Cluster counting report

SuperB La Biodola meeting

May 31st 2011

Marcello Piccolo

The menu

- Quick reminder of the expt'l setup
- Quick reminder of the threshold algorithm
- A novel low *rearming time* algorithm
  - Comparisons on counting and fakes
- Test Beam run (and regrets)
- Conclusions

Expt'l apparatus

- Most of the data shown come from a continuous cathode square section device 17 mm. side.
  - Shown a first glance to different gas mixes during the April coll. Meeting
  - Concentrate on 90/10 (He/Isob) mix.
  - Try to elaborate a strategy to improve the cluster finding efficiency
- Most of the data were collected with a Sr^{90} source :
  - Trigger with a scintillation counter (4 cm thick)
  - good separation between 2 MeV electrons and cosmic rays
  - Overall efficiency ~ 20%

Ways to count spikes

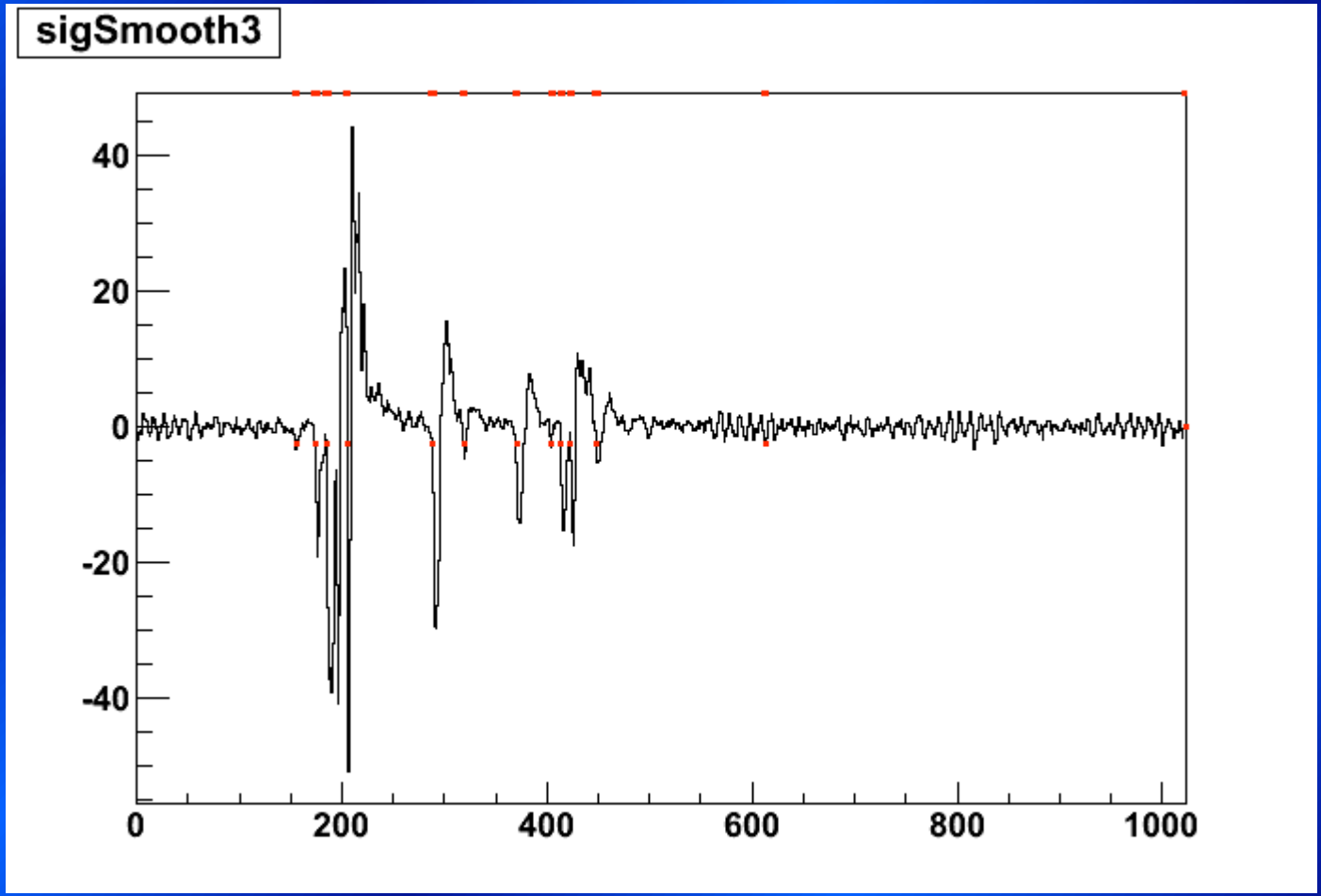
The hardware differentiator was discussed in April, so I will concentrate on software algorithms applied to the full recorded waveform.

the first method , already reported is based on a threshold applied to single (sca) channel , referred to a locally evaluated baseline.

we developed a different method , based on conditions applied to the (local) slew rate.

