Analysis of Time Information from 2006 BCAL Cosmics Runs

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Data Set

4 runs from /work/halld/bcal06 directory:

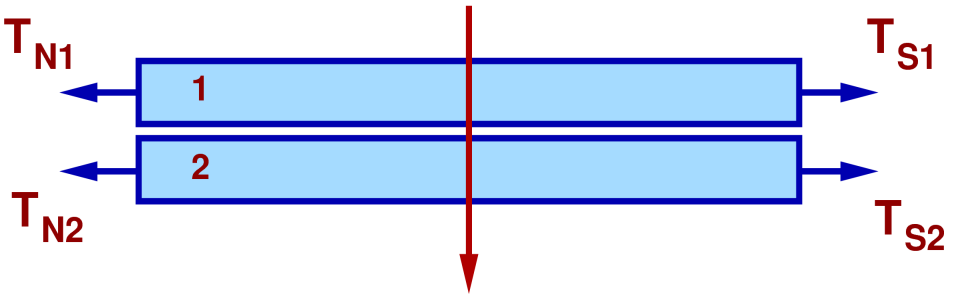
Run #	Trigger Position (cm)
2458	+100
2459	+150
2475	- 50
2476	- 150

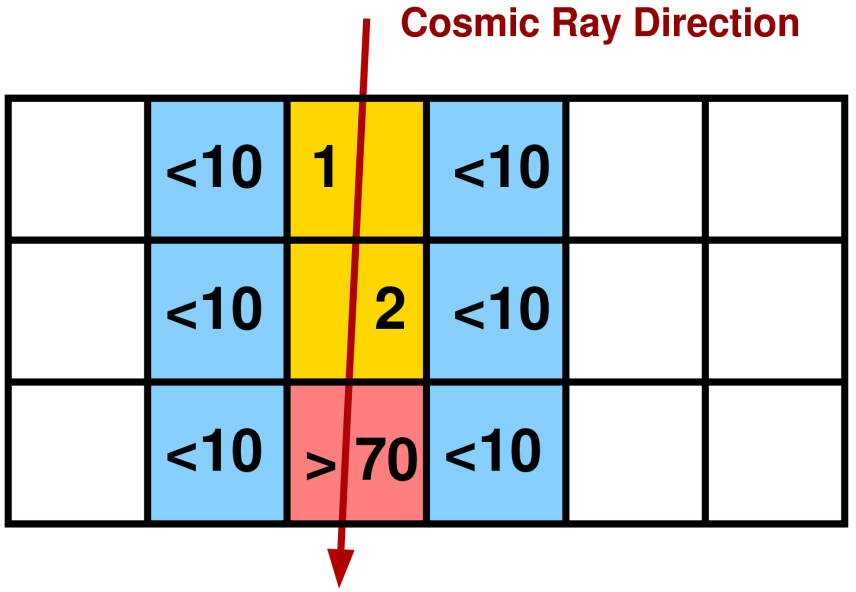
Time calibration as it was on Autumn 2007 !

Mean Time-of-Flight & Event Selection

To eliminate the tagger influence, we use the difference between mean times from 2 segments in the column:

