SAMPA - a new ASIC for MPGDs

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RD51 Mini Week

SAMPA chip development context

ALICE looking forward for LHC RUN3 increased luminosity

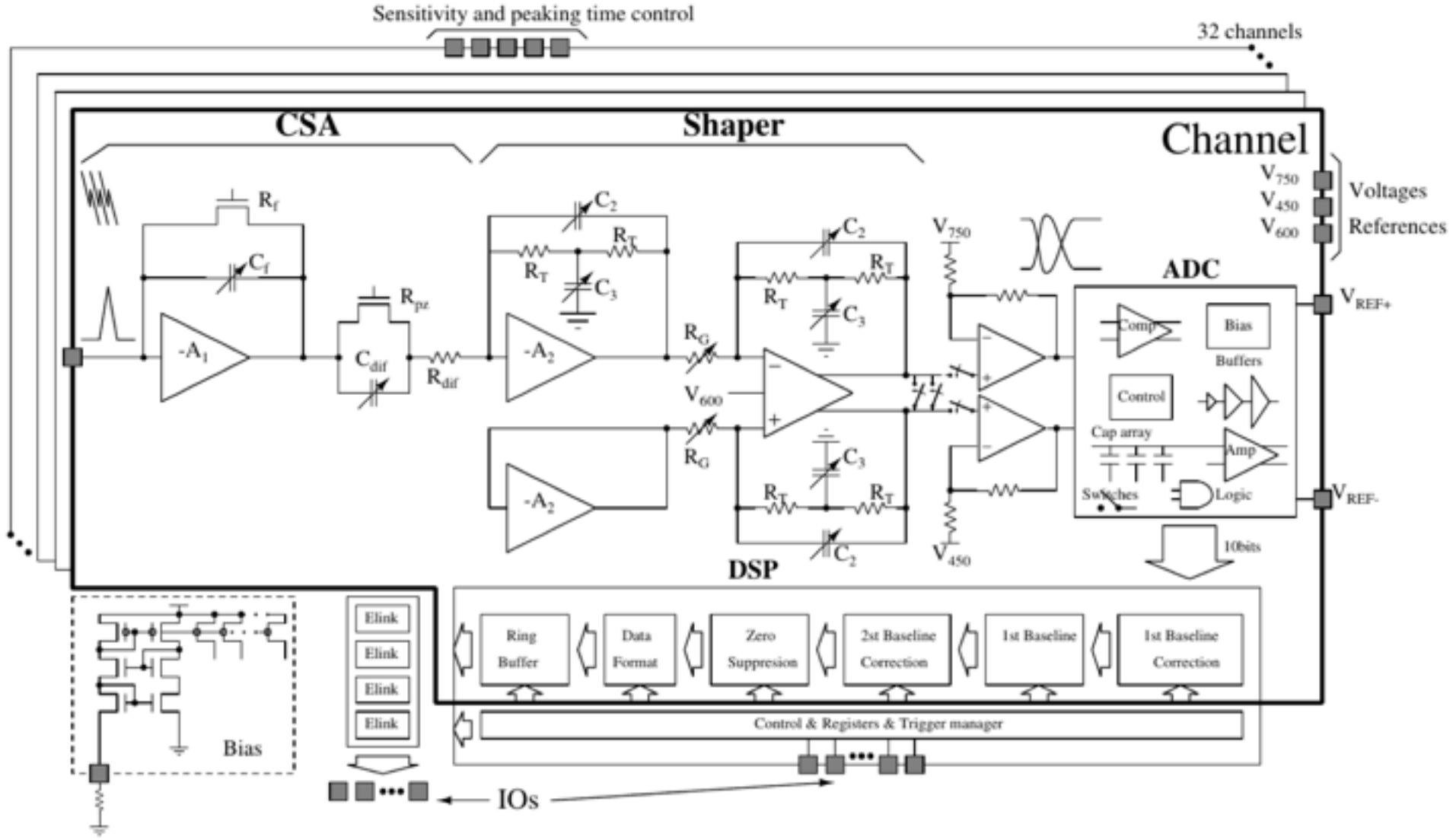
The “physics” requirements are

- interaction rate up to 50 kHz
- trigger-less readout

For the ALICE TPC, that turns in “technical” requirements:

