EICROC activity @ BNL

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EIC-Japan meeting
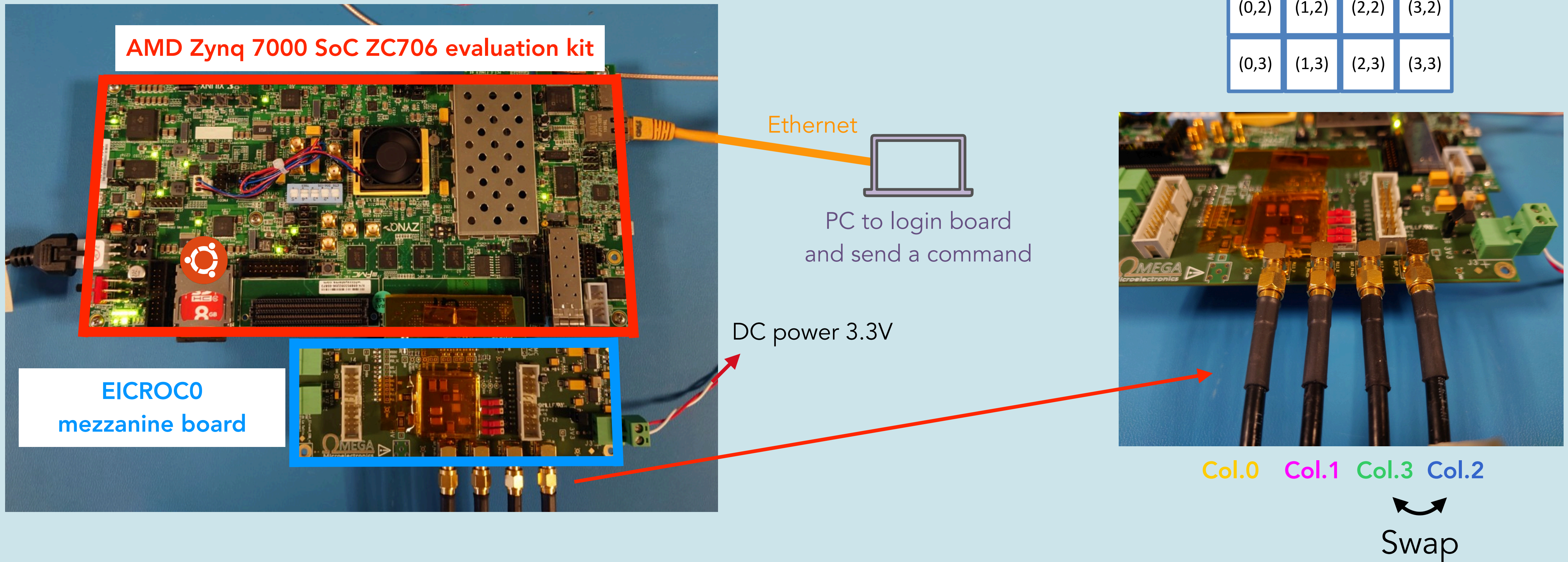
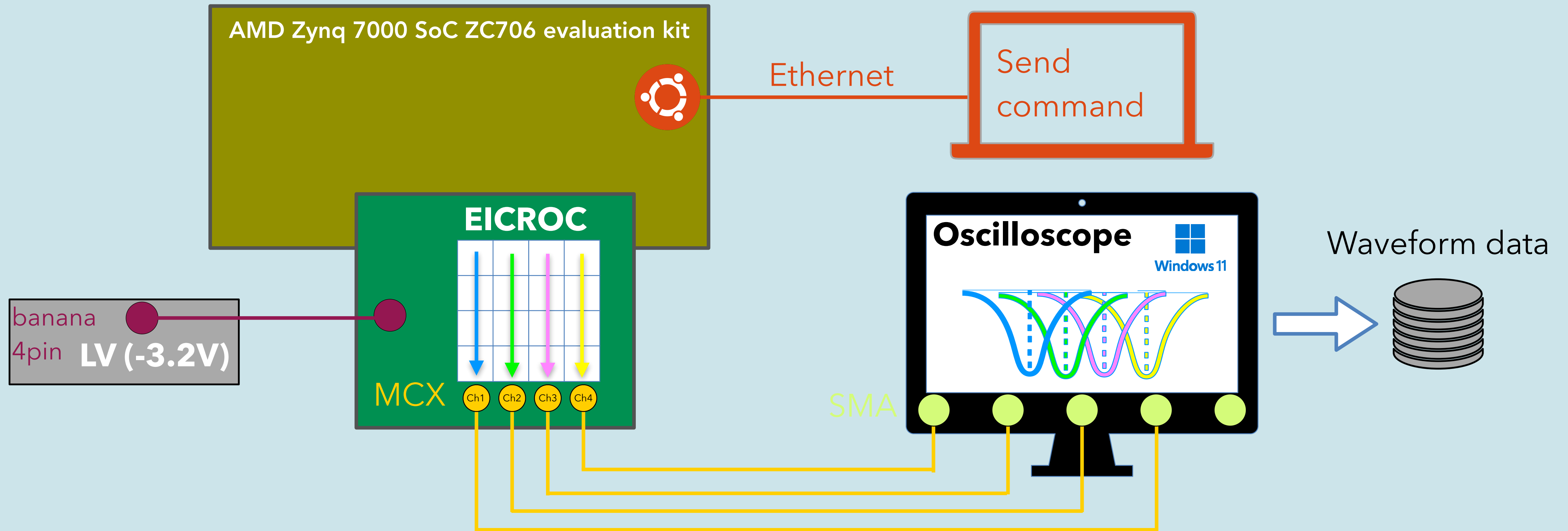09/14/2023

- Yano stayed at BNL for about 2 weeks to join the R&D of the EICROC0 (4x4 pixel)
- EICROC0 is characterized by injecting charges

RICROC0 test setup

- Ubuntu is installed on the evaluation board
- The command is sent to the board from one's computer to inject charges
- The waveform is saved in excel format on the oscilloscope

