XCAL LED quality check and time alignment consideration

Outline

- CALO sub-detector status with checking by LED timing scan tools
- Comparison of the time measurements by two methods

XCAL LED quality check

Last week on Friday after GCW the LED time scan data were collected for all CALO sub-detectors (see Calo logbook for a run reference). The reason was to check performance of all calo sub-detectors after HV control board firmware upgrade.

Summary of the tests:

HCAL

HV and LED systems are in a good condition. One – two problematic channels were fixed (see Yury's talk). Summary signal shapes on: /scratch/everyone/akonDATA/hcA-C_56526_090904

ECAL

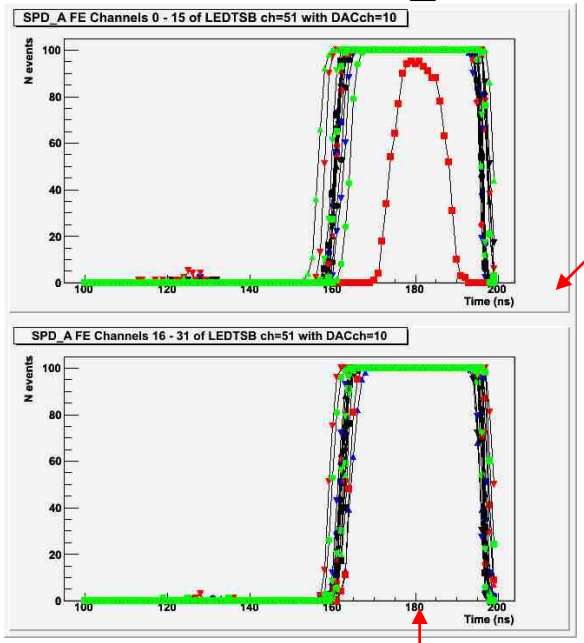
After HV board firmware upgrade it was found a few boards with low power supply, due to a bad contact into LV connectors (for details see Irina's talk) and other problem with ECTELL_12 (for details see Stephane's talk). All ECAL signal shapes on: /scratch/everyone/akonDATA/ecA-C_56535_090904

PS/SPD

HV and LED systems are stable. Only one problem has been detected during the LED time scans. Explanation on next slide. The sub-detectors signal shapes on: /scratch/everyone/akonDATA/spd56569_calibr090904 and /scratch/everyone/akonDATA/ps56569_calibr090904. Still a few LED groups have a lit bit low intensity and could be tuned.

SPD LED quality check

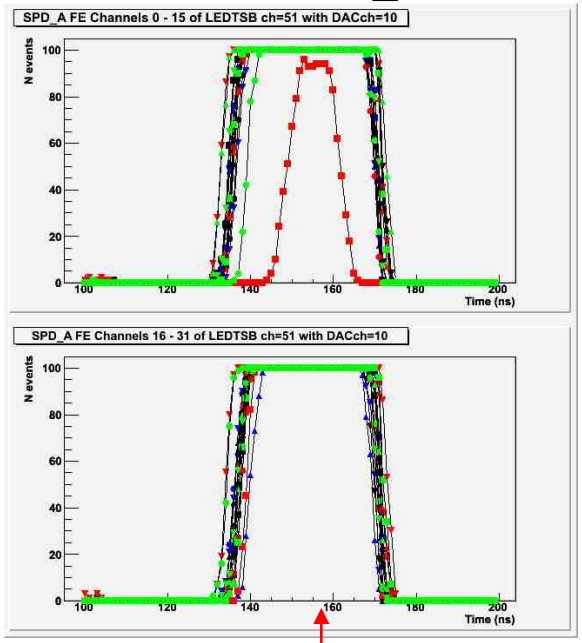
Run 54591 calibr_090817



Shifted signals

182 ns

Run 56569 calibr_090904



157 ns

Problem with calibration signal shift by 25 ns.

Few weeks ago Daniel found problem with LED timing. LED timing scan (run 54591) has been done and it was observed that there is 25 ns timing shift compare with previous runs. Richard and Federico investigated this and told us that they knew about the TFC problem because somebody complained about calibration data shifted by 25ns. Recipe has been corrected and new time scan done (run 56569). PS/SPD timing for LED monitoring is correct now.

Remark: All recipe changes must have a track into logbook.

