University of Texas, Arlington, TX, USA, September 14 - 16, 2016

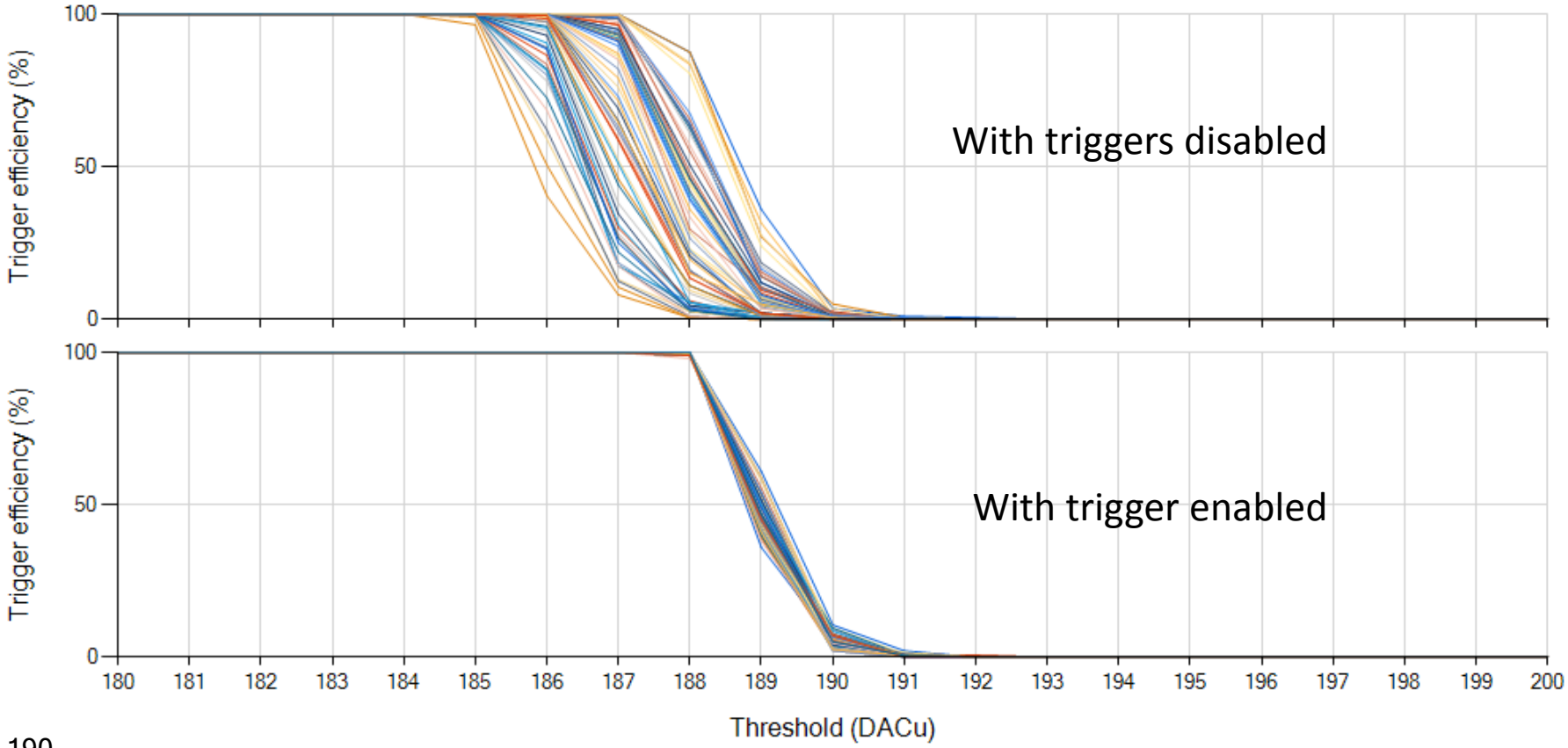
About (digital ?) noise and Scurves

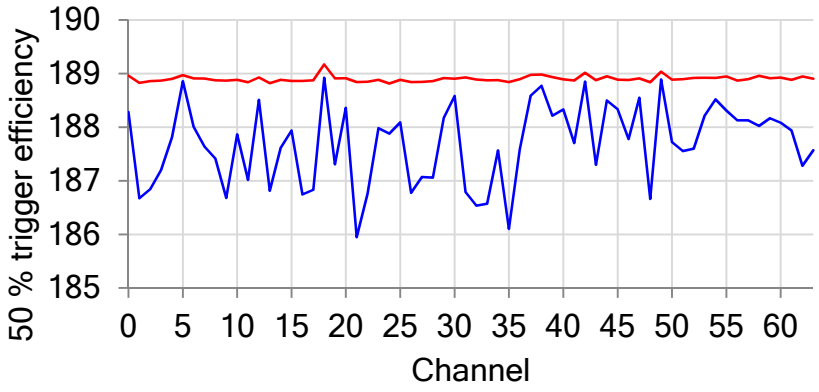
Jean-Baptiste CIZEL

Rémi CORNAT

Scurves with or w/o enabling trigger

⇨ Shift of the S-curves position (Omega testboard measurement)



