ADC ANALYSIS AND AGING, BCM1F

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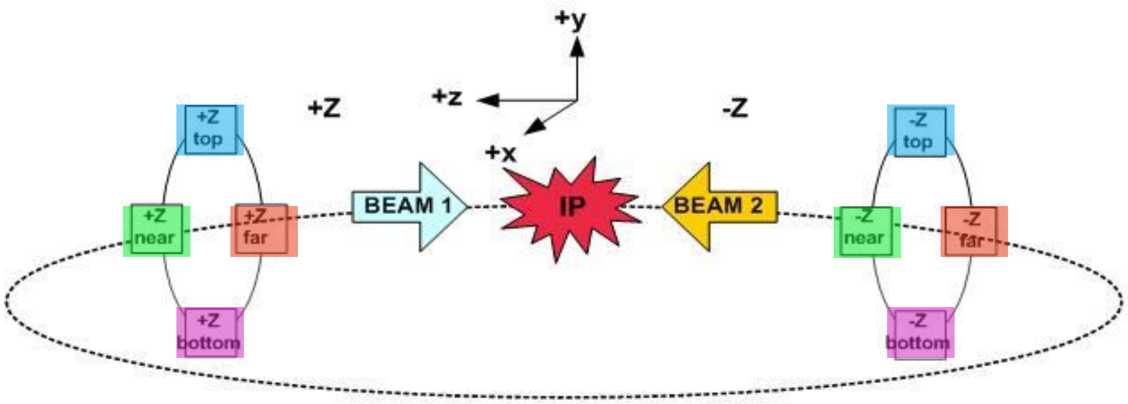


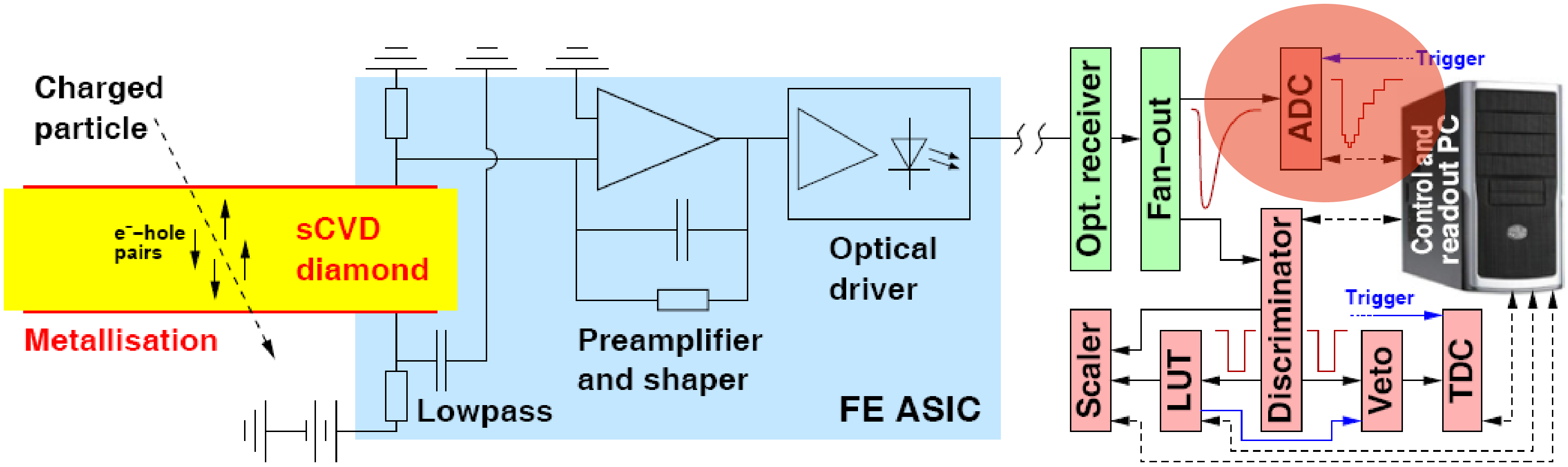
BRM Meeting

Zeuthen

Structure

- Baseline Definition
- Signal Amplitude Spectra
- Baseline Measurements 2011
- Time Arriving Fill Structure (ADC & TDC)
- BCM1F Time Resolution
- Radiation Aging
- Long Signals
- Conclusions

Introduction

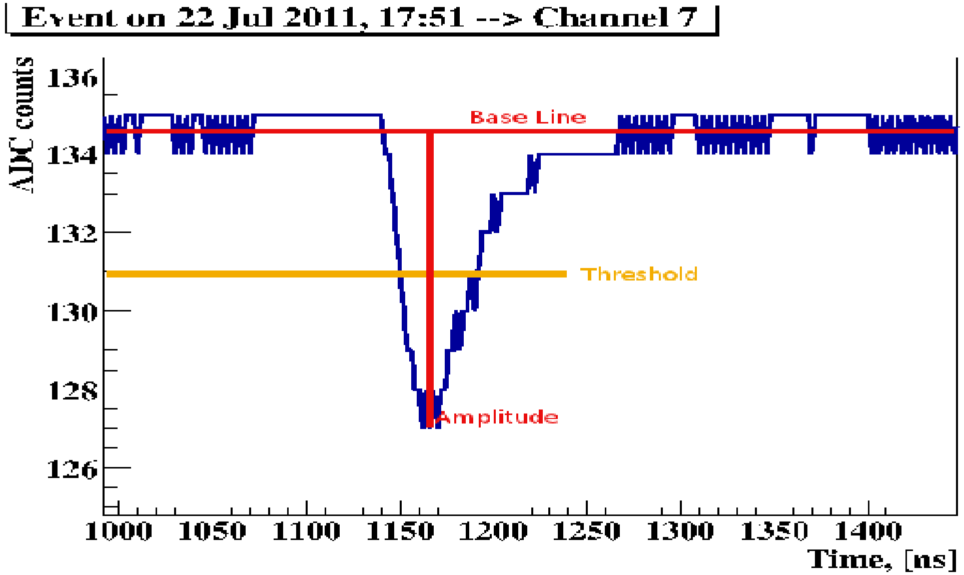


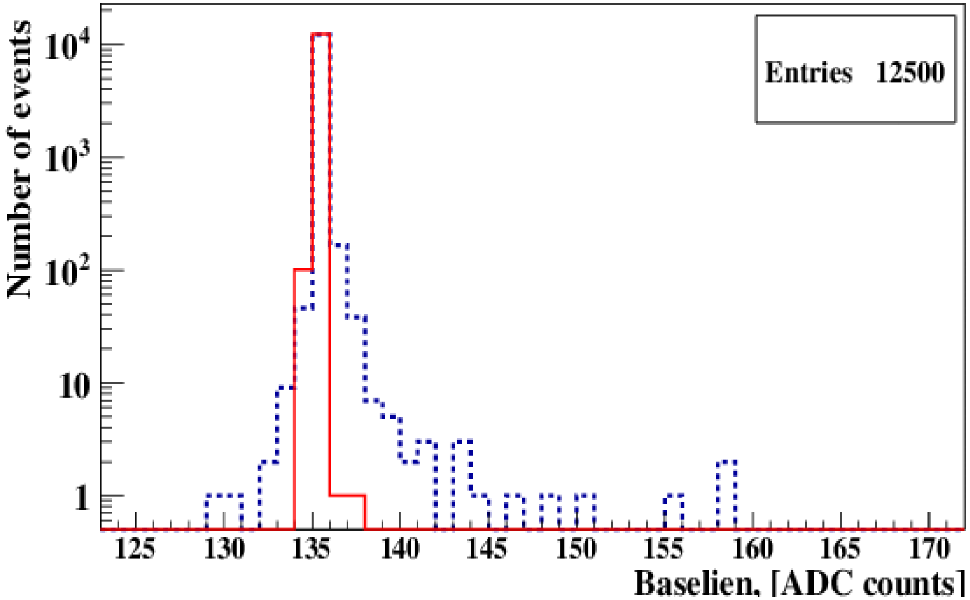
> 8 sCVD diamond sensors of BCM1F - deliver bunch-by-bunch information on both the beam halo and collision products near the beam pipe and close to the IP in CMS.

> Modules (sensor, a pre-amplifier and an optical driver) at 4.5 cm from the beam axis, Z position - 1.8 m on both sides of the IP.

> Allow to measure the flux of beam halo particles as well as of collision products.

