Ledge Effect Identification

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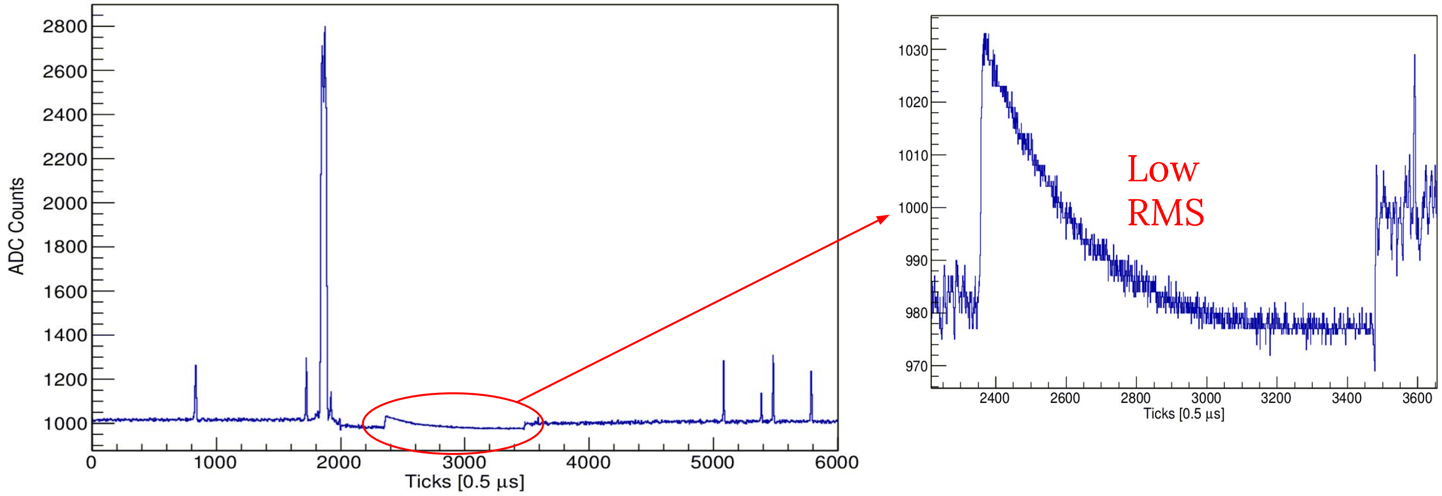
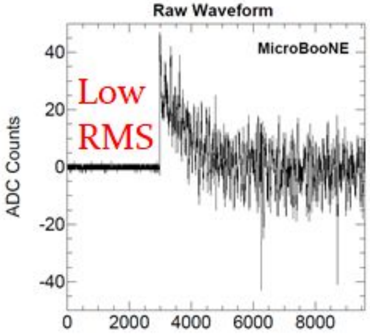
1/23/2018

