Preliminar Analysis of PMT Signals

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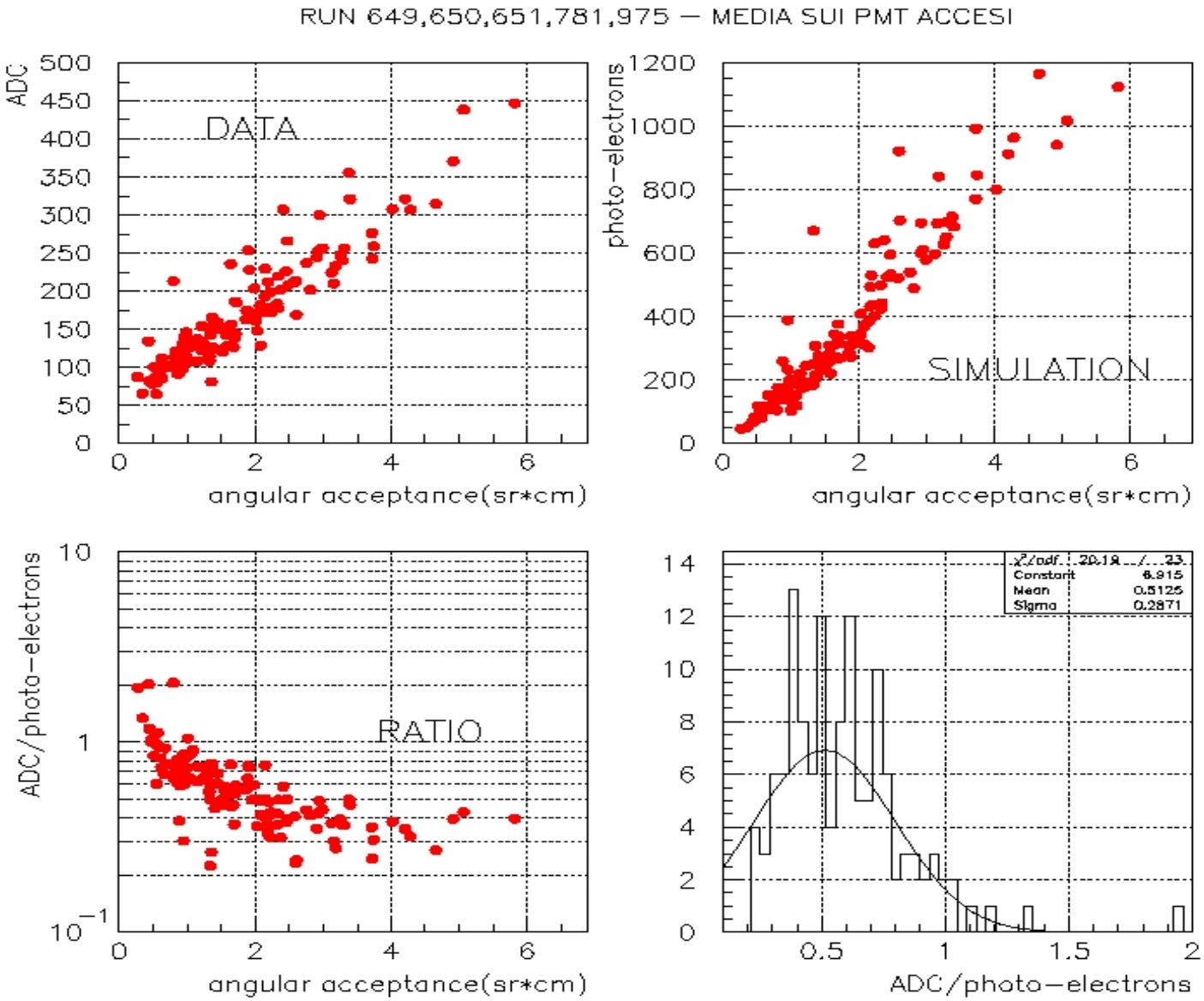
Icarus Meeting September 3-4 2003 LNGS

Comparison DATA - SIMULATION

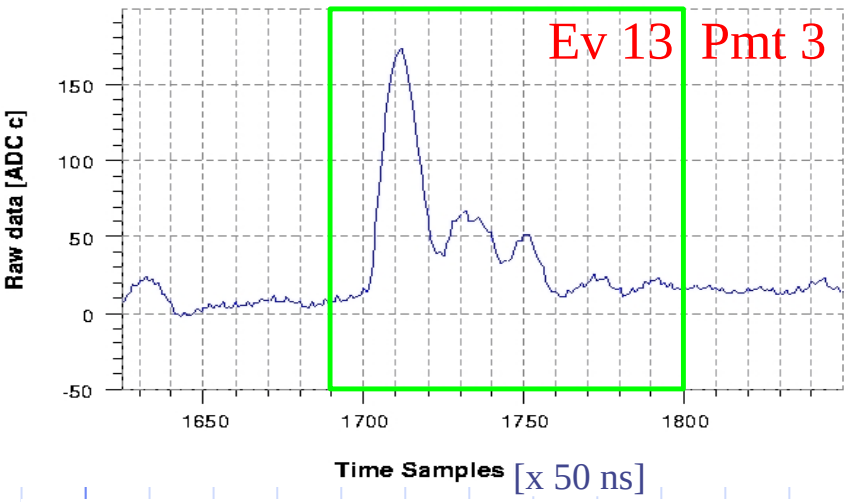
- Analysis puts in evidence some discrepancies between Data and Simulation.
- We try to understand PMT Signals better.