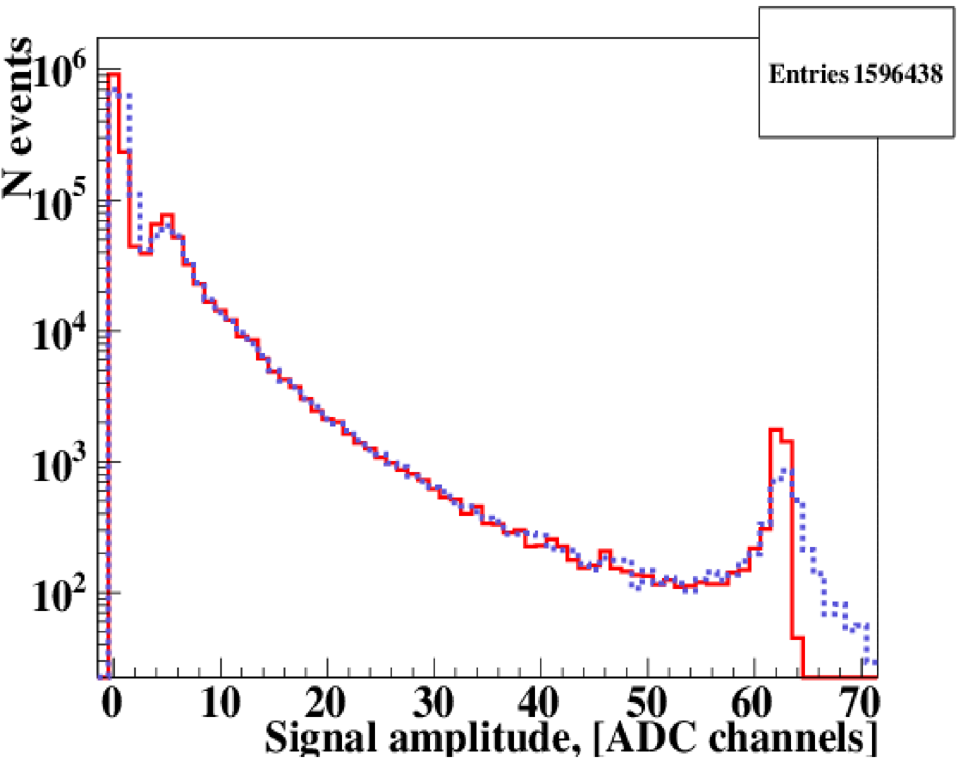
Baseline Calculation

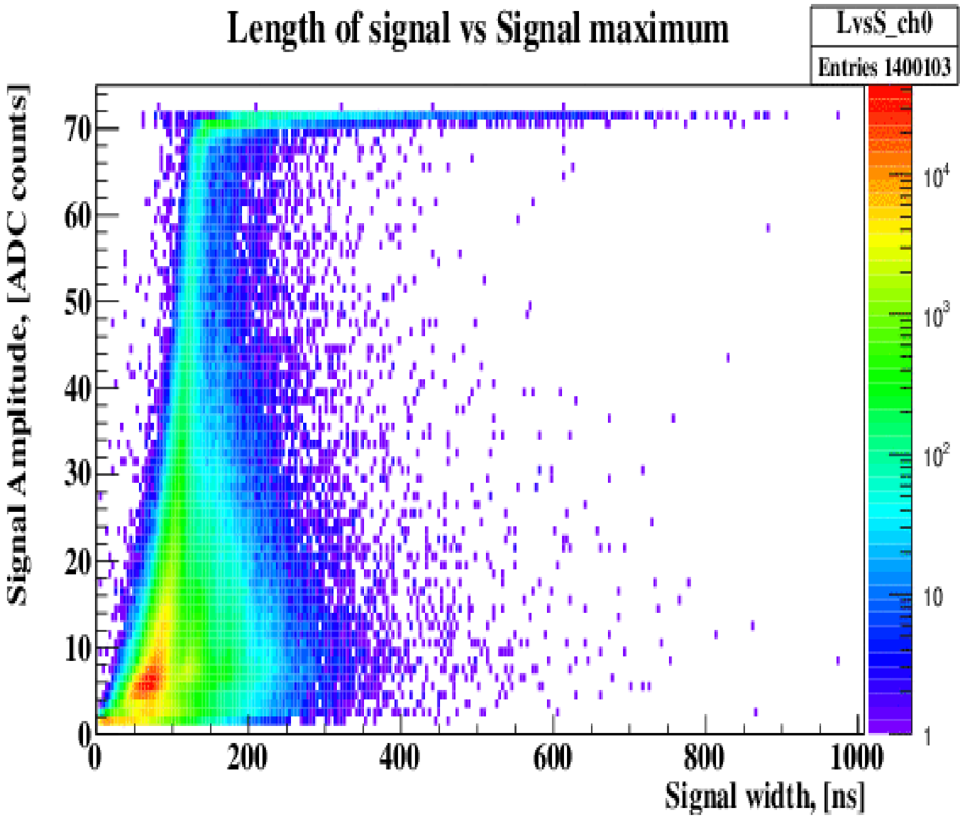




- Flash ADC CAEN v1721 shows signals with 2 ns samples
- Baseline is calculated for each single trigger within abort gap
- Baseline stability shown on the histogram with blue color
- Averaging last 100 baselines for each trigger improves baseline stability – red color
- Threshold can be set differently
  - As used for scalers of BCM1F
  - Constant Fraction Discriminator