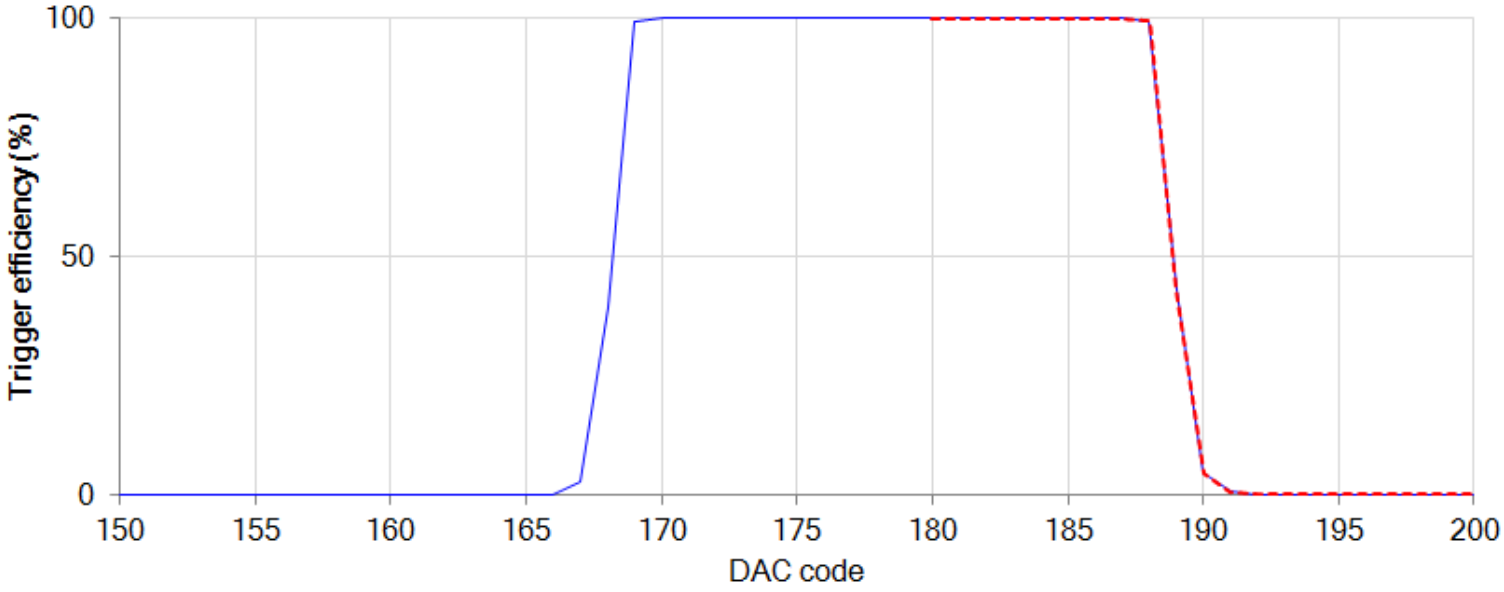


Gathering information on noise and pedestal of a single channel requires to mask the others but transposition to reality (max. nb. of chn. enabled) is difficult.

Plots : courtesy of Jean-Baptiste CIZEL

Modeling Scurves

« Real » pedestal S-curve (blue) & model (red) from which can be extracted the noise and the pedestal position (Measured on Omega testboard)



$$S(x) = 0{,}5\left(1 - \mathrm{erf}\left(\frac{|x-\mu|}{\sigma\sqrt{2}}\right)\right)$$

With :

