

Status report of the Micromegas R&D for COMPASS at Saclay

Maxence Vandenbroucke

CEA Saclay / DSM / IRFU / SPhN

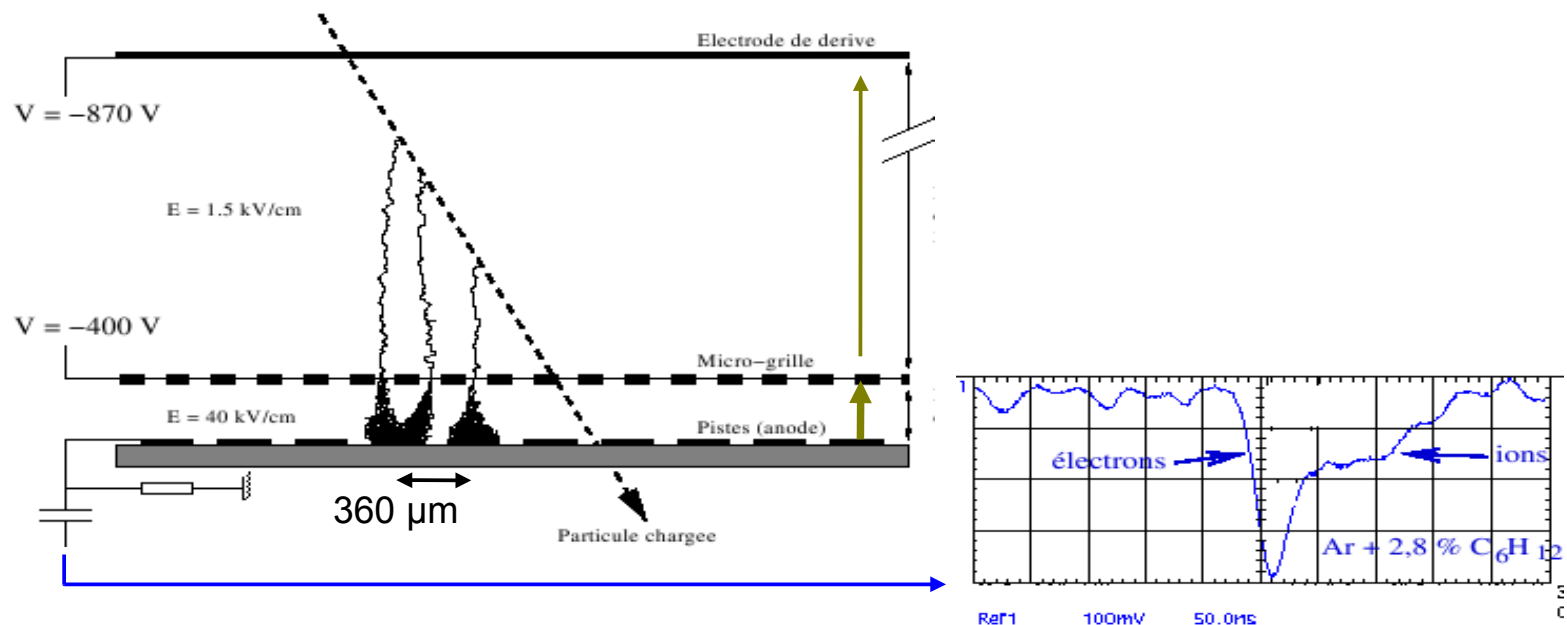
RD51 meeting, Bari, 6th - 10th October 2010

Summary

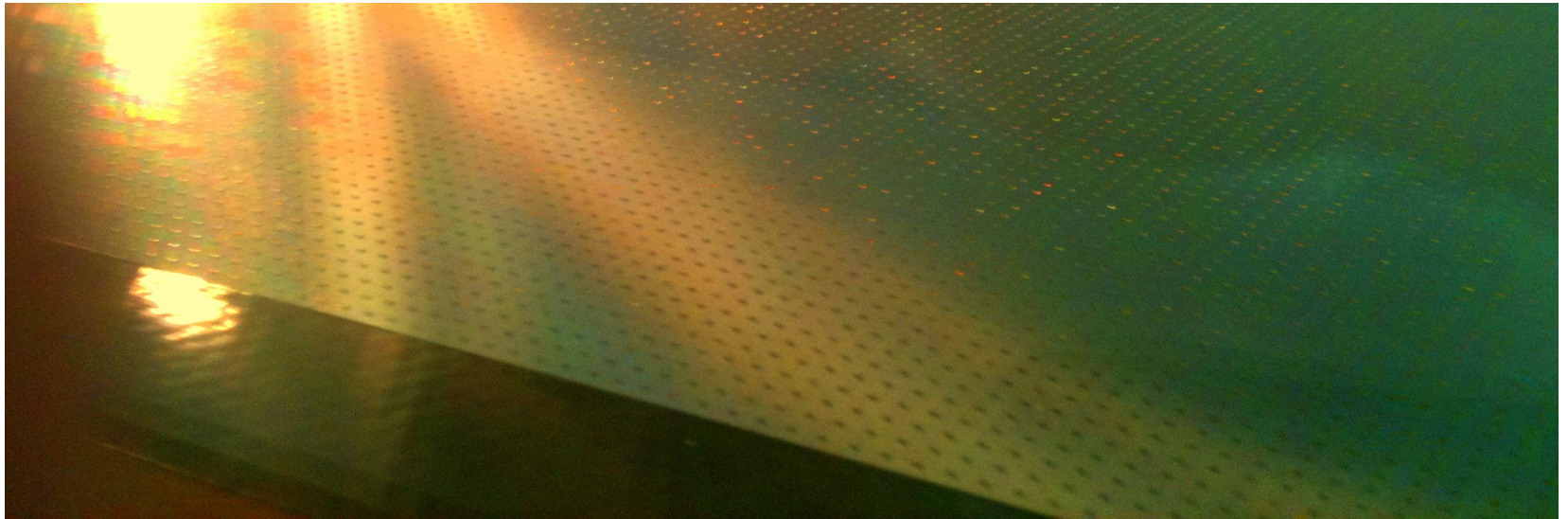
- Motivation
- Pixelized Micromegas at COMPASS
- APV's parameters optimisation for Micromegas
- Test beam on PS T11
- Gain measurement
- Outlook

Motivation of MM R&D

- Pixelized center for COMPASS :
 - Tracking with high hadron flux, including in beam area
 - Integrated FEE with APV 25
 - Sparks reduction at high rate
- Spark reduction :
 - Resistive paste and layer on strips
 - GEM amplification stage

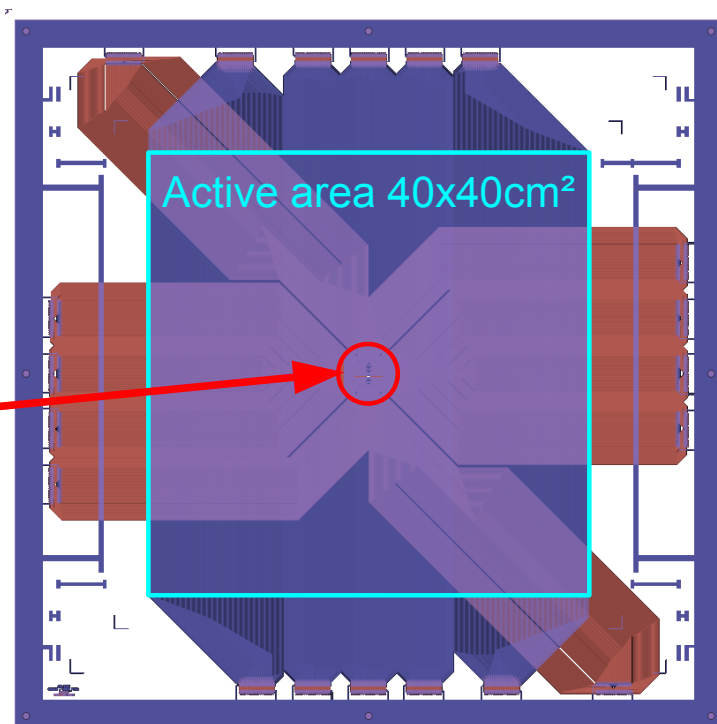
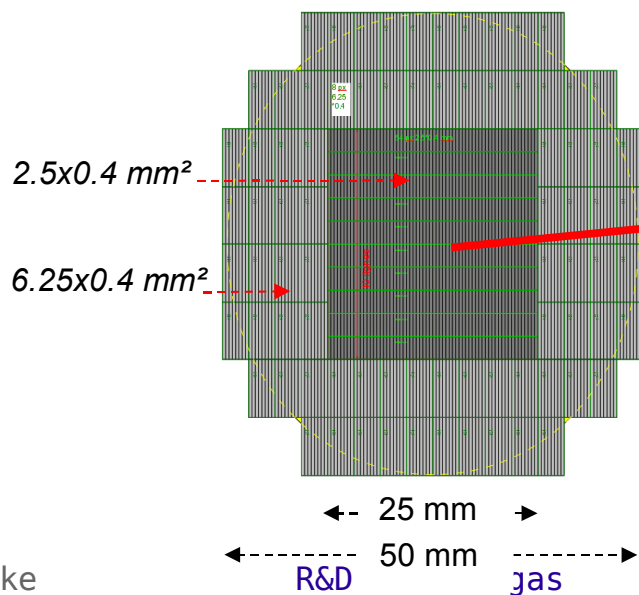
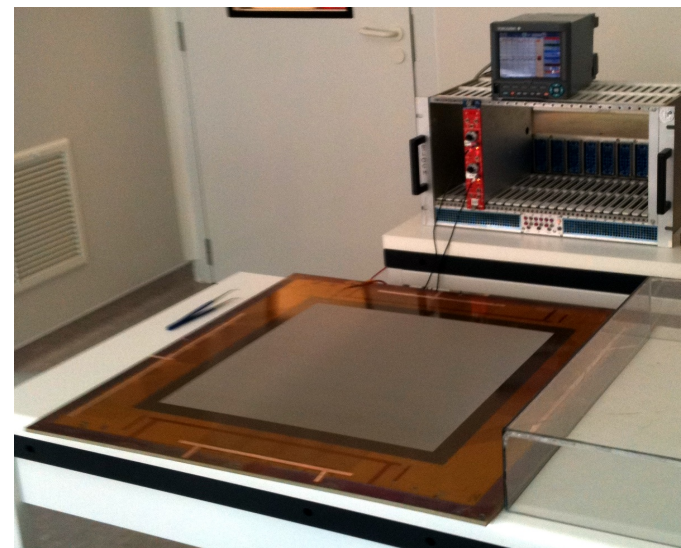