Amplitude Spectrum

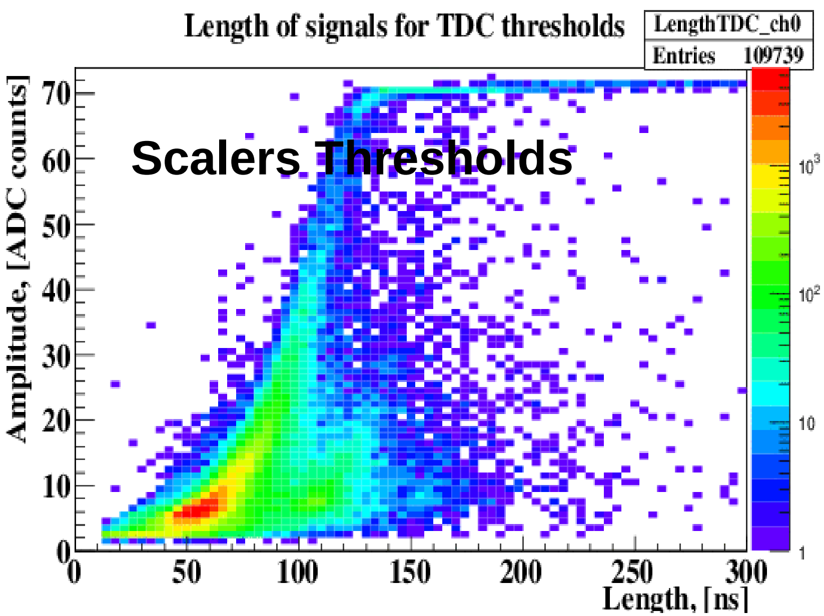


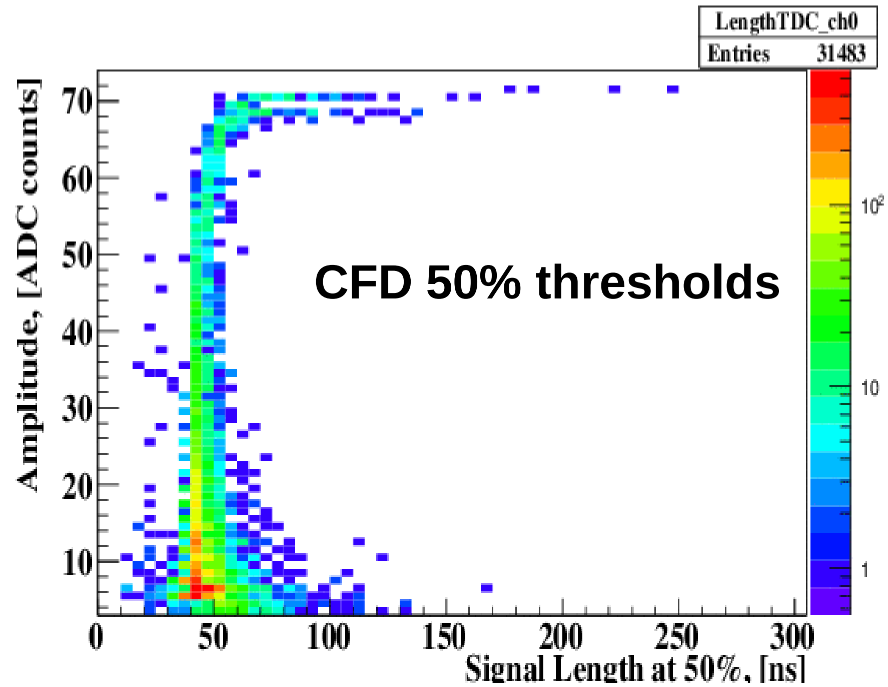


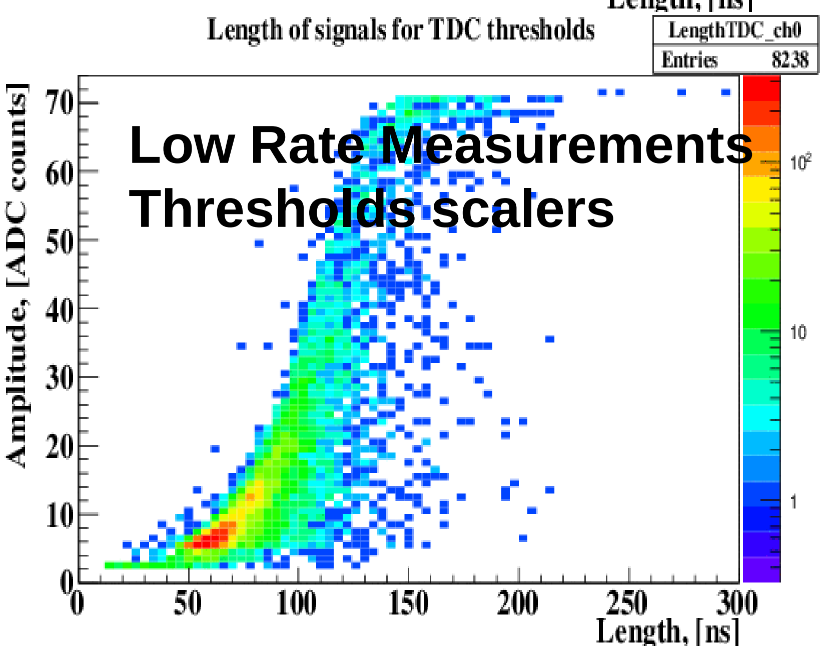
- Baseline stability is important for amplitude calculations
- Blue – single baseline determination
- Red – 100 BL averaging
- Improves pedestal & saturation peak

- Length of signal over threshold as a function of signal amplitude.
- Most of long signals are in saturation
- Low threshold 0.1 ADC counts leads to overlapping of signals and shows double and triple peaks

Signal Amplitude vs. Signal Length



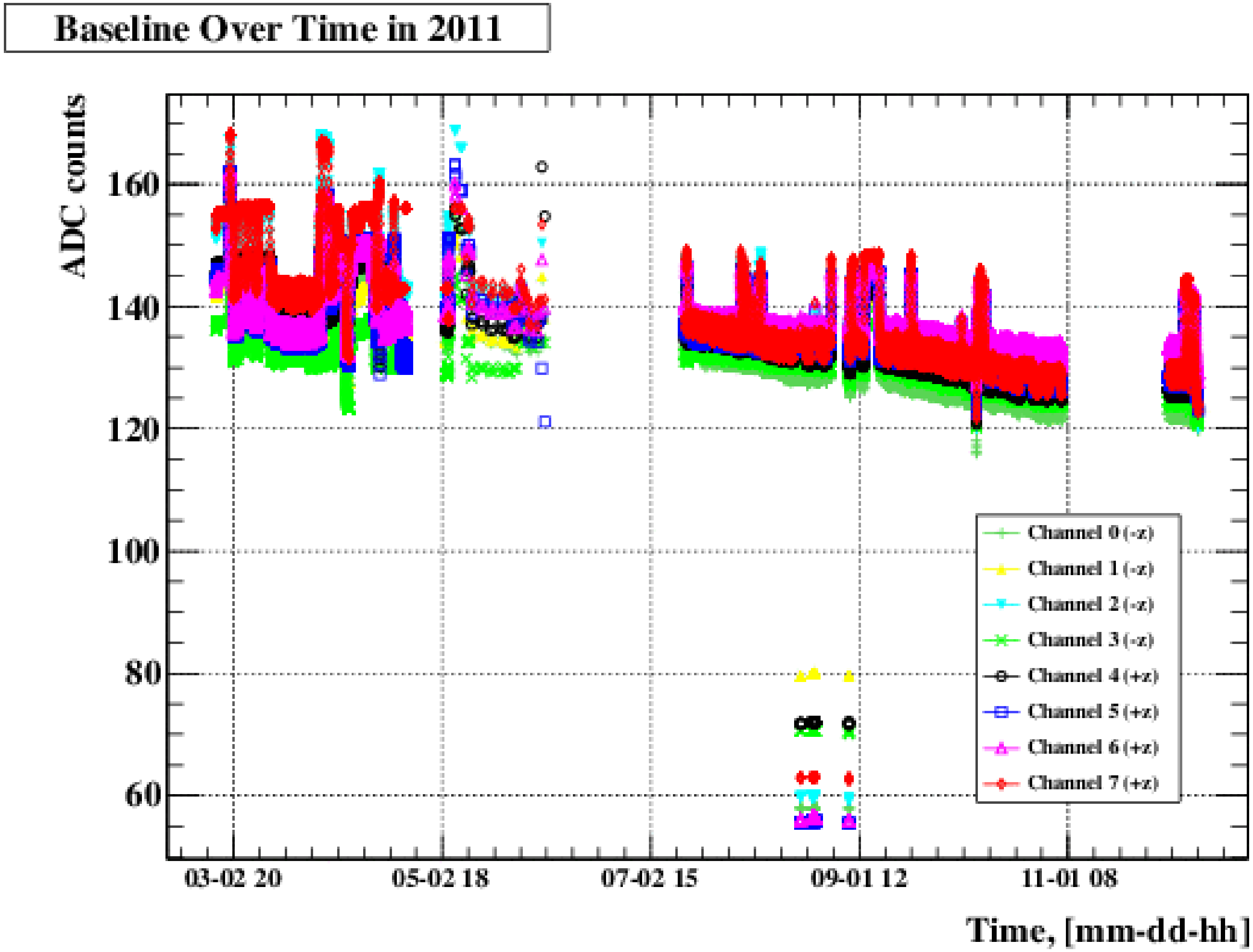




➢By setting fixed threshold arriving time distribution has a jitter

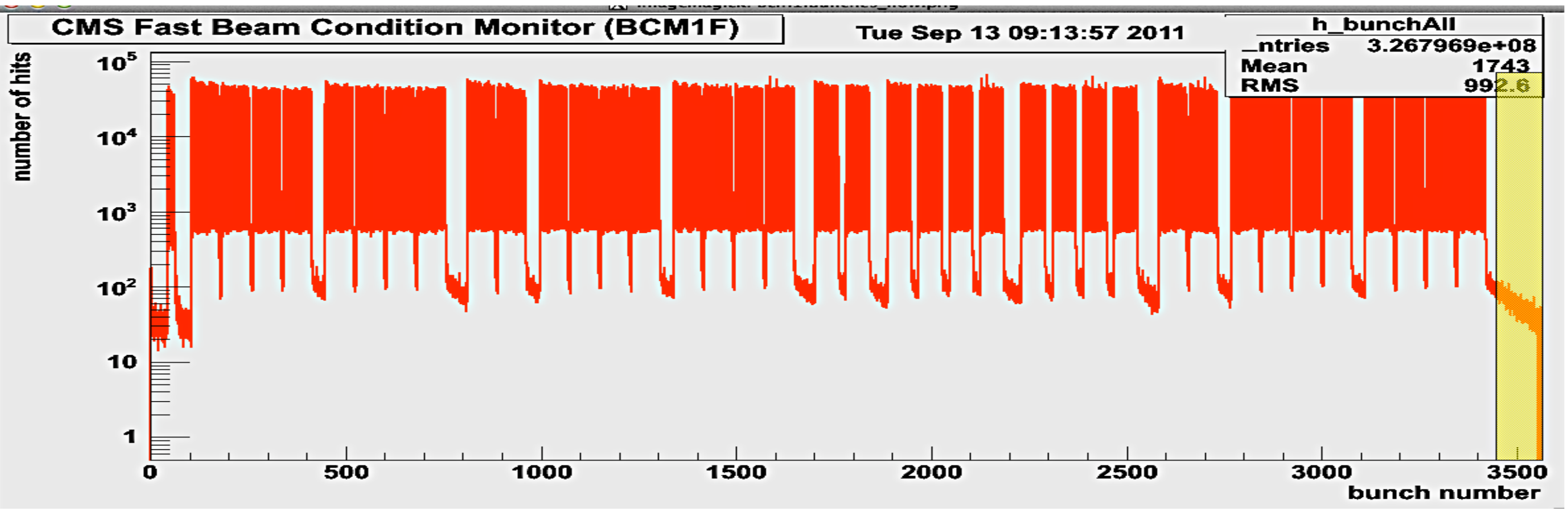
➢Constant Fraction Discrimination – CFD Time over threshold ~40ns for 50% of amplitude.