Waveform

- Each charge is injected into each pixel 15 times triggered by the oscilloscope
- EICROC0 makes a strange signal when it loads a configuration file
- Average waveform is calculated excluding the strange signal
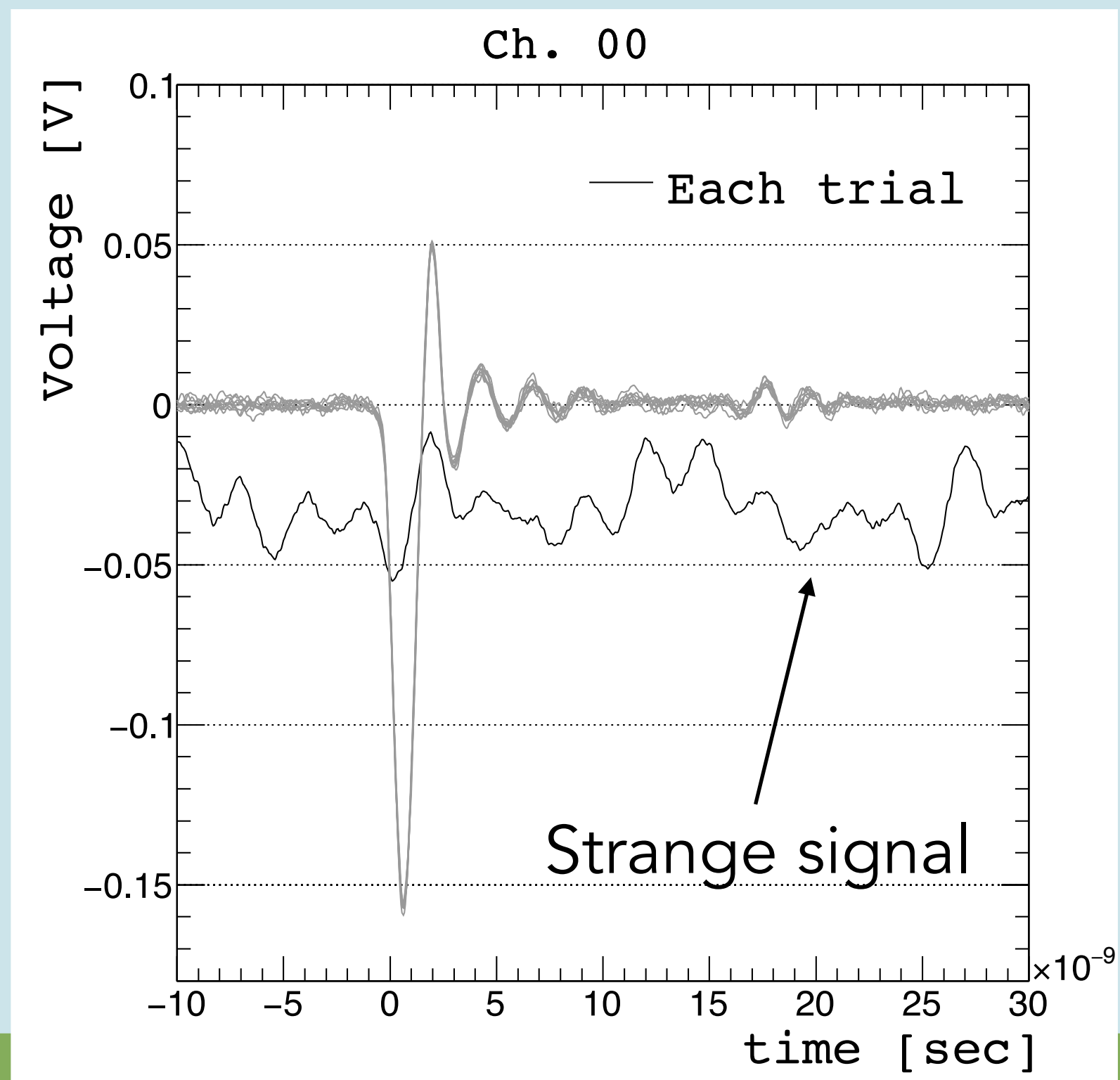
Exclude the first signal
and
calculate average
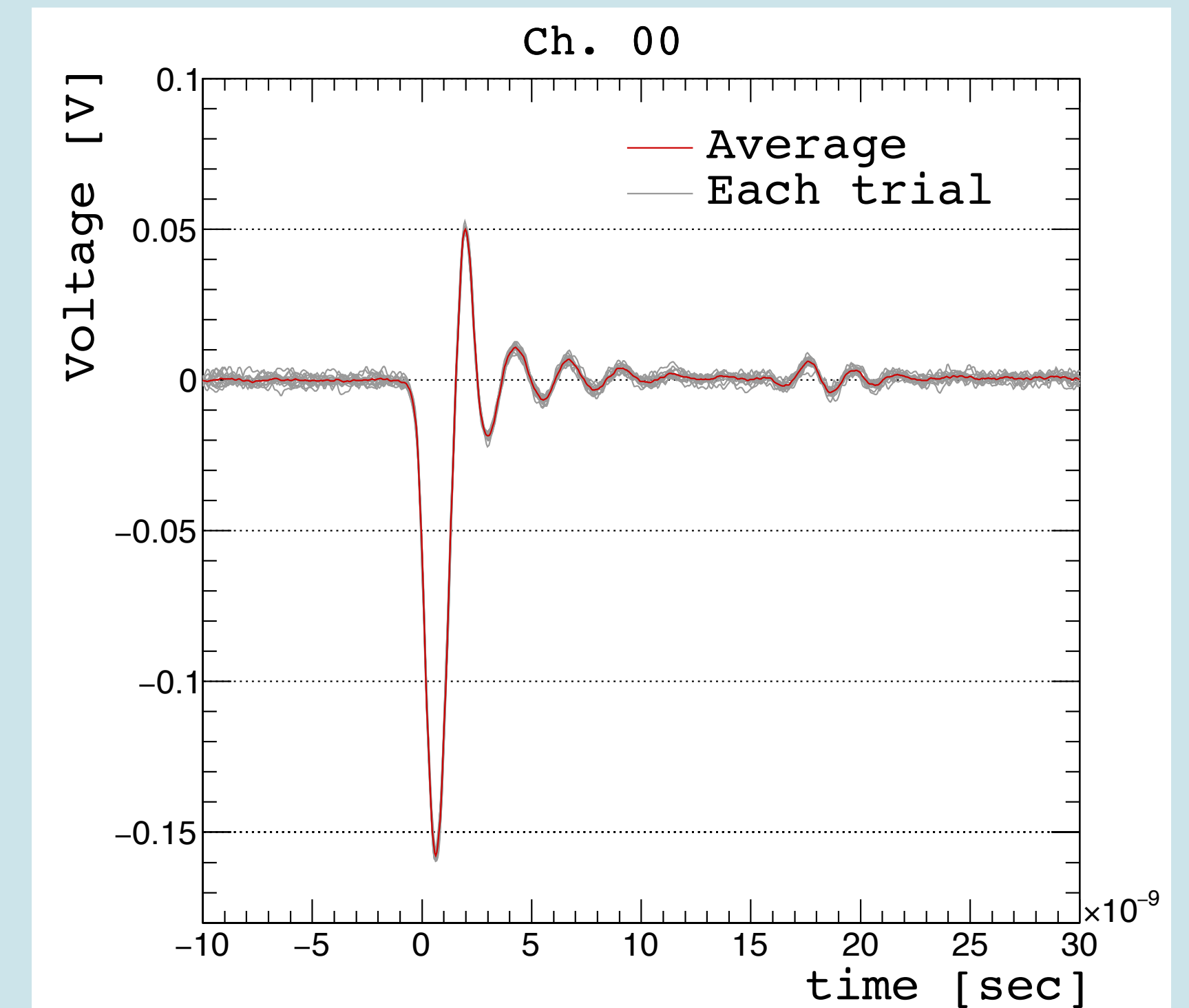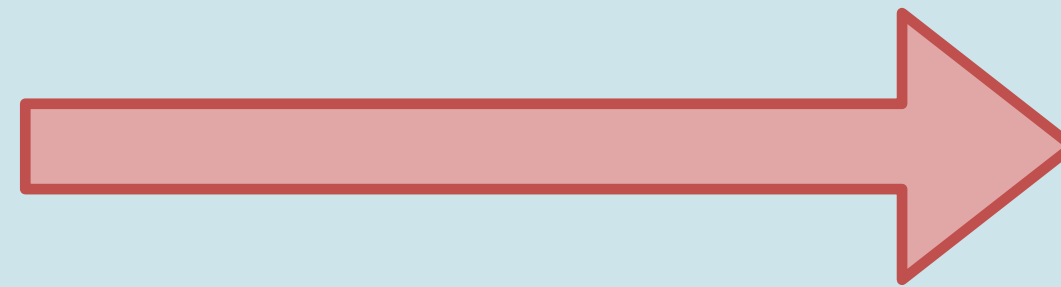
Cross-talk between the columns

Charge injection into Col.0
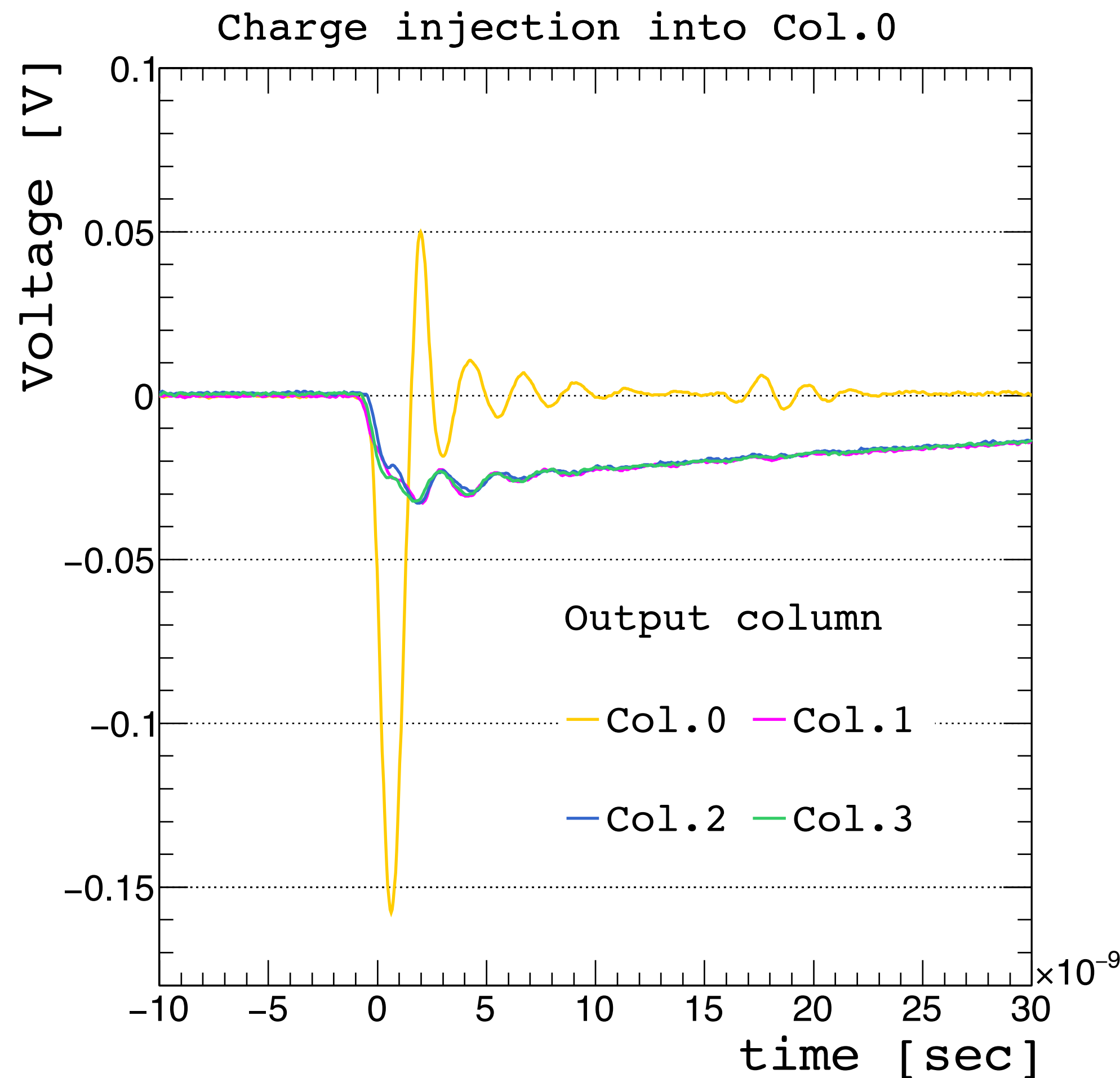
- When the charge is injected into a column, the other columns emit a strange signal

