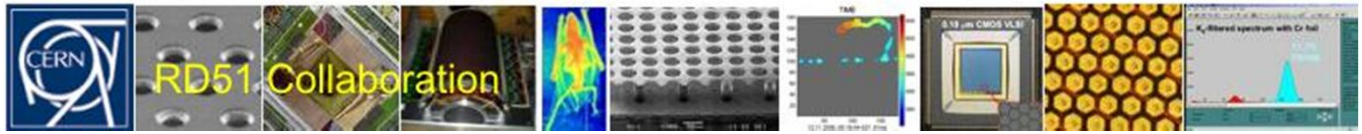

Timing Performance of A-PIC at High Rate

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OUTLINE

1. WHAT is A-PIC
2. INTRODUCTION to the SETUP
3. MEASUREMENT SCHEME and A-PIC
4. INTENSITY SCAN from 50 kHz - 3.0 MHz
5. OUTLOOK

WHAT is A-PIC

Analogue Pickup Amplifier/Shapers

APICs

H. Muller et al., A-PIC User manual

This activity, we kicked off already since beggining of 2012

Portable, battery-operated preamplifier-shaper for charge-generating detectors

WHAT is A-PIC (cont.)

Main Characteristics:

- Dual-polarity CSA preamplifier 2mV/fC (1mV / 3125 electrons)*
- CSA discharge time constant 5 us (max average signal rate 100 kHz)
- CSA intrinsic risetime 10ns
- Triple spark input protection
- Input leakage current < 50 fA
- BNC input 50..2000 OHM input impedance via potentiometer
- SHV input capacitive (4nF) up 5kV to BNC input
- CSA monitoring output of preamplifier (fixed gain 10)
- Variable amplifier gain = 1 ... 1000, via 20 turn potentiometer
- Gain Monitor output V_{mon} = (- 0) .... (-2V) (1kOHM)
- 2nd order shaper with $Gamma_2(t)$ pulse-shape
- Two selectable peaking times (default = 100/8000 ns)**
- Complementary 50 Ohm linear outputs up +/- 0.3V***
- Complementary 1M Ohm Outputs up +/- 3V
- Baseline potentiometer 20 turn, +/- 2V
- Test pulse generator pushbutton (pos. charge injection @ 7 kHz to CSA input)

- Portable, metal box, 144 x 100 x 58 , ½ kG
- Autonomous operation via rechargeable Lithium battery 12 V / 2.5Ah
- Power consumption 70 mA (Battery charge current not included)
- Battery charge connector for solar panels 13-50V, 200 mA
- Battery Autonomy min. 24 h (fully charged)
- Battery charge-up indicator LED (green)
- Power indicator LED (red)
- Battery voltage range 12.5 (max)... 9.6V (min)
- Electronics operating voltage (+/- 4V25)
- Direct power (+ charger) via R232 cable to NIM modules (+/-12V)

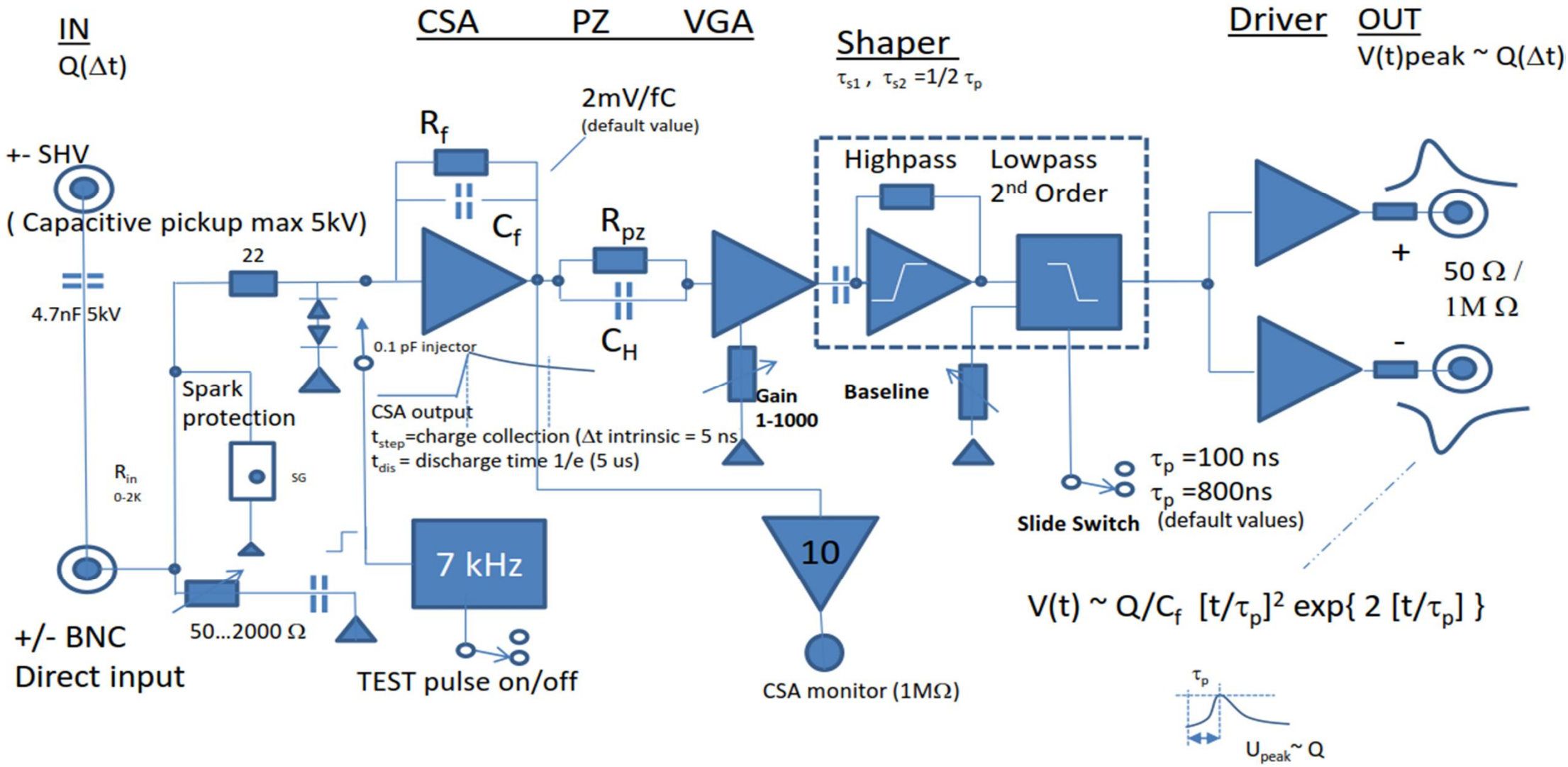
H. Muller et al., A-PIC User manual

*lower gains by factor 5, 10, 20 on request
**different shaping times (30ns ... 20us) on request
*** to be increased to +/- 1V in APIC 1.2 revision

WHAT is A-PIC (cont.)

