ALERT Meeting

AHDC simulation

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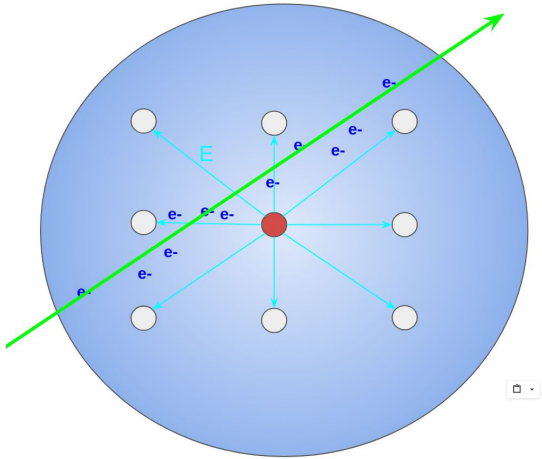
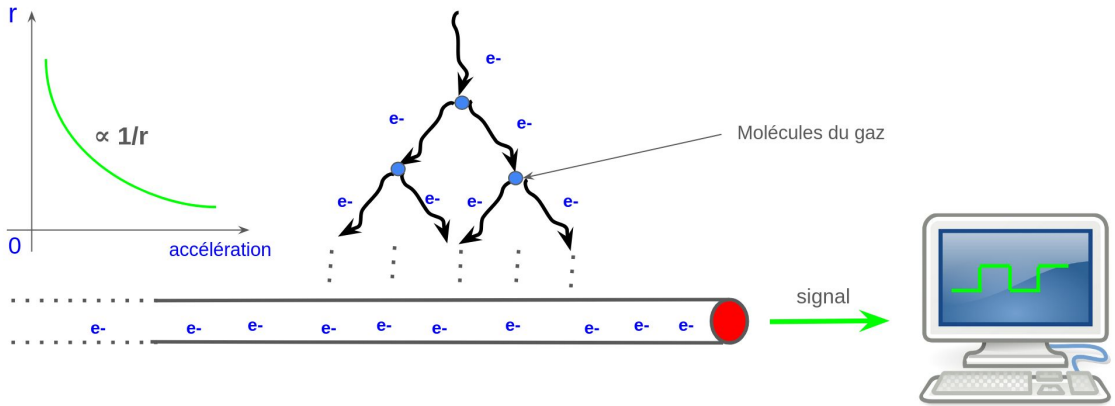
AHDC signal

- A Hyperbolic Drift Chamber
- 3026 aluminium wires; 576 sense wires
- **gaseous** detector

AHDC detection cell



signal generation

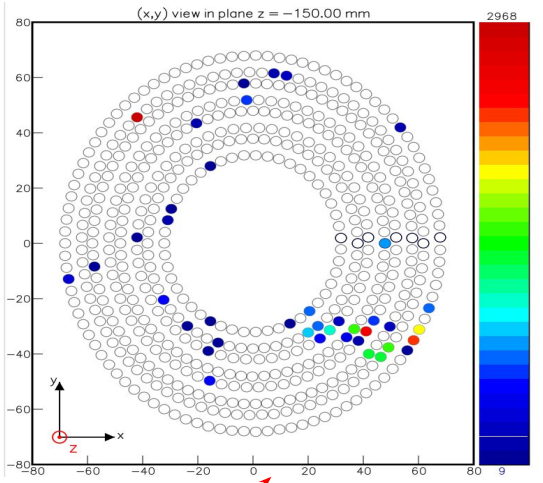


- sense wire connected to the HV ~ 1400 V
- field wire wire connected to the LV

charged particle → Electric field → electronic avalanche → Drift of electrons → AHDC signal ← ? simulation