Baseline Tool

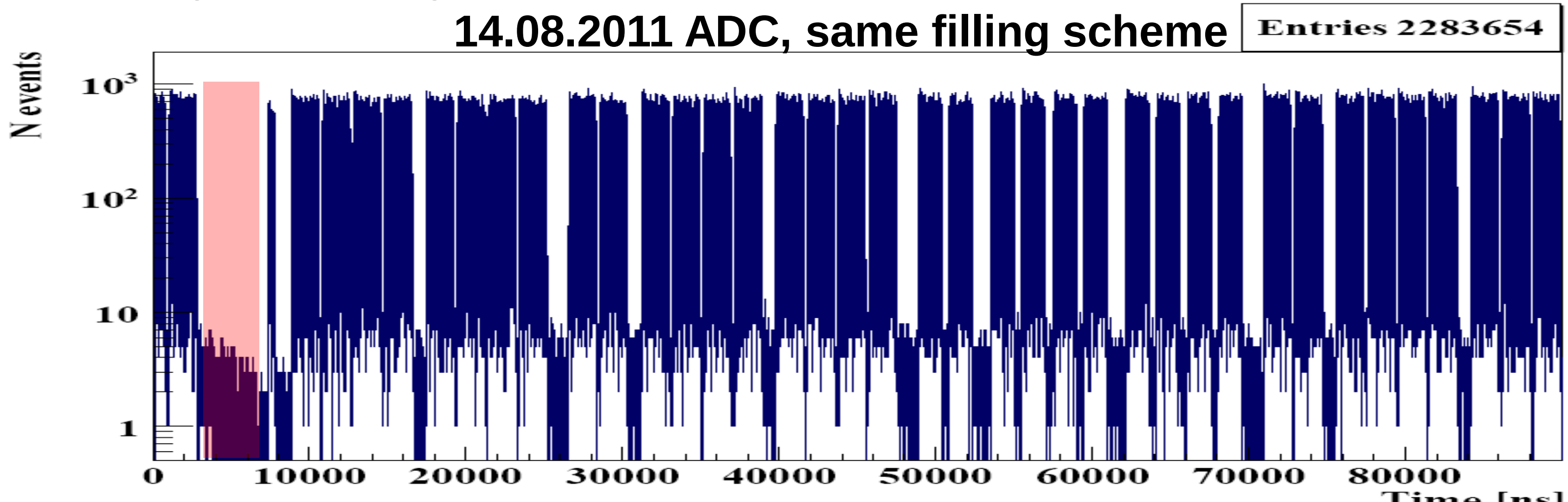


- ➢ Full 2011 baseline tool for BCM1F was operated
- ➢ BL Tool is sensitive for temperature and collisions
- ➢ BL moved down in ~10ADC counts
- ➢ Low values are corresponding switched off HV and LV