- μ the pedestal's position
- σ the RMS noise

$$P(x) = 1 - (1 - S(x))^N$$

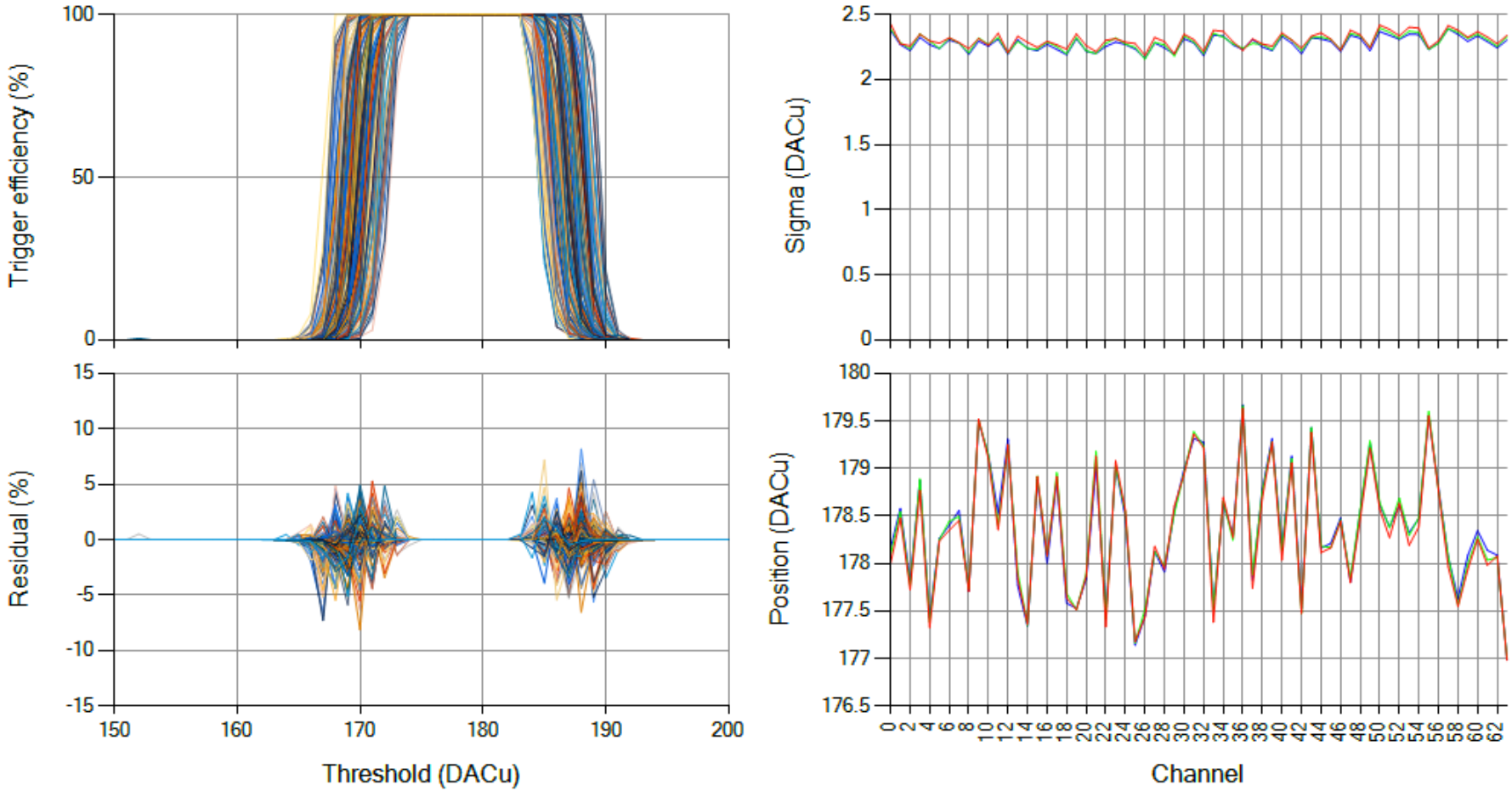
Probability to have at least 1 triggers in N pseudo events

$$using\ N = 2 \times f_c \times t_{acq}$$

With :

- f_c the central frequency of the shaper
- t_{acq} the acquisition time

Courtesy of Jean-Baptiste CIZEL



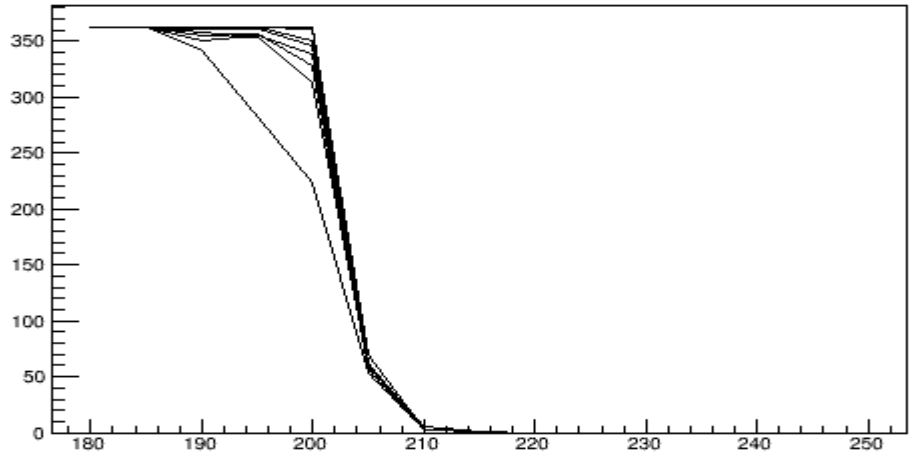
S-curves on pedestals with $C_f = C_{comp} = 6$ pF (test board) for 3 acquisition times :

- 100 µs (red) ;
- 1 ms (green) ;
- 10 ms (blue).

Courtesy of Jean-Baptiste CIZEL

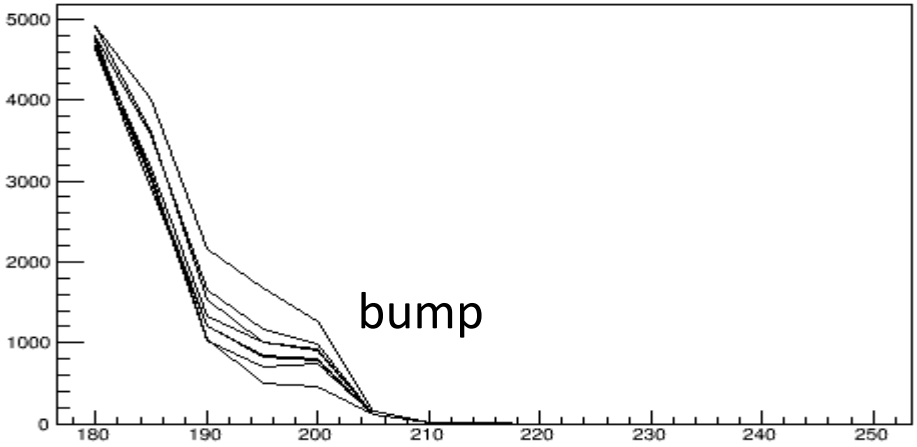
BUT: Data from FEV11, 8 triggers enabled

Counting any number of triggers (hits) in a spill as ‘1’ (OMEGA method as used for test board+labview)
Max scale = number of spills