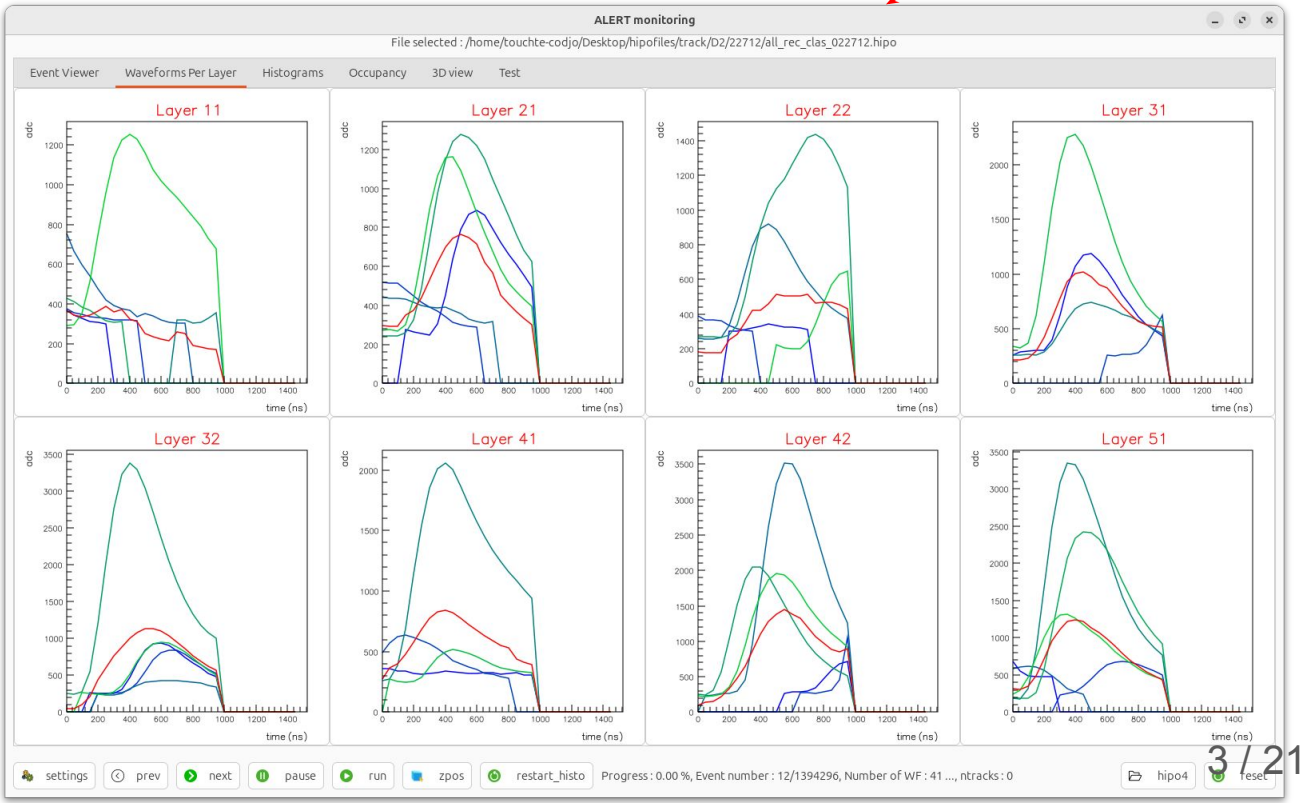
Example of real AHDC signals

- Run 22712



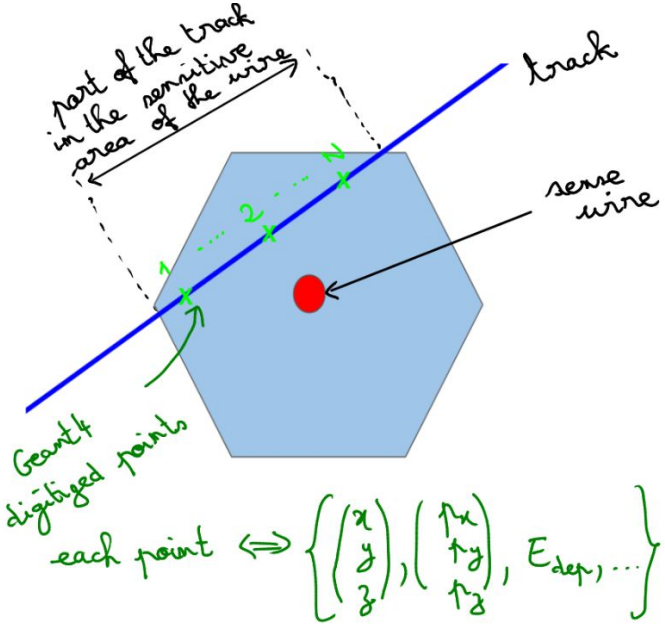
AHDC XY view

waveforms in amon



All waveforms/signals per layer

AHDC simulation



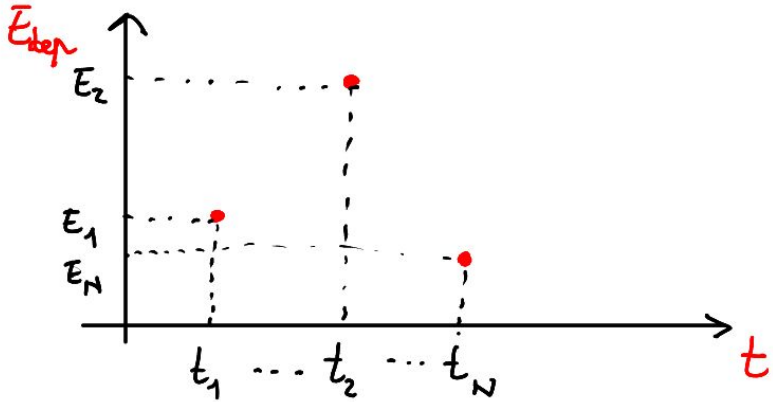
1) We use $\begin{pmatrix} x \\ y \\ z \end{pmatrix}$ to compute the distance d_i of the i-th point/step to the wire.
↳ doca.

2) We use an empirique distance to time function:

$$f(x) = 7x + 7x^2 + 4x^3$$

3) At each step i, we associate the time:

$$t_i = f(d_i).$$

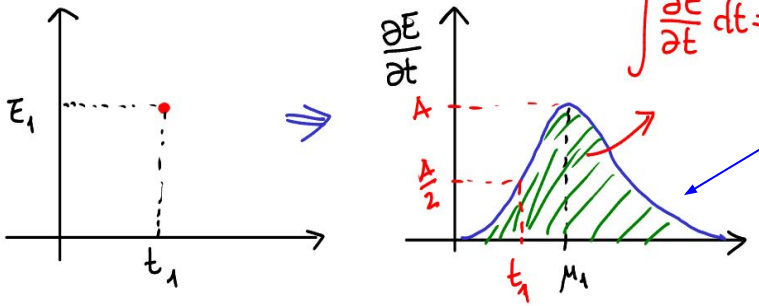


From step points calculated on Geant4 to non continuous deposited energy over the time

AHDC simulation

➡ We change all punctual distribution to a deposited energy over integrated over the time

. If only one step:



The envelope is a Landau distribution

t_1 : leading Edge Time

$$\frac{\partial E}{\partial t} = E_1 \times \mathcal{L}_{(\mu_1, \sigma)}(t)$$

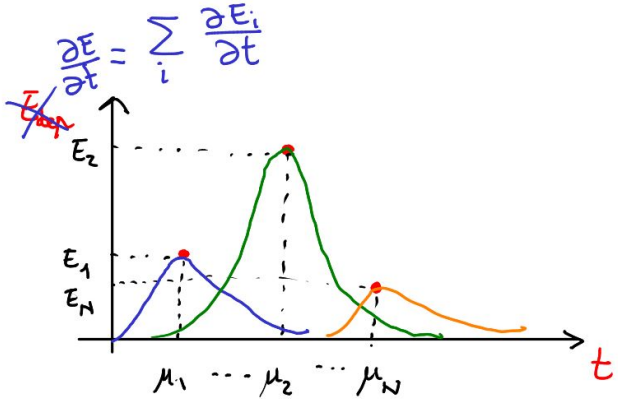
σ : scale parameter is free

$$\mu_1 = t_1 + 1.36\ \sigma$$

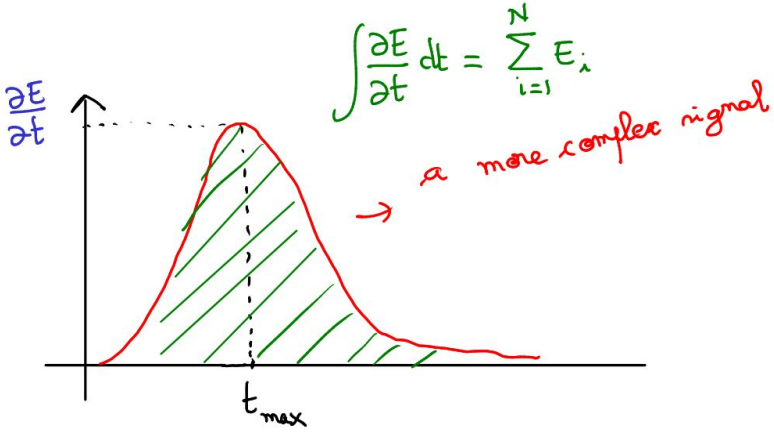
AHDC simulation

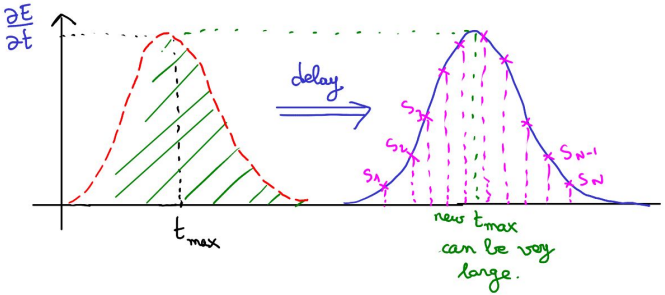
➡ We change all <u>punctual distribution</u> to a deposited energy over integrated over the time

- If multiple steps, we have:



superposition ➡

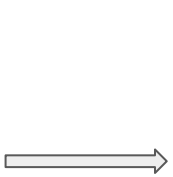


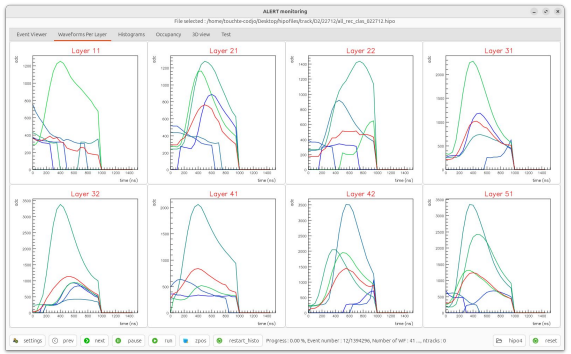


Delay and digitization : samples are stored in **AHDC::wf** bank

AHDC simulation

- We have 2 free parameters :
  - scale σ parameter of the landau distribution
  - delay added to the resulting signals
- We can use real data to calibrate these parameters
- But we know real data are corrupted by the noise