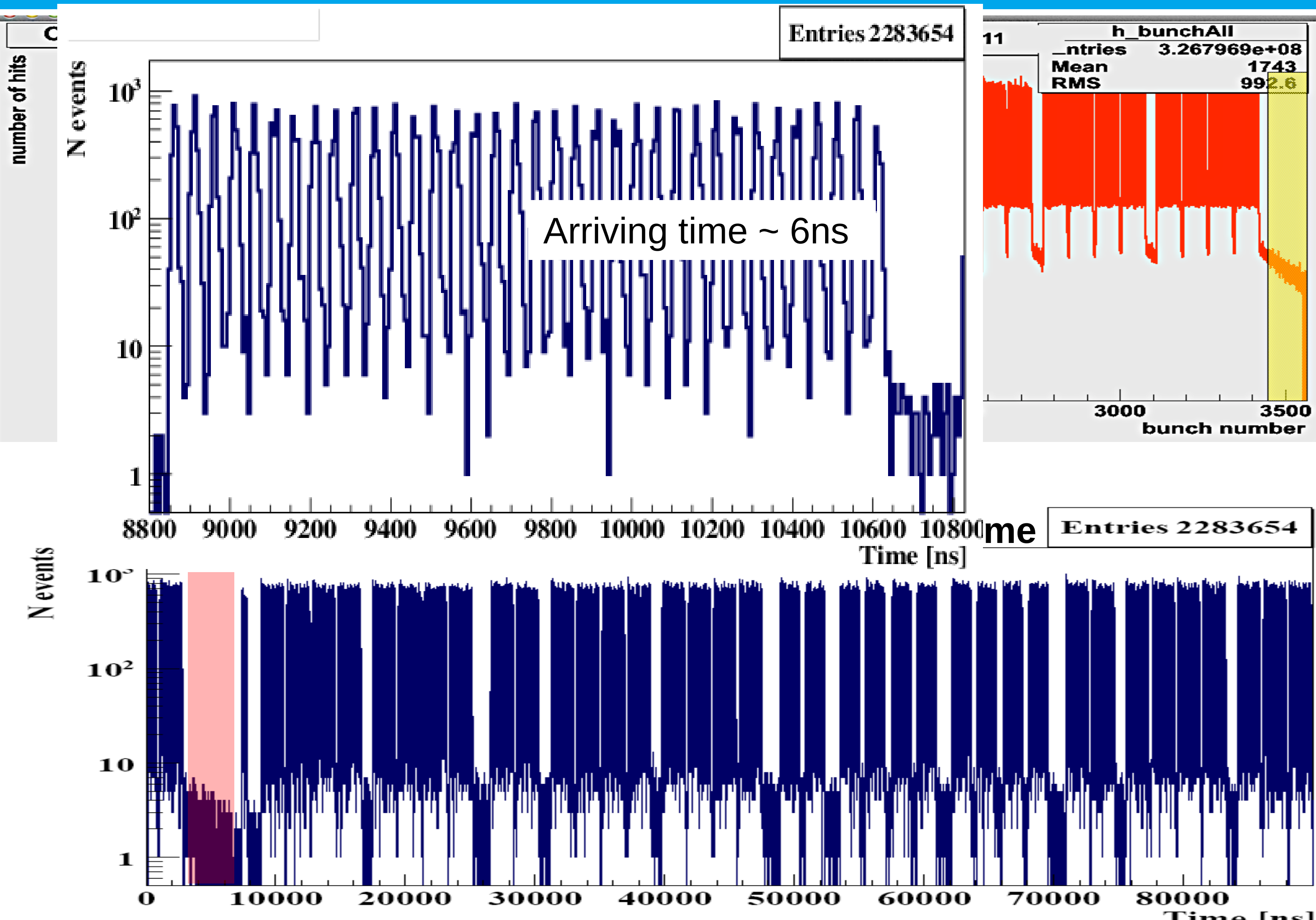
Bunch structure repetition as in TDC



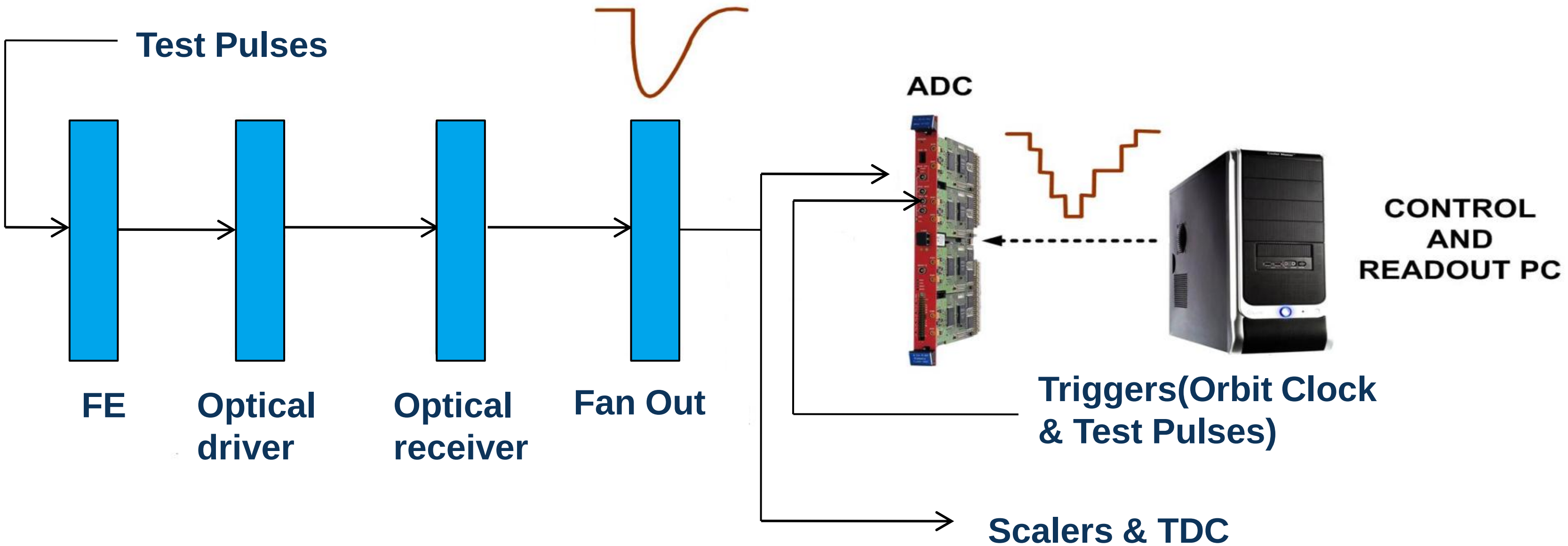
Finding of ADC signals with fixed threshold



Bunch structure repetition as in TDC



Time Resolution by BCM1F ADC module



- Time Resolution Measurements with test pulses:
- TP feed to FE-electronics of all modules and measured by ADC
- Trigger for ADC can be TP or orbit clock
- For Intrinsic Time Resolution with TP, one TP is plugged to ADC directly

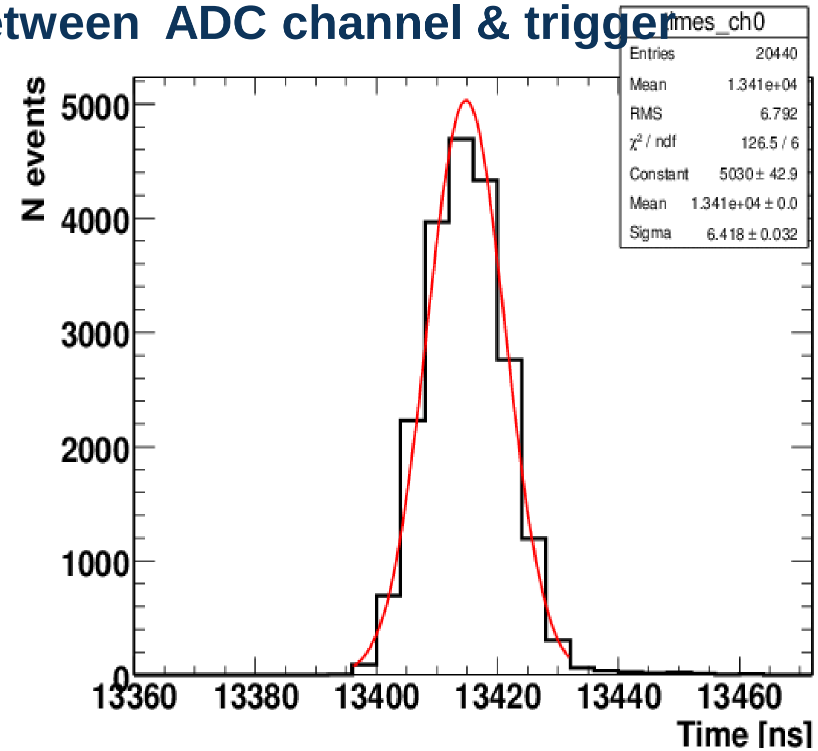
Time Resolution with Test Pulses

Arriving Time Distribution – in respect to ADC trigger (Test pulses were feed to ADC trigger in and 1ADC channel)

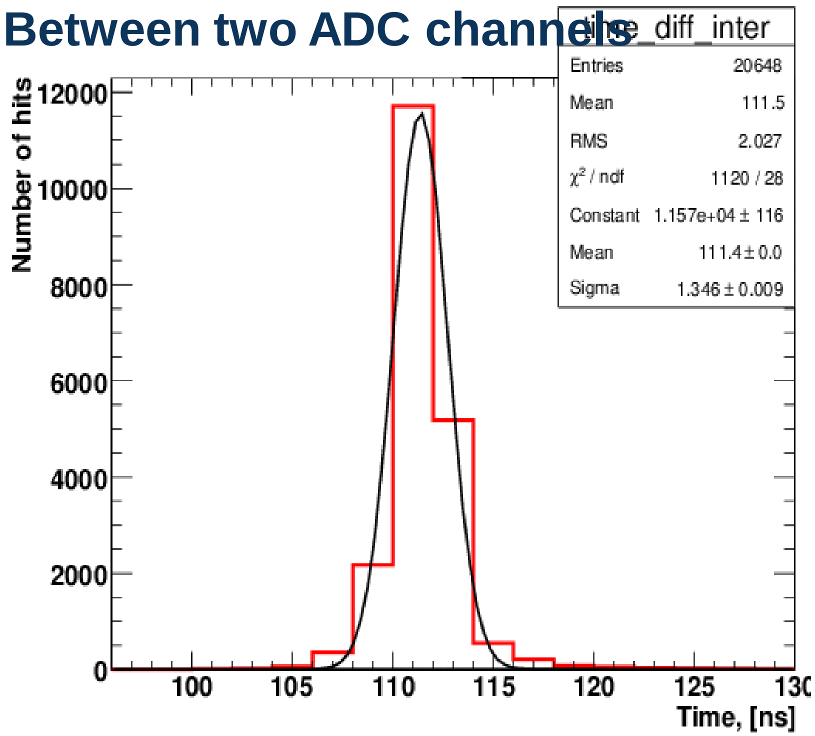
Intrinsic Time Resolution – two ADC channels in respect to each other (Test pulses were feed to 2ADC channels)

