

DCH Summary

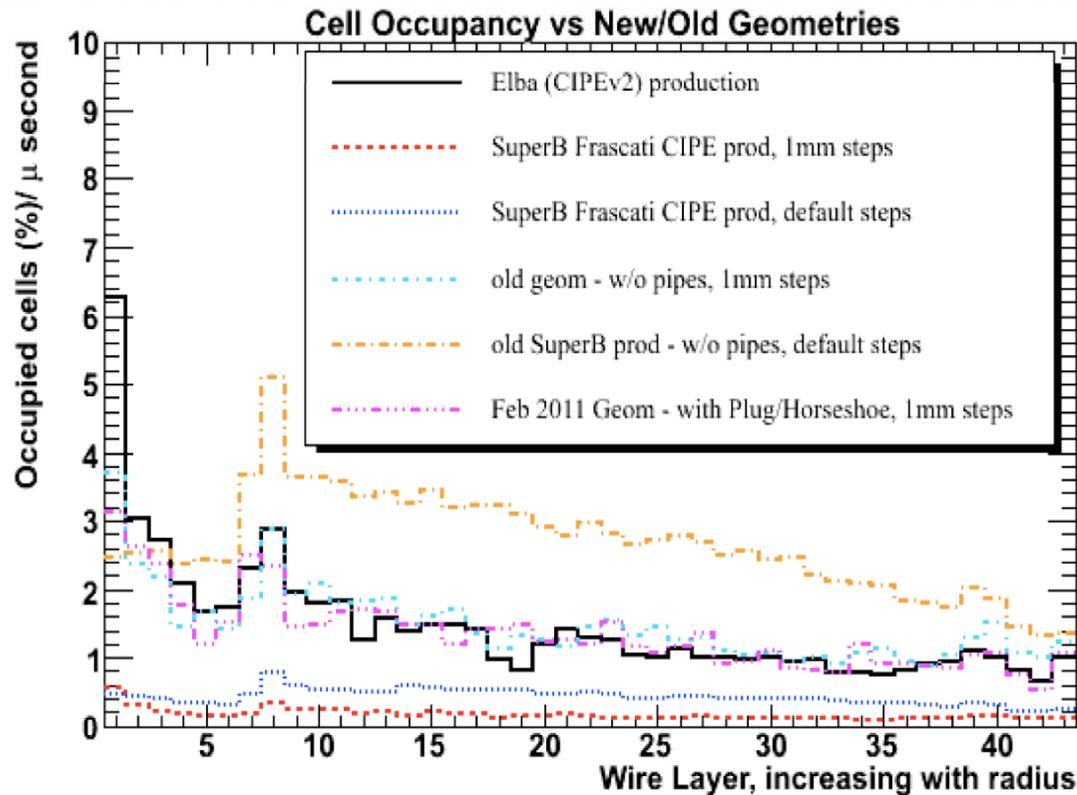
La Biodola, 1 Jun 2011

G. Finocchiaro, M. Roney

Outline

- Backgrounds
- Wire aging studies
- Prototype 2
- Cluster counting studies

DCH results for latest FullSim prod



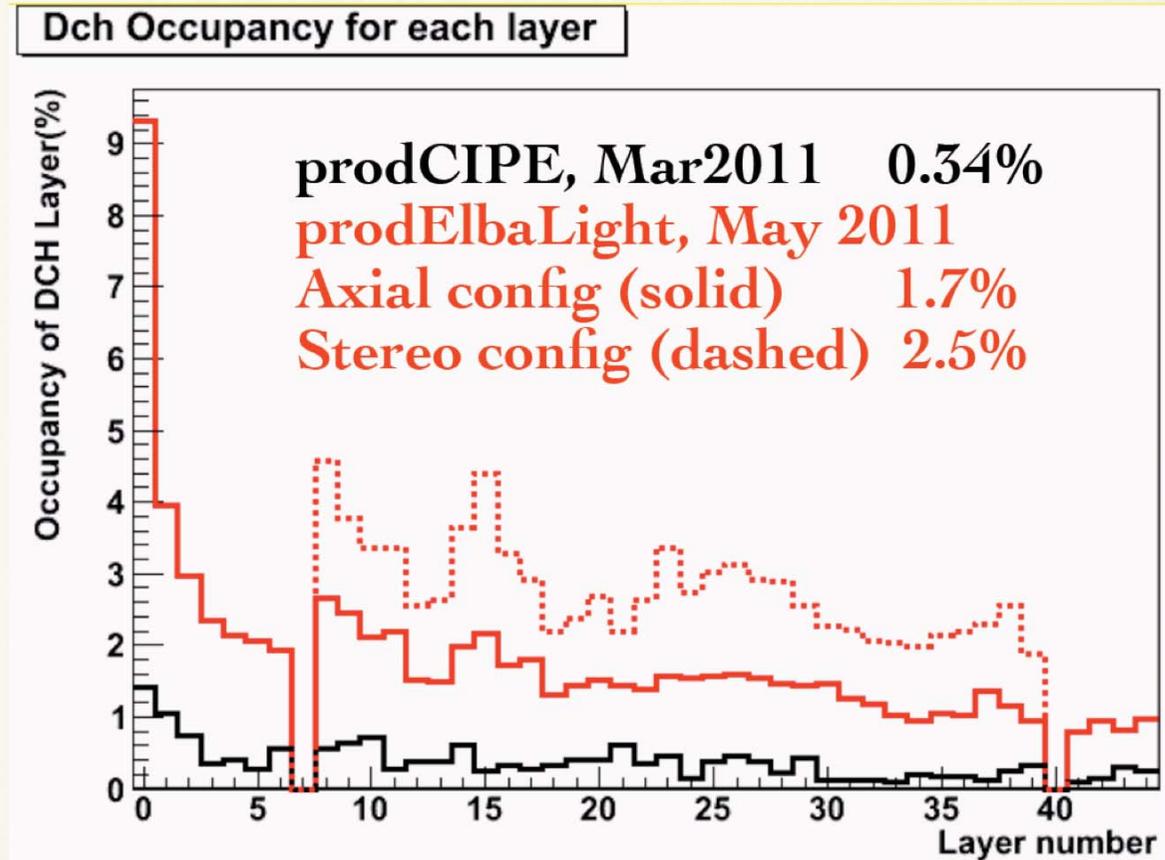
D. Lindemann

- DCH occupancies risen since April meeting in Frascati back to previous levels (1-2%) after bug fix in FullSim (tracks ended in the final focus)
- 1 mm step-size implemented in DCH FullSim production gives more realistic occupancies

DCH results for latest FullSim prod (2)

R. Cenci

- Comparing only productions with 1mm step limit
- Occupancy back to Dec2010 value (but it was w/o 1mm step limit)
- Bug in simulation was fixed before this production
- Stereo contribution is now evident