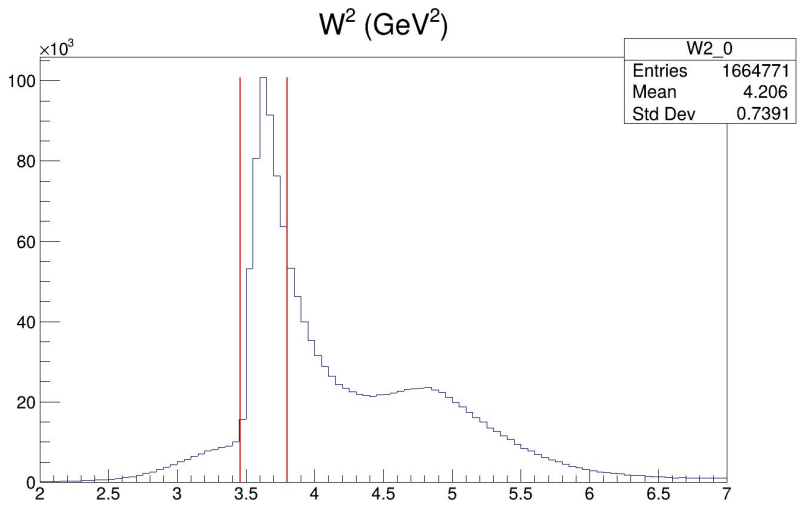


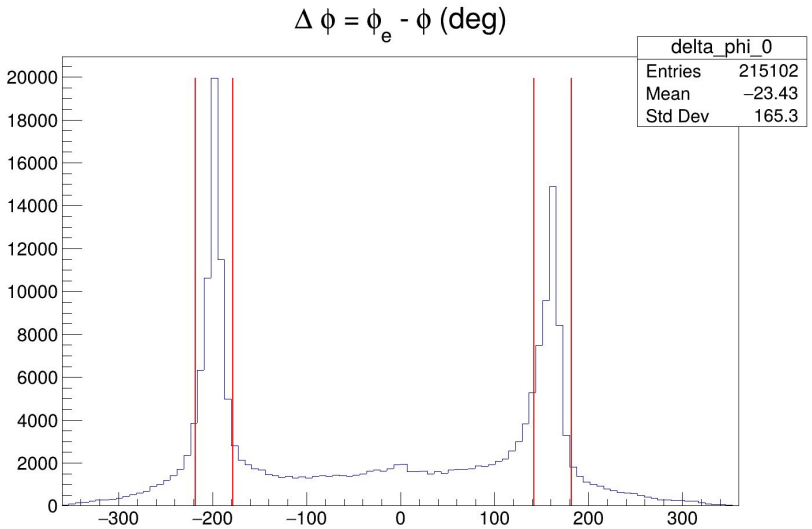


We will only looked at waveforms associated to tracks outcoming from elastics event

Elastics events

- Study run 22712, D2 target
- Compute the kinematics variables and apply cuts





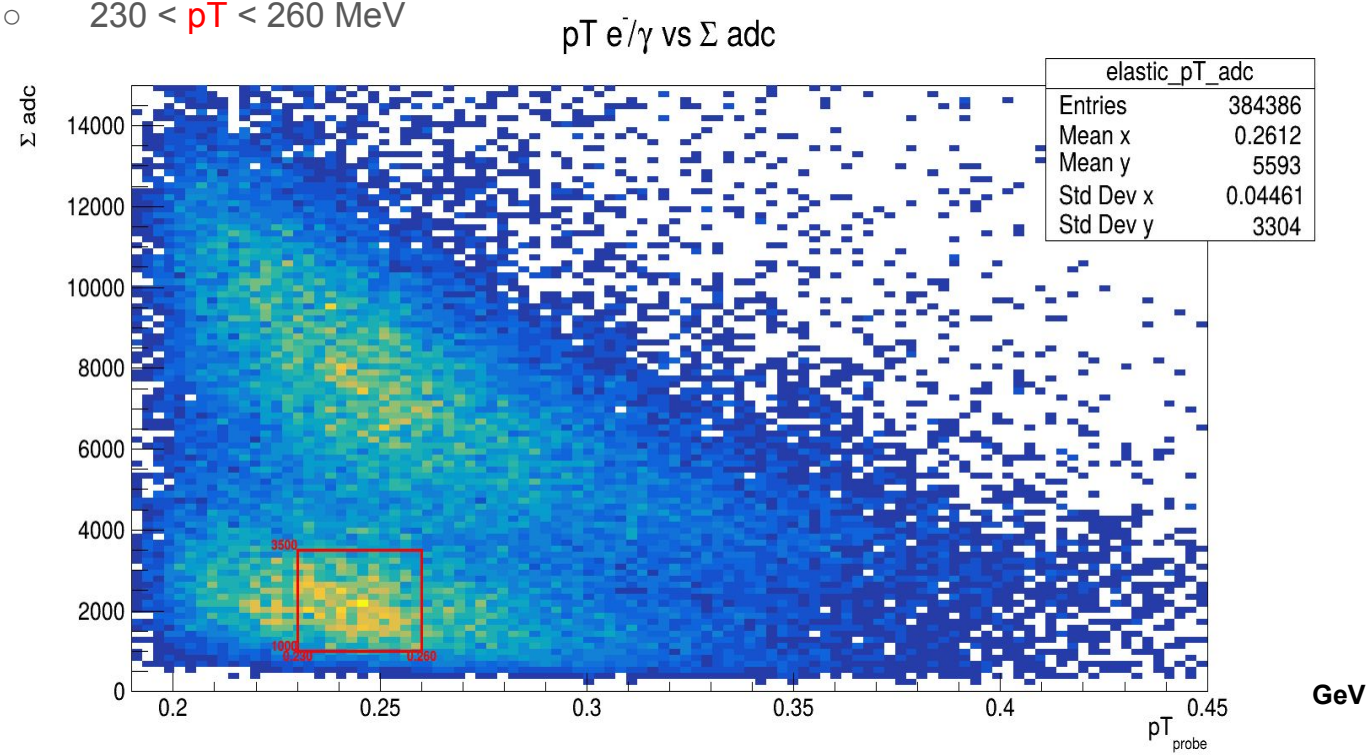
3.46 < W2 < 3.8 GeV²

| Δϕ - peak | < 20 deg

only electrons

Elastics events

- pT electron vs deposited energy (sum ADC) of the track
- Select proton that correspond to
  - 1000 < Sum ADC < 3500
  - 230 < pT < 260 MeV