Block Diagram:

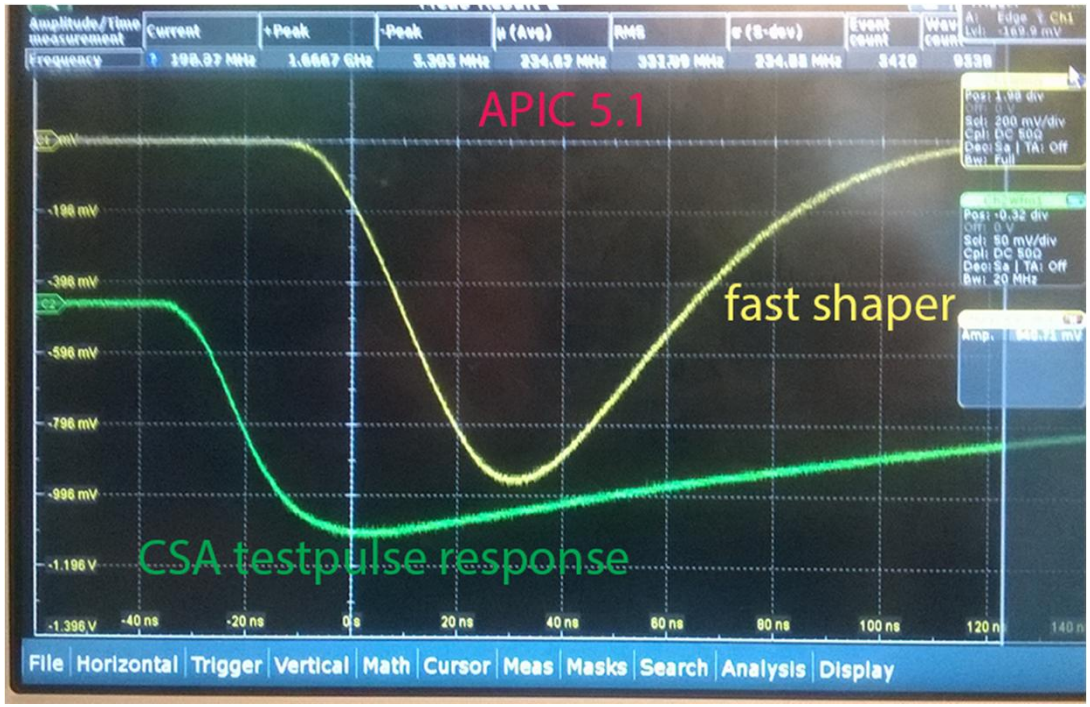
H. Muller et al., A-PIC User manual

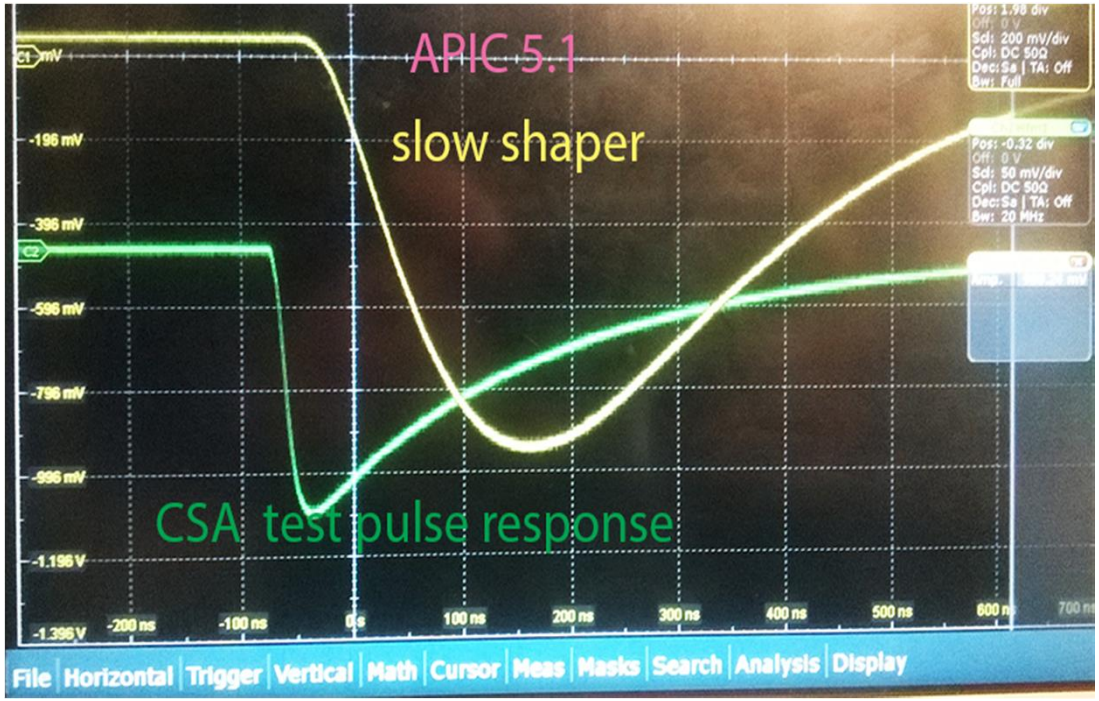


WHAT is A-PIC (cont.)

