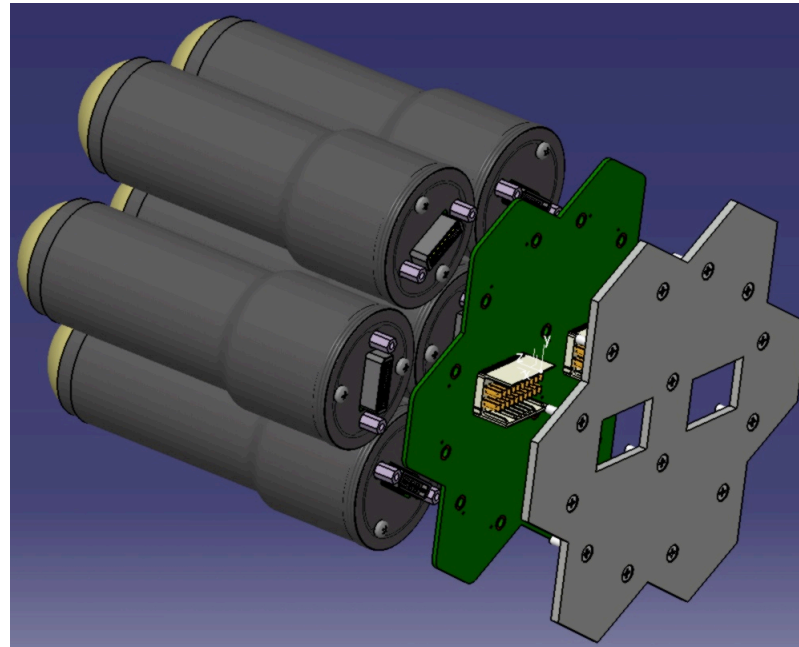


FPM electronic performances



NectarCAM team at IRAP

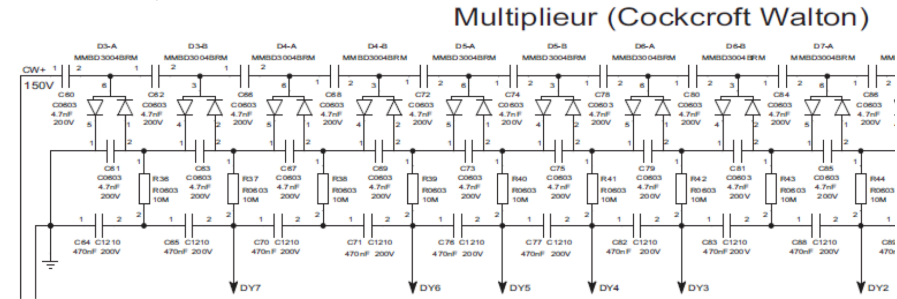
Ch. Jarnot, P. Jean, J. Knödlseher, J.F. Olive, P. Ramon,
Th. Ravel, A. Tsiaghina, Ch. Marty, R. Mathon, V. Waegebaert.

P. Jean - PC meeting - 7 Dec 2017

HVPAv3

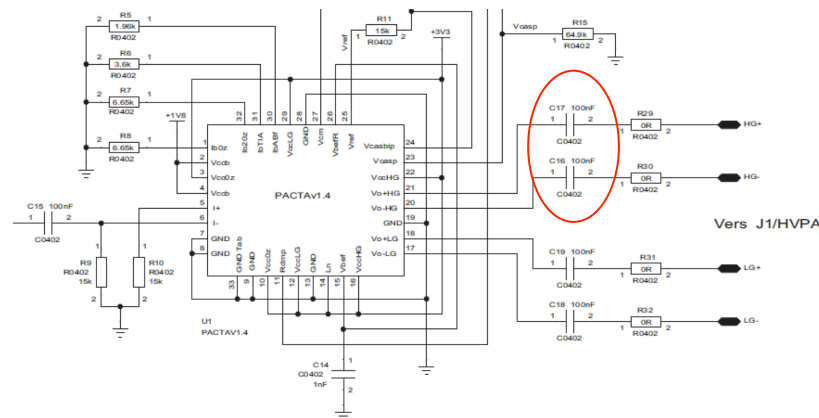
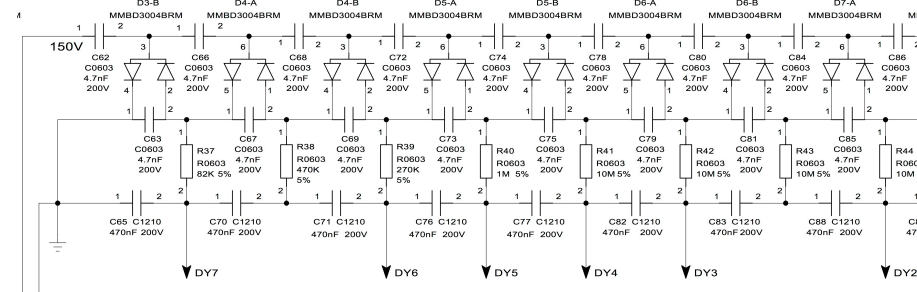
Modification of the HVPAv3 => HVPAv4 design

