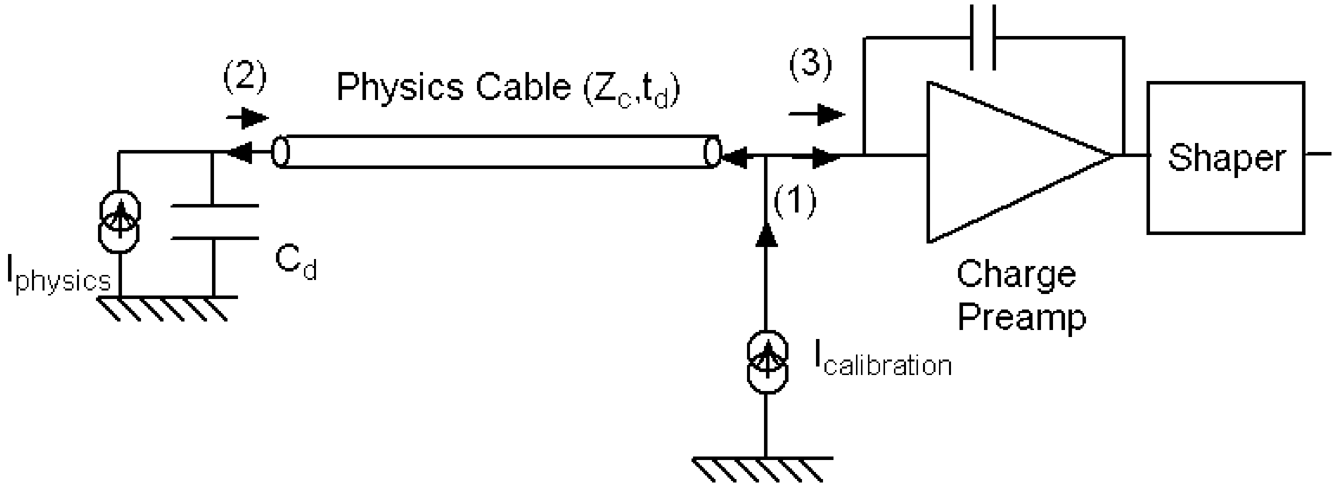
A Simulation of
Calibration Signal and Physics Signal

simulation $\Longrightarrow$ signal at the shaper output for:
$\rightarrow$ a given $I_{calibration}$ (a step, parameter $\Rightarrow$ amplitude I_0^p)
$\rightarrow$ a given $I_{physics}$ (a triangle, parameter $\Rightarrow$ amplitude I_0^c)



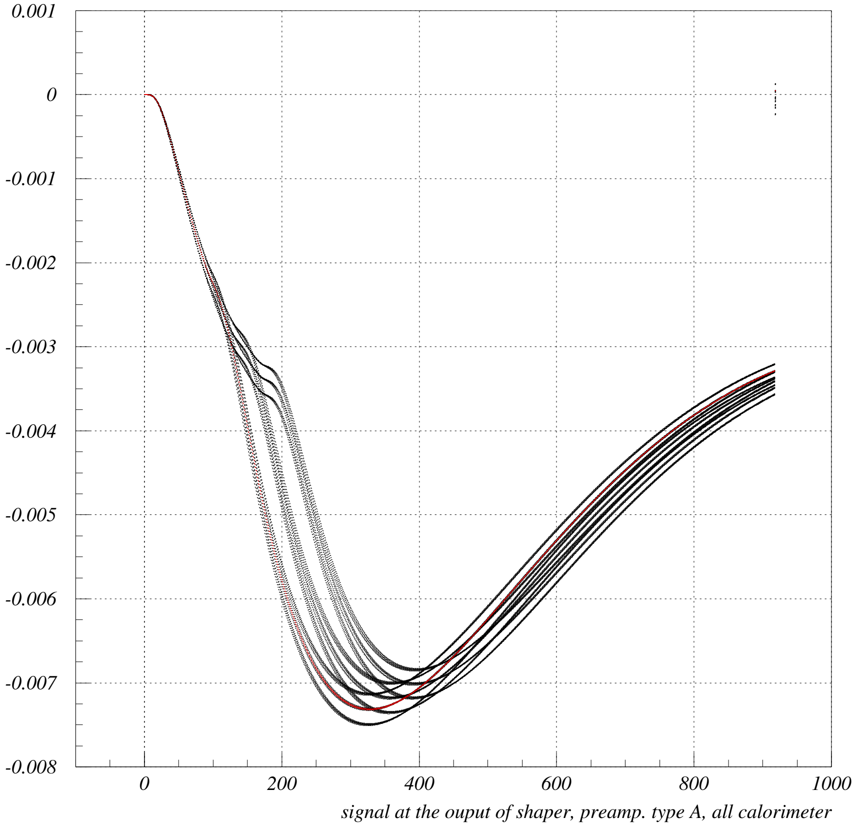
$\rightarrow$ up to preamp. output $\Rightarrow$ signals are analyticaly calculeted (parameters : Z_c, cable impedance from module to preamp.; t_d, cable delay; Z_{in}, input preamp. impedance; C_d, channel capacitance)
$\rightarrow$ then results are convolved with the measured shaper answer to a dirac.