Same exp. data

Counting total number of hits for the whole acquisition (with saturation at 15 per spill)
Max scale = 15*nb of spills



1st method make an artificial zoom on the « bump »

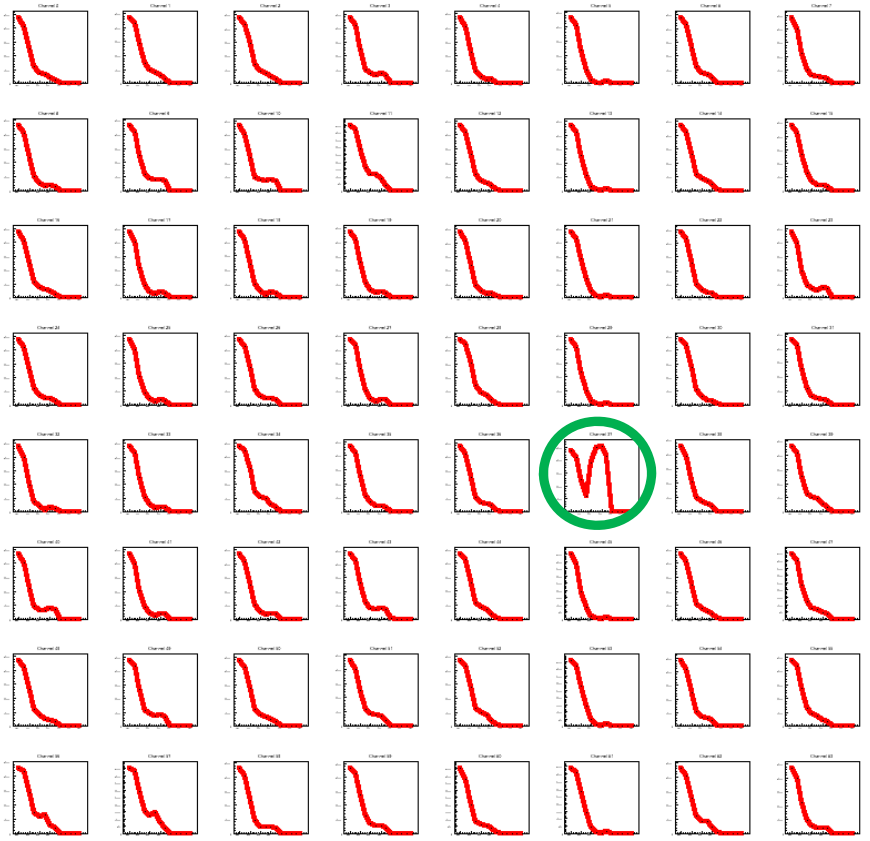
Bump & channel 37 (FEV11)

Indeed, channel 37 has something wrong

Not for all chips

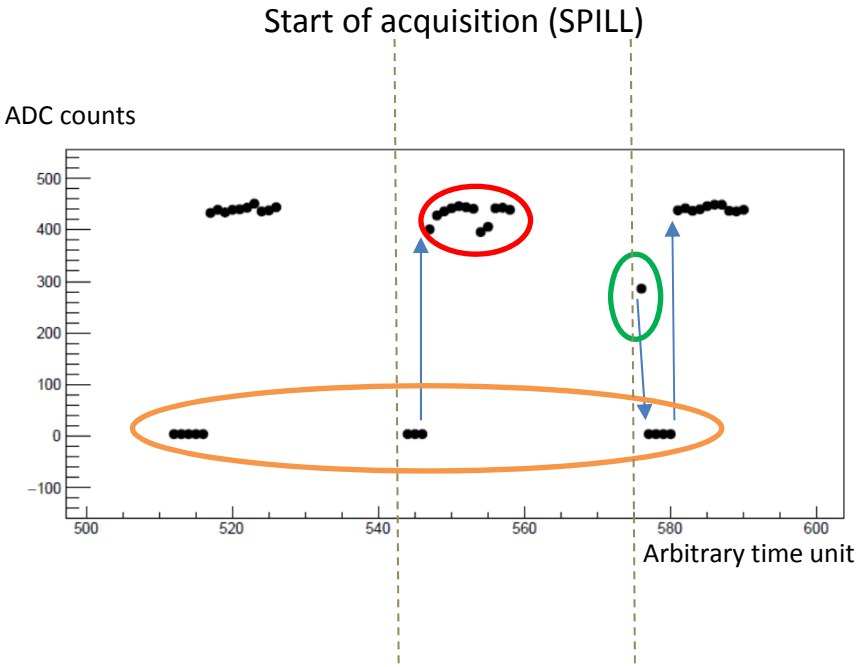
Similar but smaller « bumps » in other channels