- un-gated “sensor” -> GEMs (was MWPC)
- new front-end chip -> SAMPA

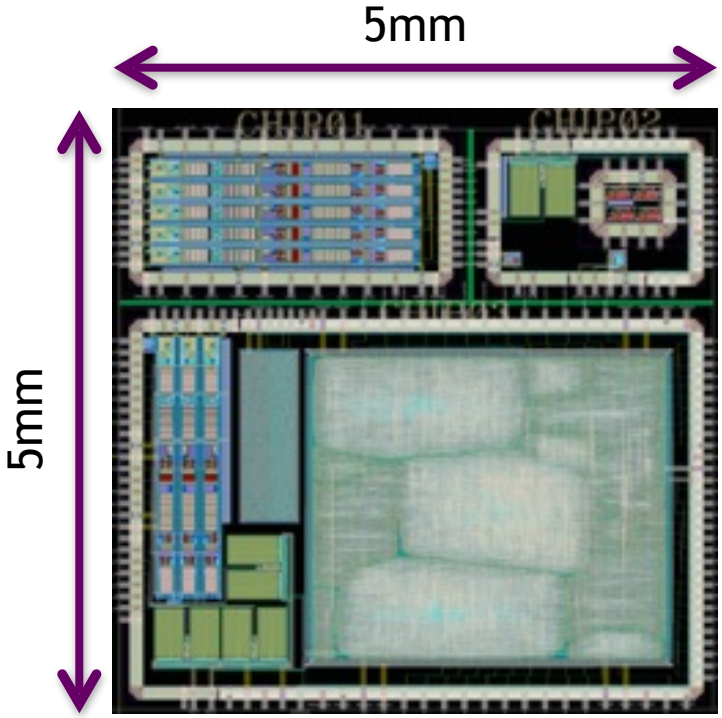
Block Diagram



Status of the project

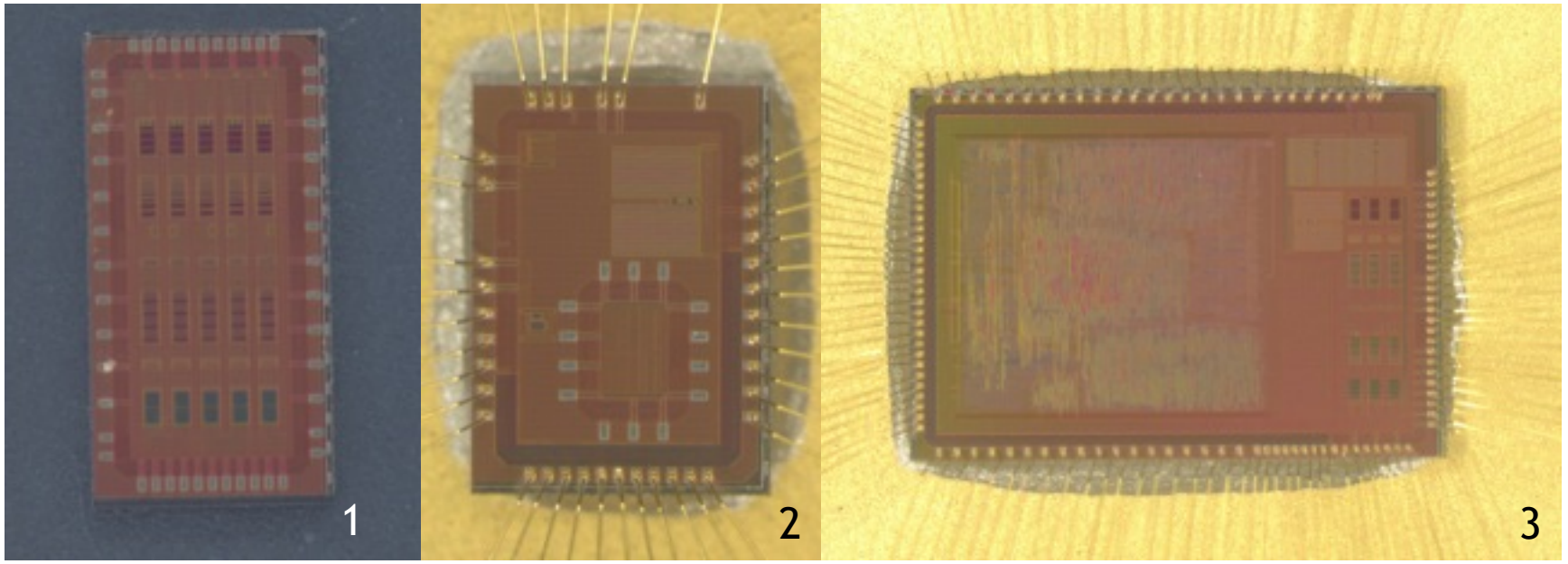
- First Multi Project Wafer prototype received
  - PRESENTLY BEEING TESTED
- Design of the next prototype (MPW2) in progress. Aim is to have a first full 32ch prototype by summer 2015.
- In this talk: only some first results of playing with SAMPA and a GEM detector.

The MPW1 chip(s)