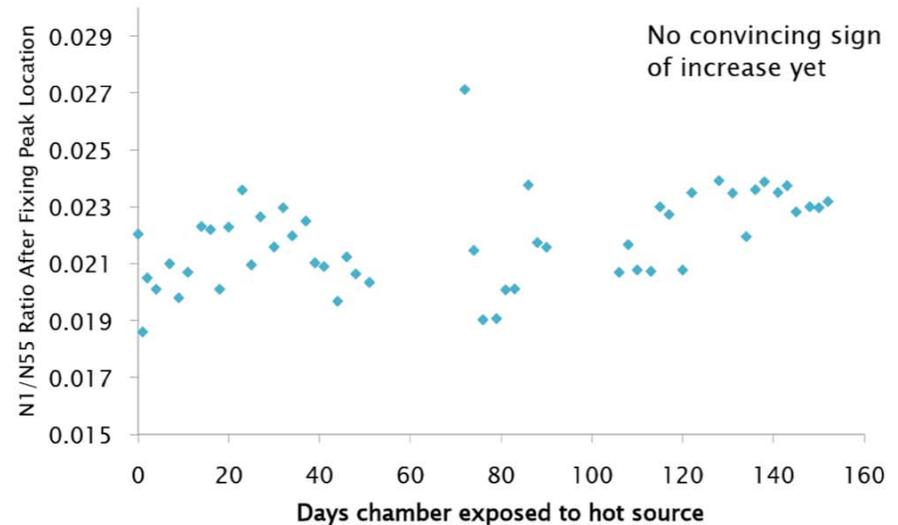
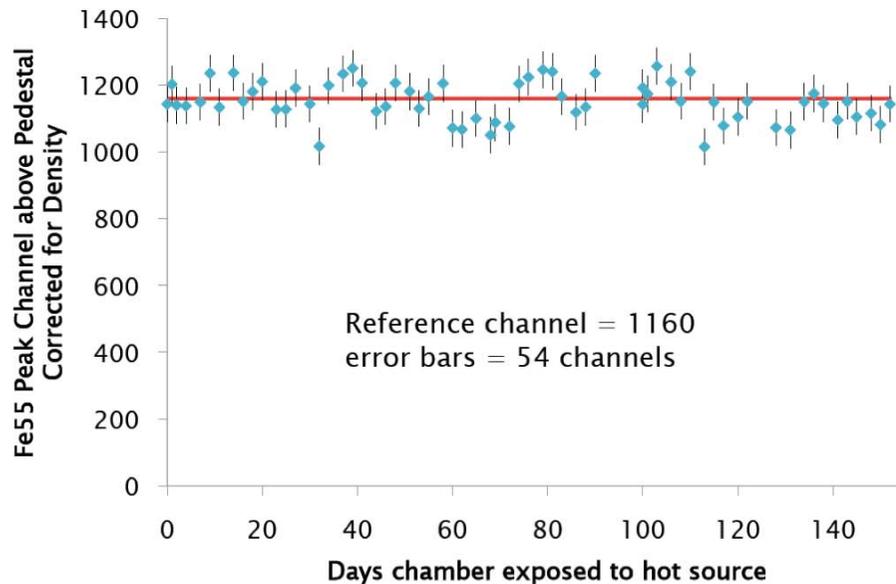
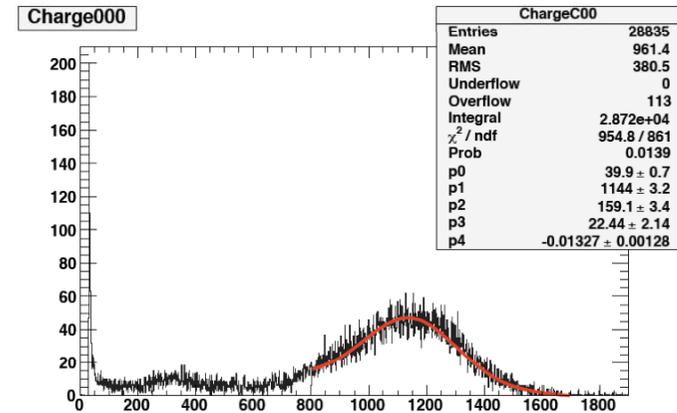


Wire aging studies

R. So

Fe55 Spectrum (Low-intensity)

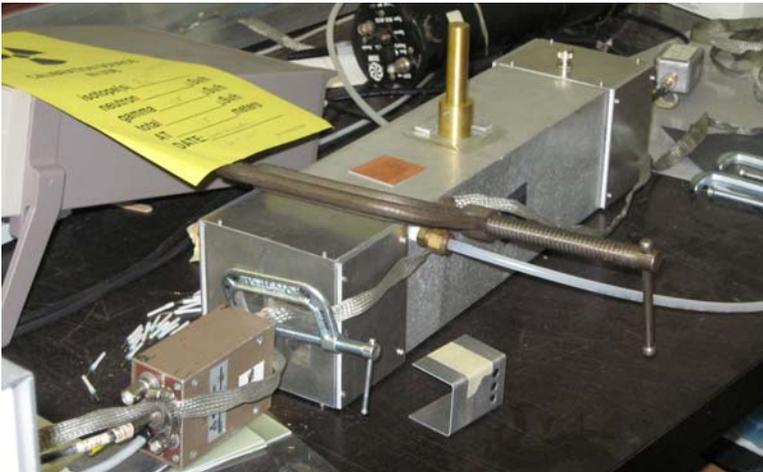
- ▶ Age chamber with a 100 mCi 55Fe source; measure 55Fe spectrum with a low-intensity source
- ▶ Monitor current, 55Fe peak location (gain), and ratio of small pulses to 55Fe interactions
 - Number of small pulses increase as Malter effect sets in.



Wire aging studies (cont.)

- BaBar wires and gas already show a lifetime $>100\text{mC/cm}$. Next studies will use SuperB wires and gas, and a second chamber for gain normalization.