I) The Pixel Micromegas at COMPASS :

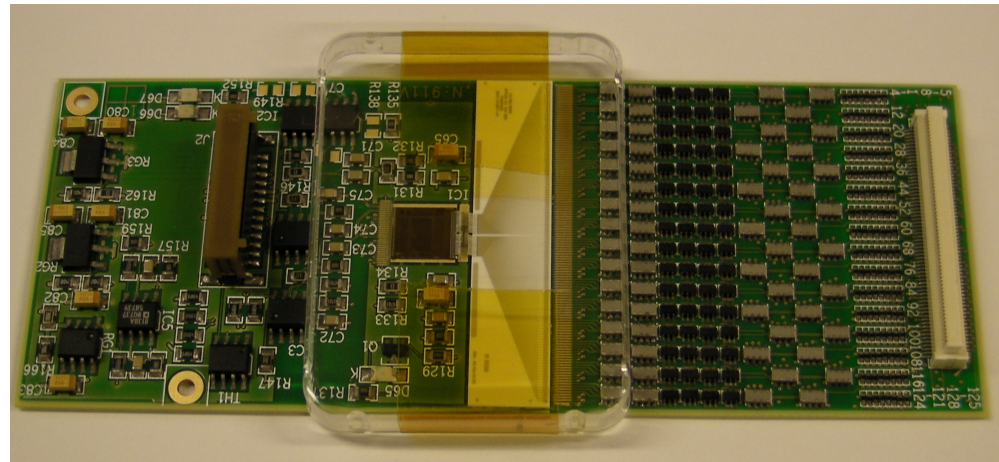


Pixel Micromegas

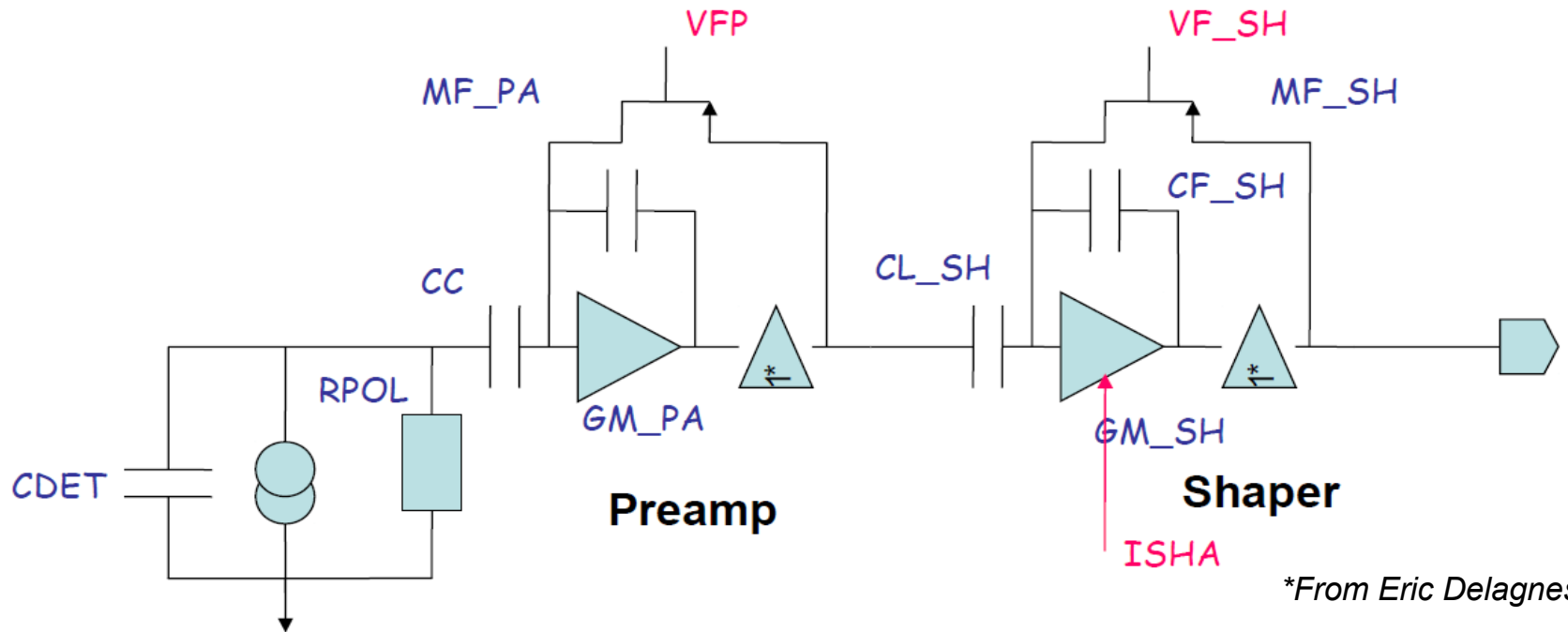
- Micromegas bulk technology
- 40x40cm² active area with rectangular pixels
- 2560 channels read by APV 25
- Data taking on COMPASS since end of 08/2010
- Comparable performances with old MM
- Characterization ongoing



II) APV tuning for Micromegas :



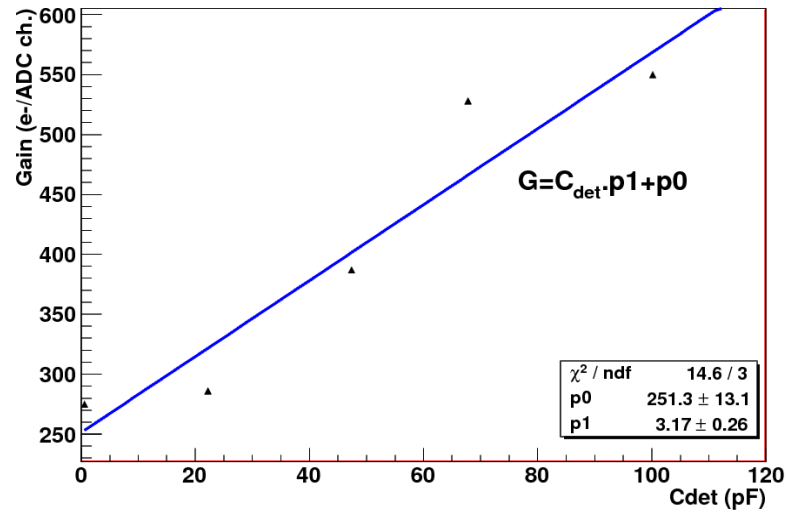
APV tuning – 3 main parameters



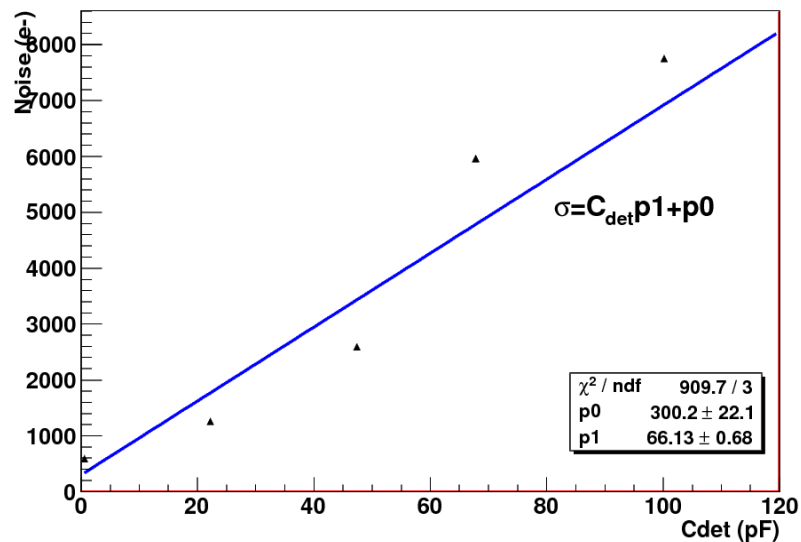
- VFP : Preamplifier feedback current
- ISHA : Shaper powering current
- VFS : Shaper feedback current
 - Optimization between noise, amplitude and time occupancy of the APV signals

APV tuning – Influence of Cdet

- Gain increases with input capacitor:

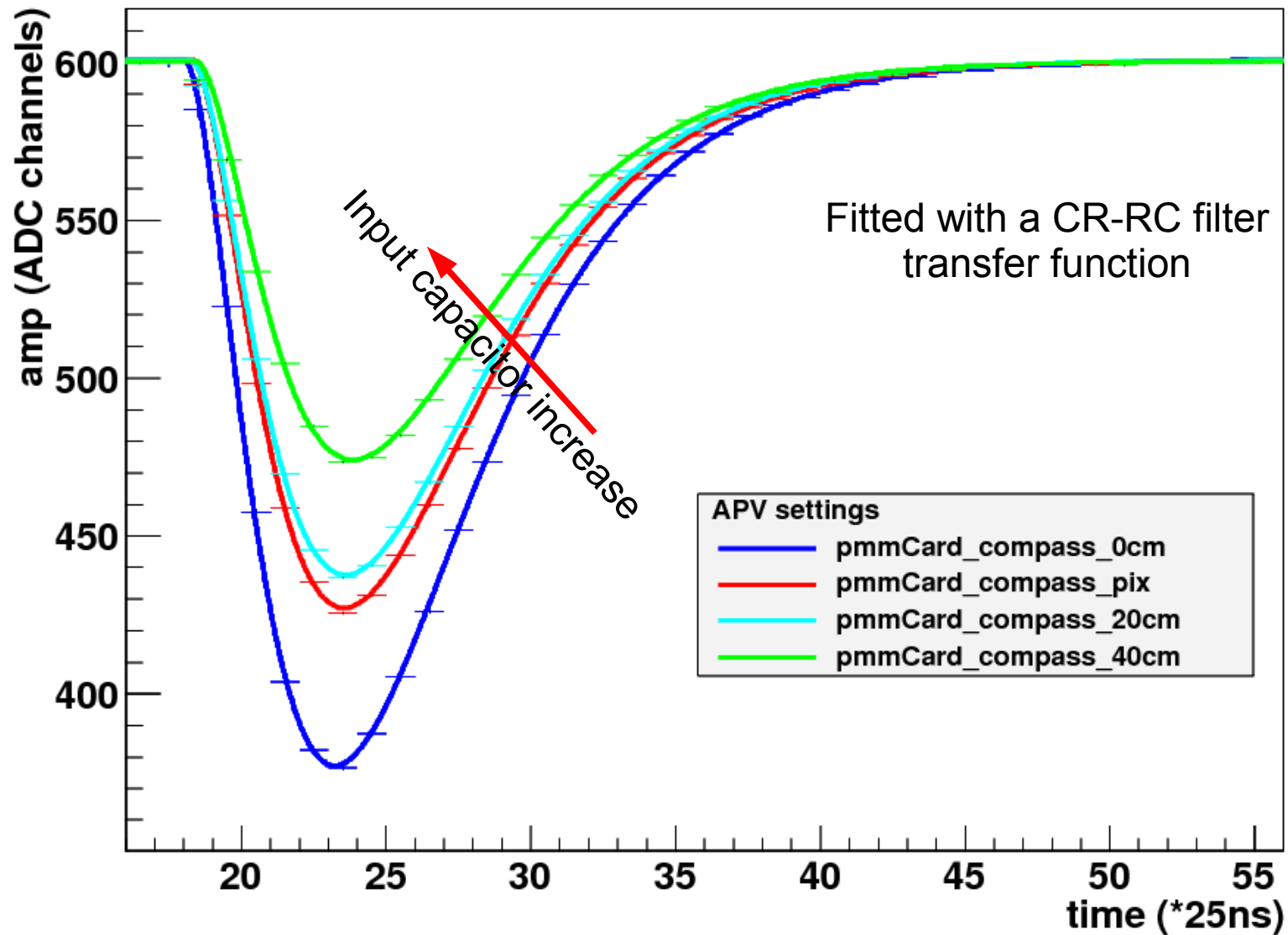


- APVs' output signals noise increases with the input capacitor:



APV tuning – Importance of Cdet

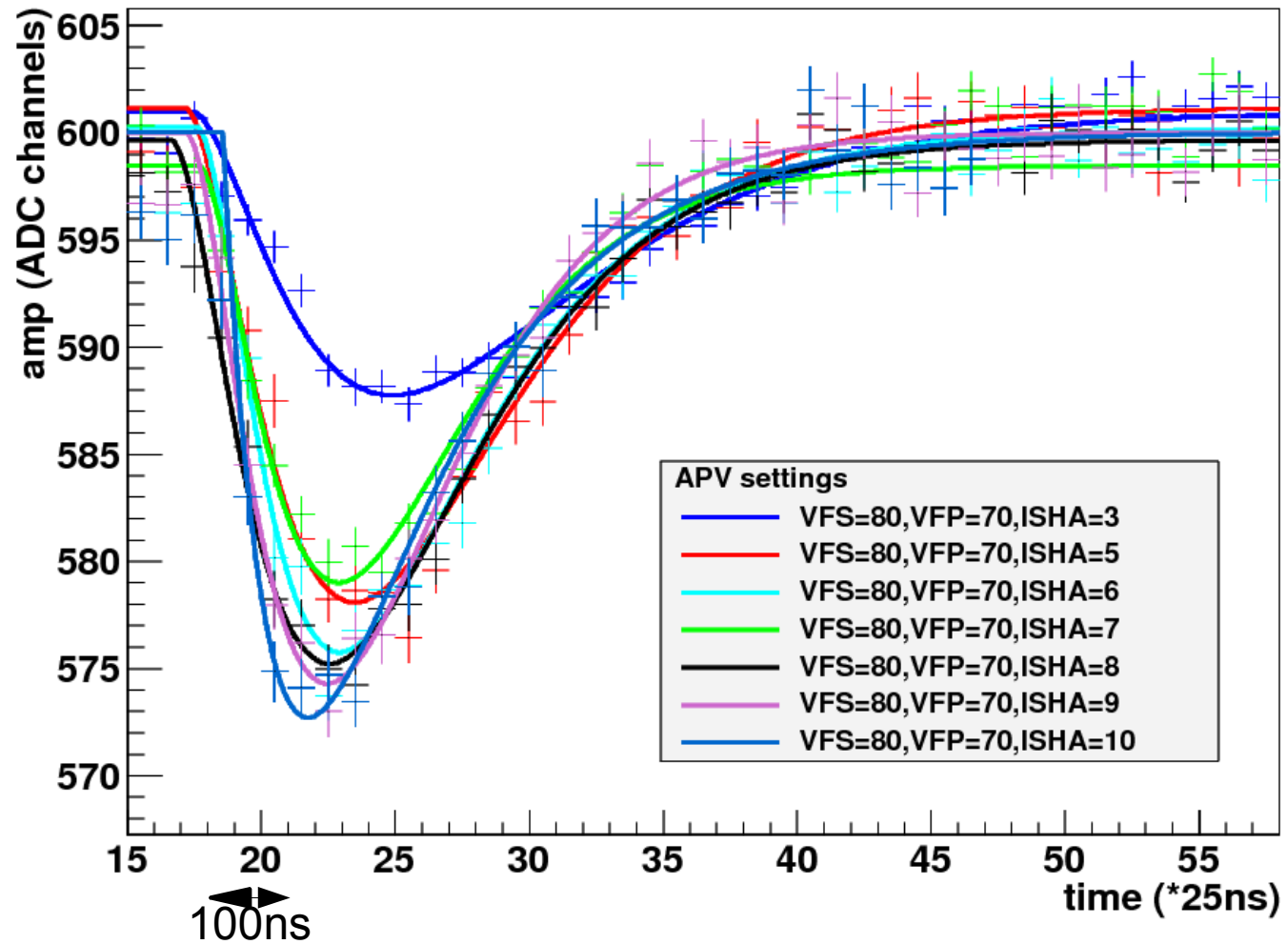
I r f u
cea
saclay



- Further studies using a 40cm PMM strip as Cdet (worth case scenario)

