adc/amplitude calibration of the CAEN-V1742 board / DRS4 chip

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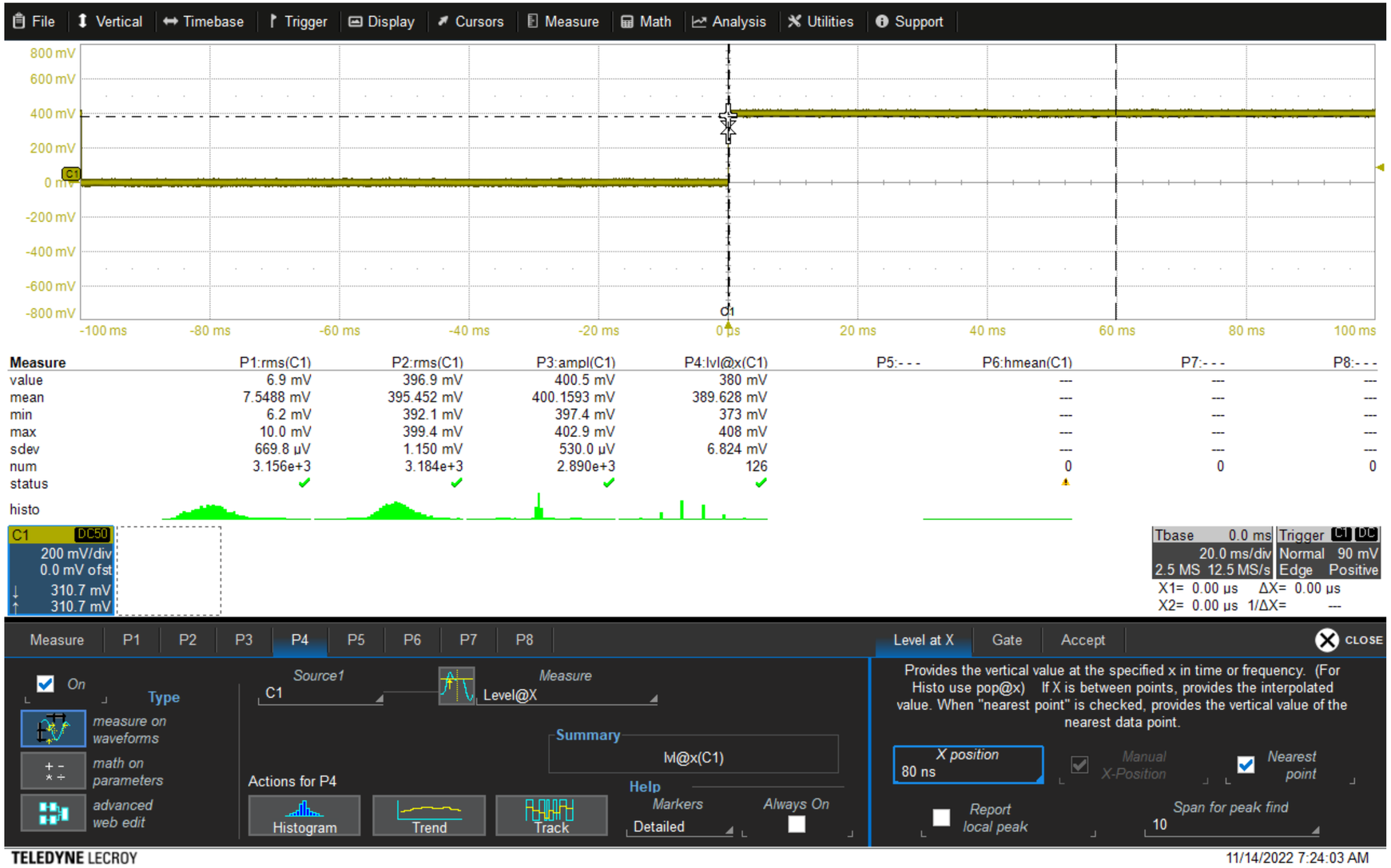
19 Jan 2023

Setup:



An example Pulse of 400 mV

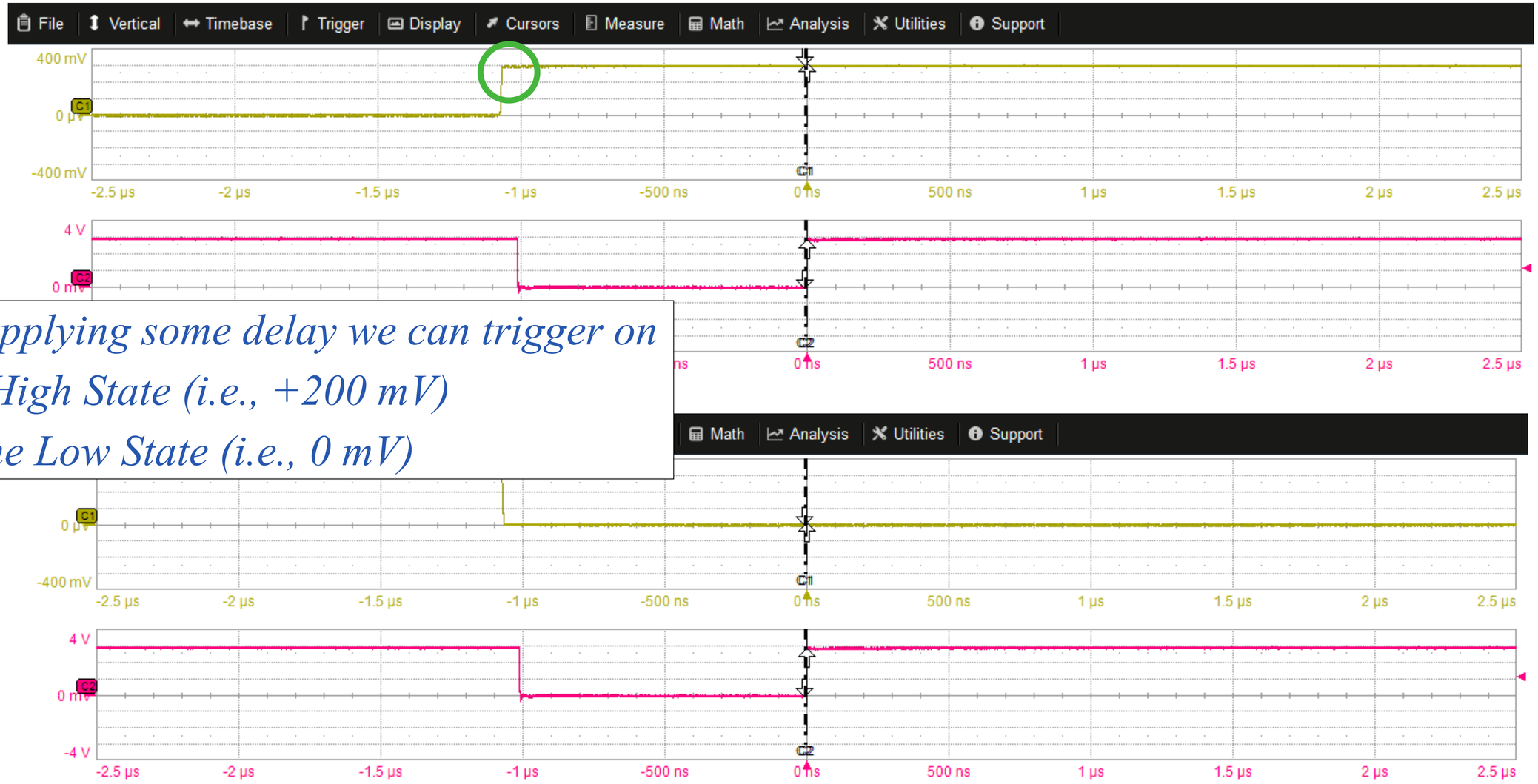
- pk-pk mean vale = 400 mV
- rms at high state = ~1.5 mV

List of Pulses used

- -300 mV
- -200 mV
- 0 mV
- 200 mV
- 300 mV

Setup:

The pulses applied for calibration



By applying some delay we can trigger on the High State (i.e., +200 mV) or the Low State (i.e., 0 mV)

Procedure:

working with ~ 1000 events, Data file = ASCII

The events does not start from a certain fixed cell ID.

However, at the end, the amplitude correction for all the cells of a channel is stored in an organised set.

Run 1 (Ch_i):

Event 0					
4	5	6	...	2	3

Event 1					
324	325	326	...	322	323

Event 2					
77	78	79	...	75	76

...

Event 999					
134	135	136	...	132	133

Run 1 (Ch_i):

Cells are organised event-by-even for a Run

(a manual check is done with 3 events to validate the code)

Event 0					
0	1	2	...	1022	1023

Event 1					
0	1	2	...	1022	1023

Event 2					
0	1	2	...	1022	1023

...

Event 999					
0	1	2	...	1022	1023

Procedure:

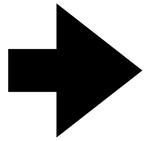
Number of events= ~ 1000 events, Data file = ASCII

The events does not start from a certain fixed cell ID.

However, at the end, the amplitude corrections will be presented in an organised set.

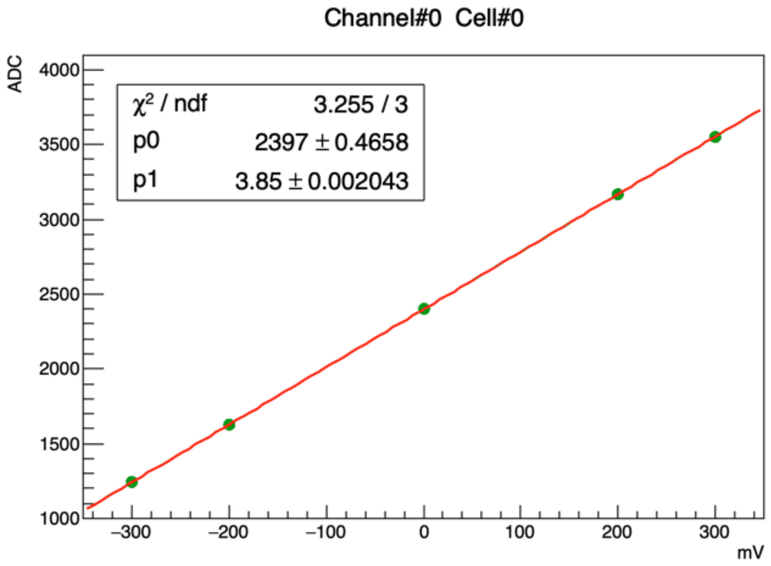
Run 1 (Ch_0), X mV:

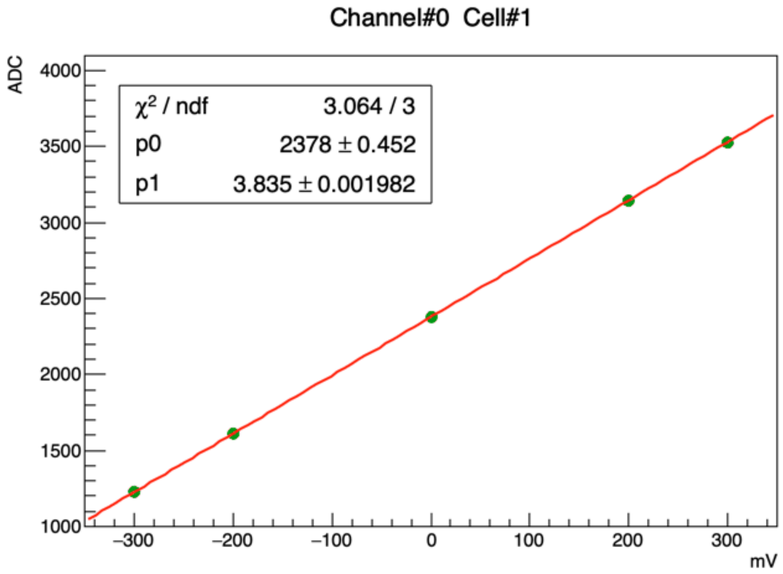
Event 0		Event 1		Event n		Run 1 (Ch_i), X mV
0	+	0	+	0	=>	adc_ave of cell#0
1	+	1	+	1	=>	adc_ave of cell#1
3	+	3	+	3	=>	adc_ave of cell#2
:		:		:		:
1022	+	1022	+	1022	=>	adc_ave of cell#1022
1023	+	1023	+	1023	=>	adc_ave of cell#1023

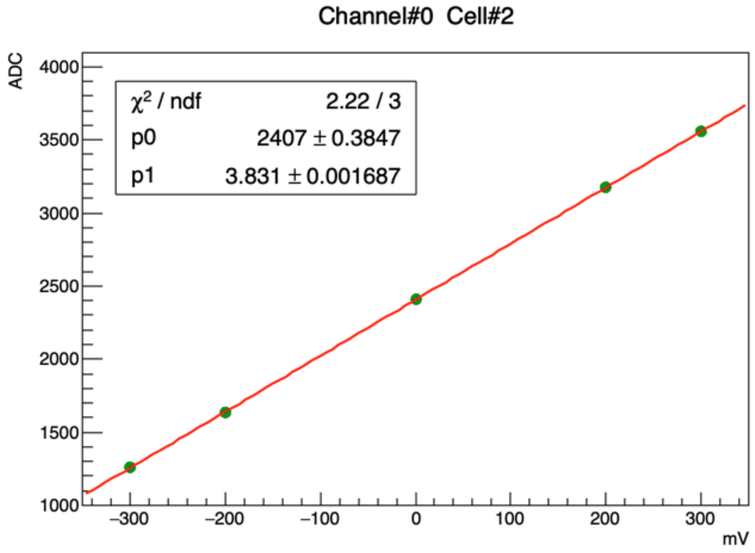


Run 1 (Ch_i)
adc_correction of cell#0
adc_correction of cell#1
adc_correction of cell#2
:
adc_correction of cell#1022
adc_correction of cell#1023

