Monitoring Pre Processor Fine Timing

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Introduction

- The Analogue Trigger Tower signals are digitized at the Pre Processors of the L1Calo system.
- For a good energy resolution and correct Bunch Cross Identification, the signal peak must be sampled correctly.
- The aim of the present work is to monitor any drastic change in the peak sampling.
- The fine timing stability should be monitored both online and offline.
- Online monitoring should not be memory intensive

- A Landau Gaussian hybrid function best describes the TriggerTower signal

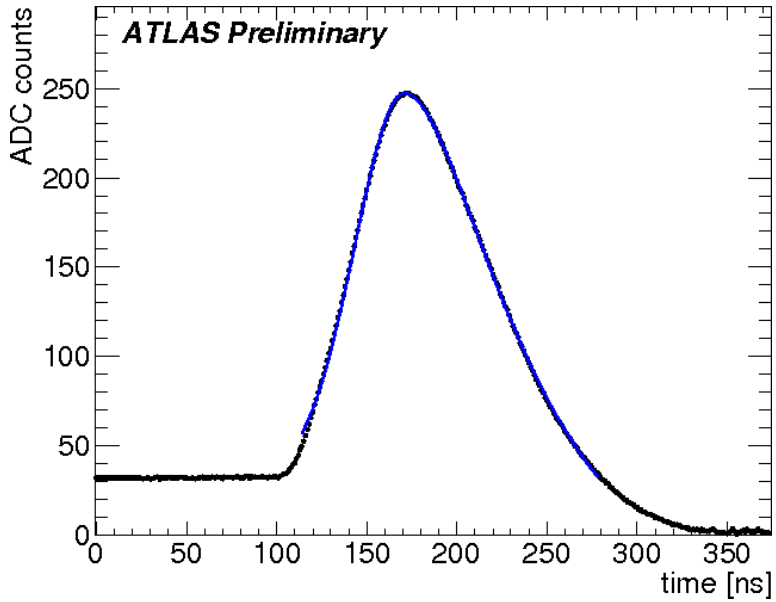


Figure: Reconstructed Trigger Tower signal using PHOS4 Scan

- A Landau Gaussian hybrid function best describes the TriggerTower signal
- We assume the peak described by three ADC slices can be approximated by a parabola
- We define a parameter FineTime which is a measure of the offset of the ADC peak from the true analog signal peak.

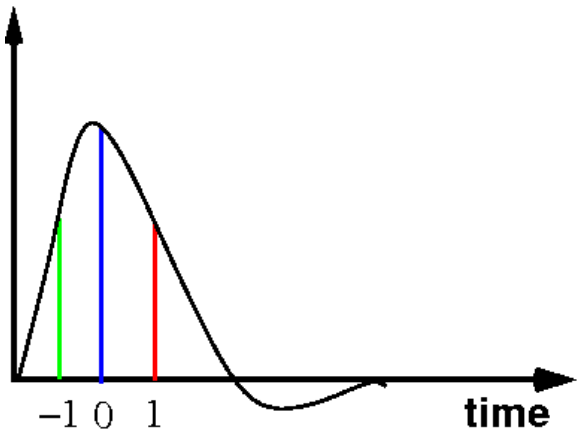
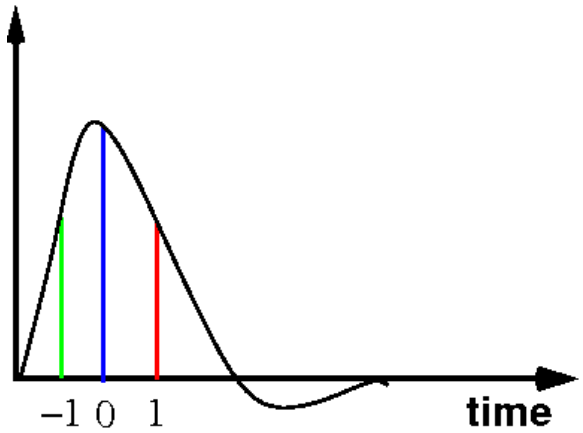


Figure: Calculating FineTime

  - The parameter is extracted by solving a second order polynomial for the three central ADC slices.
  - For ease, we first rescale the time so that the peak falls at coordinate origin