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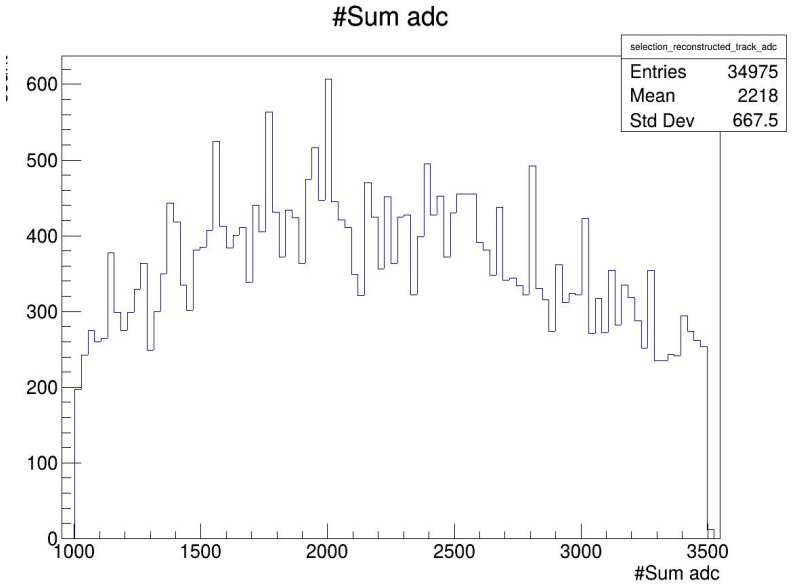
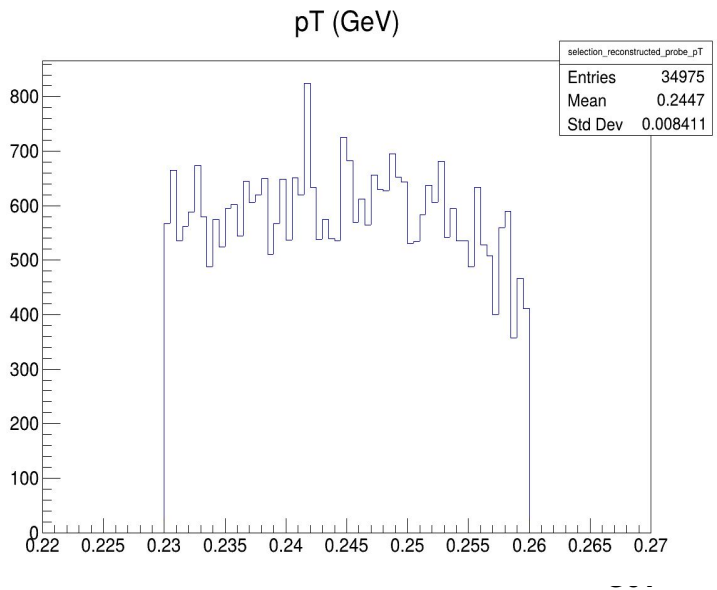
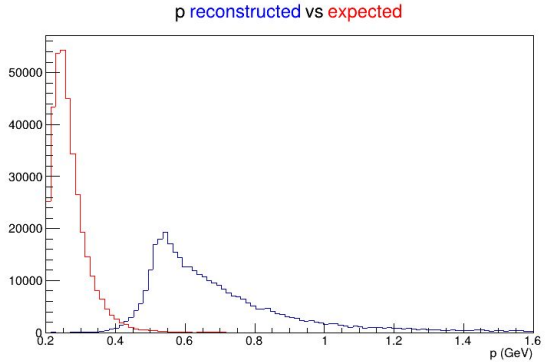
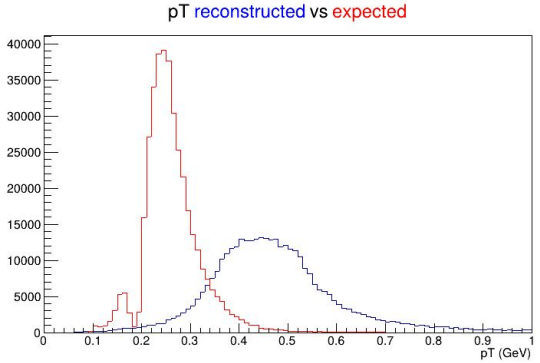


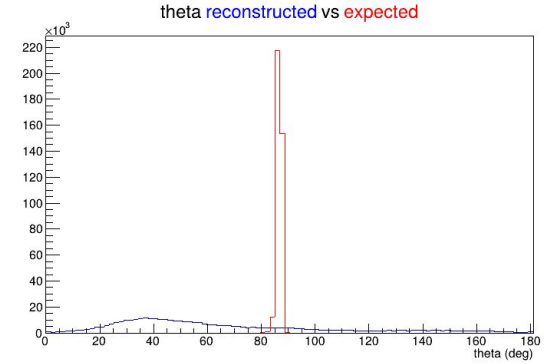


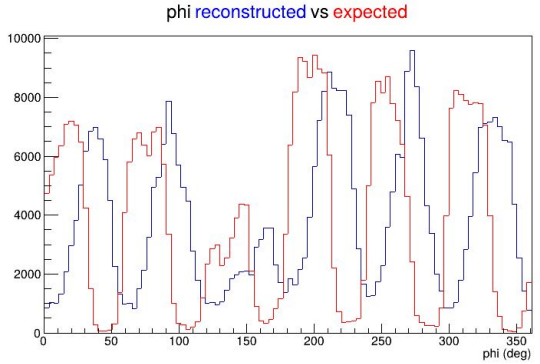
Elastics events

- Current AHDC reconstruction not good for the moment
- From electron kinematics to expected tracks