Aging chamber (BaBar wires and gas) being irradiated by ^{55}Fe source



1 Jun 2011

New chamber has bare aluminum field wires, as planned for SuperB

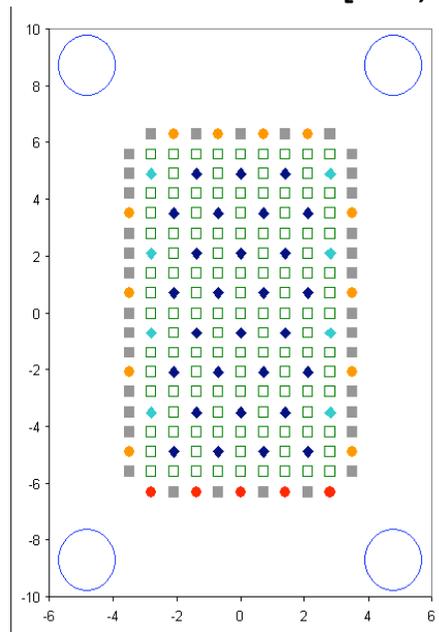
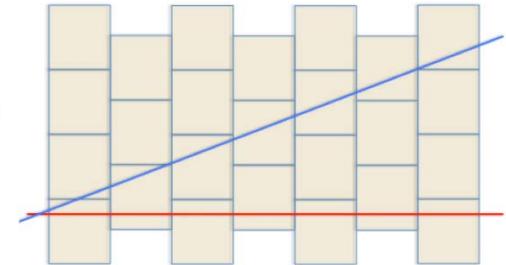


DCH Summary

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Prototype 2

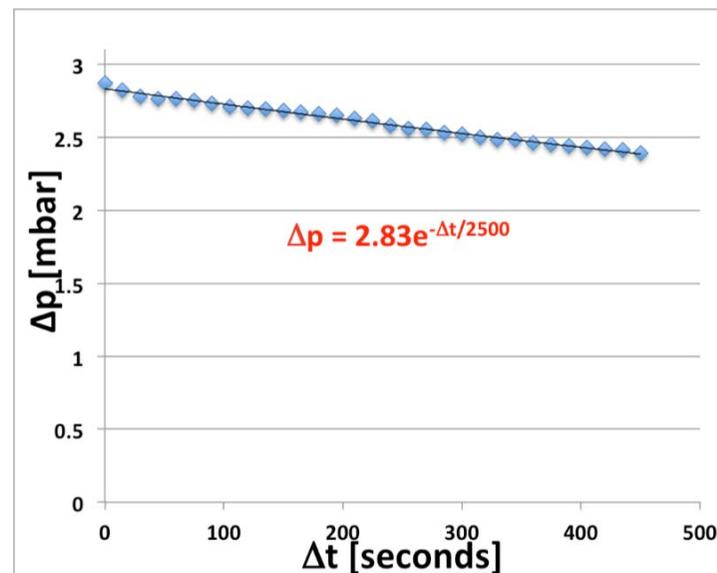
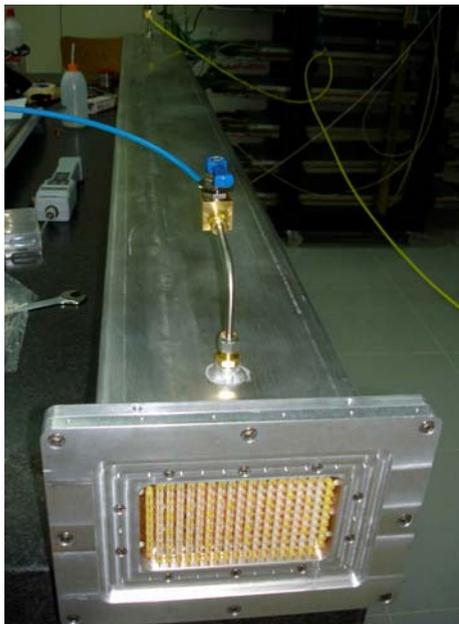
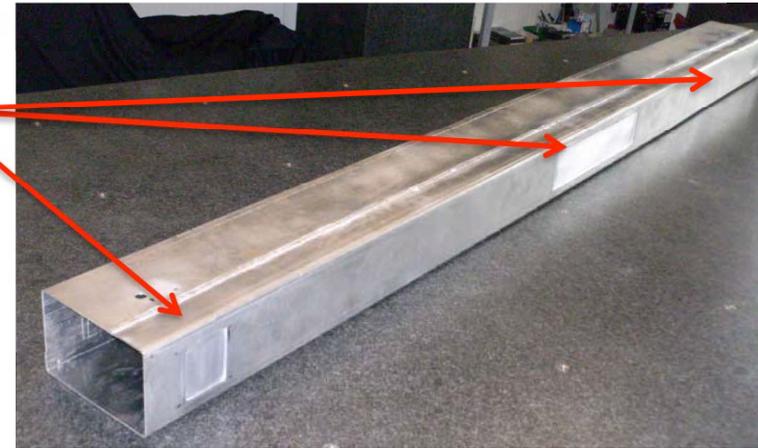
- 2.5m long prototype to study DCH response from single clusters in a realistic environment, serve as a test bench for the final FEE, and for the DCH trigger
- Square drift cells - side=14mm, 3:1 field-to-sense ratio
- 28 sense wires arranged in 8 layers (3-4-3-4-3-4-3-4)
- Tracks with $\vartheta \in [-20, +20]^\circ$ cross all layers



Guard wires ensure very good linear charge and reconstruction homogeneity on all cells

Gas Tightness, e.m Shield

- External tube
 - 3mm thick Al, 3 pairs of 0.3mm thick windows to minimize material are milled at mid length, close to, and far from the RO electronics
- Al flanges
 - With O-rings to ensure gas tightness



- Gas tightness test shows leak rate of $<3\text{cc/min}$ (*in He*)
- He concentration on the endplates much less than in clean-room atmosphere (after proper sealing of the feed-throughs)