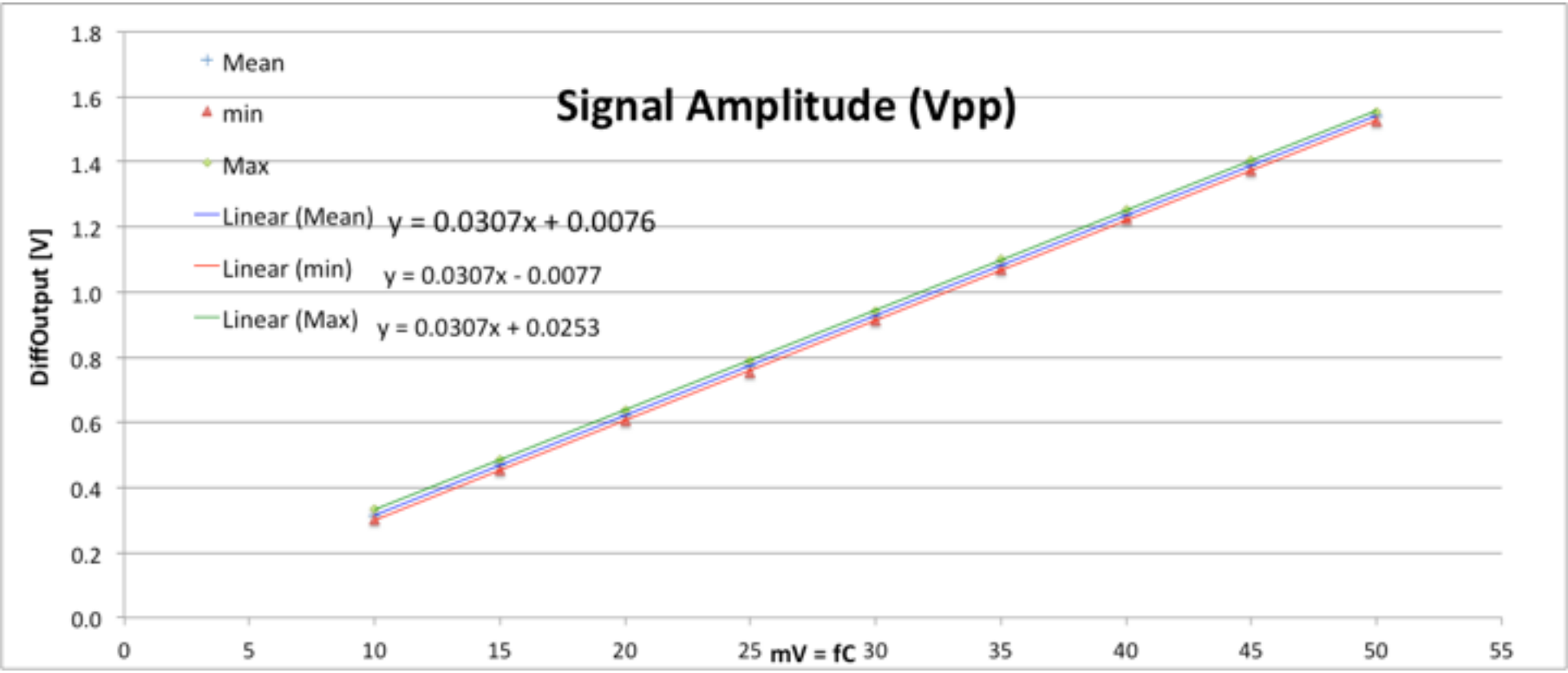


MPW1: sample split in three chips

- **Chip1: analog (CSA + shapers), 5 chs**
- Chip2: ADC (1 ch) + LVDS Receiver and Transmitter prototype
- Chip3: full chain (CSA-Shaper-ADC-DSP), 3chs

