Mu2e experiment: Tracker circuit

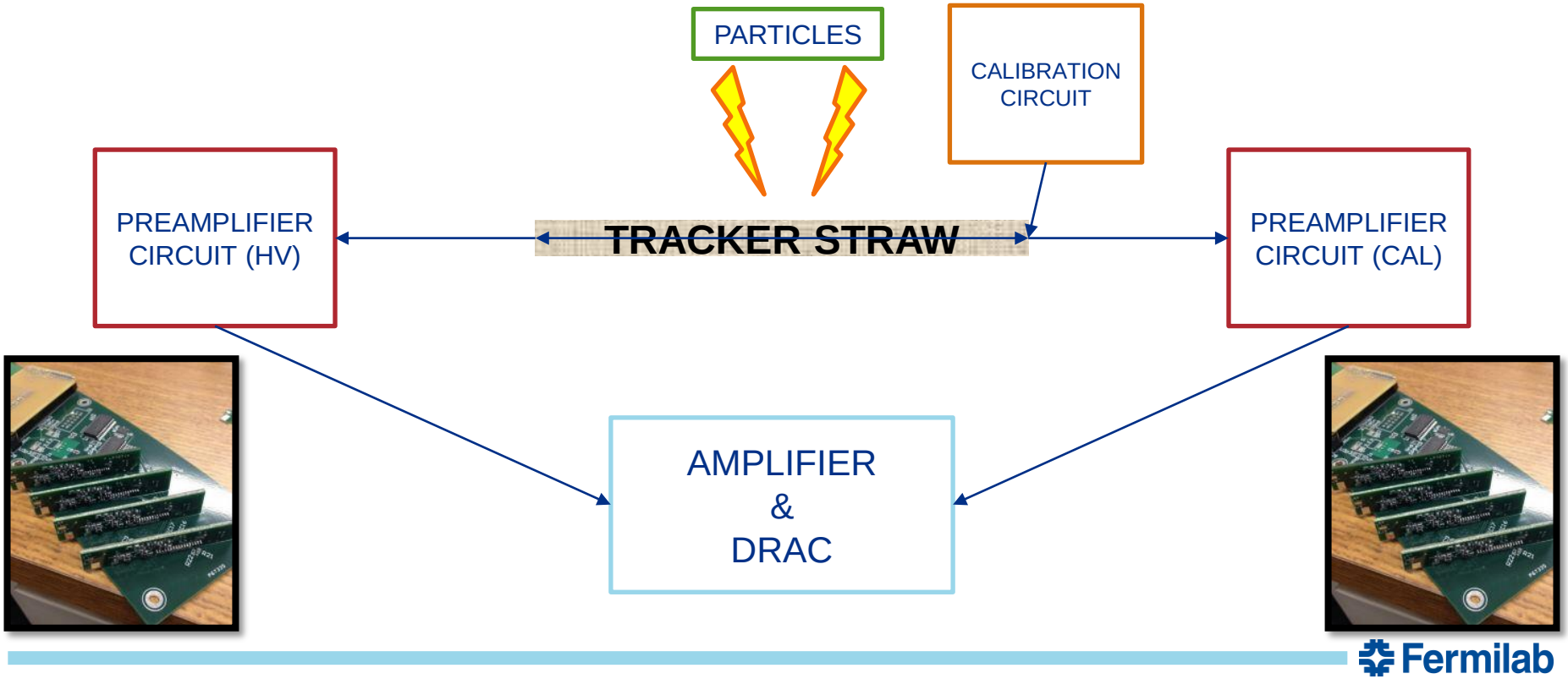
Francesco Cosimi

Supervisor: Vadim Rusu

Final Review Summer School 2018

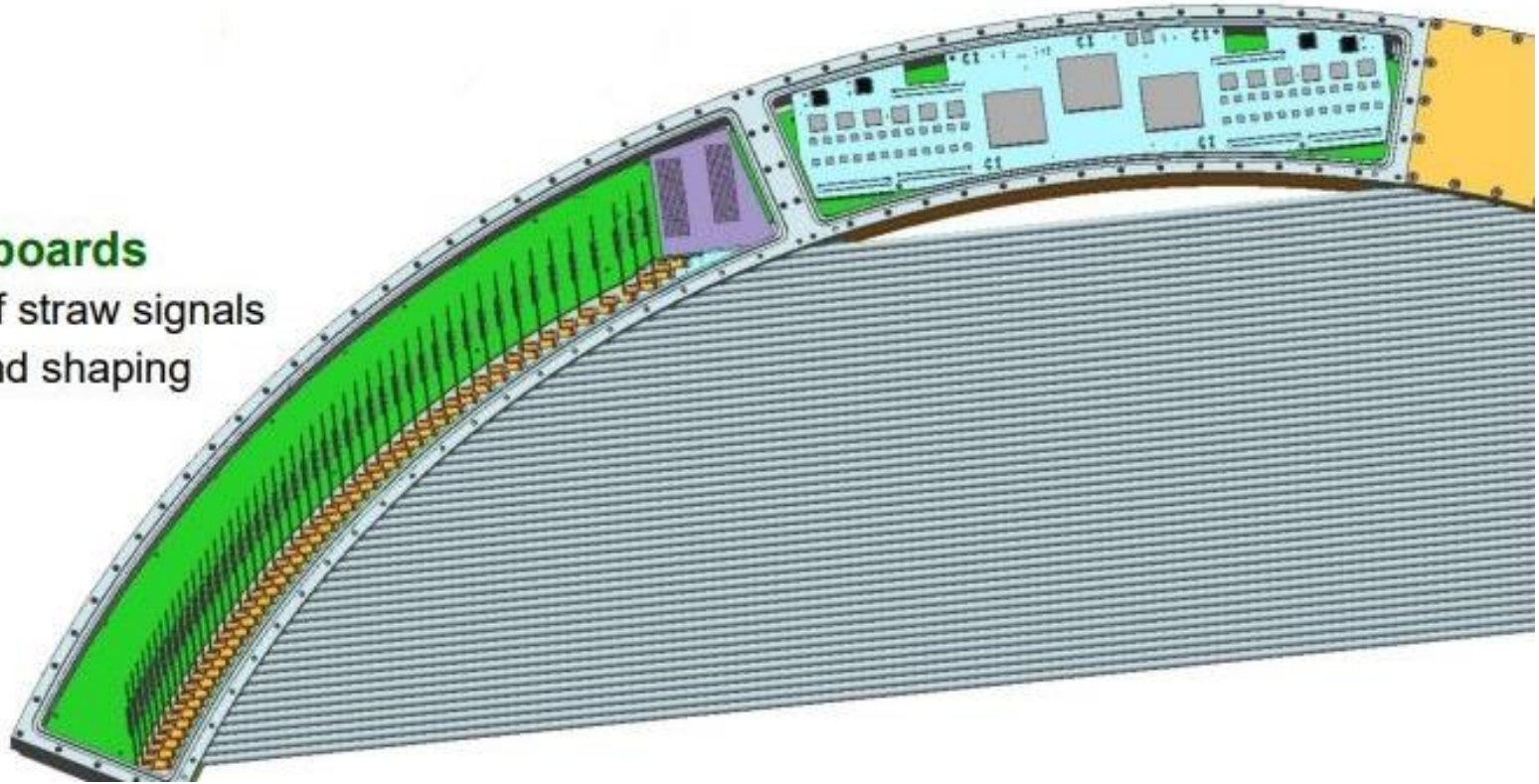
25th September 2018

CIRCUIT BLOCKS



DRAC mezzanine card

Digitization and ROC

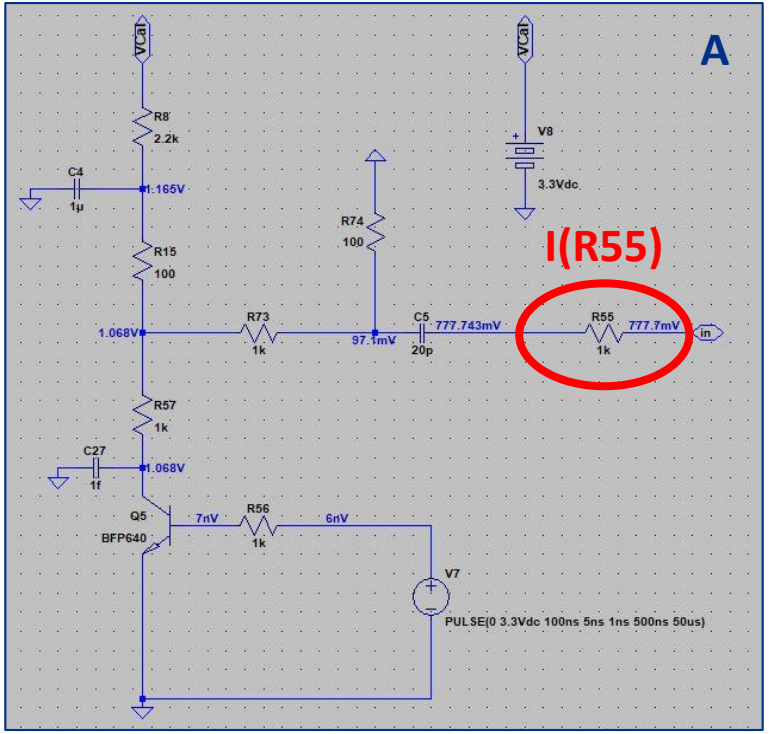