FineTime

$$f(x) = ax^2 + bx + c$$

$$\text{peak} \equiv P \equiv f(0) = c$$

$$\text{inferior} \equiv I \equiv f(-1) = a - b + c$$

$$\text{superior} \equiv S \equiv f(1) = a + b + c$$

$$\text{FineTime} \equiv x_{max} = \frac{-b}{2a}$$

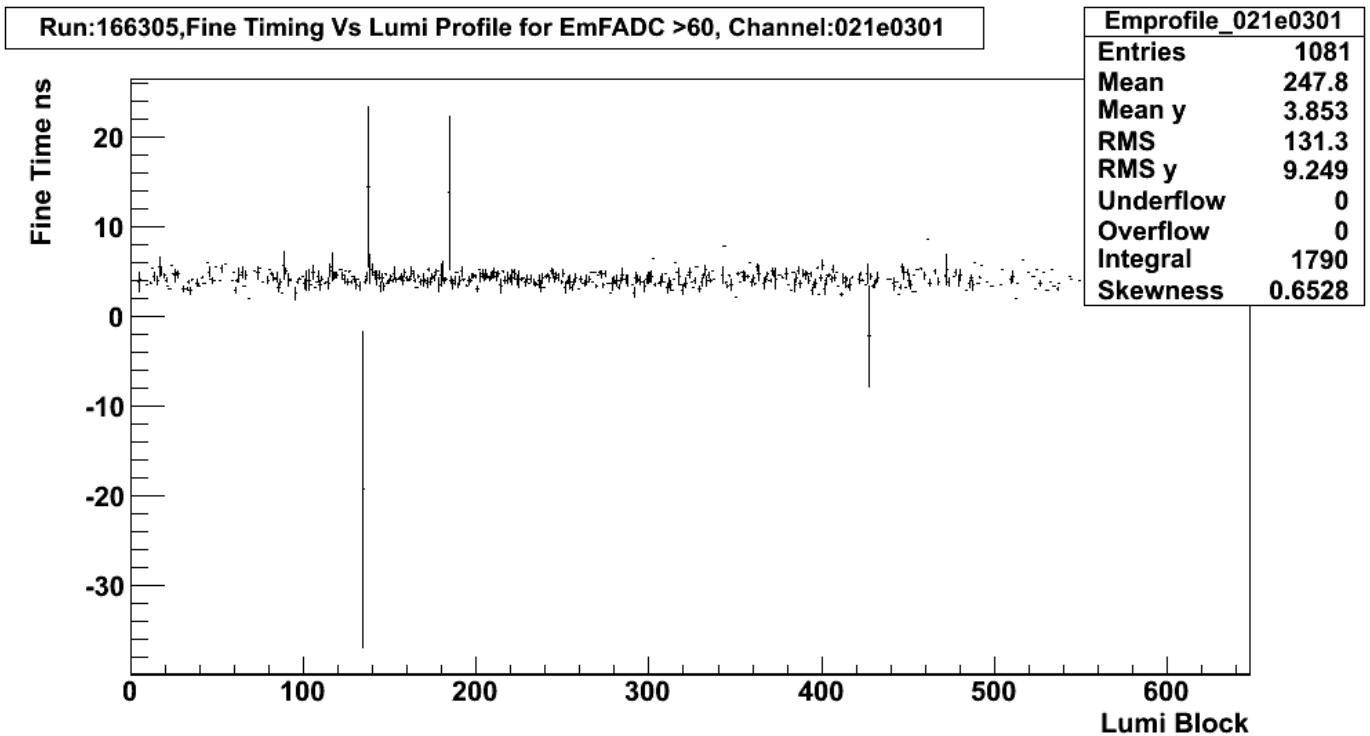
$$= \frac{S - I}{2[2P - S - I]} \times 25\text{ns}$$

