



9/16/2026

FHCal EICrecon status update

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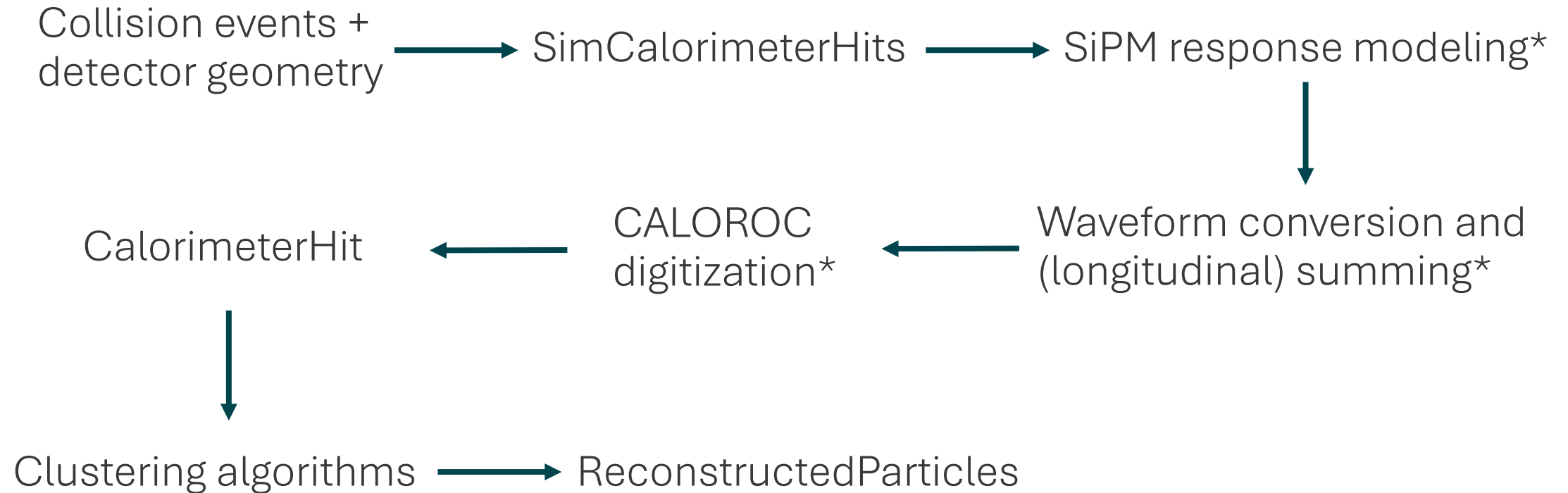


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Overview / current status



* = new

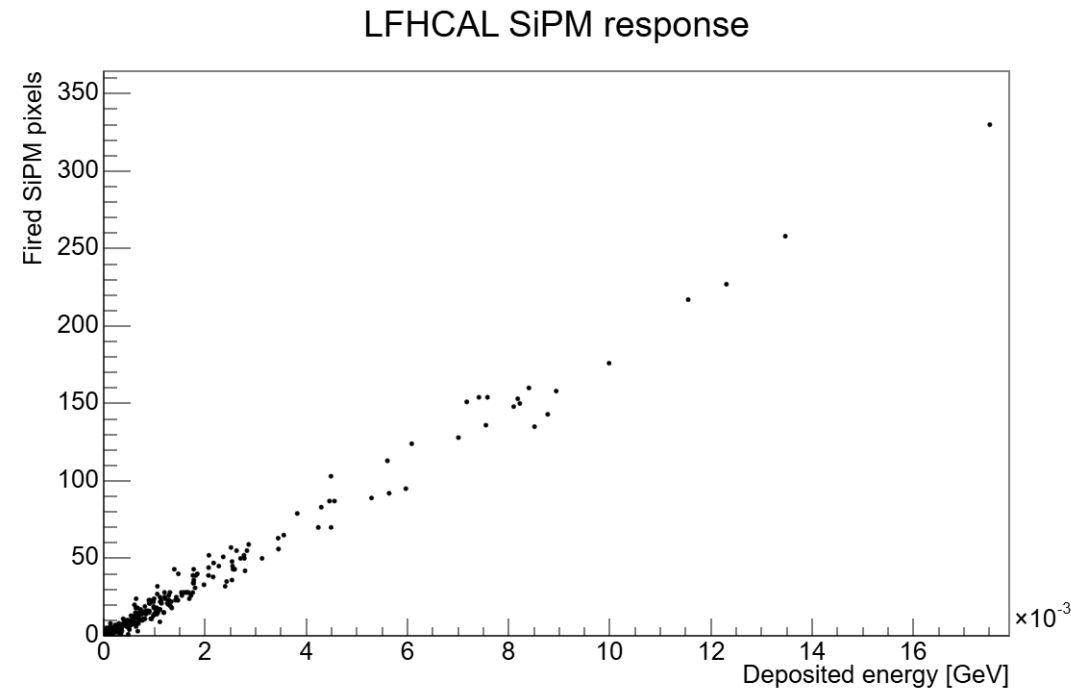
SiPM response modeling

SimCalorimeterHit energy values are directly converted into number of photons detected by a SiPM via a conversion factor:

- $\mu = (\text{hit energy}) \times (12 \text{ photons per MIP})$; equivalent to 18.75 photons per MeV

An exponential firing probability with binomial sampling is used to model SiPM saturation and statistical fluctuations.

- Fired pixels $\sim \text{Binomial}(N, 1 - e^{-\mu/N})$
 - $N = 7,284 \text{ pixels / SiPM}$



Pulse generation

Convert an amplitude (fired pixels in this case) into a waveform with a chosen shape, gain, width, and timing offset.