Fast and Slow shaper response:

H. Muller et al., A-PIC User manual





τ_{peak}: 20 ns

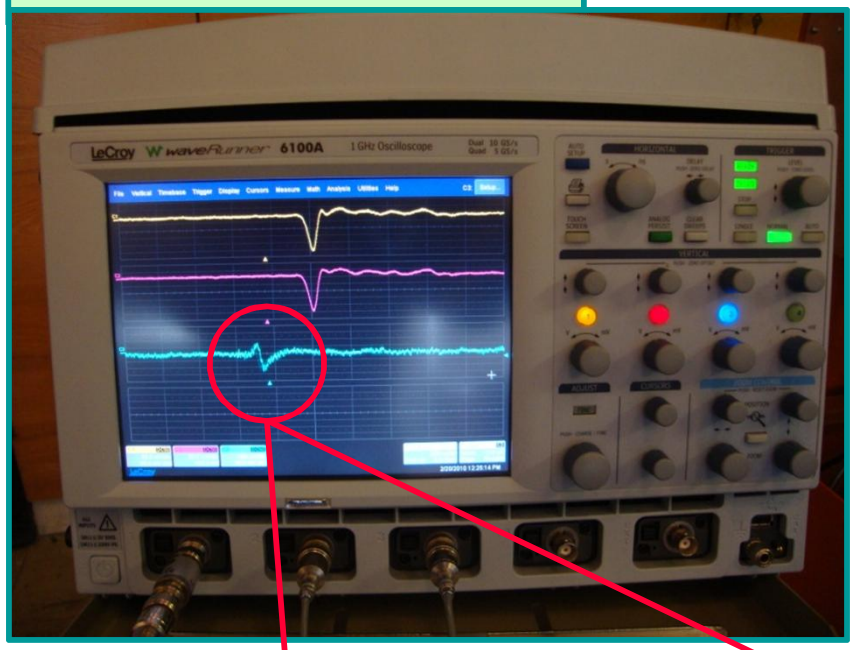
Full width pulse: 100 ns (5τ)

τ_{peak}: 120 ns

Full width pulse: 600 ns (5τ)

WHAT is A-PIC (cont.)

GEM-TPC test in lab



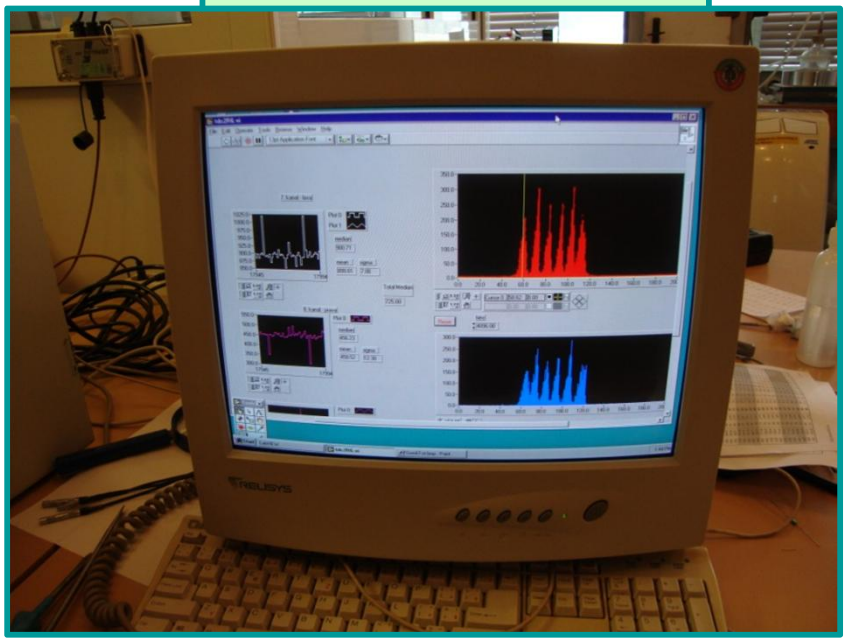
Trigger Signal before reshaping

Trigger Signal with rise and decay time reshaped

It can be observed:

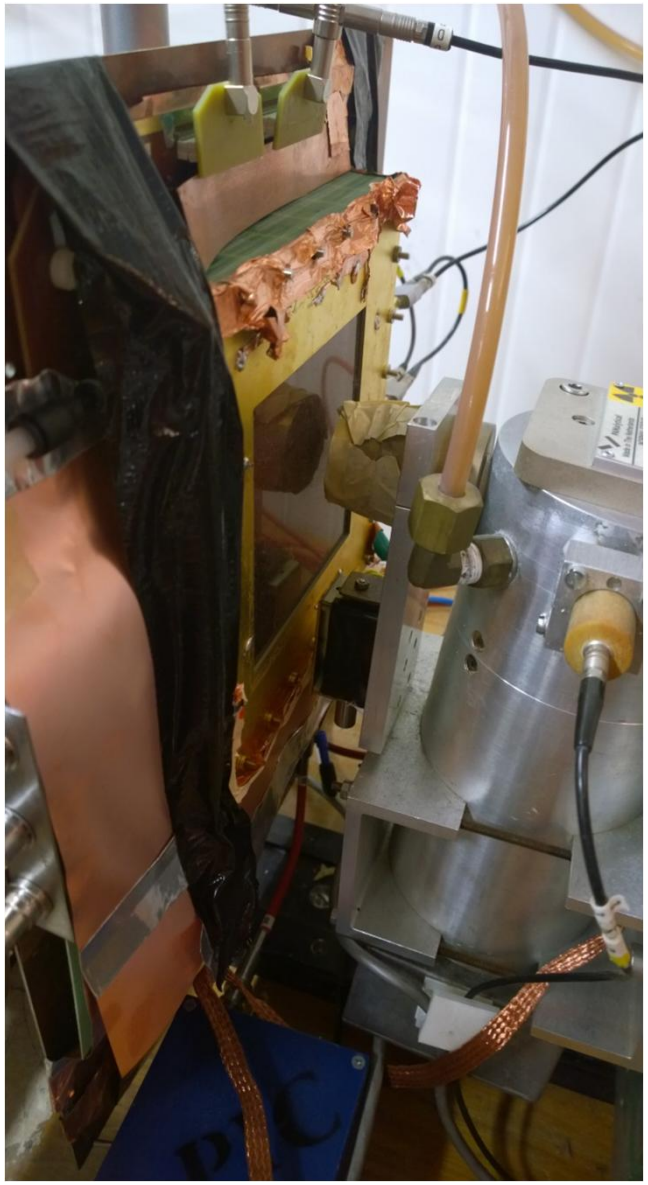
- Signals from the delayed lines are very clean
- Same relative time between them
- Trigger signal bipolar, it can be that the 40% negative overshoot is due to e- transparency loses in the GEM 3

GEM-TPC tracking capabilities for ^{55}Fe



In the picture above there are multiple picks from the different source positions.
The source was not very well collimated therefore a mm scale resolution on X was achieved and the trigger was taken from the bottom of the GEM3