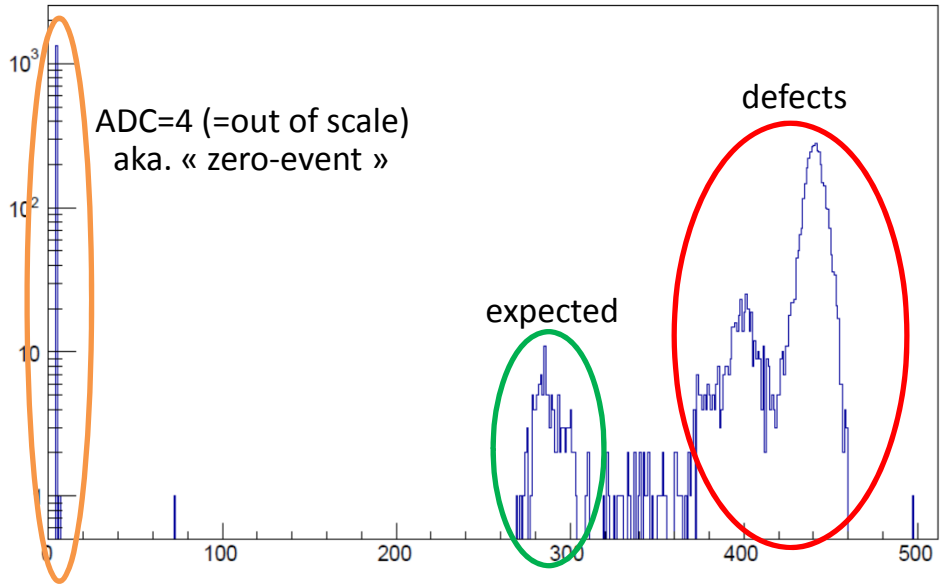
Chips 0, 4, 8, 12 : expected S curve but never reach 0 for high trigger thresholds



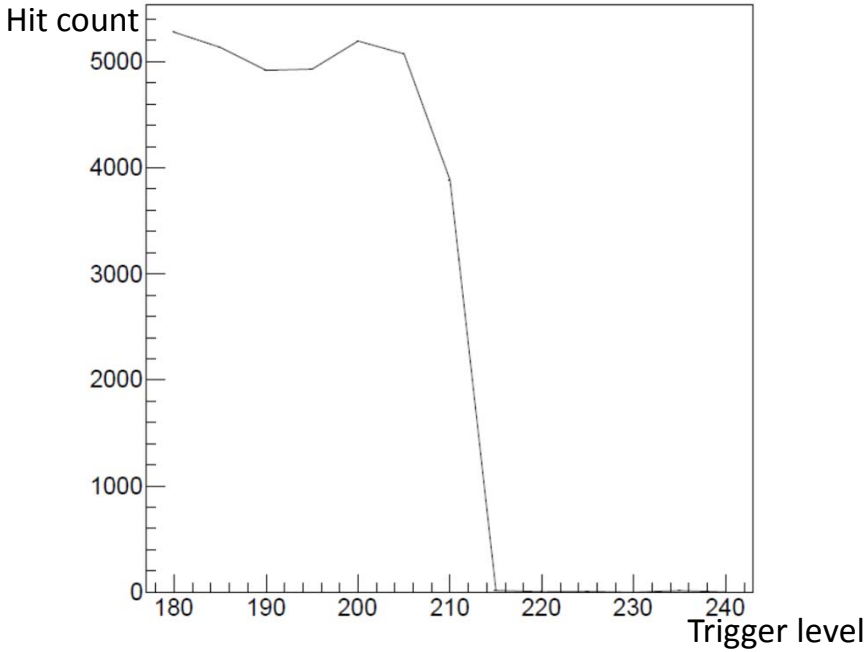
All the following is with power pulsing, all preamps powered

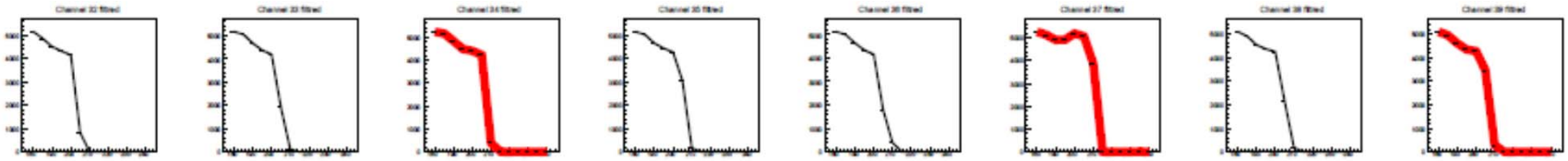
Time view of channel 37 & spectrum





Scurve of channel 37 alone (all others masked)