$$\mathbf{ToF} = (T_{N2}+T_{S2})/2 - (T_{N1}+T_{S1})/2$$



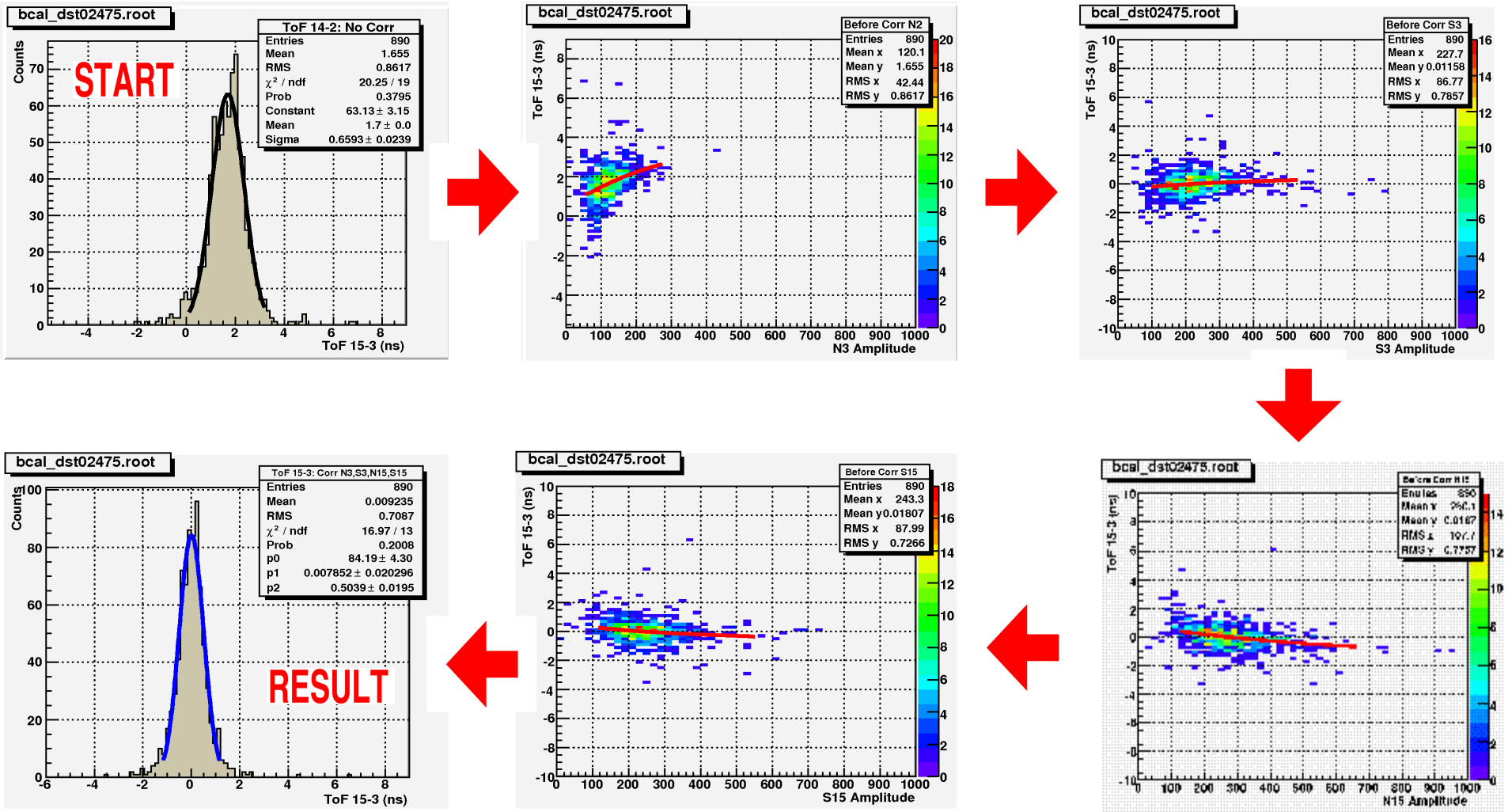


Selection of “muon” event

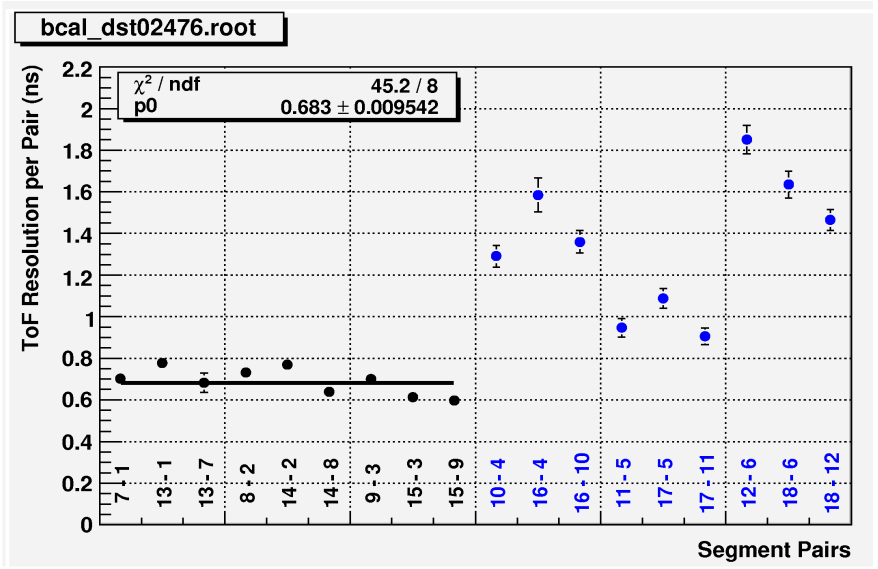
Time-Walk Correction

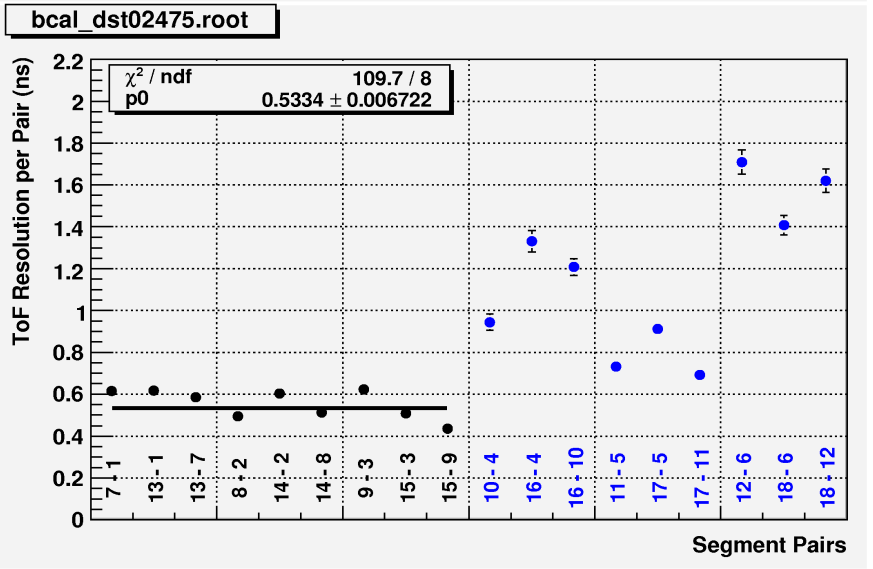