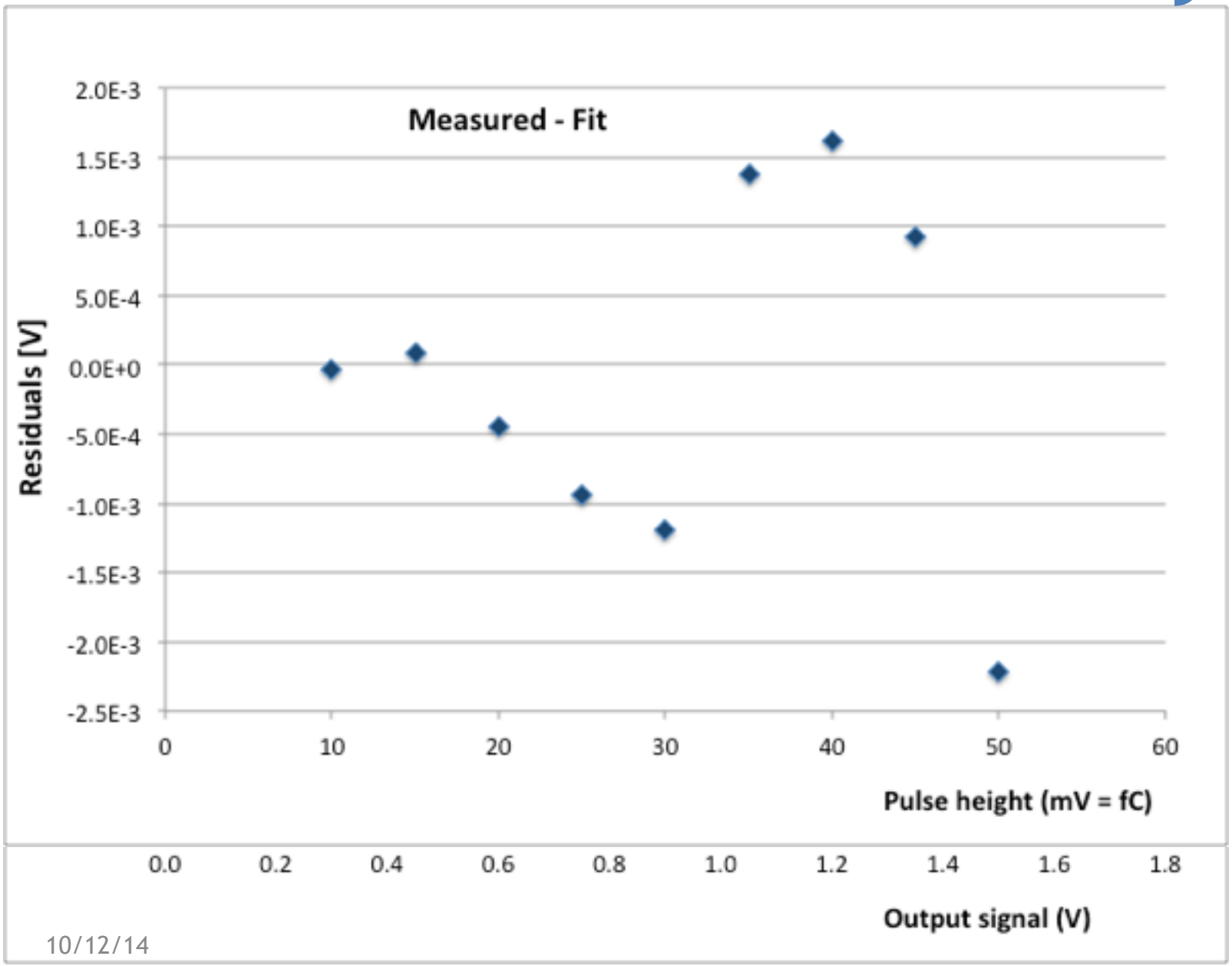


A look at the gain

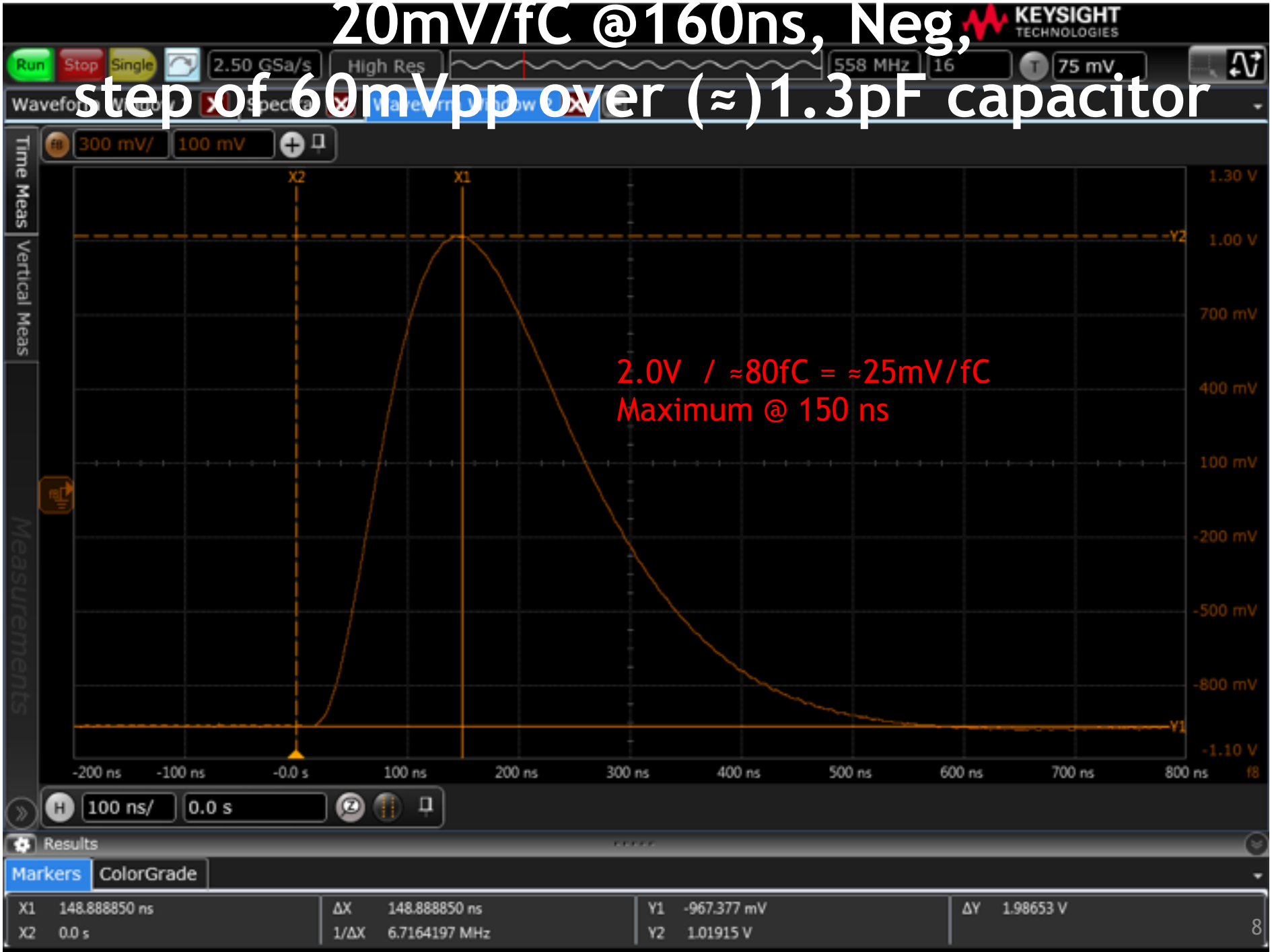


30mV/fC; 160ns
Scope “measurements”