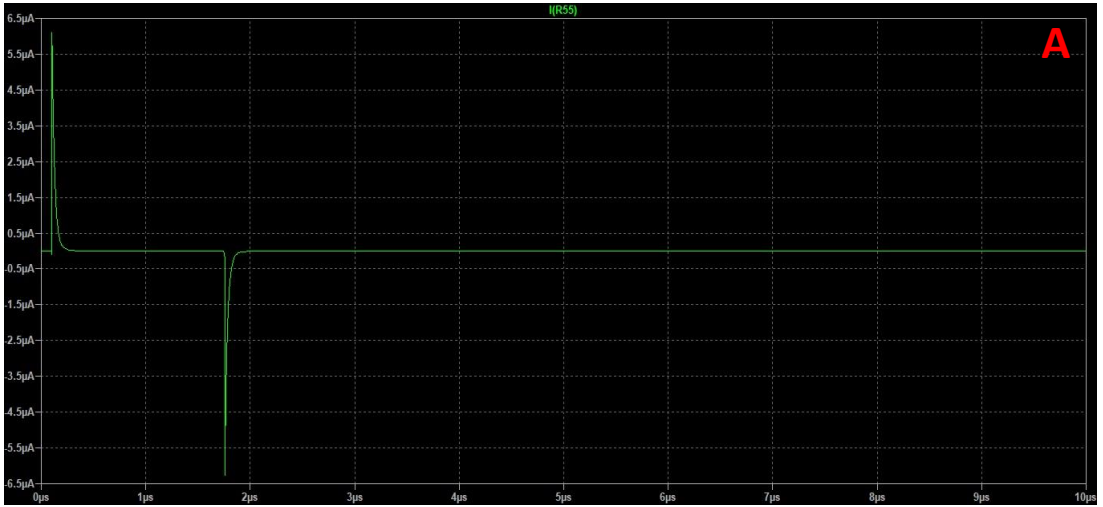
Preamp boards

Readout of straw signals

Preamp and shaping

CALIBRATION CIRCUIT

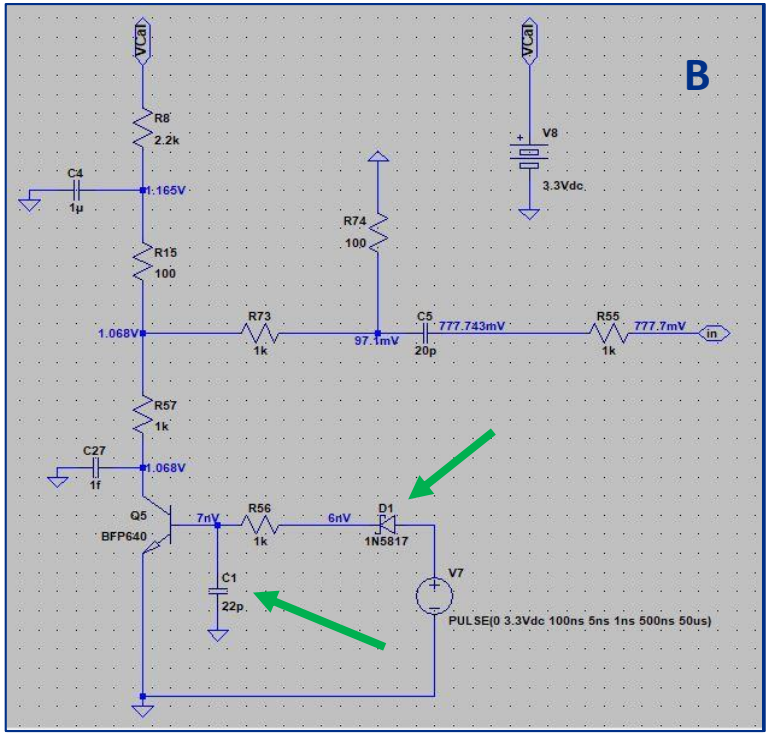


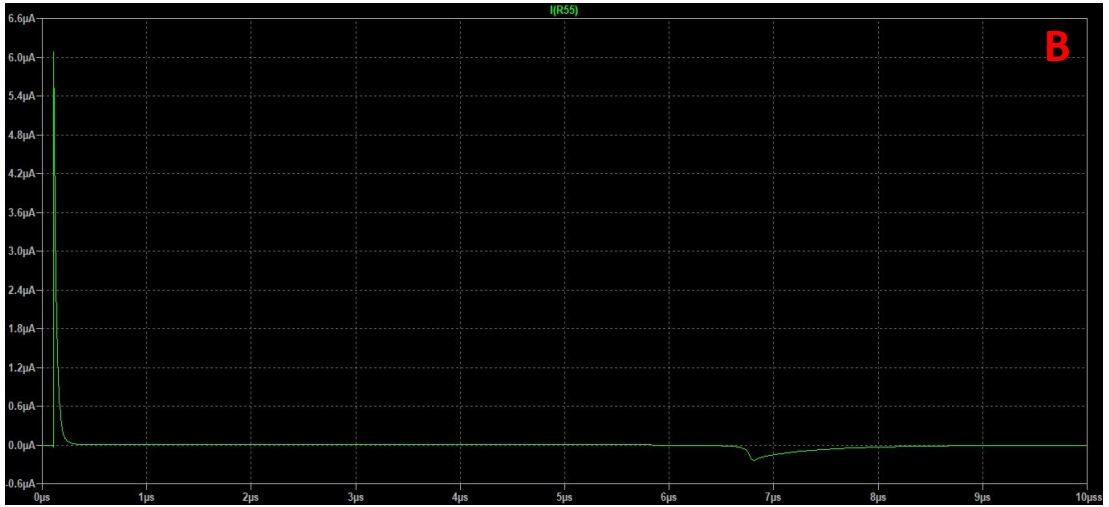


A: simulation of the original circuit.

B: same current but using the diode D1 and a 22pF capacitor.