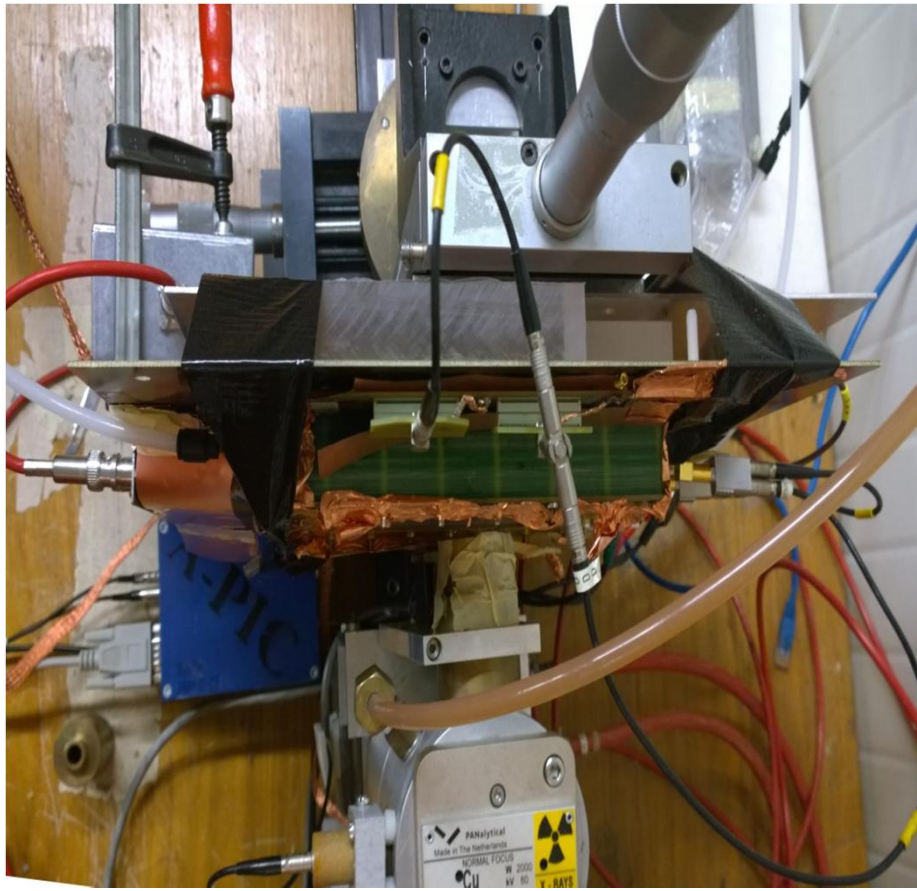
INTRODUCTION to the SETUP



Triple GEM detector:
Area: 10 x 10 cm^2
Gain: 10^4
Gas Mixture: $ArCO_2$ (70/30)
$\eta_{primaries} = 293e^-$

Colimator:
Diameter: 1.6 mm
Area: 8.04 mm^2
Fluence: 3.5 10^3 - 3 $10^6/mm^2$

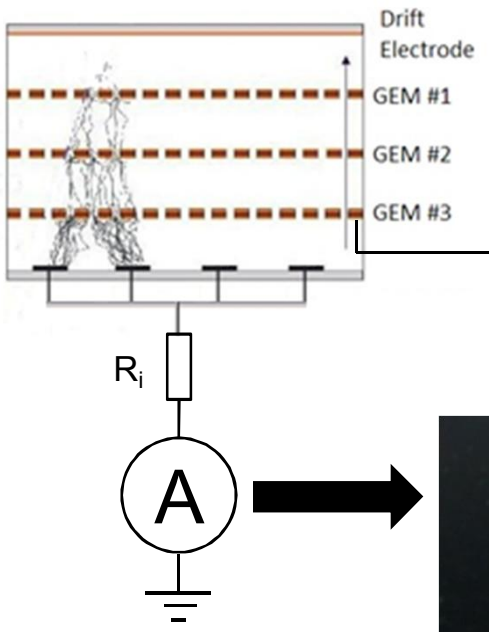
X-ray Tube:
Anode: Cu
HV: 16 kV
Current: up to 3 mA

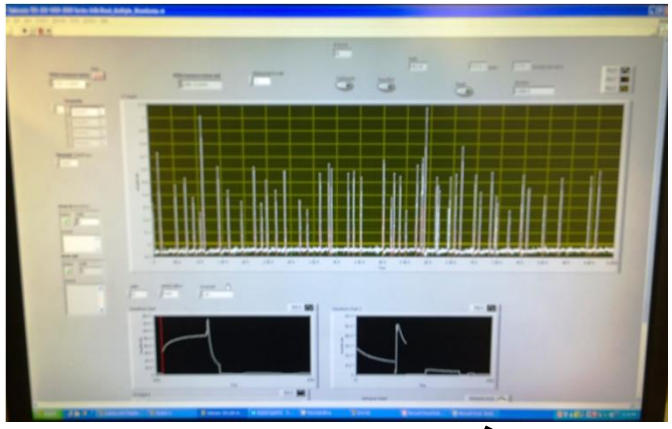


A-PIC:

τpeak: 30 ns
Full Width: 150 ns
Gain: 2mV/fC

MEASUREMENT SCHEME and A-PIC

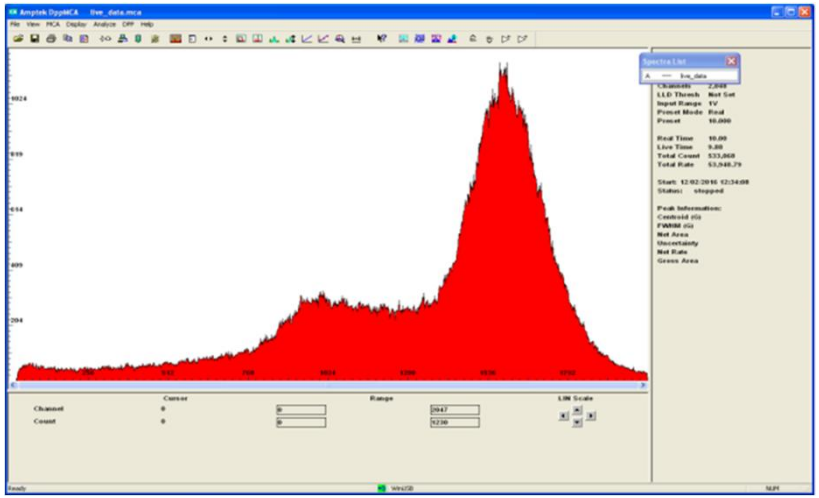




A-PIC

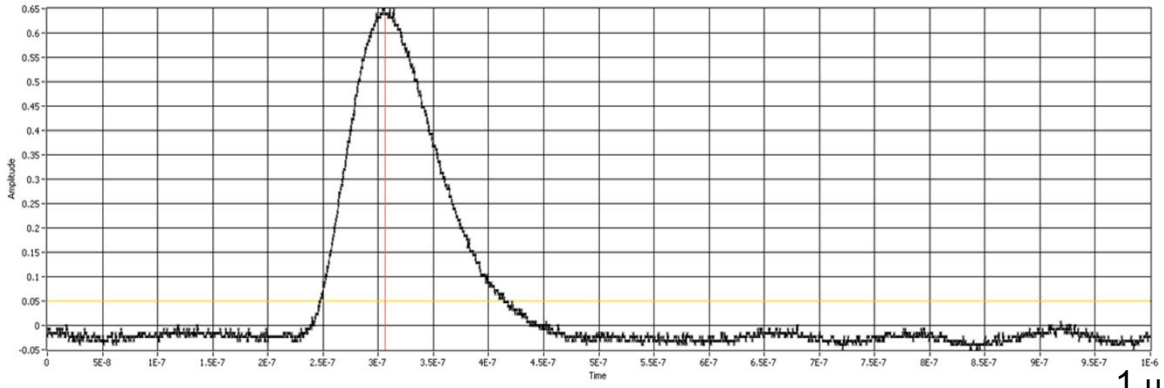
\- → Oscilo scope

\+ → MCA

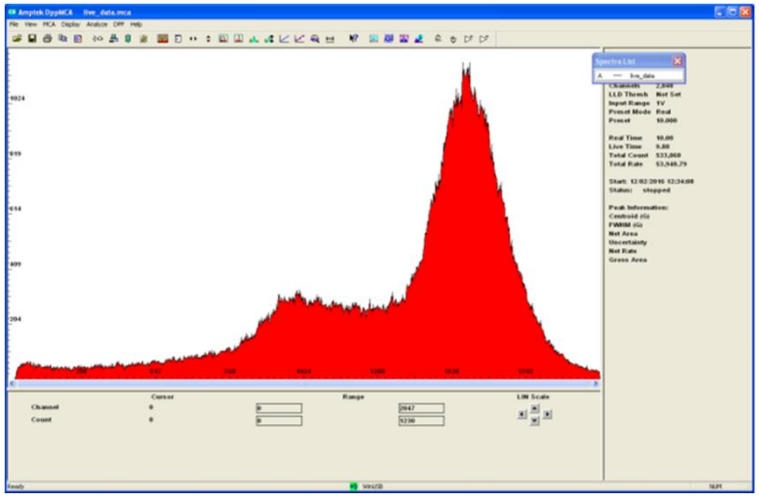


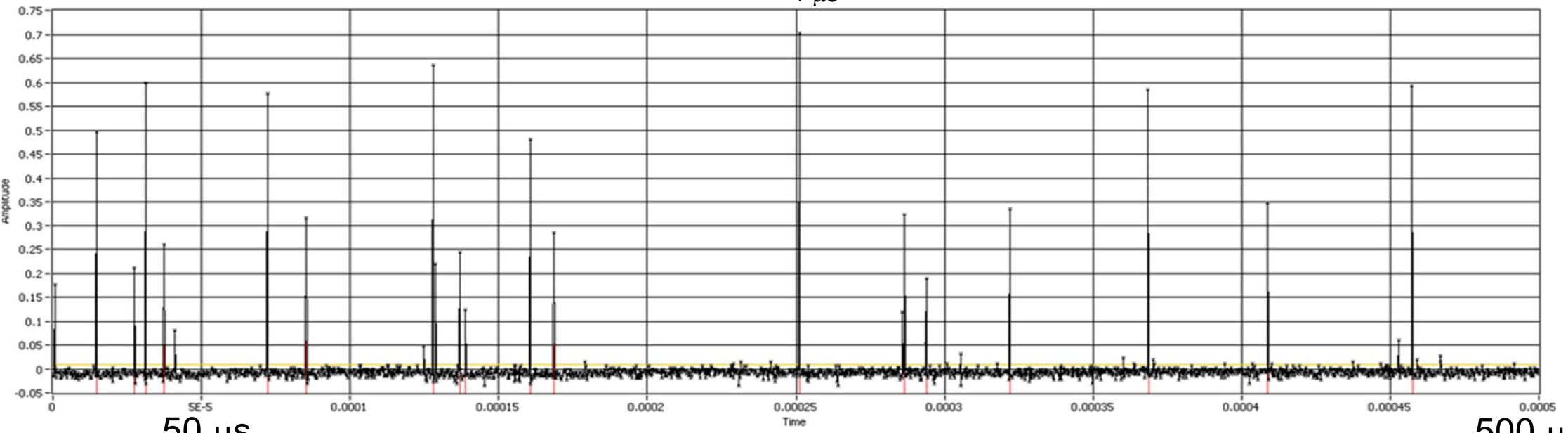
INTENSITY SCAN from 50 KHz - 3MHz

Fluence: 50 10^3 γ/mm^2



