Satus on Front-End Readout Electronics
→ The FATALIC Project ←

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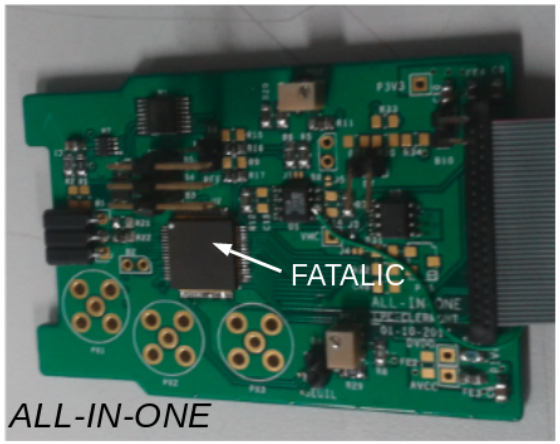
Tile Upgrade Week

– Wednesday 17th of February 2016 –

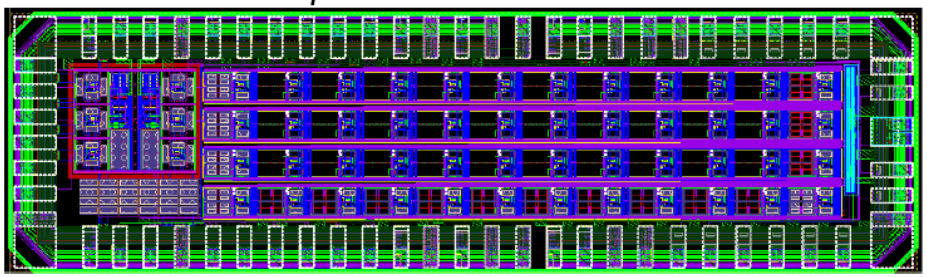
Overview

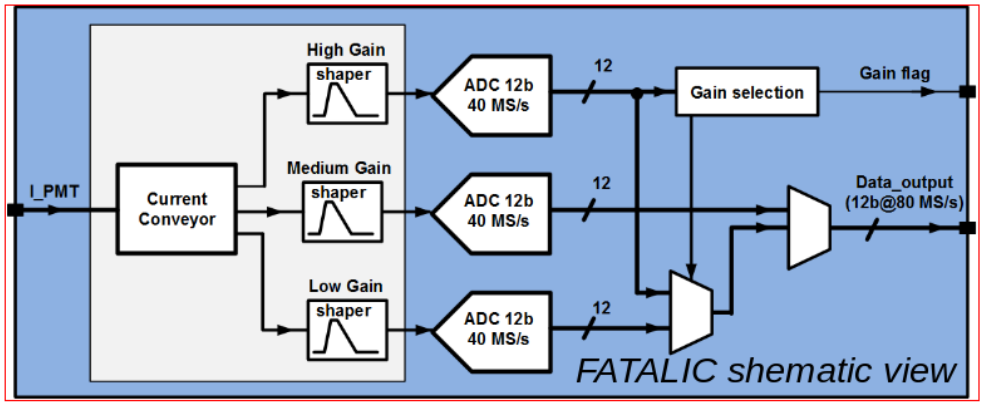
Front-end ATlAs tiLe Integrated Circuit

FATALIC chip embedded in the "All-in-One" FE board



FATALIC microscop view

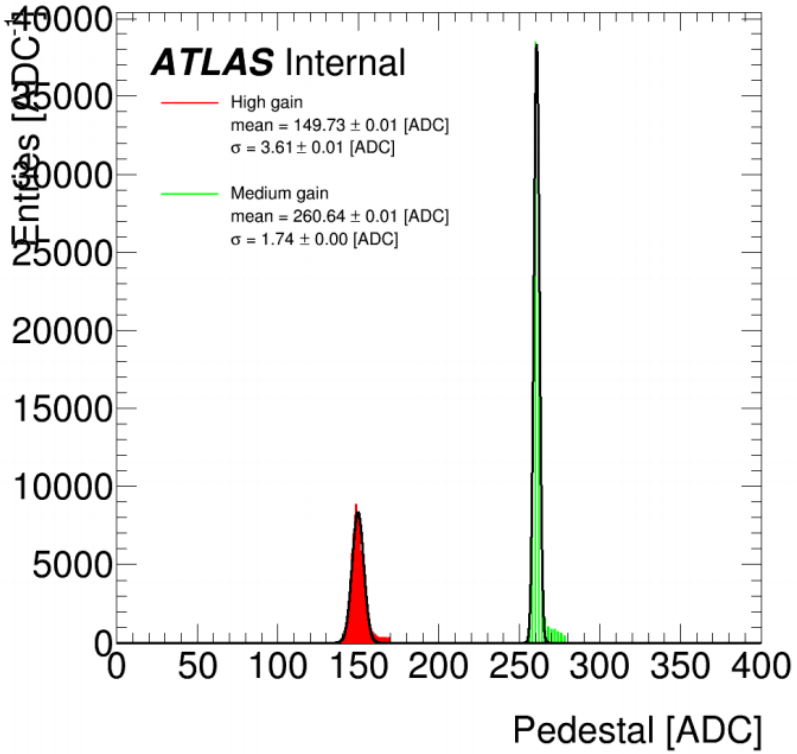




Main characteristics of FATALIC:

- A 3-gain PM-signal **analog processing** (current conveyor + 3 shapers)
- 3 embedded **12-bit ADCs** (one per gain)
- An **auto gain-selection** (MEDIUM and {HIGH or LOW})