APV tuning - ISHA

- ISHA : Shaper powering current



=> Influence on the rising time, must cover the 100ns of the MM signal

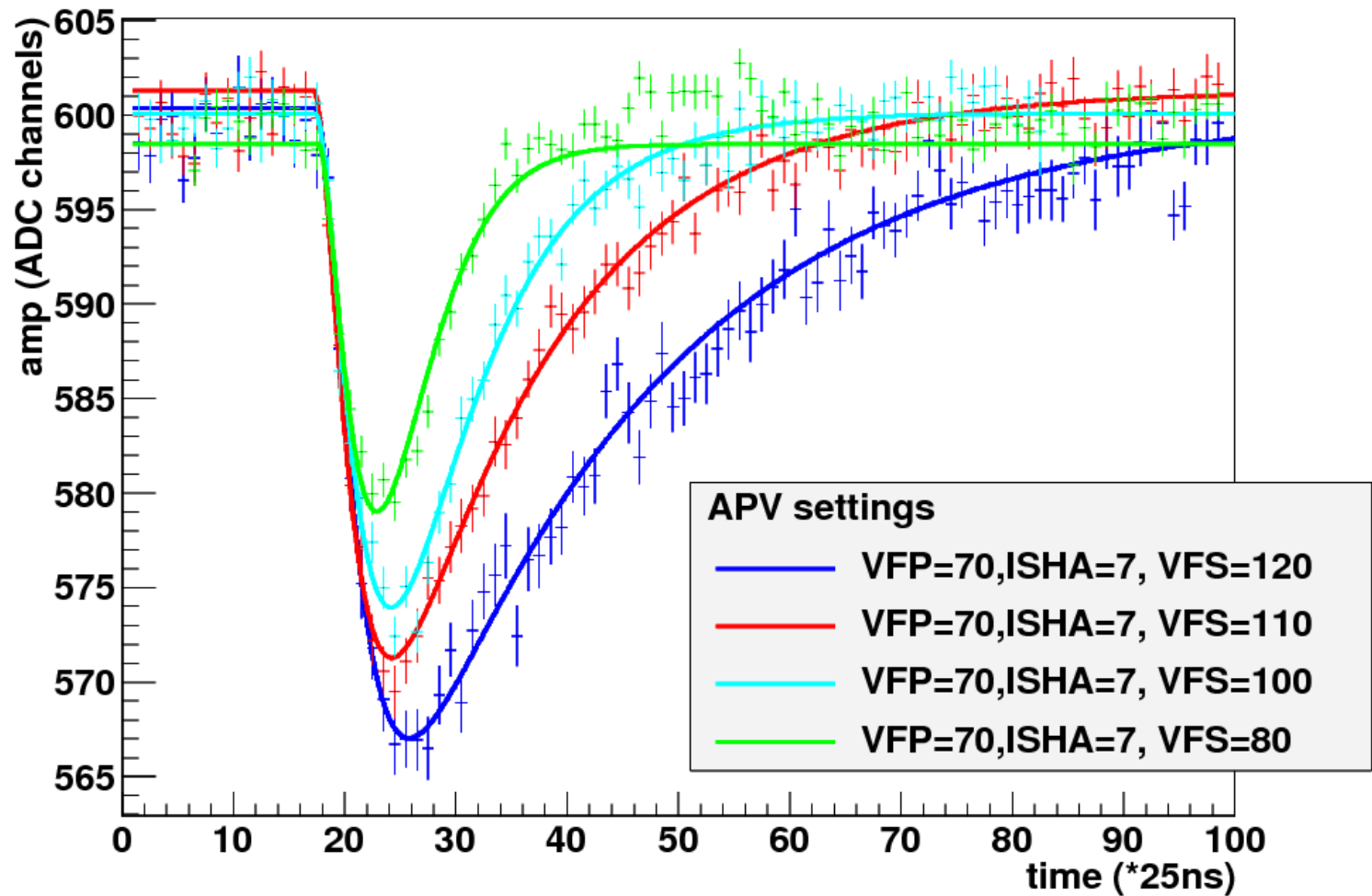
APV tuning - VFS

I r f u



saclay

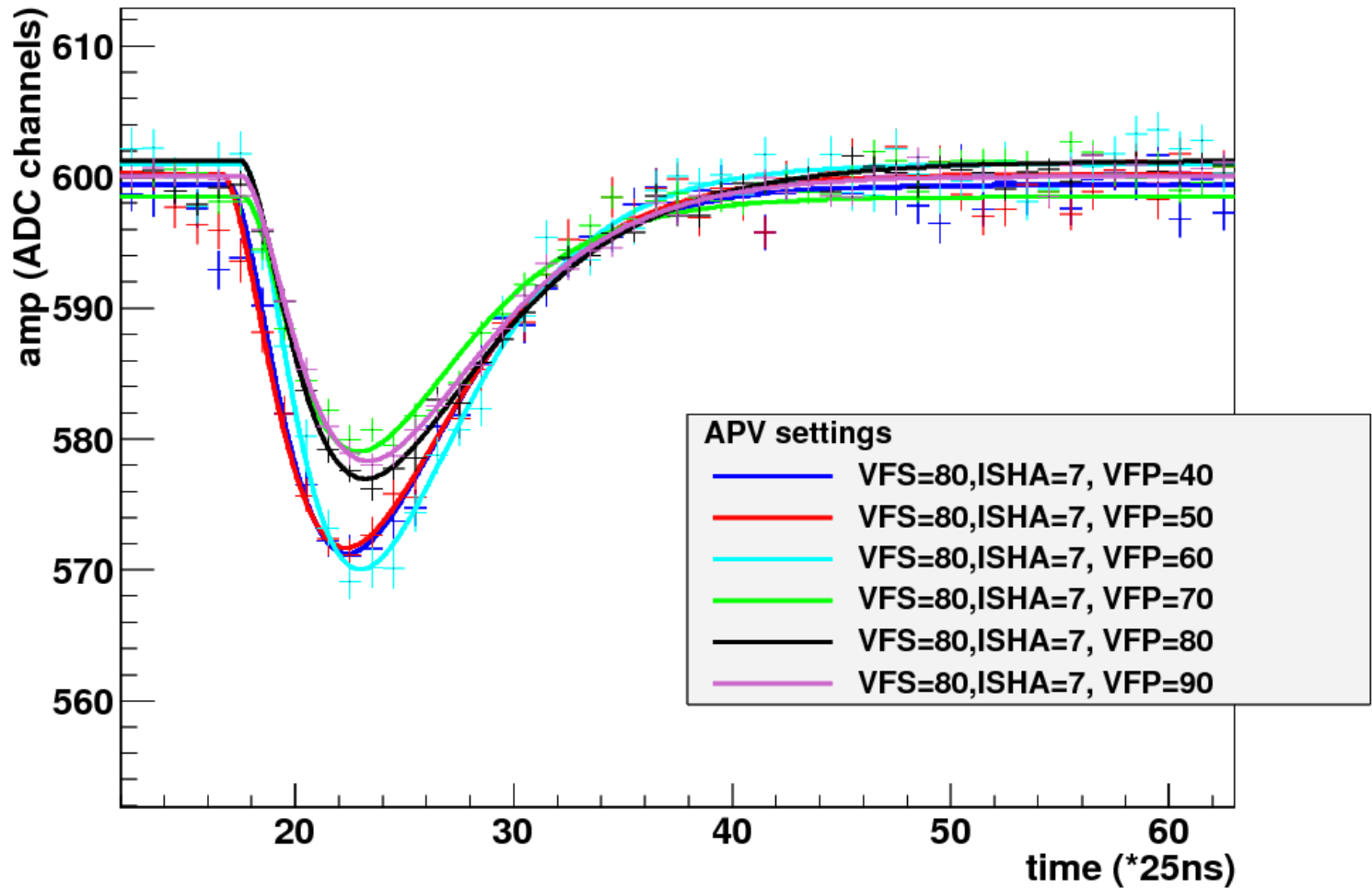
- VFS : Shaper feedback current



=> Influence on the exponential decay, must be the shortest possible without undershoot

APV tuning - VFP

- VFP : Preamplifier feedback current

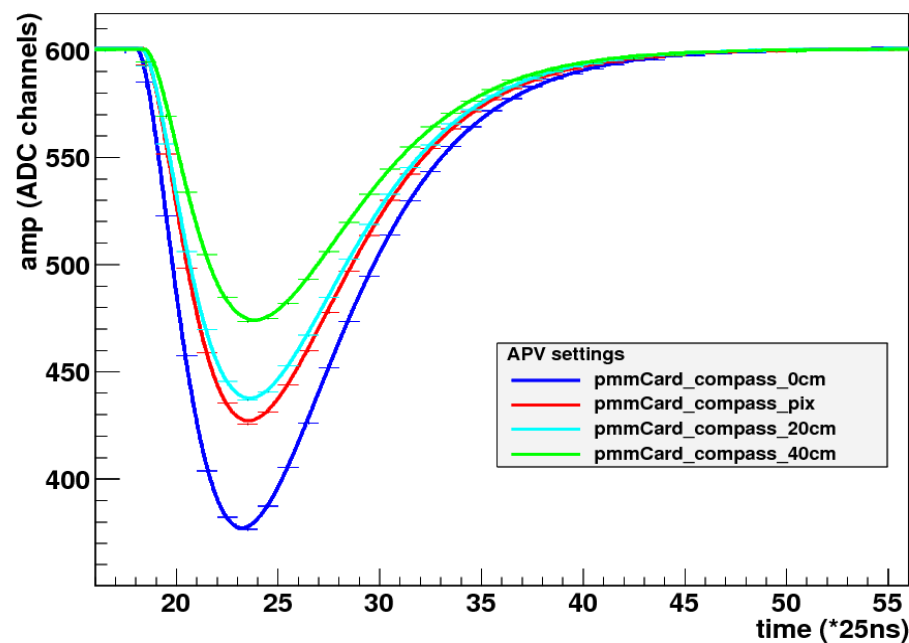


=> Influence of the preamplifier hidden by the shaper

APV tuning – Final choice:

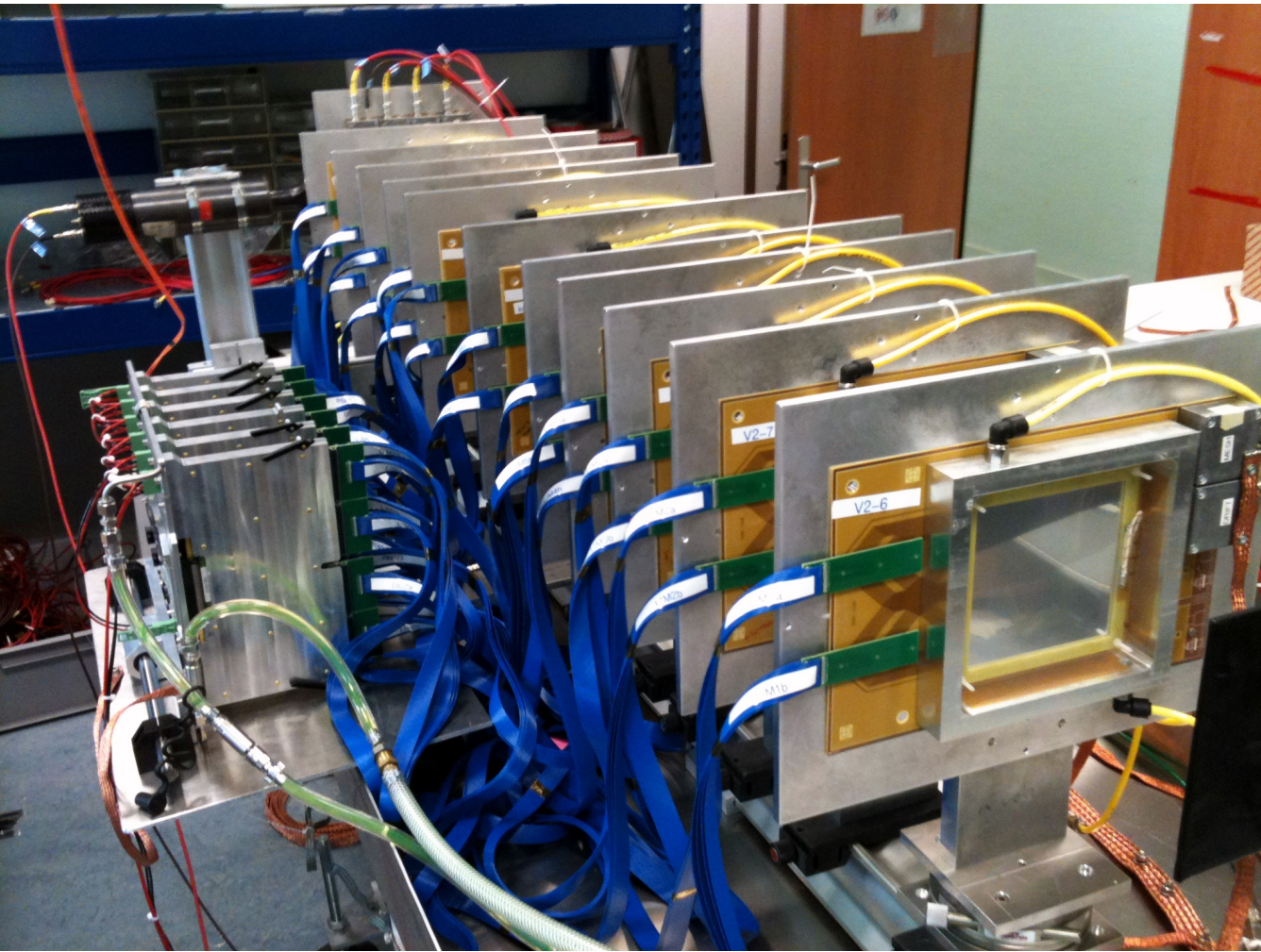
➤ APV COMPASS settings : VFS=80, VFP=70, ISHA=5

- Noise ~ 900e- (40cm strip)
- Rising time of 150ns
- Total length 450ns
- G = 488e-/ADC ch.