1 µs



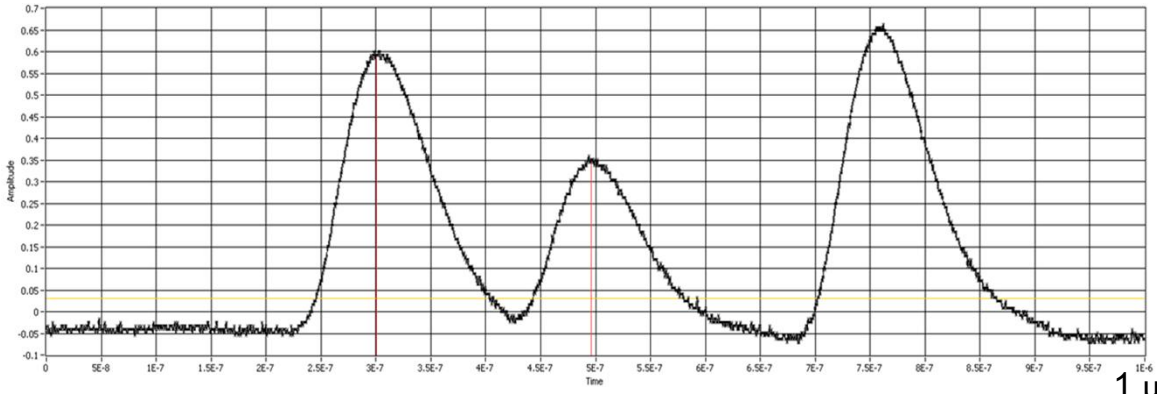


50 µs

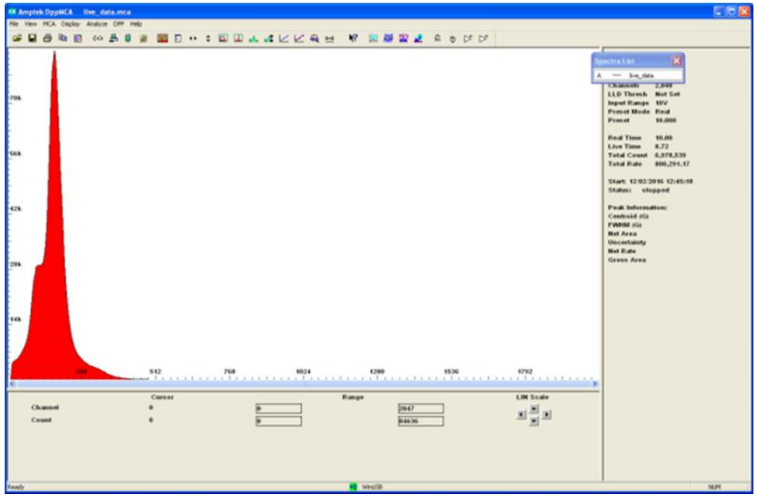
500 µs

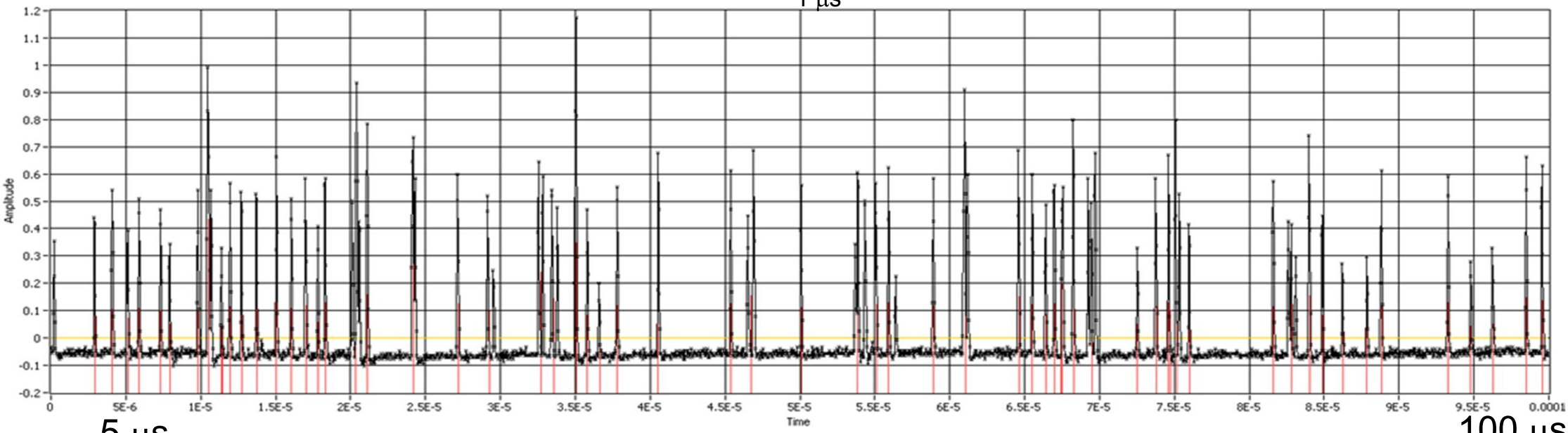
INTENSITY SCAN from 50 KHz - 3MHz

Fluence: 500 10^3 γ/mm^2



1 µs



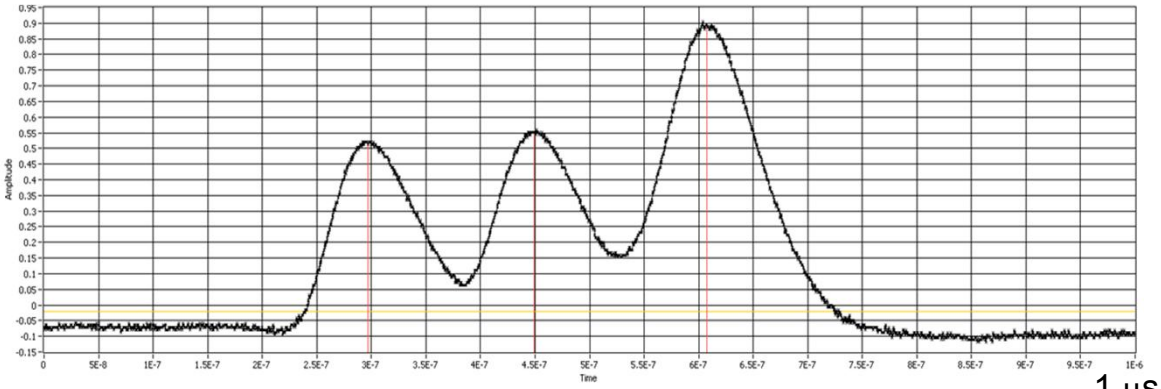


5 µs

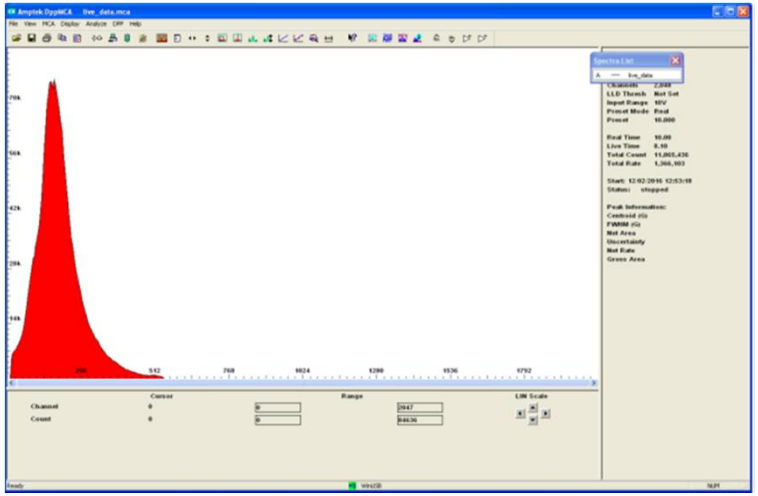
100 µs