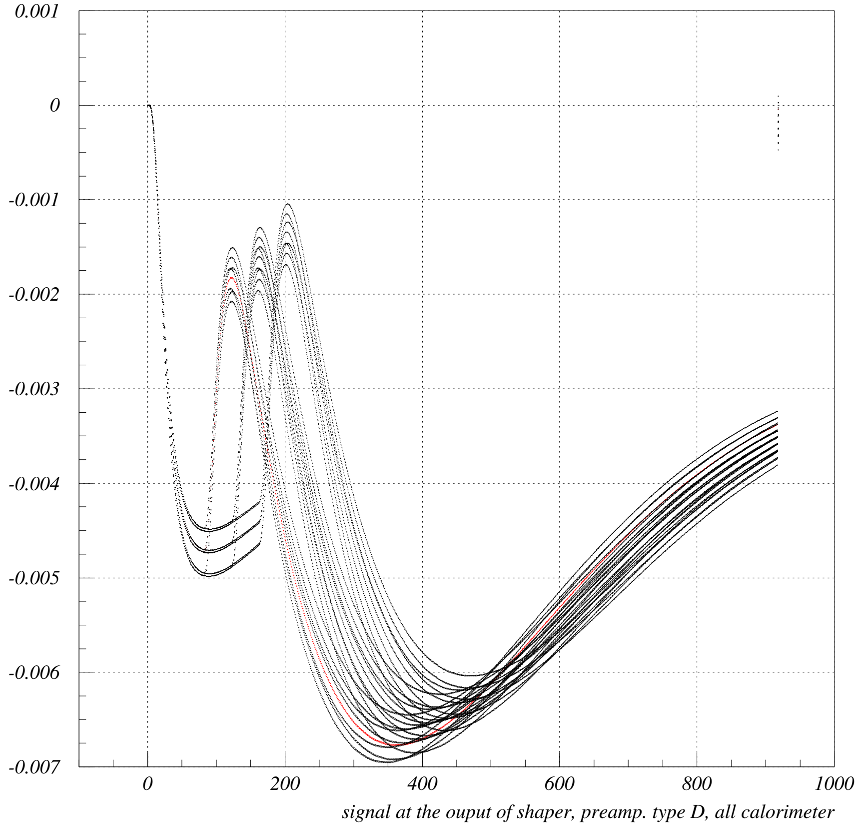
NB: for physics $\Rightarrow$ 1 signal.
for calibration $\Rightarrow$ signal can be split in 2 terms. One representing the fraction of current $\frac{Z_c}{Z_c+Z_{in}}$ that flows directly into the preamp. and a second one flowing into the cable, bouncing on the detector capacitance C_d and arriving in the preamp. after $2\ t_d$.

Envelope of Calibration Signals

$40ns < \textit{delay} < 80ns$, $Z_{in} \pm 10\%$ arround Z_c, $C_d \pm 10\%$ arround nominal value

$\Longrightarrow$ those variations barely correspond to the whole calorimeter possible variations.