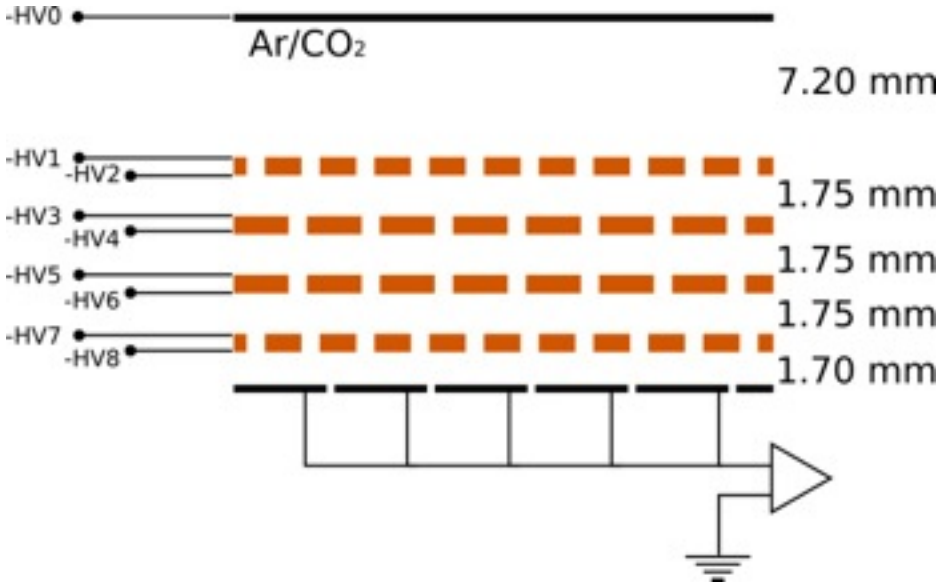
A closer look at linearity

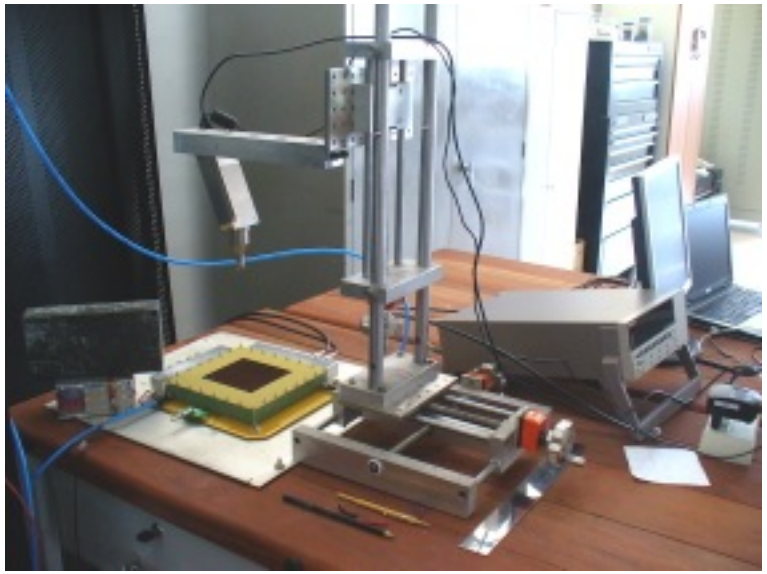


20mV/fC @160ns, Neg, step of 60mVpp over (≈)1.3pF capacitor



“our” GEM



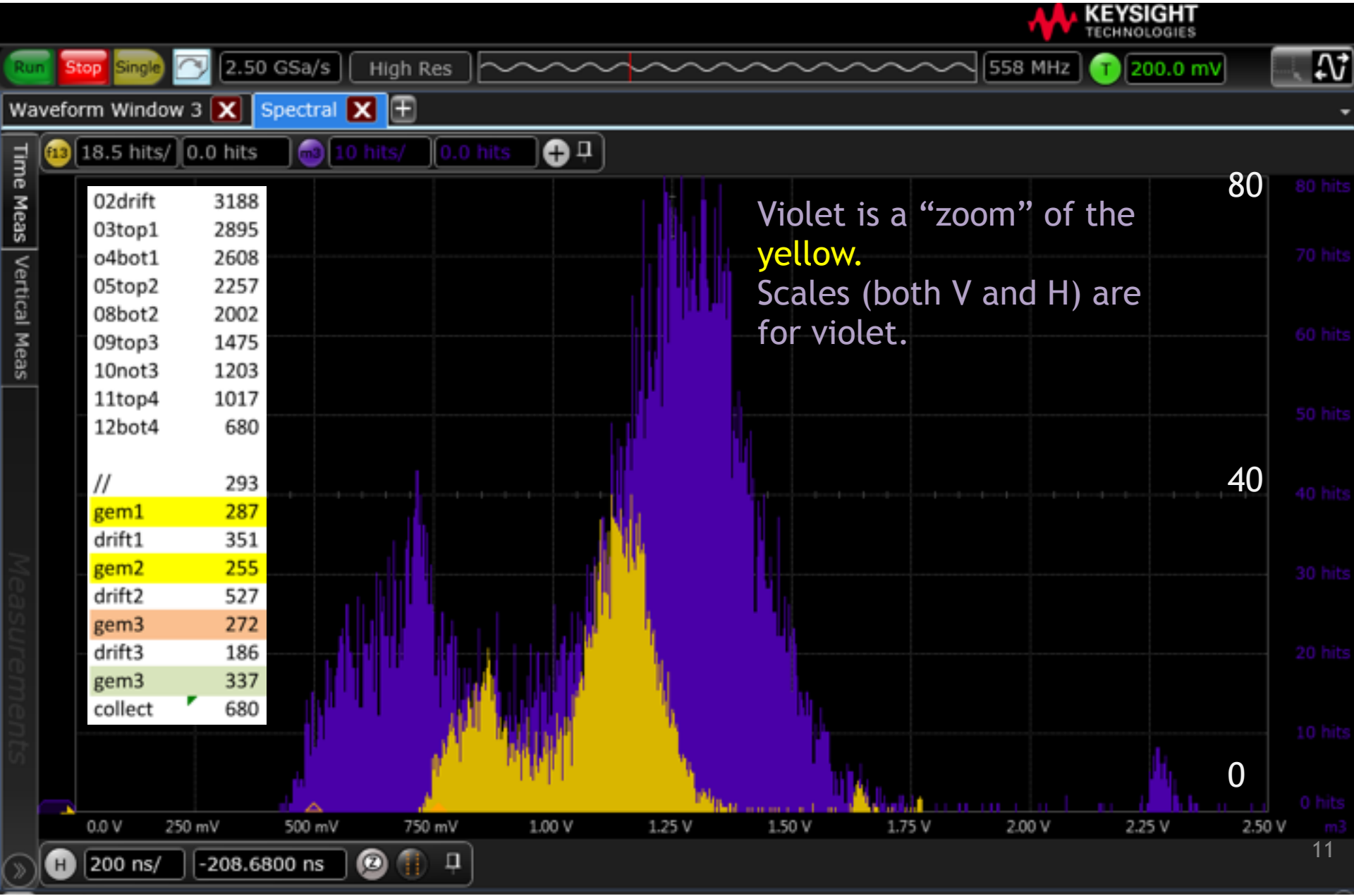


- 4 GEMs setup, with different pitches to minimize ion back-flow,
- 120 readout pads, 8.2 × 10 mm2 ,
- 9 independent HV channels,
- Ar/CO2 mixture (90/10).