- A **12-bit data output bus** with the data of the 2-selected gain multiplexed

Noise Measurement



Definition

Averaging ADC output values when no signal is present

$$\sigma_{\text{noise}} \equiv \sqrt{\langle \left(\text{ADC} - \langle \text{ADC} \rangle\right)^2 \rangle}$$

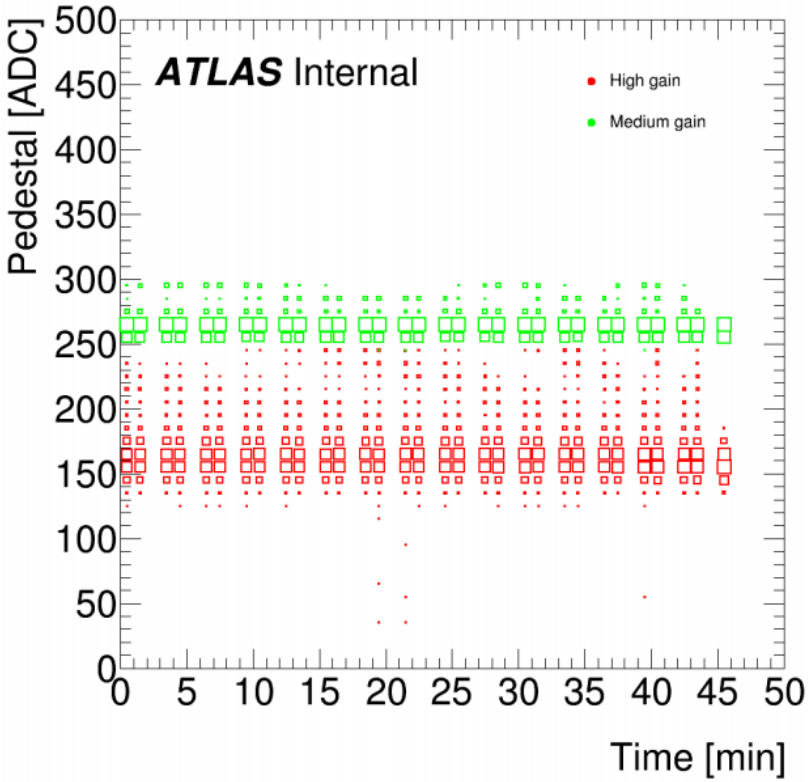
This particular measurement:

$\sigma_{\text{noise}} = 8.9$ fC

Important comments:

- Final noise might depend on the configuration (PMT, HV, EMC, etc ...).
- Many tests are on going, over { many configurations $\otimes$ many cards }
- **Very robust intrinsic noise of FATALIC: 6.94 $\pm$ 0.43 fC**