$$\text{FineTime} = \frac{S - I}{2[2P - S - I]} \times 25\text{ns}$$

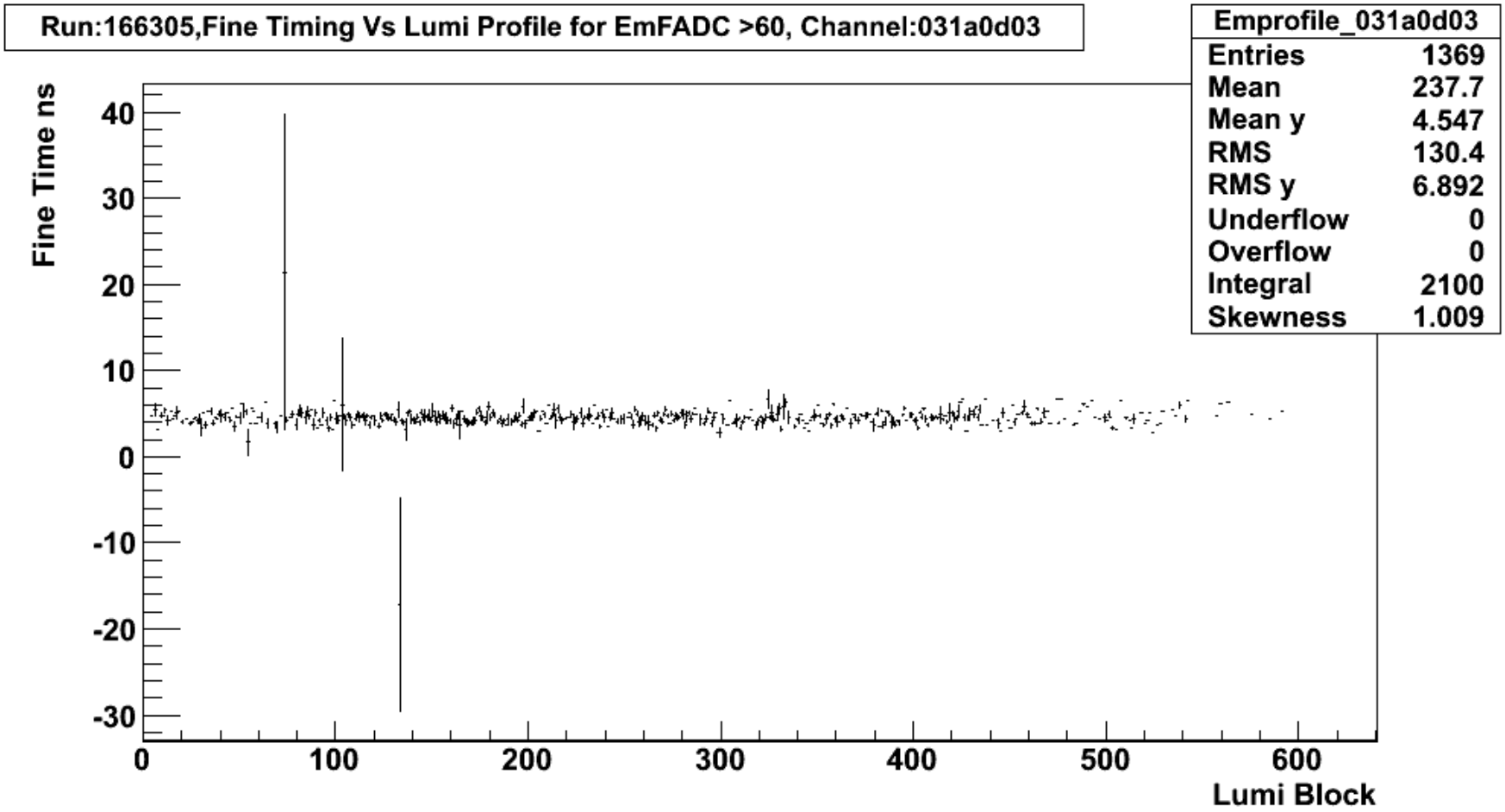
- If the Superior and Inferior slice have the same magnitude, then the peak is sampled correctly and FineTime $= 0$
- But this is not quite true
- The aim of monitoring studies is to see the jitter in FineTime check for any large variation
- **Quality cuts:**
  - zero denominator caused by unusual peaking
  - Peak slice happens to be at the boundary of ADC slice

Results

- Picked a random EGamma stream dataset from run 166305
- ADC cut of 60 adu
- The offline code "lives" in the package *TrigT1CaloCalibUtils* and the online one in *TrigT1CaloMonitoring*
- The code runs on Athena release 16.6.1 and trunk versions of 5 other packages.