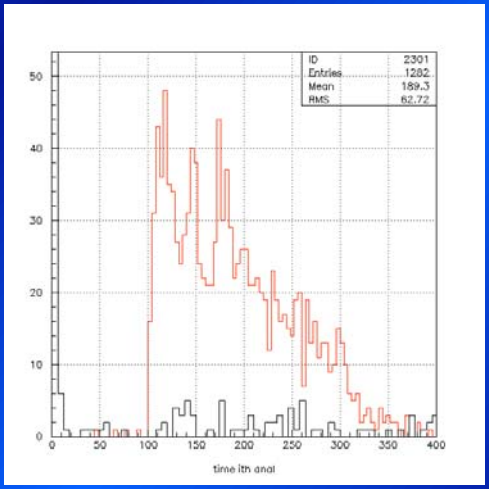
Please remember: all of this is work in progress not an established algorithm .

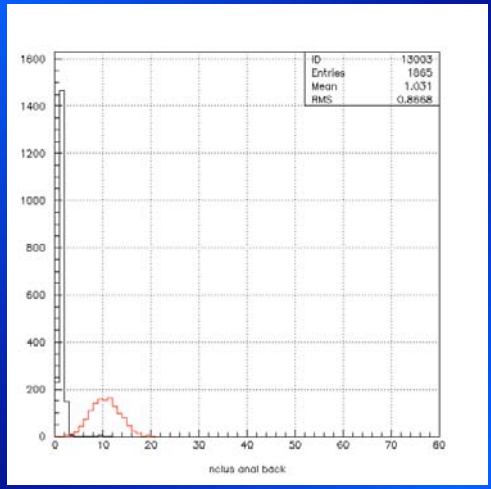
A typical pulse (showing the cut variable for the threshold method)

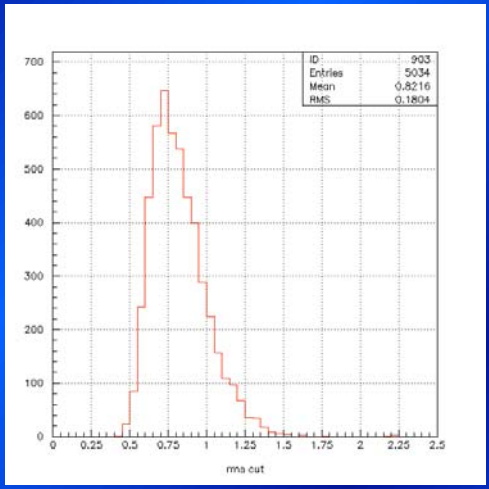


Limitations of the threshold method

- The threshold method is inherently uni-polar, so it does present a non negligible dead time, as it works on a sort of differentiation (local baseline subtraction).
- Furthermore the background hits the method finds, sets a limit to the threshold one is able to impose.
- On the bright side, the methods has built in a rejection against the high multiplicity clusters (responsible for Landau tail)