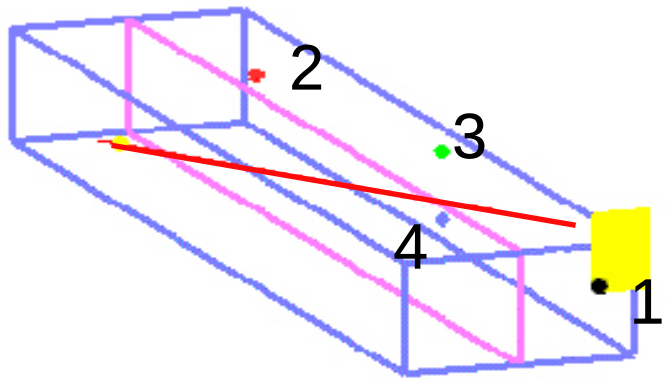
Comparison DATA-Simulation

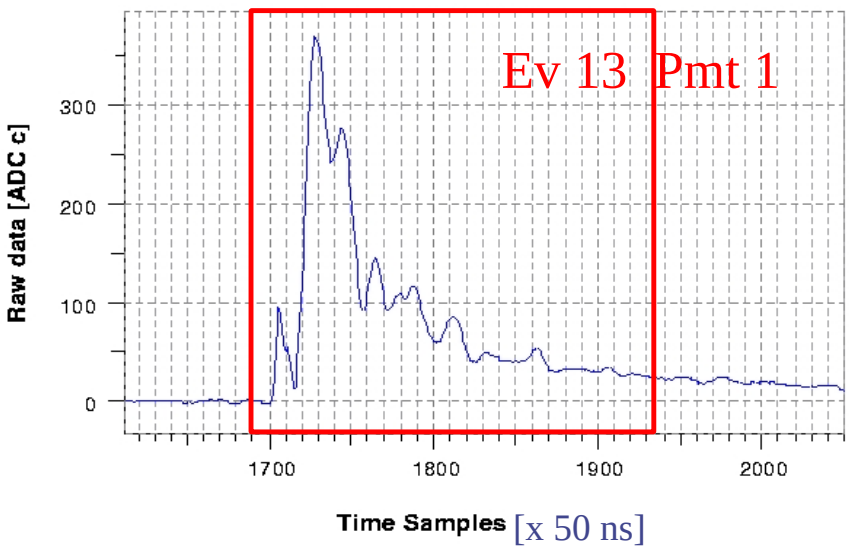


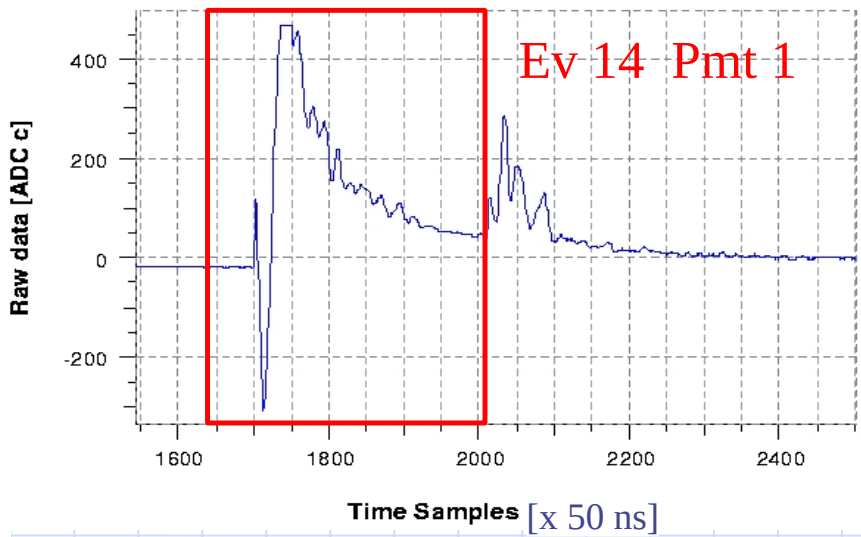
Data Sample: Run781

Some Examples of signals:

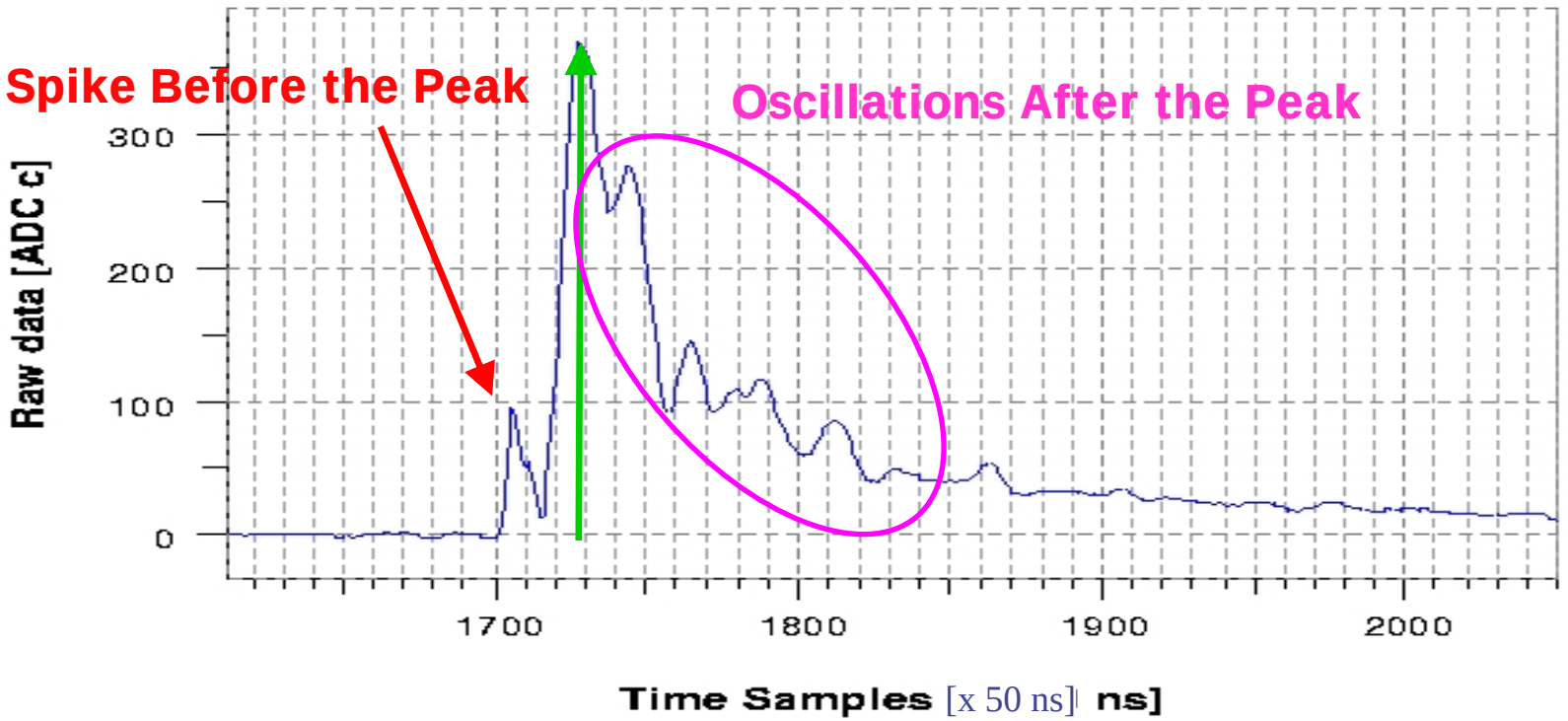








Bad Signal Characteristics

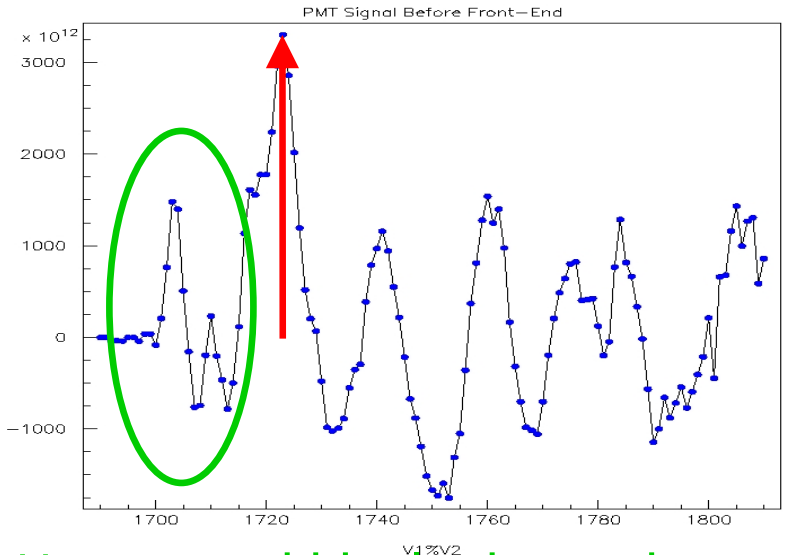


The front-end circuit is an integrator, so the information of the number of photons is carried by the hit amplitude. For this reason we are not interested in what happen after the peak.