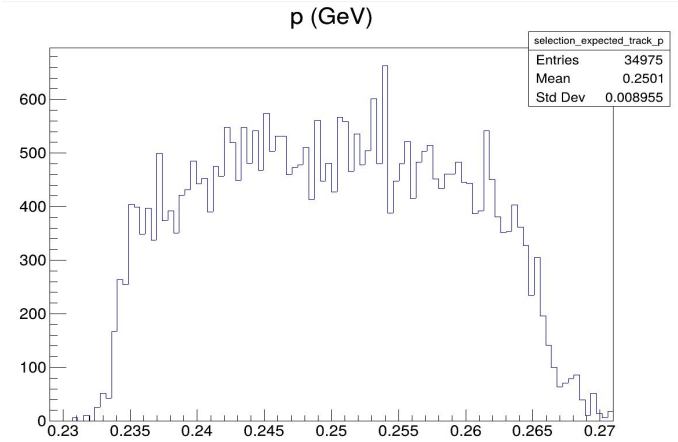


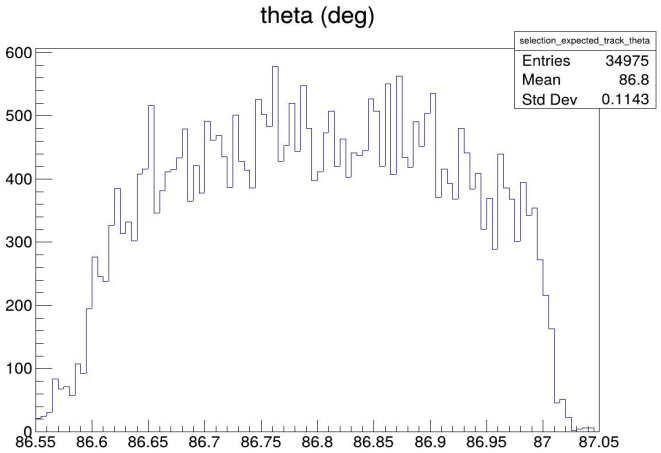


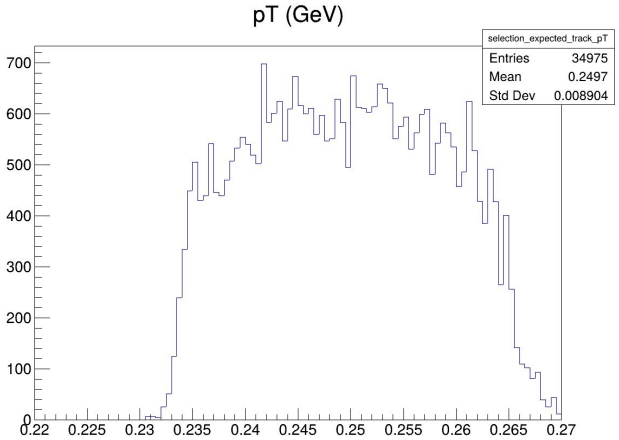


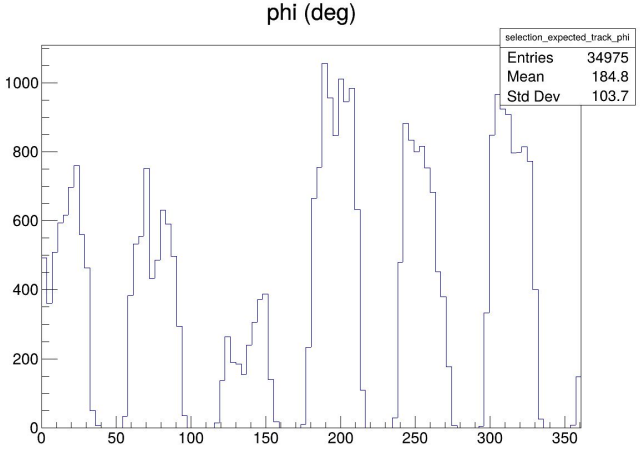


Elastics events / Proton to simulate









Elastics events

- Simulation calibration
  - ➢ Estimation of σ

$$\sigma_{Landau} = \frac{FWHM}{4.017} = \frac{ToT}{4.017}$$

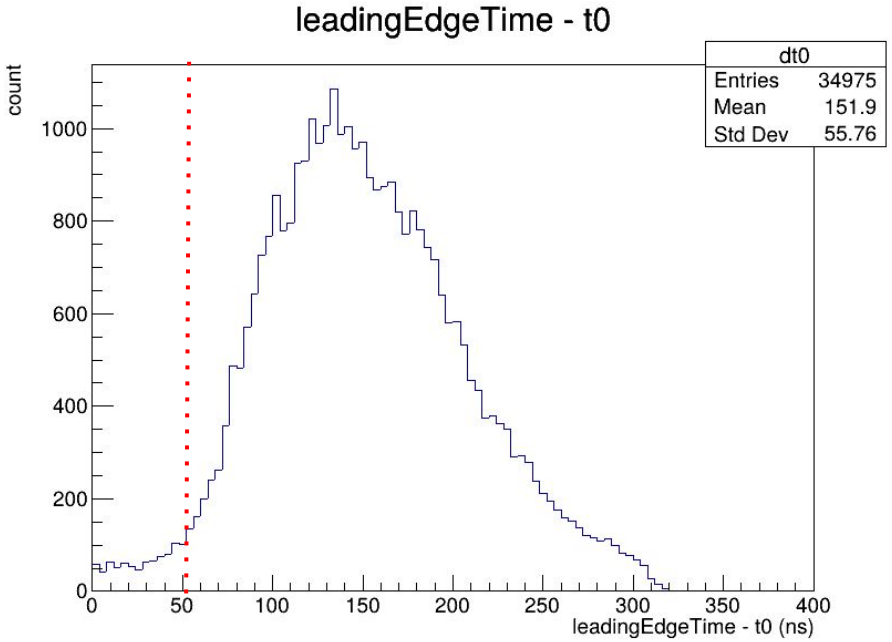
  - ➢ We deduct μ

$$\mu_{Landau} = driftTime + 1.36\,\sigma$$

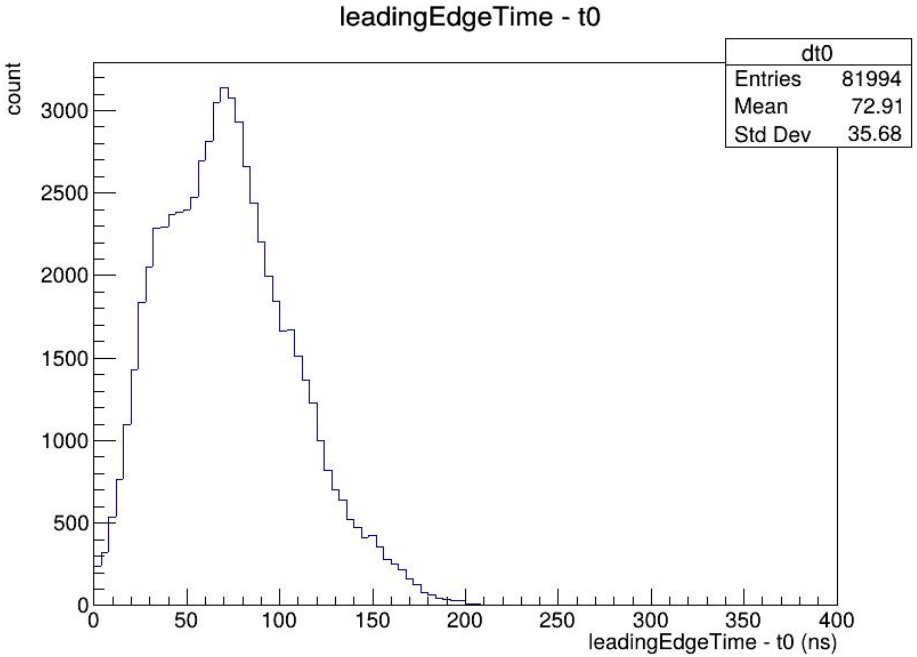
  - ➢ The delay is estimated by the delay **t0**