Example of the abnormal waveform

Run 5194 Channel ID 7341

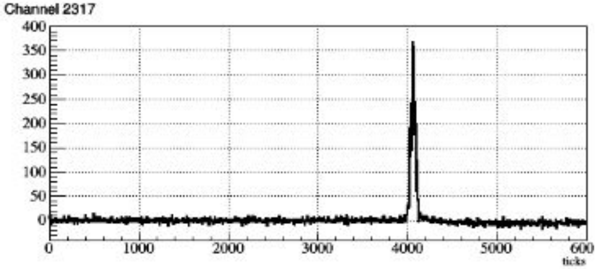


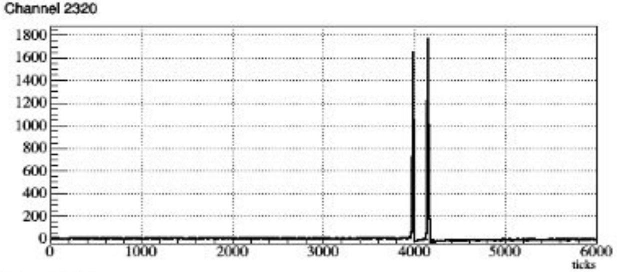


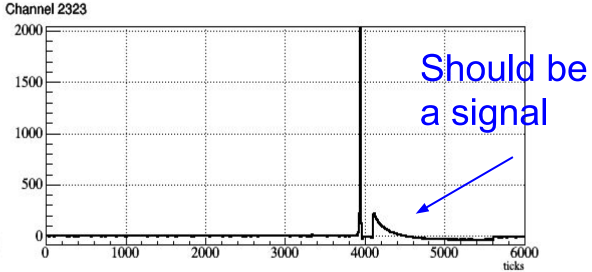
MicroBooNE

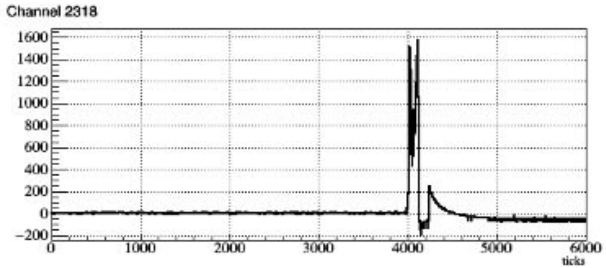
- ❖ Left: Ledge Effect, reported by Tom Junk on 9/18, see https://indico.fnal.gov/event/16526/session/34/contribution/82/material/slides/0.pdf (page 25)
- ❖ In the ledge region, the noise level seems to be reduced
- ❖ While not for the region before the ledge such as in uBooNE (preamp saturation)

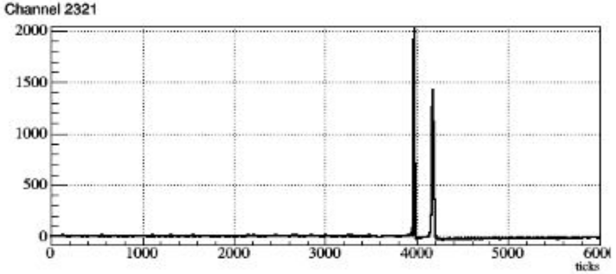
Adjacent channels of “ledge”