- For example, the left figure shows each oscilloscope output when a charge is injected into the pixel [0,0], which corresponds to col.0 in the figure

- The cross-talk of each column has the same shape, but a smaller amplitude than the signal so it can be ignored by setting a trigger threshold

# Correlation between injected charge and maximum amplitude
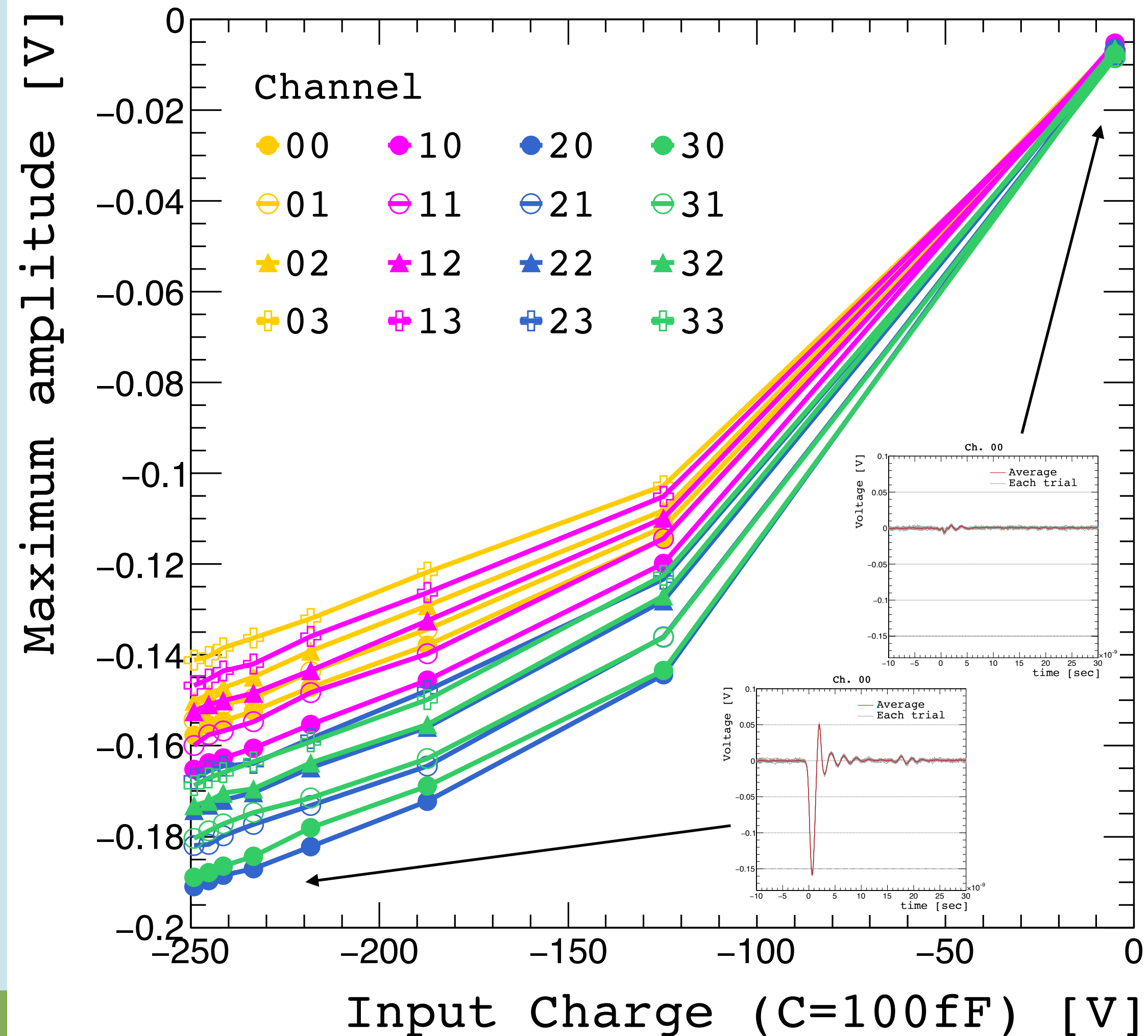
- The linear correlation is observed with high charge injections, but low charge injection (-5.05 V) case deviates from the trend

- The correlation is linear in all pixels, but the amount of maximum amplitude is not uniform, and the same grouping in each column (color) can be seen

Maximum amplitude in each pixel

- In the same column, the larger pixel number has a higher amplitude in all columns.