CALIBRATION CIRCUIT



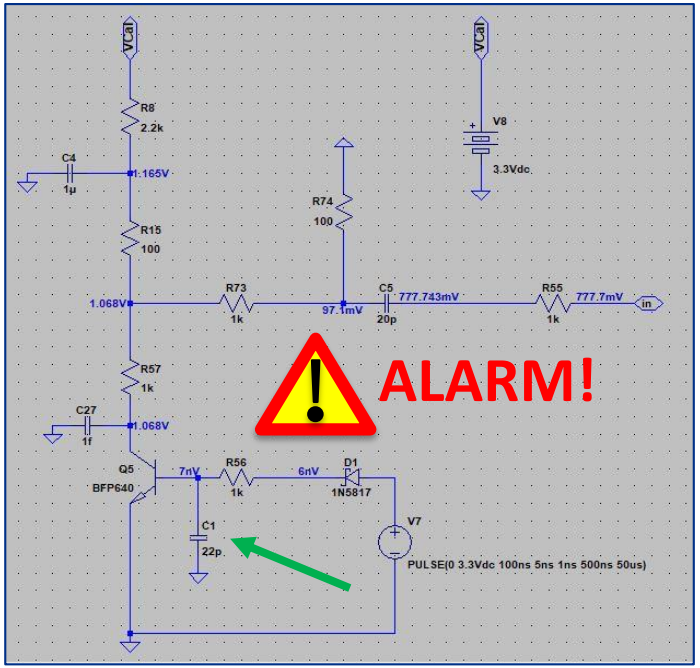


A: simulation of the original circuit.
B: same current but using the D1 diode and a 22pF capacitor.

IF THERE ARE DELAYS, DO THEY MAINTAIN A CONSTANT VALUE, OR THEY MIGHT BE VARIABLE?

- ❑ PASSIVE TOLLERANCE
- ❑ VOLTAGE SUPPLY
- ❑ TEMPERATURE
- ❑ PARASITIC (ACTIVE COMPONENTS)

The C1 capacitor introduces a delay and its position is similar to Q5's parasitic capacitance C_{BE}.

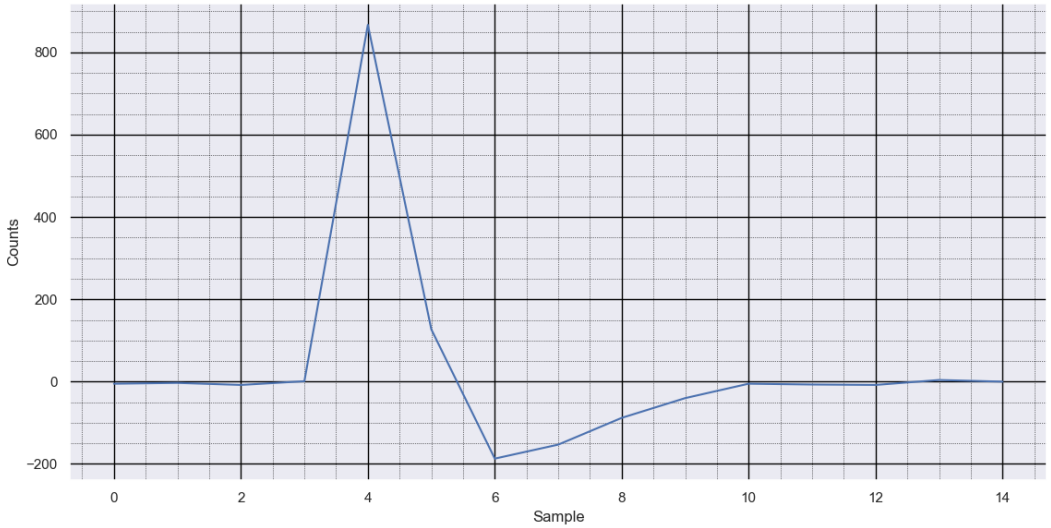


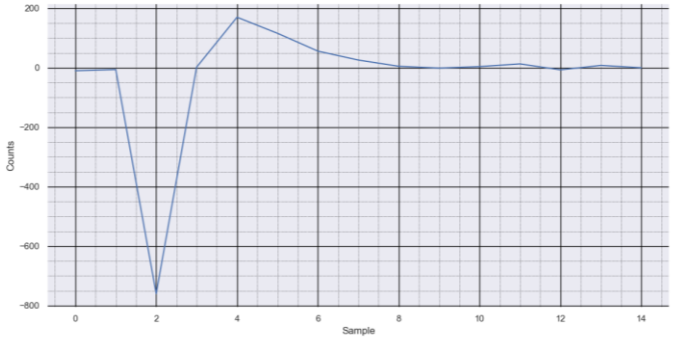
WHICH WERE THE AIMS FOR THE SECOND PART?

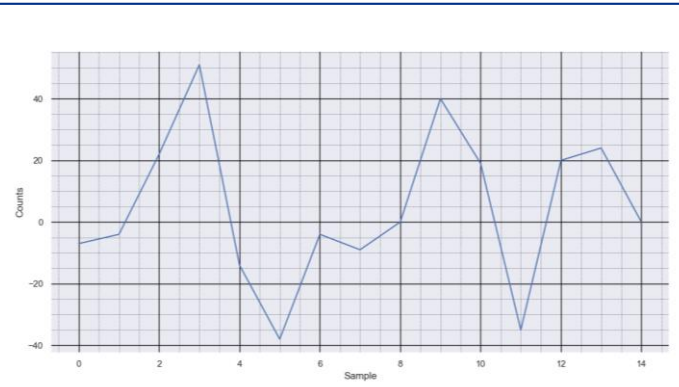
Analyse the timing features of the tracker. Especially focusing on the delay between CAL and HV side, and the period of the calibration pulses.

Comparison between *real* calibration signals (scope connected to the preamp) and simulations, trying to match them as much as possible.