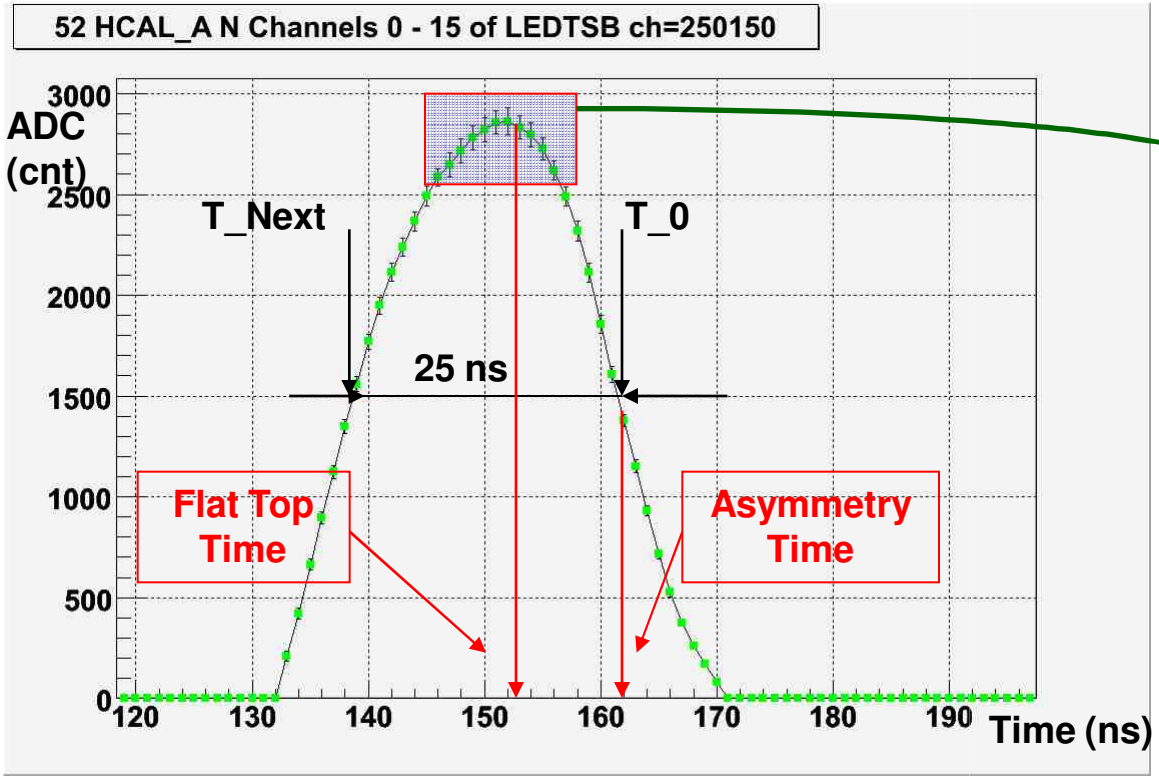
Comparison of the time measurements by two methods

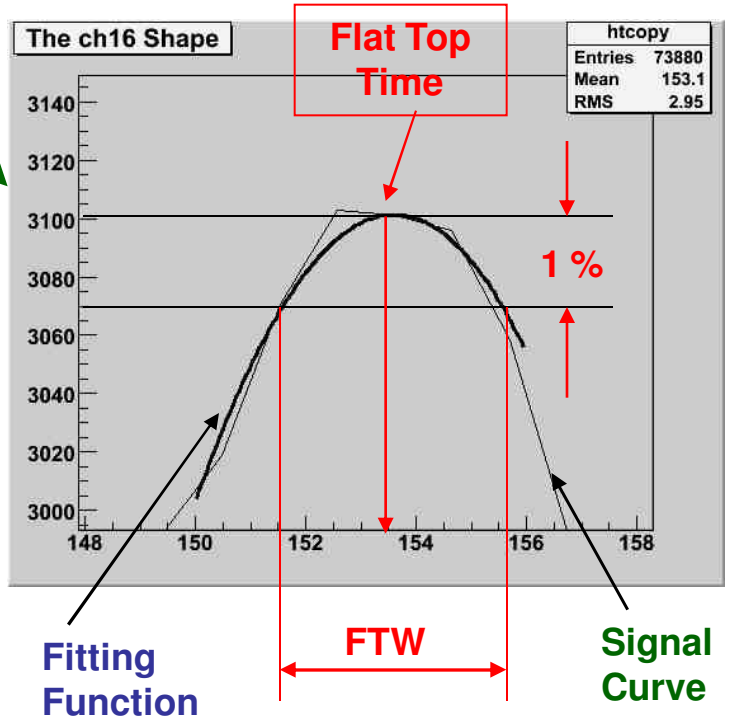
Introduction

The CALO sub-detectors time alignment is performed with using the TAE events and asymmetry calculation for defining with more precision a signal arriving time. For this method an uniform signal shape is assumed. But this is correct with some error, due to a time alignment must be optimized for a flat top of the signals.