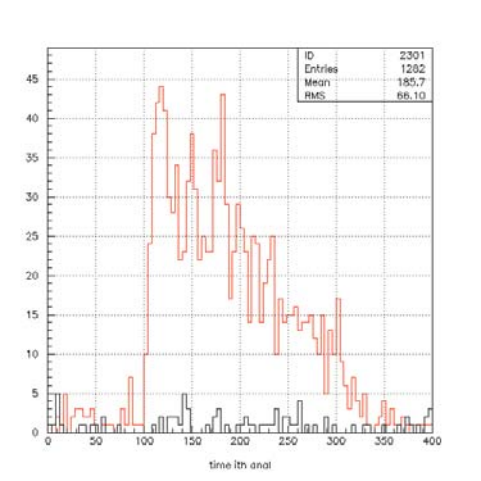


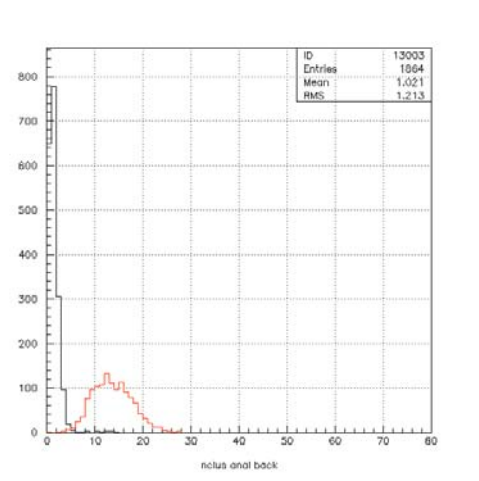


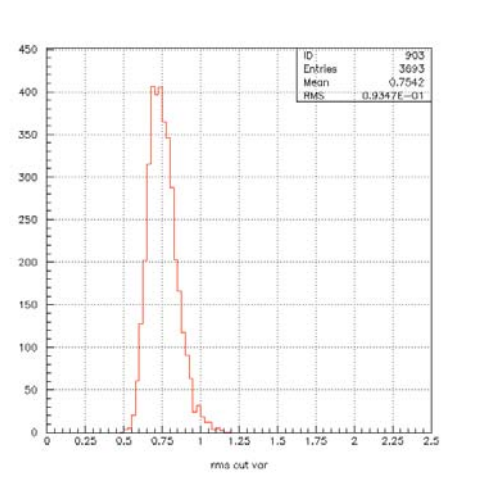
Now the slew rate method

Here we again build a locally subtracted amplitude $VS_i = V_i - (V_{i-1}+V_{i-2}+V_{i-3})/3$.

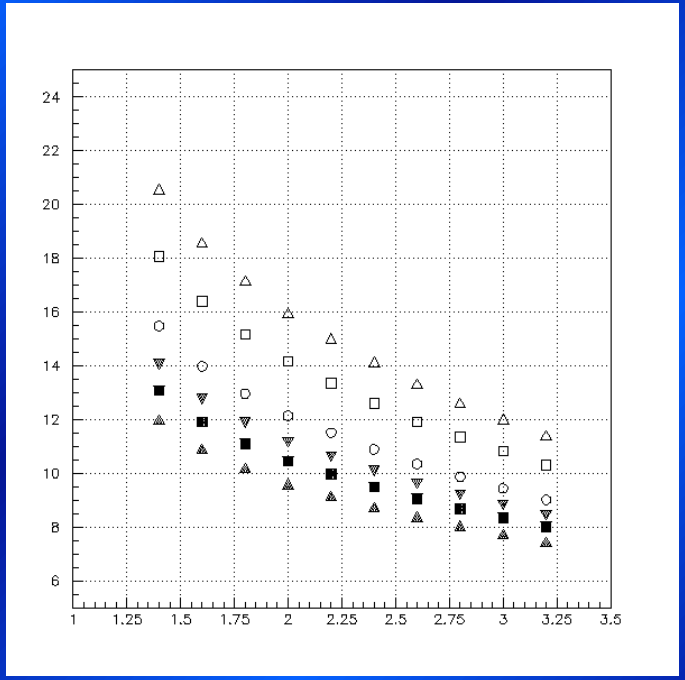
- We evaluate differences for VS between i^{th} , i^{th-1} and i^{th-2} and require each of them be greater than a cut value.
- Dead time here is imposed from outside as, for this method, the *rearming time* is just the SCA granularity.