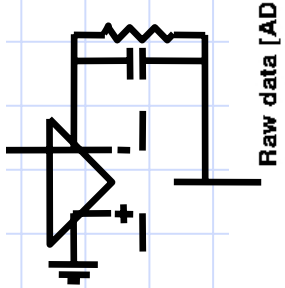
First Step

- We tried to go back up to the input signal by software

Reconstructed Input Signal

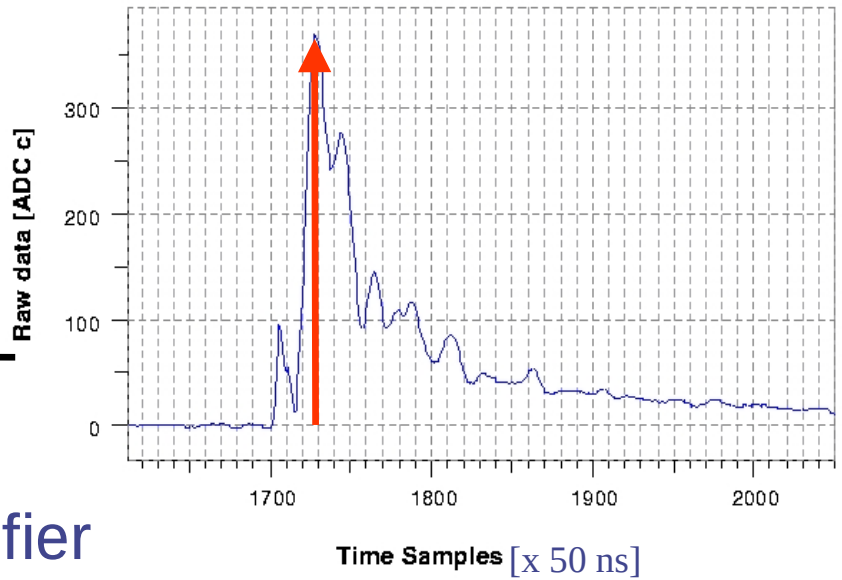


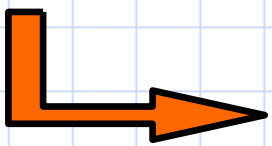
Unexpected bipolar input shape Before the Peak



PreAmplifier (integrator)

Real Data





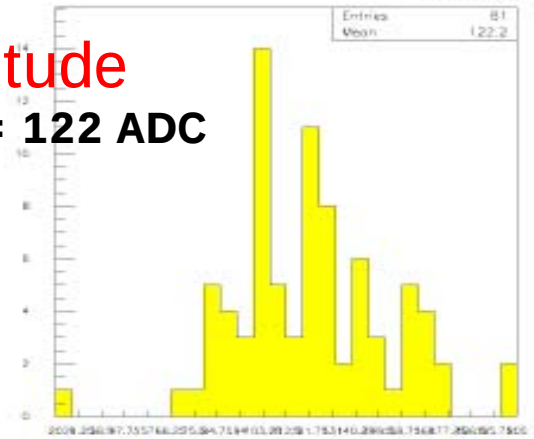
Electronics seems not to work in the expeted way

Good Signals

RUN781 – Good Signals

Amplitude

Mean = 122 ADC



Amplitude – Good Signals (ADC)

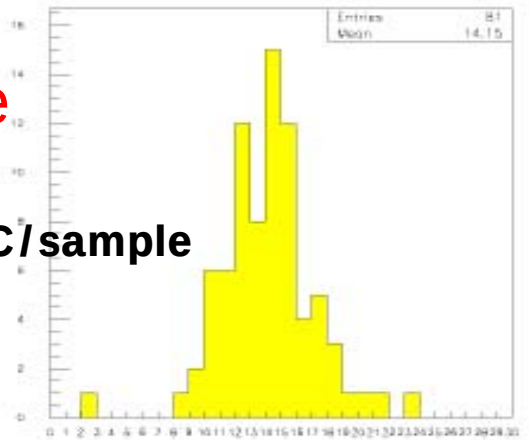
Hit Time

Mean = 1708 sample

Hit Time – Good Signals (sample)

Rising-edge Slope

Mean = 14 ADC/sample

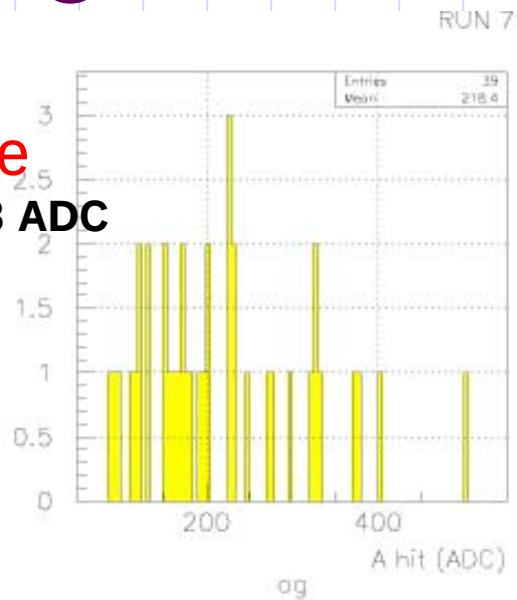


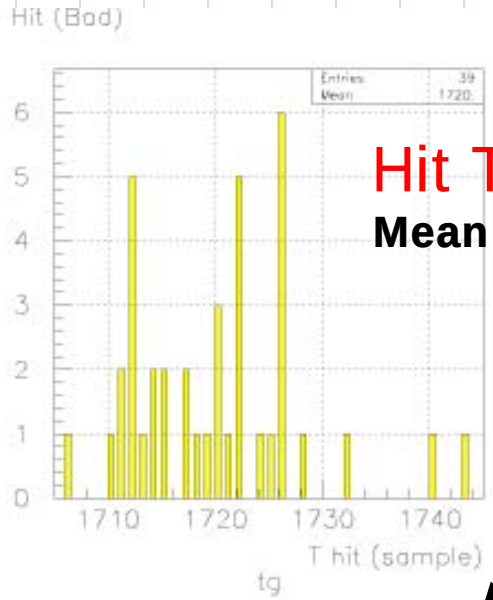
Slope – Good Signals (ADC/sample)