Ch#0 :: Calibrating each Cell



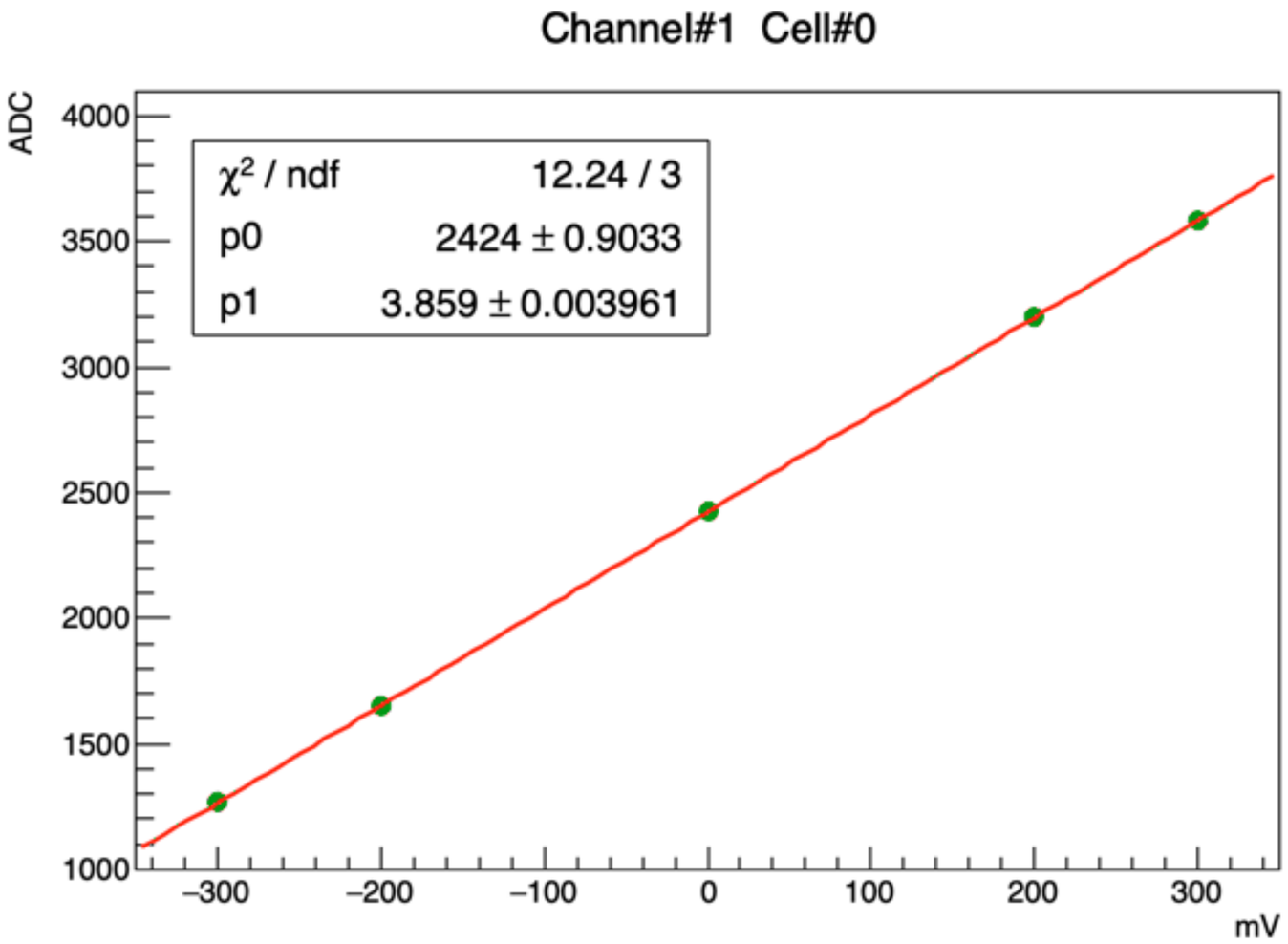




And so on ....

Calibration plots for all 1024 cells are printed for documentation

Ch#1 :: Calibration example



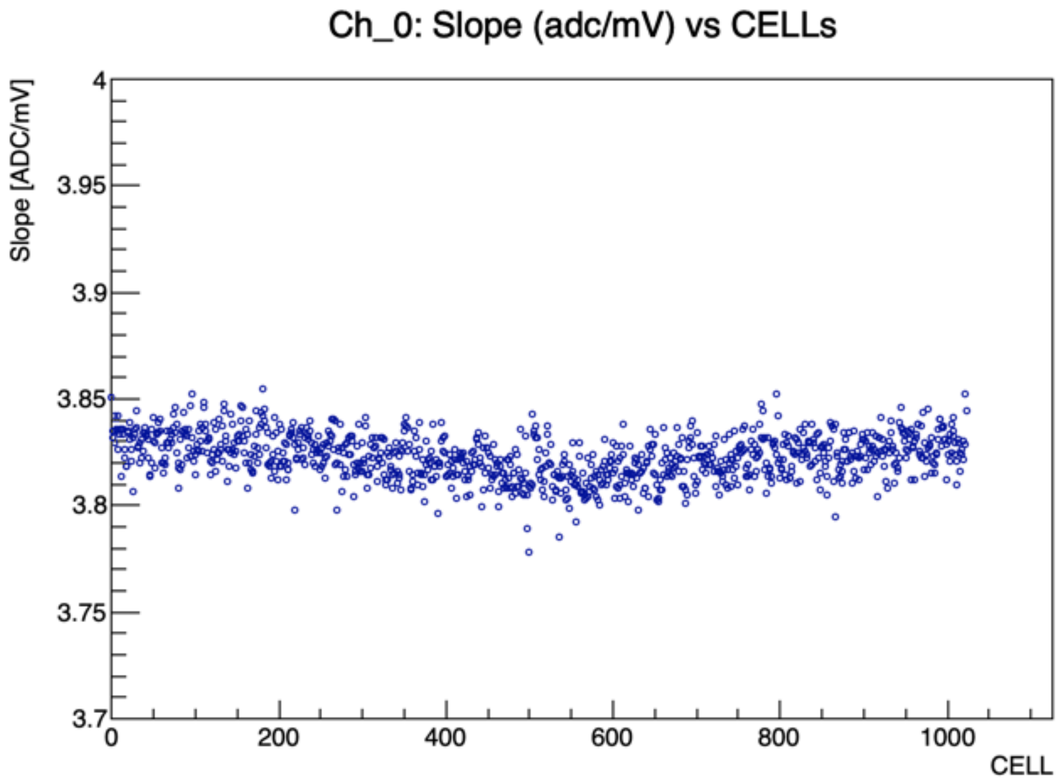
A movie showing calibration for the first 24 cells of channel#1

