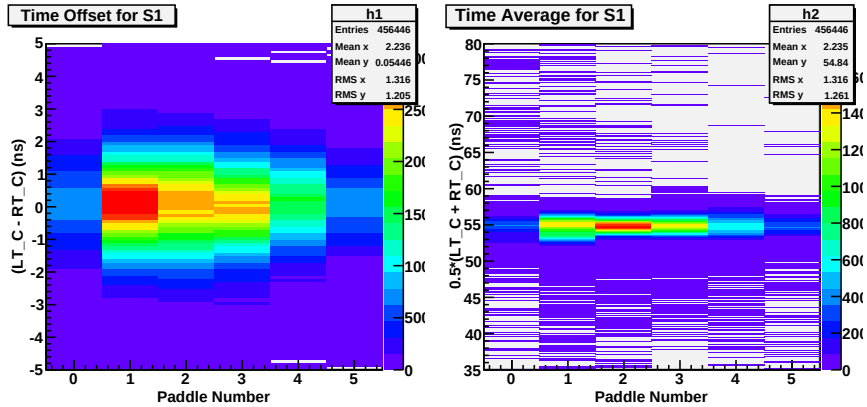
Effect of MIP Value Change: Time Offsets & Averages

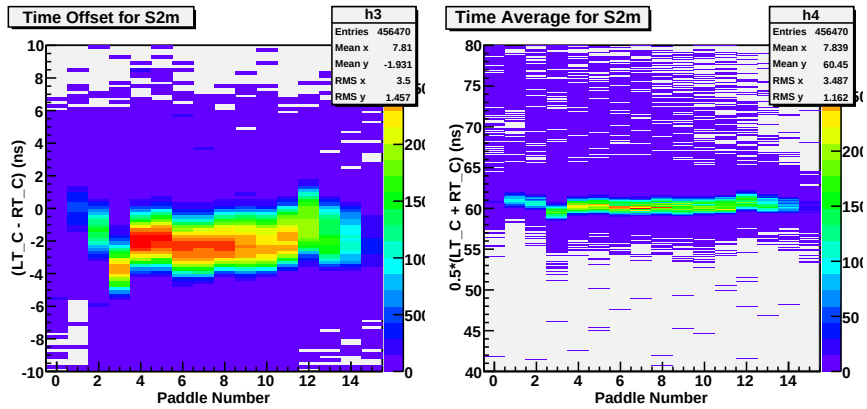
- MIP = 50





- MIP = 1295.7

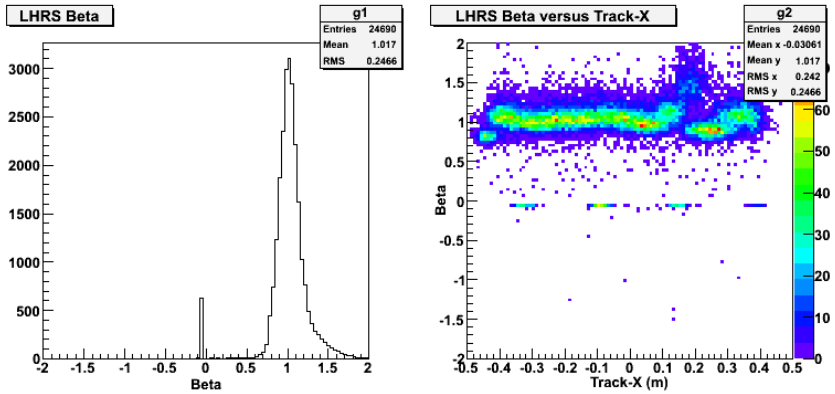




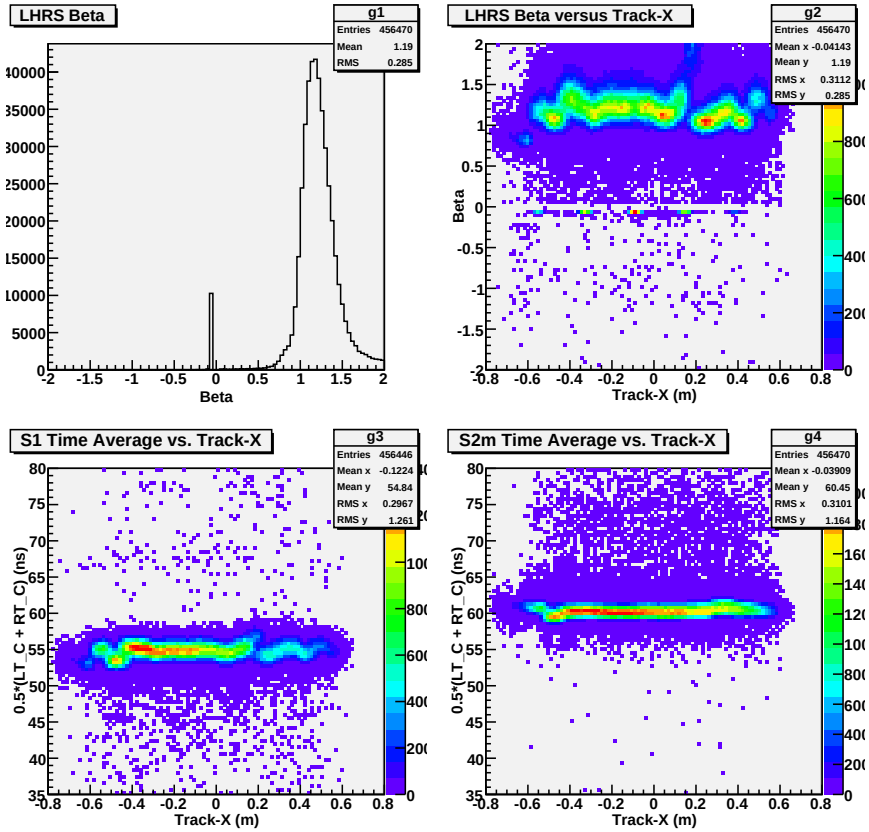
S2m Timewalk Correction (5)

Effect of MIP Value Change: β vs. track-x

- MIP = 50



- MIP = 1295.7



S2m Timewalk Correction (6)

- Clearly, if we keep the new MIP value, the time offsets and averages need correcting
- The main issue is – is it ‘OK’ to change this MIP value? Or is it intrinsic to S2m?

Summary

- Scintillator Calibration:
  - S1 timewalk has been completed, coefficients have been updated in the DB (on my machine)
    - Corrected slope of TDC vs. $1/\sqrt{\mathrm{ADC}}$ is consistent with 0
  - Have a handle on the S2m timewalk issue
    - The small MIP value renders the timewalk correction method incorrect

What's Next?

- Scintillator Calibration:
  - Work through the S2m timewalk problem
    - Hopefully this will be done soon, now that I know what the issue is. . .
  - For β vs. track-x: consider S2 - S1 (RT) histos?
    - Was looking at this as well over the past week, but got tied up in finishing the timewalk instead. . .
- Optics is getting underway
  - Been reading a number of technical notes $\&$ theses . . .
  - Finish up understanding the DCS, TRCS, and FCS
  - Gather Optics runs, Survey information – generate some characteristic plots to see how things look with our current matrix elements
- Geant4 Simulation: obtained the program valgrind at the suggestion of Elaine – should help find the memory leak issue (hopefully!)