An LED timing scan technique allows to measure an optimal time on the top of the signal and simultaneously calculate arrival time with asymmetry method. This allows to make comparison of these methods. Of course a PMT response on LED is a lit bit different then on particle, due to a light shape is defined by LED driver in first case and a WLS fiber decay time in other case (Y11 in CALO).

HCAL LED timing definitions





Signal shape of the FE integrator output

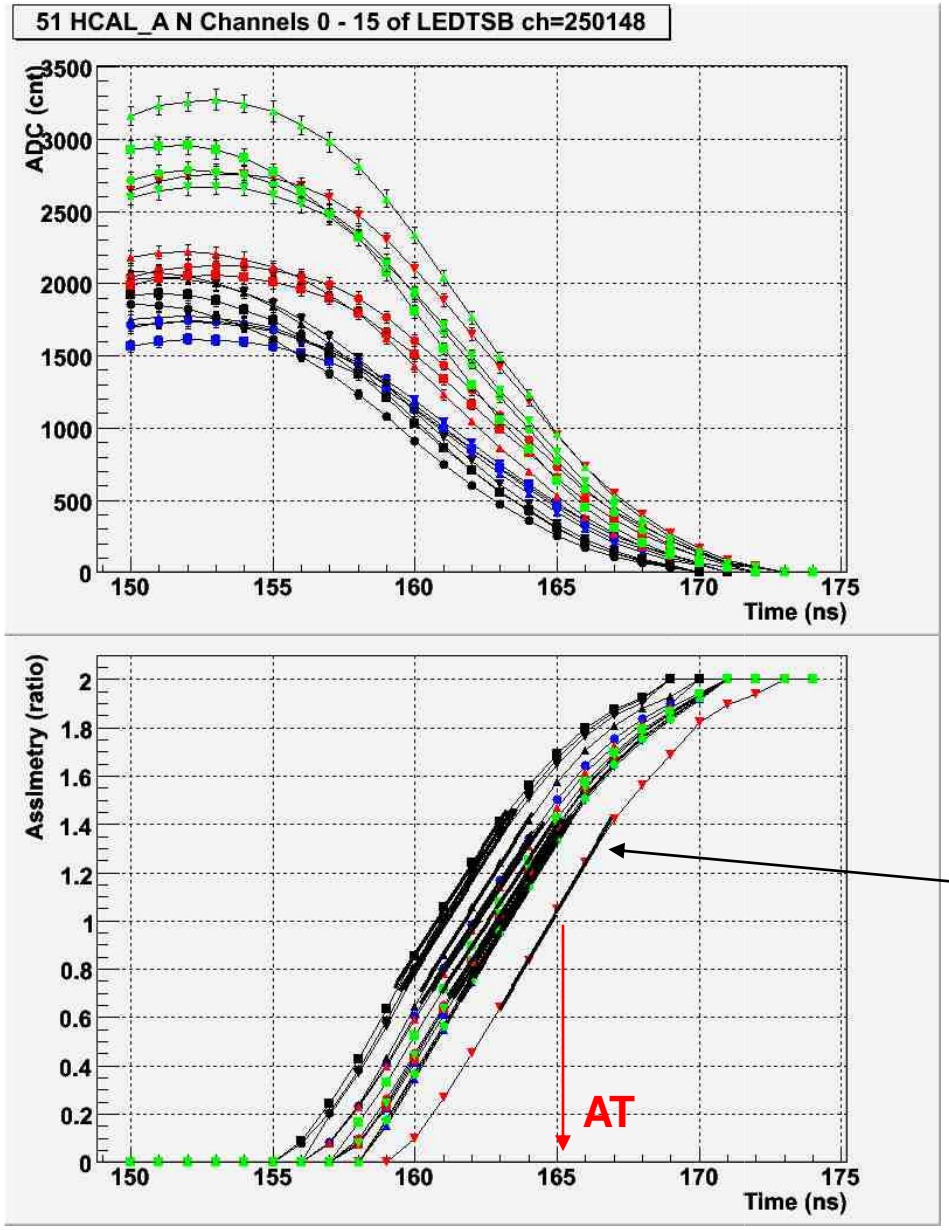
Asymmetry R = (Anext – At0)/(Anext + At0)

Asymmetry Time (AT) is T_0 time, when asymmetry R = 0.