- Col.0 >= Col.1 > Col.2 >= Col.3
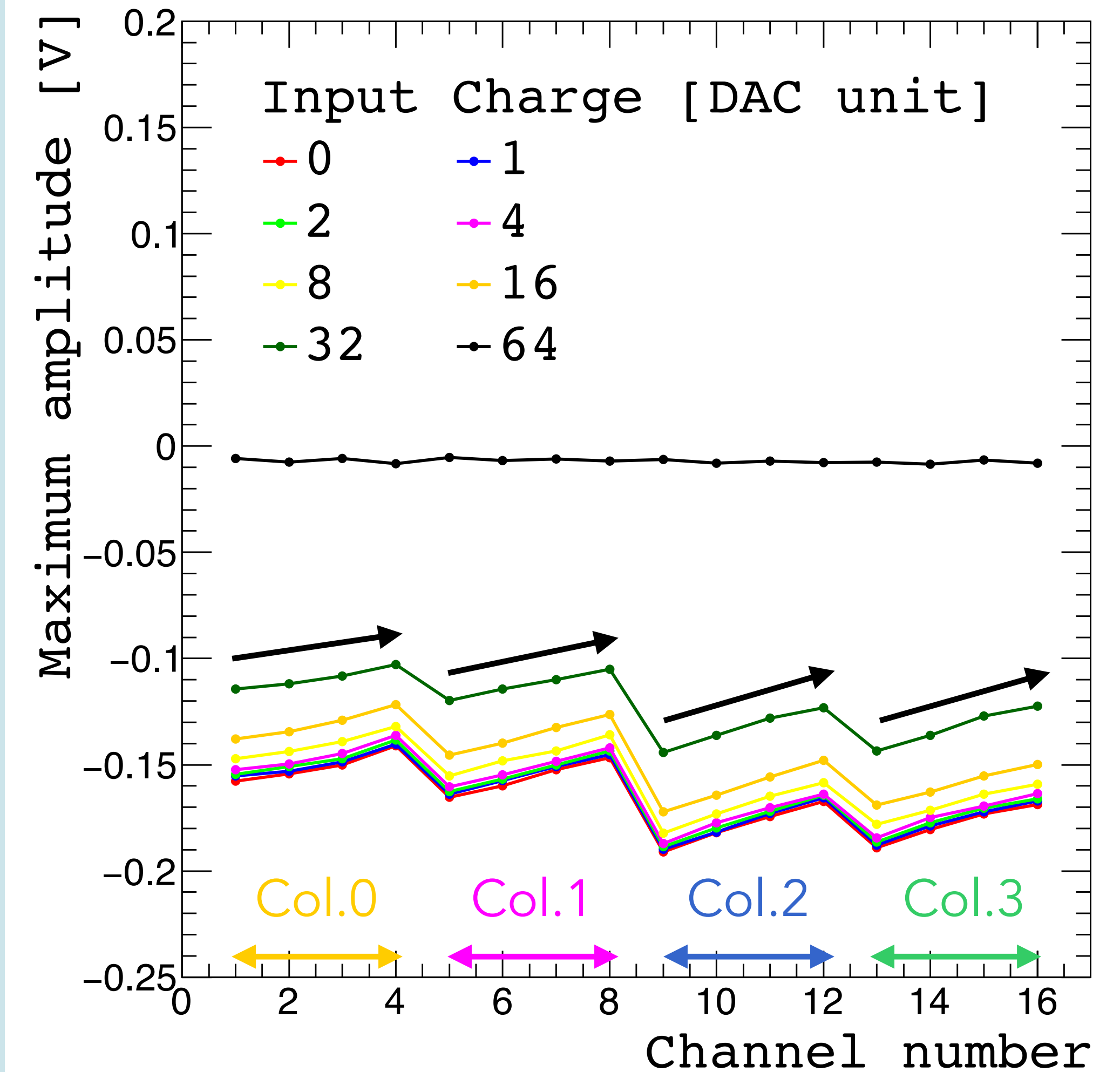
Maximum amplitude and overshoot timing
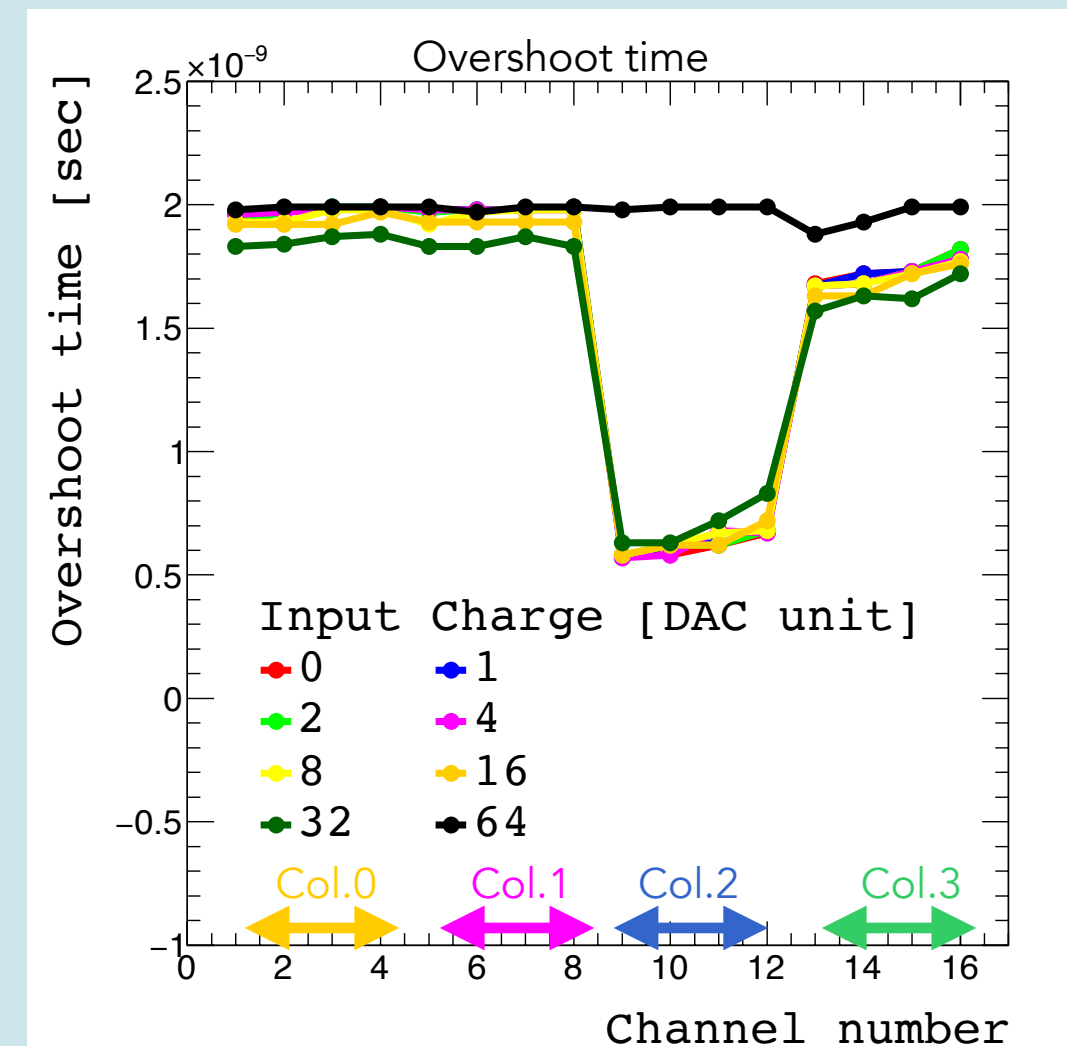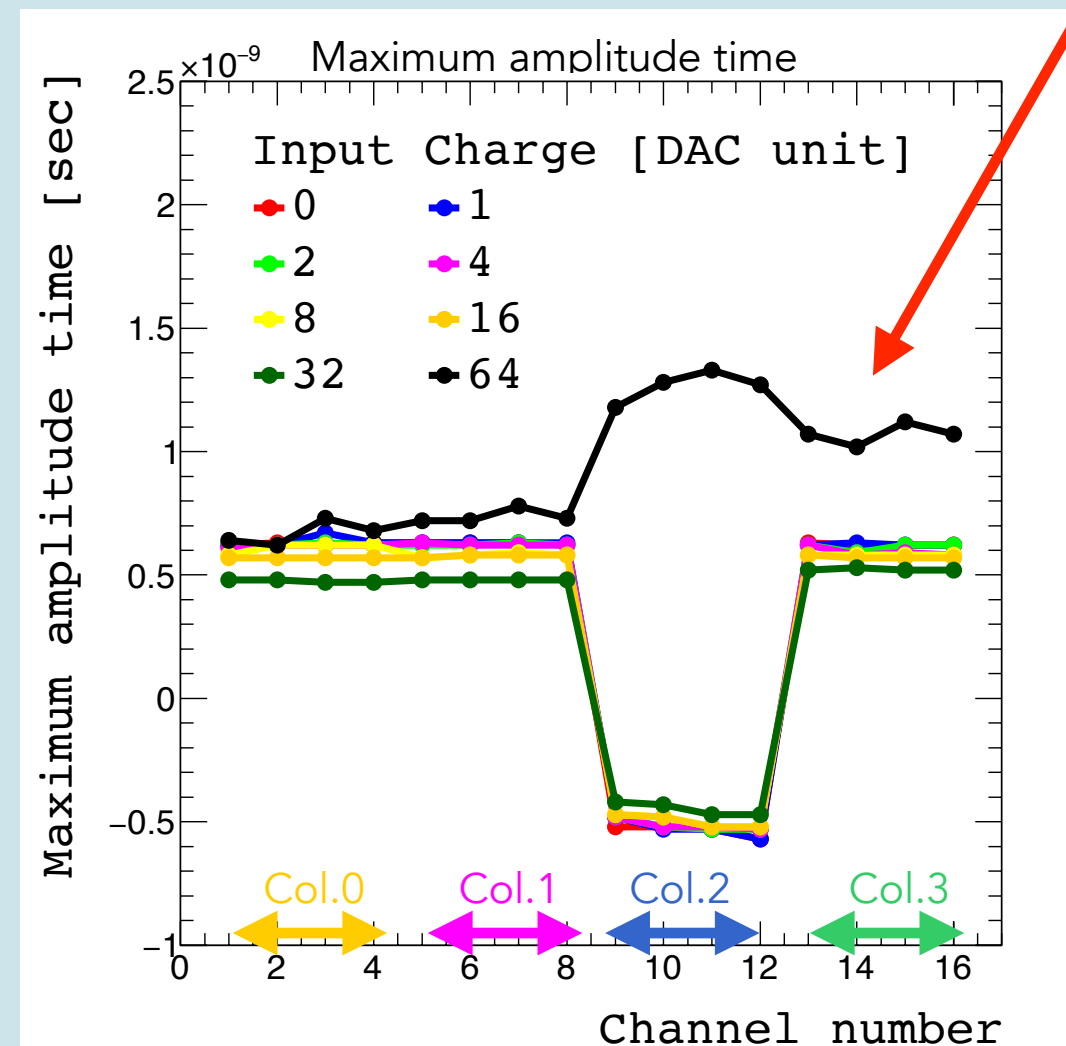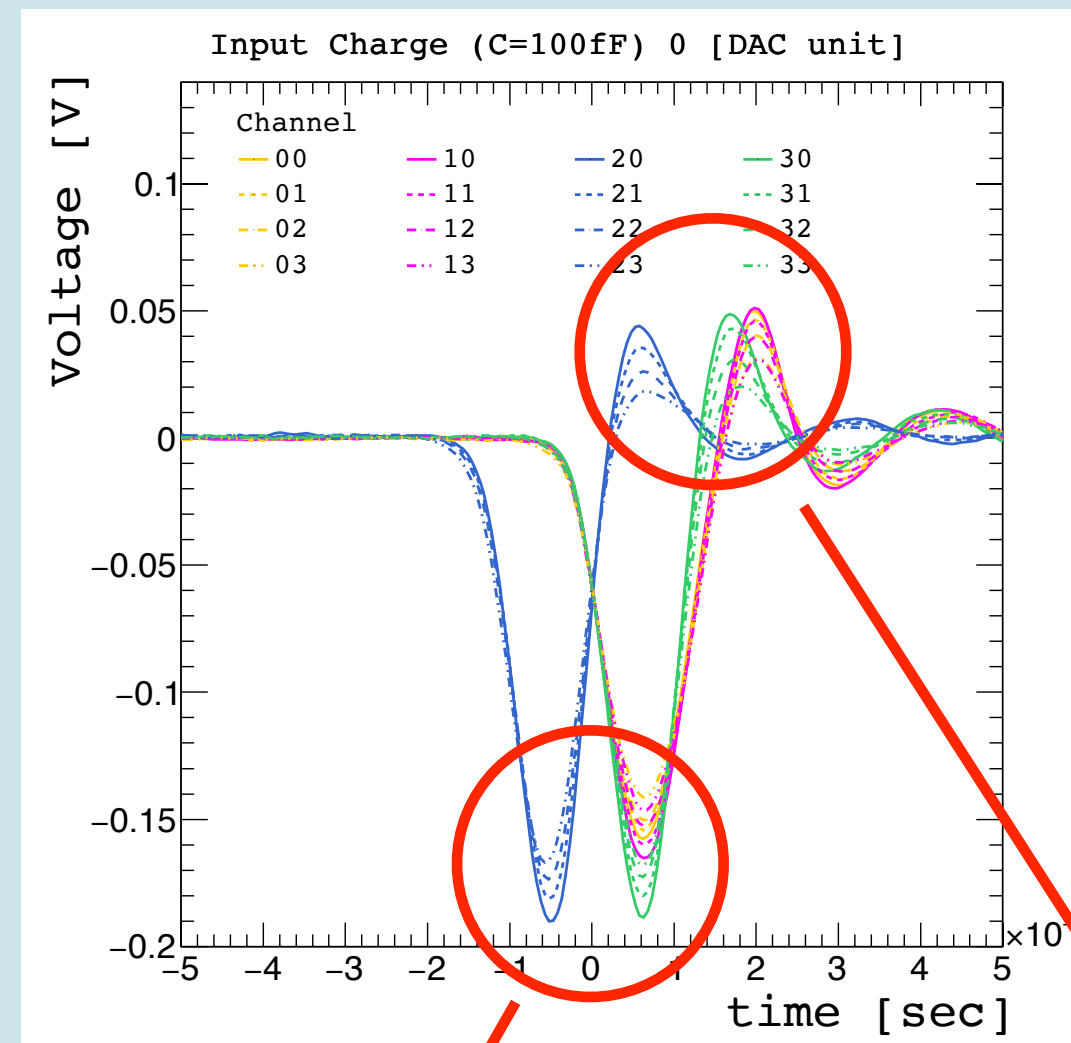
- The maximum amplitude timing of col2 is faster than the other cols

