

Test-beam Data: electronic pulses from PMTs and FATALIC

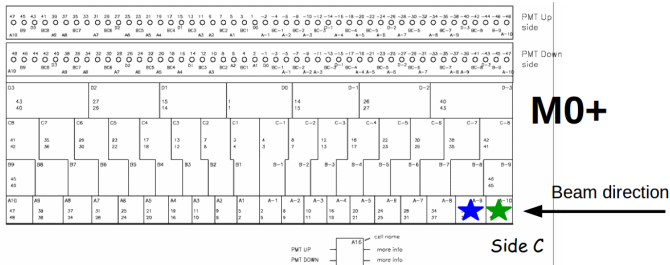
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Clermont-Ferrand – France

Tile Upgrade Meeting
– Wednesday 28th of October 2015 –



Introduction



FATALIC analog pulses
 PMT38 cellA9
 PMT39 cellA9

PMT direct output pulses
 PMT47 cellA10
 PMT48 cellA10

Electron : 50 GeV, > 90 % purity
 Muons : 180 GeV
 Pions : 180 GeV

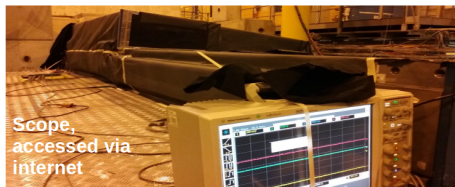
One comment: A10 cell $\sim 8X_0$, all the energy of electrons is contained in the first cell
 → FATALIC barely sees electron pulses

More information: <https://pcata007.cern.ch/eLog/TB2015/142>

Introduction



4 channels (2 PMT, 2 FATALIC shaper)
Trigger on muon scintillator signals



More information: <https://pcata007.cern.ch/eelog/TB2015/142>

Raw Pulses from the Scope

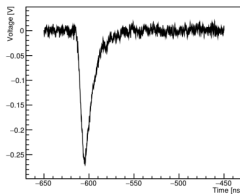
electrons

muons

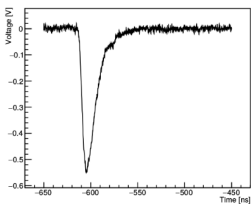
pions

PMT

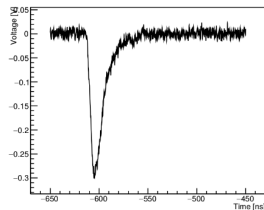
PMT direct output, evt 714



PMT direct output, evt 1

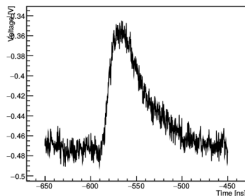


PMT direct output, evt 301

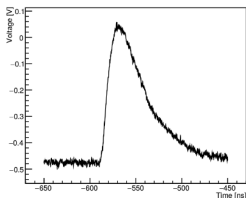


FATALIC shaper

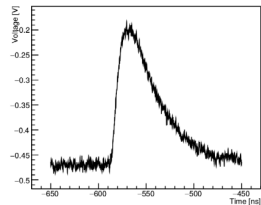
FATALIC analog output, evt 721



FATALIC analog output, evt 19



FATALIC analog output, evt 306



Pulses Analysis

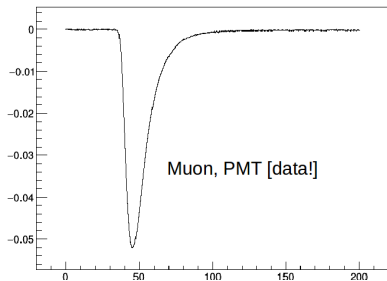
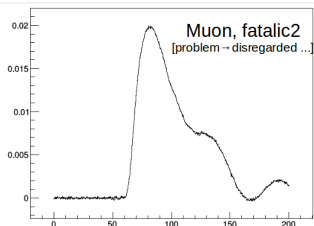
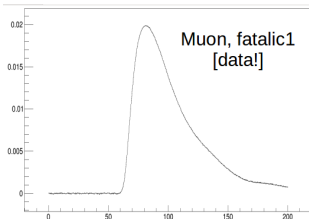
What can be done?