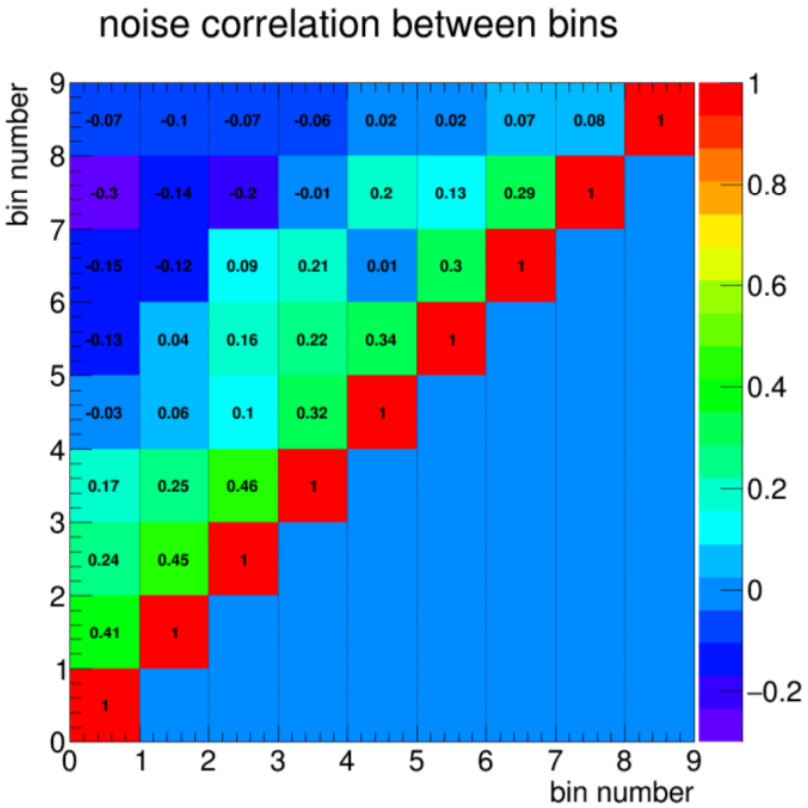
Noise Stability



Time Stability

Checking that the noise is stable, which is the case. Longer runs will be analyzed in the near future (over several hours)