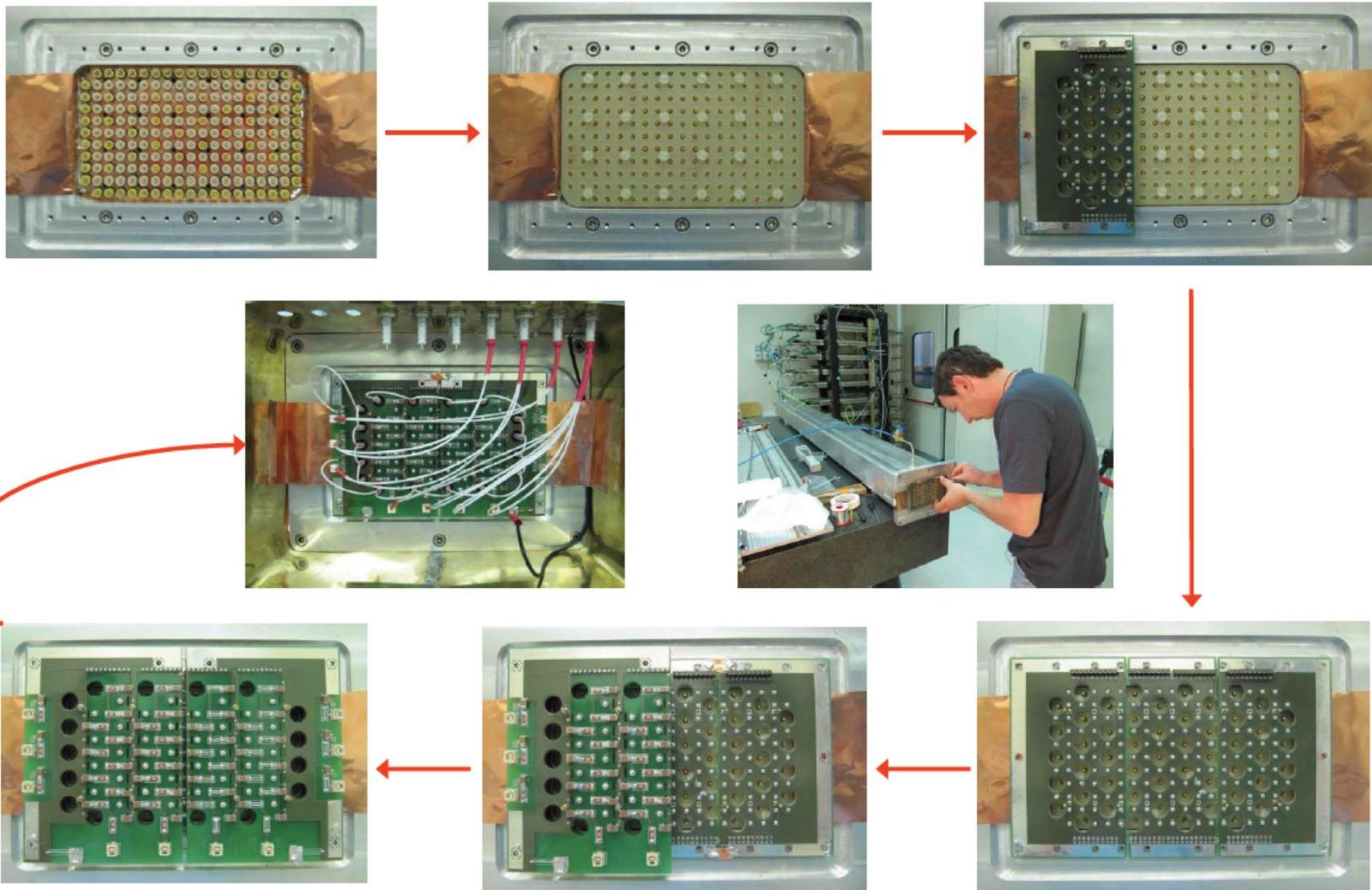
Prototype 2 Electronics

Signal amplification requirements

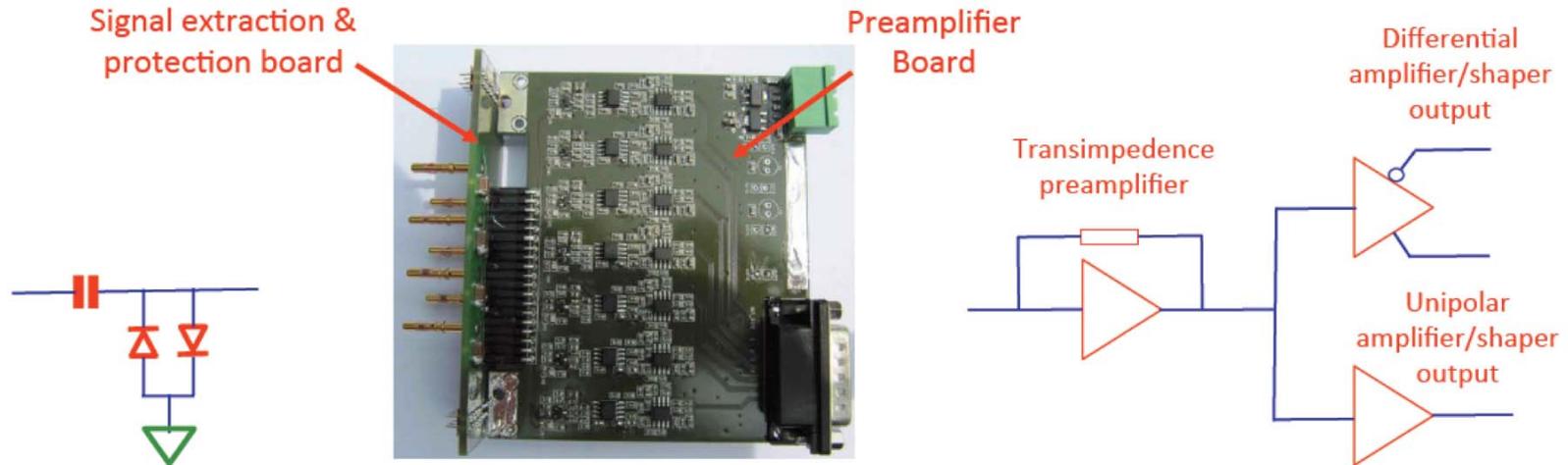
- $BW \geq 250$ MHz
- Amplification ≥ 5 mV/fC
- Noise ~ 2000 erms

On Detector FEE boards

1. Feedthrough lock board (2 boards required)
2. Field wires GND boards (2 boards required)
3. HV distribution board (1 board required)
4. Signal extraction (decoupling & protection) board (1 board required)
5. Preamplifier board (1 board required)