- Last CW cell removed: voltage ratio requirement.
- => Nominal HVs closer to the Hamamatsu ones
- Modified dynodes resistors: gain stability with NSB rate.

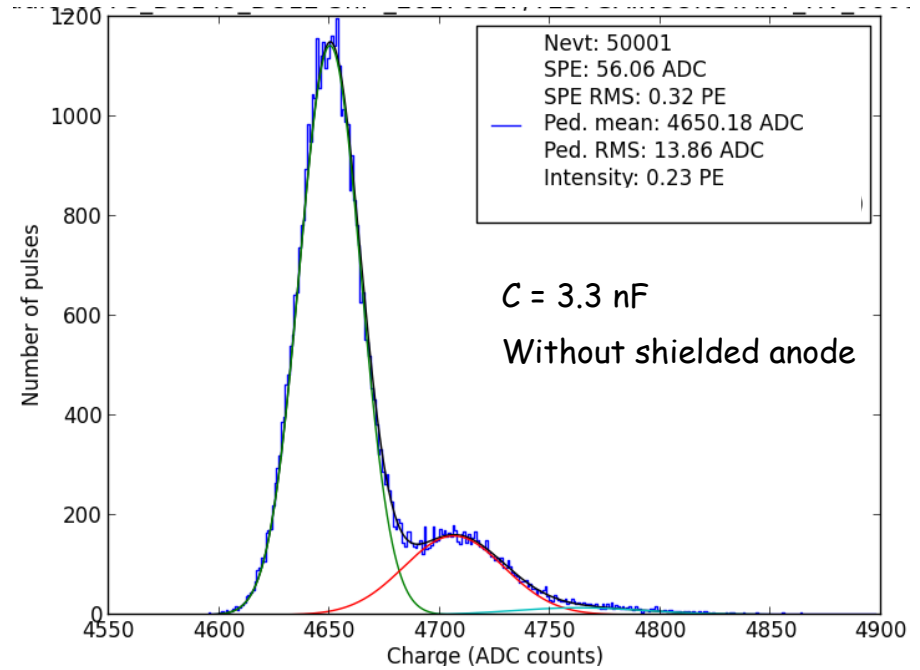
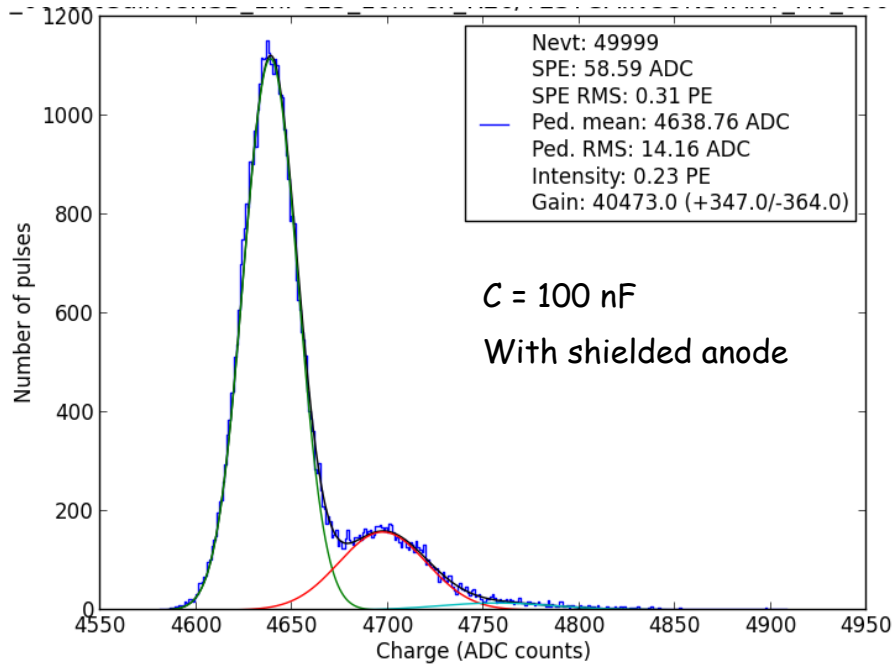