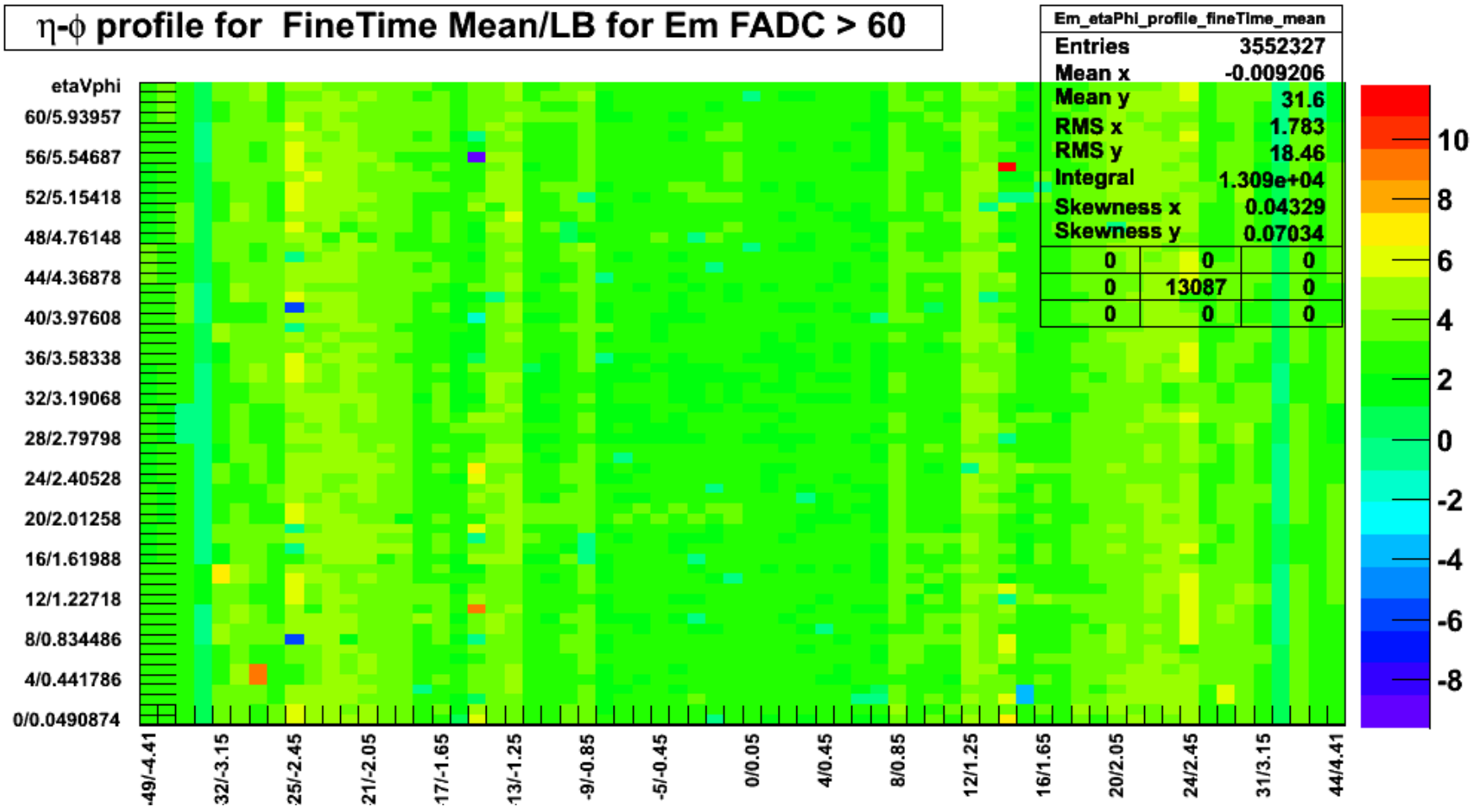


Results


Run:166305,Fine Timing Vs Lumi Profile for EmFADC >60, Channel:031a0d03
Emprofile_031a0d03
Entries 1369
Mean 237.7
Mean y 4.547
RMS 130.4
RMS y 6.892
Underflow 0
Overflow 0
Integral 2100
Skewness 1.009
Fine Time ns
40
30
20
10
0
-10
-20
-30
0
100
200
300
400
500
600
Lumi Block