Bad Signals : Hit

Amplitude

Mean = 218 ADC





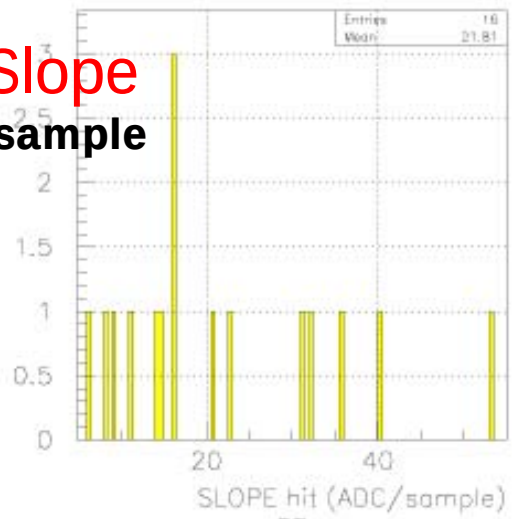
Hit Time

Mean = 1720 sample

Hit Delay!!!

Rising-edge Slope

Mean = 22 ADC/sample



Problems:

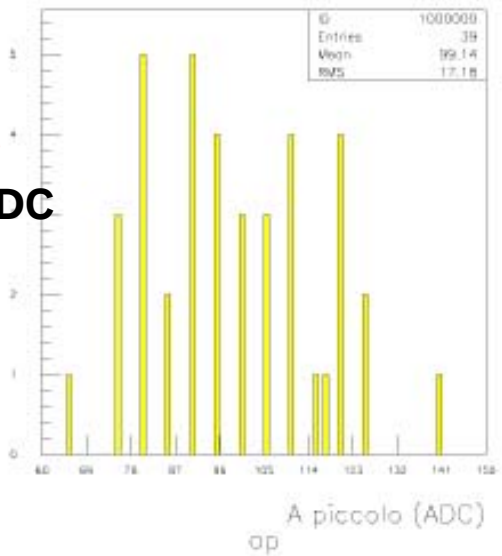
-Which is the correct T_0?

-Are we taking the correct Amplitude for data analysis?