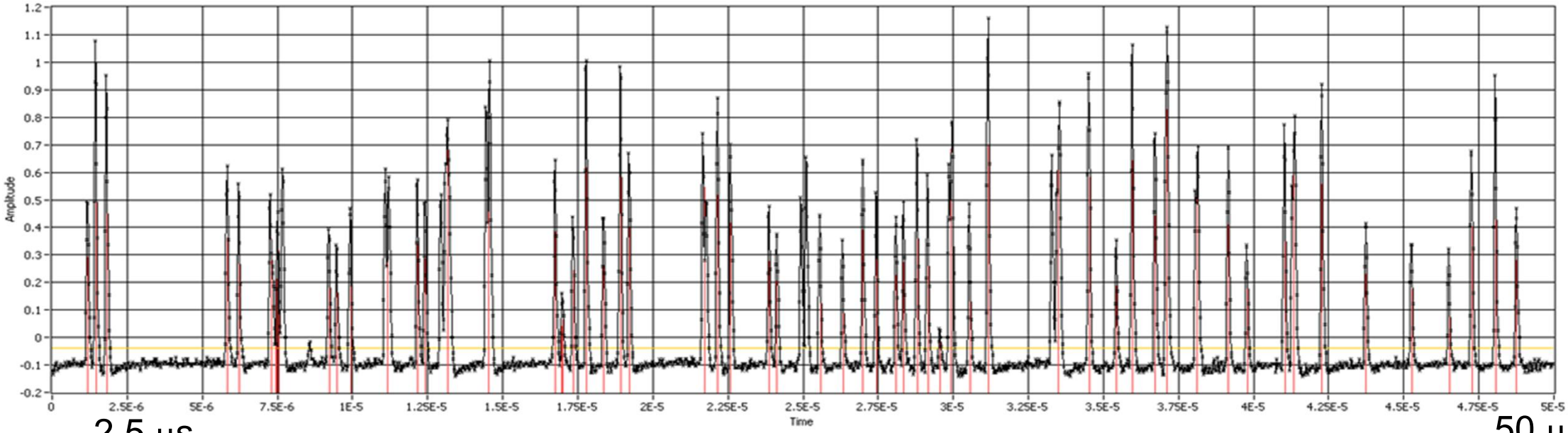
INTENSITY SCAN from 50 KHz - 3MHz

Fluence: 1 10^6 γ/mm^2



1 µs



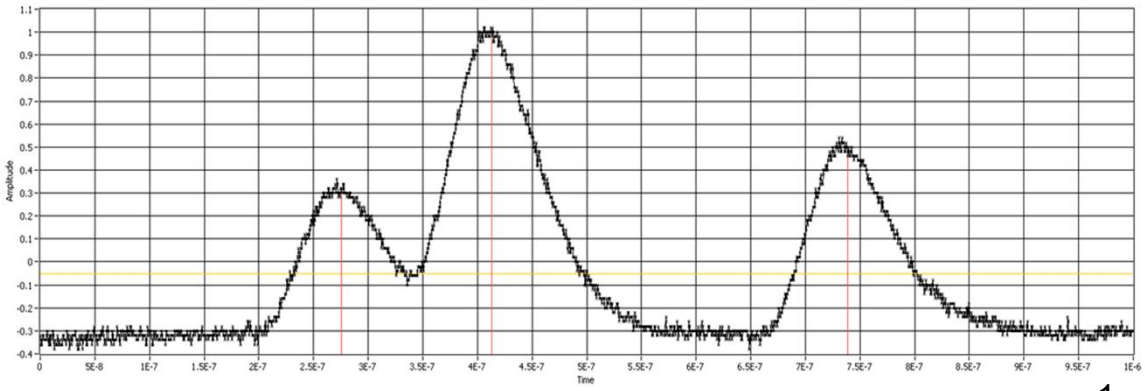


2.5 µs

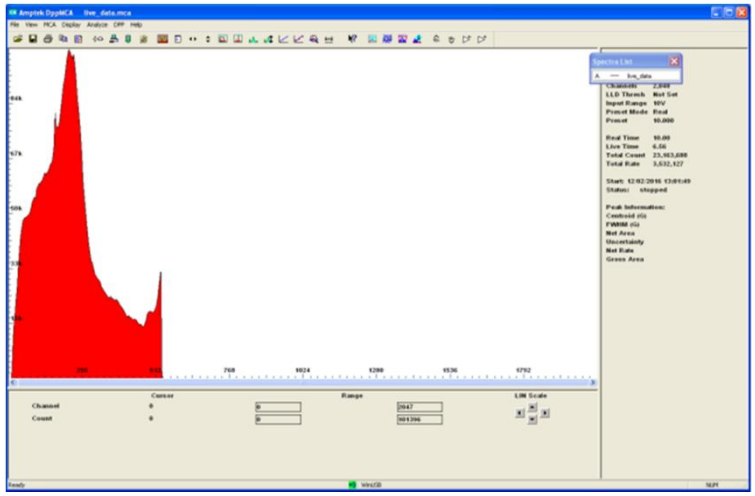
50 µs

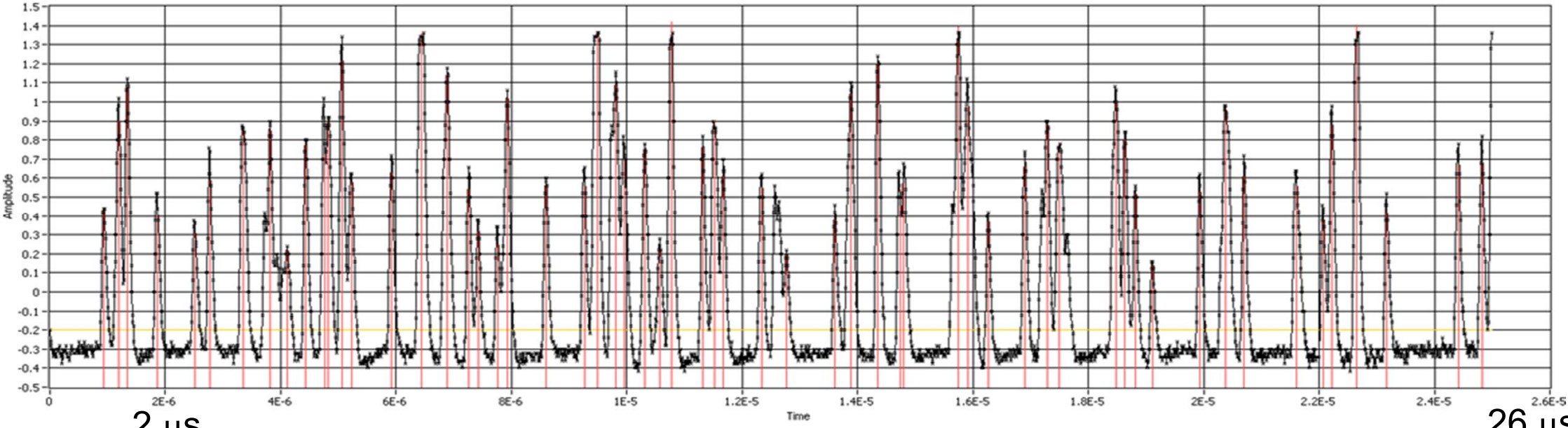
INTENSITY SCAN from 50 KHz - 3MHz

Fluence: 2 10^6 γ/mm^2



1 µs



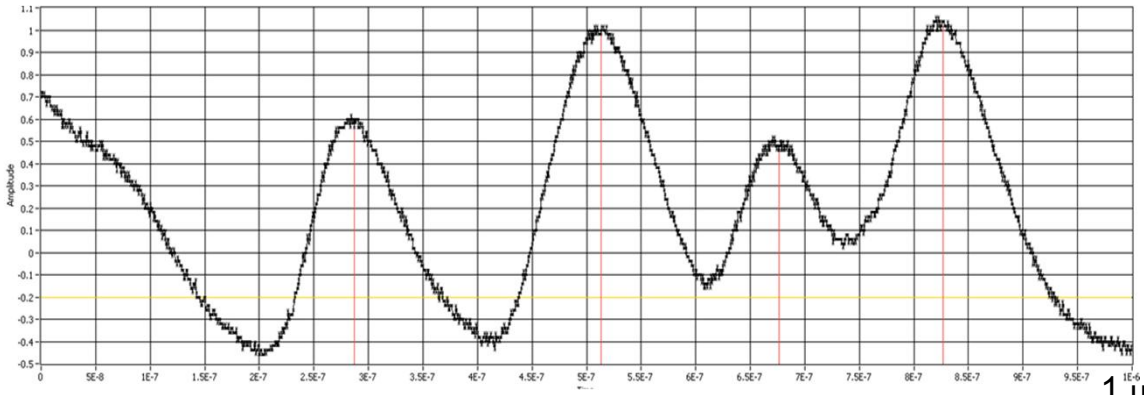