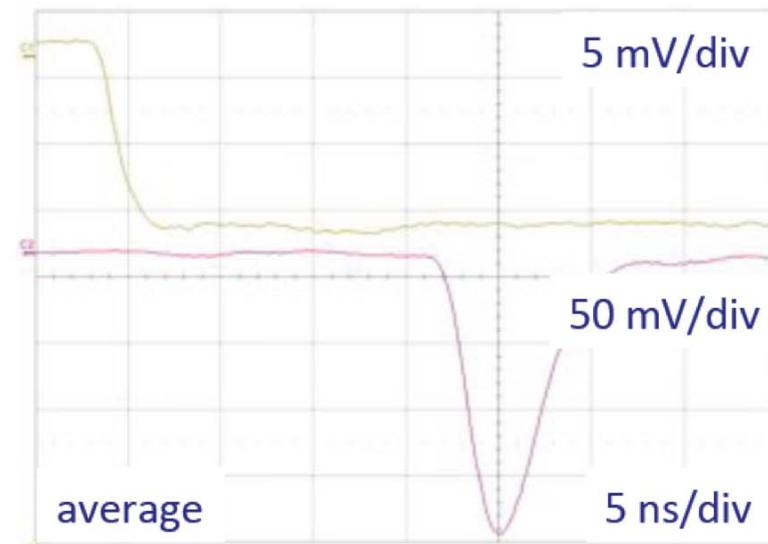


28 chs DCH preamplifier board main features

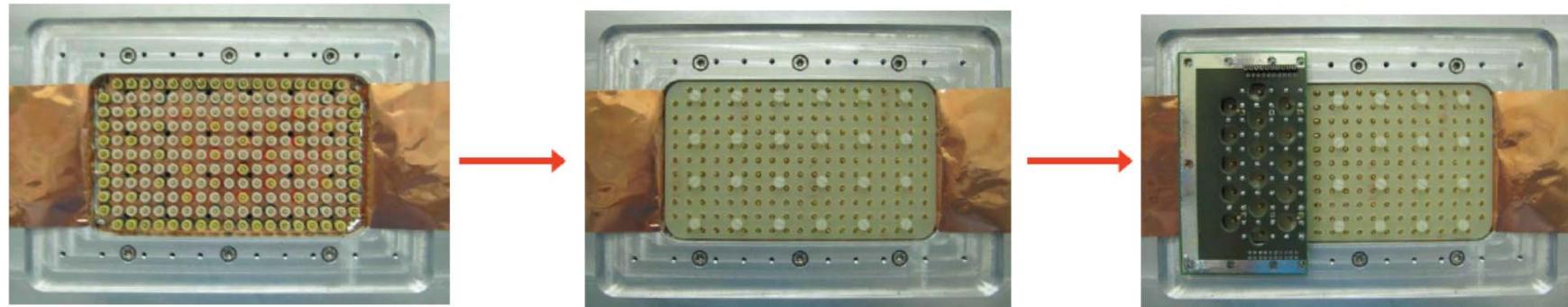


Preamplifier main features

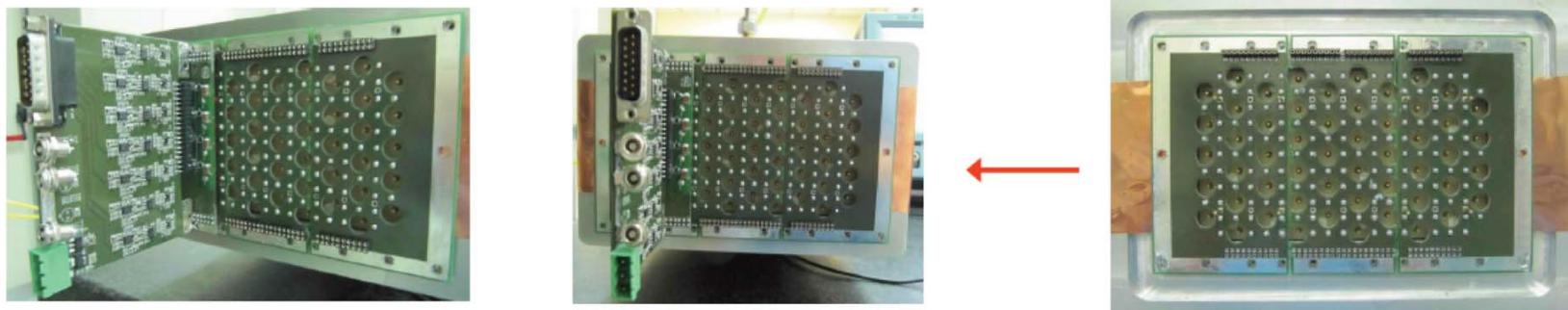
- Number of channels : 7
- $Z_{in} \approx 60 \Omega$
- Gain $\approx 8.8 \text{ mV/fC}$
- Noise $\approx 2500 \text{ erms @ } 250 \text{ MHz BW}$
- Rise time $\approx 2.4 \text{ ns}$
- Unipolar & Differential outputs ($50 \Omega - 110 \Omega$)
- Test input
- Supply Voltage : + 7V (310 mA) - 7V (190 mA)
- Power Dissipation : 490 mW/ch



1.8 pF injecting capacitance



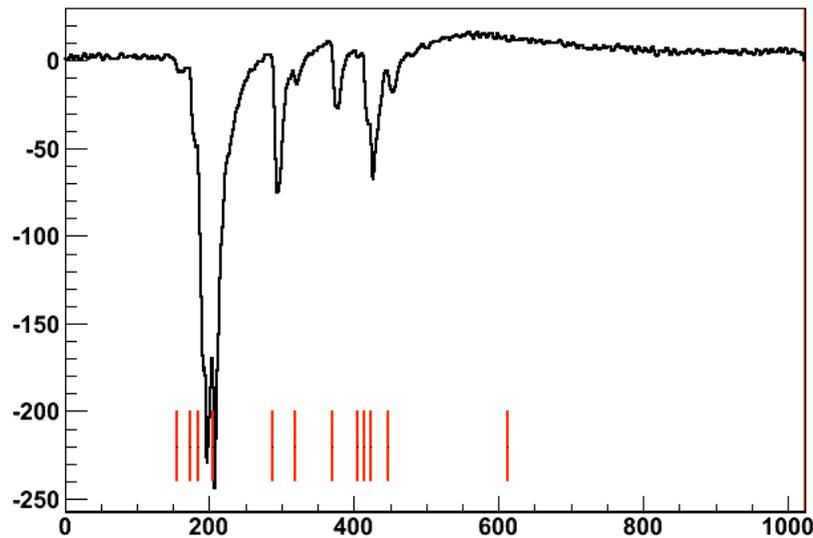
- Front-End side FC design is in progress
- Test will start as soon as FC will be available (≈ 2 week)