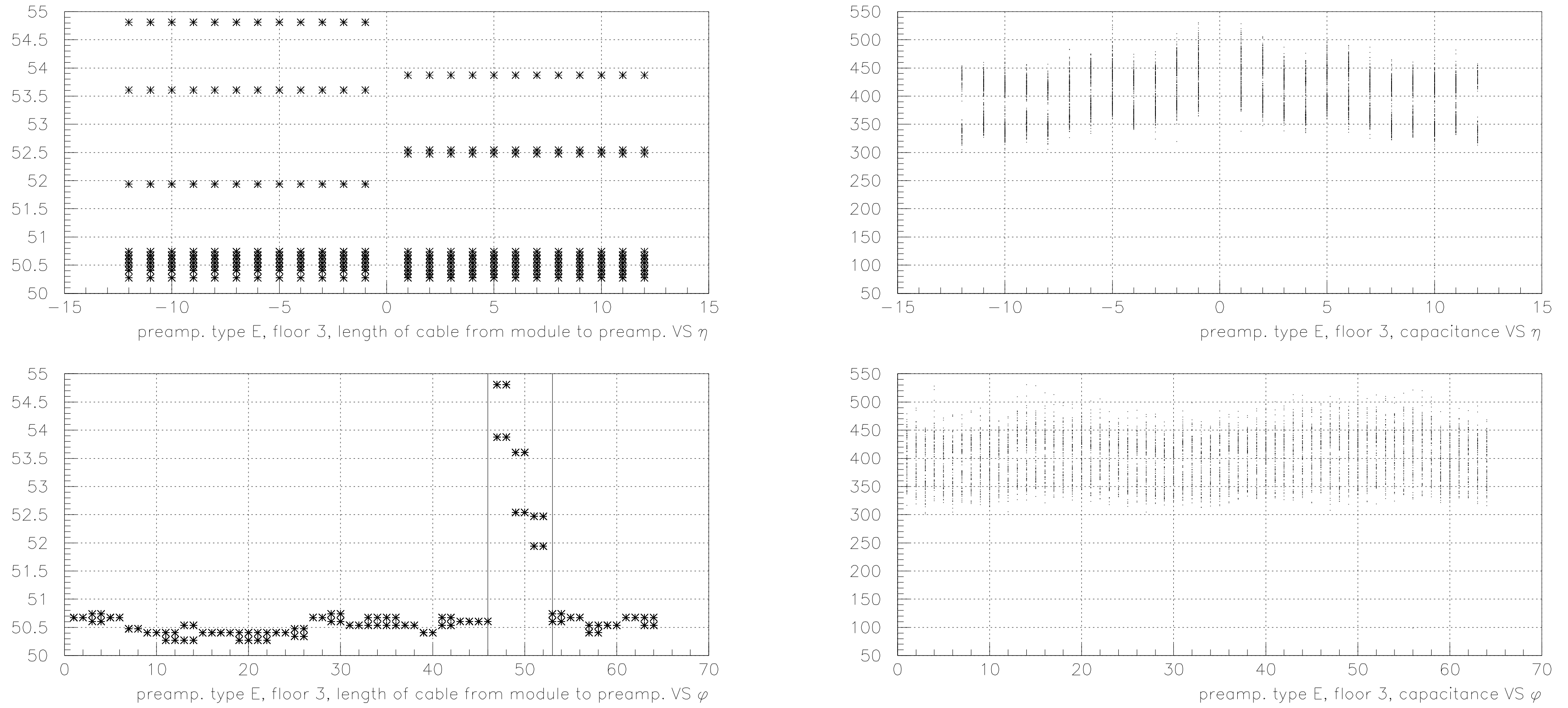


Seem to be impossible to calibrate the whole calorimeter in one time !

Mélissa Ridel

Attempts to Define Sectors in the Calorimeter

$\Longrightarrow$ example in EM3, for type E preamp.



