TOF Update

A badly needed update of the TOF calibration software and its authors.

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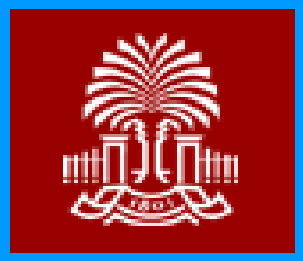

Tim's Legacy

- Tim left us a pdf file which essentially outlays the rest of the calibration and reconstruction software for the TOF wall.
- We've gone over it as a group, and we've tried to divvy up the remaining tasks within USC.
- Unfortunately, most of what's left, as Tim foretold, depends on **tracking**!

TOF Wall Light Propogation

- One of the larger corrections we need to make in the time of flight wall is the corrections for the time light from a point in the bar to reach the face of the phototube.
- This correction can account for over 20 ns (400 bins) of time that the wall measures.
- We plan the correction to consist of plotting a graph of TDC bins vs. y-position in the bar. We'll then fit it to a function (maybe linear, maybe not), and use that to scale the time down.
- **Relevance to tracking:** we need to find the y-position of the bar in order to make this plot. We've been using SPFit, but as TPC calibration is not yet complete, it's not working so well (more on that later).
- Once we have tracking, this shouldn't be difficult to do

TOF Wall Time Walk

- Since we've got ADCs and TDCs in the wall, we've got to do a time-walk correction.
- This should eventually boil down to a TDC v. ADC graph, but we've got a couple of roadblocks to deal with first...
- 1. The spread of TDC hits is very large, due to the fact that light propogation can widen the distribution of TDC values to a given ADC value quite a bit (remember that it's up to a 400 bin difference from top to bottom).
- I think the way to go about handling this it to bin the bars up into 60 bins (making 5 cm cubes), and plot only the TDC-ADC pairs who come from tracks in each bin. We'll have to see if that's overkill on binning.
- 2. (And we've had lots of discussion on this) Pulse shape will vary with distance along the bar because photons will not arrive so closely together further away from a PMT.

The Pulse Shape Question

- Each photon will contribute a certain amount of charge over a period of time, when it hits the face of the tube.
- If lots of photons hit it at the same time, there will be a very high, very narrow pulse. Conversely, if the photons are more spread out in their arrival, then the pulse will be shorter and broader.
- If the hit is close to the PMT, then most of the photons will travel in a straight line to the PMT. But the further away the hit is, the longer some of them will have to travel, increasing their spread in time. This will change the shape of the pulse.
- So, the question is, then: **is the pulse shape distortion a significant effect, and if so, how the heck do we account for it, given only the integration of the pulse in the ADC?**

Handling propogation, time walk interdependence

- If one looks at a raw TDC time pulled straight out of the wall, it is effected by both timewalk and light propogation. We need to get these corrections seperately. Here's one way to do this:
- 1. Bin each TOF bar into pieces, such that light propogation does not have a significant effect on the TDC value, yet is big enough to allow enough statistics.
- 2. Use the corrections for each bin (or, maybe average them all up, if they're similar enough) to apply the timewalk to all of the TDC hits, and then fit them to a light propogation correction.
- 3. Correct all the hits in a bar for light propogation, and then make a timewalk for the entire bar (or maybe not?).
- 4. Ship these attained calibration constants (or iterate on the two calibrations some more?).

Bar-to-bar variations: cable delay

- There's lots of cable delay in the TOF electronics.
- And we mean lots.
- To get precise correction for all the delay, we need some software help.
- Tim's algorithm was to use a histogram of all the uncalibrated TDC hits, take the mean, and use that to calibrate the cable delay constants. This histogram, however, is rather broad (see his 05-06 presentation), and it can probably be cleaned up if we wait until after timewalk and light propogation
- Once we have TDC time calibrated with those, we can use tracking to find hits that are shared between a vertical and a calibration bar. We can take a calibrated time difference between them, and use a histogram of those differences to adjust the TDC values for bar to bar variations.

Who's left at USC

- Tim's departure leaves four people at USC working on MIPP:
  Myself
  Kevin Wilson
  Jiajie Ling (maybe)
  Carl Rosenfeld
- Kevin and I have been progressing in advancing our knowledge of software, but I don't think that we may call ourselves “experts” yet (though Kevin is a computer whiz in general).
- Jiajie and Dr. Rosenfeld are further behind in software. They're catching up, but it will take some time yet.
- Therefore, USC will need your patience and some extra help as we try to keep pace.

Kevin Wilson's work

- Kevin Wilson has been charged with the timewalk calibration.
- As stated before, we need good tracking to make this work. He has a framework layed out for this correction, but it's not much good without tracking.
- Since then, he has been studying using top-bottom time difference to give some kind of y-position. I am not very knowledgeable about the specifics of his module, and I was not able to get to talk with him before today's meeting.
- Unfortunately, I was not able to put plots into this presentation, but I'm sure that we can have some for you the next time around.

Myself

- Tim gave me the light propogation correction before he left. It has stuck with me since.
- Blah blah blah need calibrated tracking blah blah blah
- I have done some studies as to the present usefulness of SPFit with respect to the TOF wall.
- What the module does is read in the TOFDigits and SPFit lines, get the corresponding bar, and see if there are sane TDC values in the top and bottom PMTs. If so, fill a histogram. If not, check the adjacent bars. If we have one of those that are good, then fill a histogram with that bar. If not, record the bar which the track went through as not having a good time hit, find the nearest bar with good hits a both top and bottom, get the x distance, and plot that in a histogram. At the end, go through and find all bars with a good TOF hit and without a track, and put that in a histogram as well.

Jiajie and Dr. Rosenfeld

- Jiajie was brought on to work with MINOS (and/or?) NOMAD analysis. He may also make some contribution to MIPP—besides taking shifts—but that is not yet decided. He is also a graduate student.
- Dr. Rosenfeld is working on becoming familiar with running experiment software, such as onmon. In the midst of everything else he has to do (he is a full professor at USC), he is making progress.
- Unfortunately, not much can be expected of them in the near future, but we can expect Dr. Rosenfeld (and Jiajie, if will work on MIPP analysis) to be useful in the analysis phase.

TOF software TODOs

- **FINISH CALIBRATION**
- Dr. Mishra has great interest in seeing how much particle seperation we can really get in the time of flight wall. In fact, he wants a plot like the much touted Mone Carlo pid graph Tim has thrown aroung in a lot of his presentations, except he wants it done with actual data. He is also very set on getting it done this summer.
- We need to figure out an algorithm for producing this plot, and then implementing it in software. I suspect it's going to require full reconstruction, just like everything else in the TOF wall does.
- If we can accomplish this, then we should have only a few loose ends to tie together before TOF will actually be analysis-ready.

In Summary

- The TOF needs time walk, light propogation, and cable delay calibrations
- All of these are dependent upon calibrated tracking to varying degrees.
- Even though we do not have an expert on staff right now, we are trying very hard to accomplish our software goals. We just need time and a little help from the group.
- We are set on having calibration done as soon as we can, and particle seperation very soon thereafter.

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