Results: Ch#0 :: Slope (adc/mV) and Offset (adc) profile

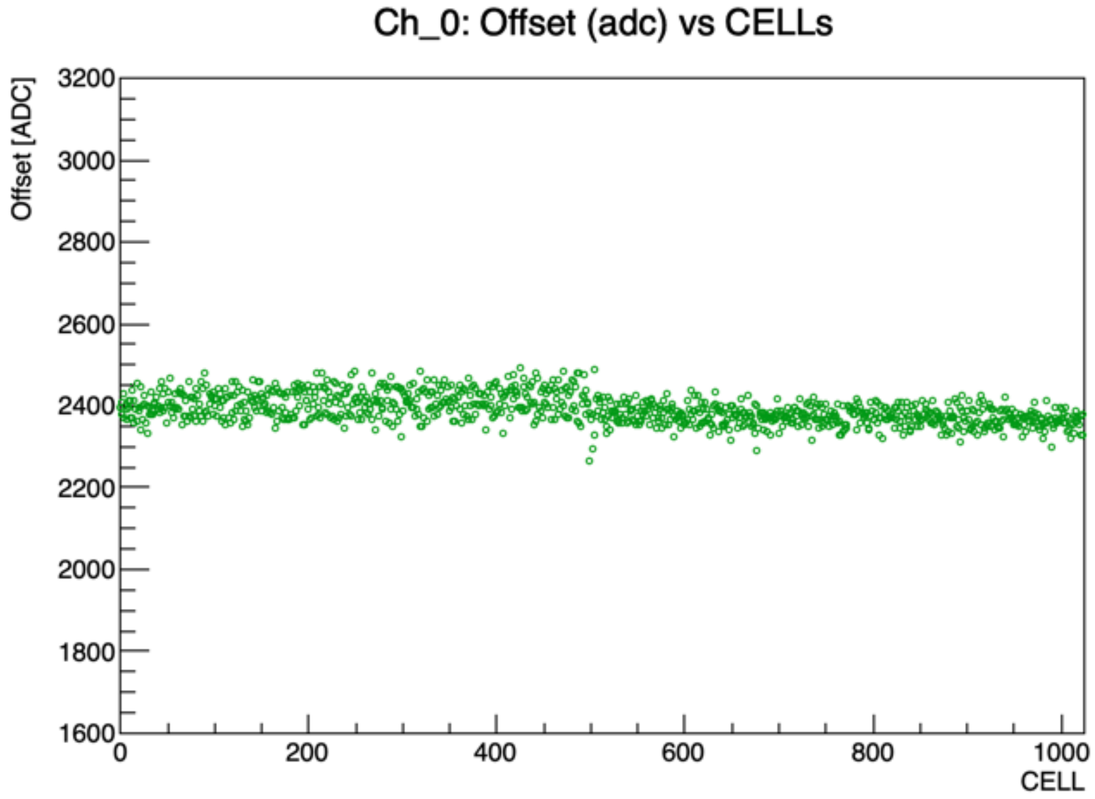
All results are from Channel#0

averaged over 1000 Event

Slope



Offset

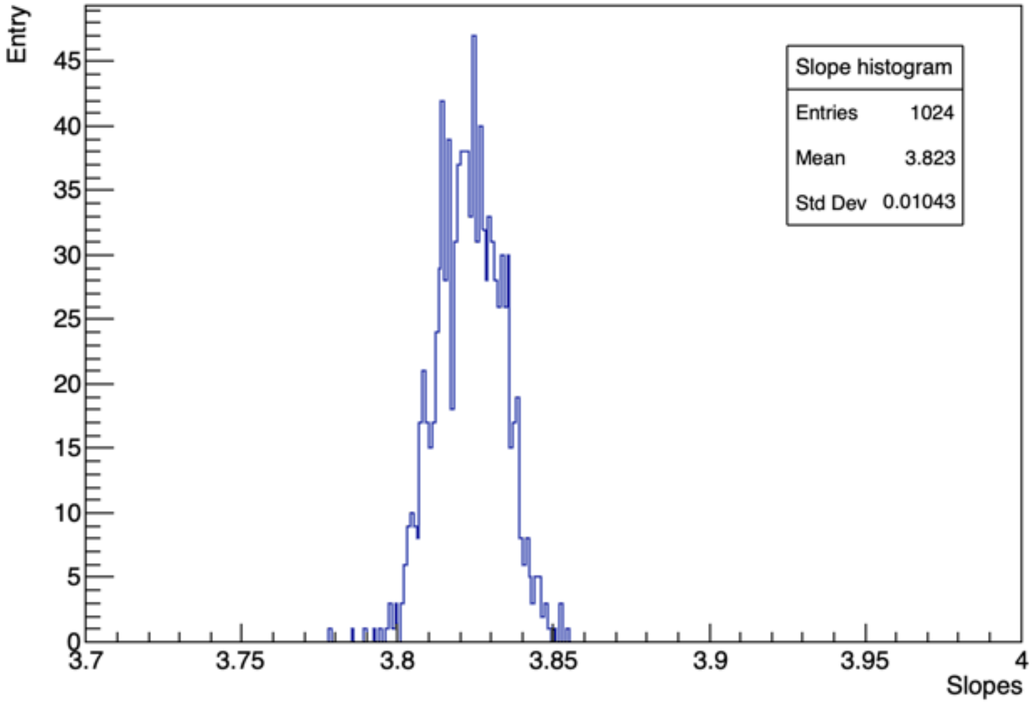


Results:

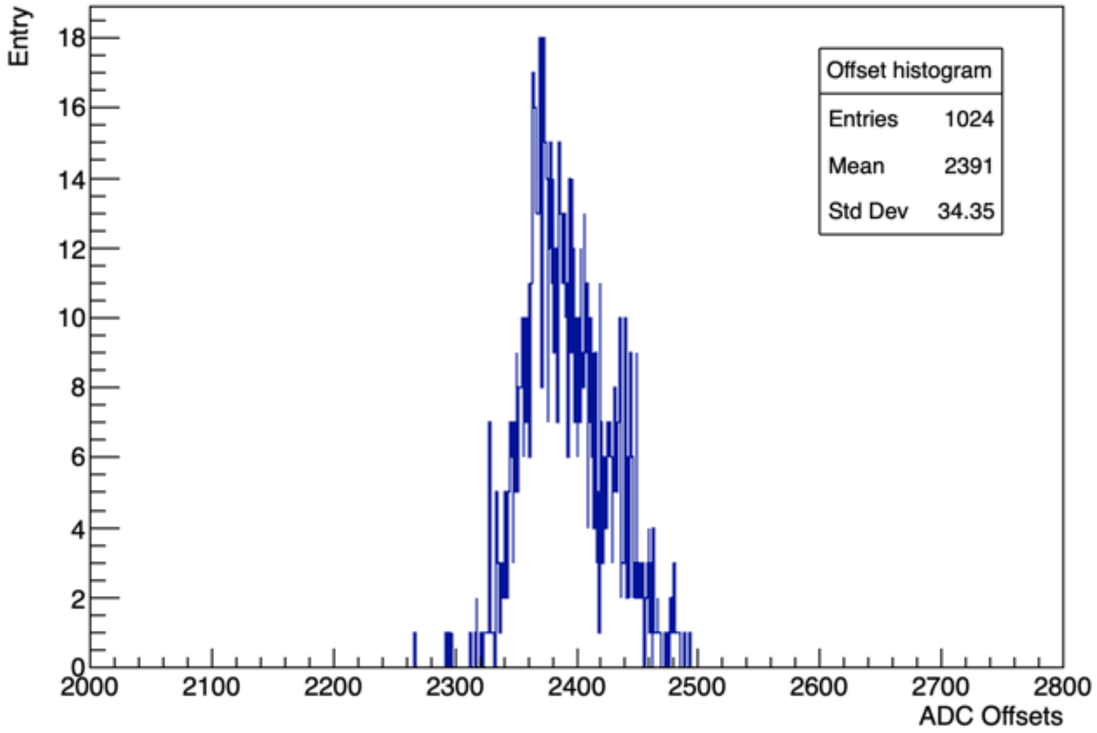
Ch#0 :: Slope (adc/mV) and Offset (adc) histogram

averaged over 1000 Event

Slope



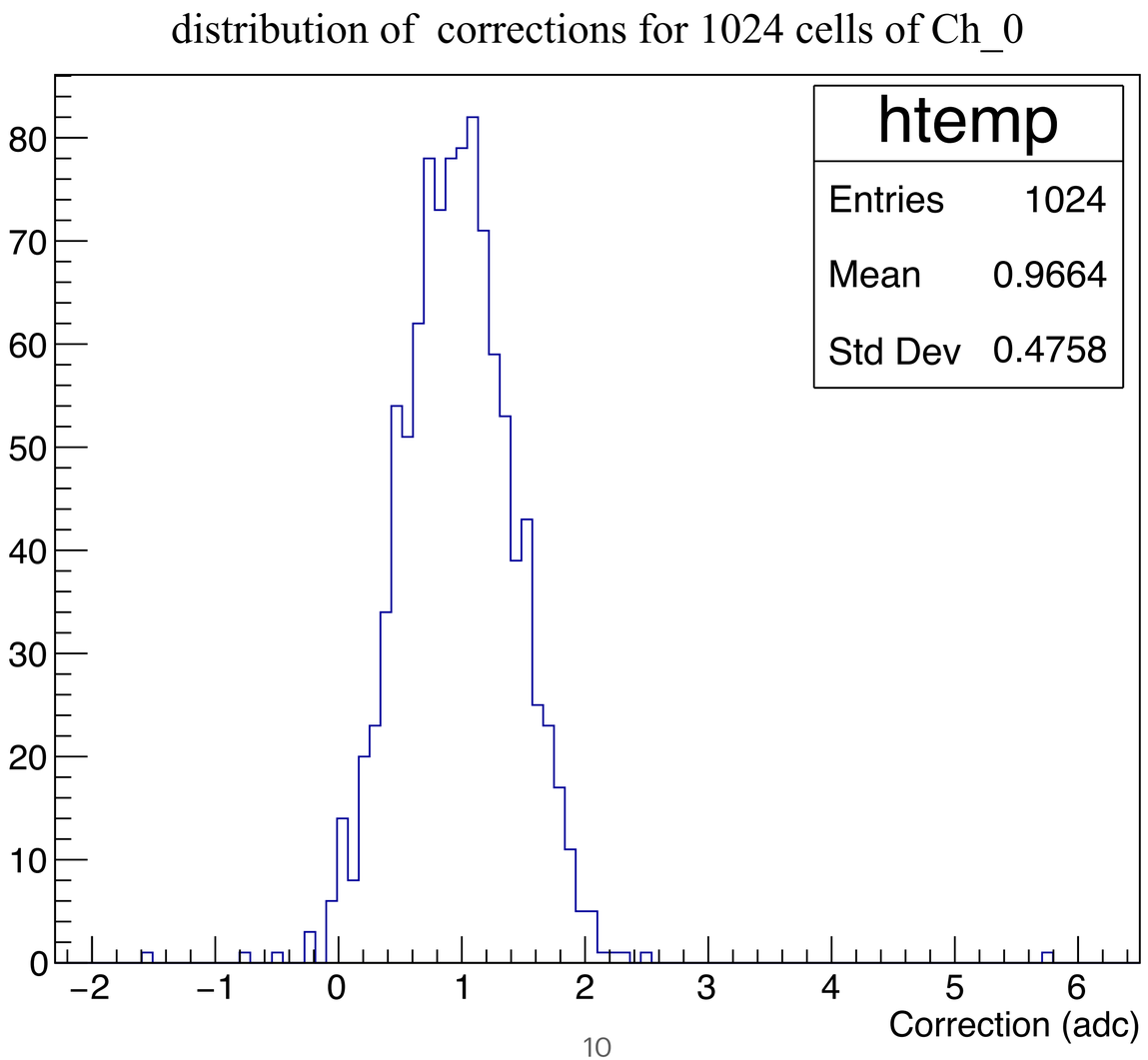
Offset



Results:

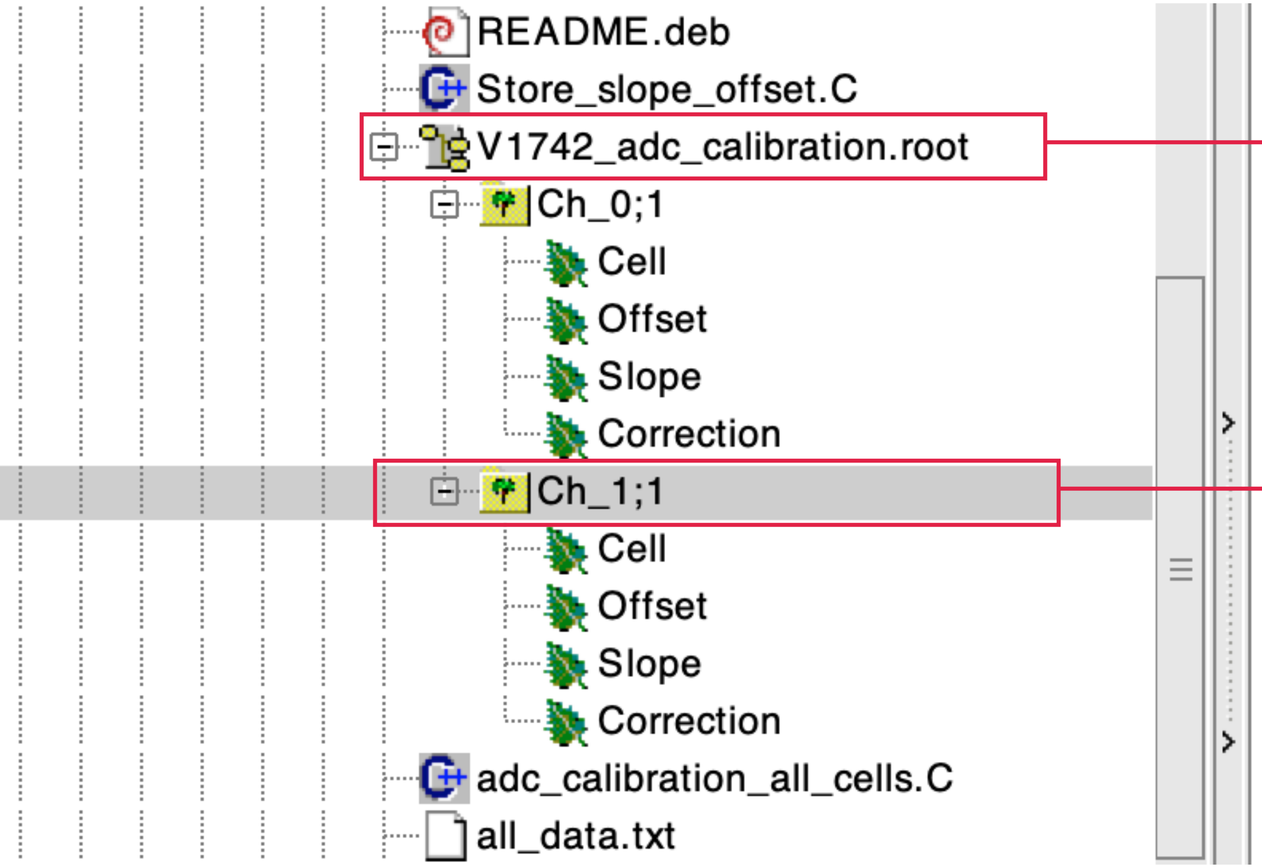
Ch#0 :: Correction (adc) Calculation

$$(\text{correction})^{\text{cell\#0}} = (\text{fit\_offset})^{\text{cell\#0}} - (\text{adc\_0mV})^{\text{cell\#0}}$$



