Active Ganging Board

48 SiPMs 6x6 mm^2

(= 17.3 cm^2)

Gustavo Cancelo
Dante Totani

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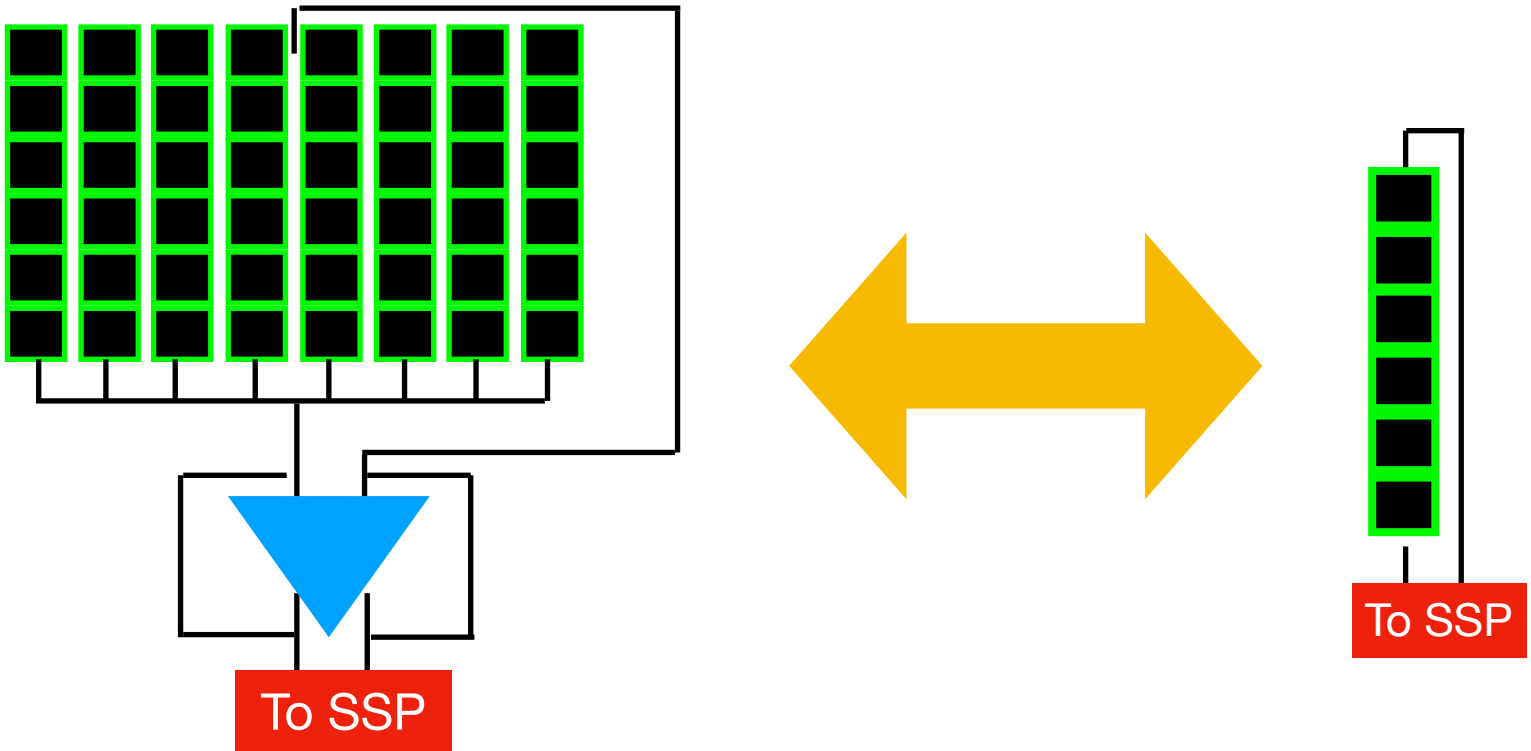
Fermilab