Flat Top Time (FTT) is a maximum of the fitting function;

Flat Top Width (FTW) is a time interval, where a signal change is less then 1 %.

HCAL LED timing



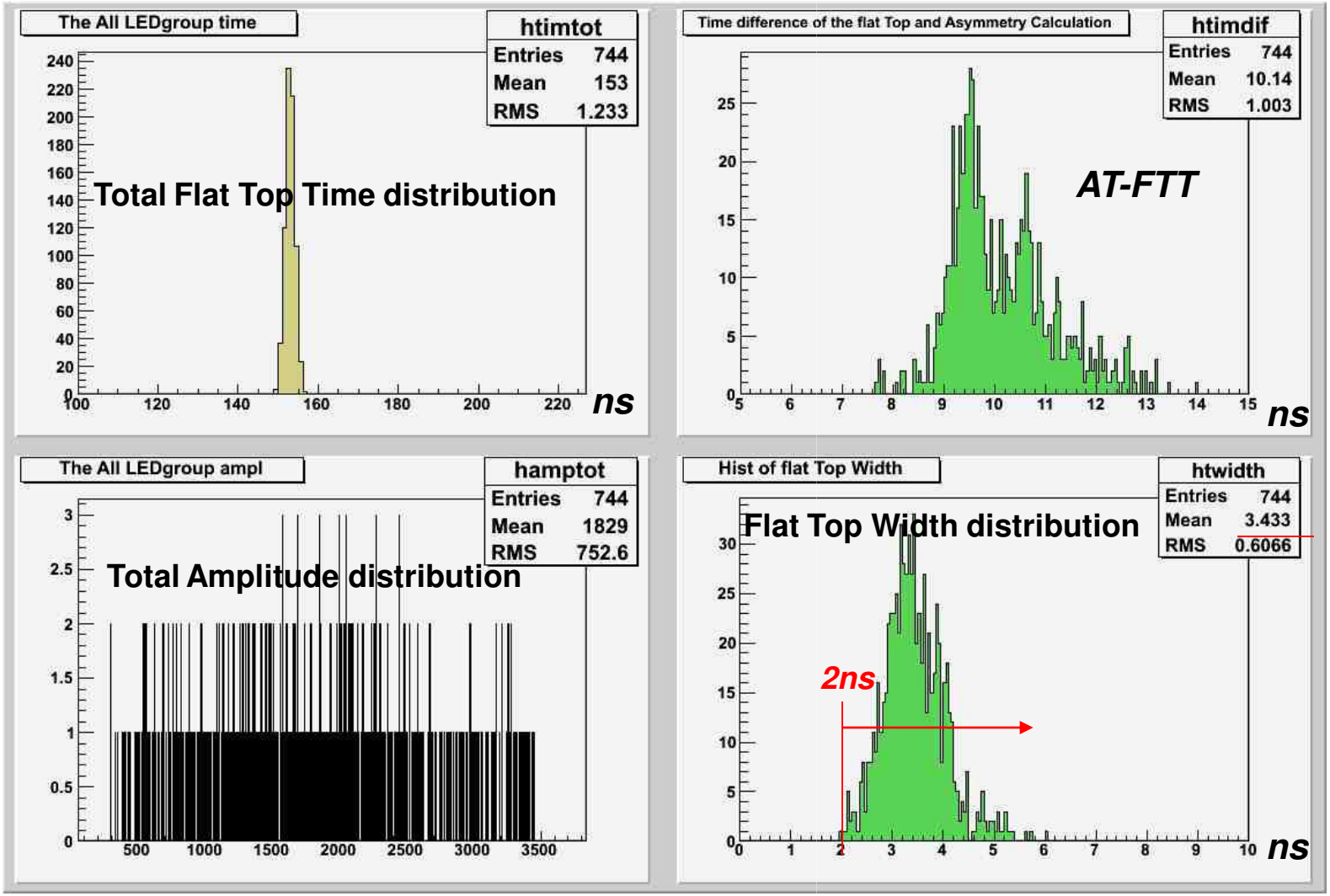
- Analysis has been done for the HCAL LED timing scan data.
- Analysis program produces asymmetry curves, fits them and calculates Asymmetry Time (AT).
- In the same time the Flat Top Time and the Flat Top Width are calculated.
- Next slides show distribution of this values.