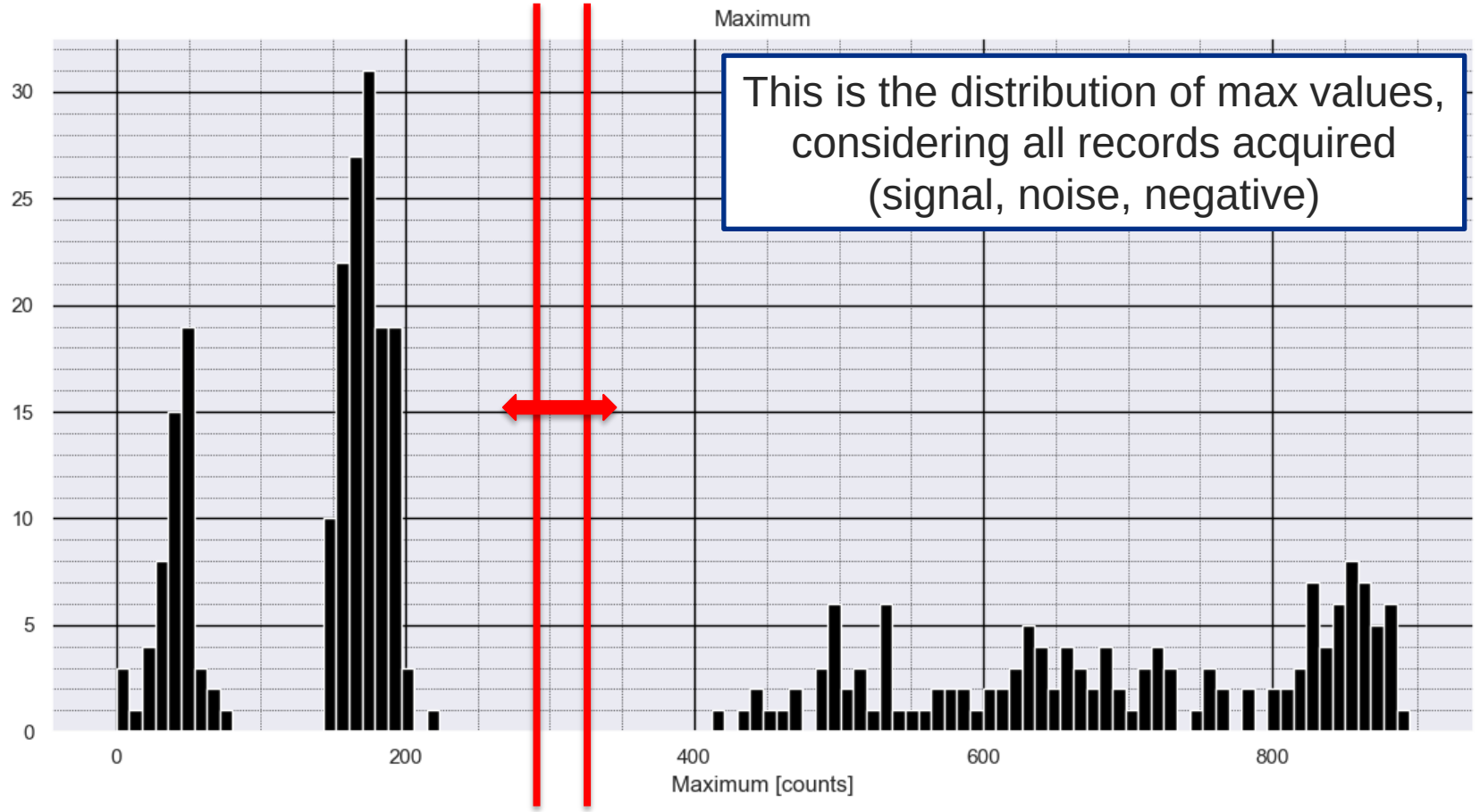
RECORDS



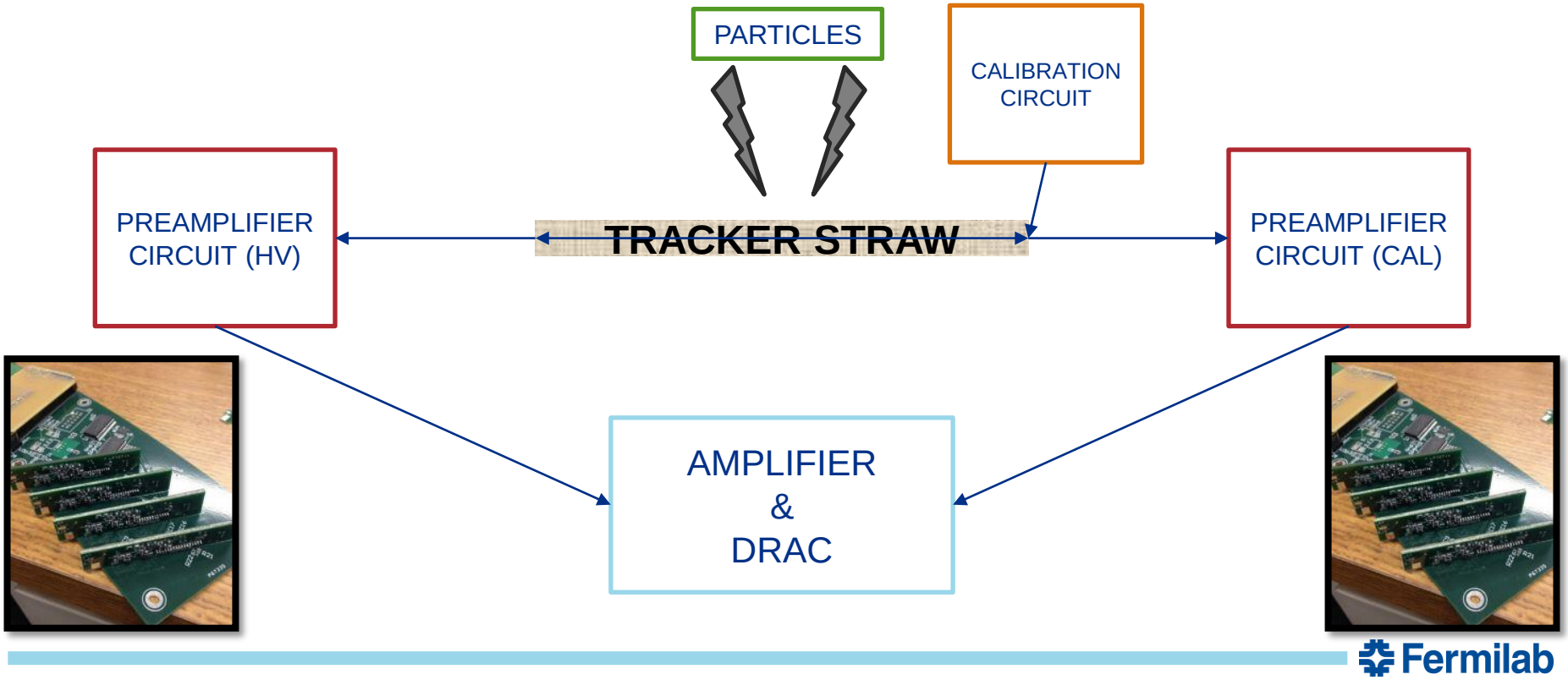


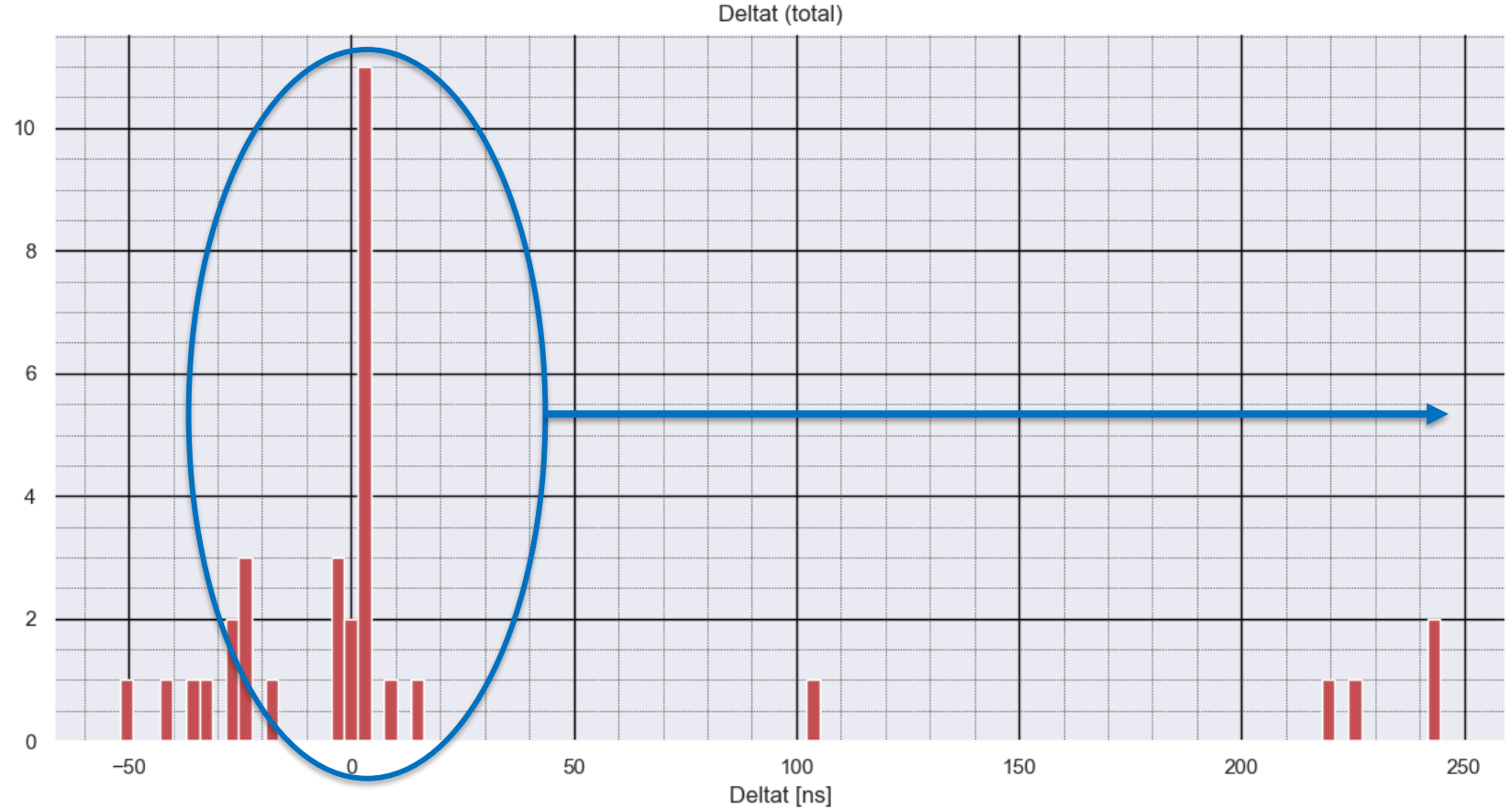