setup

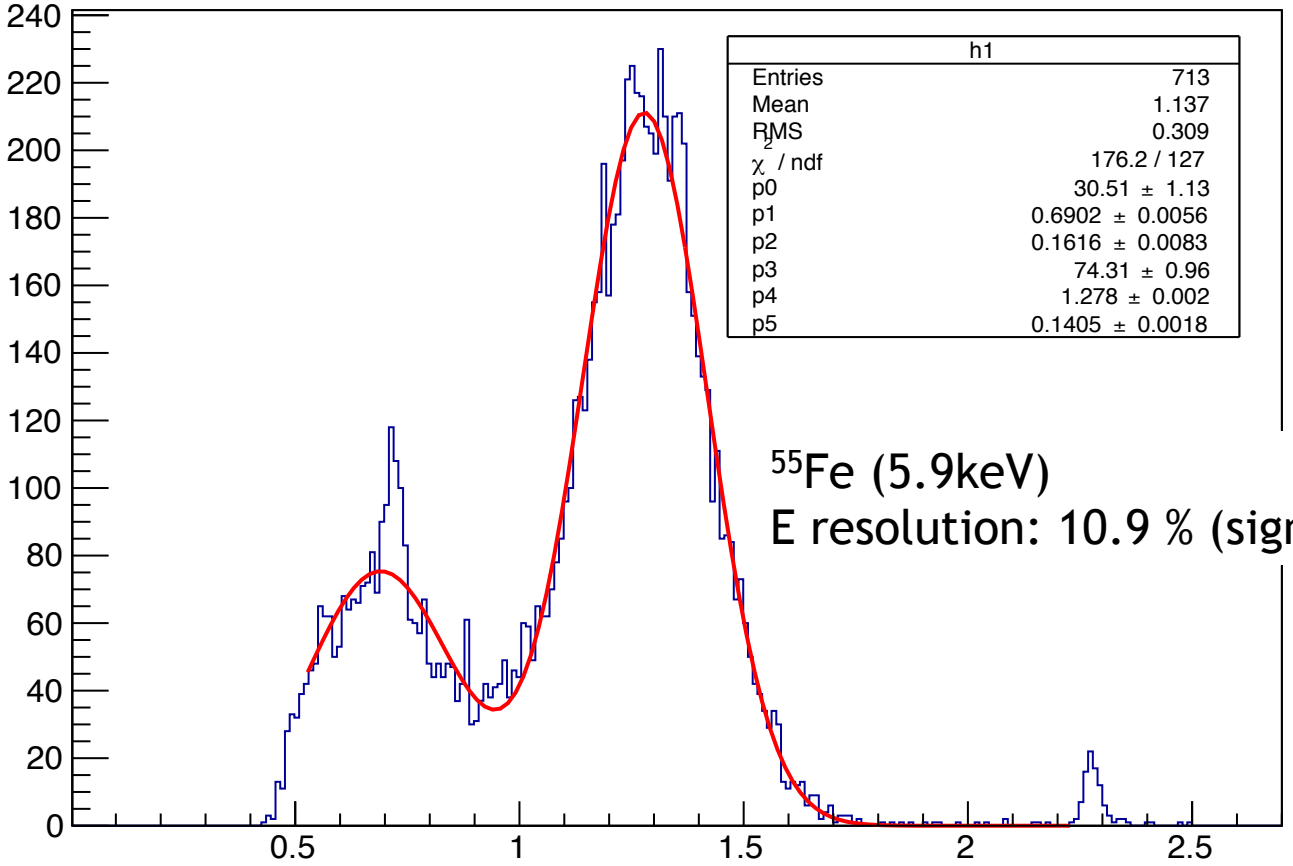
- All pads shorted, but one
- One pad connected to one of the channels of the SAMPA MPW1_chip1 (“analog”)
- Looked at shaper output with a scope
- Used a Fe55 source
- GEM stack gain adjusted to match SAMPA dynamic range

Scope histo


KEYSIGHT TECHNOLOGIES
Run
Stop
Single
2.50 GSa/s
High Res
558 MHz
200.0 mV
Waveform Window 3
Spectral
18.5 hits/
0.0 hits
10 hits/
0.0 hits
Time Meas
Vertical Meas
Measurements
02drift 3188
03top1 2895
o4bot1 2608
05top2 2257
08bot2 2002
09top3 1475
10not3 1203
11top4 1017
12bot4 680
// 293
gem1 287
drift1 351
gem2 255
drift2 527
gem3 272
drift3 186
gem3 337
collect 680
Violet is a “zoom” of the yellow.
Scales (both V and H) are for violet.
80
40
0
80 hits
70 hits
60 hits
50 hits
40 hits
30 hits
20 hits
10 hits
0 hits
m3
0.0 V
250 mV
500 mV
750 mV
1.00 V
1.25 V
1.50 V
1.75 V
2.00 V
2.25 V
2.50 V
H
200 ns/
-208.6800 ns


KEYSIGHT TECHNOLOGIES
Run
Stop
Single
2.50 GSa/s
High Res
558 MHz
T
200.0 mV
Waveform Window 1
Waveform Window 3
Spectral
Waveform Window 2
Time Meas
Vertical Meas
Measurements
200 mV/
-300 mV
500
-300
-1.10
-609 ns
-409 ns
-209 ns
-9 ns
191 ns
391 ns
591 ns
791 ns
991 ns
1.19 µs
1.39 µs
500
-300
1.10
200 ns/
-208.6800 ns
Results
Markers
X1 97.777700 ns
X2 -33.300000 ns
ΔX 131.077700 ns
1/ΔX 7.629063 MHz
Y1 -957.400 mV
Y2 -311.300 mV
ΔY 646.100 mV