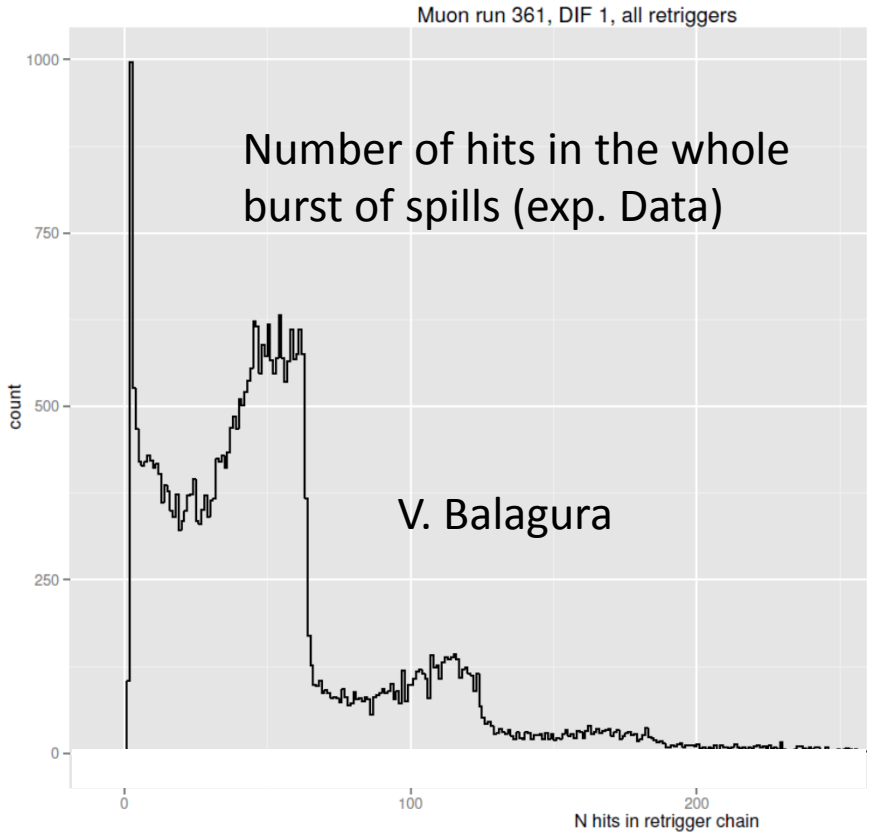




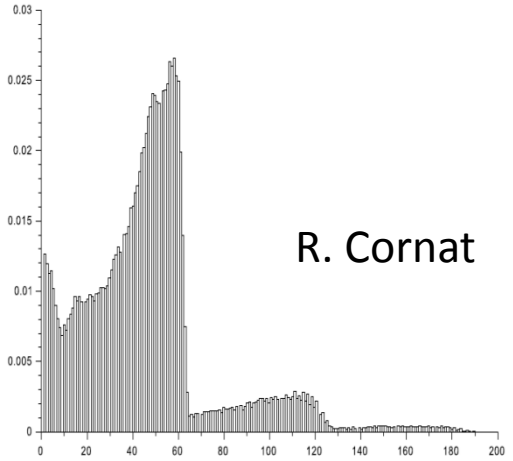
Same for channels 32 to 39

Retriggers (aka. Successive BX)

BX, BX+1…BX+N sampled in a burst



MC sim.

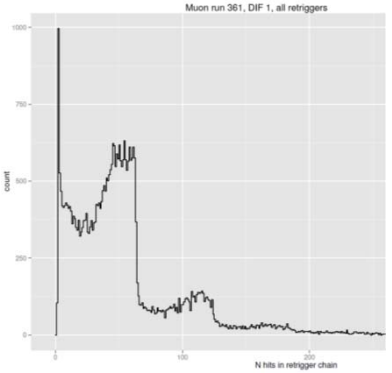


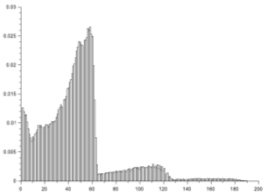
R. Cornat

Re-triggers (aka. Successive BX)

MC sim. assumptions :

- normal distribution of initial number of hits
  - all channels independent (independent random trials)
  - (constant) high probability to trig if not triggered previously
  - (constant) low probability to trig if already triggered
  - stops when close to a max. of already triggered
- **Nothing from chip's internal functioning (no SCA, …)**





=> Memory effect (state variable)

=> sum(hits)>64 explained assuming that a full chain of successive BX is in fact a concatenation of several independent sub-chains with a probability that the next sub-chain restart immediately after the previous one.

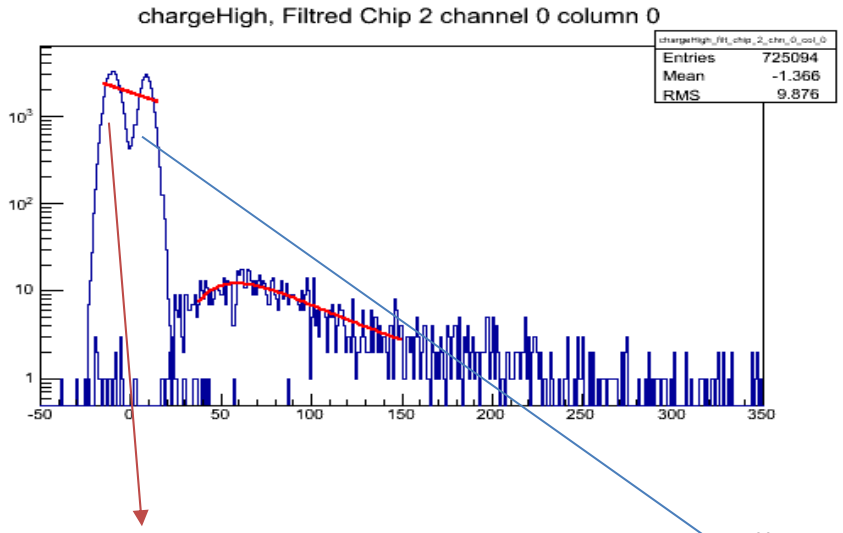
Guesses

⇒ Almost internal phenomenon

⇒ Self-sustained up to a certain point

⇒ Not really correlated to SCAs and internal timings/clocks

⇒ “Memory” effect can be explained as a charge accumulation injected from digital parts through substrate (change in offsets, bad bias of transistors etc.) ?



“HAS triggered” state

“NOT already triggered“ state

Indeed a correlation with double pedestal exists (detailed study by V. Balagura)

Conclusion ?