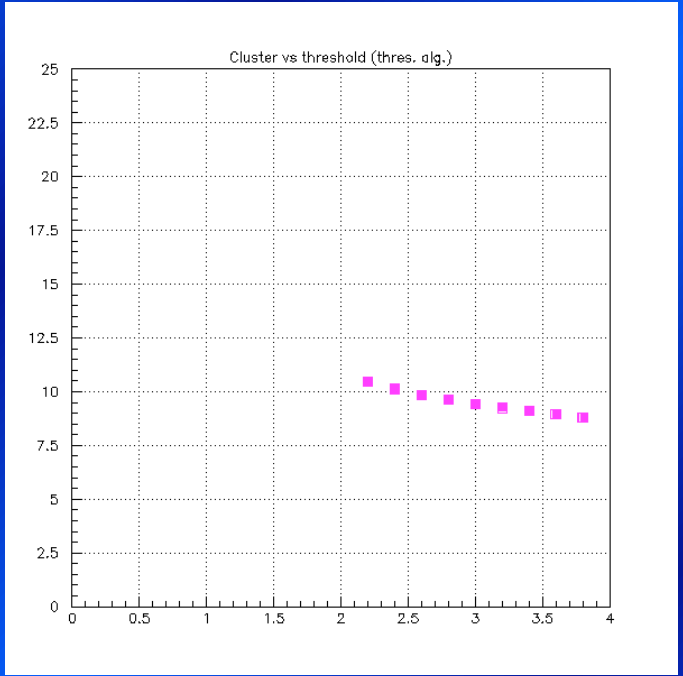


Performances for cluster counting

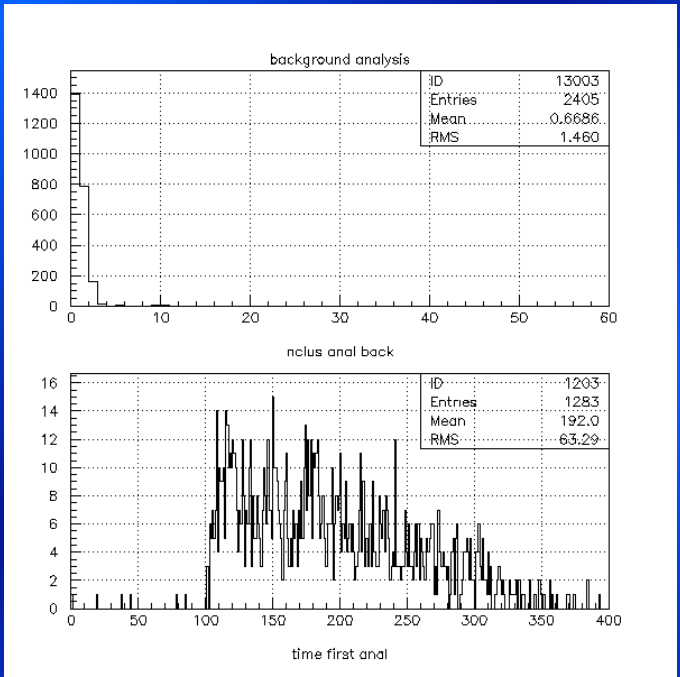


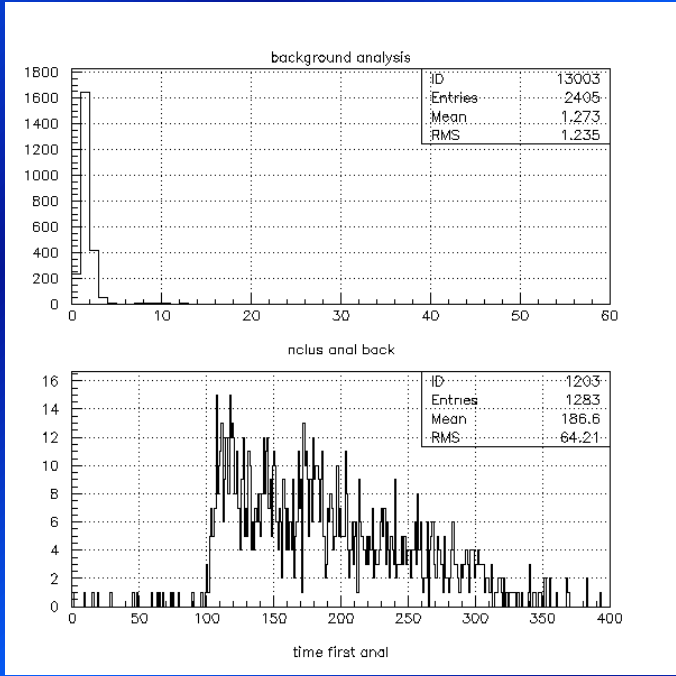
Number of clusters vs cut variable value
At different dead times