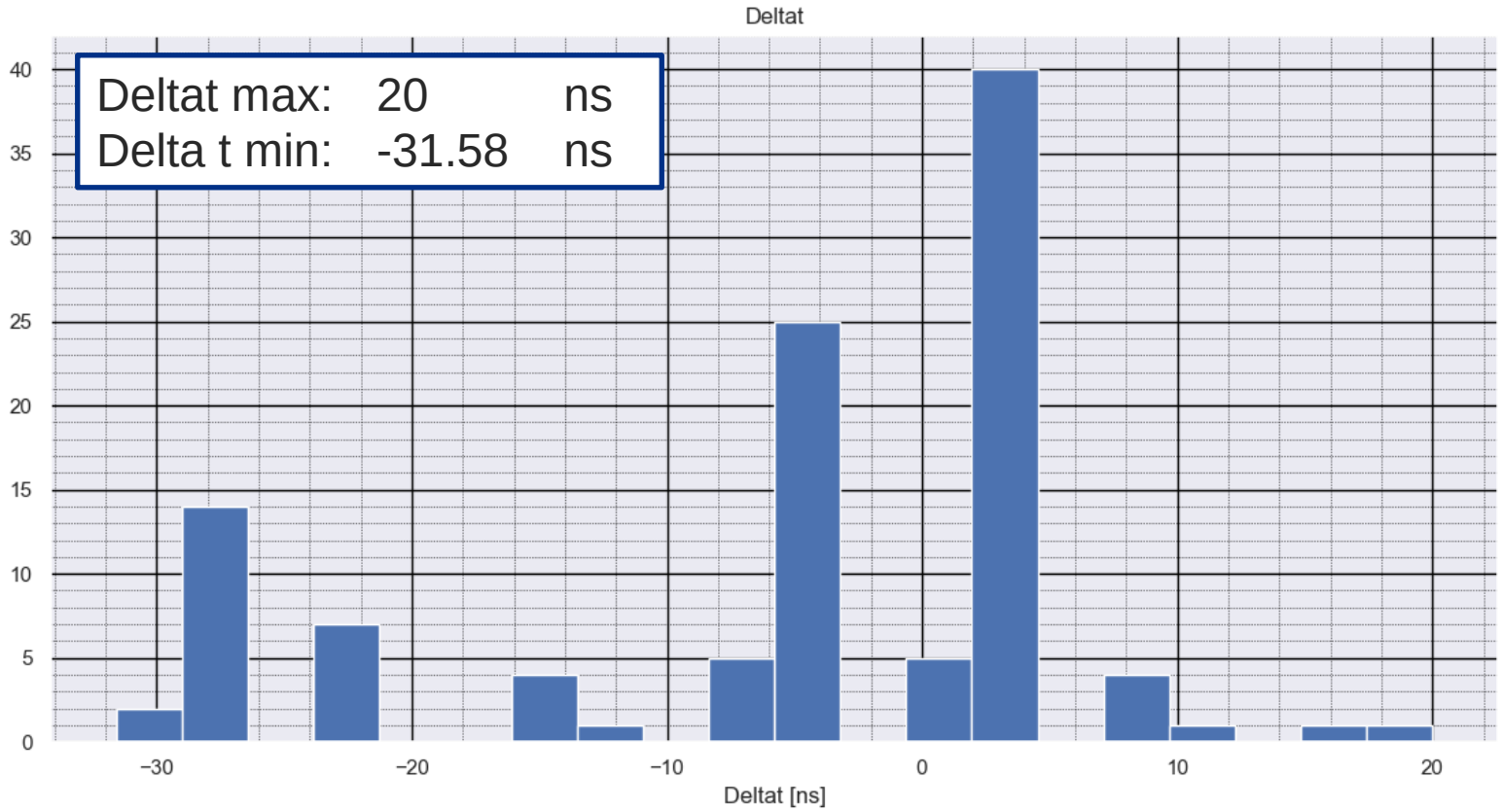
Here we have 3 different types of records that we obtain from the digital circuit