Need of a model for 2nd method Scurves (MC+poisson+gauss)

Evidences of “noise” due to internal triggers+digital activity together with a memory effect, this can cause :

- An instantaneous pedestal shift
- Retriggers that can be self-sustained

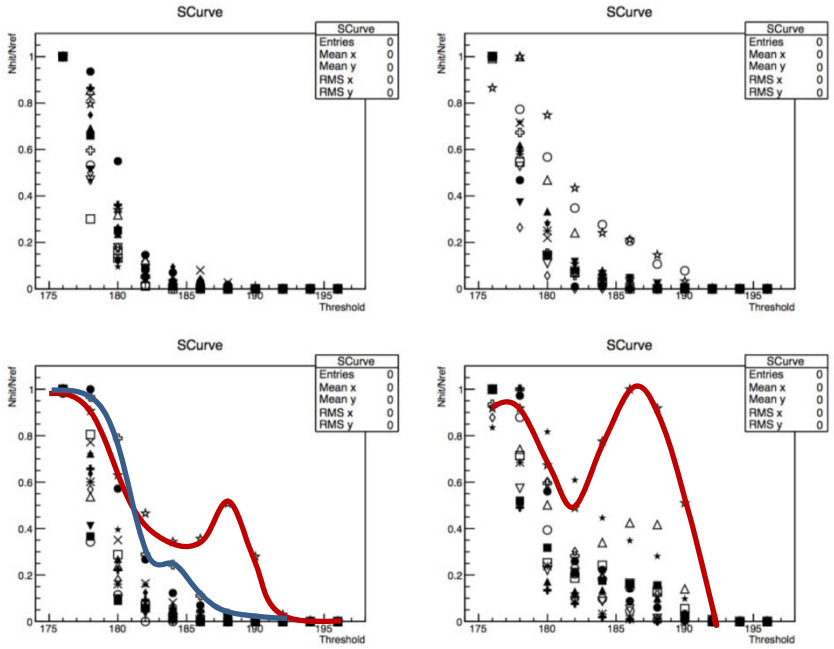
Main issue during the June TB

Depends on trigger configuration (and more ? -> behavior during June TB)

⇒ Nothing clear seen in PCB layout or package layout concerning channel 37
⇒ Would be interesting to test on COB board

Bump also seen on COB version (no package, different PCB)

- R. Poeschl https://agenda.linearcollider.org/event/6892/session/6/contribution/4

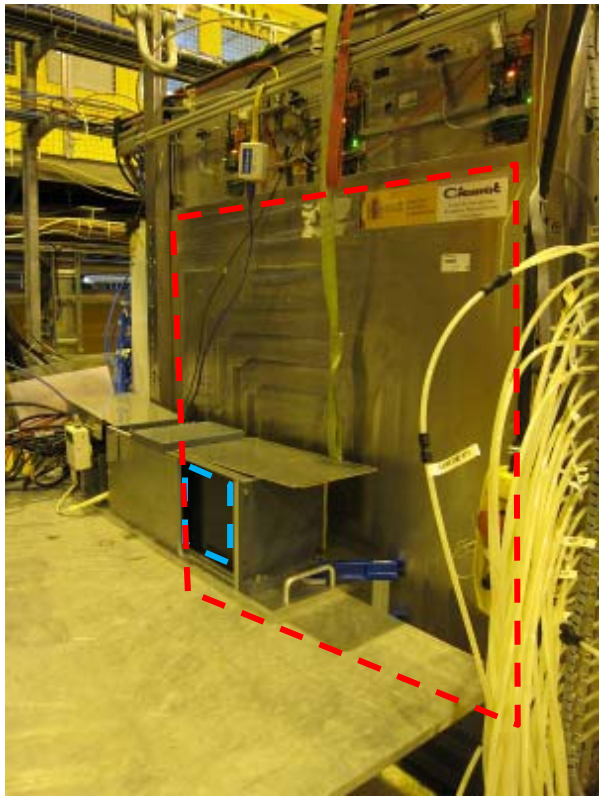


Part II

SDHCAL - SiW ECAL
Common test beam

Common TB (SDHCAL/Si-WECAL) in June @SPS

10 layers ECAL installed in front of m^3 SDHCAL



Slow control & DAQ : ok
Common SPILL signal : ok, start with same value
Common Fast CLK : cabled, not used yet
Alignement of ACQ windows : ok (scope checked)