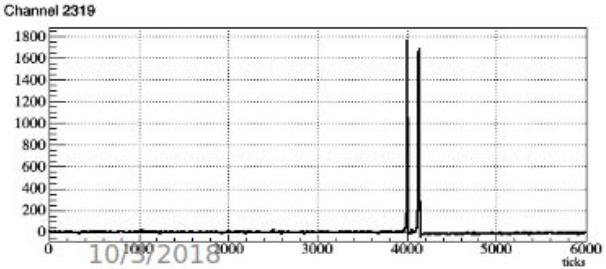


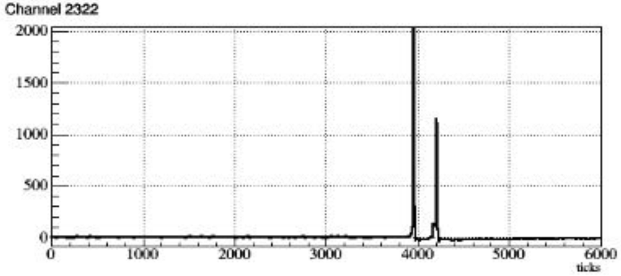






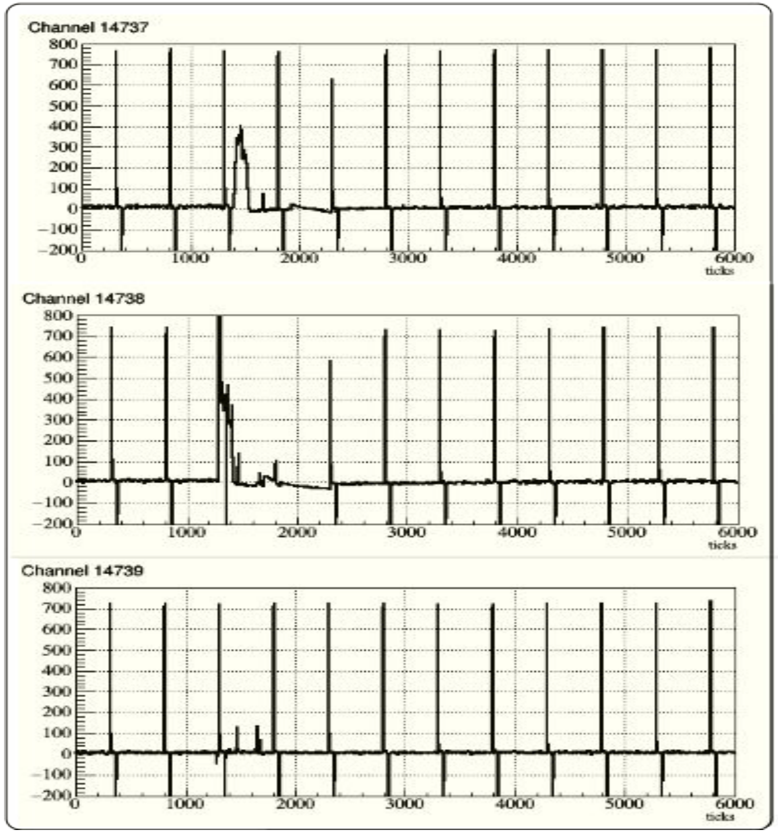
Real signal could be suppressed by ledge effect





Example of ledge in pulser data

- ❖ A suppression of pulser signal is also observed
- ❖ The larger the primary charge is, the shorter delay time

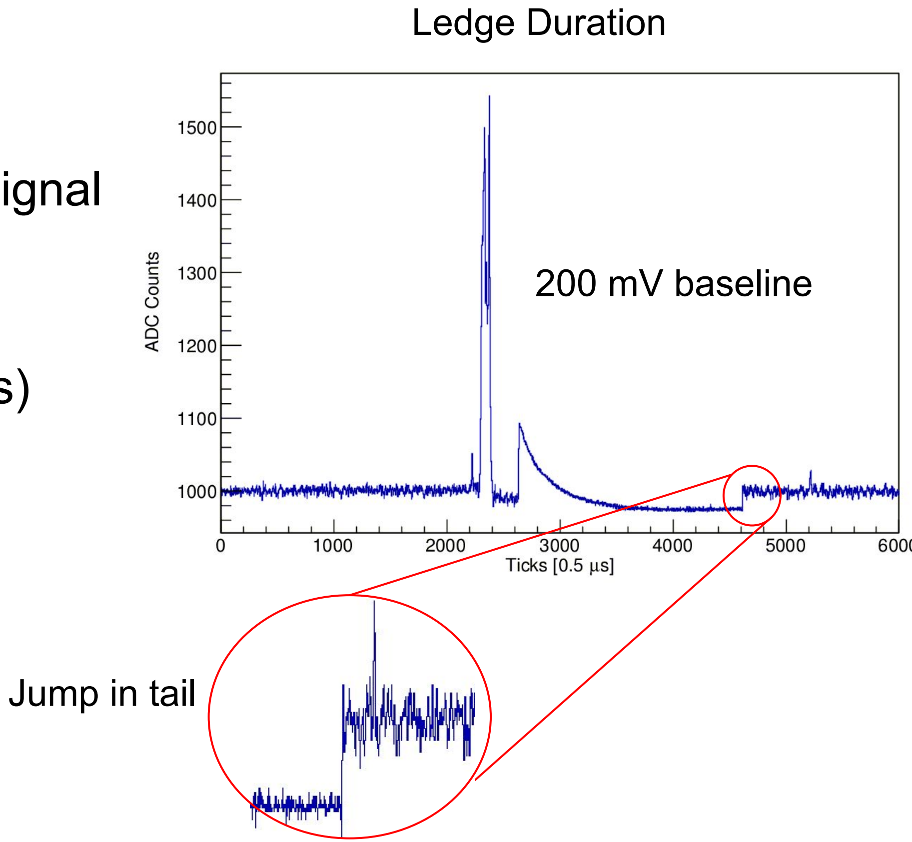


Two baseline configurations

- The FE ASIC baseline is programmable
  - 200 mV: a lot of waveforms with ledge effect were identified, this configuration can be used to study the characteristics of the ledge effect
  - 900 mV: The value of the baseline was changed since run 5177, the ledge effect is significantly suppressed