Number of clusters vs threshold

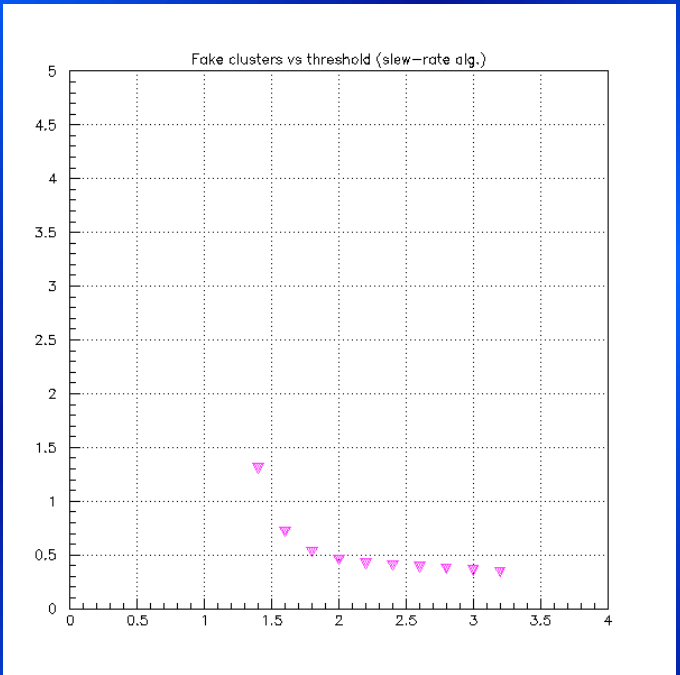


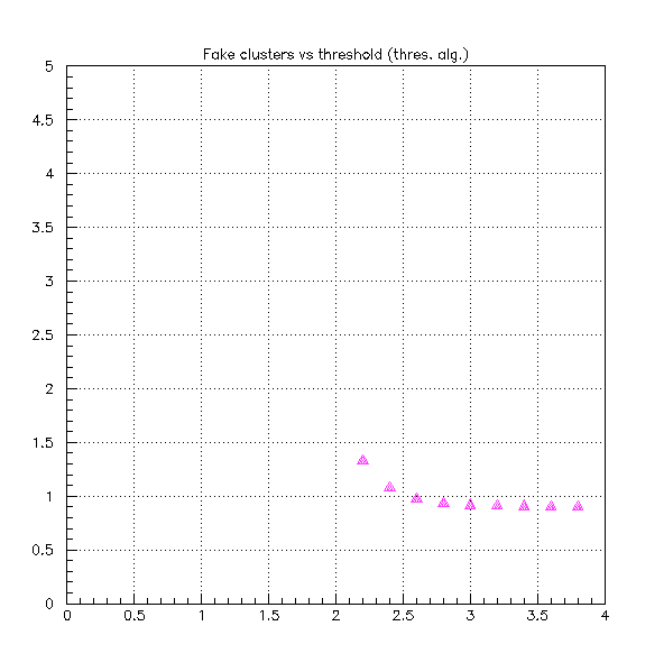
What about fakes ?





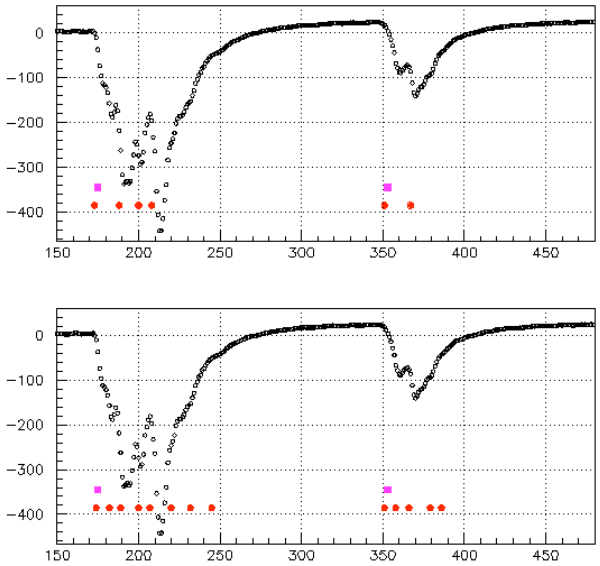
What about fakes ? (cont.)