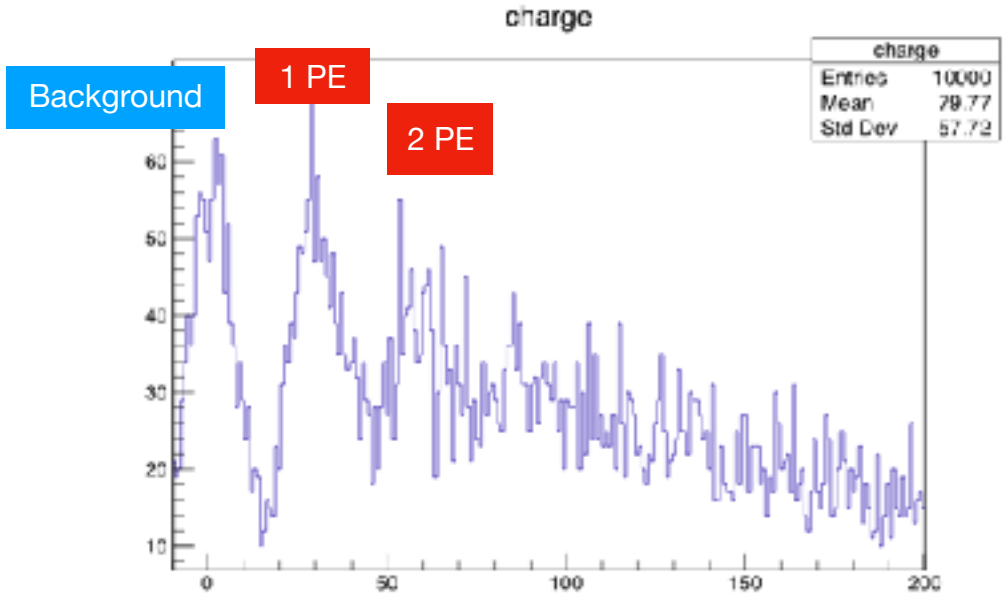
The 48 SiPMs are arranged in 8 groups connected in “Active Ganging” of 6 SiPMs connected in “Passive Ganging”

Using an OpAmp stage we can decouple the SiPMs capacitances and sum signals from more groups of SiPMs without changing the pulse shape (timing and amplitude). Moreover we can amplify the SiPM signal. Since only a fraction of the noise comes from the SiPMs, increasing the signal helps to increase the Signal over Noise ratio.

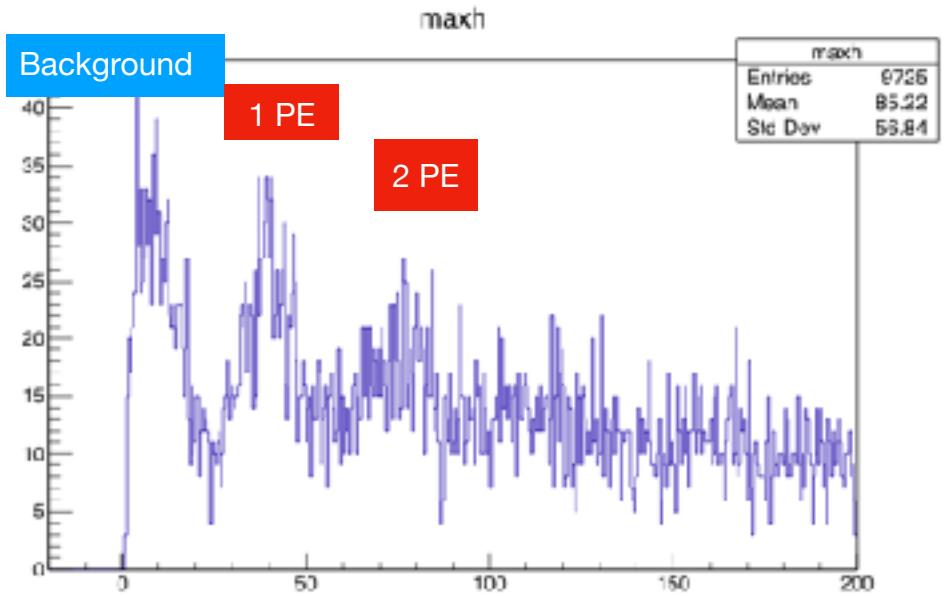


48 SiPM response to LED light.

(SSP triggered on LED pulse. Temperature=-70C. V_bias=54 V. OpAmp Gain=6.)



(ADUs x ticks)/100



(ADUs)