III) PS T11 test beam:

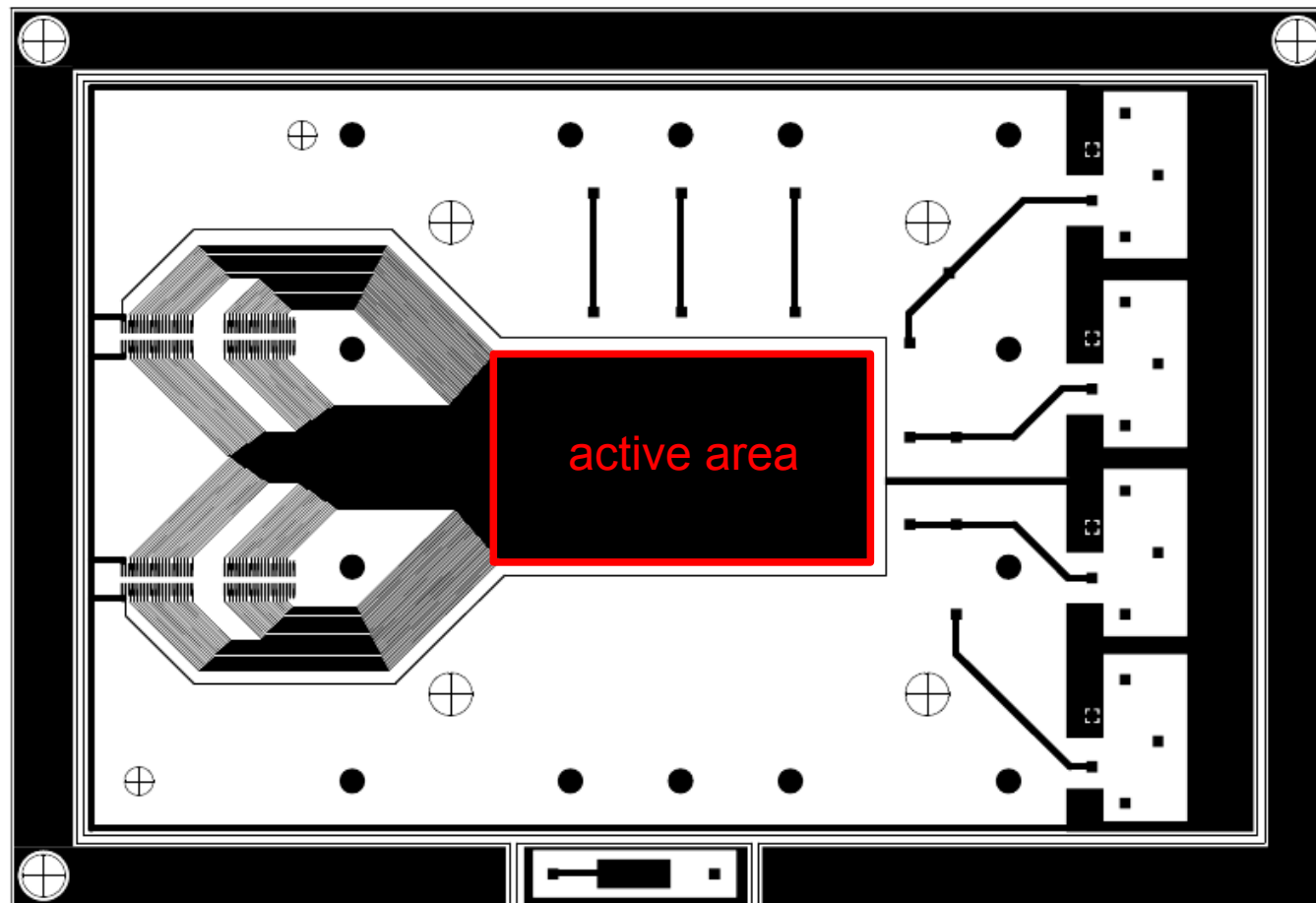
COMPASS / CLAS12 test beam



T11 test beam - Prototypes

- Standard 6x10cm bulk detectors:

- 144 strips with 400 μ m pitch read by AFTER/T2K FEE



| | |
|------------------|--------------|
| N:PHOTO | CEA-SACLAY |
| TRACE N: ED:1 | DU. 26/04/10 |
| DOCUMENT DE BASE | N:C1. |
| COUCHE #1 TOP | PCB TF10 |

T11 test beam 08/2010

- Beam of the T11 line of the PS at CERN :

- From 300MeV to 3GeV hadrons (Pi+ or Pi-)

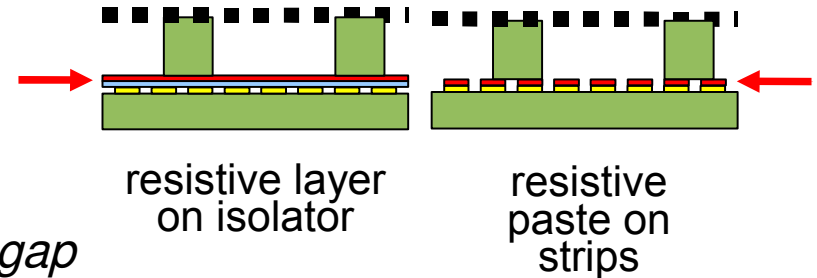
- AFTER/T2K FEE and DAQ

- Different detectors :

Bulk Micromegas, 128 μ m amplification gap

- Bulk MM made at CERN and CEA
- Different mesh (18, 16 and 50 μ m wires)
- 2 MM with GEM amplification stage (1 and 2mm gap)
- 2 MM with a resistive layer + isolation on strip (kapton of 1M Ω / \square and resistive paste of 10M Ω / \square)
- 2 MM with resistive paste on strip

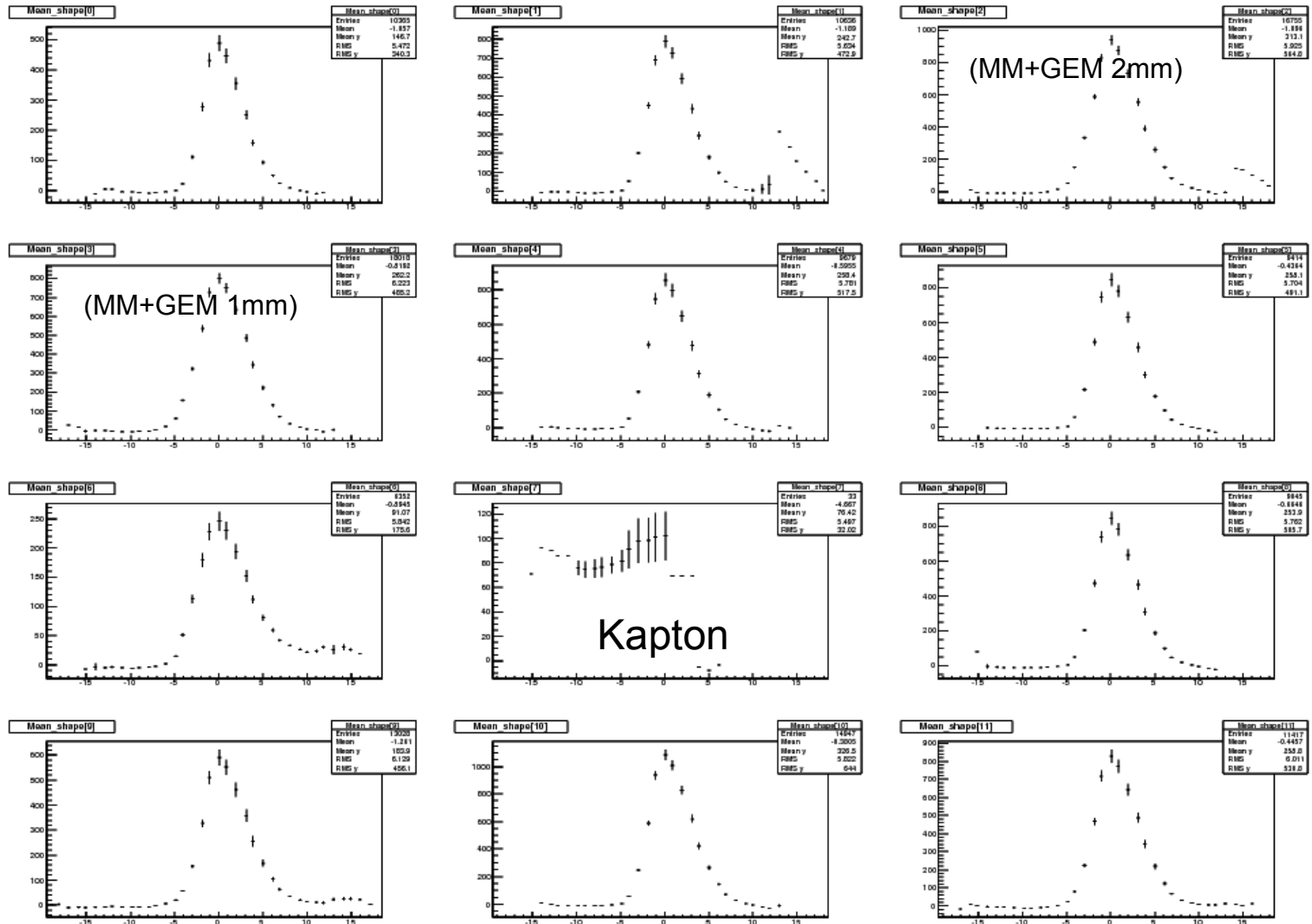
=> Characterization of new detectors types at low energy, influence of hadrons' impulsion on sparks...