Jitter due to ADC trigger chock – can be up to 16 ns

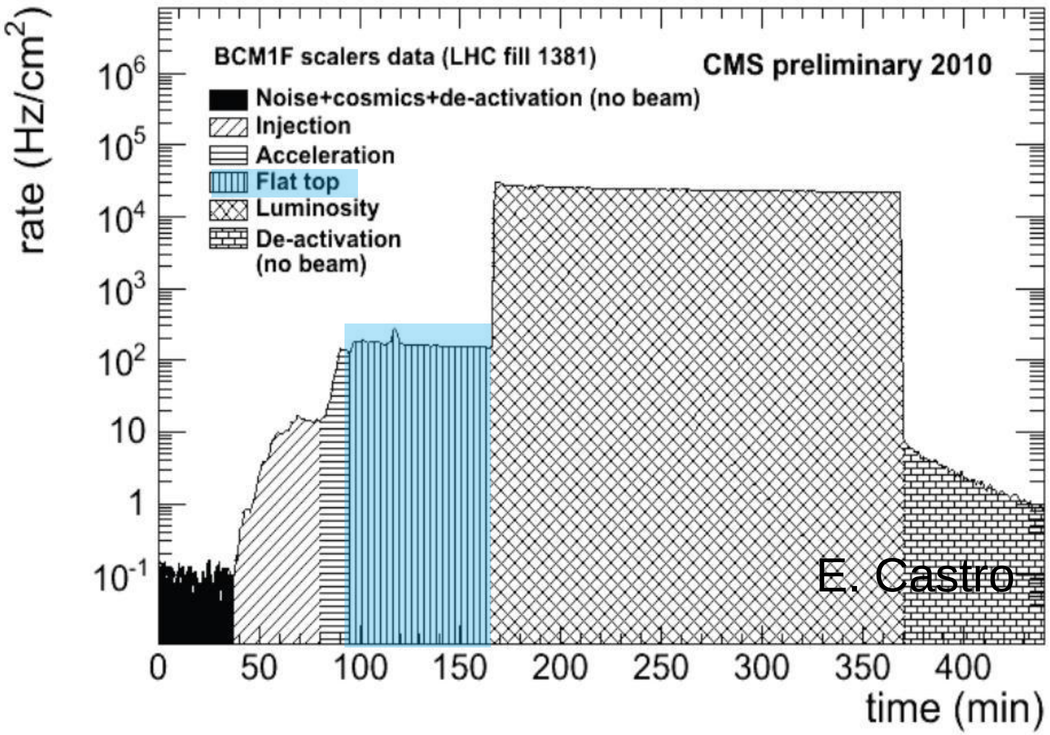
Between ADC channel & trigger

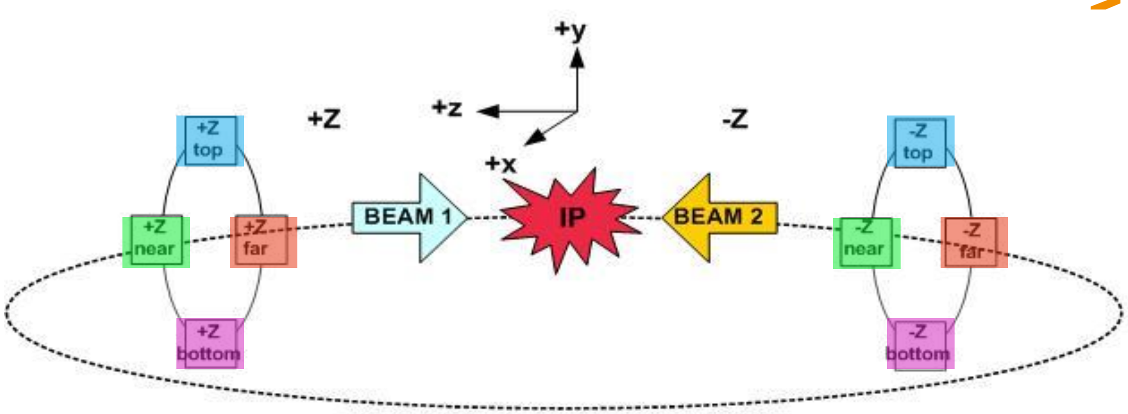


Between two ADC channels



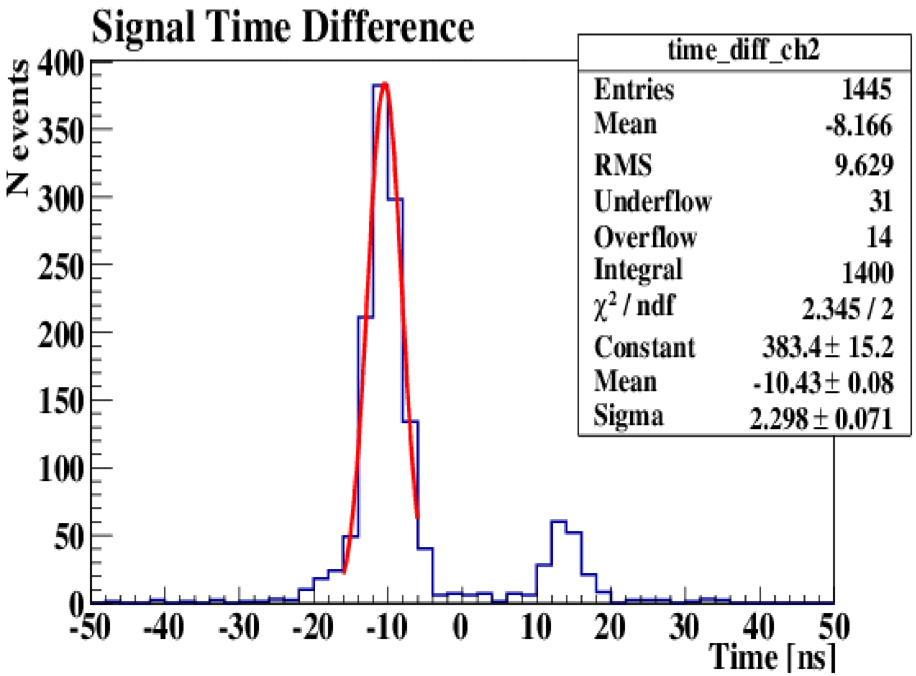
LHC Operating Stages by BCM1F

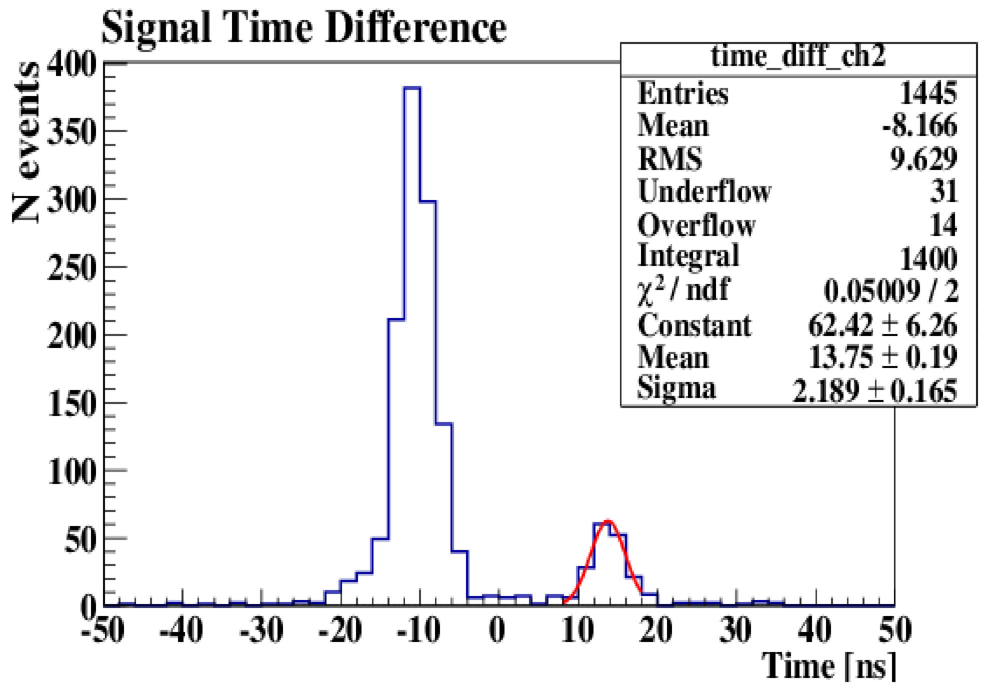




- Hit rate with the scalers during an LHC fill. Different steps of the fill are well characterized.
- Flat top – stage after injection and acceleration and before squeezing (collisions) → No collision products.
- Flat top operating step was used for measuring halo particles by ADC.

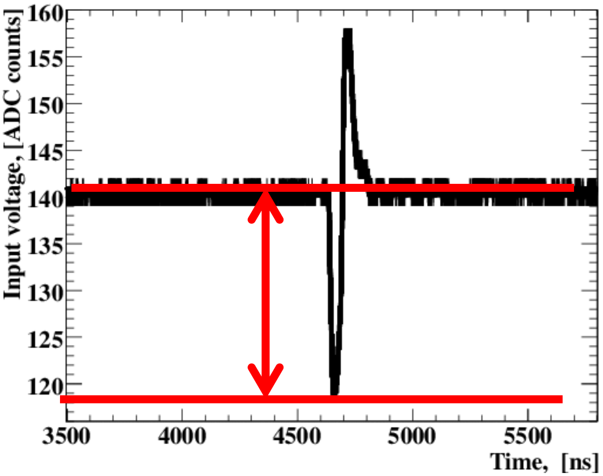
Intrinsic Time Resolution, CFD FlatTop measurements