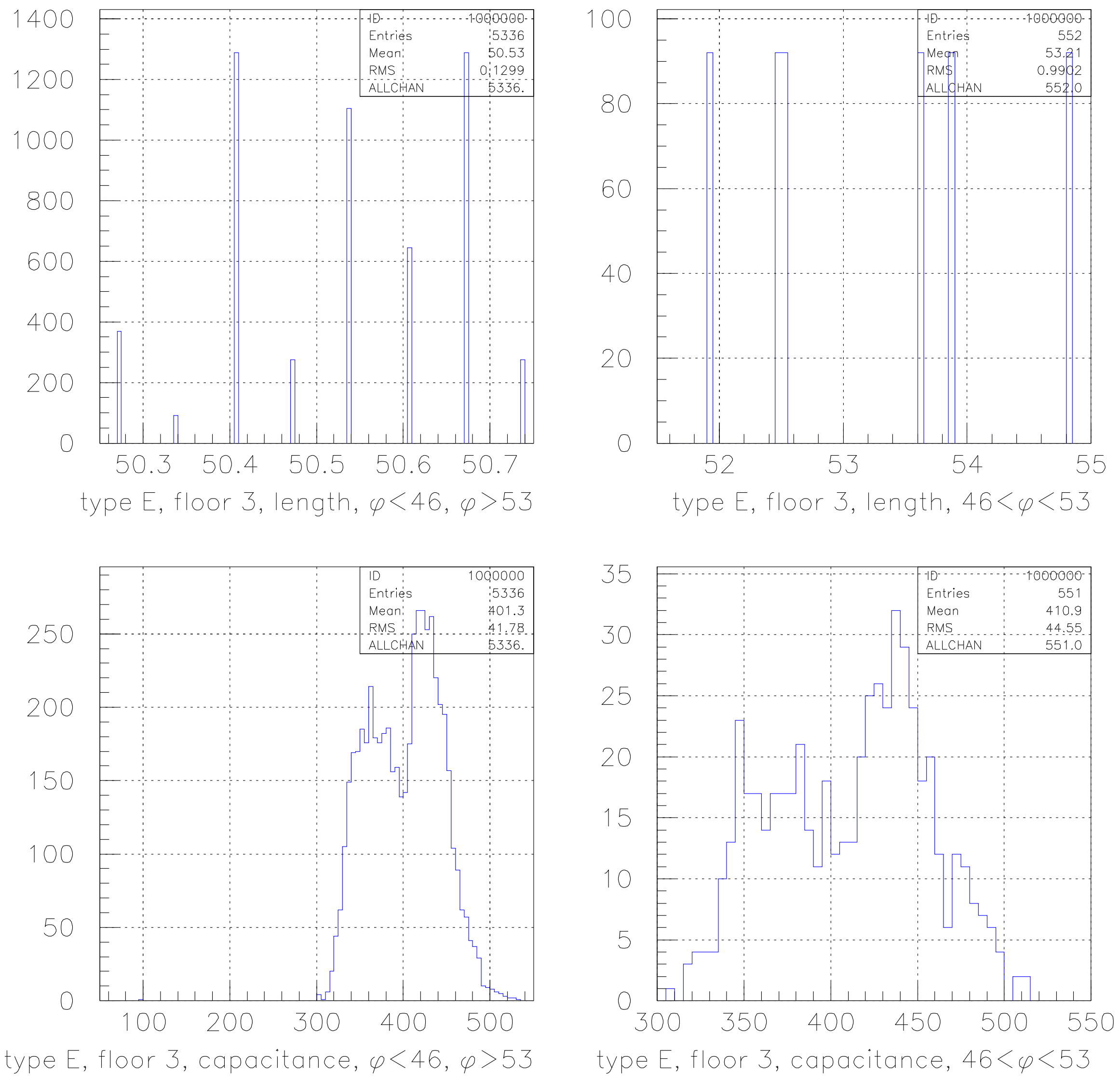
For cable length, no simple sector in η, 2 sectors in ϕ : $46 < \phi < 53$ and $\phi \leq 46$, $\phi \geq 53$.

For capacitance, no simple sector at all.

choice $\Longrightarrow$ 2 sectors in ϕ.