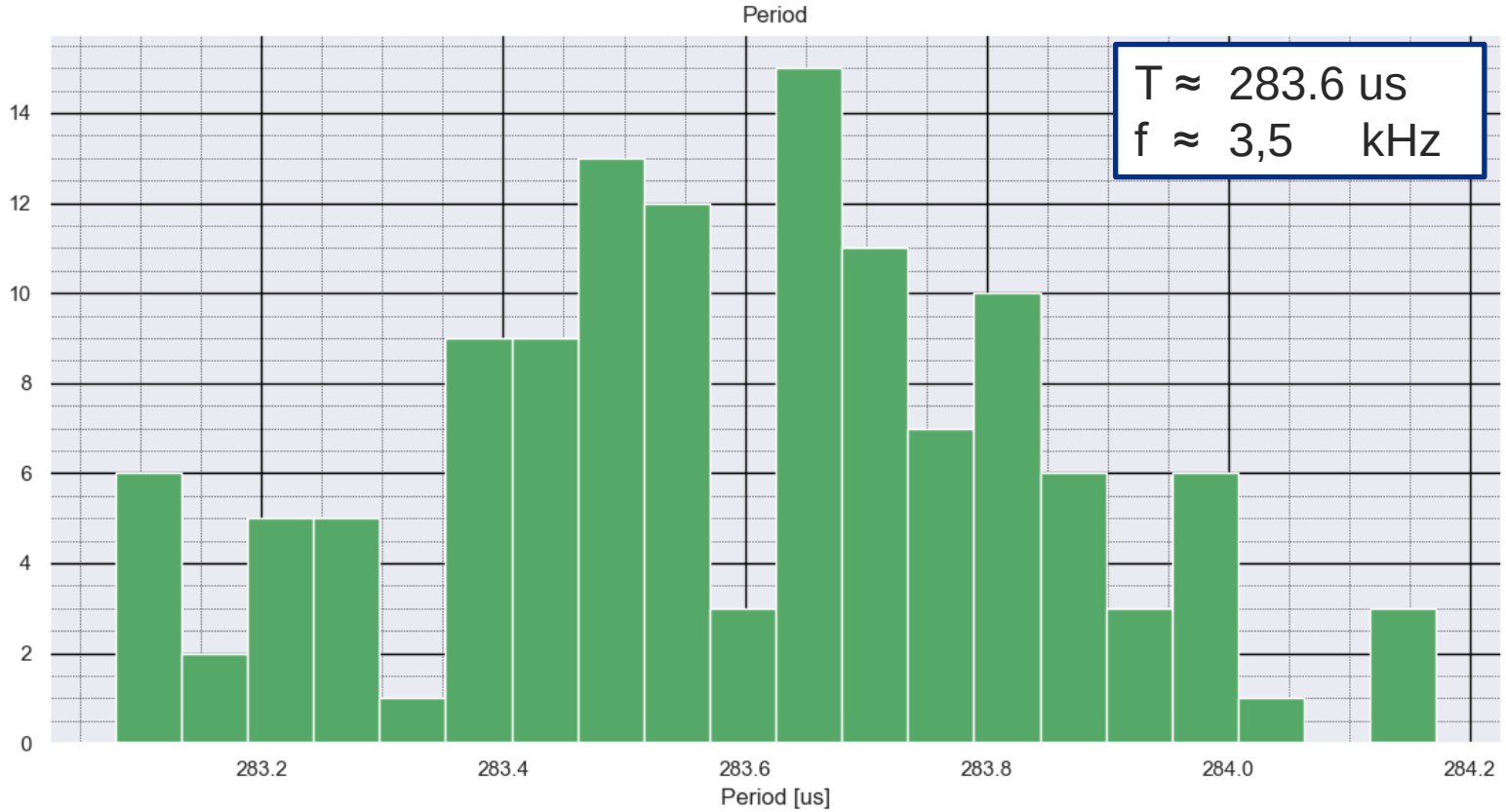

Maximum
30
25
20
15
10
5
0
0
200
400
600
800
Maximum [counts]
This is the distribution of max values, considering all records acquired (signal, noise, negative)

CIRCUIT BLOCKS




Deltat (total)
10
8
6
4
2
0
−50
0
50
100
150
200
250
Deltat [ns]

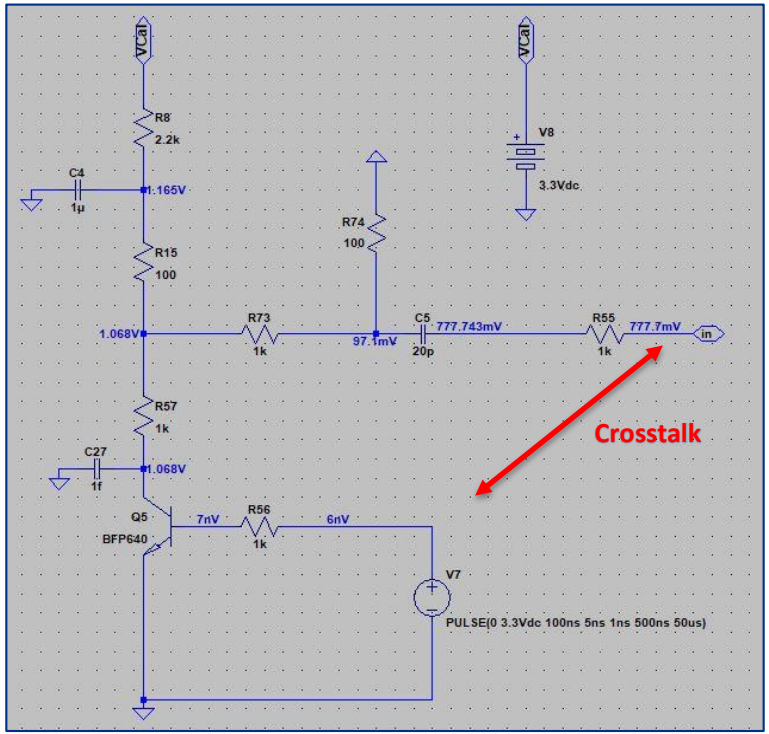

Deltat
Deltat max: 20 ns
Delta t min: -31.58 ns
40
35
30
25
20
15
10
5
0
−30
−20
−10
0
10
20
Deltat [ns]


Period
T ≈ 283.6 us
f ≈ 3,5 kHz
14
12
10
8
6
4
2
0
283.2
283.4
283.6
283.8
284.0
284.2
Period [us]

SCOPE vs SIMULATION

Calibration circuit:

We have to consider the effects of parasitic, especially capacitive coupling between signals.



Choose file number [1- 10]: 8

File 8

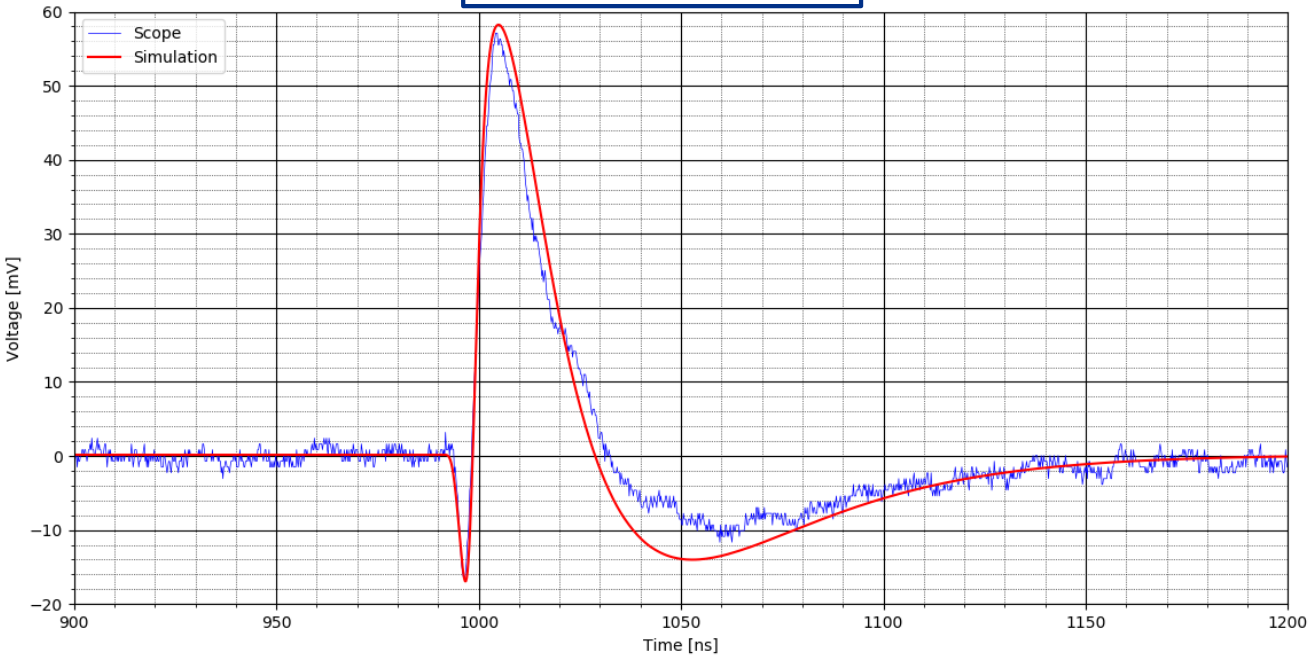
Vmax simulation: 58.2292 mV
Vmax scope: 57.0938 mV

