Time walk correction

We need to take particles that pass through the scintillator bar in the same place and time and deposit different energy in the scintillator.

The best method to determine the time walk is to perform a scan with a laser beam pointed at the center of bar and plot the time recorded in the TDC versus the ADC...

I combined number of run from the production (runs # 3299, 3300, 3319, 3320, 3321, 3322, 3323, 3325) and plotted the TDC versus ADC for each PMT.
The reference point was scintillator bar that located in front of the examined bar. For example: when checking the bar 5 from layer 5, I use bar 5 from layer 4 as a reference.

I plotted the following:

$$\text{Left TDC} - 0.5*(\text{TDC\_left\_ref.bar} + \text{TDC\_right\_ref.bar}) \quad \text{vs} \quad \text{Left ADC}$$

and similar for the right side
The cuts that I used:

- TDC > 0
- cut on TDC to be inside the integration window of ADC (the correction is relevant only when we have valid ADC data).

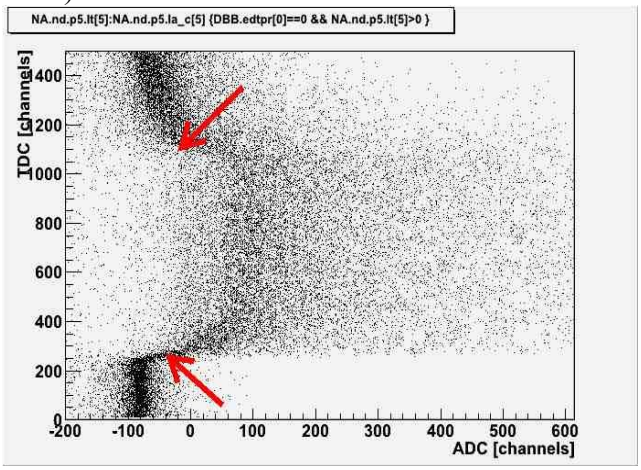

Fig 1: Red lines mark the ADC integration limits

- cut on a small region of the reference bar ADC, to eliminate the contribution of time walk in the reference ADC.

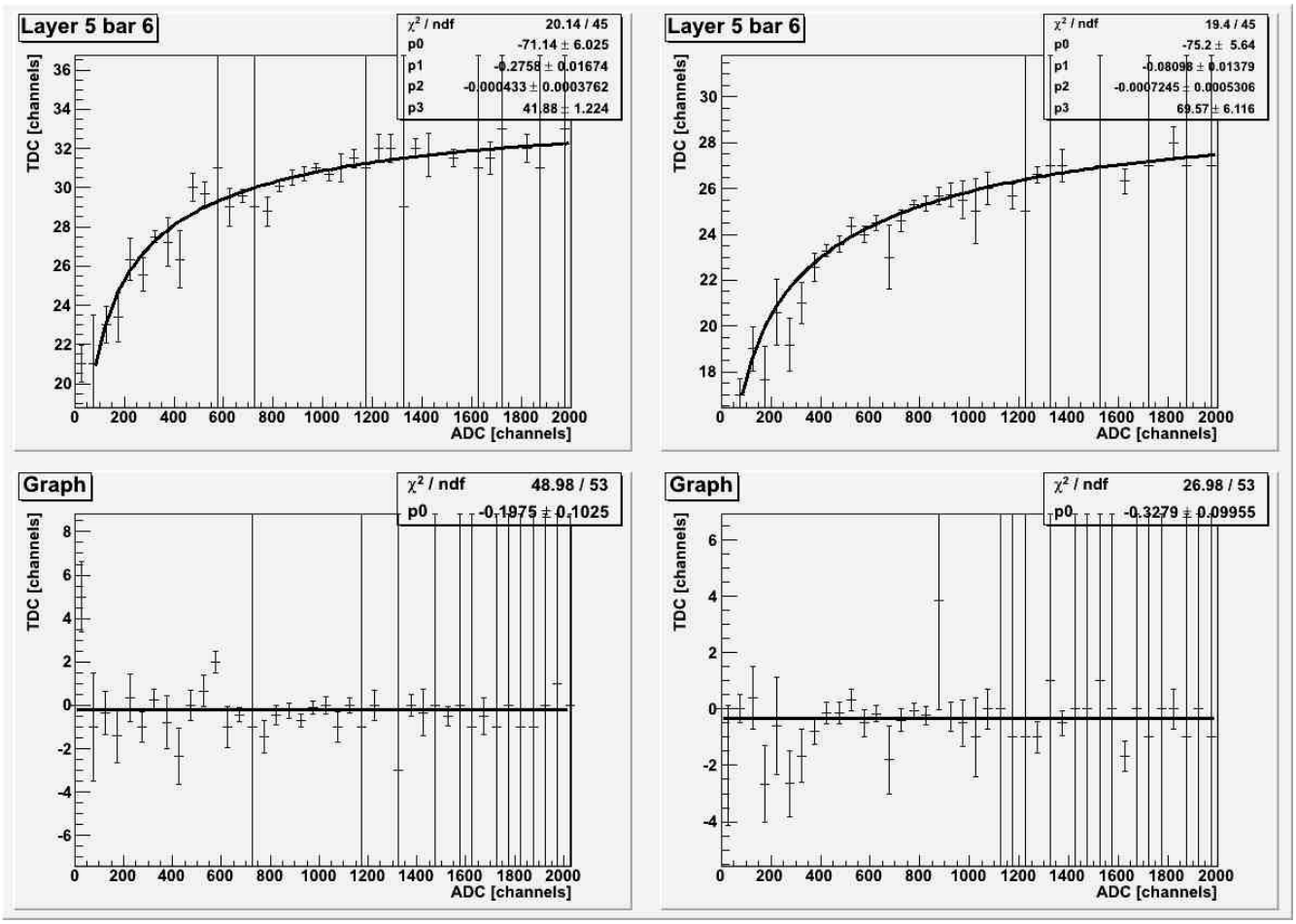

Fig 2: Top two graph show the TDC dependence on the ADC channel due to the time walk.The bottom two are time walk corrected. (left side graph are for left PMT and right are for right)