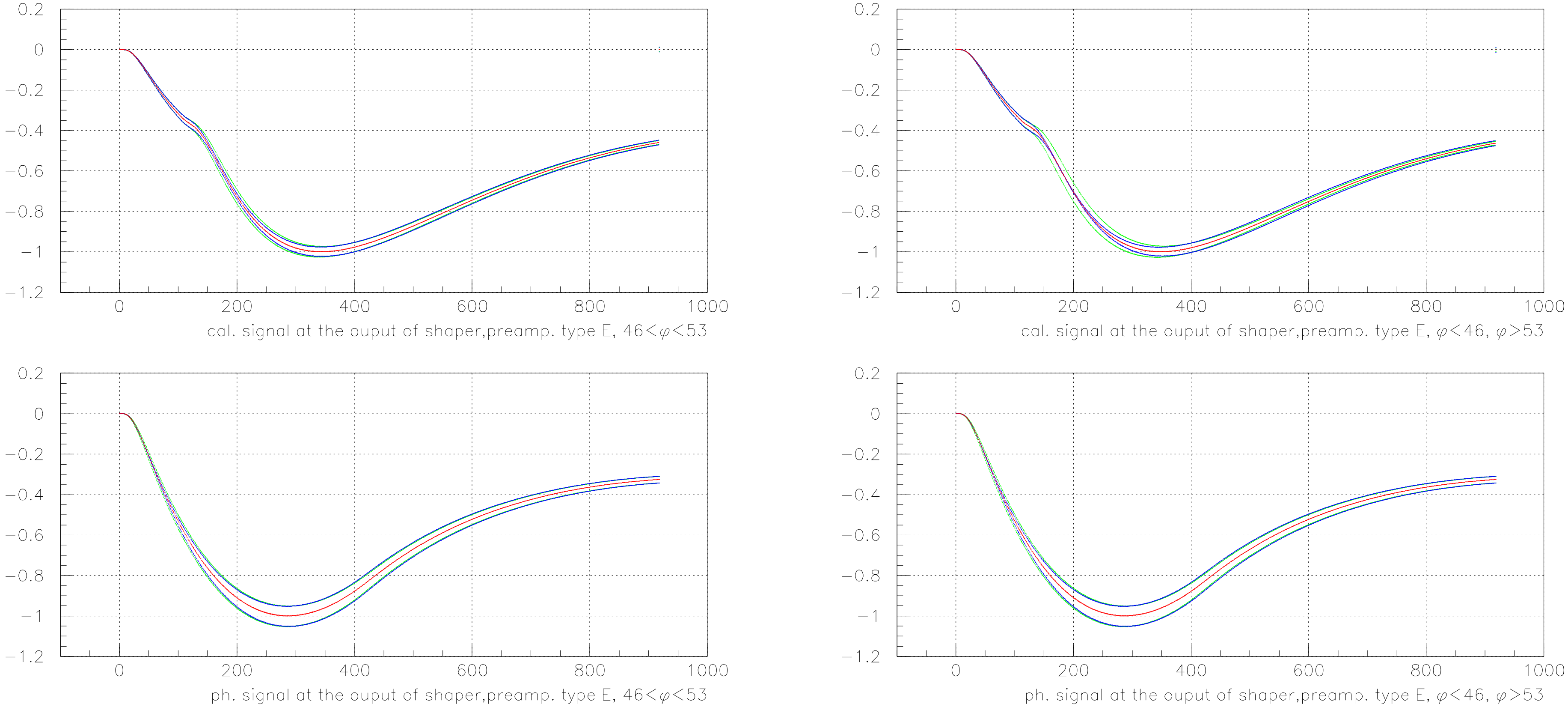
Detector Parameters of the 2 Sectors

Now, the cable length exhibits a smaller variation in propagation delay.



$\Longrightarrow$ We can expect much smaller envelope for the signals.

Calibration and Physics Envelopes in the 2 Sectors



Mélissa Ridel

Parameters Impact : Z_{in}

For physics and calibration, red curves ⇒ mean of all 3 parameters.

Other curves ⇒ vary all parameters.
Physics signal is measured at its maximum ⇒ impact of the parameters on physics is the difference Δphy, between red curve and others. It makes sense only at the time of the maximum for the red curve ⇒ Δphy^{tmax}.

Calibration signal can be measured at any time ⇒ impact of the parameters on calibration is the difference $\Delta cal(t)$, between red curve and others.

$\frac{\Delta cal(t)}{\Delta phy^{tmax}} - 1$ will be interesting to

- find the closest point to 0 ⇒ calibration and physics fluctuate the same way.
- find a stable point ⇒ there is a (large) difference between the variation of physics and the variation of calibration but this difference is not sensitive to the fluctuation of the parameters.

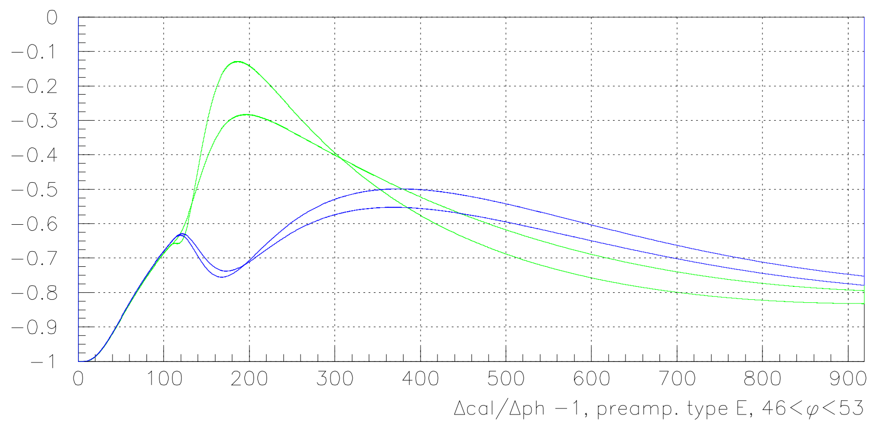
$$\frac{\Delta cal(t)}{\Delta phy^{tmax}} - 1$$