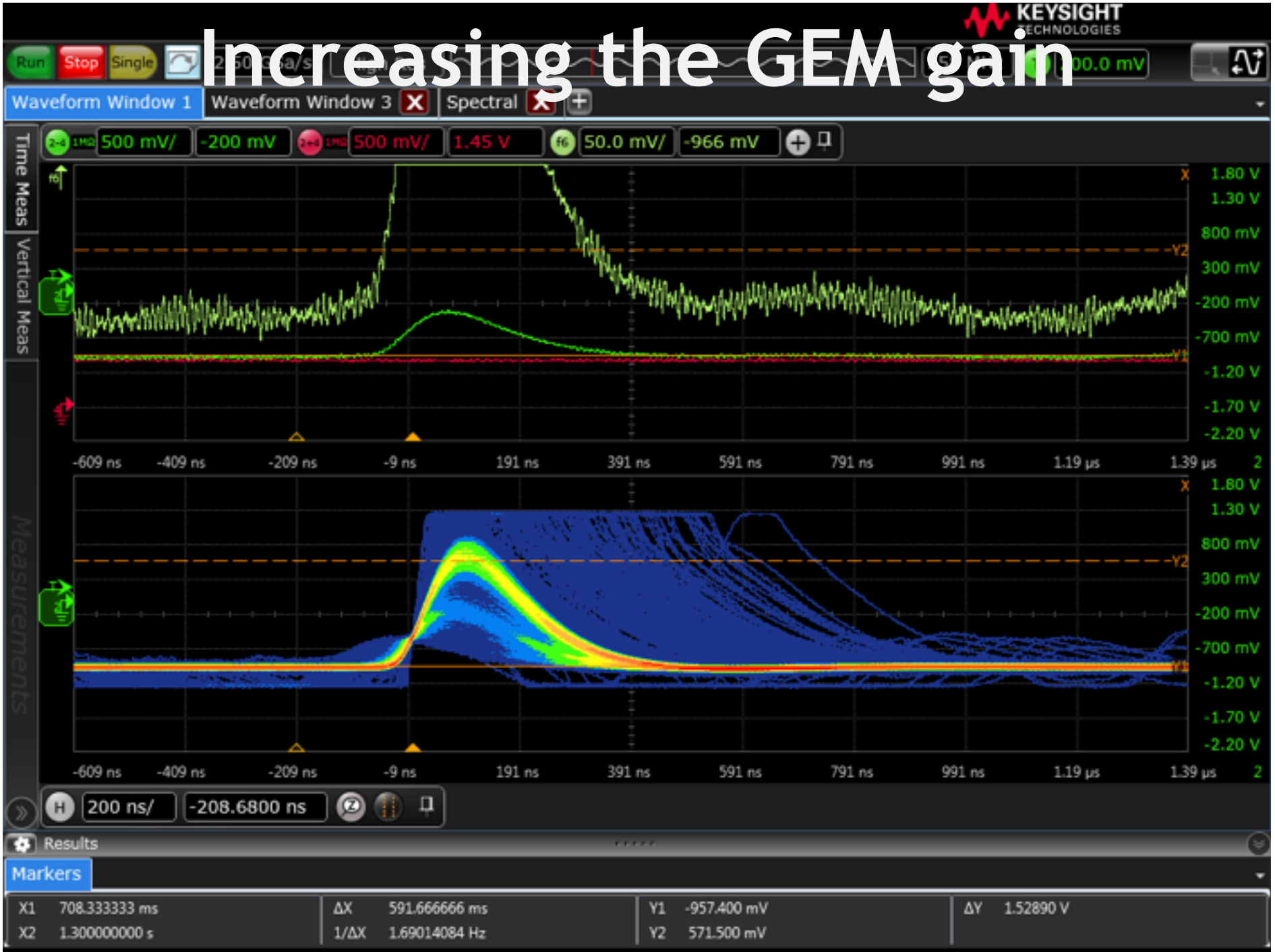
Iron



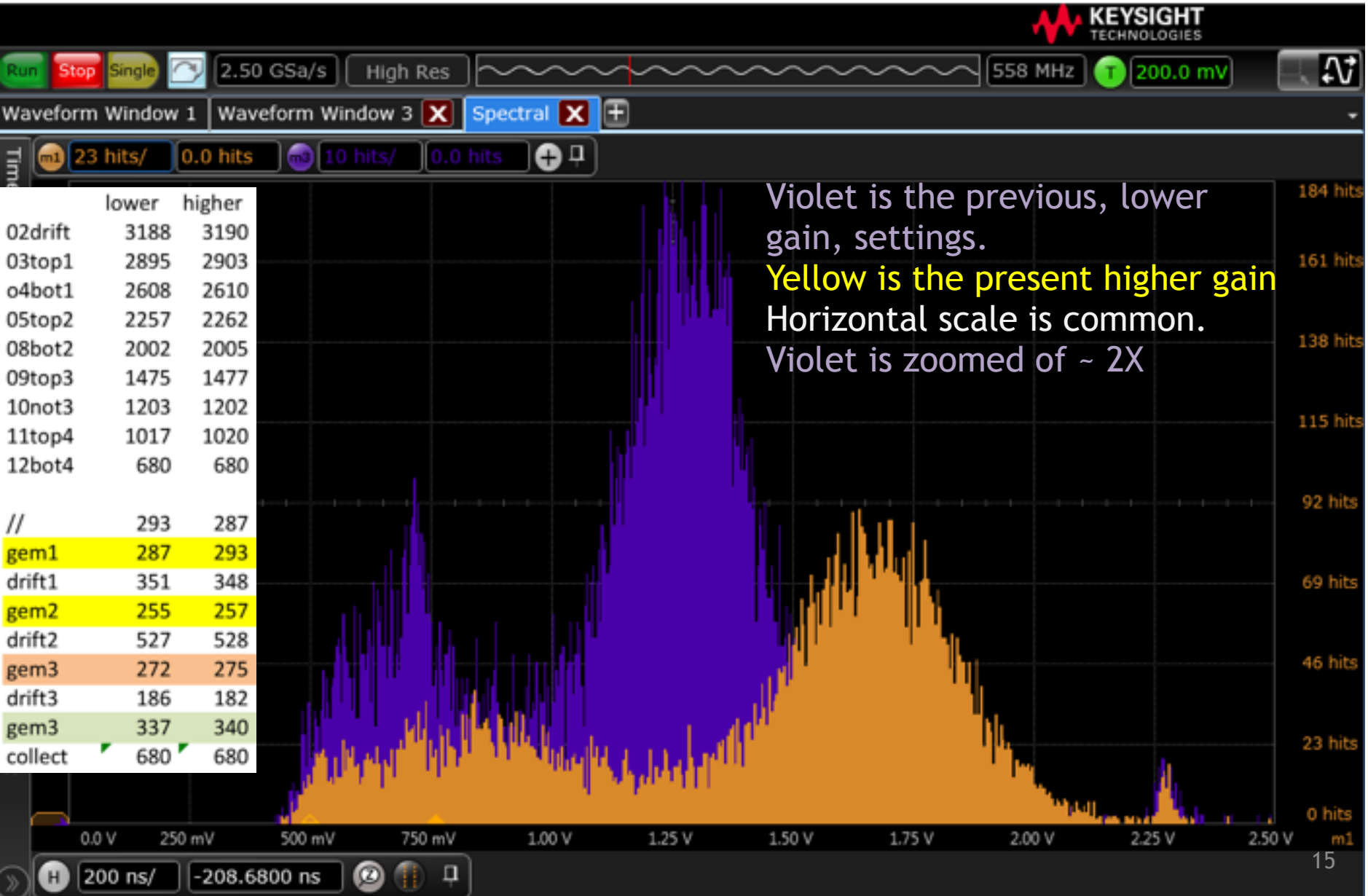
^{55}Fe (5.9keV)