tmax simulation: 1004.8 ns
tmax scope: 1004.2 ns

t_rise simulation: 3.4 ns
t_rise scope: 4.4 ns

t_fall simulation: 16.4 ns
t_fall scope: 20.4 ns

Pulse: crosstalk between lines



Pulse: NO crosstalk between different lines

Choose file number [1- 5]: 2

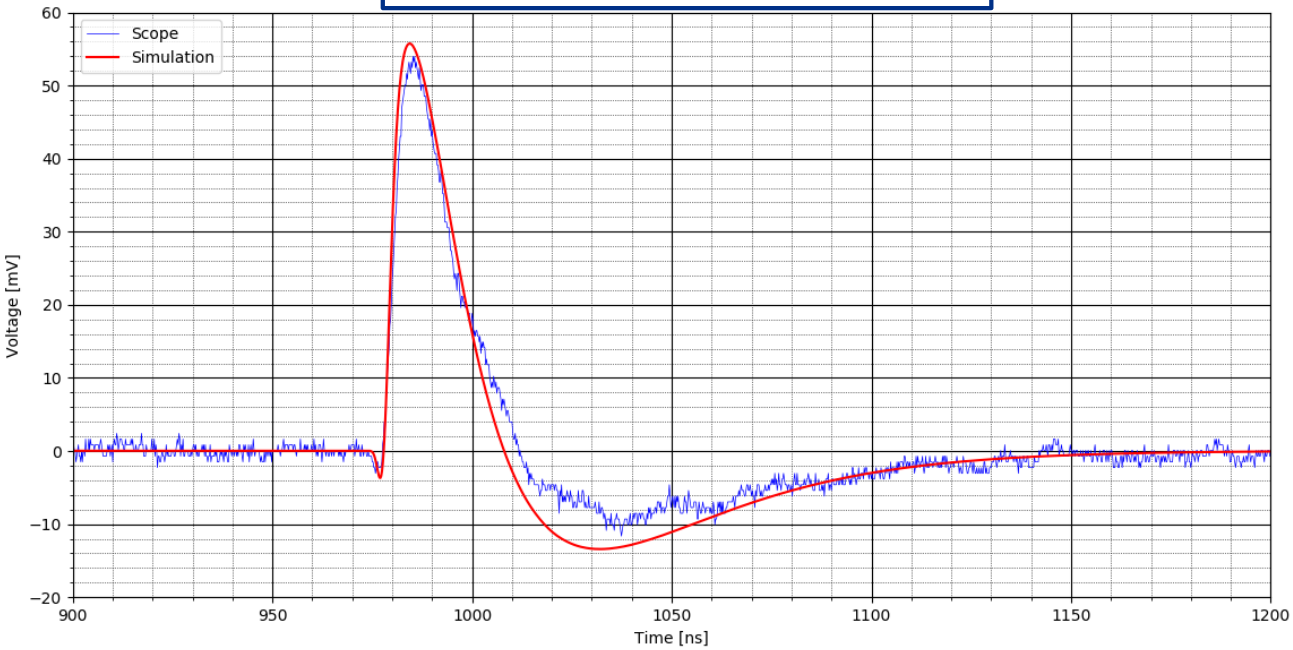
File 2

Vmax simulation: 55.7341 mV
Vmax scope: 53.9805 mV

tmax simulation: 984.4 ns
tmax scope: 985.2 ns

t_rise simulation: 3.6 ns
t_rise scope: 4.6 ns

t_fall simulation: 16.8 ns
t_fall scope: 20.6 ns



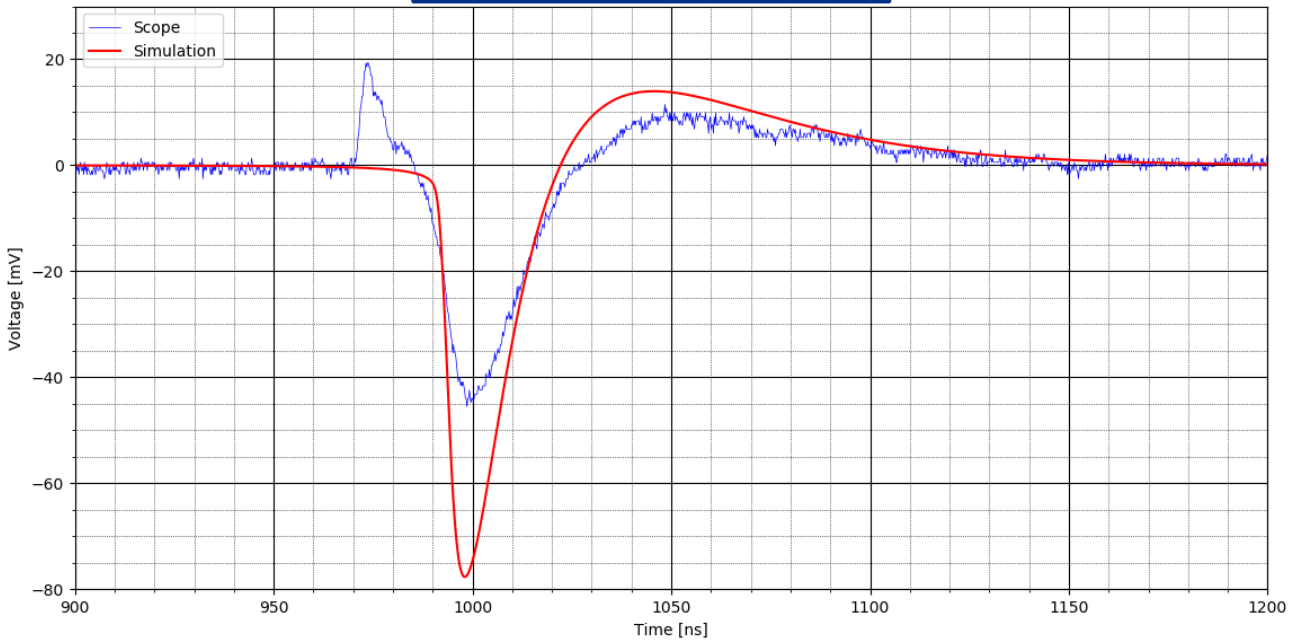
Choose file number [0 - 1]: 0

File 0

Vmin simulation: -83.6109 mV
Vmin scope: -45.5352 mV

tmin simulation: 998.5 ns
tmin scope: 998.6 ns

Negative: crosstalk between lines



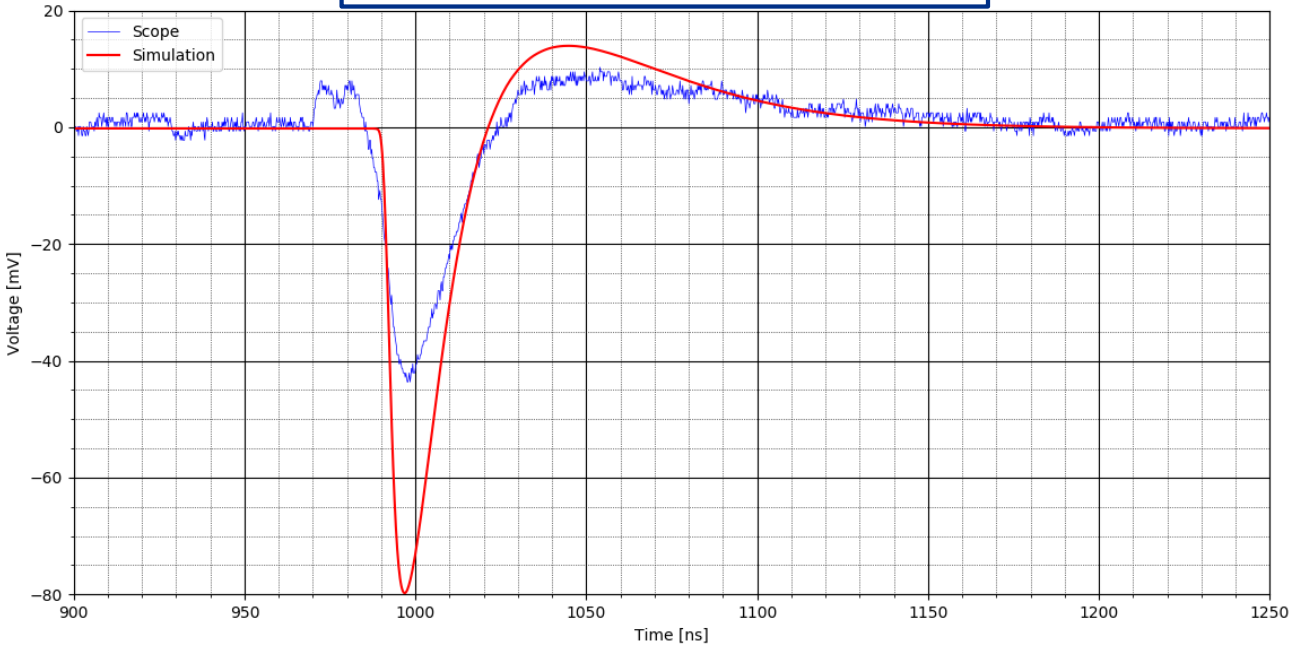
Negative: NO crosstalk between different lines