HVPAv4

- Resistor and protecting diodes at the PACTA input.
- => required by Univ. Barcelona
- Modified coupling capacitors at the PACTA output: to reduce pedestal RMS without shielding anode wire.
- => with $C = 3.3 \text{ nF}$ (instead of 100 nF), the reduction of the noise is as good as with the anode wire shielded.

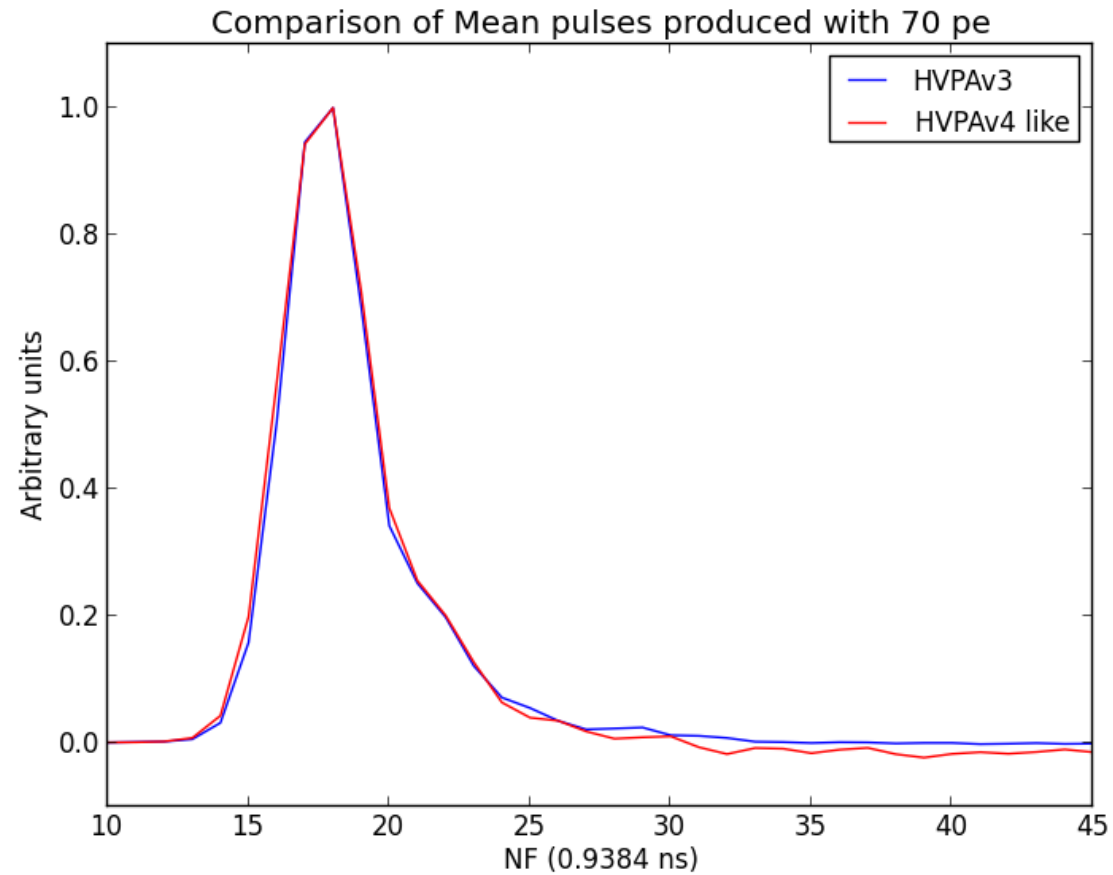


- Nominal gain/SPE/Noise of DUs with modified HVPA boards.