- Look at **pulses event-by-event**: check the shape, the energy range (high fluctuation in pion energy deposit), etc ...
- Look at **average pulse shape**: average pulse PDF over all events
- Find an **analytic function** for pulses: valuable input for simulations
- Compare with **pulses taken before phase-I** (with Jim Picher's help)
- **other idea?**

What is already started?

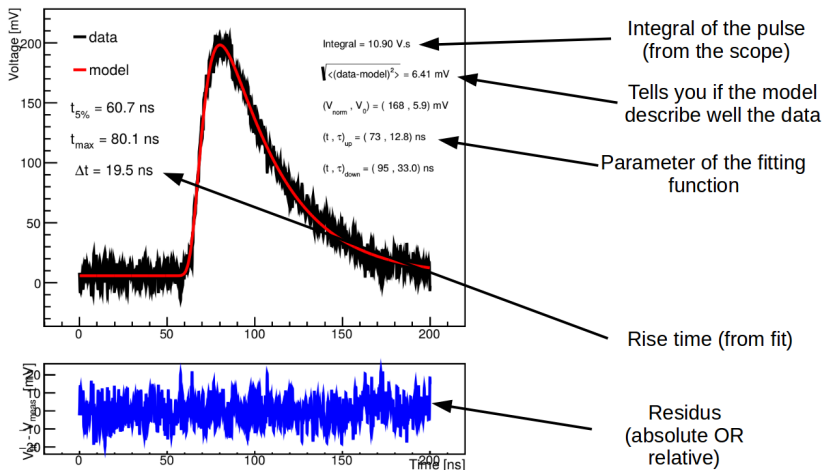
- Analytic function to fit shapes
- Look at pulses event-by-event
- Look at averaged pulses

Averged pulses - example of muons



Analytic pulses

FATALIC analog output, evt 00218



Goal : perform this fit on all pulses and study their properties statistically

Analytic pulses

Fit function: empirical form based on

- ❶ Normalisation and offset
- ❷ Very steep turn-on (Erf function)
- ❸ turn off (exponential)

Rise time definition: In this presentation, the rise time is

$$(\Delta t)_{\text{up}} \equiv |t_{V_{\text{max}}} - t_{5\%V_{\text{max}}}|$$

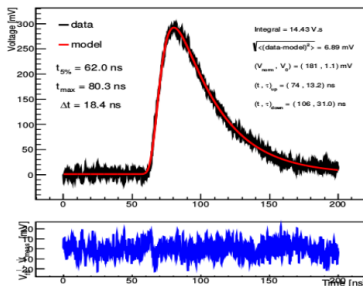
Advantages:

- fit both PMT and FATALIC pulses (see next slide)
- Comparison of two pulses in term of few parameters
- Rise time less sensitive to fluctuation

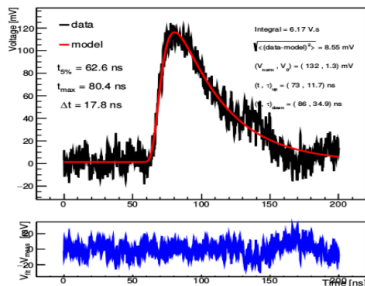
Possible applications:

- Can be used in electronics simulation
- numerically test (E, t_0) reconstruction stability for different sampling timing, (in time) pile-up, etc ...