Noise Correlation

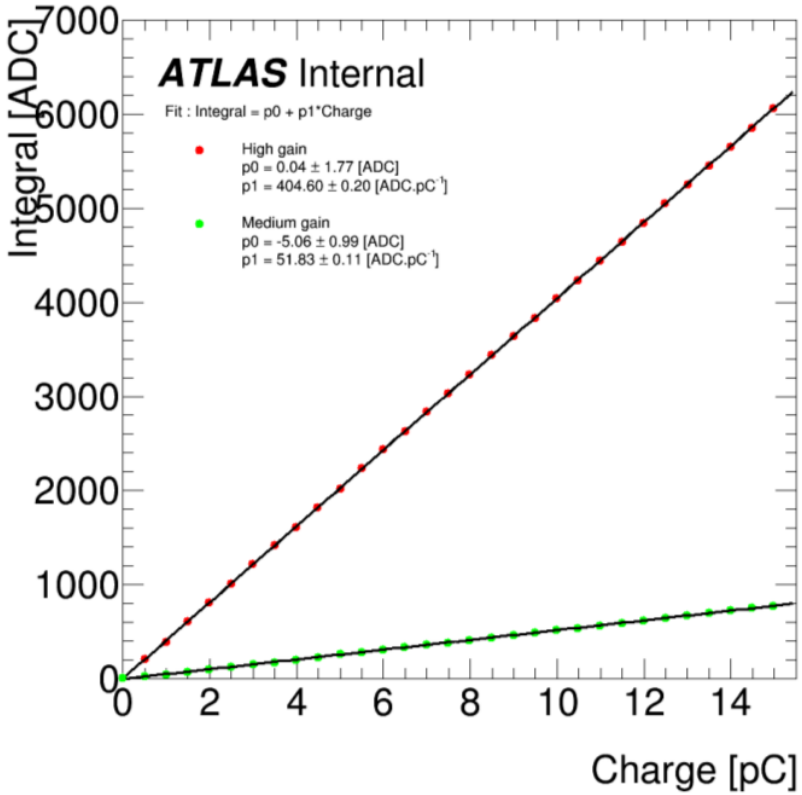


Prepare signal reconstruction

Measurement of the sample-to-sample noise correlation, needed to OF algorithm

Overview

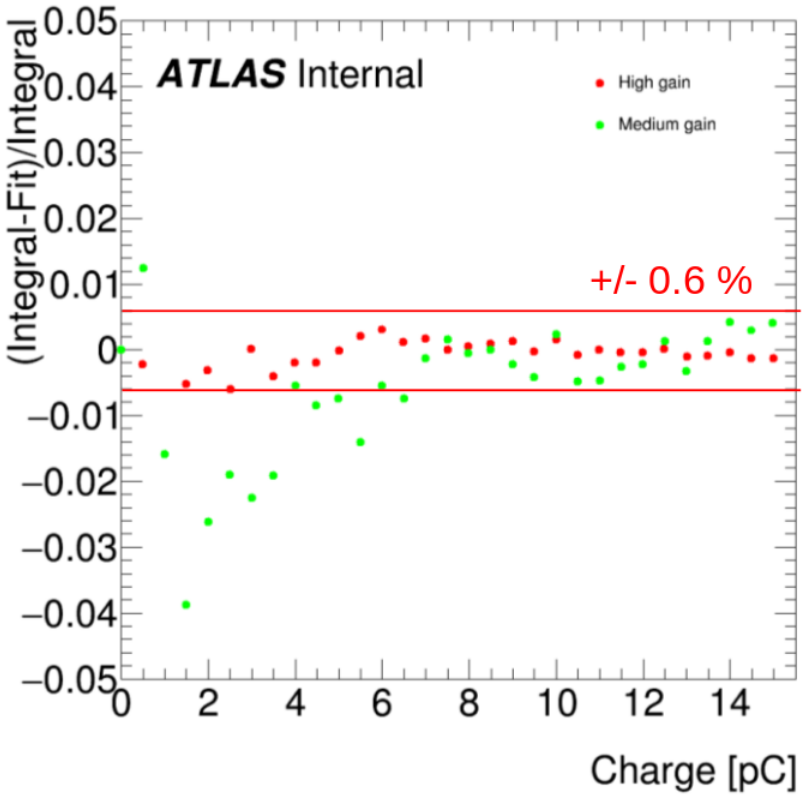
Linearity



Fine scan of the response:

Study the full-chain reponse for Q between 0 and 15 pC. Very good linearity after removing pedestals (in a simple way - no OF here)

Residus



Non-linearity:

At the level of few per milles for the high gain (medium gain irrelevant for this range of injected charge)

To come: investigate the linearity over the whole charge range

Overview

Motivations

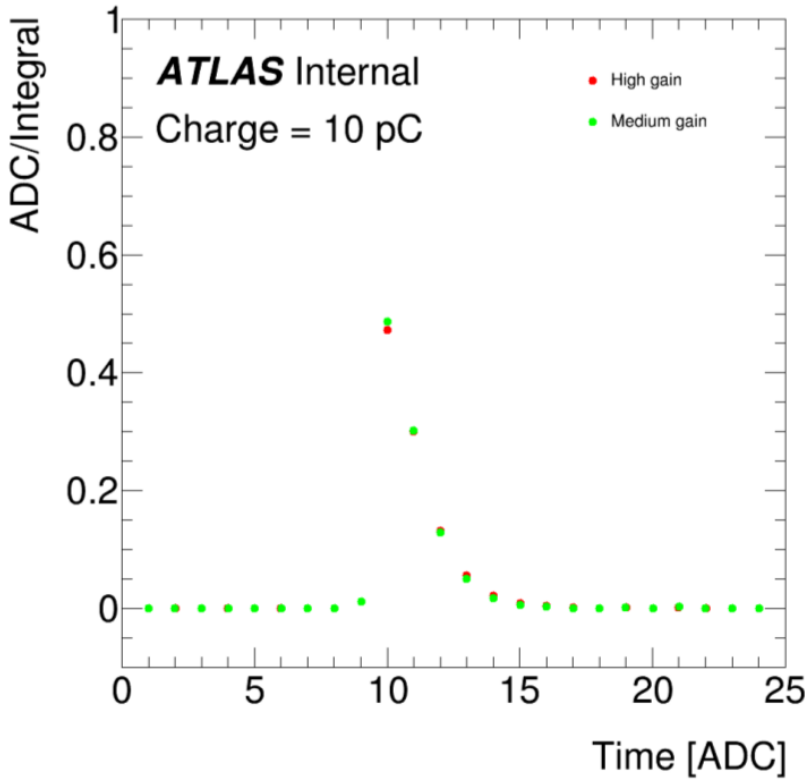
Readout response should depend on pulse shape (different frequency spectrum)