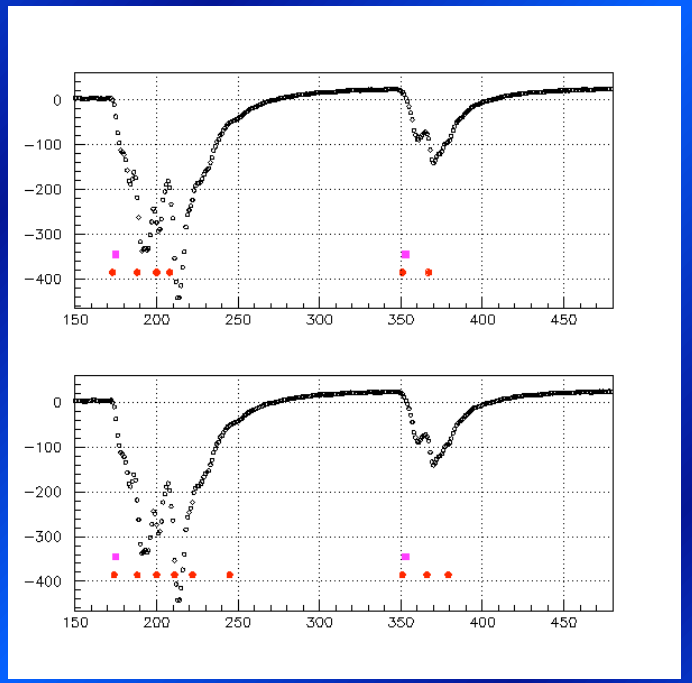


11 nsec. Dead time

Pulse shapes and Cluster Counting

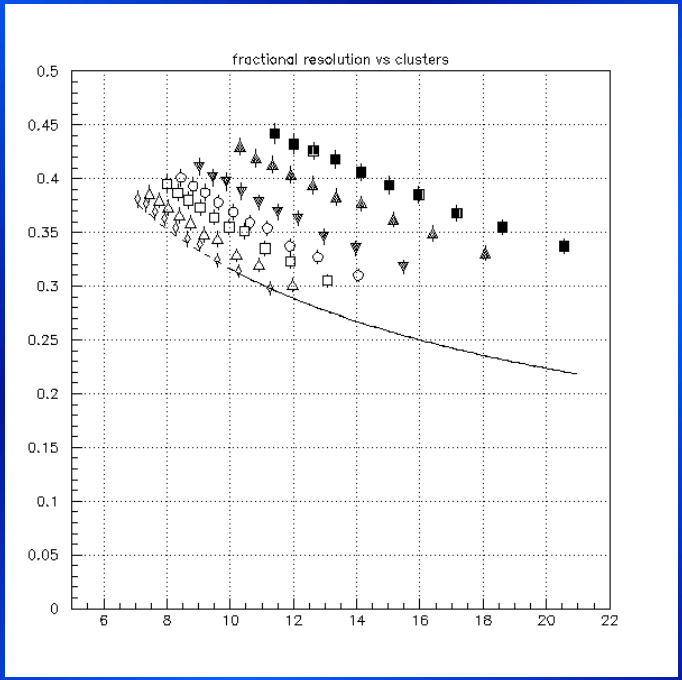


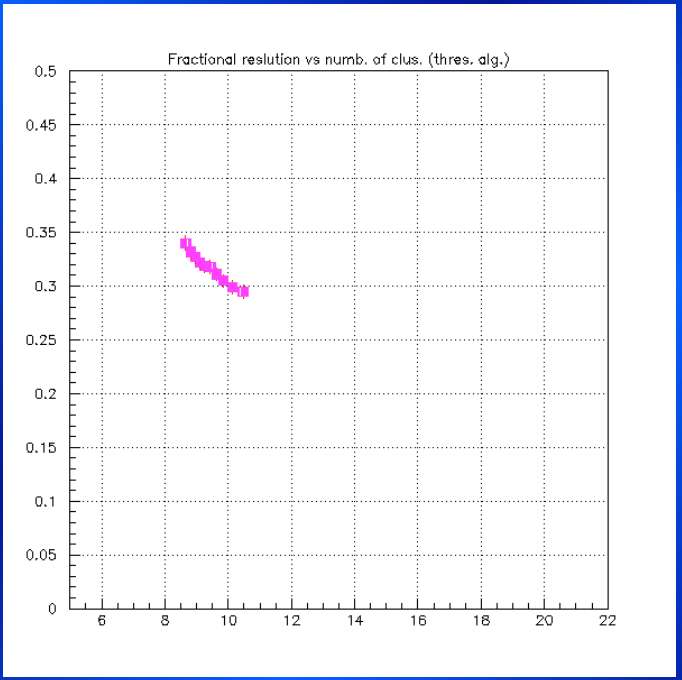
Event #5 upper threshold meth. Lower slew rate
Dead time 6 nsec.