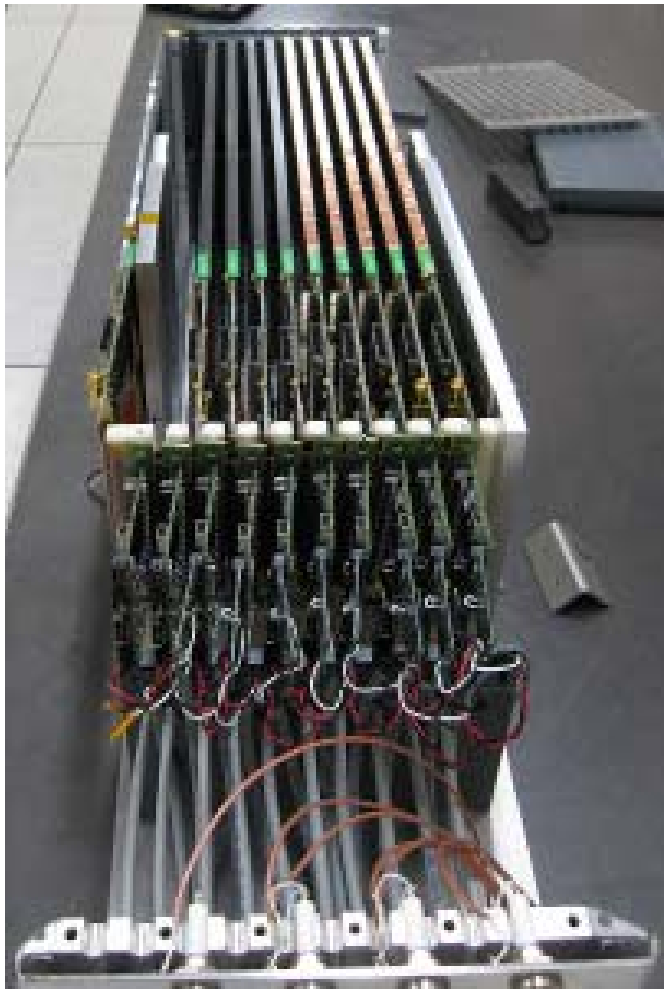
Configuration from master SW : ok
Run control from master SW : ok
Data exchange (in both directions) : concept ok

ECAL – SDHCAL distance (detecting materials) : ~ 7 cm

Si-W ECAL behaviour

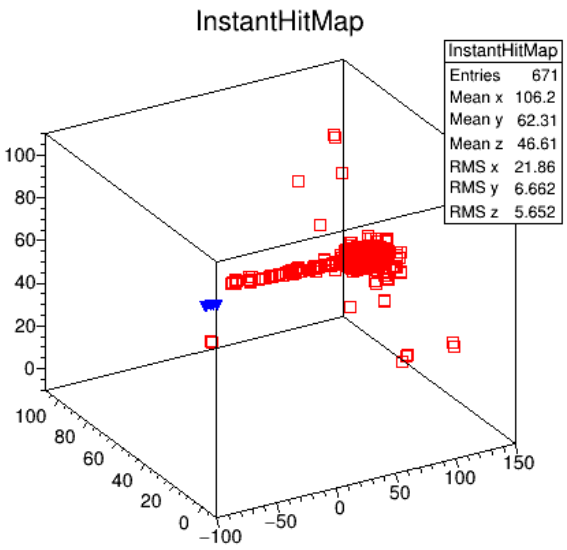
High noise (apparently), but essentially retriggers

Trigger threshold had to be set rather high ~85% MPV



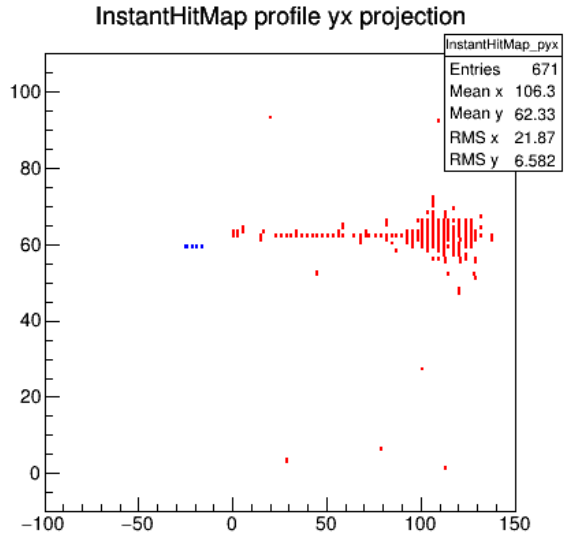
NOTE :

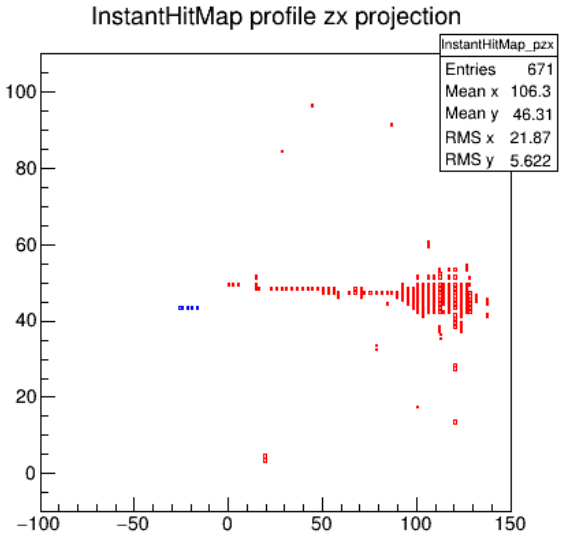
- Completely new detector
- 4 SLABS untested at Lab.
- No shielding (as with test plates)
- Soldered contacts (reliable but change in impedance of power lines)



Finally :
8 slabs in good state
2 slabs lost (after power cut which damaged 1 slab)

1st common run with muons Launched on June 16th





Common events found
(plot : courtesy IPNL)

Note: 3D data not aligned

Priorities for the next steps

- Analyse June TB data and find a fix for the noisy behavior of the slabs

- Next engineering step is building a long detector module
  - 4 front-end boards together (4096 channels) already tested
  - Plans to partly equip boards with sensors then add boards (tools at LAL, LPNHE, LLR)
  - Increase FEV number up to [8..10]

- Plan a production of additional short slabs (up to ~20 layers)