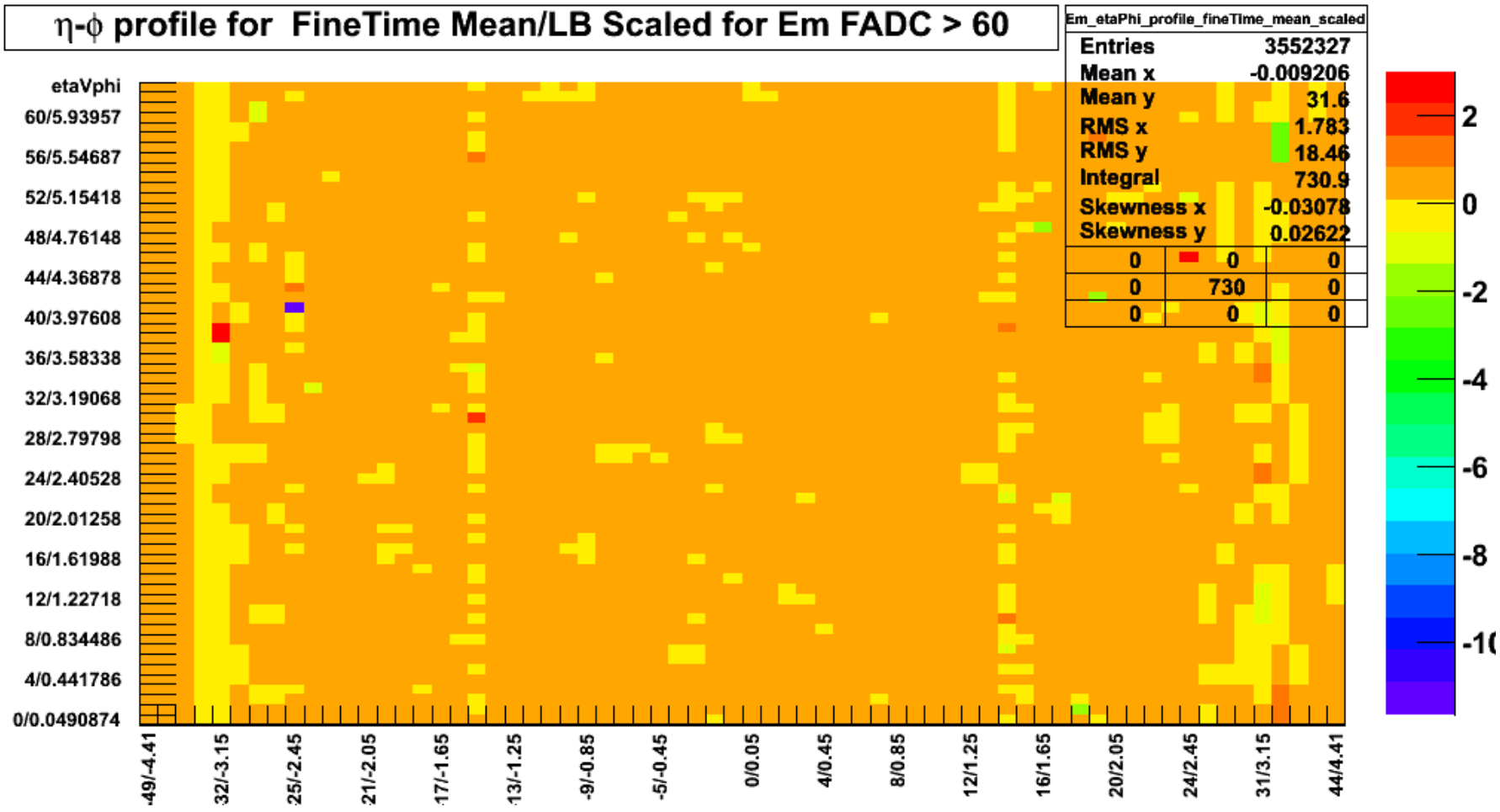
Results

The mean of FineTime in each Lumi block, separated in $\eta - \phi$ and the channel