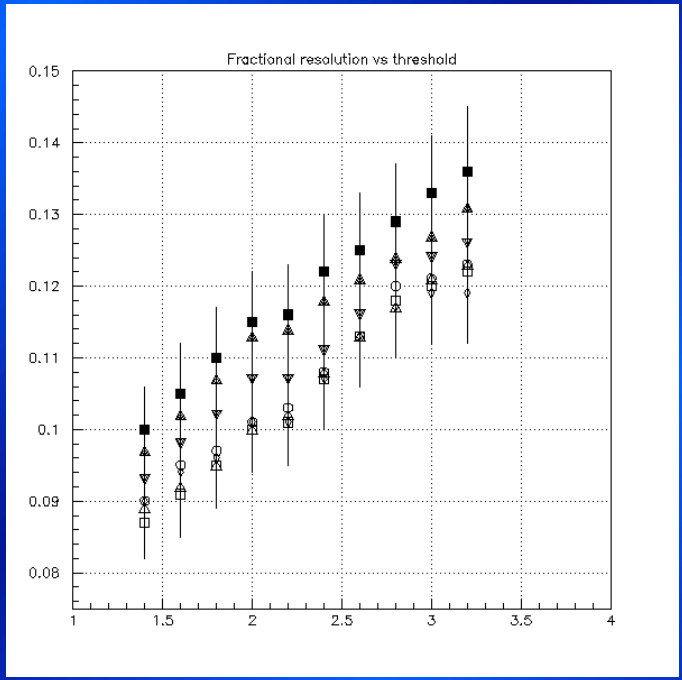
Event #5 upper, threshold meth. Lower slew rate
Dead time 10 nsec.