E resolution: 10.9 % (sigma)

Increasing the GEM gain

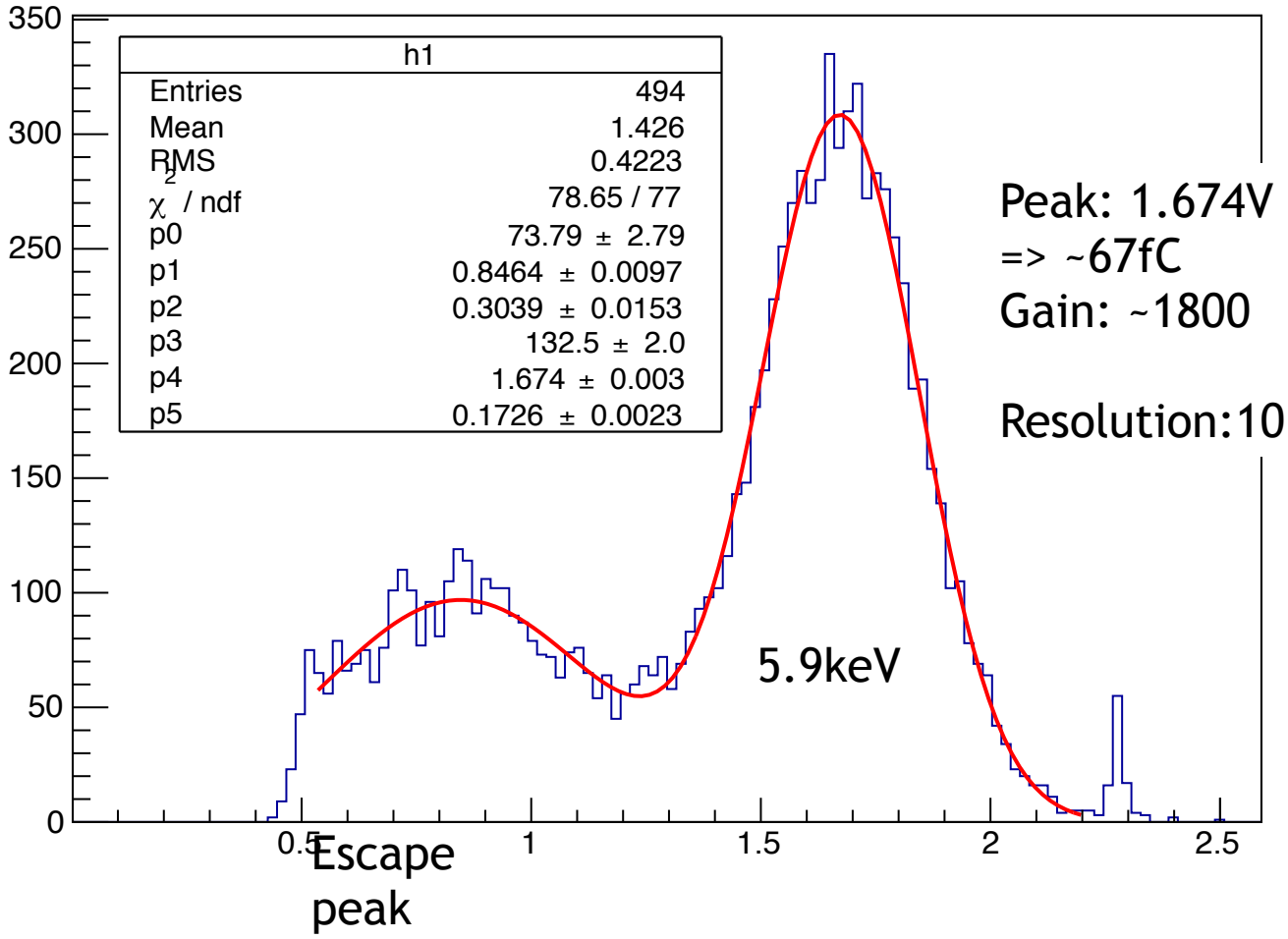


Low vs higher gain



	lower	higher
02drift	3188	3190
03top1	2895	2903
o4bot1	2608	2610
05top2	2257	2262
08bot2	2002	2005
09top3	1475	1477
10not3	1203	1202
11top4	1017	1020
12bot4	680	680
//	293	287
gem1	287	293
drift1	351	348
gem2	255	257
drift2	527	528
gem3	272	275
drift3	186	182
gem3	337	340
collect	680	680

Iron


h1
Entries 494
Mean 1.426
RMS 0.4223
χ2 / ndf 78.65 / 77
p0 73.79 ± 2.79
p1 0.8464 ± 0.0097
p2 0.3039 ± 0.0153
p3 132.5 ± 2.0
p4 1.674 ± 0.003
p5 0.1726 ± 0.0023
350
300
250
200
150
100
50
0
0.5
1
1.5
2
2.5
Escape peak
5.9keV
Peak: 1.674V
=> ~67fC
Gain: ~1800
Resolution:10.3% (sigma)

Conclusions

- First try of SAMPA chip (analog, “PASA like”, part) connected to a GEM detector.
- Setup and connection still to be cleaned up..

but

Without a doubt, it is working!

End of Slides