- The injection charge dependence hierarchy of timing can be seen, a lower charge = smaller signal is faster

- The overshoot timing of col2 is faster than the other cols as well

- The col3 overshoot timing is a little bit smaller than col0 and col1 in spite of the maximum amplitude timing being the same
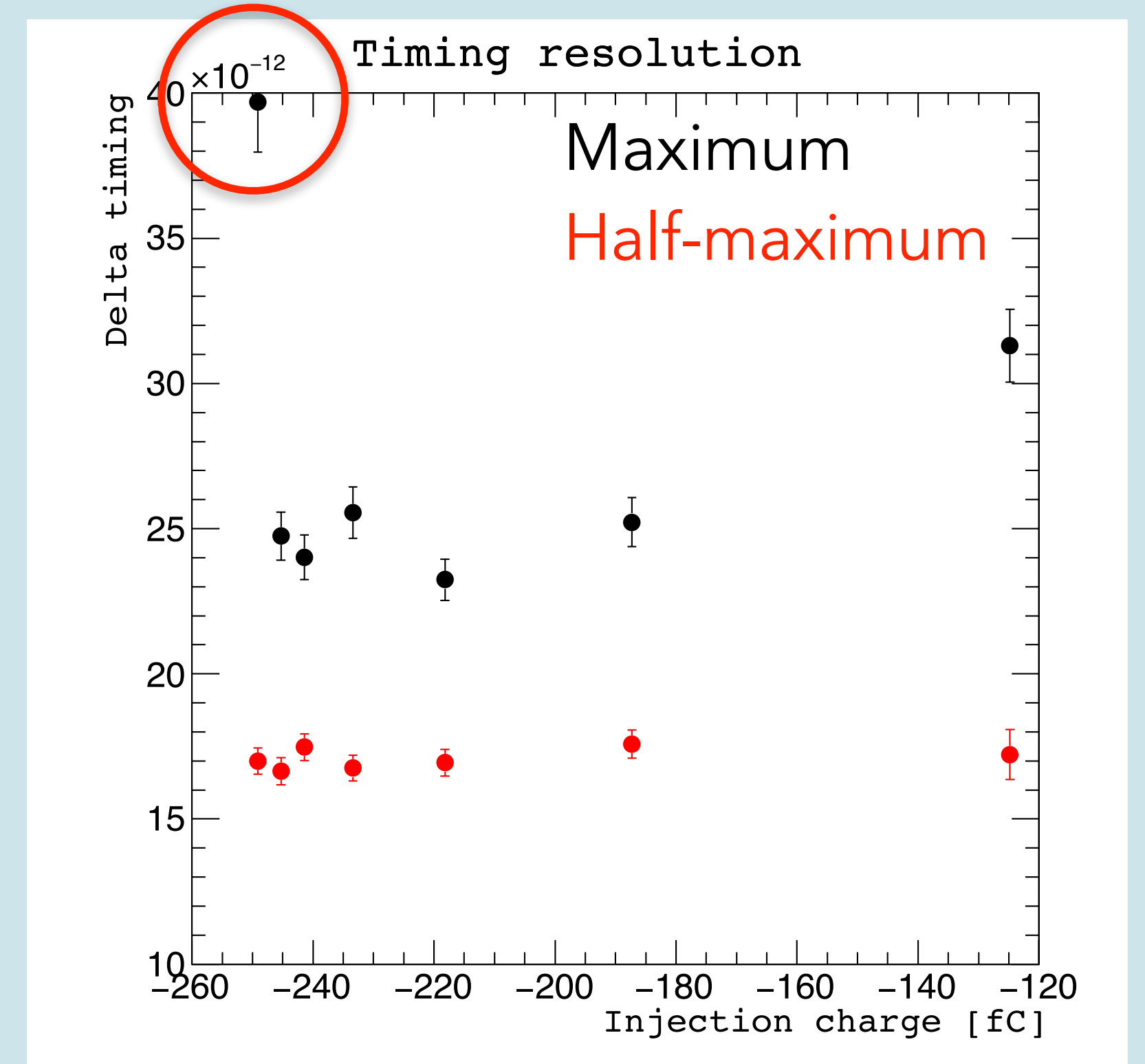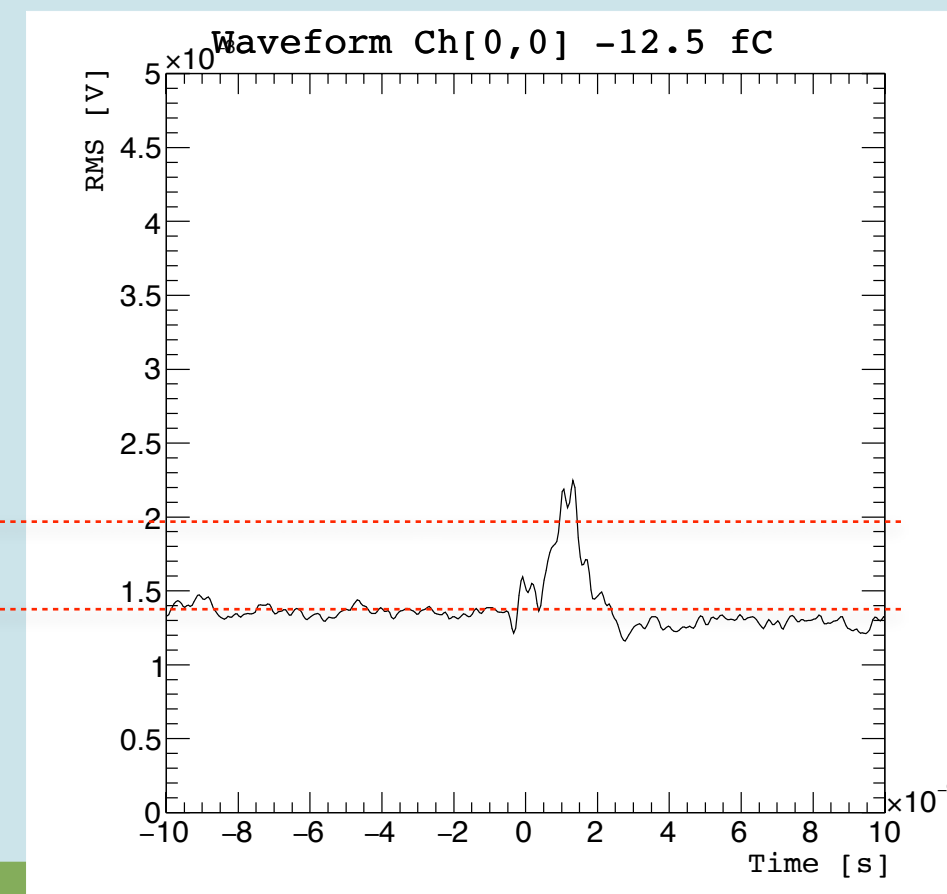
Timing resolution