Bad Signals : Spike

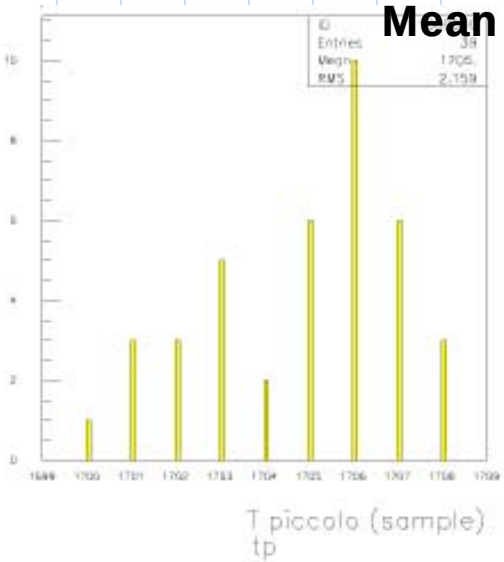
Amplitude

Mean = 99 ADC



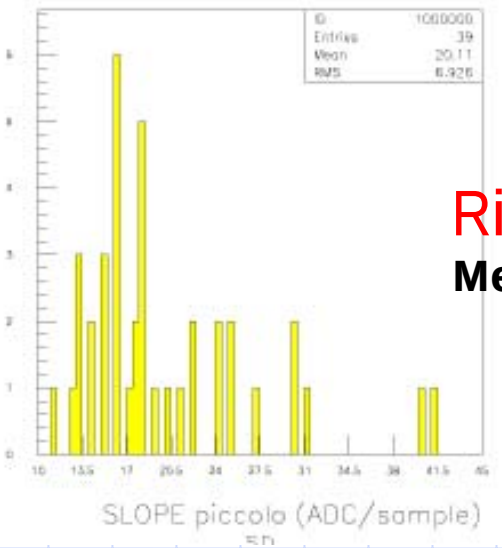
Hit Time

Mean = 1705 sample

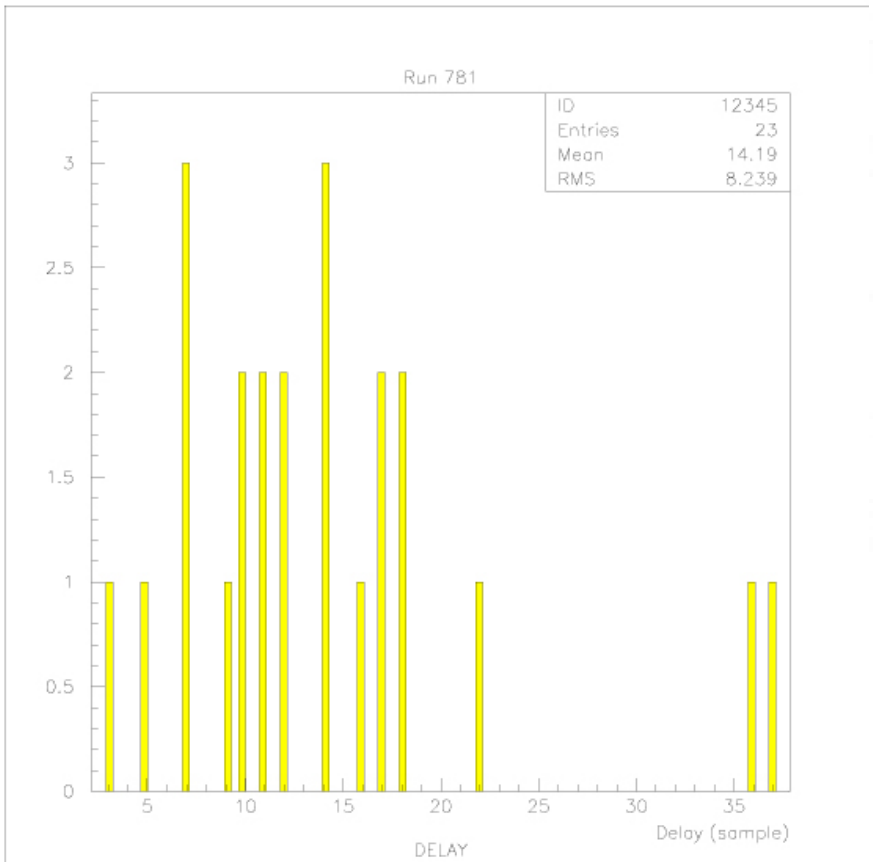


Rising-edge Slope

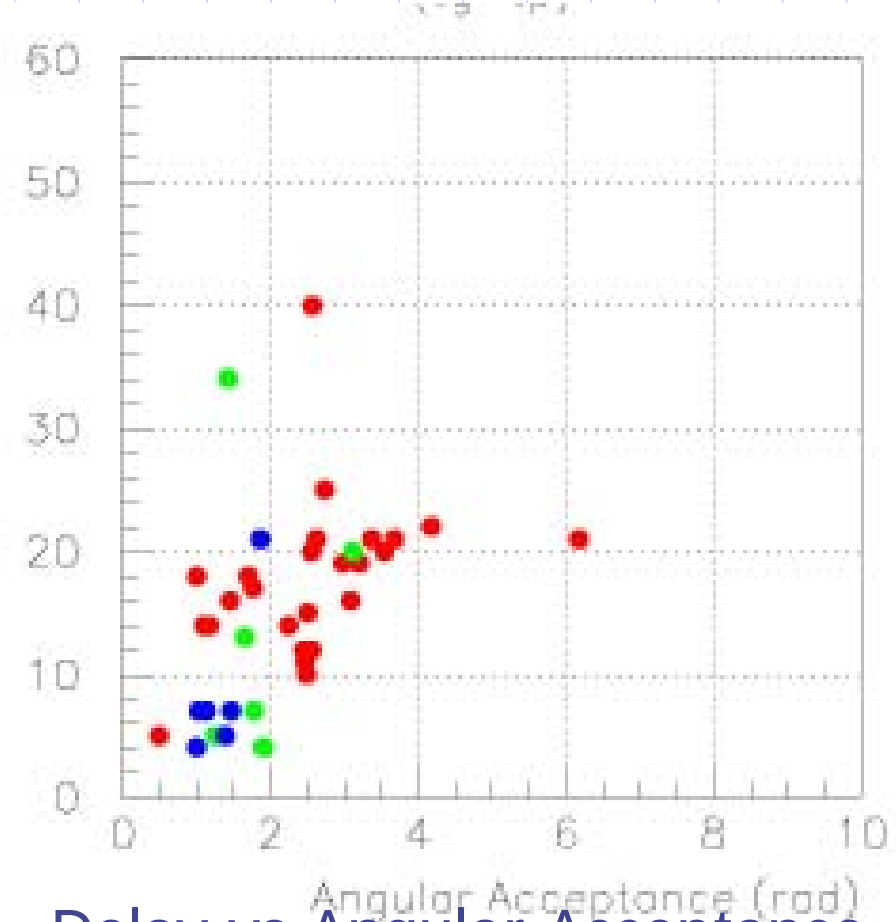
Mean = 20 ADC/sample



Bad Signals: Hit Delay