Successive event-by-event correction of "ToF" value on 4 amplitudes (viz., A_{N1}, A_{S1}, A_{N2}, and A_{S2}) with the function:

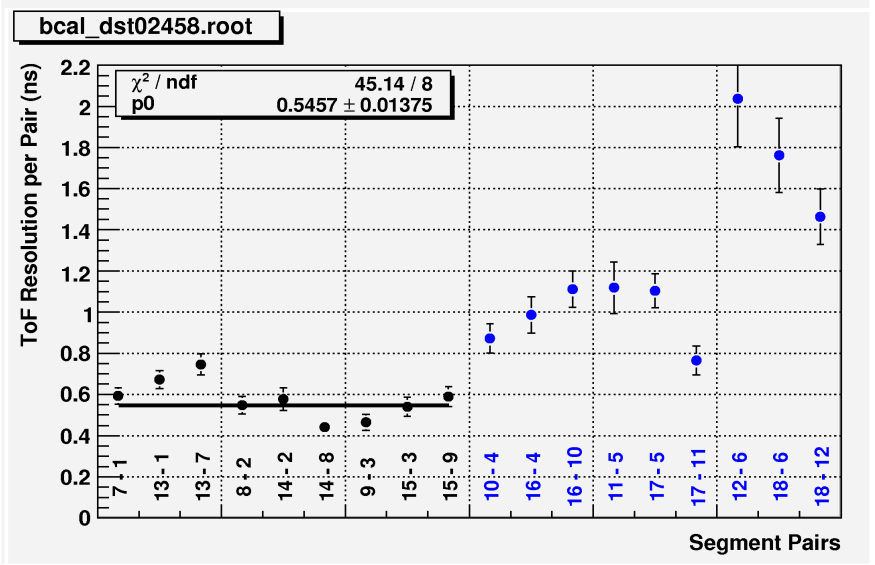
$$\mathbf{ToF\ (A) = P_0 + P_1*(A)^{-1/2} + P_2*(A)^{-1/3}}$$