resistive layer
on isolator

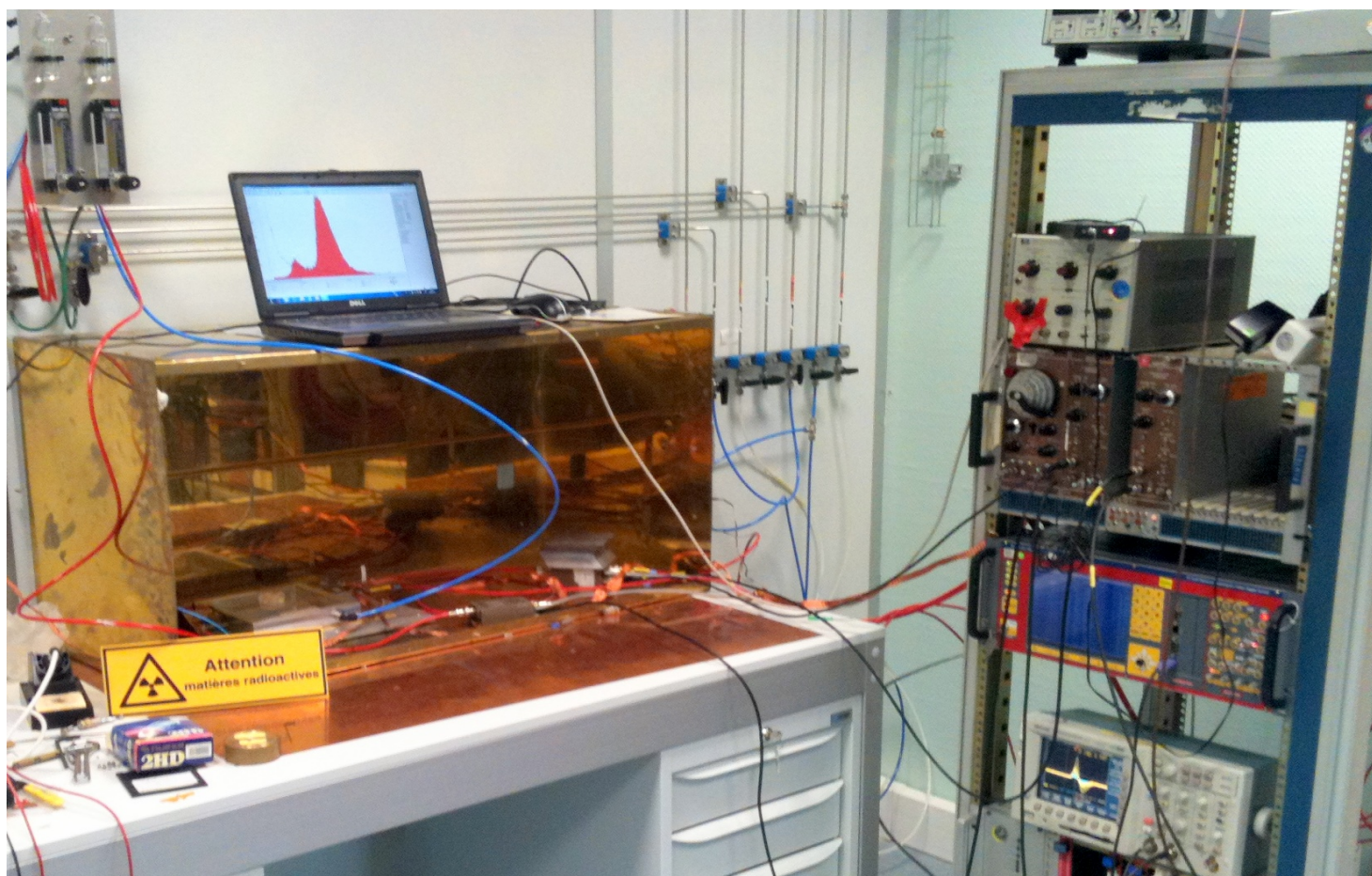
resistive
paste on
strips

T11 – Mean signal shape



=> Analysis ongoing, results on characterization should be ready soon
=> Low amplitude of “resist” MM signals

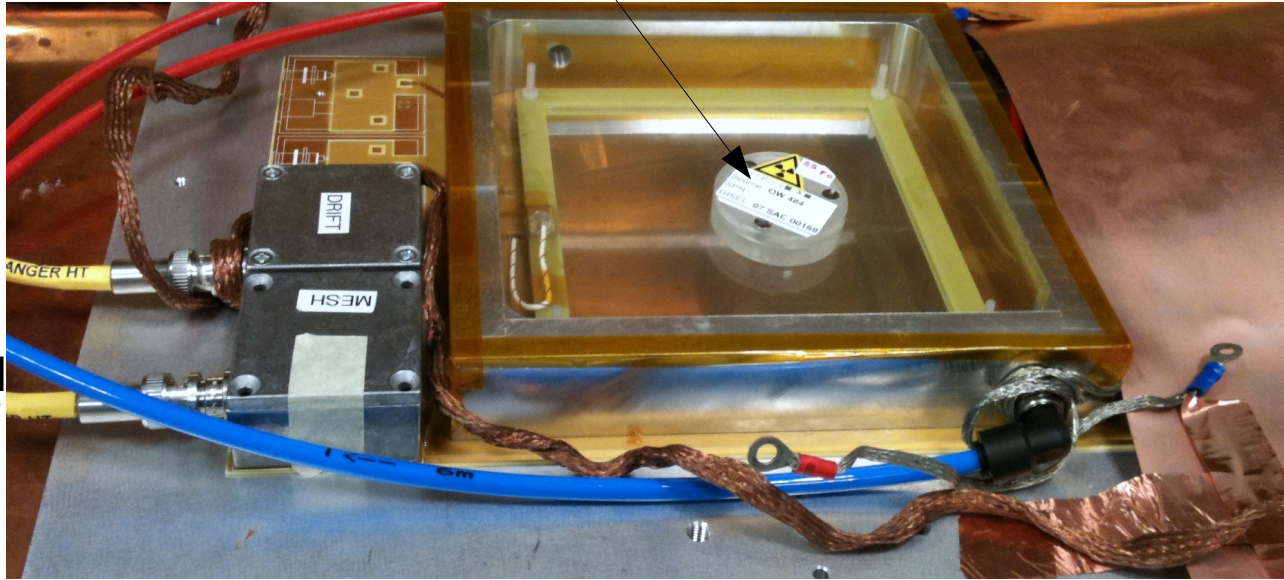
IV) Gain measurement :



Gain Measurement - Basics

Fe55 source (5.6KeV photons)