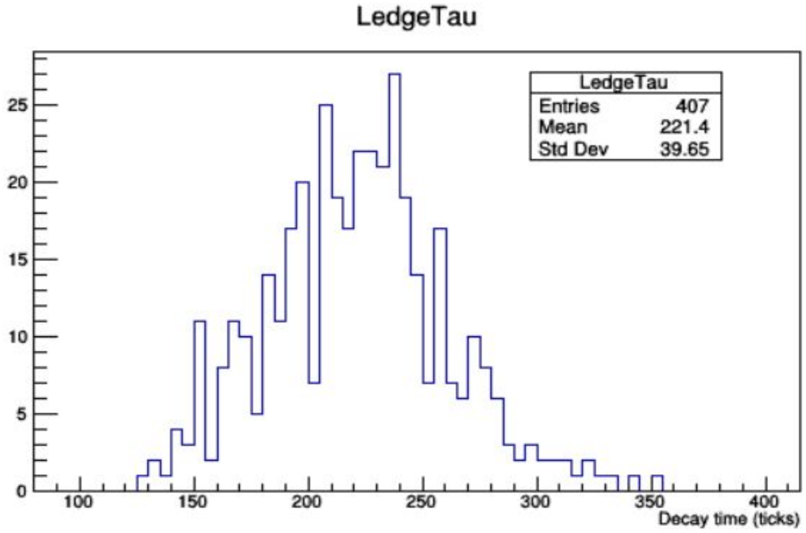
Characteristic of the ledge effect

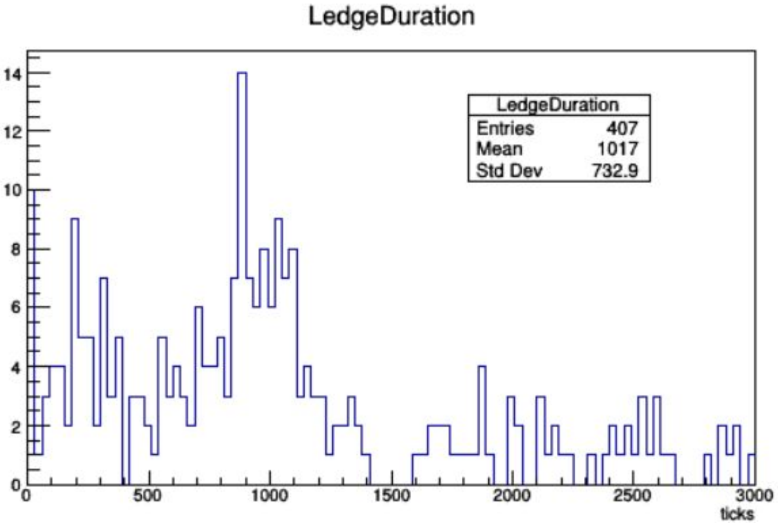
- It is observed after a relative large signal
- Close to the baseline
- Sharp edges
- Continuously decreasing (τ ~ 100 μs)
- Relative small noise