Shape: Landau

Sampling interval: 0.5 ns

Gain: 10

Stop condition: amplitude falls below 1 after at least 250 ns

Width: 10 ns

Max length: 32,000 samples

Offset factor: 3

* The BIC pulse generation script require SimCalorimeterHit object as an input, where an arbitrary amplitude value is stored in the “energy” field. In this case, fired SiPM pixels.

Pulse combining and noise

Sum waveforms within each readout channel when the time gap between them is less than the configured threshold.

- Separation: 0 ns
 - Measured from the latest end of the current (combined) waveform to the next waveform's start

Then add random fluctuations and a constant baseline to each combined waveform.

Noise scale: 5.4×10^{-5} (arb. units)

Baseline: 1.6×10^{-4} (arb. units)

Poles: 2

Alpha: 0

Variance: 0.5

Each waveform point becomes its original amplitude + baseline + random noise $\times$ noise scale.

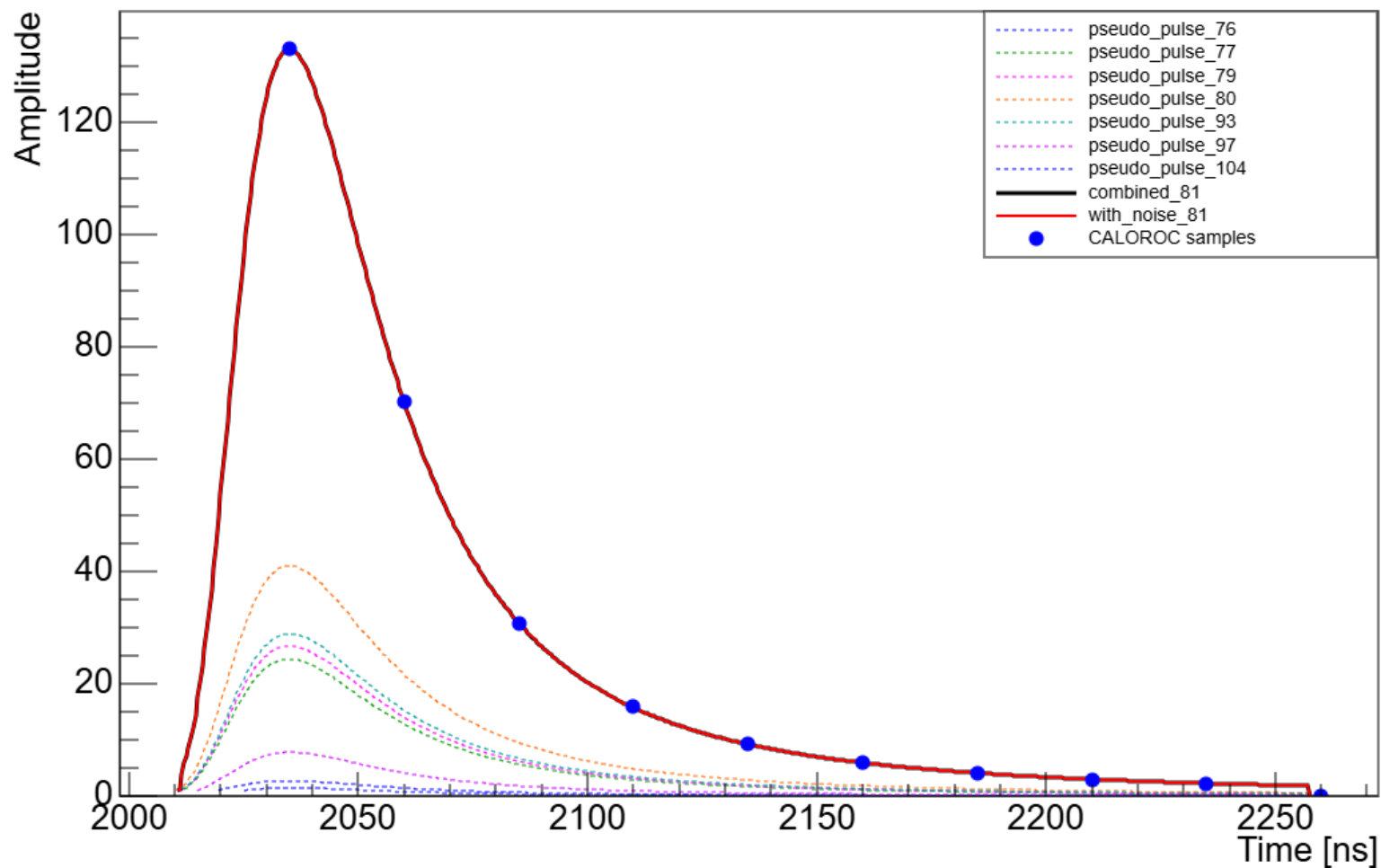
CALOROC1A digitization

Convert the waveform into digital amplitude and timing measurements.

- Sampling: 10 points, 25 ns apart; 10 ns phase
- ADC: 1,024 codes over 250 amplitude units
- ToA: threshold 5; 1,024 codes over 25 ns
- ToT: threshold 200*; 4,096 codes over 200 ns

Plot 1

Event 0, channel 88495988, combined pulse 81



CalorimeterHit conversion

Somehow convert CALOROC1A back to a Reconstructed Calorimeter Hit with the following fields:

- Cell ID
- Hit energy
- Hit time

Summary

Things seem to run; need to figure out parameters:

- SiPM response
- Pulse model
- Electronics noise
- CALOROC1A digi
- Conversion back to CalorimeterHit

Insert status

- Redesign as been merged into ePIC
 - New rate studies as campaigns release
 - Intermediate collections (particularly CALOROC digitization outputs) can be used for even more realistic values
- EICrecon has also been adapted
 - Certain clustering parameters may still need tweaking (alongside most parameters mentioned in this presentation)