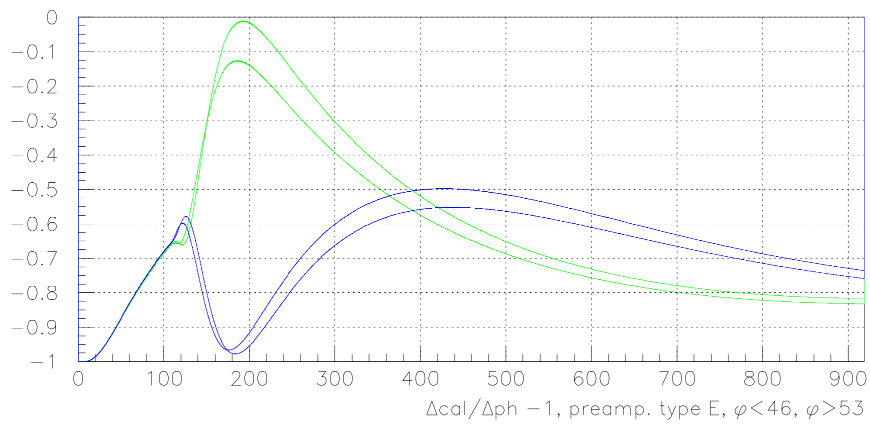
All parameters haven't the same impact on the physics and on calibration.

With one point, the stable one, the correction to apply to physics is known.

The closest point to 0, is also the most sensitive to parameters.

It can give an indication of the correction coefficient to apply to the physics.





$\Longrightarrow$ Which time is best to calibrate ?

Calibration Strategy?

When calibration timing(s) is (are) decided,
the simulation $\Rightarrow$ can help to convert DAC values into GeV.

For example, if the calibration point is the maximum of the calibration signal

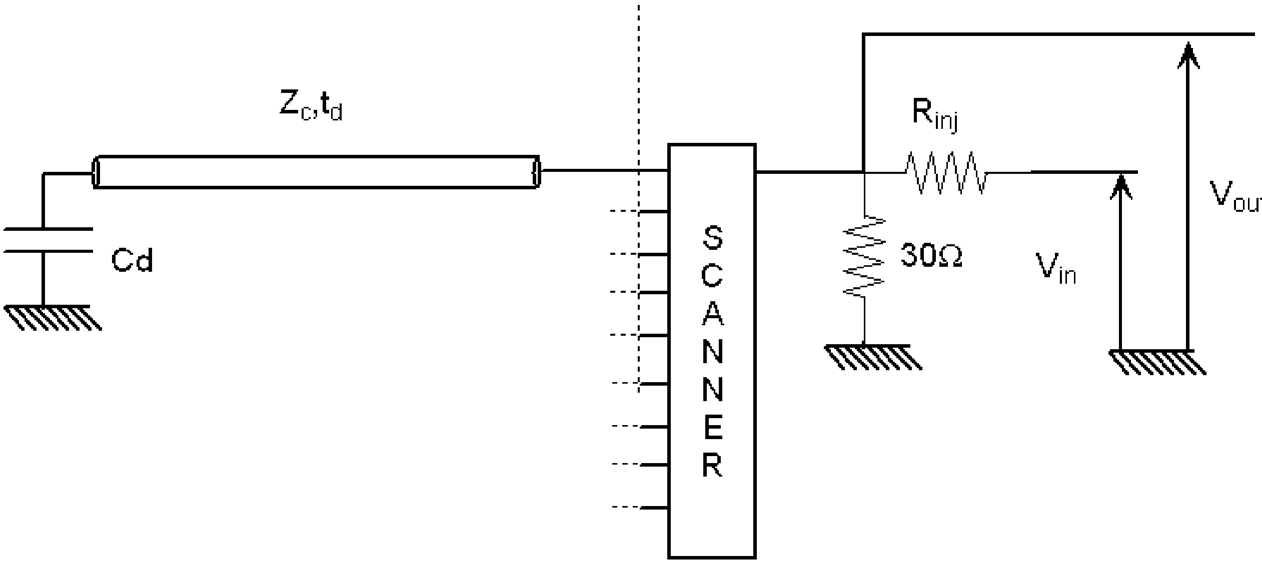
- for a given amplitude of the input physics signal I_0^p (which corresponds to an energy or a charge) $\Rightarrow$ the maximum of physics signal is known.
- for a given amplitude of the input calibration signal I_0^c (which corresponds to a DAC value) $\Rightarrow$ the maximum (this is our example) of calibration signal is known.