Based on data with 200mV FE baseline

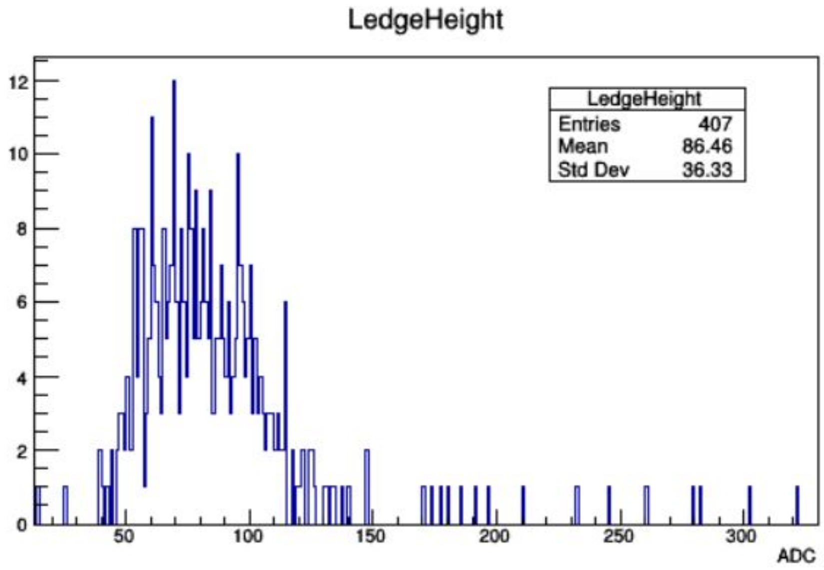
- ❖ The ledge duration has a mean decay time of 110 μs
- ❖ The duration of the ledge has a wide distribution

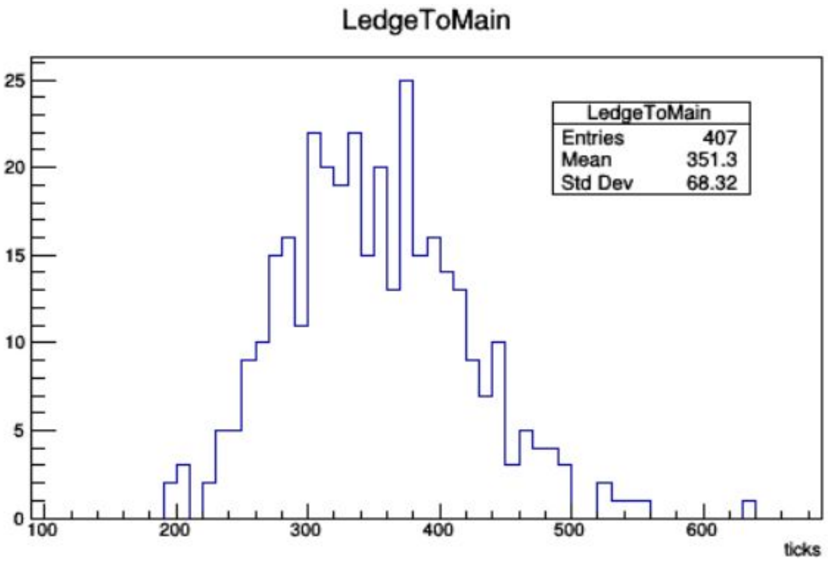




Based on data with 200mV FE baseline

- ❖ The ledge has a mean height of ~80 ADC
- ❖ The mean time from the main pulse to the ledge is about 175 μs