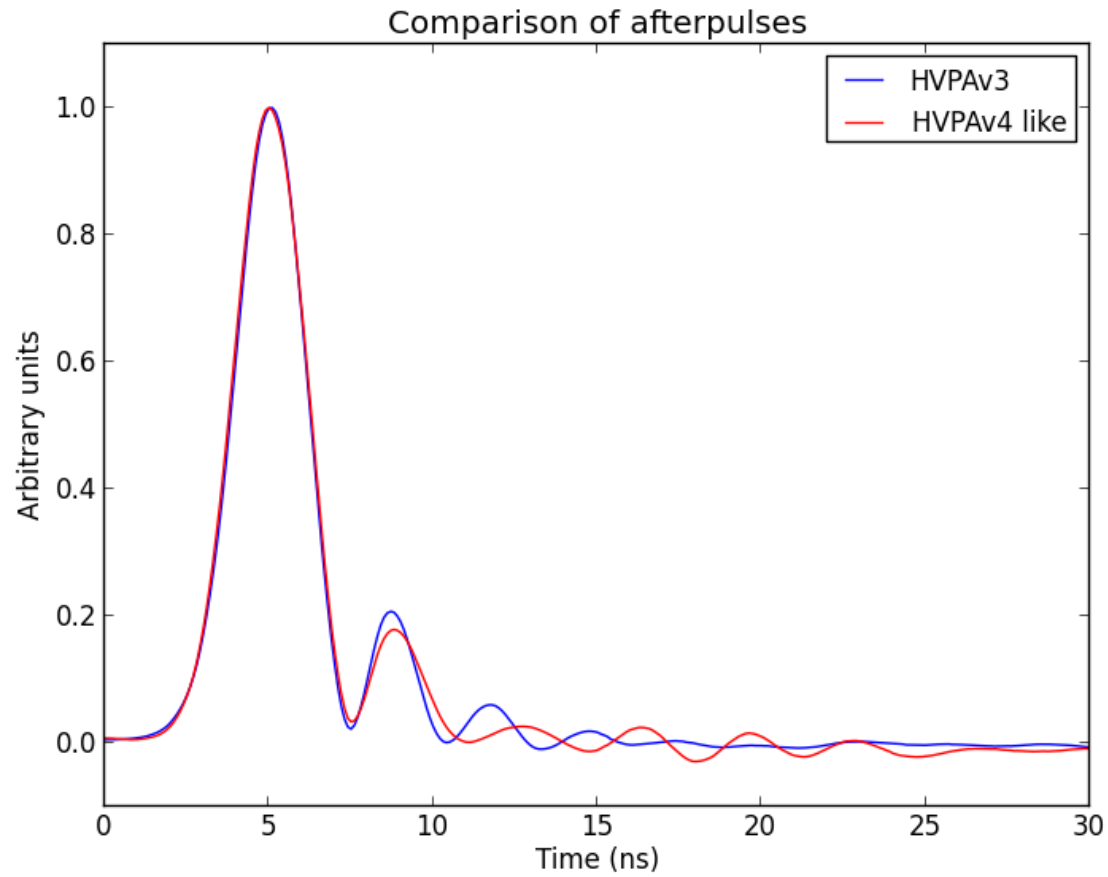
- With $C = 3.3 \text{ nF}$, the reduction of the noise is as good as with the anode wire shielded: $\sigma_{Ped} \sim 14 \text{ DC}$ (window 14 ns),
- The new coupling capacitors yield to a slight reduction of the SPE position: from 1 % to 4 %,
- Charge resolution at $G = 40 \text{ k}$ is $\sigma_{Ped}/SPE \sim 0.25$ (with an integration window of $\sim 14 \text{ ns}$).