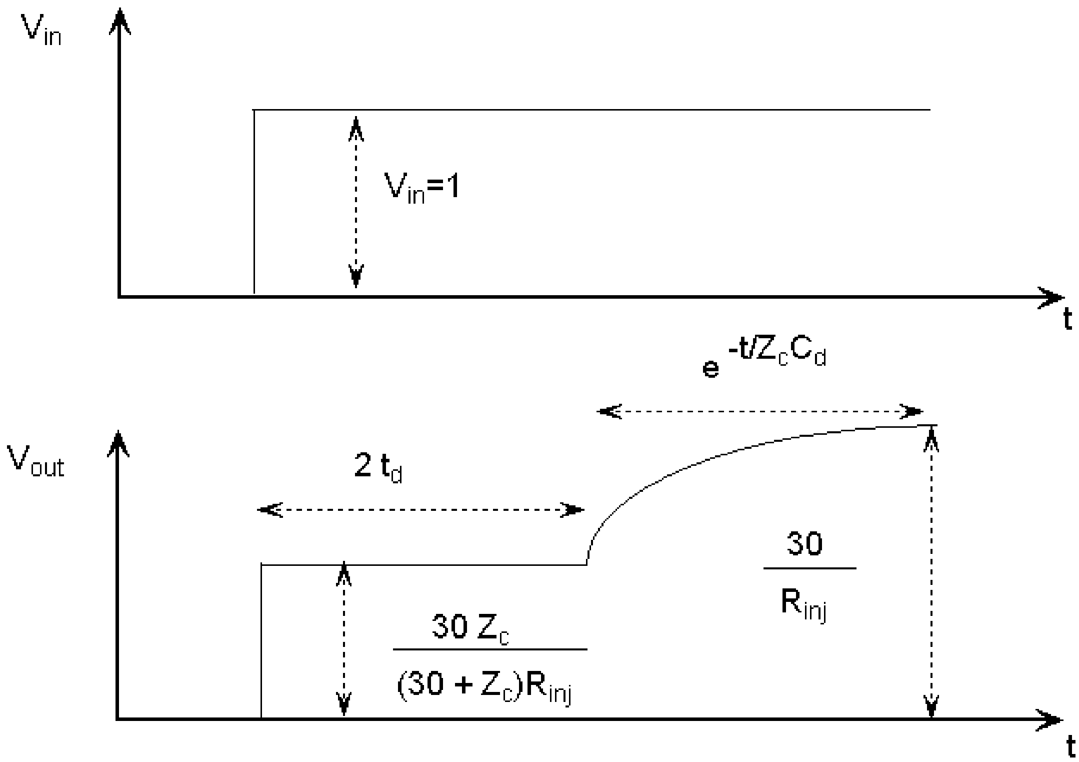
$$3.65\ GeV \text{ or } 0.865\ pC \Longrightarrow 2000\ DAC$$

This calculation is made assuming that the cable delay, the channel capacitance, the preamp. type, ... and the calibration point are known. The value should be calculated by cell, and may vary a lot.

The Following ...

- try to understand the fluctuation of physics and calibration for each parameter
  $\Rightarrow$ then propose
  - possible time(s) to calibrate
  - a strategy of calibration depending on
    * sectors in η, ϕ
    * preamp. type
    * layer
    * time independant parameter: C_d, t_d
    * time dependant parameter: Z_{in}
    * ... and time we will have to calibrate
- measurement of signal before preamp. with a card made at Orsay able with
  - an input step $\Rightarrow$ to measure t_d, Z_c and (C_d)
  - the calibration signal in input $\Rightarrow$ to have a database of calorimeter waveforms.
    Those waveforms could be convolved to a measured preamp. + shaper $\Rightarrow$ studies depending only of Z_{in} which is the real time dependant parameter.





If V_{in}= *step*, V_{out} is a measurement of t_d, Z_c and (roughly) C_d values and dispersions.

If V_{in}= *Calibration Signal*, V_{out} can be convoluted with the electronics response.