The function that I used to fit the data:

$$TDC = a * X^{b} + c * X + d$$

where a,b,c,d are fitted parameters and X is the ADC.

Example for the time walk correction that was done with laser (in Hall B) can be found in the:
"*Nuclear Instruments and Methods in Physics Research A 432 (1999) 265 – 298*"

The difference between fig 2 and fig 26 is TDC common stop and TDC common start respectively.

The dependence that they measured:

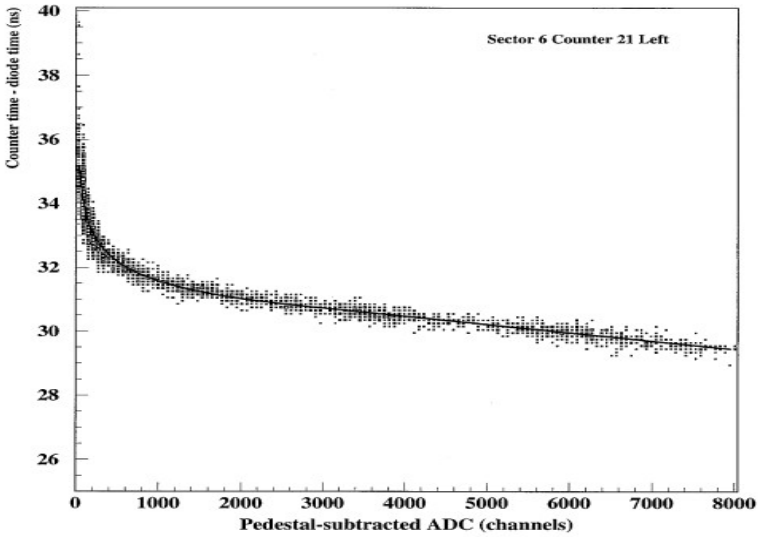

Fig. 26. Typical example of the dependence of the TDC times (ns) vs. the pulse height (ADC counts). The line shows the fitted time-walk function Eq. (10).

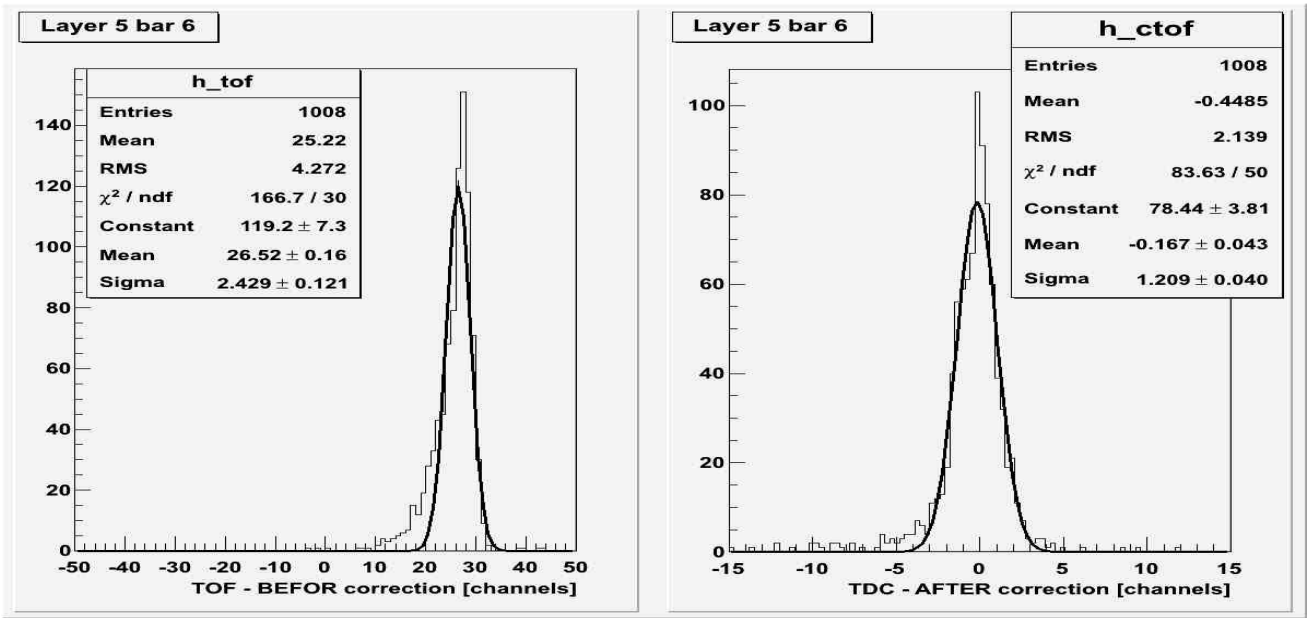

Fig 3 Left histogram show the TOF before the time walk correction and the right one after.