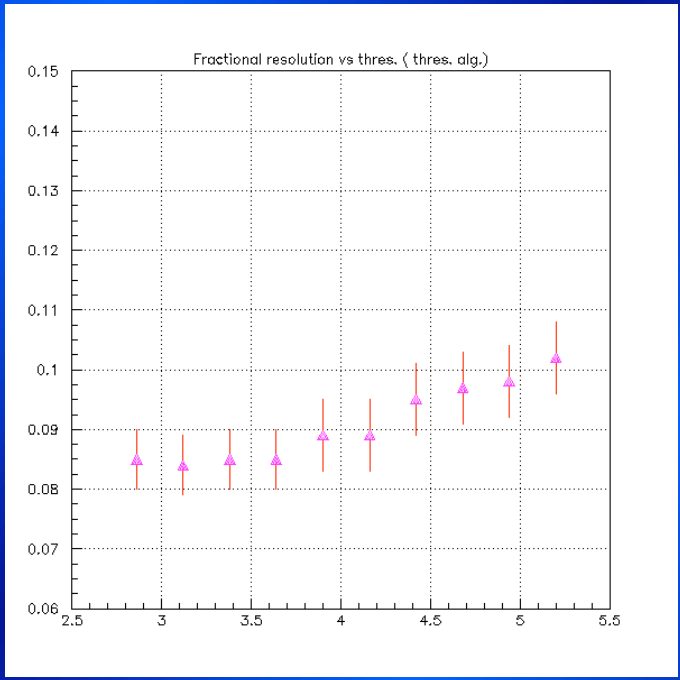
Let's look at distributions width





Looking to the 10 events averages



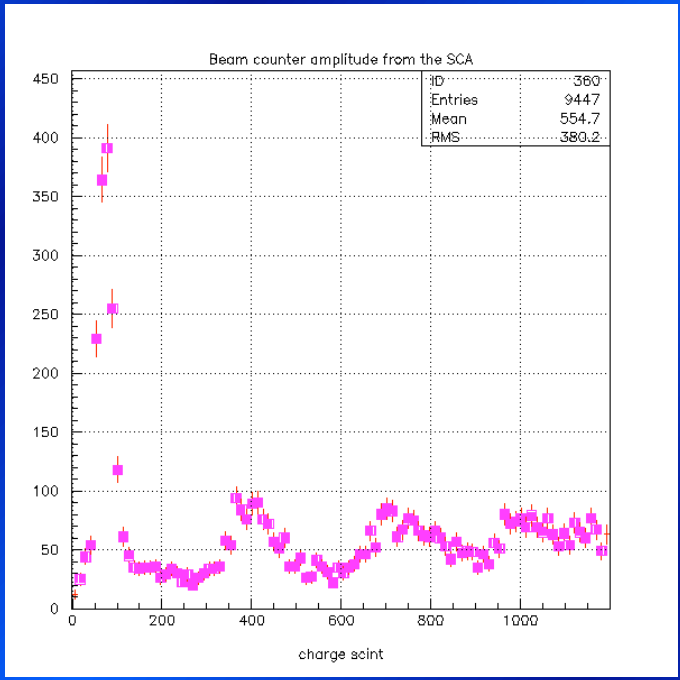


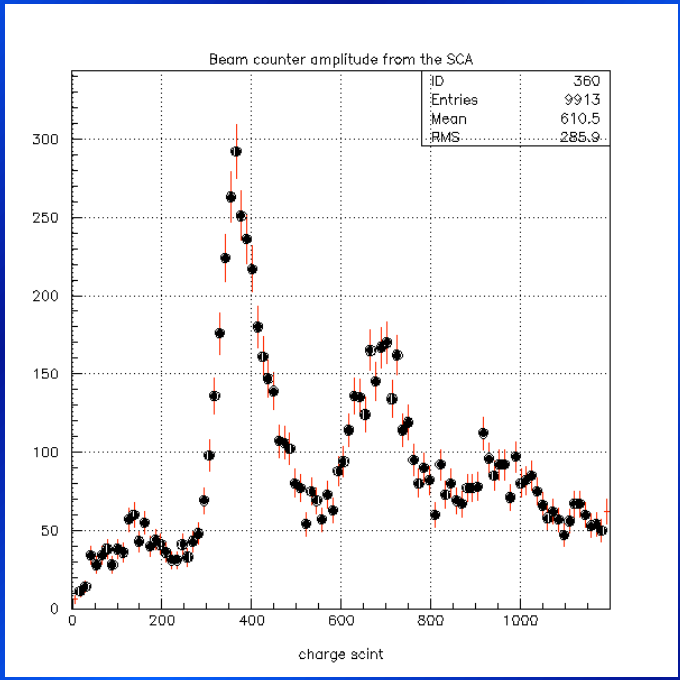
Test beam

- We had an assigned week for the BTF
  - This is a Linac line capable of delivering from single particles to 10^9 electrons in a 7 m length hall.
  - Given the situation with the long proto (no electronics/HV commissioning was carried out yet) we brought proto 1 and the 17 mm brass tube.
  - …and all the paraphernalia needed (a small truck worth)
  - As you might imagine, the setting up of the apparatus from scratch took a couple of days of hard work
  - In order to comply with the faster rate coming form the test beam a completely new DAQ software was developed and commissioned (Riccardo de Sangro)

Test beam (cont.)

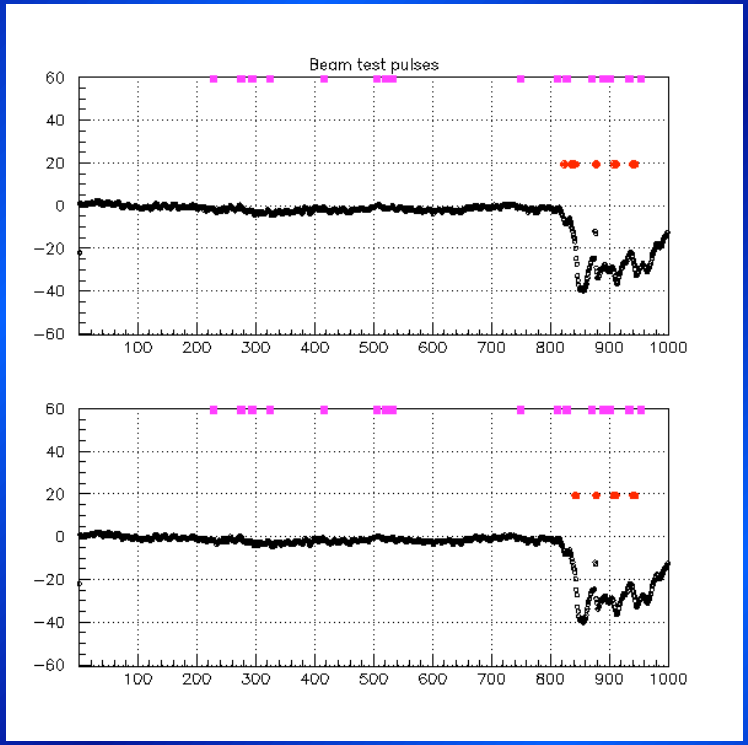
- We set up everything and started to monitor the beam quality:





Test beam (cont.)

- So we started to look at our detectors which had been gas/HV/electronics/DAQ commissioned



Test beam (cont.)

- So we were inches away to start data taking, when the Linac thermionic cathode gave in.
- A stop of at least 2 weeks (might be more than 10 weeks)
- Next attempt (if cathode allows) beginning of October.
- For sure by then the *long* proto will be on line.

Conclusions

- Even if we would have liked to have more answers , I believe that some progress has been achieved:
  - A new scheme for cluster counting has been implemented.
  - The behavior of this algorithm does resemble simulation results.
  - A completely new DAQ system was commissioned for the test beam and will be used in the next cosmic runs with the long proto.
- Stay tuned, more results will be available shortly