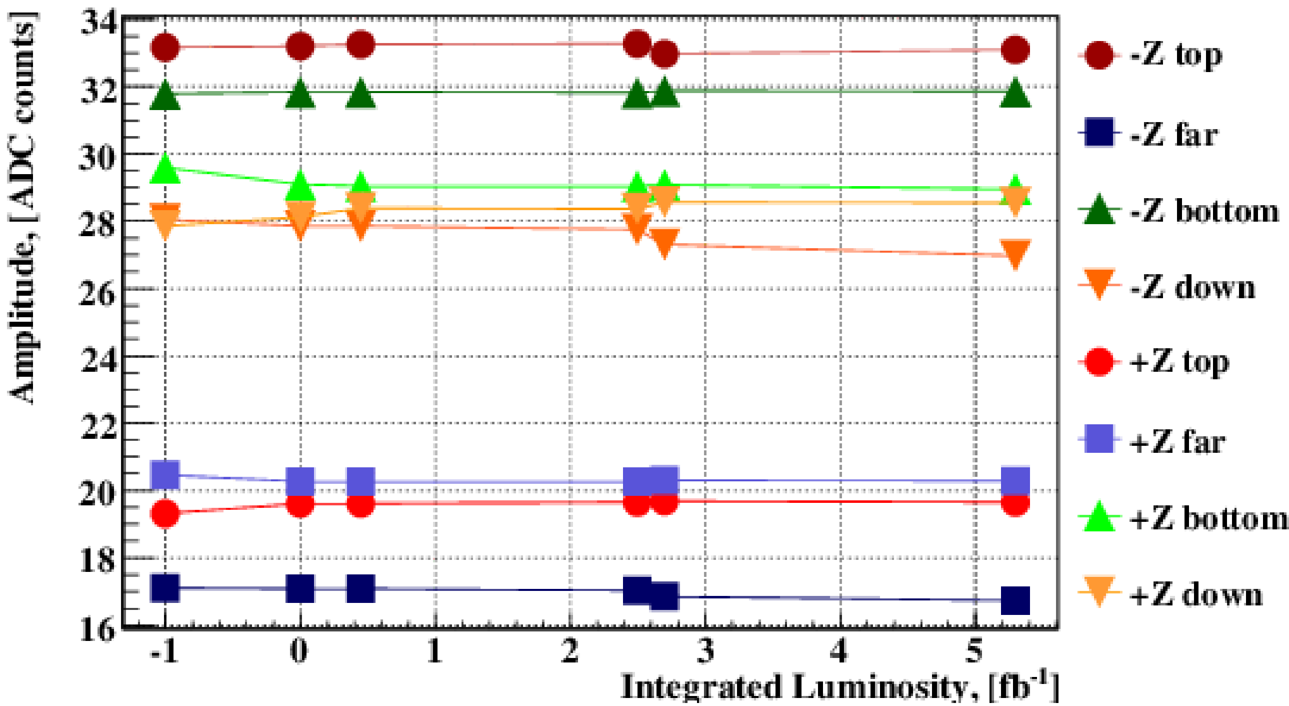


Over several Fills at Flat Top stage ADC data was recorded
Coincidence of two signals in two ADC channels are taken
Time over threshold is calculated as 50% of amplitude with CFD method
Difference between cannel ~12 ns
Sigma = 2.18±0.16, ITR = $\sigma/\sqrt{2}$ = 1,54 ns
Previous result was 1,8 ns (Ringo Schmidt 2009)

Test Pulses Monitoring



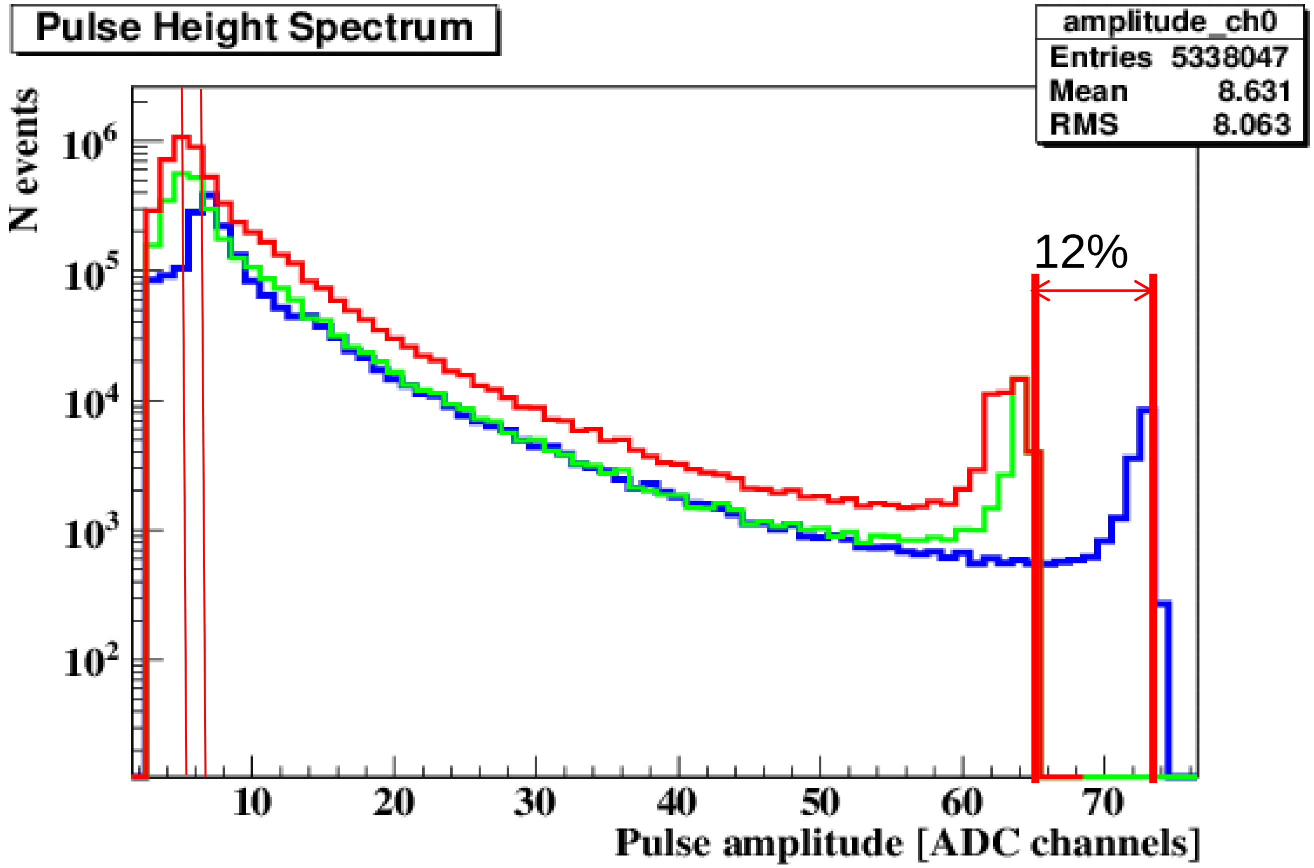
Example of test pulse



- Over 2011 test pulses measurements were done regularly to monitor FE-electronics degradation

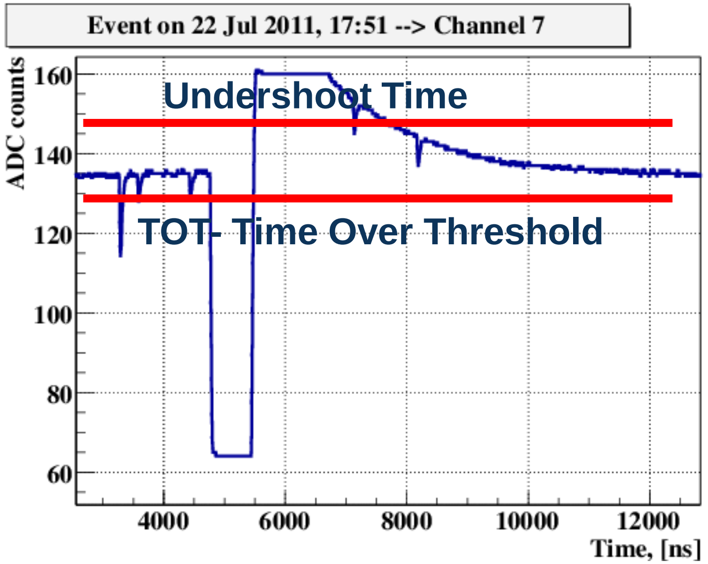
- Dependence of test pulses amplitude in respect to baseline shown as a function of integrated luminosity. -1 point shows values of test pulses amplitudes measured in 2009.