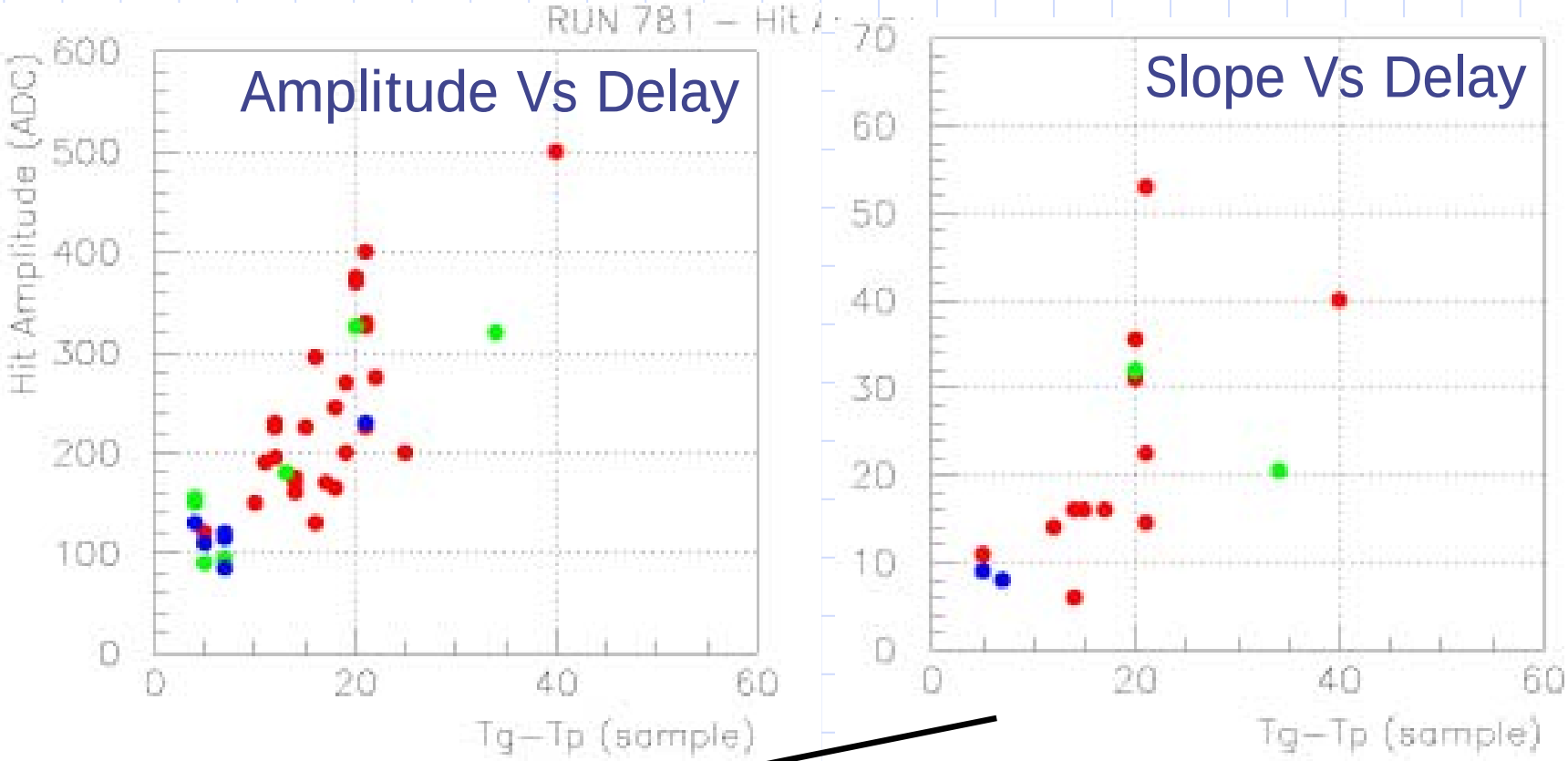


Mean = 14 sample = 0.7 μs



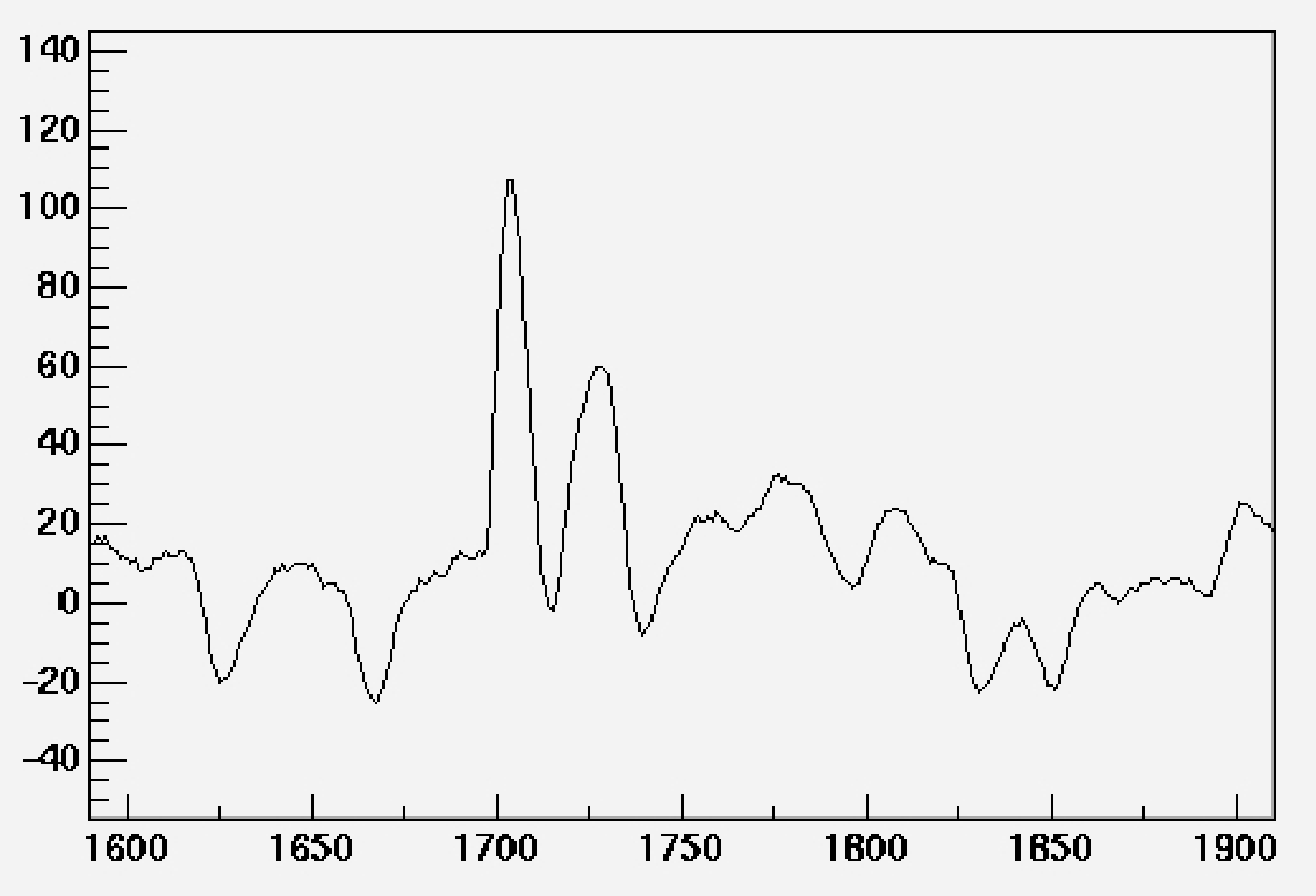
Delay vs Angular Acceptance

Bad Signals: Hit

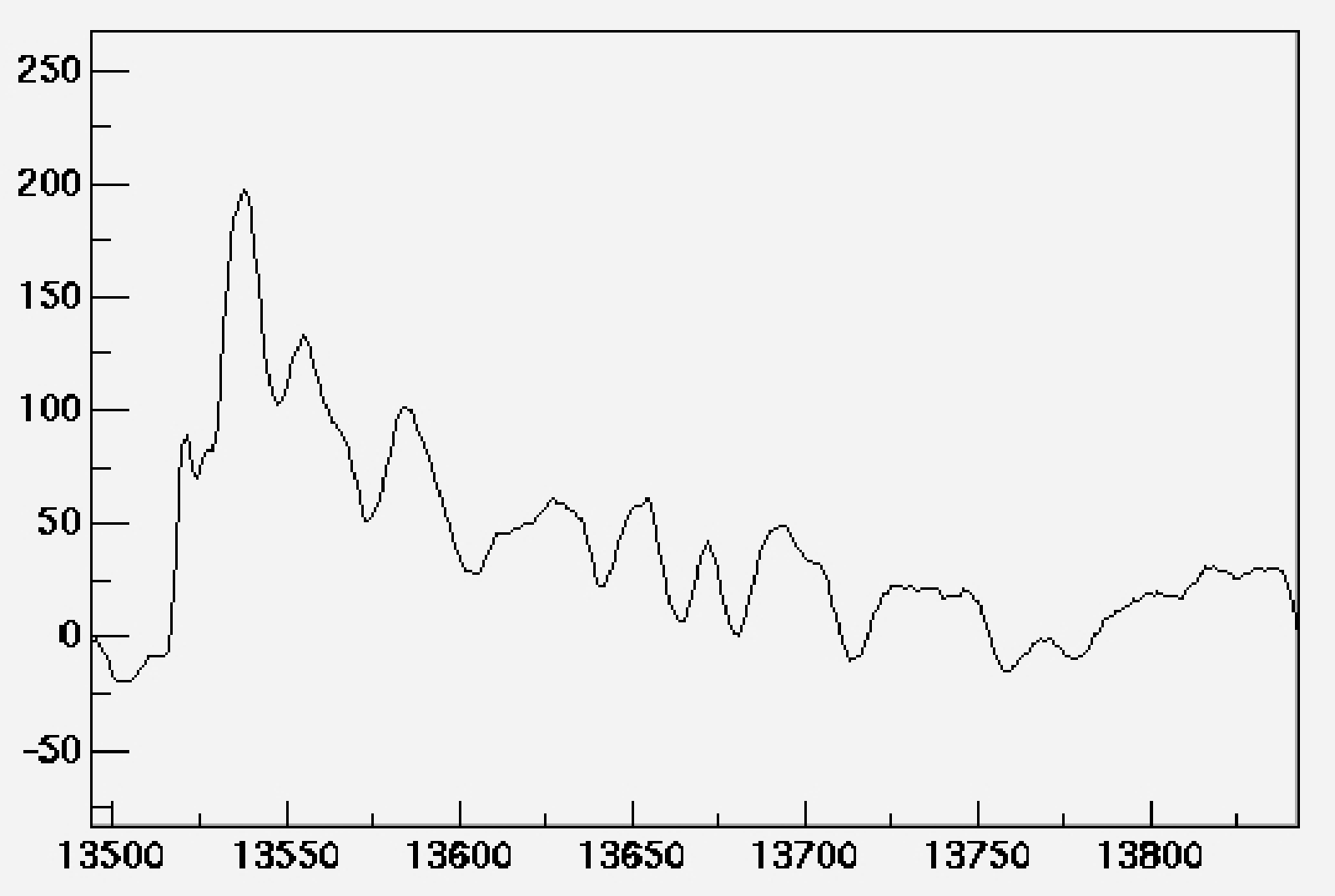


Time distorsion grows not only with Hit Amplitude but also with rising-edge slope (amplifier slew rate problem?)