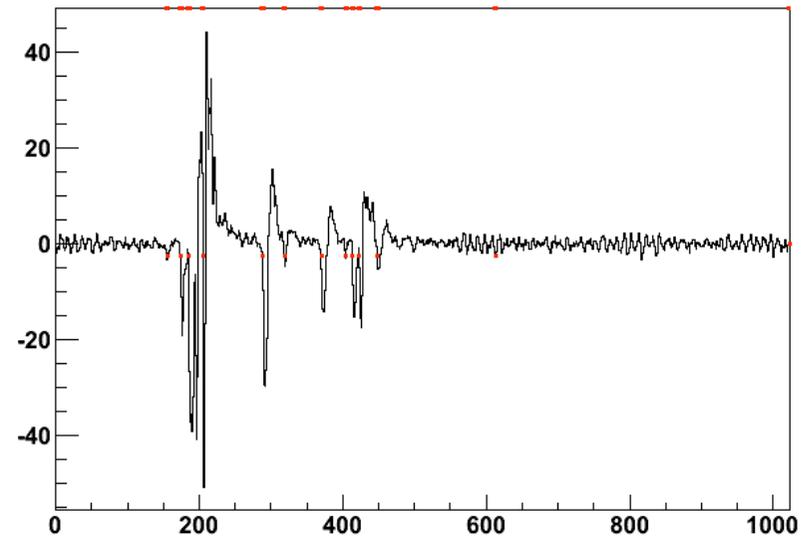
Cluster counting algorithms -1

M. Piccolo

“Threshold” method

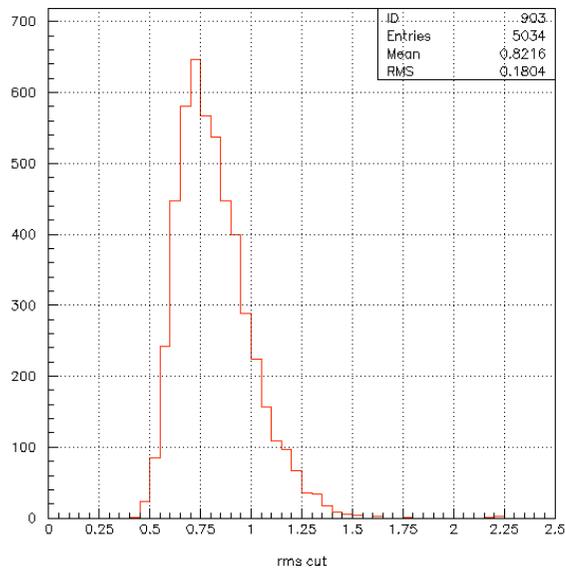


Signal from cosmic-ray track in 17mm-tube
90%He-10% i C₄H₁₀ - data
| = times of clusters found

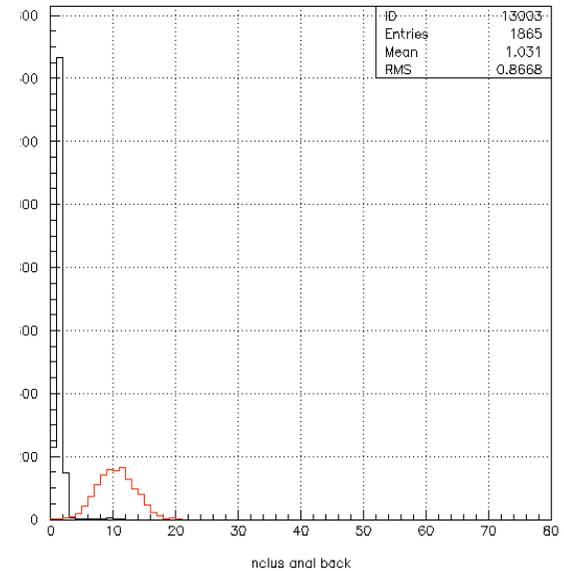
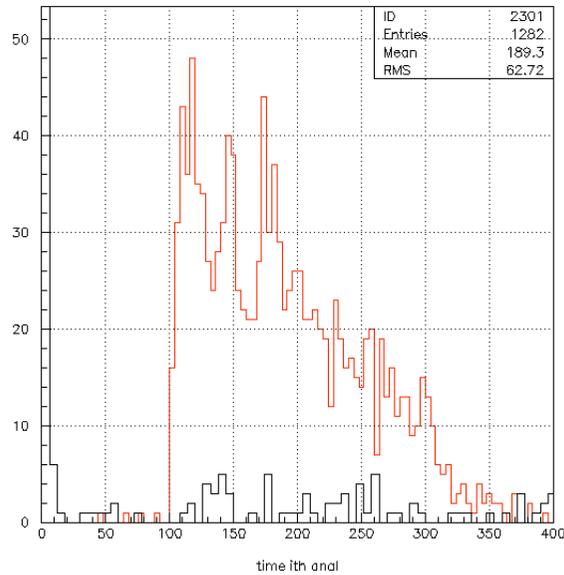


- The same signal, referred to locally evaluated baseline – a rolling average over the 3 previous channels
- Clusters are found when this variable is below a given **threshold**
- Minimum time between clusters ~8-10ns

Cluster counting algorithms - 1



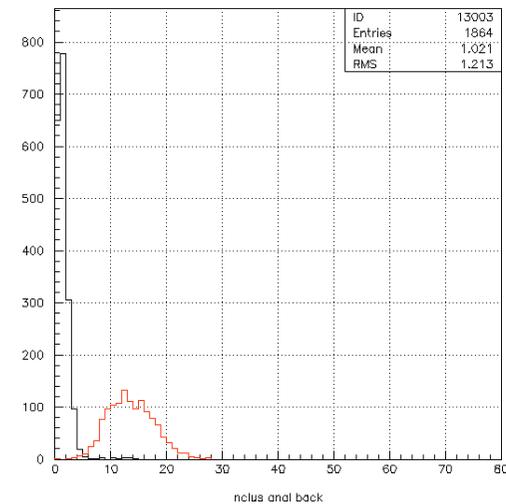
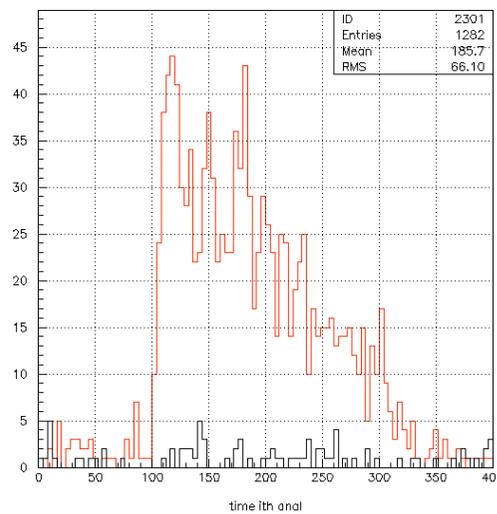
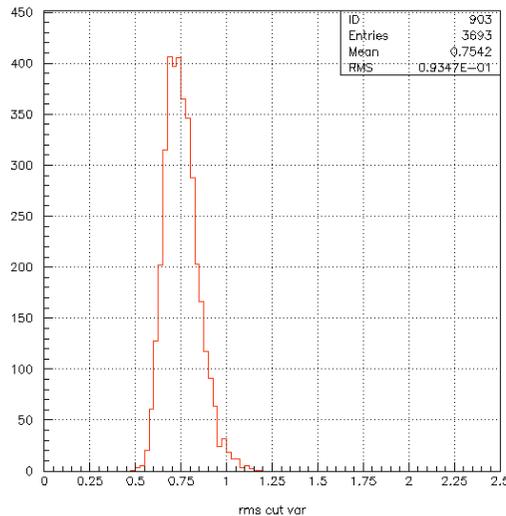
RMS of the cut variable



- Number of fake clusters estimated from time spectrum of 1st cluster, or on empty events
- ~ 1 fake cluster for $V_{thr}=2.5mV$