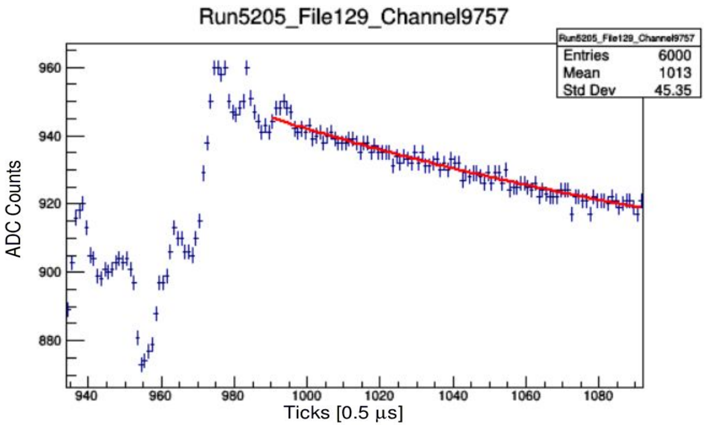
Identification of the ledge

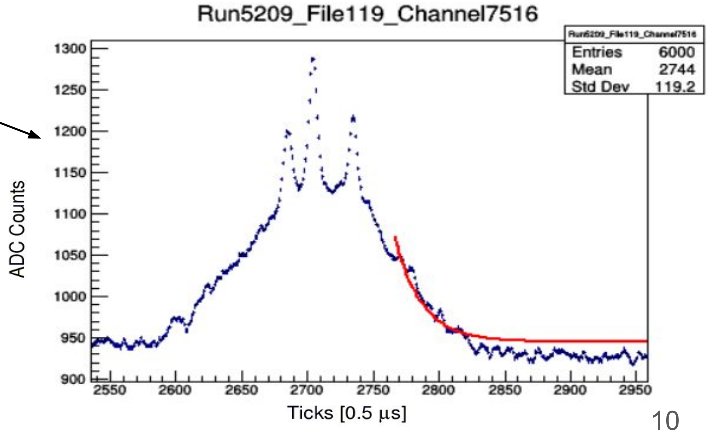
- Step 1
  - Rebin the waveform x5
    - The ledge has small fluctuations (<2 ADC compared to 4 ADC in normal regions)
    - A x5 rebin can reduce the fluctuations to less than 1 ADC in the ledge region
- Step 2
  - Find a continuously decreasing region with at least 20 bins (100 ticks) in the rebinned waveform

  - If the i-th bin is accidentally larger than the i-1 bin and if the i+1 bin is smaller the i-1 bin, ignore the i-th bin

Identification of the ledge

- Step 3
  - Find the start sharp edge.
    - Three ticks with continuously increasing ADC
    - The average slope is larger than 3.5 ADC/tick
- Step 4
  - Compare the ledge start with the baseline
    - If larger than 200 ADC, not a ledge
- Step 5
  - Test the decay time
    - if shorter than ~50 μs won't be tagged as a ledge