Aging

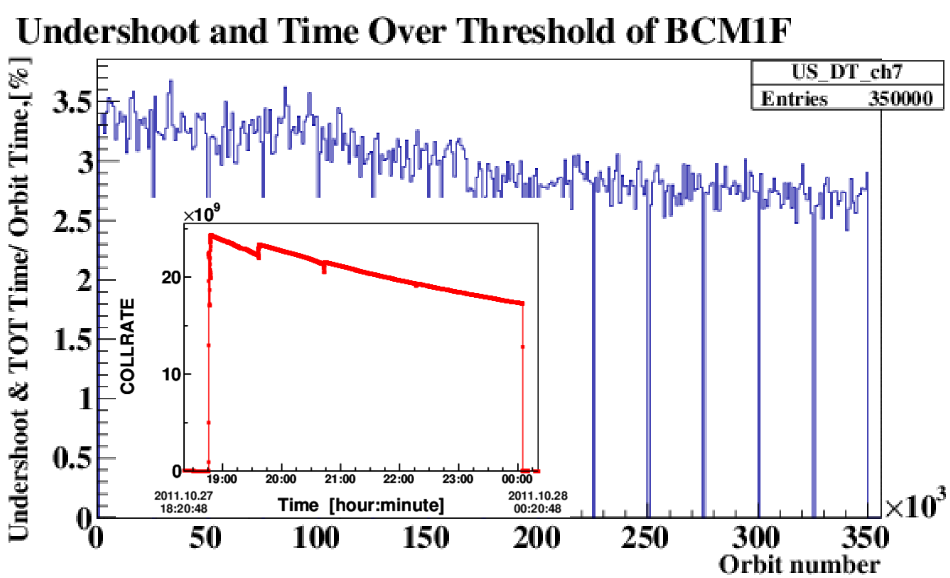


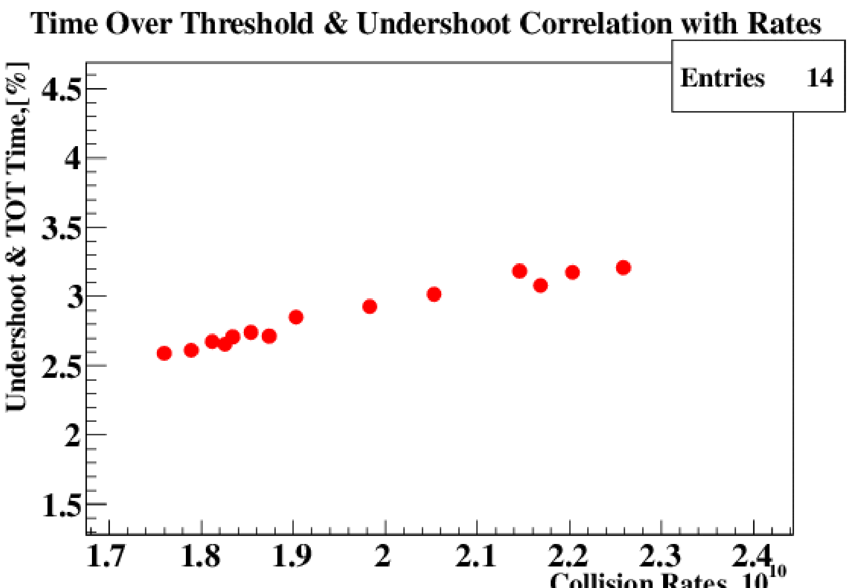
- Take spectra over half year (May, October, November)
- Shift in Saturation peak in 12%
- MIP peak shift depend on fitting 10-20%

Time Over Threshold & Undershoot Time



- ➢Proton Fill 2261
- ➢TDC thresholds to calculate time over threshold
- ➢For undershoot – BL – MIP signals
- ➢14 files over one fill were measured with ADC
- ➢First undershoot time and TOT were correlated with collision rates from LHC



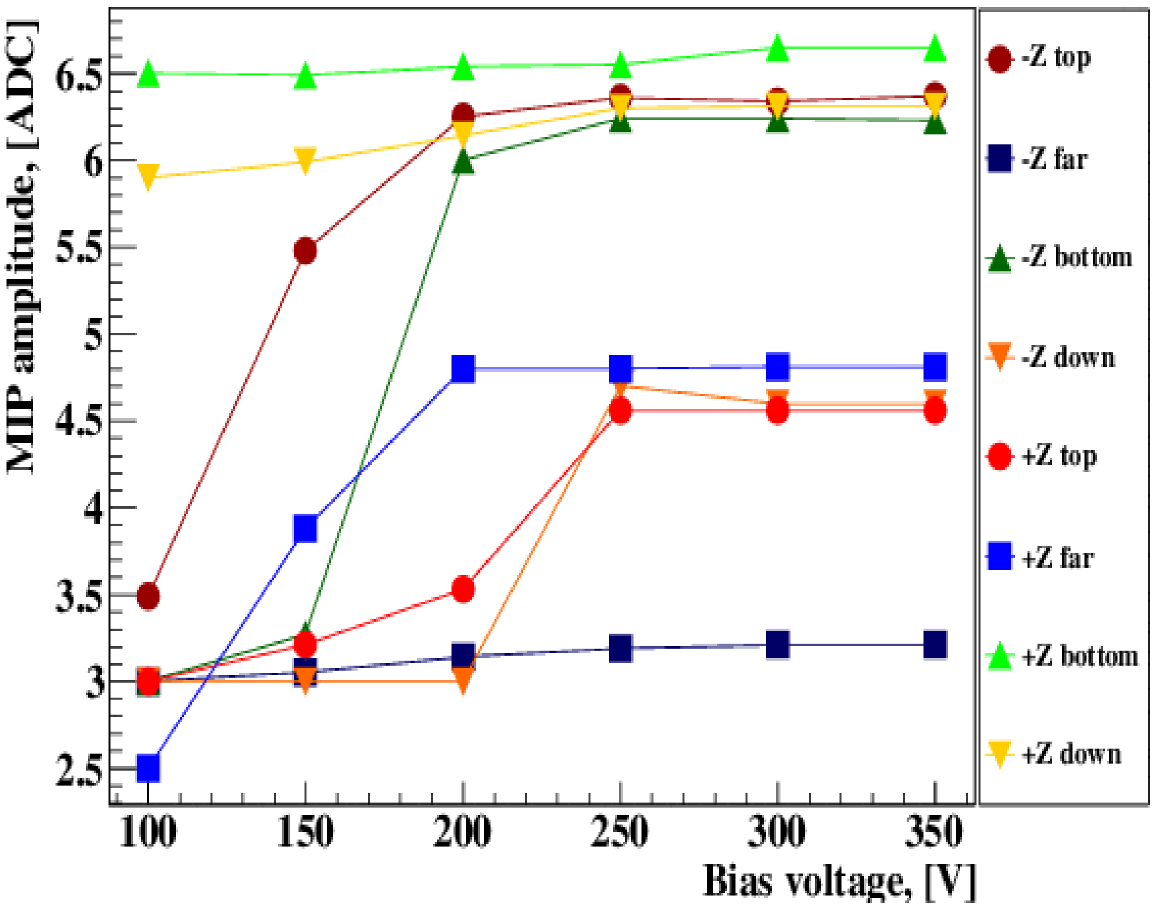


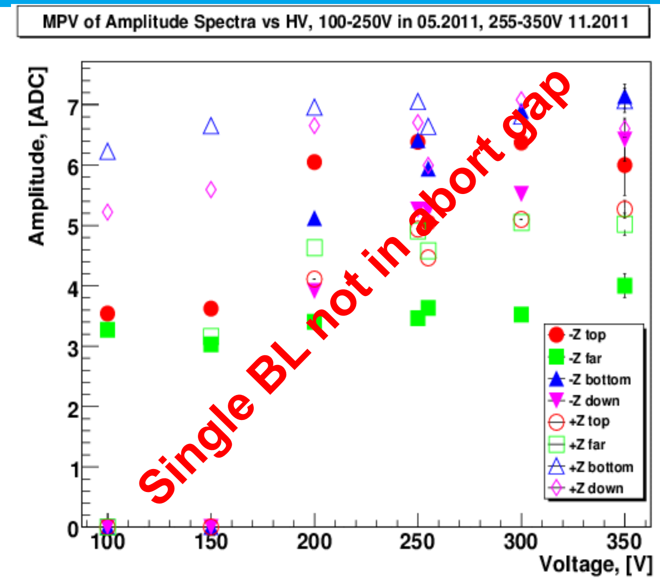
Conclusions

- ADC is a perfect tool for BCM1F characterization
- Allows to see Amplitude Spectra (MIP peaks, Saturation peaks, Separation between noise and signals)
- Baseline stability is important
- Repeats time arriving distribution as by TDC
- Arriving time distribution ~ 6 ns
- Intrinsic Time Resolution ~ 1,5 ns
- Aging in FE electronics is observed and will be defined better for new BL method
- Time when BCM1F is not recording signals correlates to collision rates

Thank You!

HV scan for BCM1F





- HV scan was made in May and November 2011
- BL stability affect MIP definition

- Problems with Landau fitting at low voltages
- In saturation for most of modules after 200V