Analysis

DATA

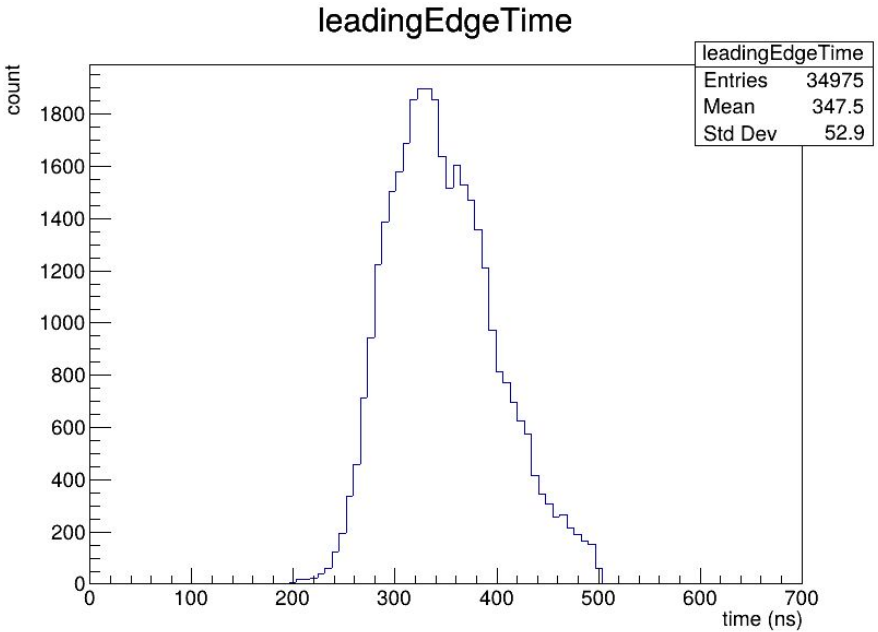


SIMU



Analysis

DATA



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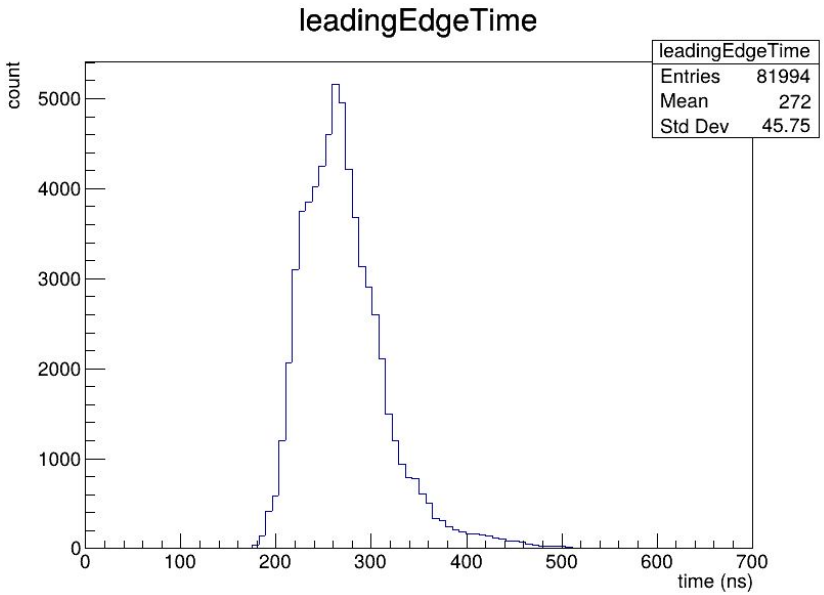
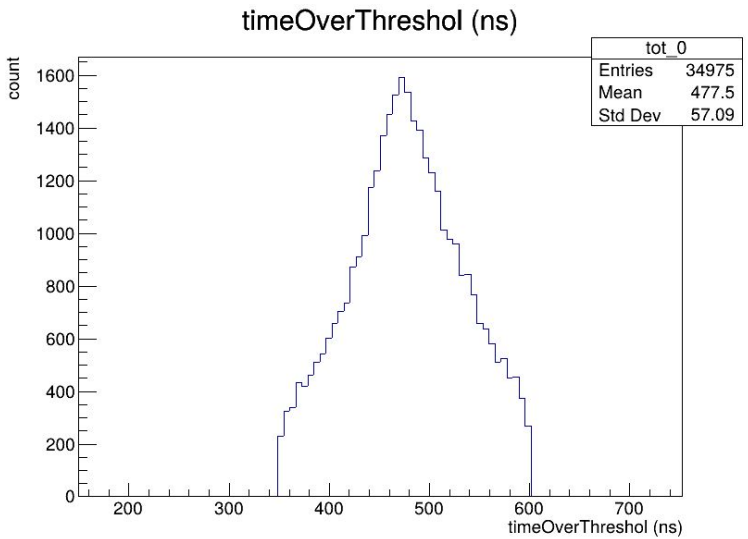
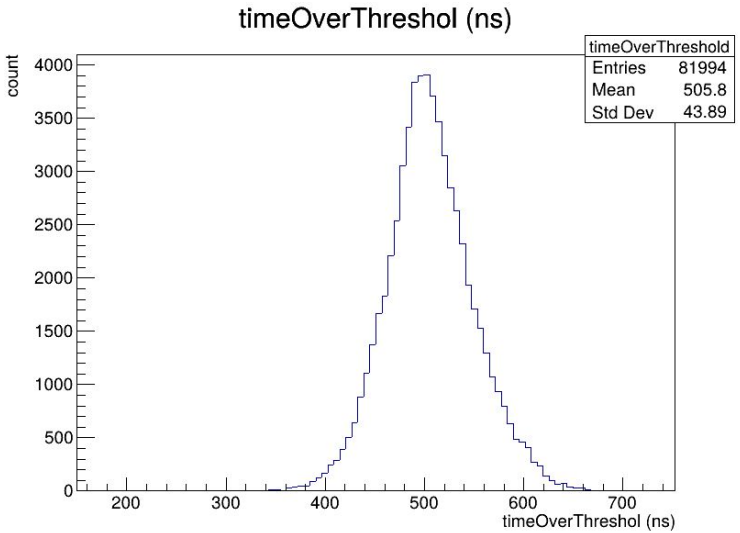