- To study timing resolution, several charges are injected into (0,0) 1000 times each
- Timing distribution is fitted with Gaussian and the sigma is defined as the timing resolution
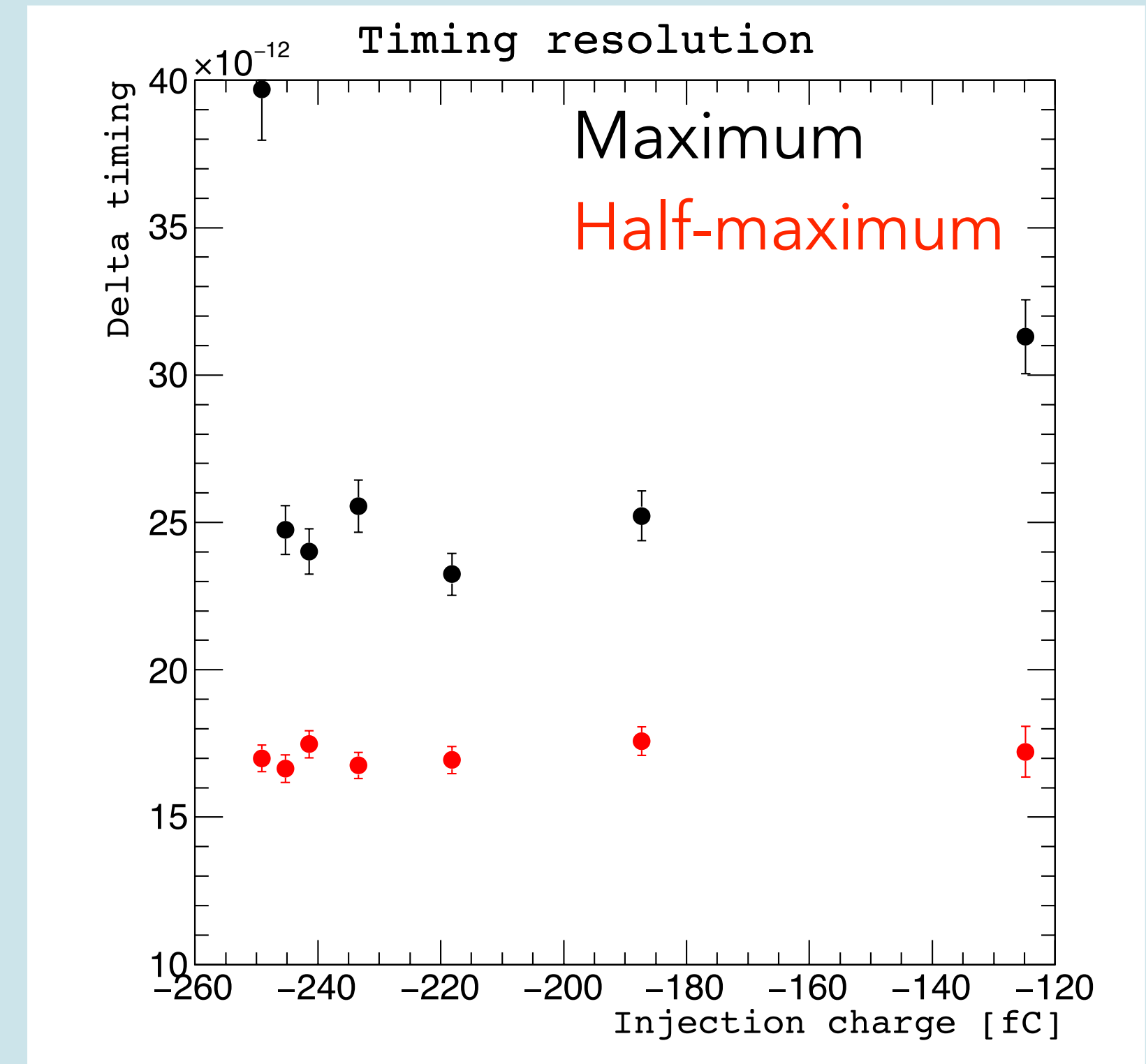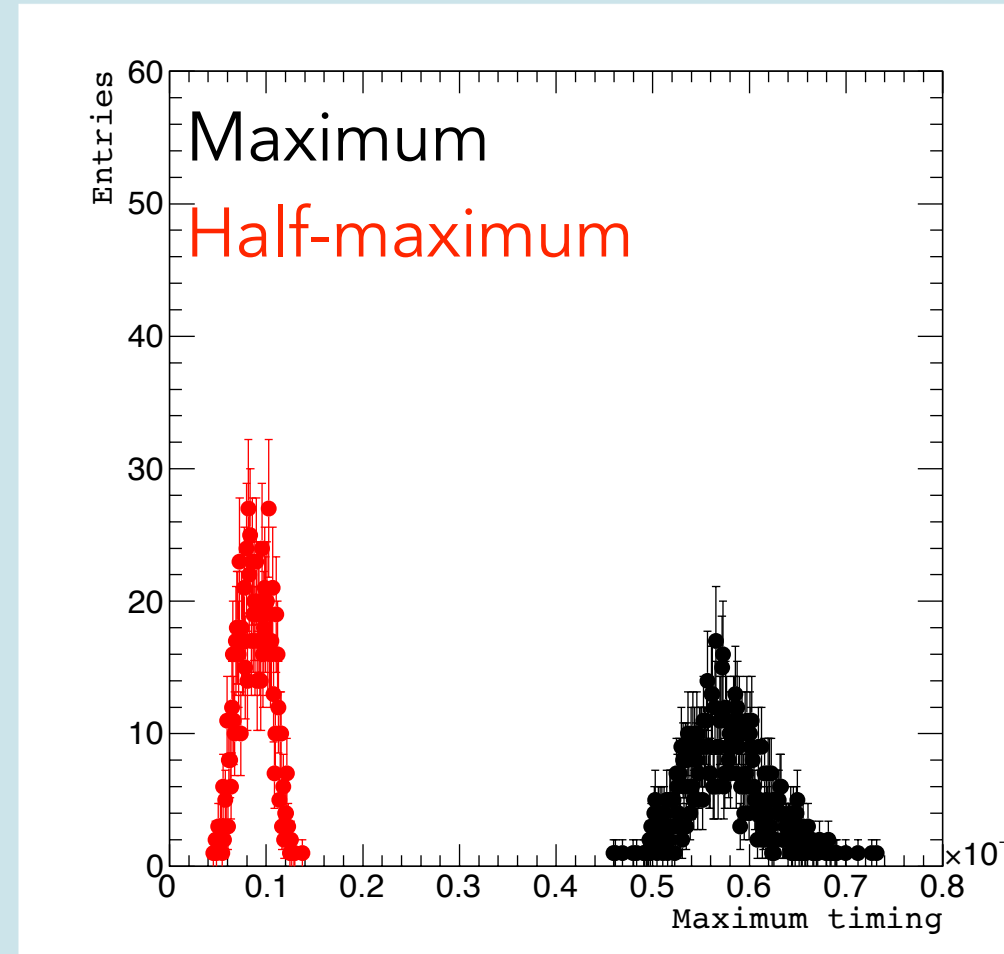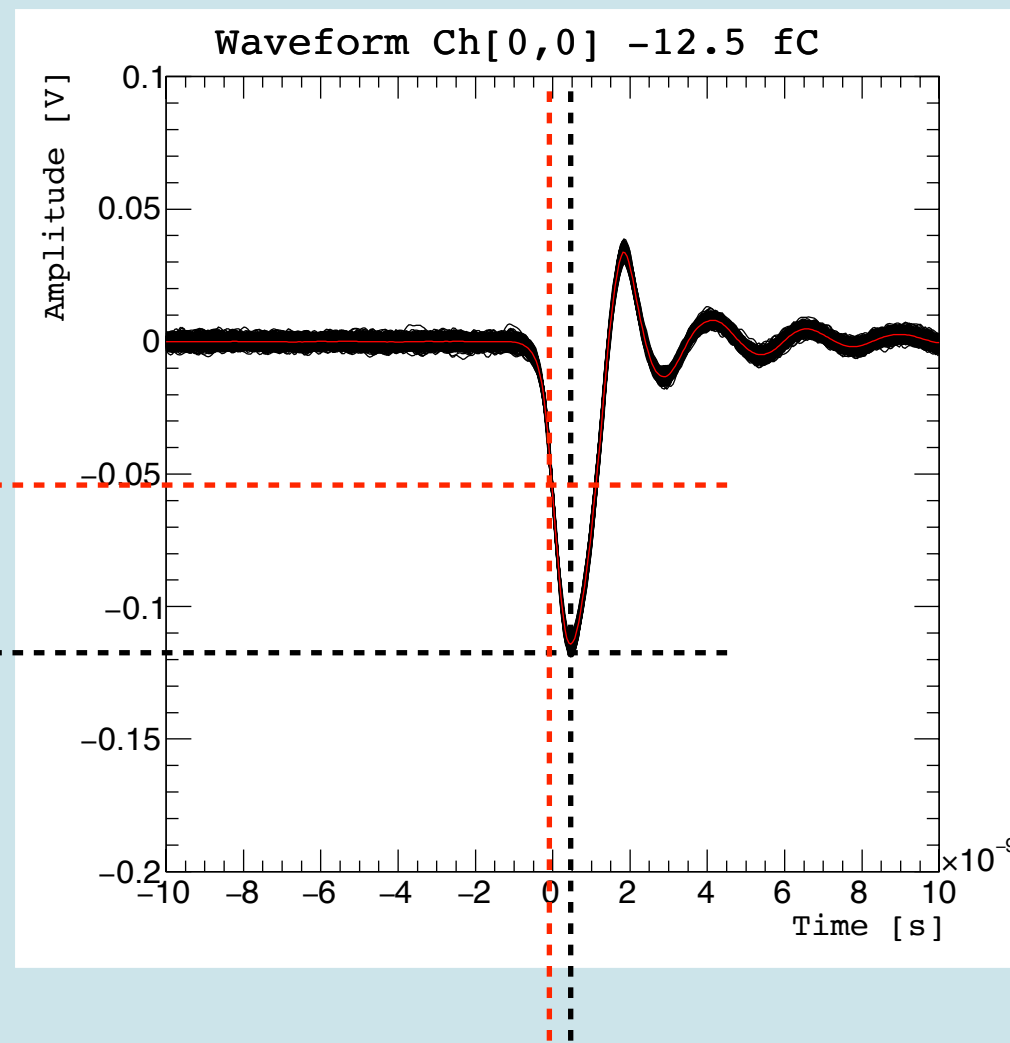
Δt ~ 17 ps (half-maximum)