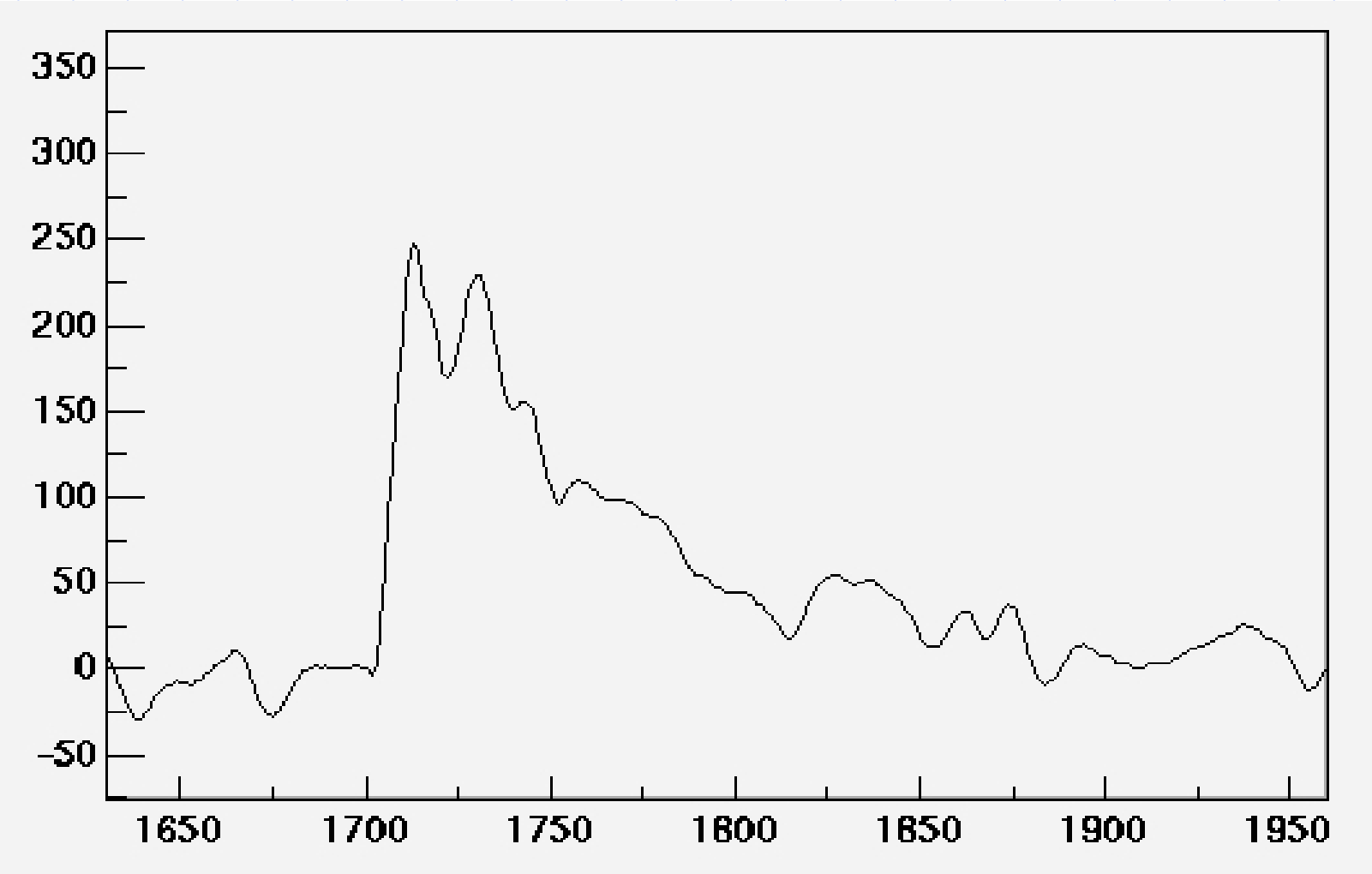
Run975 Event48 PM 10



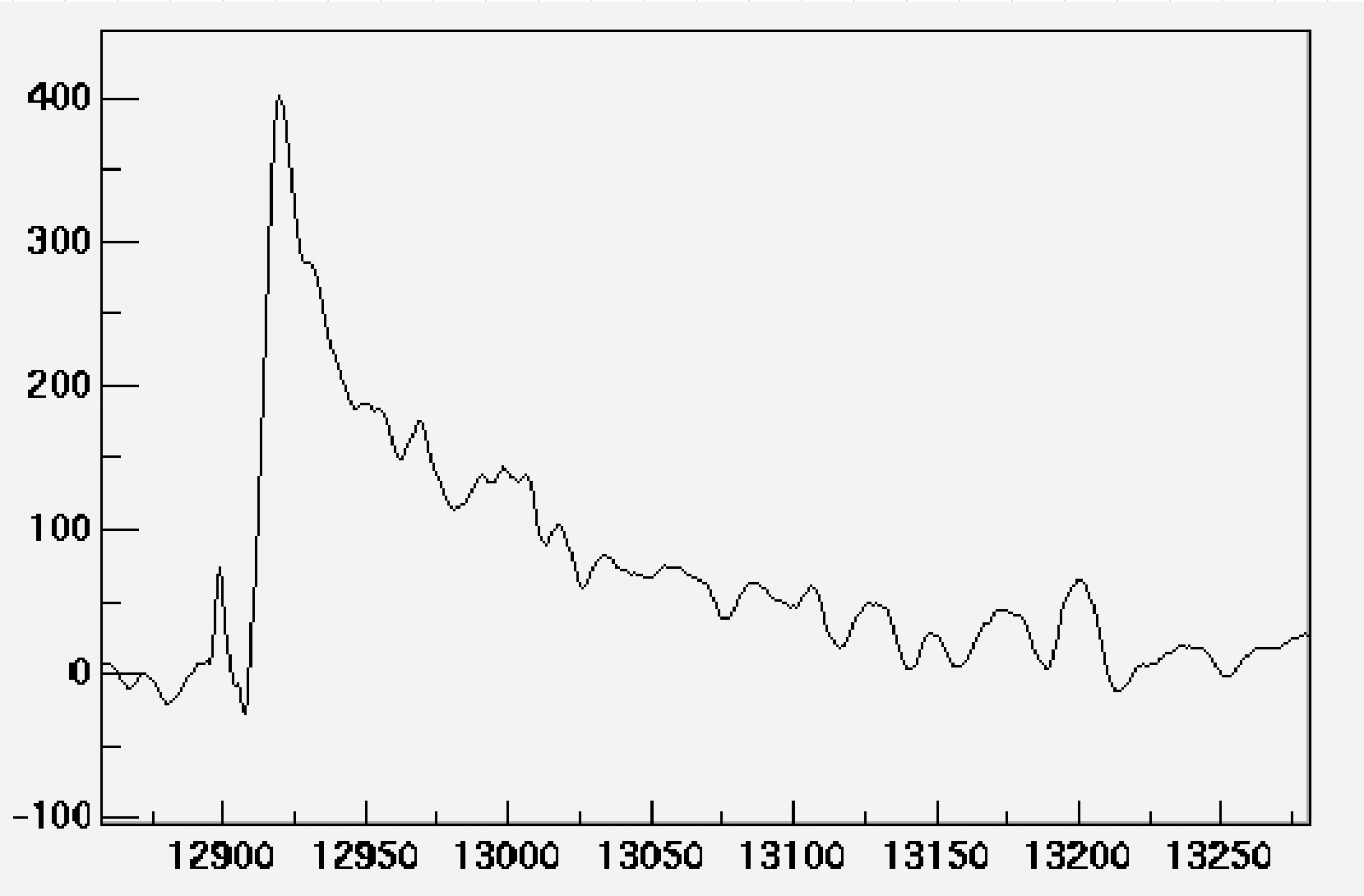
Run975 Event48 PM 11

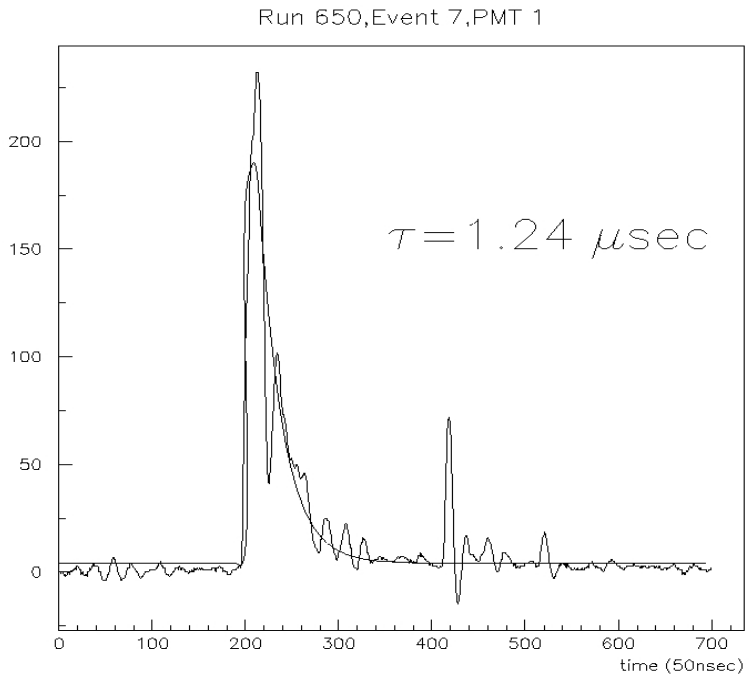


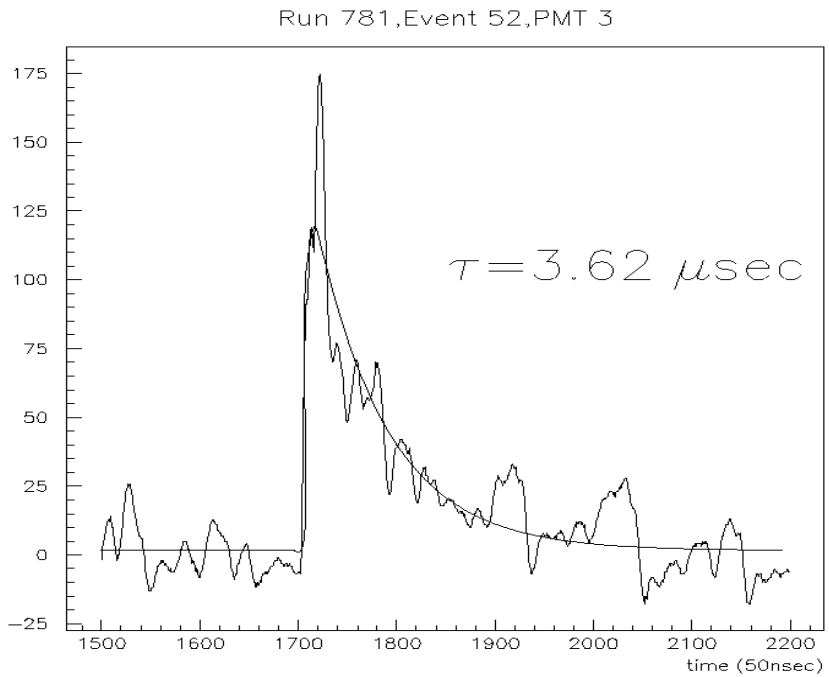
Run975 Event66 PM 10

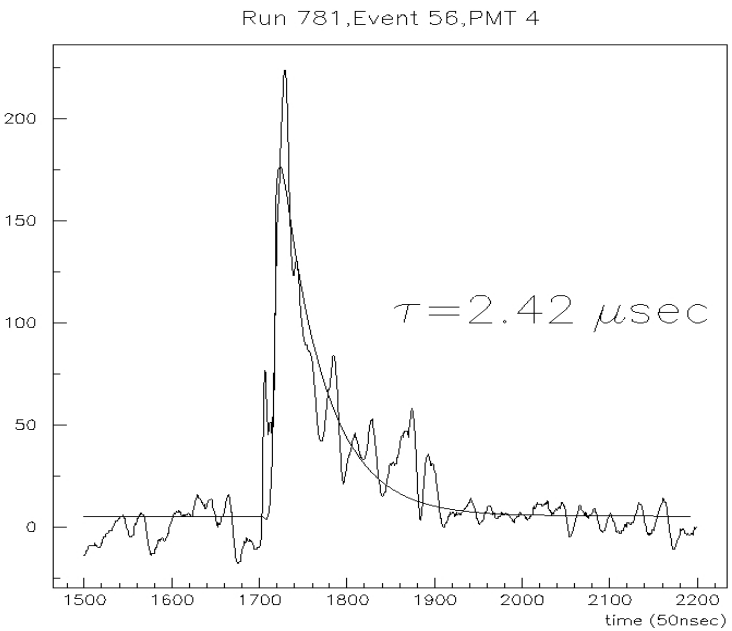


Run975 Event66 PM 8









Signal decay time extrapolated from fit

Exercise: Integral of the signals

- Hypothesis: The signal is the superposition of an exponential and an oscillating component (P=20s).
- The integral of an exponential over a fixed interval is proportional to its amplitude, while the oscillating component is mediated to zero.
- We integrated the signals over a 150 samples range.
- By knowing the circuit decay time it's possible to recover the amplitude of the exponential part of the signal.
- We assumed a decay time of 10 micros.

Exercise: Integral of the signals