Choose file number [1- 5]: 1

File 1

Vmin simulation: -79.7902 mV
Vmin scope: -43.6367 mV

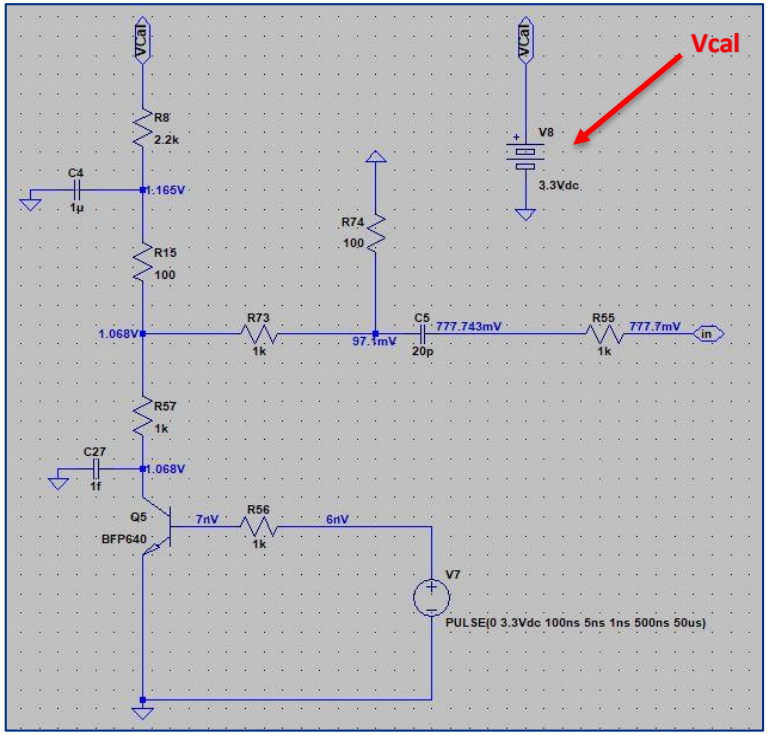
tmin simulation: 996.9 ns
tmin scope: 997.6 ns

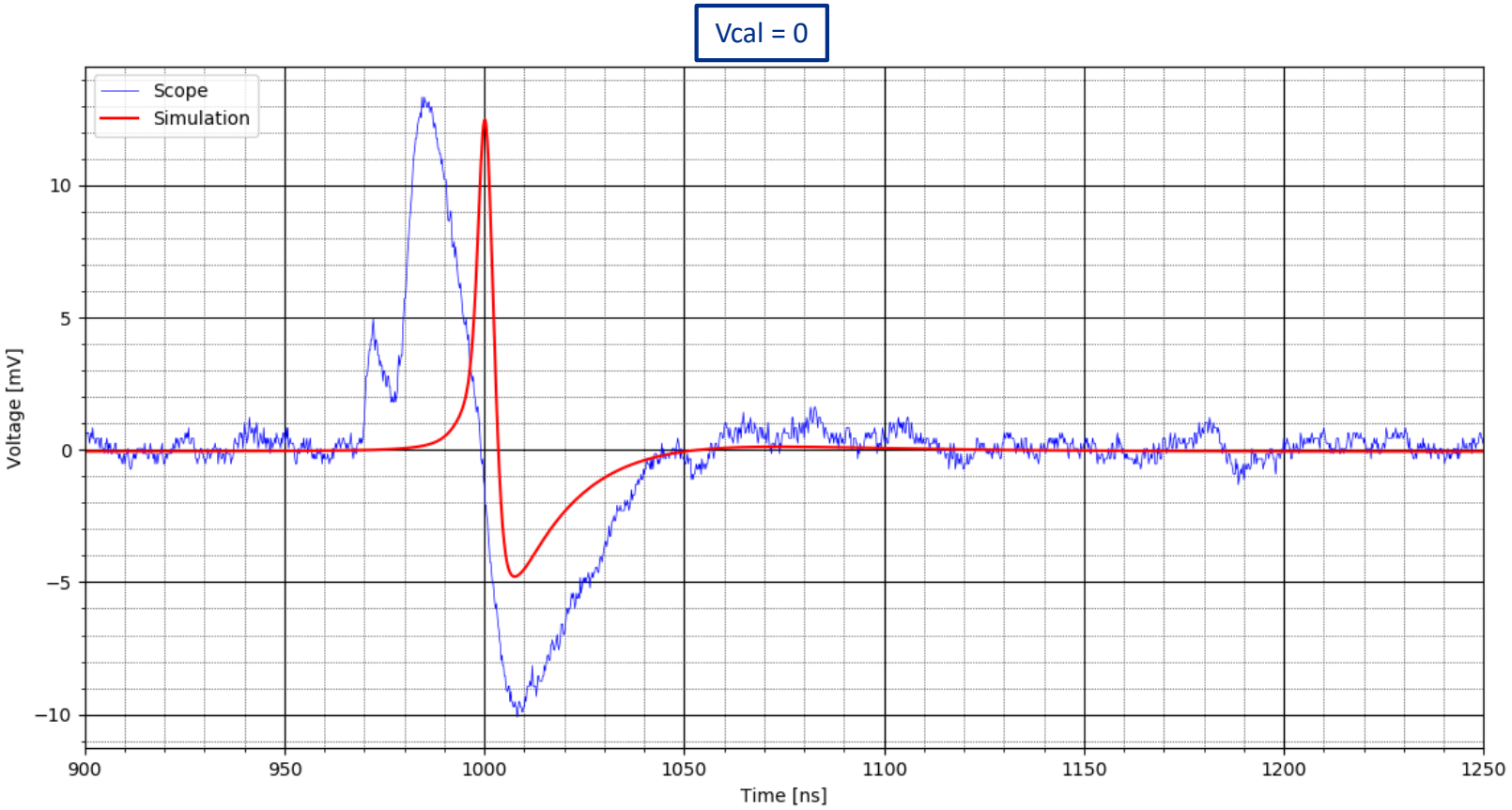


SCOPE vs SIMULATION

Calibration circuit:

Why don’t turn off this part of the circuit?
Could be interesting doing this?




Vcal = 0
Scope
Simulation
Voltage [mV]
10
5
0
−5
−10
900
950
1000
1050
1100
1150
1200
1250
Time [ns]


ANY QUESTIONS?...
...THANK YOU FOR ATTENTION
Fermilab