Cluster counting algorithms - 2

“Derivative” method

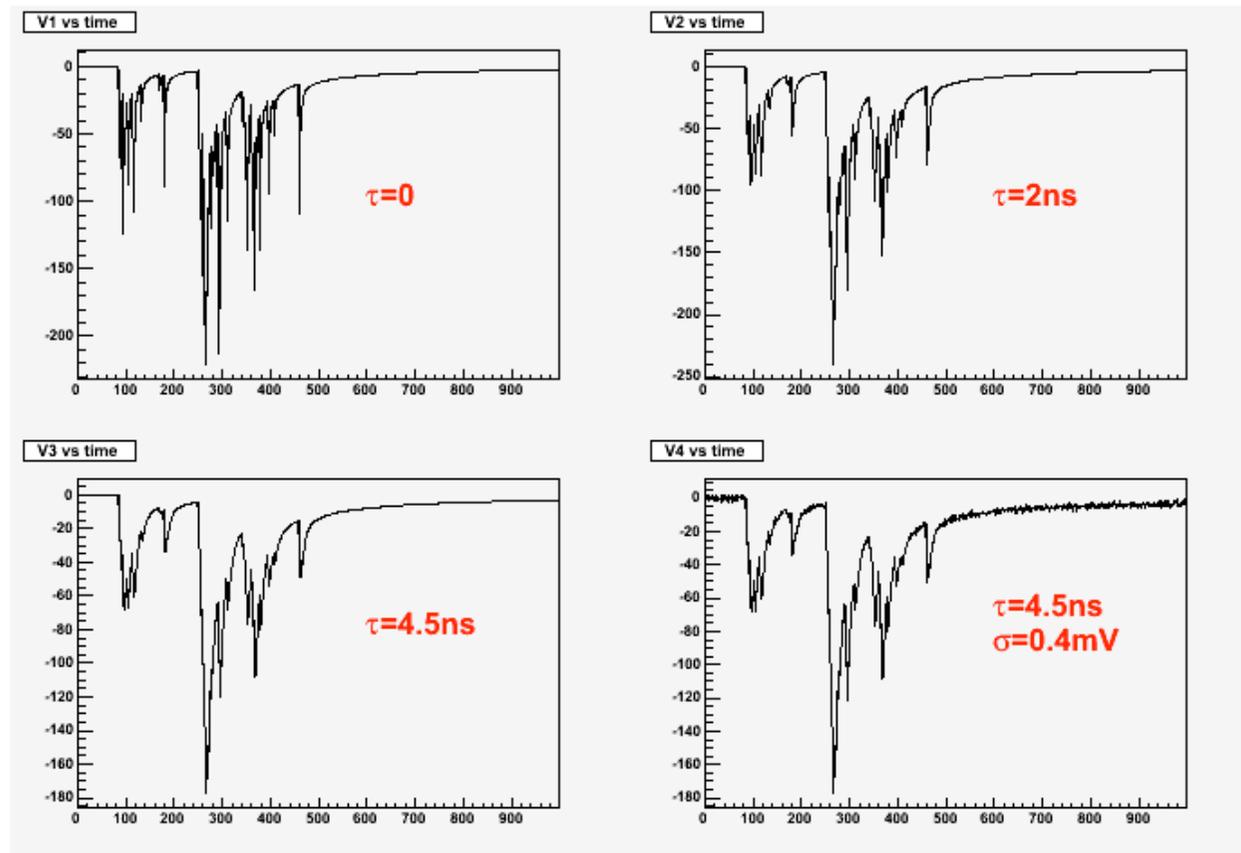


- Again, build a locally subtracted amplitude $VS_i = V_i - (V_{i-1} + V_{i-2} + V_{i-3})/3$.
- Evaluate differences for VS between i^{th} , i^{th-1} and i^{th-2} and require each of them to be greater than a cut value.
- Dead time here is imposed from outside as, for this method, the *rearming time* is just the SCA granularity.
 - An additional parameter
- Threshold value **~1.5mV/ns**
- 0.5 fake clusters/track

Cluster Simulation

J.F. Caron

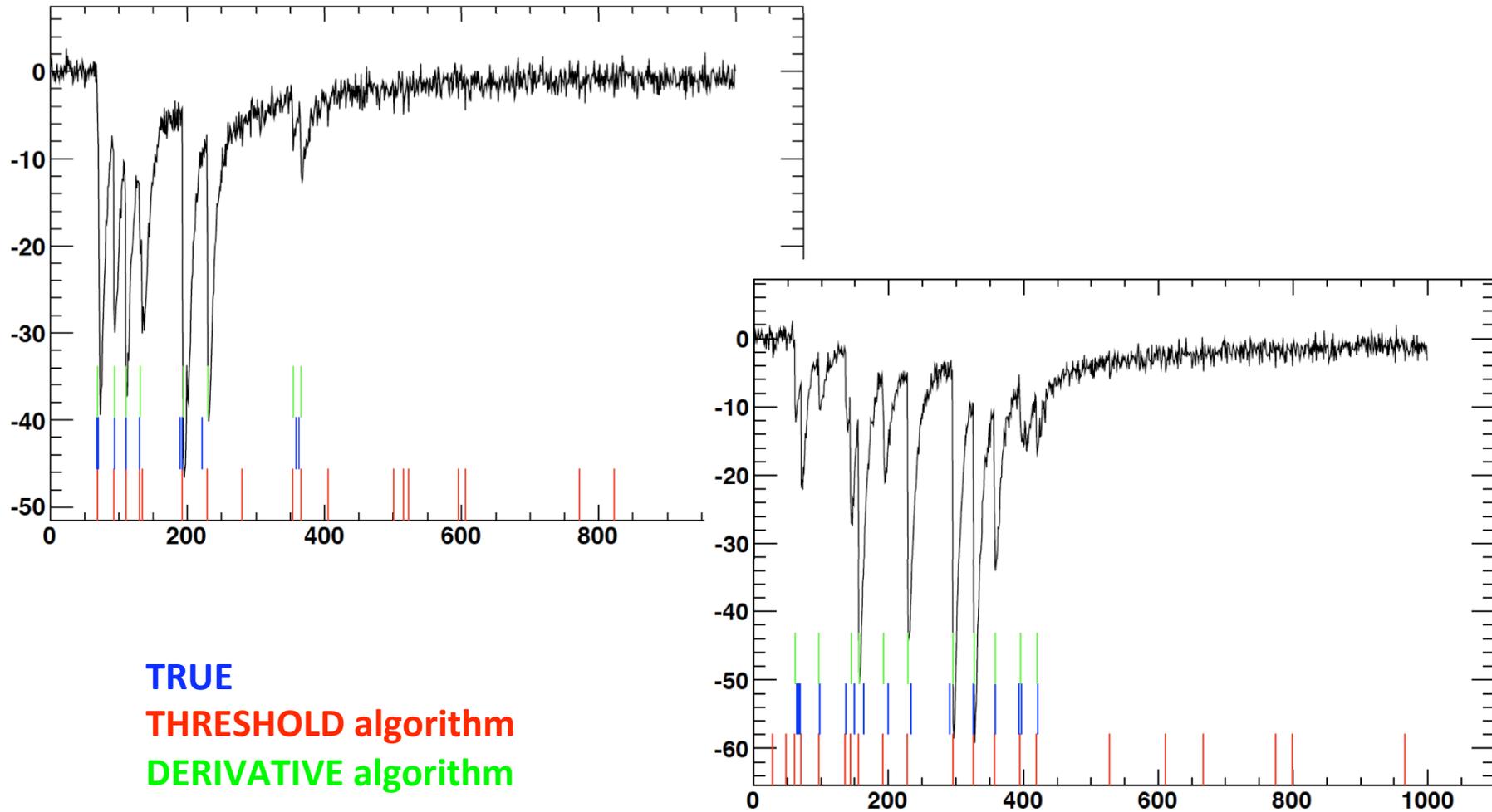
- Use Garfield to simulate signals in our gas mixtures, and apply transfer function to model the effect of FEE