Linear fit of the asymmetry curve:

$(R+1) = p0 + p1*t$

HCAL integrator output signal shapes and asymmetry R+1 curves

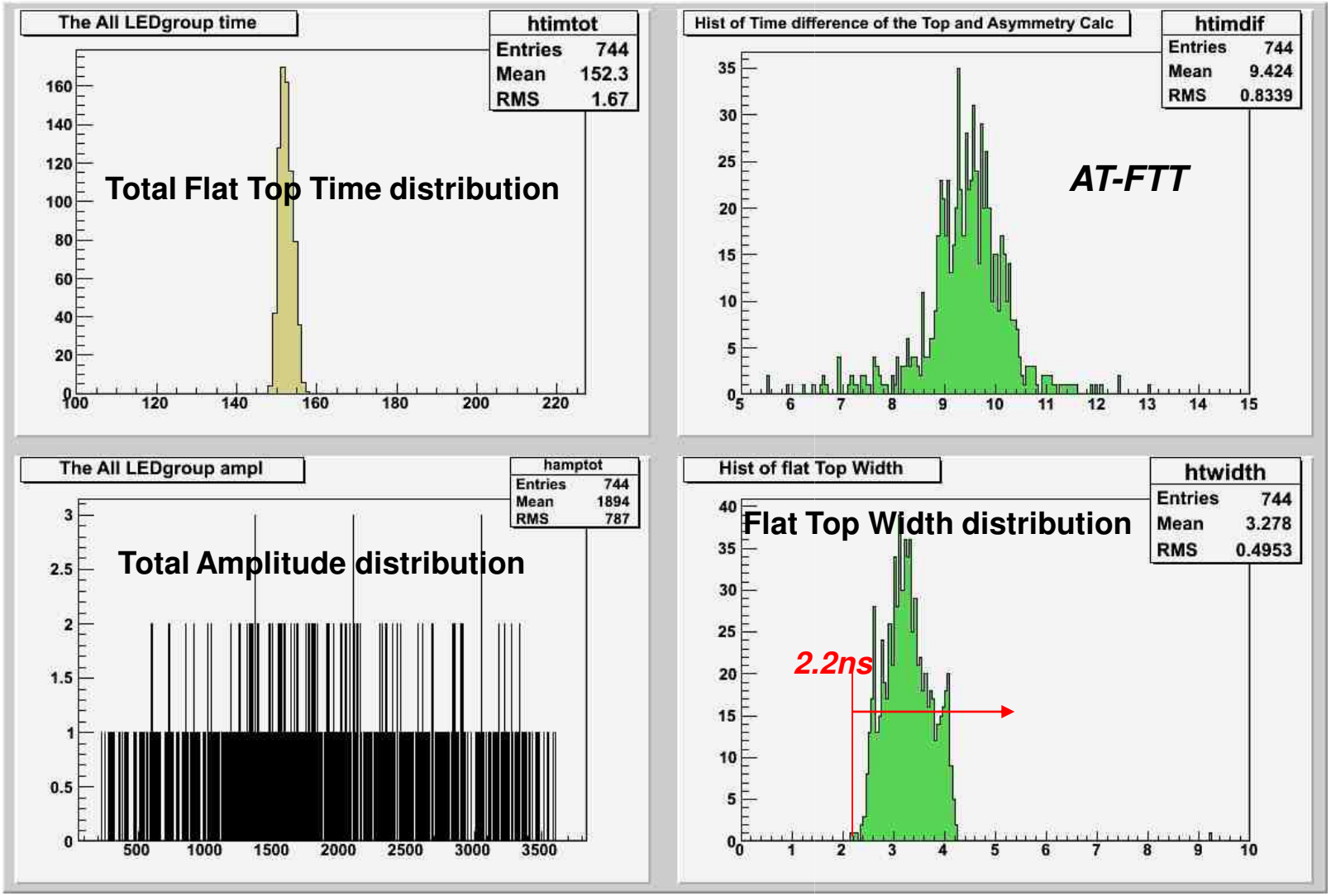
HCAL-A LED timing



RMS of the time difference (AT-FTT) is about 1 ns.