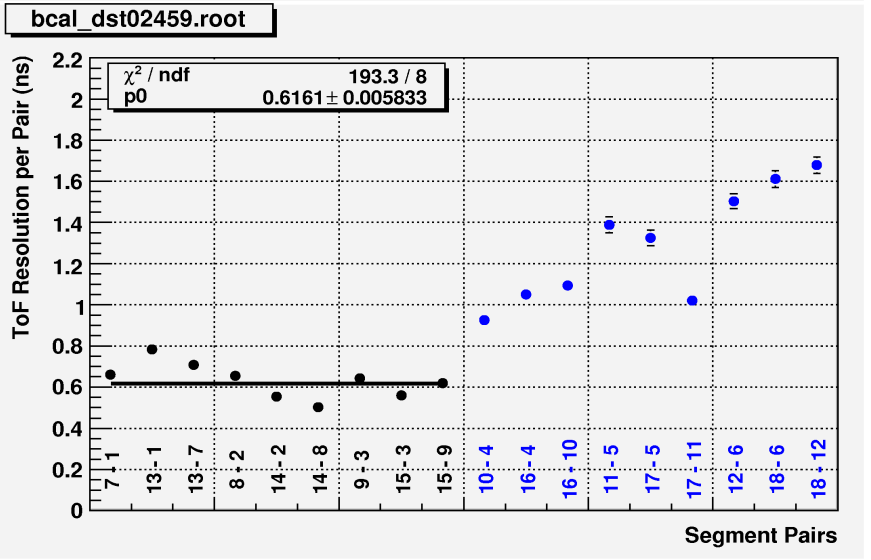


Summary over 4 Runs









Trigger Position Dependence

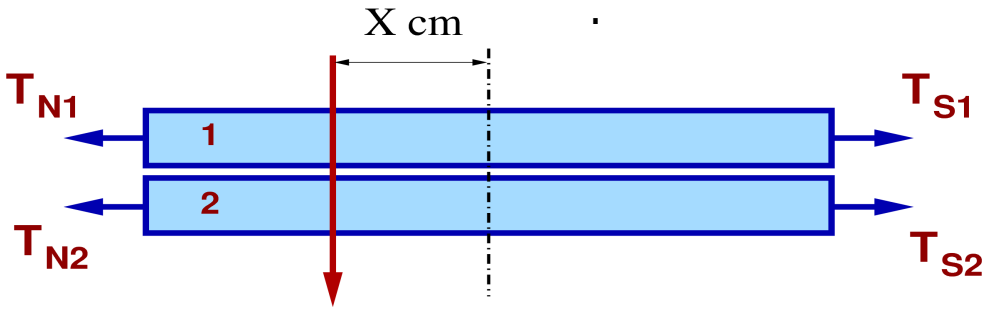
We assume that the time resolution of a SINGLE segment for the CENTRAL-POSITION muon hit can be written in the form:

$$\sigma_{t1}^2 = (\sigma_{tN1}^2 + \sigma_{tS1}^2)/4 = \frac{C^2}{N_{pe}} + B^2 = \frac{A^2}{\Delta E} + B^2$$

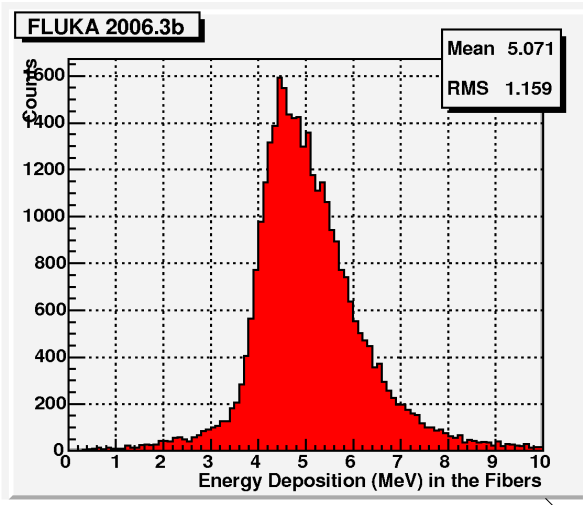
Time resolution for the PAIR of segments for the muon hit in x cm from the segment center :

$$\sigma_t^2(x) = (\sigma_{tN1}^2 + \sigma_{tN2}^2)/4 + (\sigma_{tS1}^2 + \sigma_{tS2}^2)/4 = \frac{C^2}{N_{pe}\cdot e^{x/L}} + B^2 + \frac{C^2}{N_{pe}\cdot e^{-x/L}} + B^2 =$$