- Pulse shape



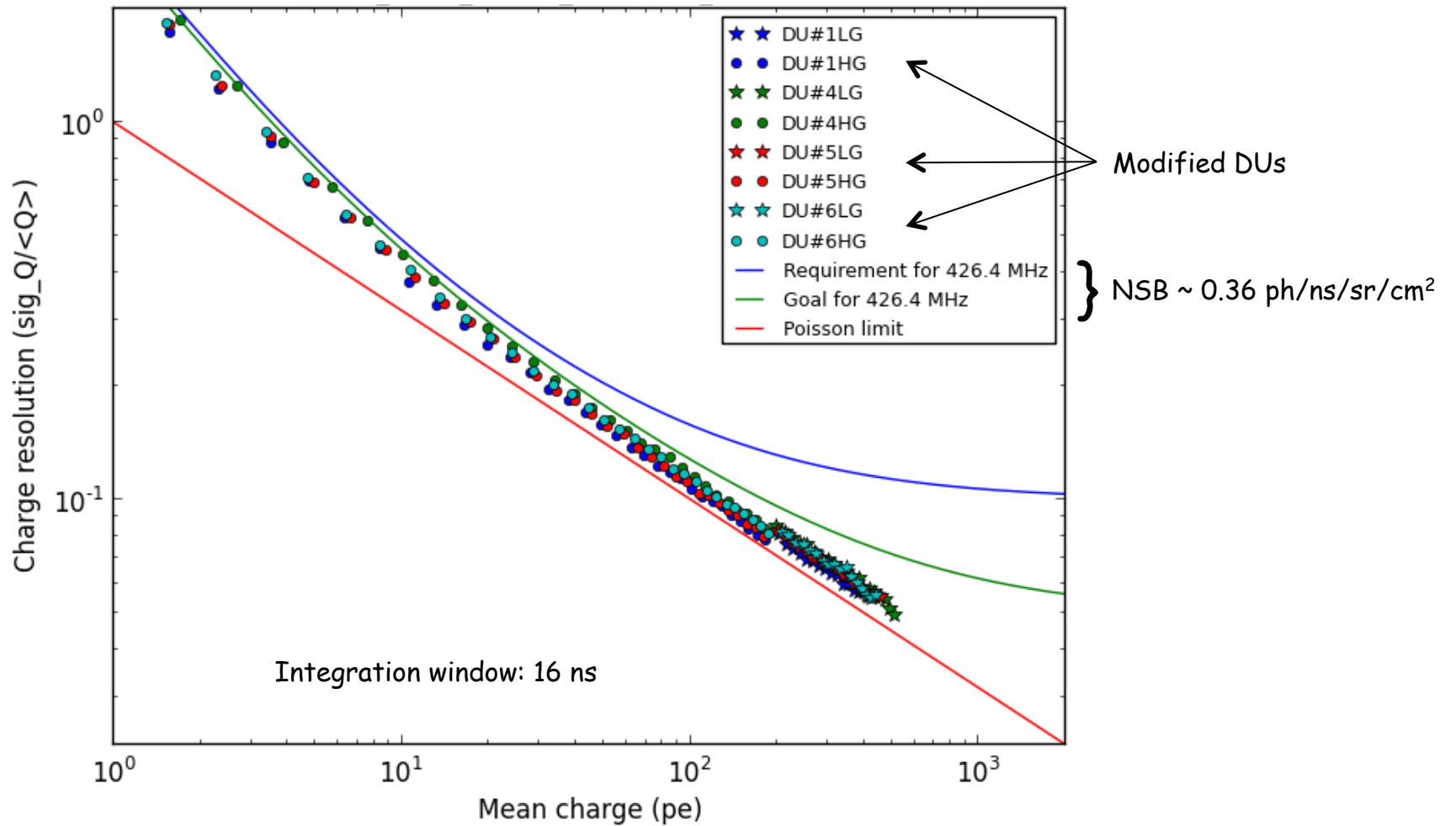
- Slight modification of the pulse shape,
- Deeper undershoot : up to ~7% of pulse amplitude at ~ 45-50 ns after the pulse peak,
- Pedestal recovery duration: measured at ~ 2.7 μ s with ~7000 pe pulses.

- Afterpulse shape



- Mean afterpulse estimate extracted from FPM data by stacking jitter-corrected afterpulses.
- The oscillations after the pulse are less damped.

• Charge resolution with NSB



- Charge resolution within the goal.

- Linearity better than 1 % in the HG range up to ~ 200 pe.

Conclusions

- The presented results were obtained with measurements made:
 - with modified HVPAv3
 - with a FEBv3
- Compared to the anode-wire shielding HVPA design, a coupling capacitor of 3.3nF produces:
 - a no critical reduction of the SPE position, => change of the PACTA-ACTA chain gain ; need to be fixed.
 - a deeper undershoot, => impact on the trigger rate? Risk to miss events?
 - less damped oscillations after pulses, => does not seem to impact too much the performances (?)
- Do we need to do more tests ? e.g. tests by changing some impedances (R and/or C) between the PACTA and the ACTA (?)
- Impact on the production:
 - anode wire shielding will increase the cost but we do not yet know how much (estimation in progress).