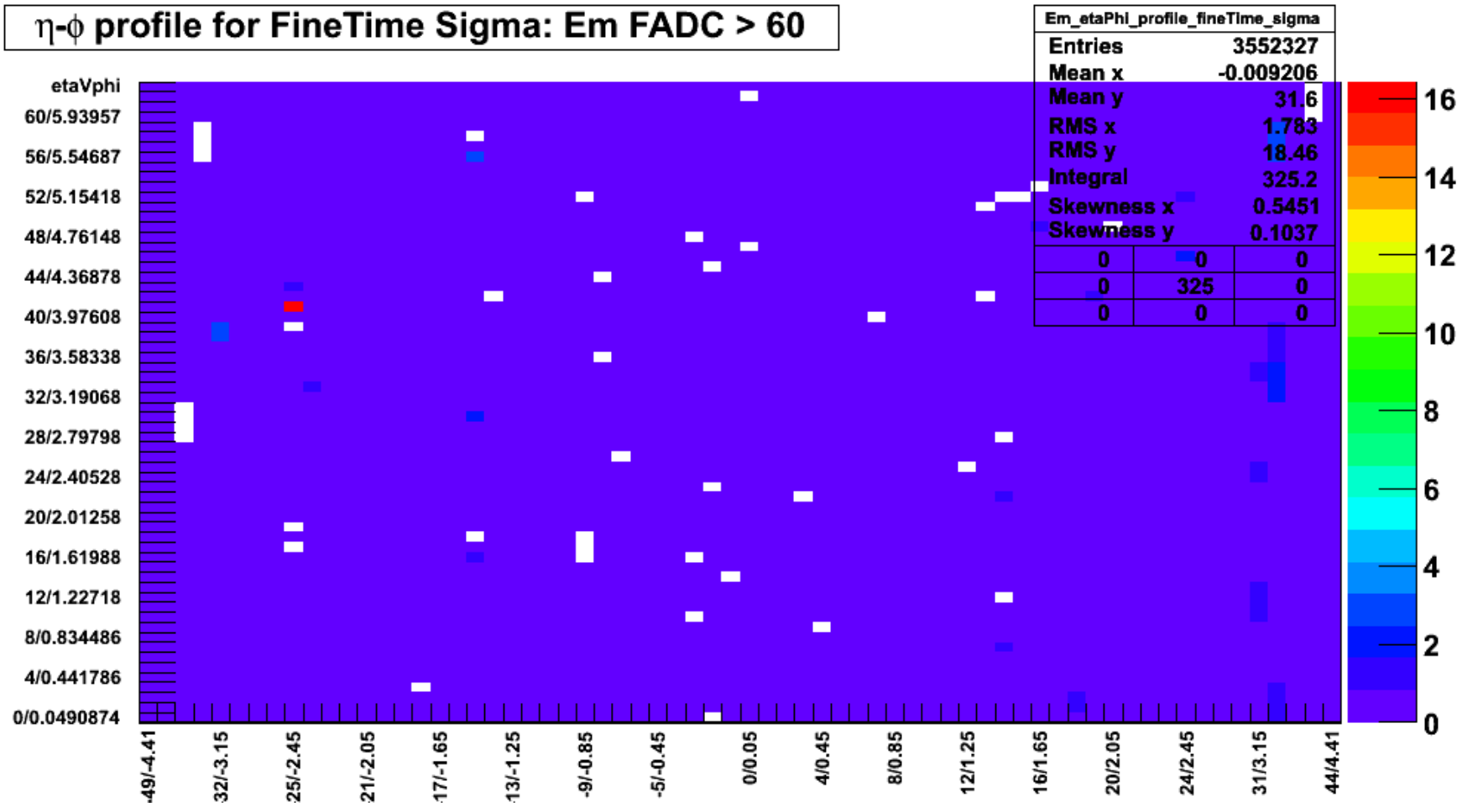
Results

The mean of FineTime each Lumi block difference the "global" mean of each Lumi block, separated in $\eta - \phi$ and channel



Results

The RMS of FineTime in each Lumi block, separated in $\eta - \phi$ and the channel



Conclusion

- A technique for monitoring the fine time offset of the PHOS4 chip of Pre Processor module has been developed
- Using this method both offline and online FineTime monitoring can be done.
- The results histograms from this analysis can be included in ATLAS DQMF