1 ADU = 0.244 mV
1 tick = 6.67 ns

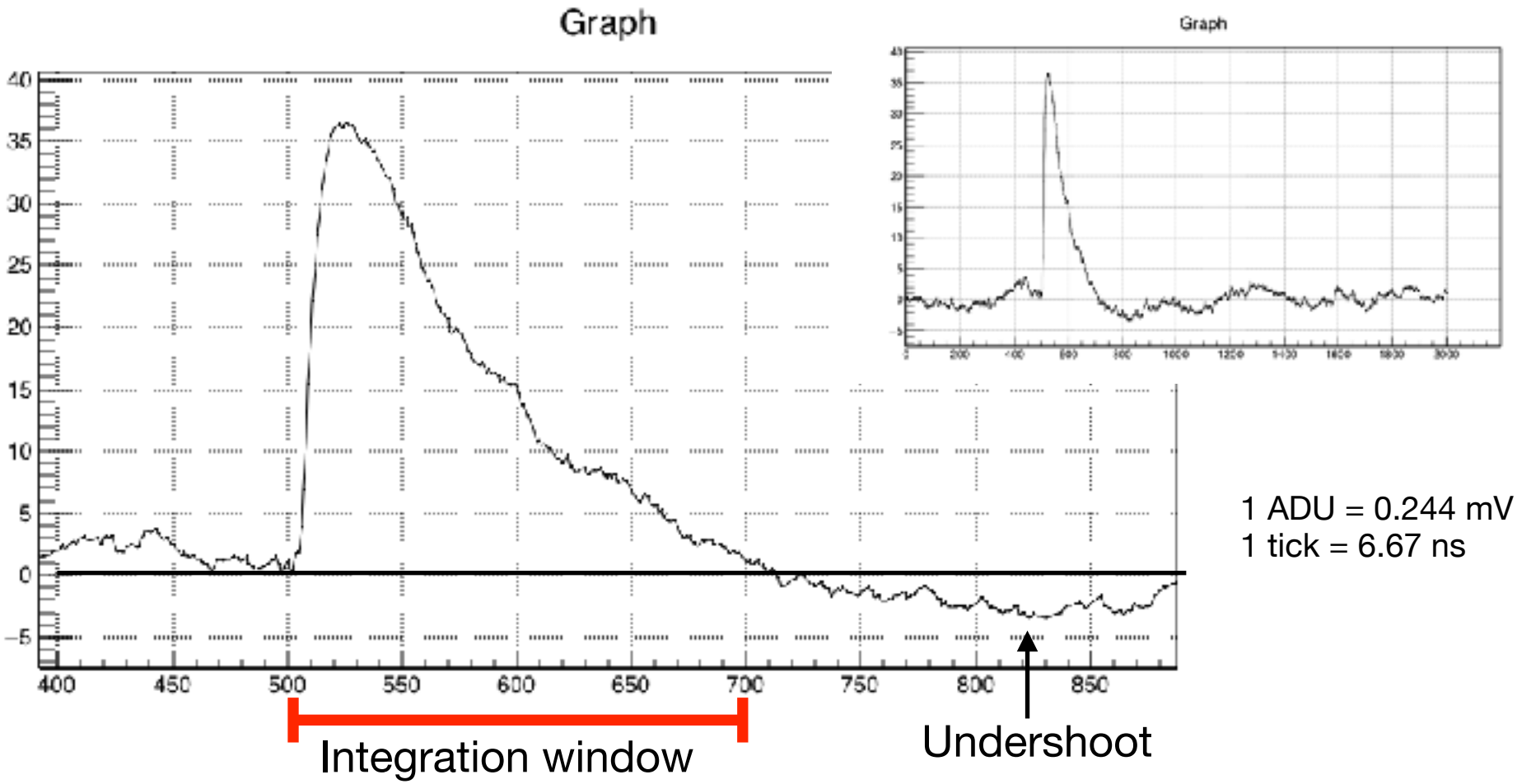
- Left histogram: signals integral in a window of $1.33\,\mu s$.
- Right histogram: signals max amplitude.

$$Charge: \frac{(\mu_1 - \mu_0)}{\sigma} \simeq 4 \qquad Amplitude: \frac{(\mu_1 - \mu_0)}{\sigma} \simeq 4$$

μ_i is the gaussian fit mean and σ_i is the standard deviation of peak "i". In our case $\sigma_0 \simeq \sigma_1 = \sigma$

Average of 511 SPE.

Temperature=-70C. V_bias=54 V.



1 ADU = 0.244 mV
1 tick = 6.67 ns

SPE Amplitude ~ 35 ADU = 8.5 mV

Rise time ~ $100\,ns$ Recovery time ~ $1.3\,\mu s$

Work in progress

These results are just the starting point for board characterization.

Next steps:

- modifying some components to balance the board in the best way.
- studying board-SSP interaction in order eliminate the undershoot
- board characterization: signal dependence from V_bias, Temperature…
- test in LN2 with LED and then in LAr (looking at the scintillation light)
- testing other configurations of SiPMs grouping

- Probably the final board will have SiPMs connected “actively” in 12 groups of 4 (passively connected) to follow the ARAPUCAs configuration. This configuration should be more favorable since the number of SiPMs passively connected is the biggest factor which affect the resolution in photoelectrons.