Amplitude fluctuation

- The fluctuation of the signal with injecting maximum charge (24.91 fC) gets larger
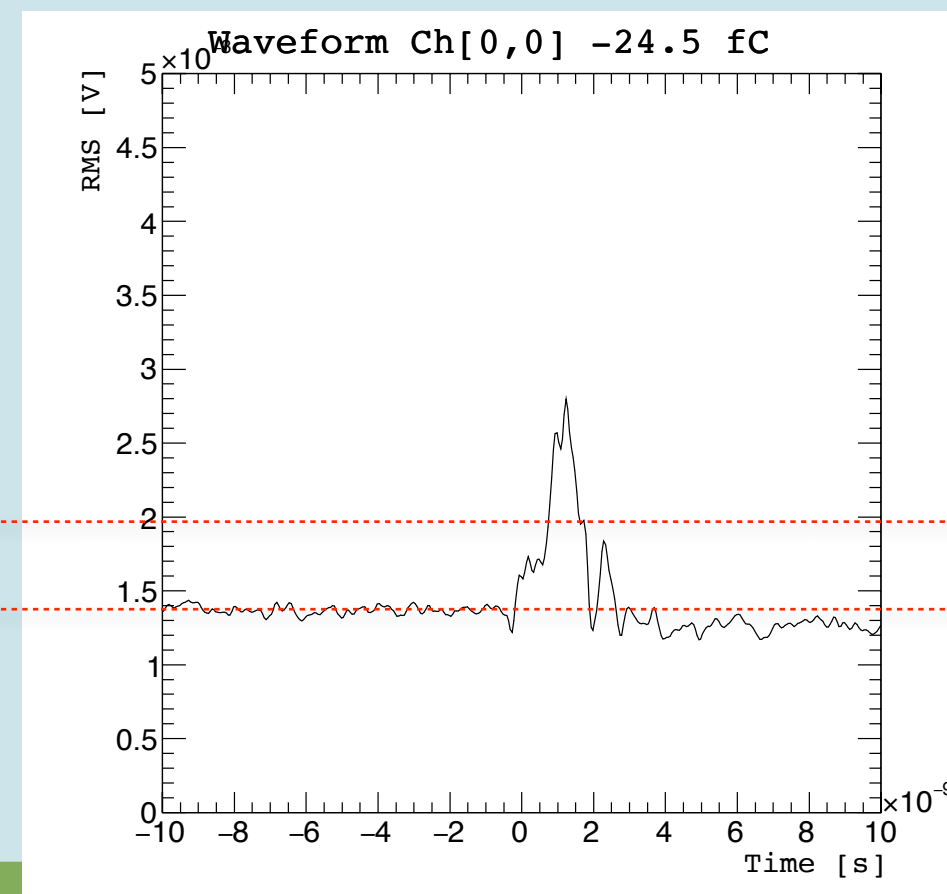
Summary