Analysis

DATA

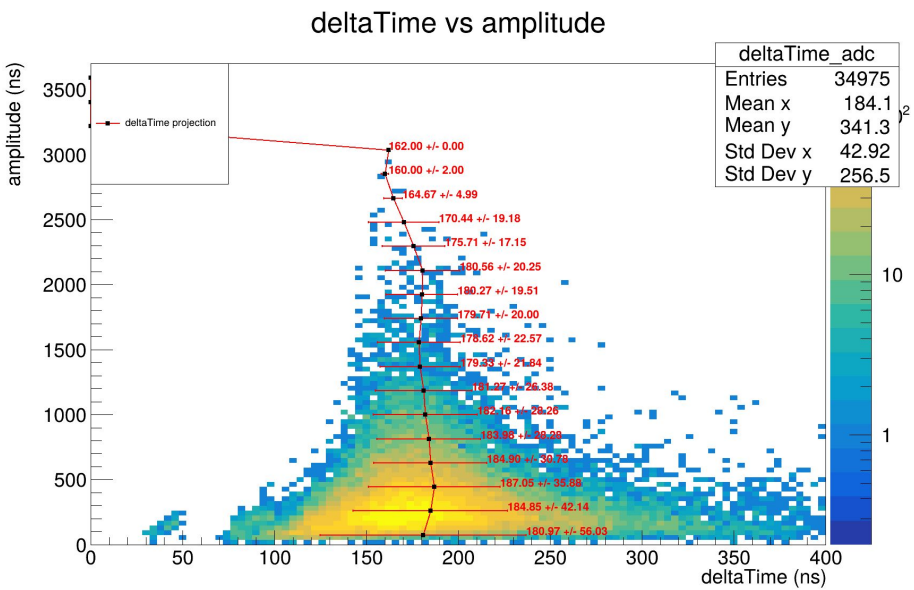


SIMU

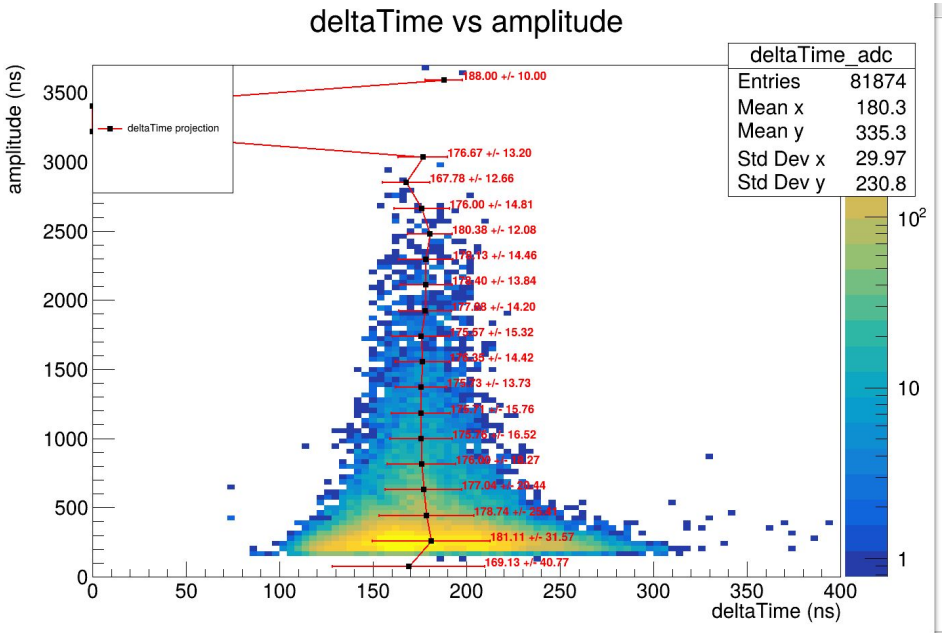


Analysis

DATA



SIMU



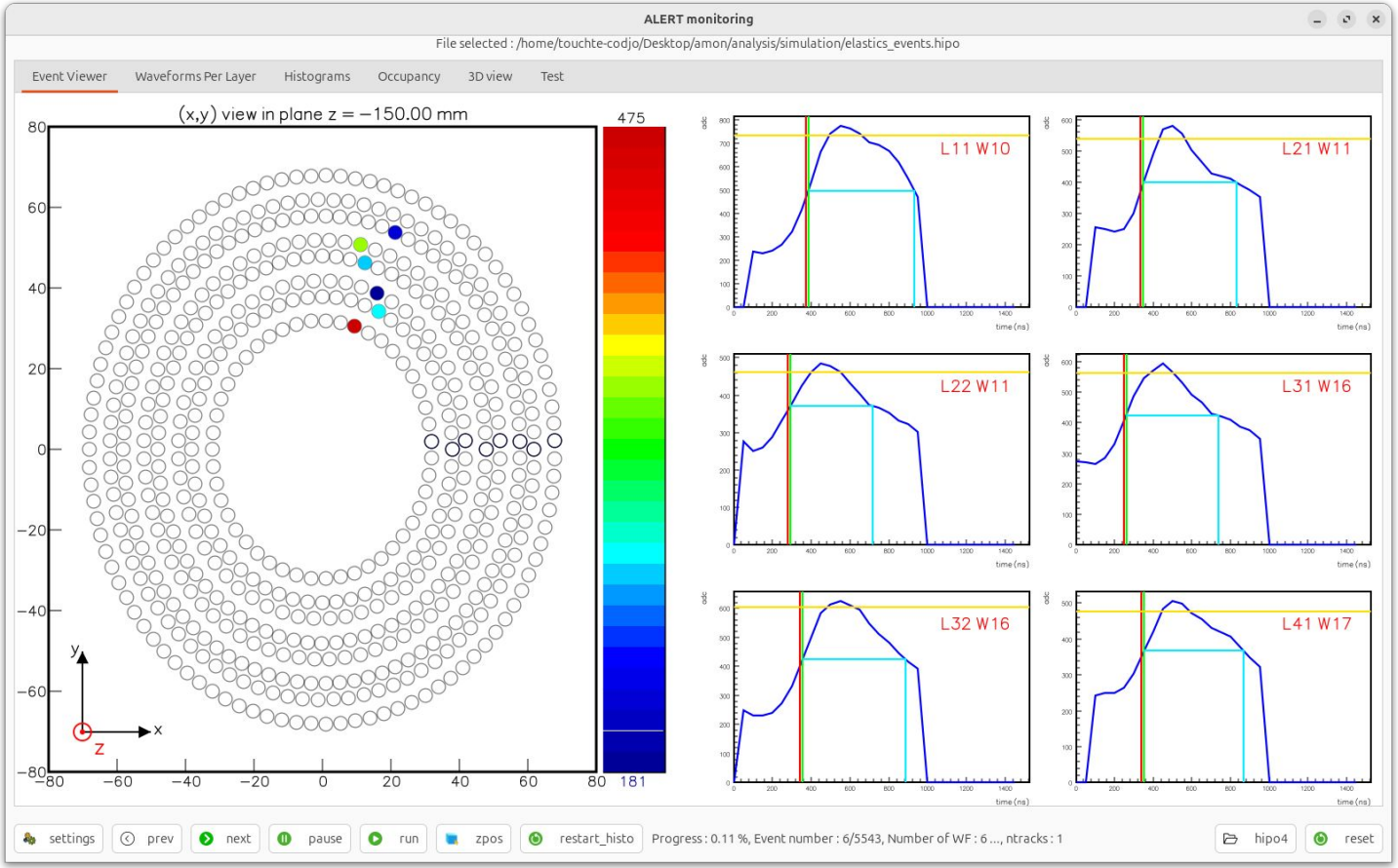
We have a hidden cut on simulation because of the wfType process that give non standard value (time = -9999) when the signal adcMax is lower that 200 (the flatness in ModeAHDC).

https://github.com/ftouchte/coatjava/blob/bd1e2fdfe146095da0f2b3d18def2b857e8892a8/common-tools/clas-detector/src/main/java/org/jlab/detector/pulse/ModeAHDC.java#L42

It is actually the first cut : that may explain the exclusion.
https://github.com/ftouchte/coatjava/blob/bd1e2fdfe146095da0f2b3d18def2b857e8892a8/common-tools/clas-detector/src/main/java/org/jlab/detector/pulse/ModeAHDC.java#L178