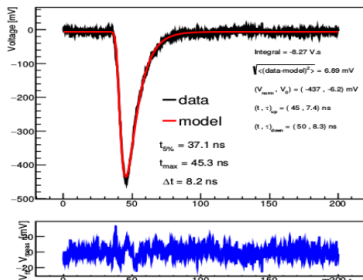
FATALIC analog output, evt 00200



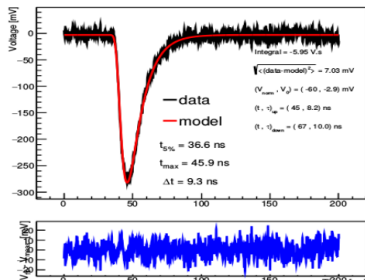
FATALIC analog output, evt 00200

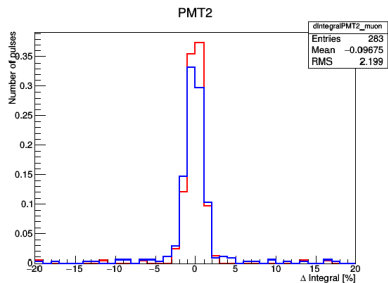
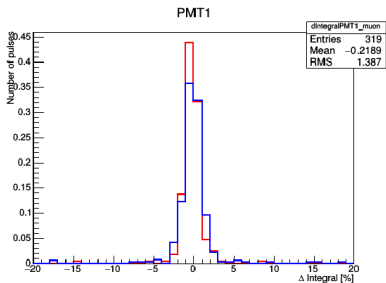
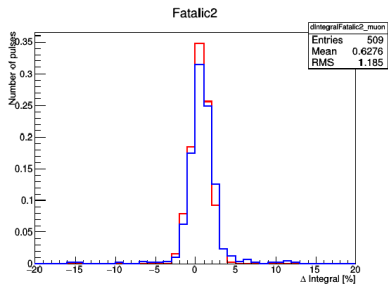
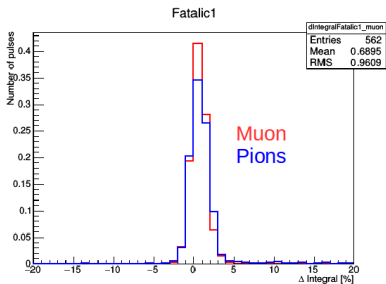


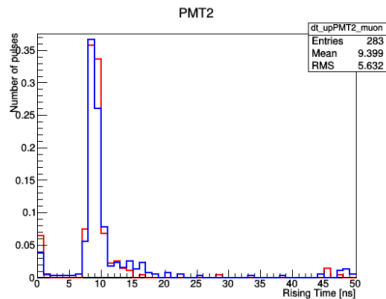
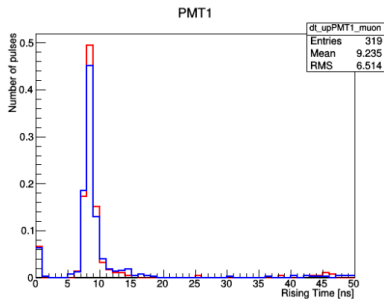
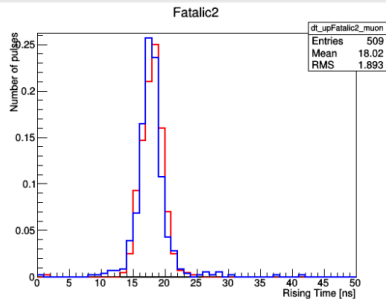
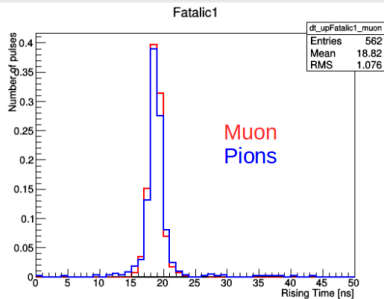
PMT analog output, evt 00200