Having a good understanding of the pulses shape is important for all aspects:

- readout characteristics measurement
- energy/time reconstruction
- simulation of electronics and full-chain up to energy reco

In the next few slides: few comparisons are shown

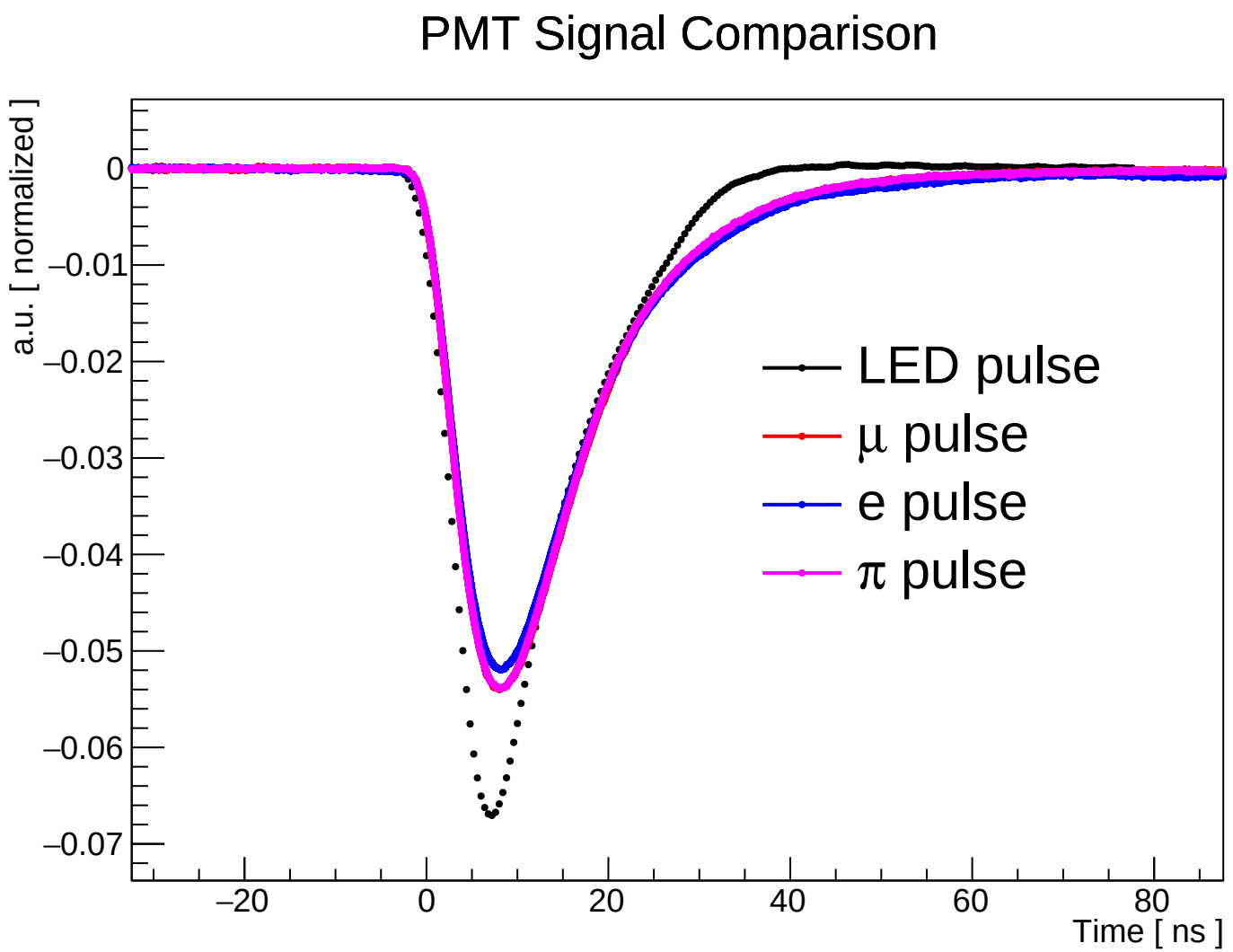
Full-chain Signal Comparison: Med vs High gain