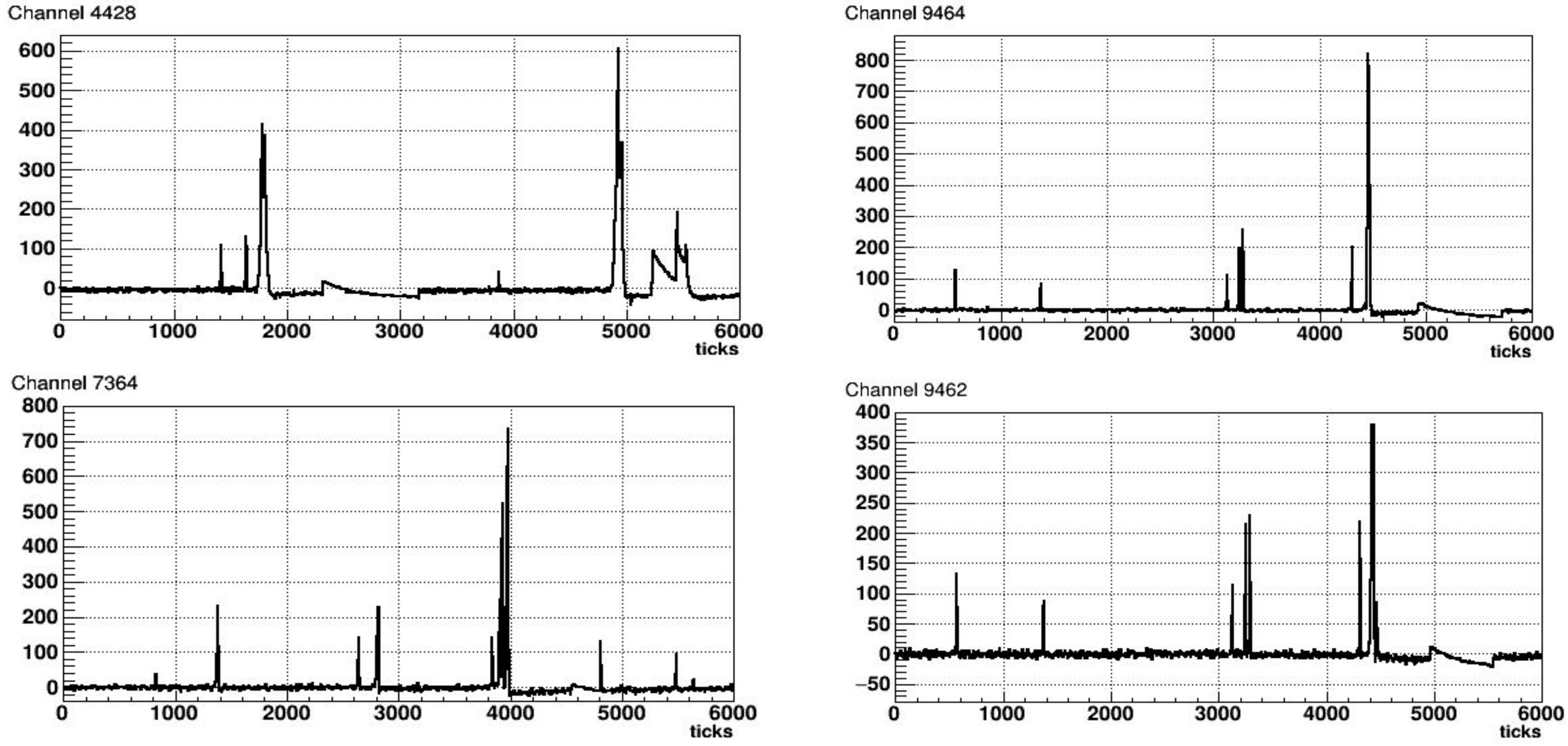


Identification efficiency and occupancy

- Efficiency (using 5 events from run 5141)
  - 58 waveforms with ledge effect were manually selected
  - The algorithm was able to identify 52 waveforms
  - We can claim an efficiency of ~90%
- Occupancy

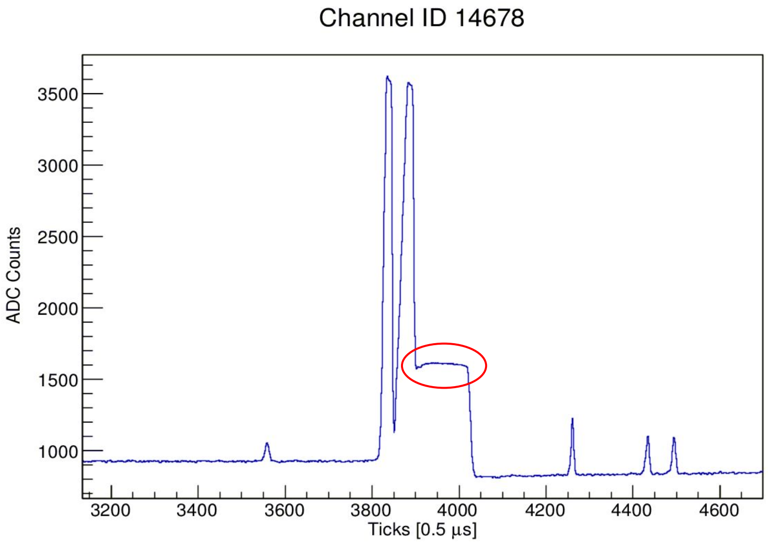
	200 mV baseline	900 mV baseline
APA 3	227 in 49 events ~0.17%	1 in 90 event ~4.1e-6
Other 5 APAs	423 in 49 events ~ 0.07%	17 in 90 events ~1.4e-5

examples of waveforms not identified by the code



Identification of the "plateau"

- ❖ As the baseline is raised, more chance to saturate ADC
- ❖ It seems to be due to a saturation of the ADC
- ❖ Step 1
  - ➢ Find a large signal (~2000 ADC above baseline)
- ❖ Step 2
  - ➢ After a large signal find a flat region of about 20 ticks (50 ADC maximum fluctuation)



Summary

- The efficiency of the ledge effect identification is calculated to be ~90%
- The ledge effect occupancy is given for the 2 different configuration of the FE baseline
- The 900 mV FE baseline configuration significantly suppresses the ledge effect
- Thanks CE experts (Veljko, Matt, Huchen, Shanshan) for very helpful discussion
- Comments and Suggestions are more than welcome. Thanks!