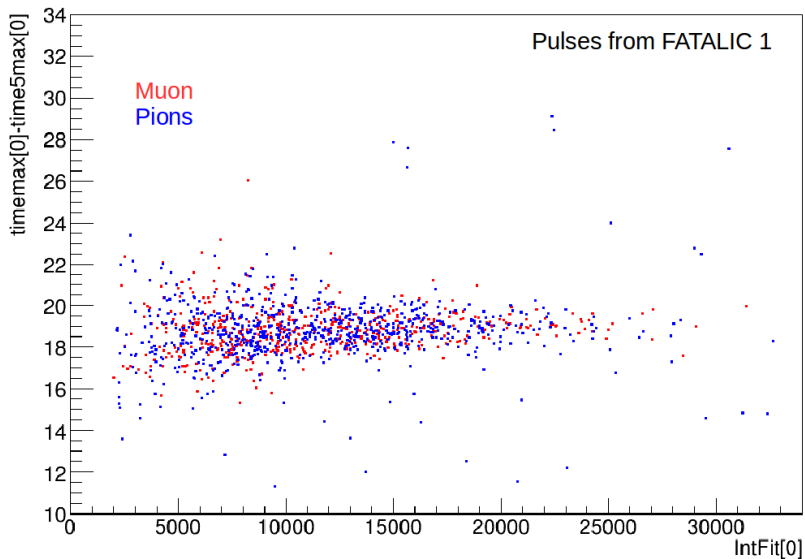
PMT output, evt 00200



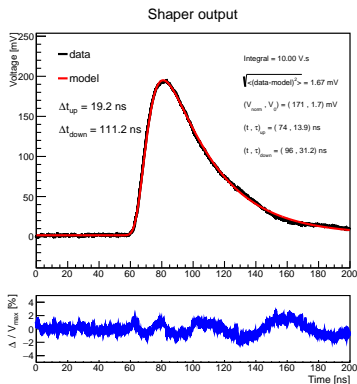
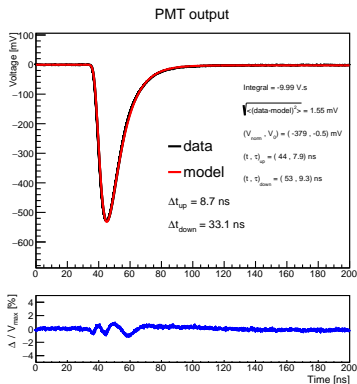




Rise time VS integral

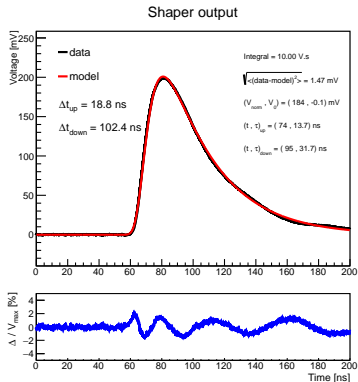
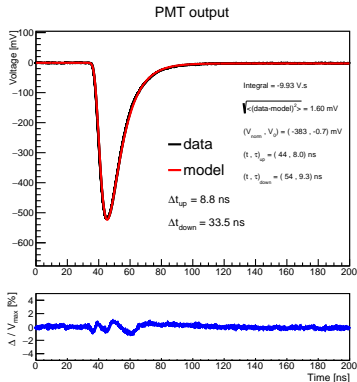


Analytic shape for averaged pulses: electrons



Precision of the analytic function better than 2% of V_{max}
 Less statistics on FATALIC because of the 8X₀ of the first cell

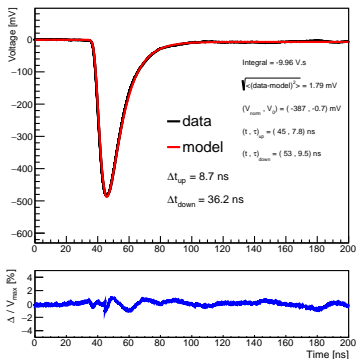
Analytic shape for averaged pulses: muons



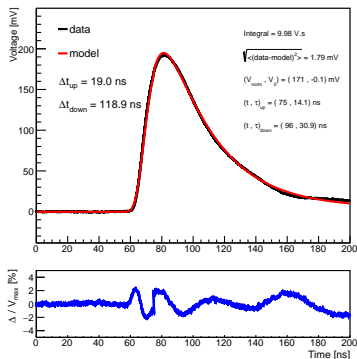
Precision of the analytic function better than 2% of V_{max}

Analytic shape for averaged pulses: pions

PMT output



Shaper output



Precision of the analytic function better than 2% of V_{max}

Possible internal note ?

Contents

1	Introduction	2
2	Test-beam data	2
3	Pulse shape studies	3
3.1	Analytical description	3
3.2	PMT pulses caraterisation	3
3.3	FATALIC pulses caraterisation	3
4	Results	3
4.1	Comparison of different particles	3
4.2	Comparison with previously measured PMT pulses	3
4.3	Comparison with LED pulses	3
4.4	Comparison with charge injector	3
5	Example of applications	3
5.1	Readout simulation	3
5.2	Energy and time reconstruction optimisation	3
5.3	Impact of pile-up on energy and time reconstruction	3
6	Conclusion	3