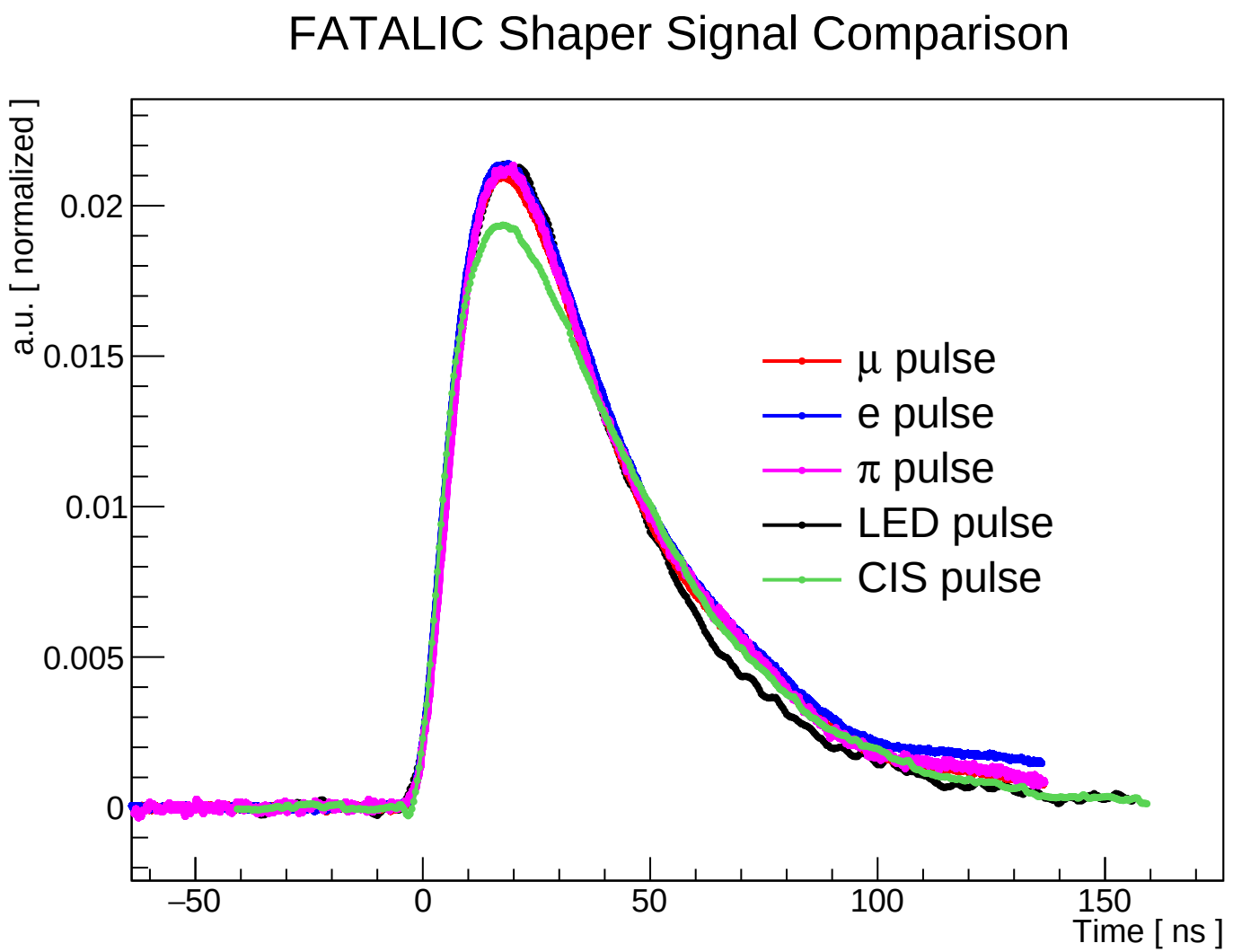
Integral fraction in each sample

Both medium and high gain show same (similar) fractions, which is important to check for OF