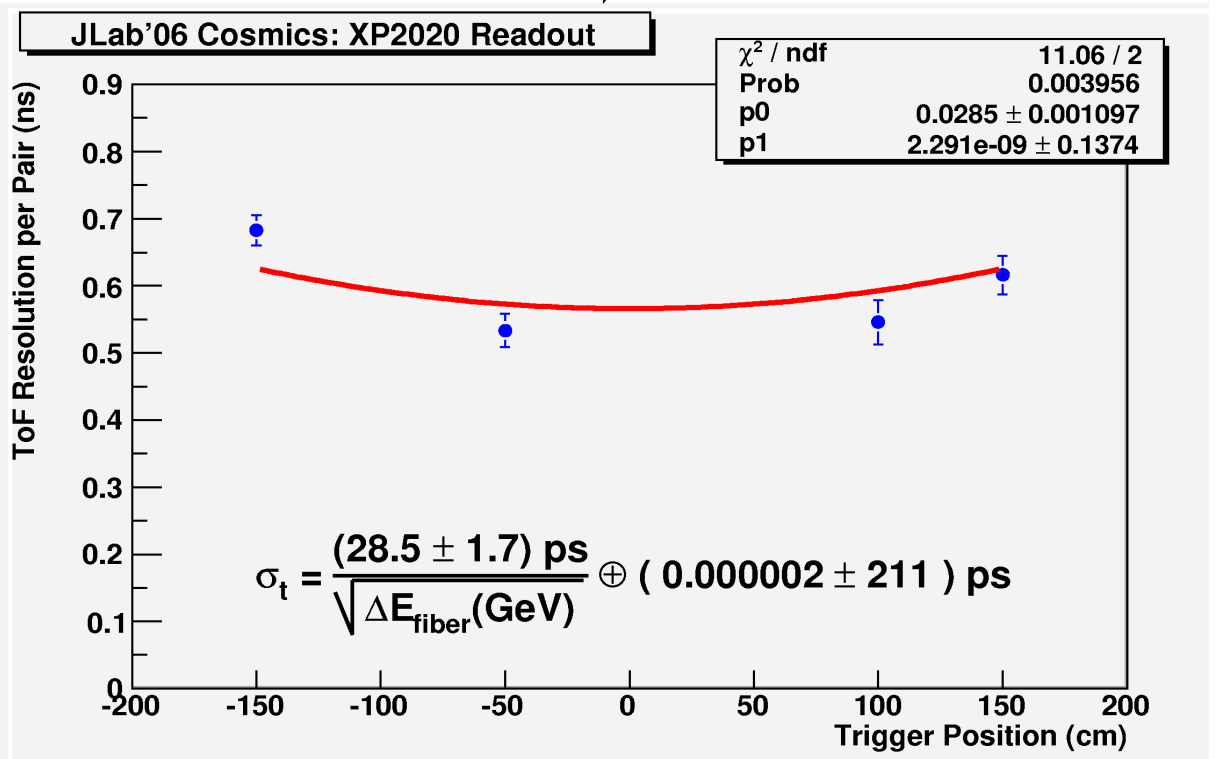
$$= \frac{A^2}{\Delta E}\left(e^{-x/L} + e^{x/L}\right) + 2\cdot B^2$$



In theory, we can separate the Energy-term and the Floor-term.



$L_{atten} = 229.1\,cm$



The Floor-term is smaller than the Energy-term for MIP energy deposition in fibers.

Projection to Photon Beam Test

If we assume $\Delta E_{fiber} / E_\gamma = 0.129$:

$$\sigma_t = \frac{(79.3 \pm 4.7)\ ps}{\sqrt{E_\gamma\ (GeV)}} \oplus (\ 0.000002 \pm 211\ )\ ps$$

To-Do List

- ✔ Analysis for every pair of segments separately => more accurate result
- ✔ Analysis of the shape of ToF distribution => independent way to access the Energy-term and the Floor-term
- ✔ We have 3 pairs of segments per column => we can extract an individual time resolution of each segment