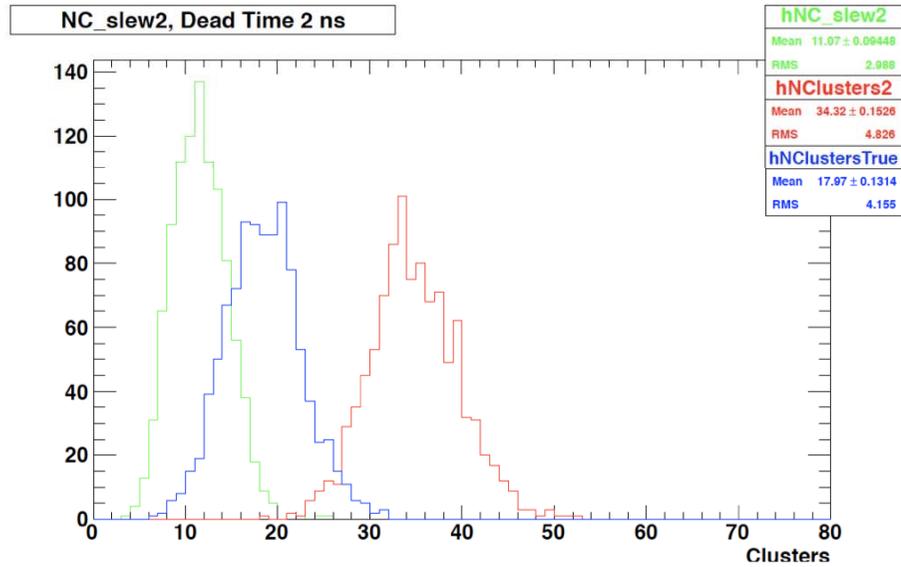
*Simulated signal from 490MeV/c π^+ in
90%He-10% iC_4H_{10} for different shaping times*

Cluster Simulation

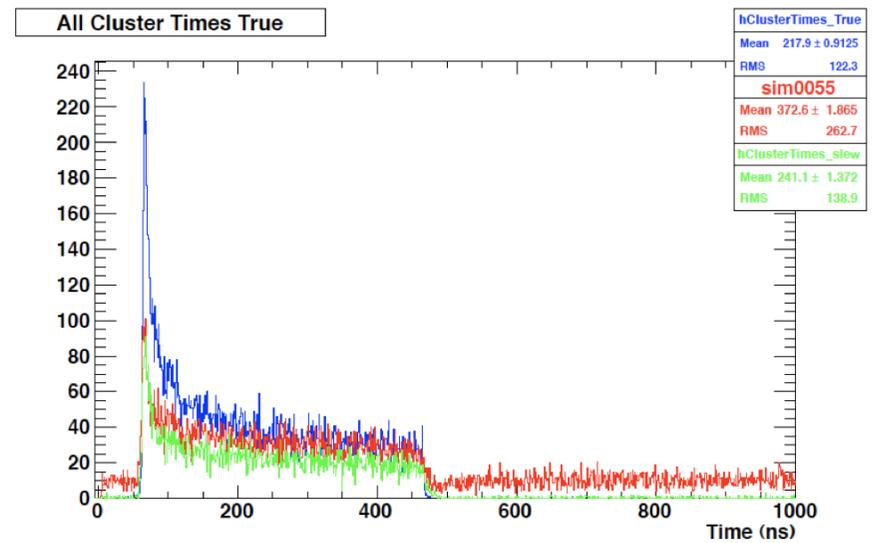
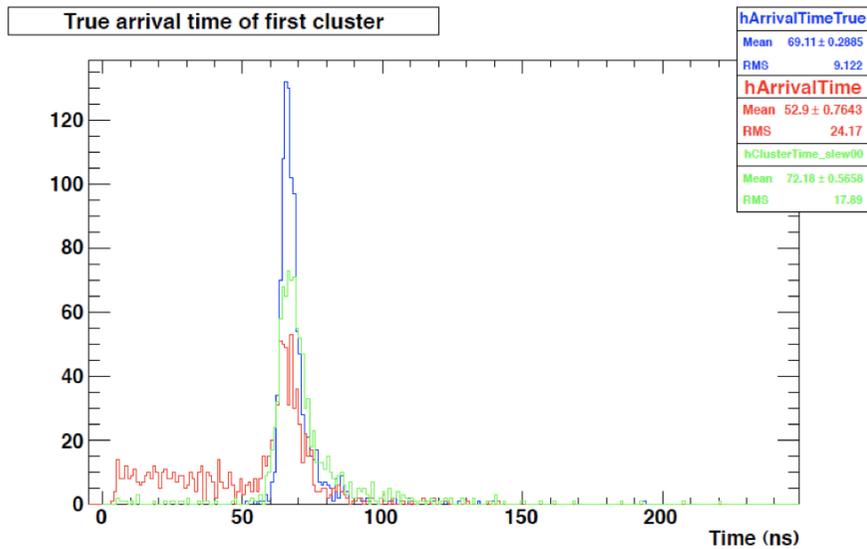
Signals from 2MeV electrons in a 17mm tube, in 90%He-10%iC₄H₁₀



Cluster Simulation



TRUE
THRESHOLD algorithm
DERIVATIVE algorithm



Summary

- Progress in simulation of background rates in the DCH
 - More realistic evaluation, effect of stereo layers
 - Important implications on cell size/number of channels, choice of gas mixture, depth of signal pipeline
 - Touschek effect in the works, common criteria for choice of safety factor
- More studies on cluster counting algorithms
 - “Software infrastructure” ready to make systematic studies vs. relevant parameters, and evaluate experimental reach
 - Input to Fast Simulation to evaluate effective impact in SuperB
- Full-length prototype built, FEE to be completed in the next few weeks
 - Commission on cosmic rays
 - Beam test @ BTF booked next October