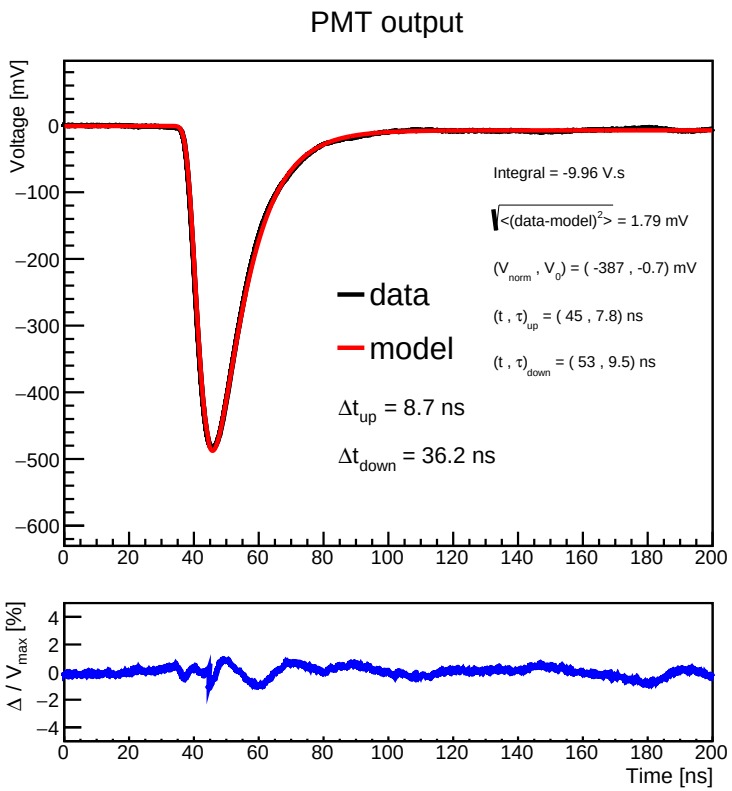
PMT Signal Comparison

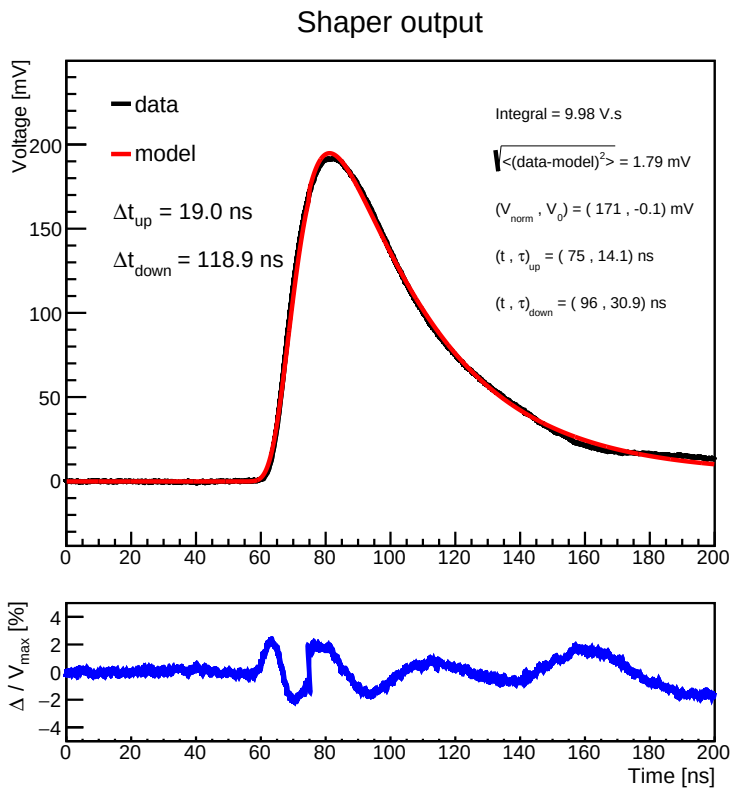


Shaper Signal Comparison



Analytical pulse analysis





Comment: might be useful for electronics simulation and to assess systematics on shape variations in different systems (CIS, LED, simulated pulses, etc ...)

Summary

Noise measurement: measurements are on going

Linearity measurement: low charge regime is now precisely characterised, need to go on the full range.

Pulse analysis: many studies on-going, need to propagate them to better establish readout performances, using simple OF to reconstruct time/energy.

Important pending point: read FATALIC data through the daughter board