HCAL – A timing and amplitude distributions

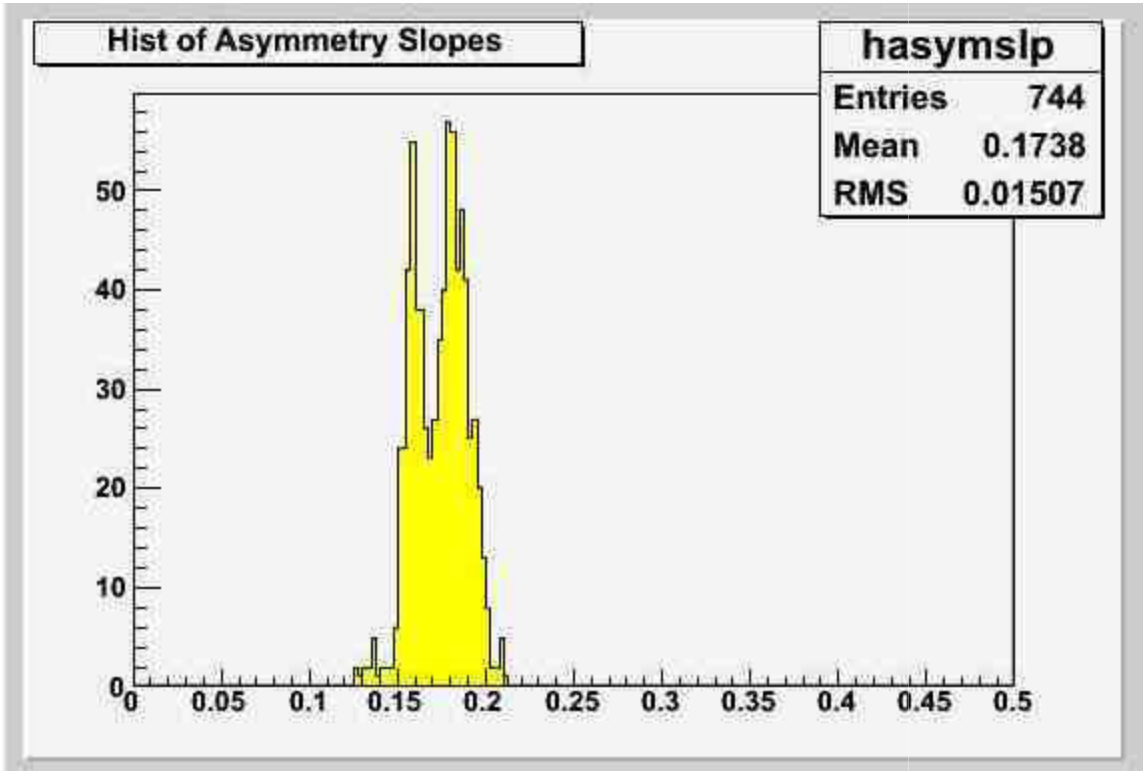
HCAL-C LED timing



RMS of the time difference (AT-FTT) is about 1 ns.

HCAL – C timing and amplitude distributions

XCAL LED timing



RMS of this distribution is about 9 %. This value shows the integrator signal shape uniformity.

HCAL – A asymmetry function parameter p1 (a slope) distribution

XCAL LED timing

Conclusion & Planning

- The LED time scan for estimation a calorimeter sub-detectors LED monitoring quality was done after HV board firmware upgrade. The PHYSICS recipe was used for FE, HV and LED intensity configuration.
  - LED time scan result looks good in general. The LED timing parameters compare with previous measurements are stable and there are only a few ten channels with a strange behavior.
  - Periodical LED time scan data collection for monitoring the LED and HV systems stability will be continued.
- Estimation of the time measurement precision with using the TAE method and flat top time method has been done.
  - For HCAL LED signals the time difference distribution has RMS of about 1 ns. For real particle the RMS will be 2 – 3 times less.
  - The flat top width mean value is about 3.3 ns and minimal width is about 2 ns.
  - May be the similar analysis will be useful and for a next TED run ?