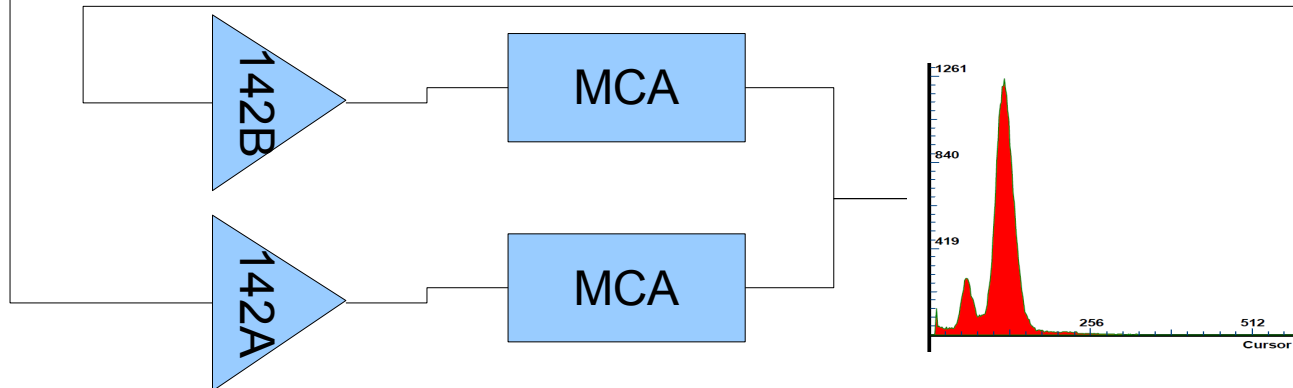
95% Ar +
5% iC_4H_{10}



144 STRIPS

1 Mohm

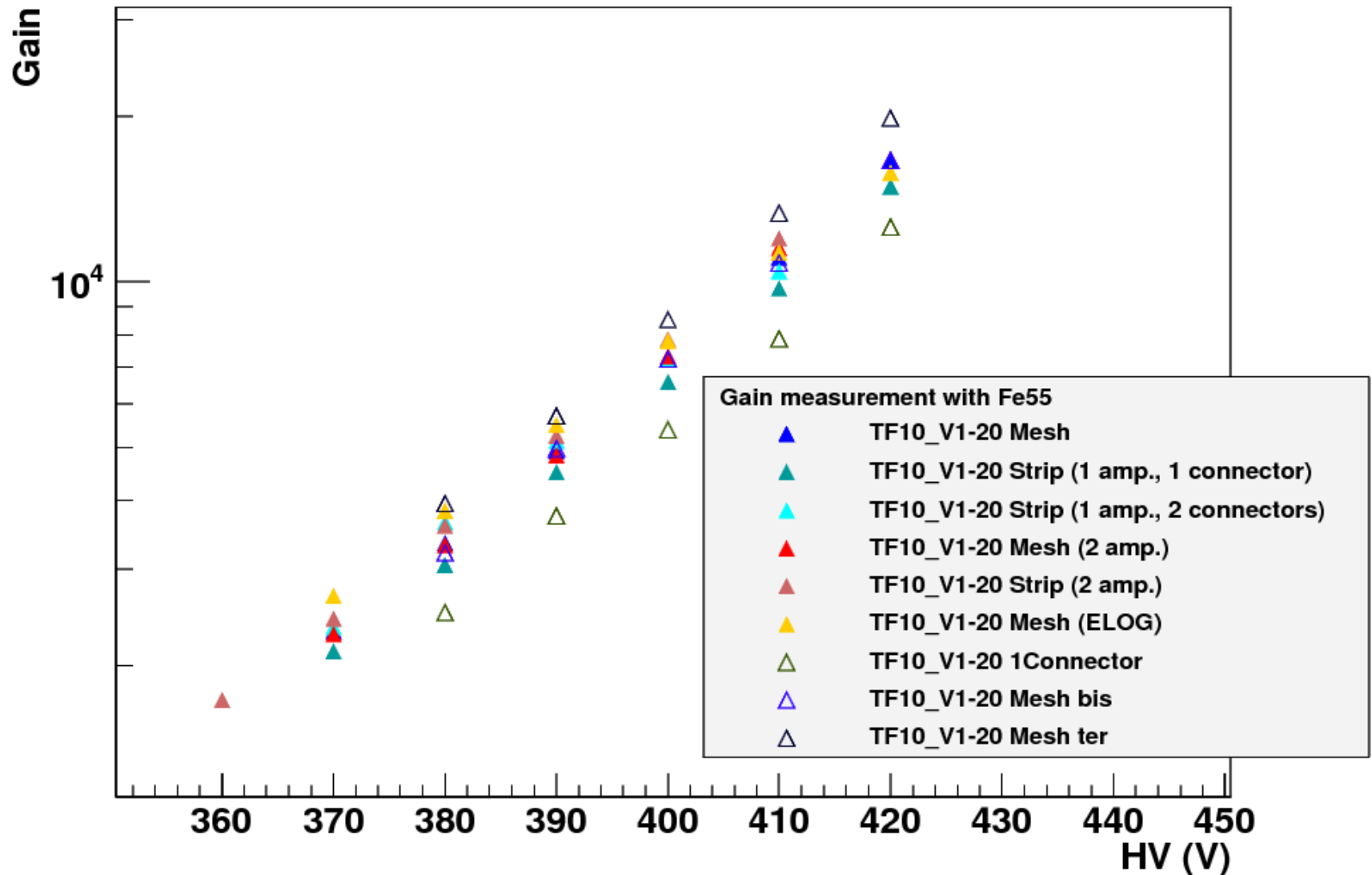
MESH



$$N_p = 225e- \\ G_{det} = N_p / N_{peak}$$

Gain Measurement - Variability

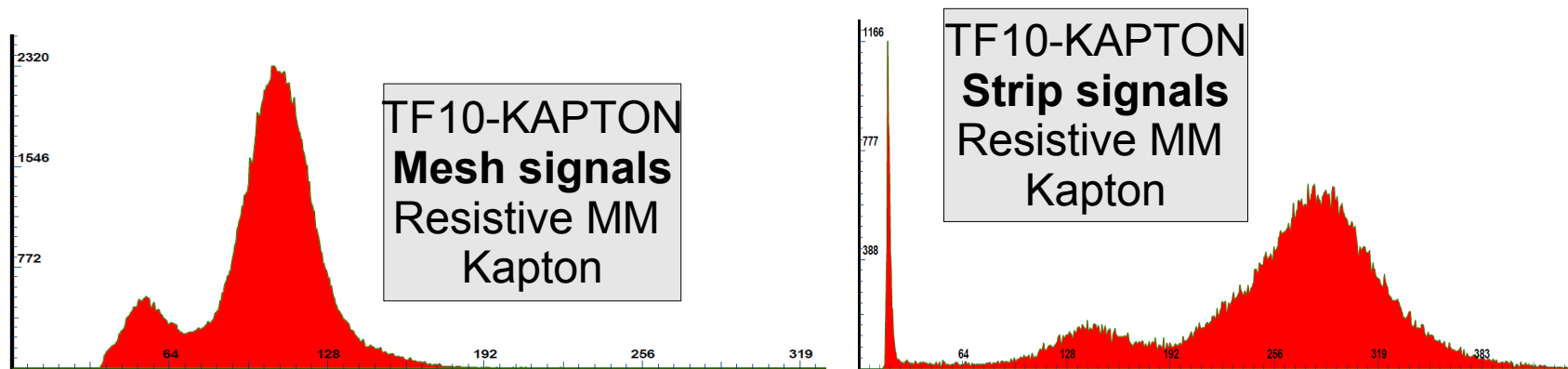
- 1 standard bulk detectors, different results :



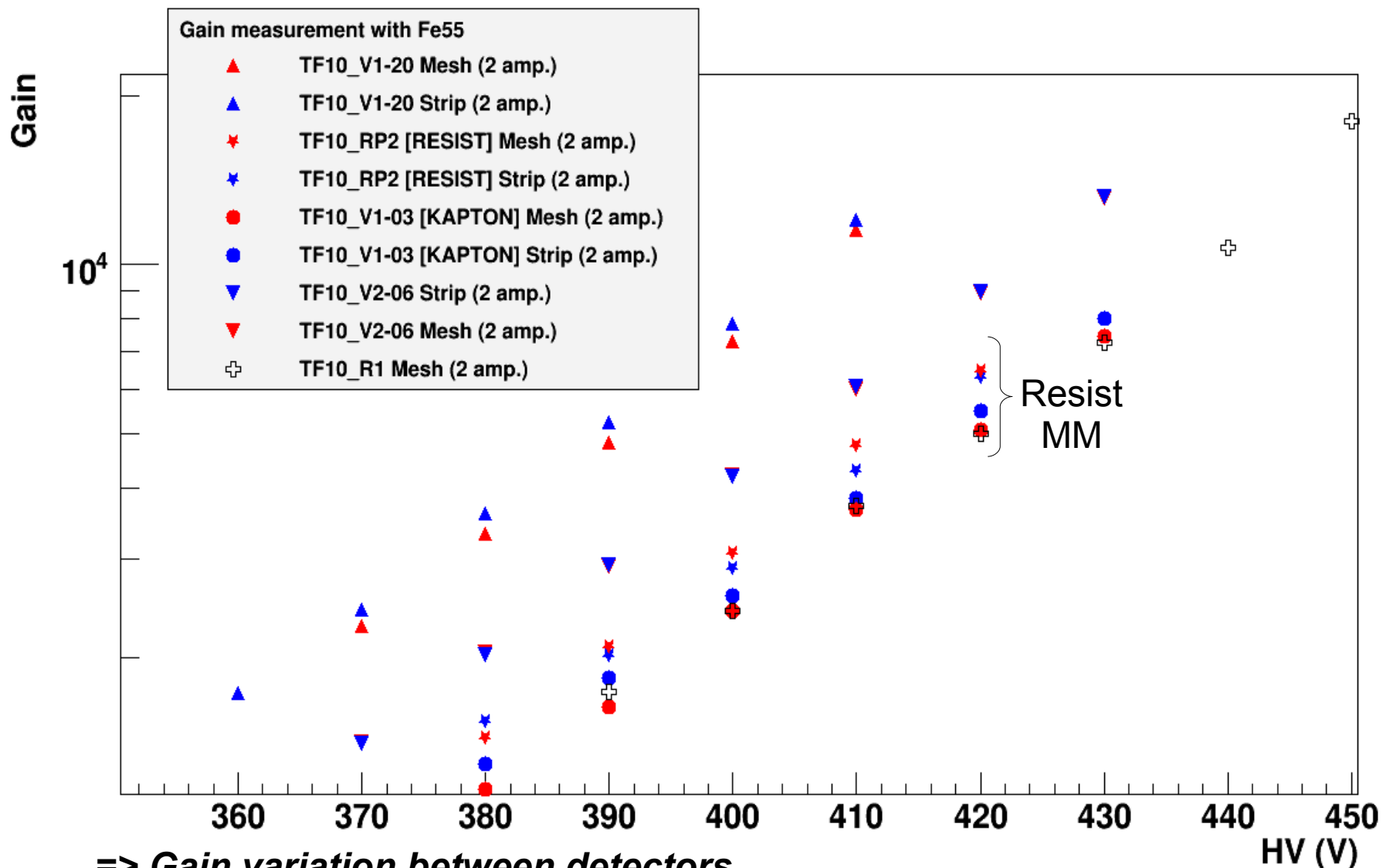
Gain Measurement - Warnings

➤ Calibration

- Measurement chain: Preamplifier + Amplifier + MCA must be calibrated using different pulse amplitudes to fit its gain and offset
- Calibration pulse on the preamplifier (ORTEC 142A/B) “Test” input and detector capacitance on “Input”
- Strips/Mesh both connected to preamplifier
- Low noise



Gain Measurements - Results



=> Gain variation between detectors
=> "Resist" MM have lower gain

Conclusion and outlook

➤ Pixel Micromegas :

- Taking data since end of 08/2010 at COMPASS with comparable performance to old MM, Characterization ongoing

➤ APV parameters optimization for MM :