2 µs

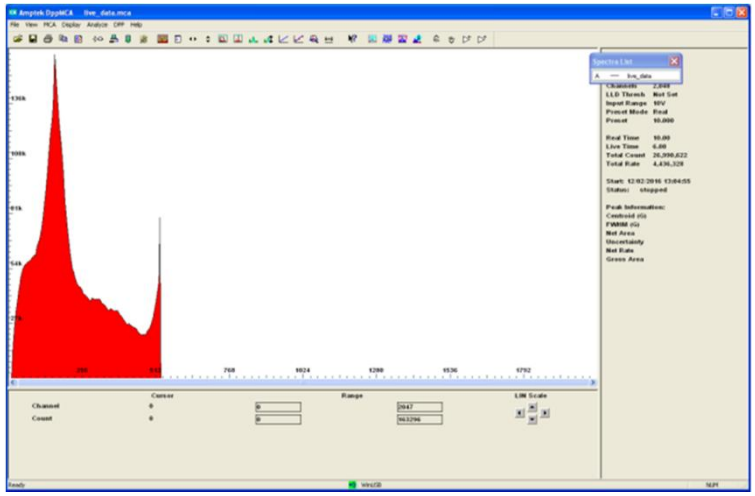
26 µs

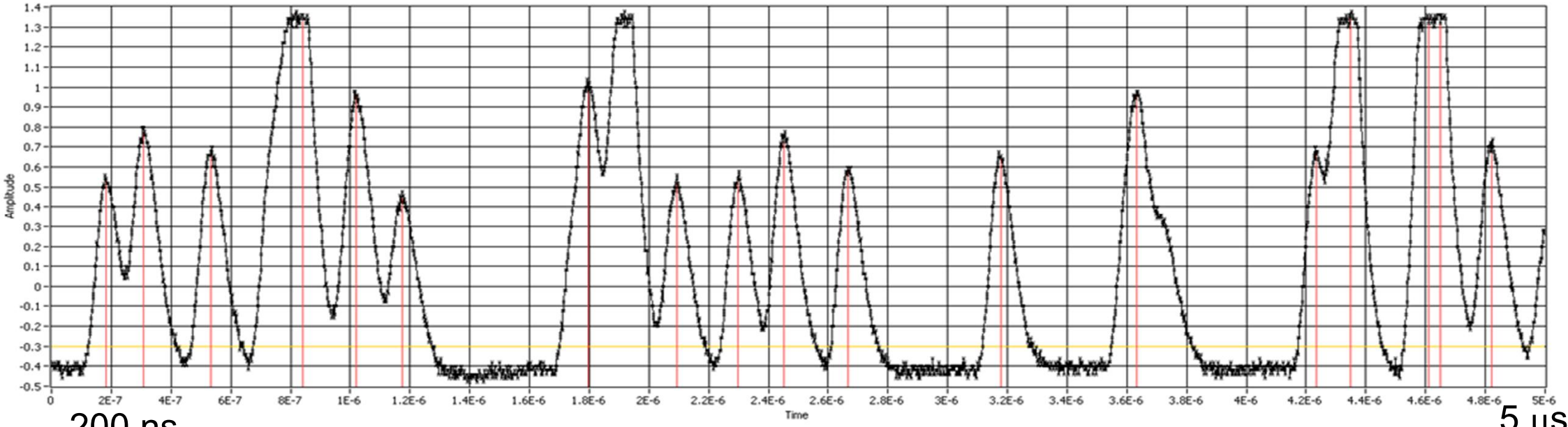
INTENSITY SCAN from 50 KHz - 3MHz

Fluence: 3 10^6 γ/mm^2



1 µs





200 ns

5 µs

OUTLOOK

1. Detailed study of its Linearity at low/High rate
2. Saturation effects
3. Sparks resistance
4. Baseline shift possible mitigations