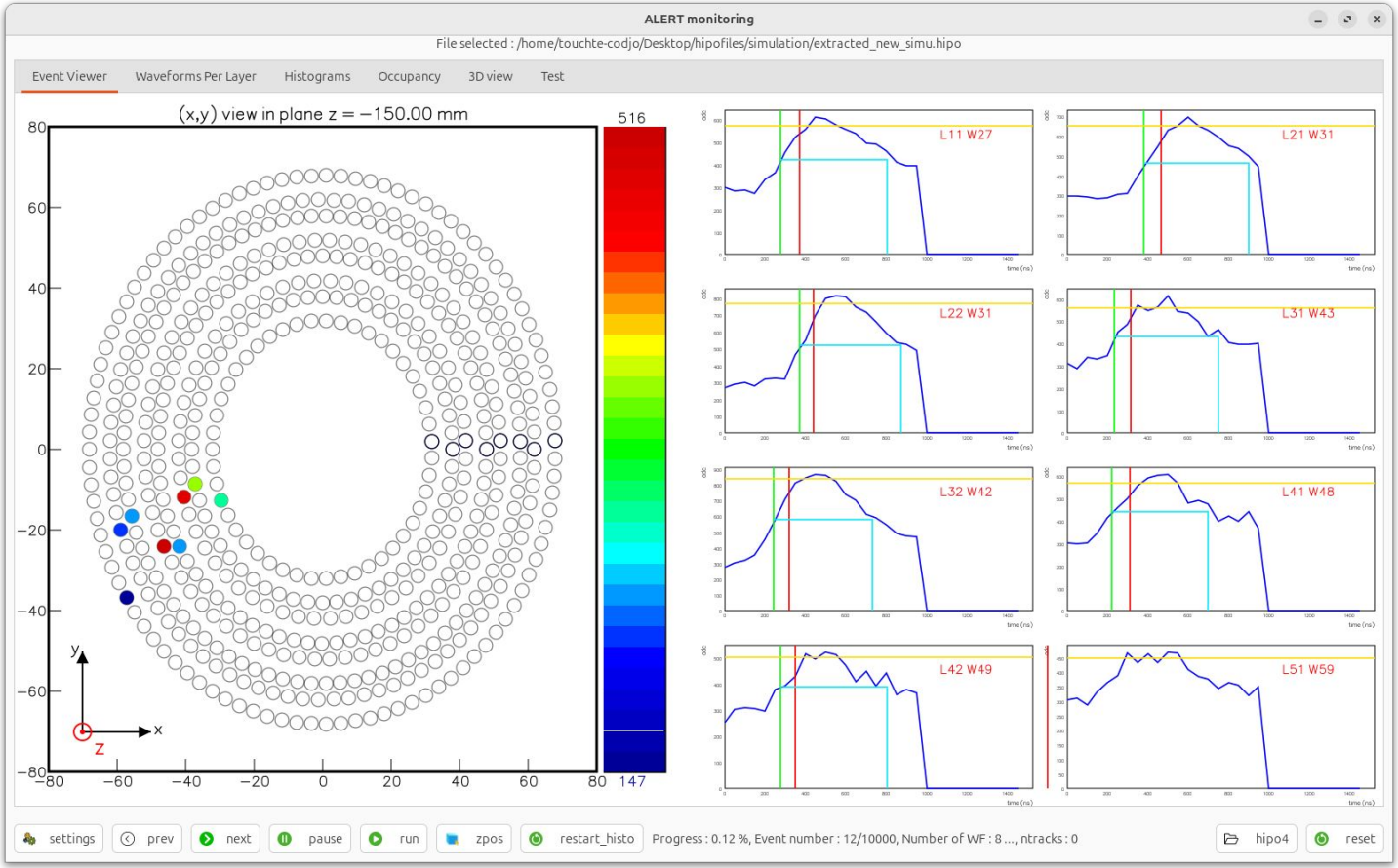
Analysis

Elastic waveforms



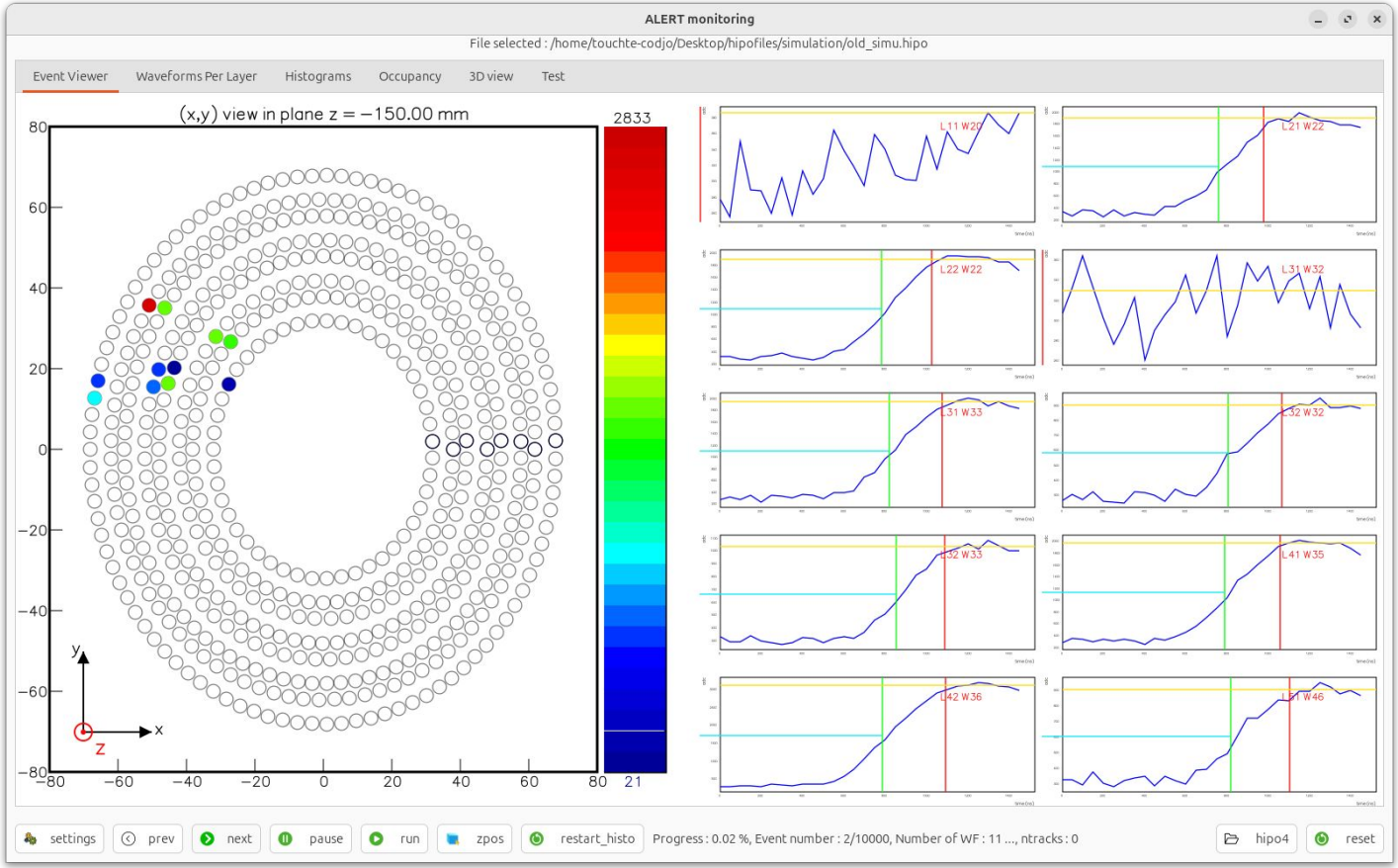
Analysis

Simulated waveforms



Analysis

Simulated waveforms (before)



Conclusion

- We use elastics data to calibrate some free parameters in simulation
- New feature in simulation
  - direct use of the t0 in simulation
- The current difference between real data and simulation
  - bad t0 calibration
  - noise level
  - decoding biais
  - elastics cuts biais