- VFS=80, VFP=70, ISHA=5
- Noise $\sim 900e^-$, rising time of 150ns and total time length of 450ns

➤ COMPASS/CLAS12 T11 test beam of August:

- 12 different prototypes tested under various beam condition on the PS
- Gain measurements shown a good agreements between mesh and strips measurements
- Gain variation between detectors not well understood
- Further studies will continue with the October RD51 test beam on SPS

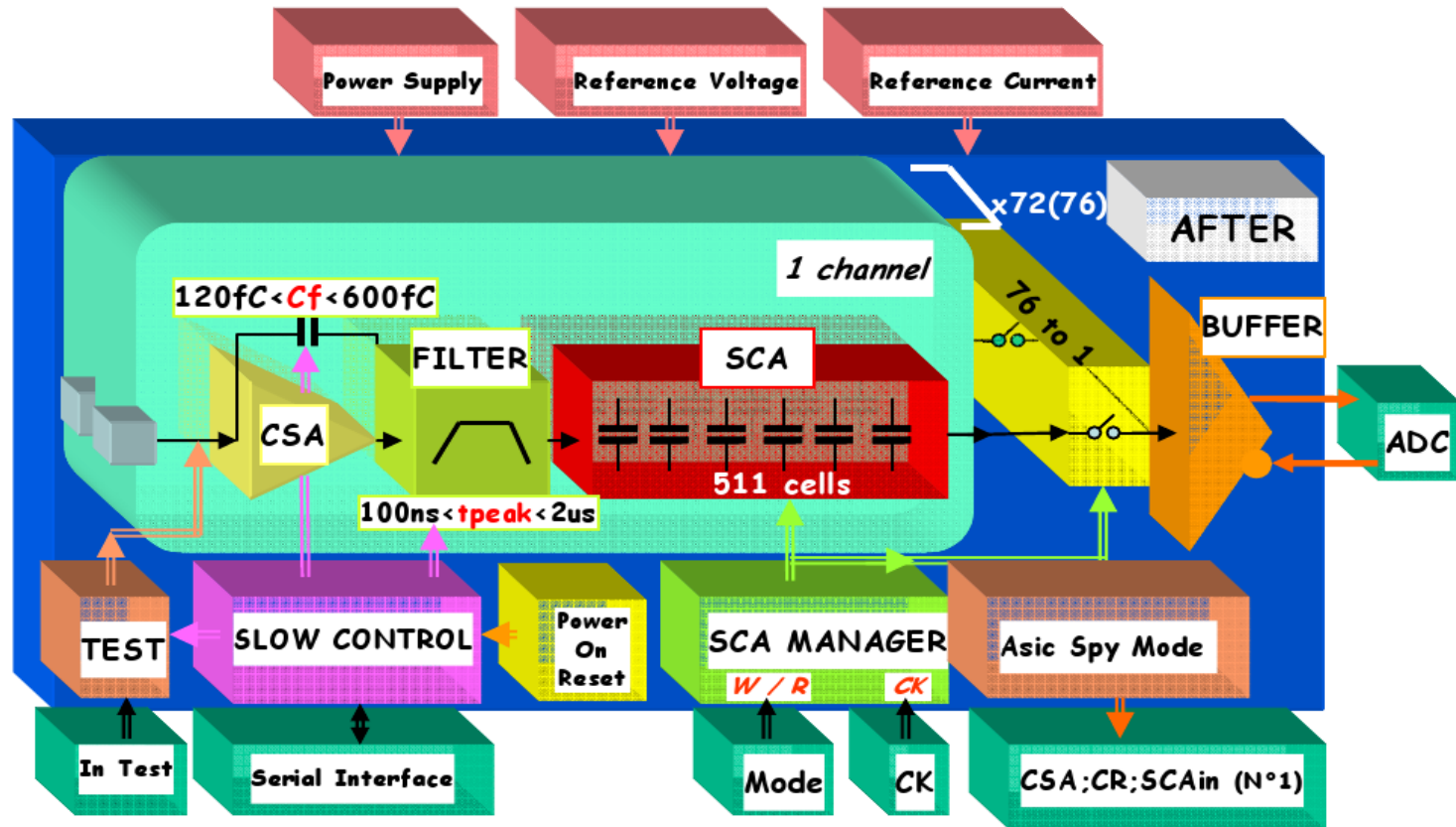
Spare...

I r f u



saclay

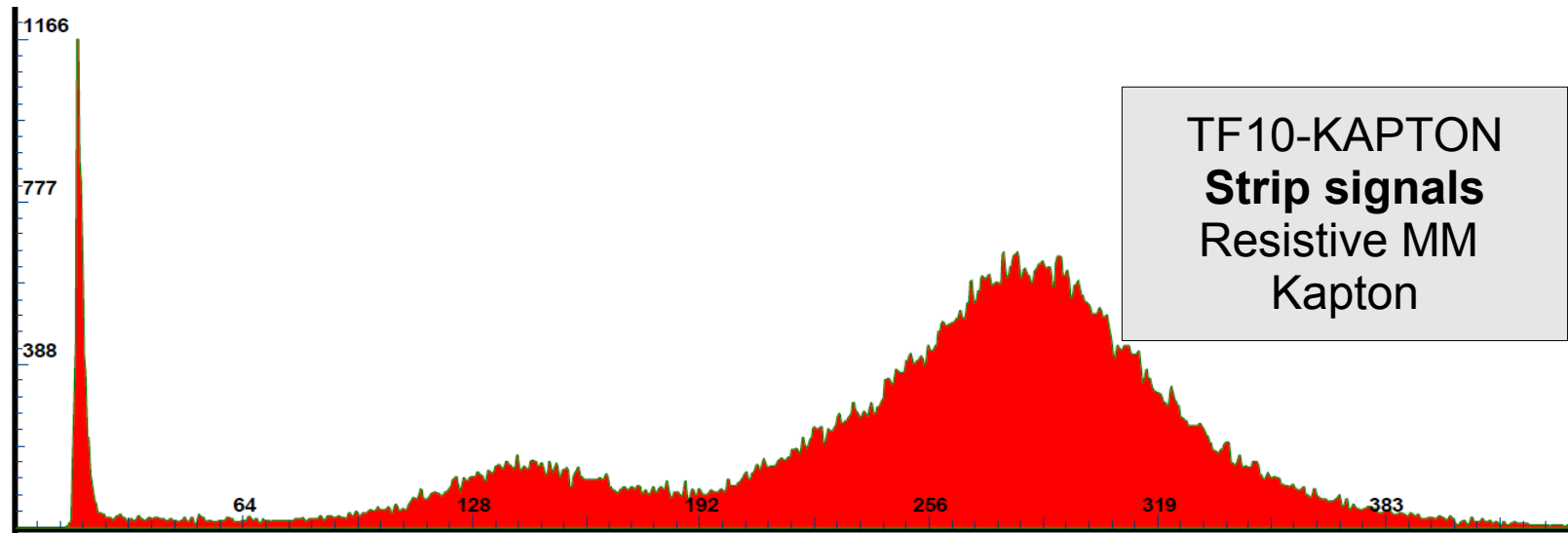
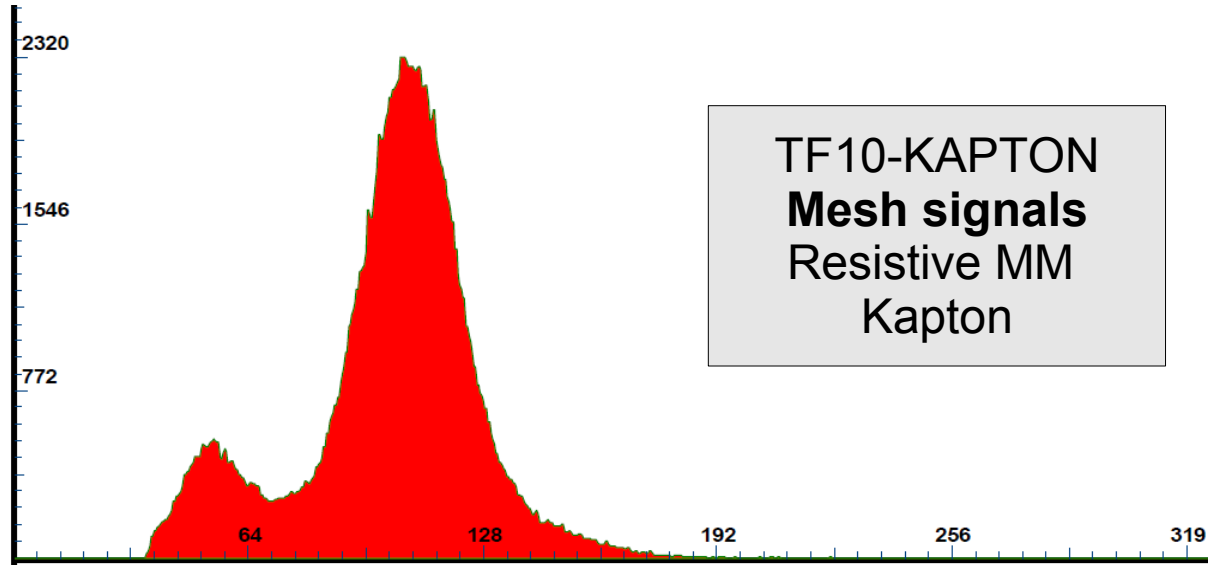
The AFTER-T2K ASIC



| | |
|--------------------|---------------------------|
| CSA ranges : | 120, 240, 360, 600 fC |
| Peaking time : | From 100 ns to 2 μ s |
| Writing freq. : | 20, 23, 27, 32, 40, 53MHz |
| Analog mem. size : | 511 cells x 76 channels |

Gain Measurements

➤ Fe55 peaks on resistive detectors :



➤ Mesh/Strip gain measurement in agreement :

T11 first results

➤ Beam profiles :

XY

XZ