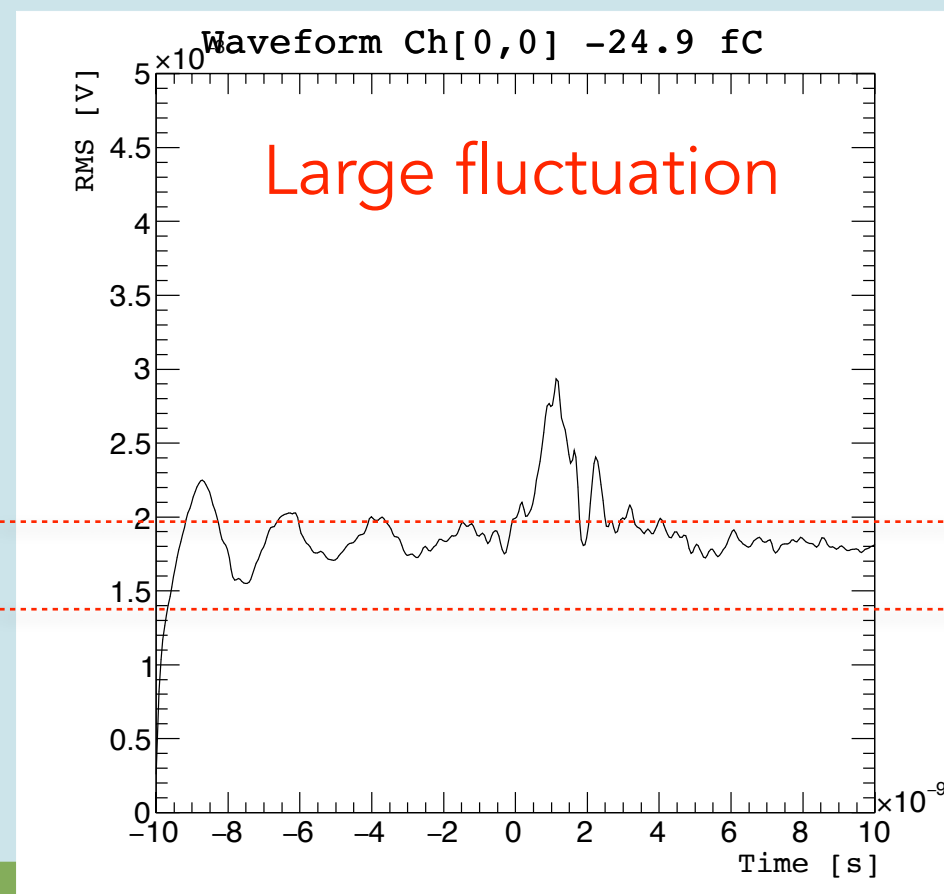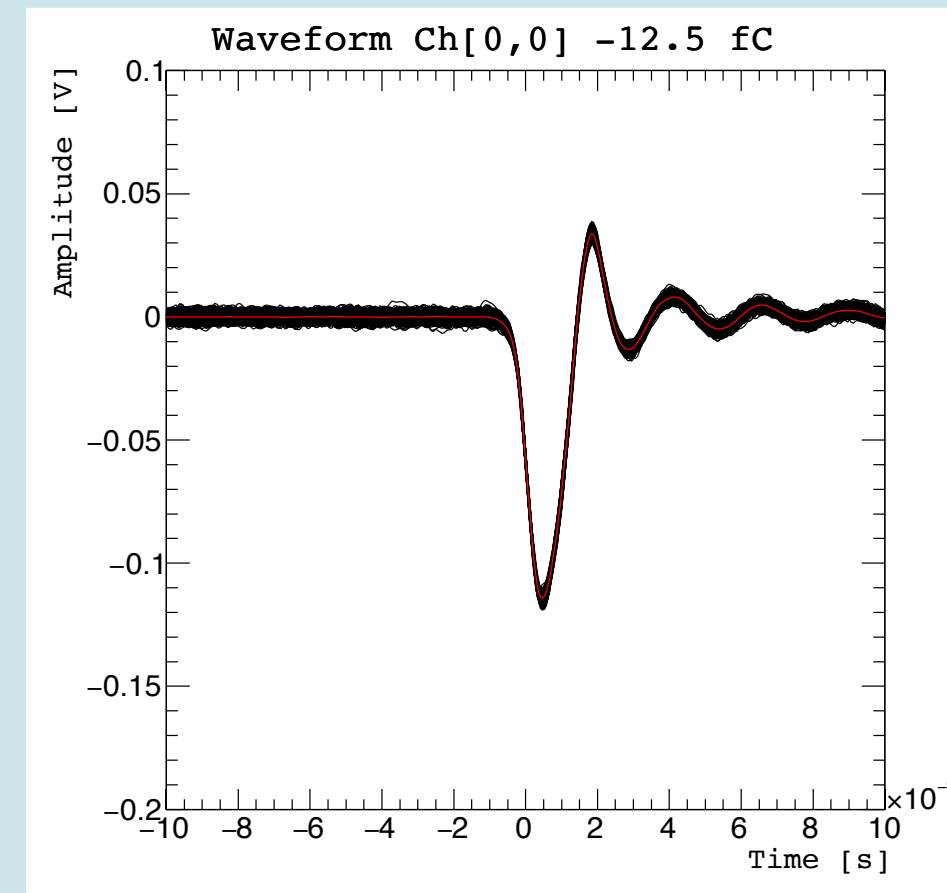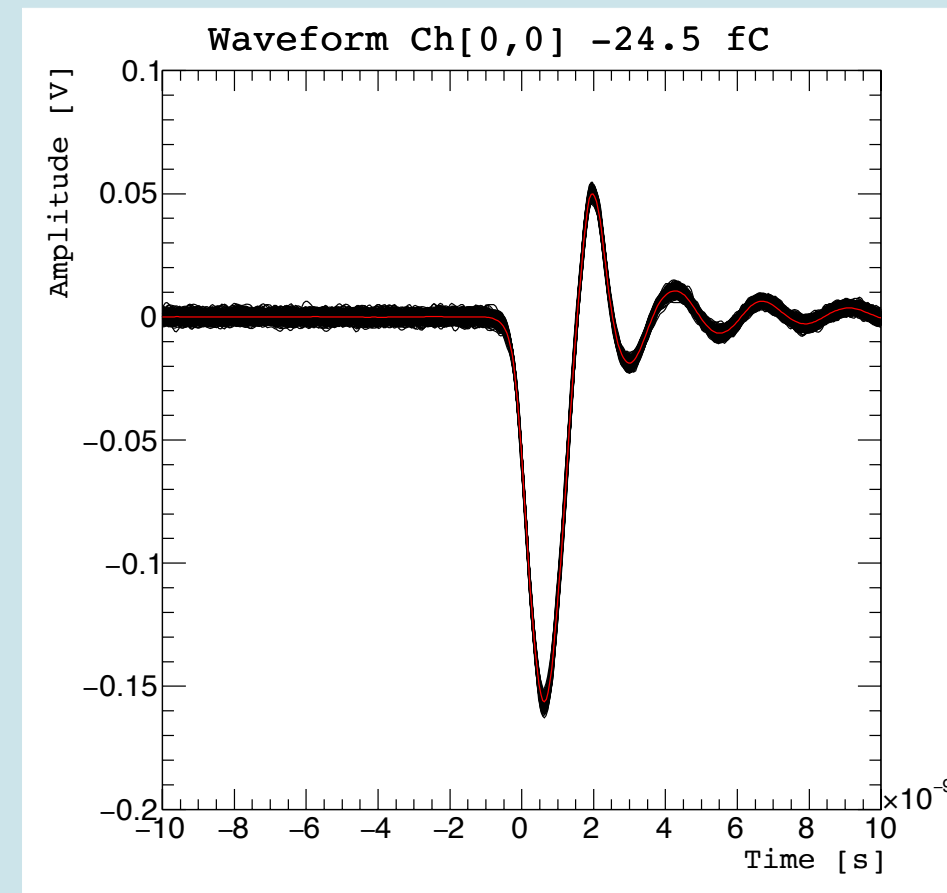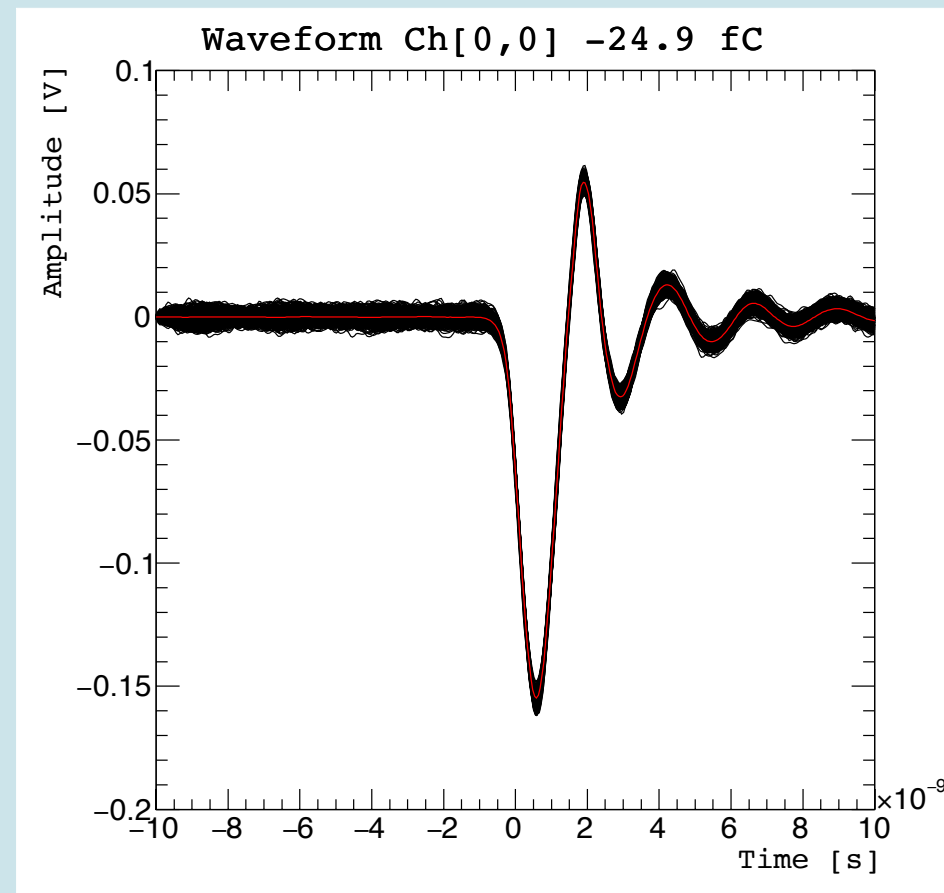- I have obtained knowledge of EICROC characterization with injection charges

- Alessandro agreed to send one EICROC0 to HU
  – An AC-LGAD will be mounted by wire bonding on the board
  – Hachiya-san is going to bring it to Japan by hand end of September

- We will be able to start AC-LGAD/EICROC R&D beginning of October
  – We borrow HV for PMT from Tsukuba
  – We have to purchase a radiation source ^{90}Sr (303 type)
  – An HU student is designing the setup support structure in CAD (build it with a 3D printer)
  – We need to buy an incubator to make a stronger and more impactful contribution to the TOF project

Setup @ HU

Constant temperature bath (20°C)

^{90}Sr

Collimator (Pb)

AMD Zynq 7000 SoC ZC706 evaluation kit

AC-LGAD **EICROC**

LEMO

HV (~-100V)

banana 4pin

LV (-3.2V)

MCX

Ch1 Ch2 Ch3 Ch4

SHV

HV (-4.3kV)

MCP-PMT

SMA

50Ω

Ethernet

Ethernet

Oscilloscope

Windows 11