Incorporating calibration to the Analysis Framework

All adc-calibration related data will be contained in V1742_adc_calibration.root

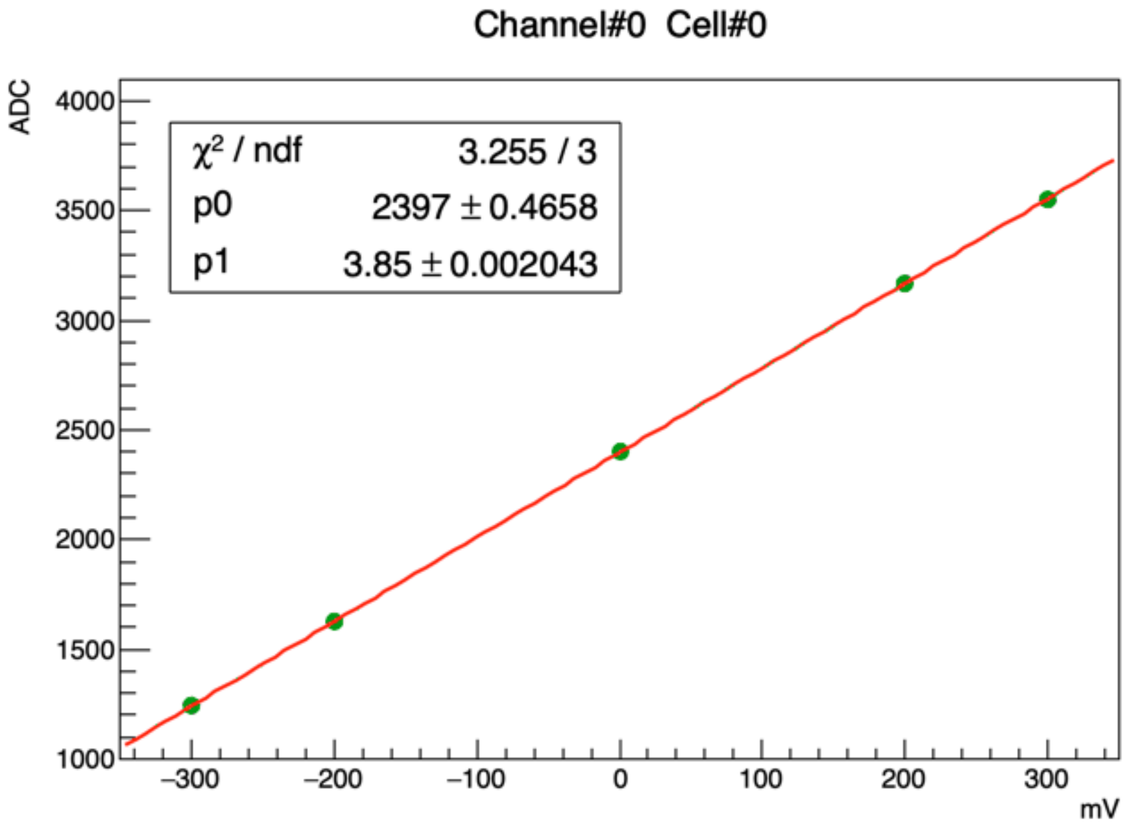


TFile contains all ‘Channels' in TTrees

Channels contain in TBranch:
slope, offset, corrections

In ‘adc' or ‘mV,' you have it as you like it

Checking for any bias in the calibration



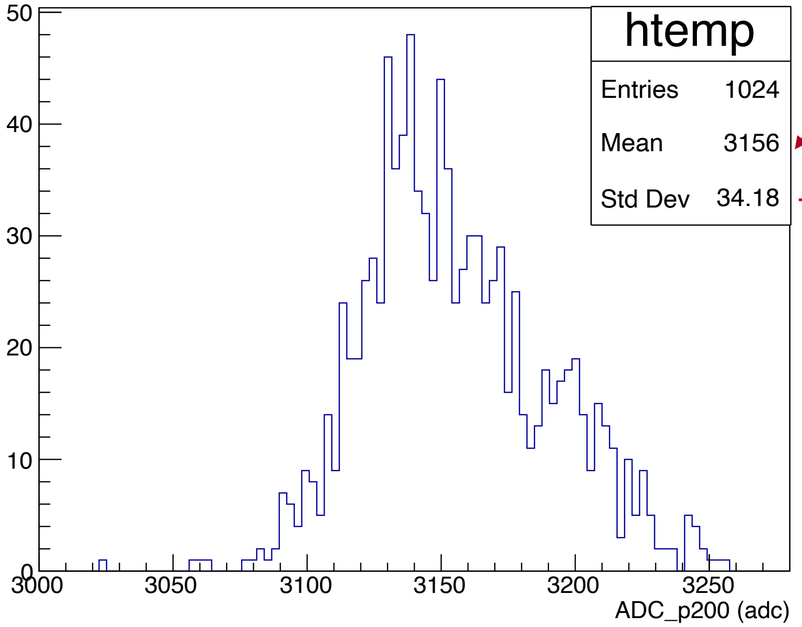
$$(\text{residual})_{X\_mV} = (\text{mean\_adc})_{X\_mV} - (\text{fit\_adc})_{X\_mV}$$

cell#i

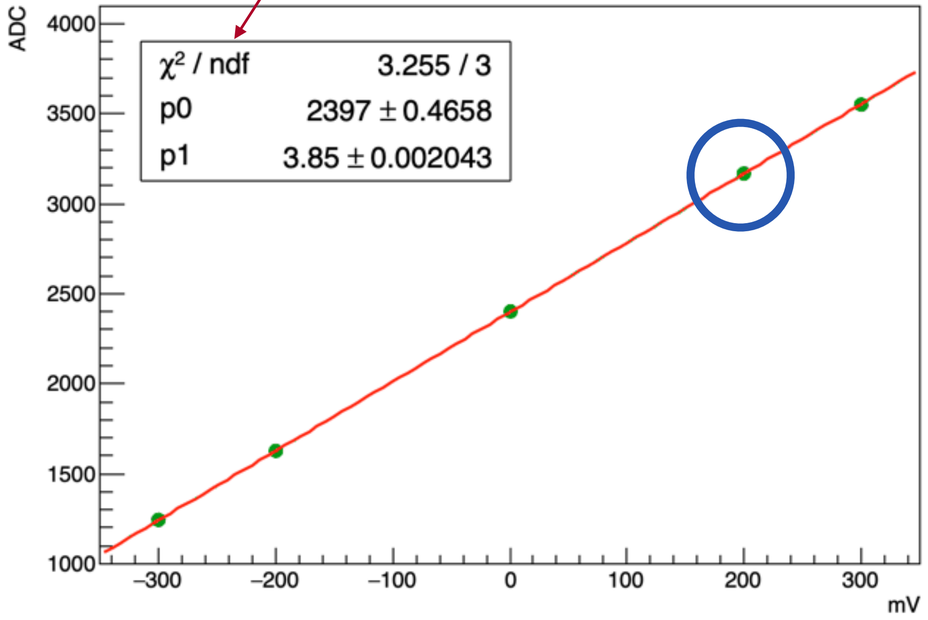
Checking for any bias in the calibration

$$(residual)_{200\_mV} = (mean\_adc)_{200\_mV} - (fit\_adc)_{200\_mV}$$

cell#0

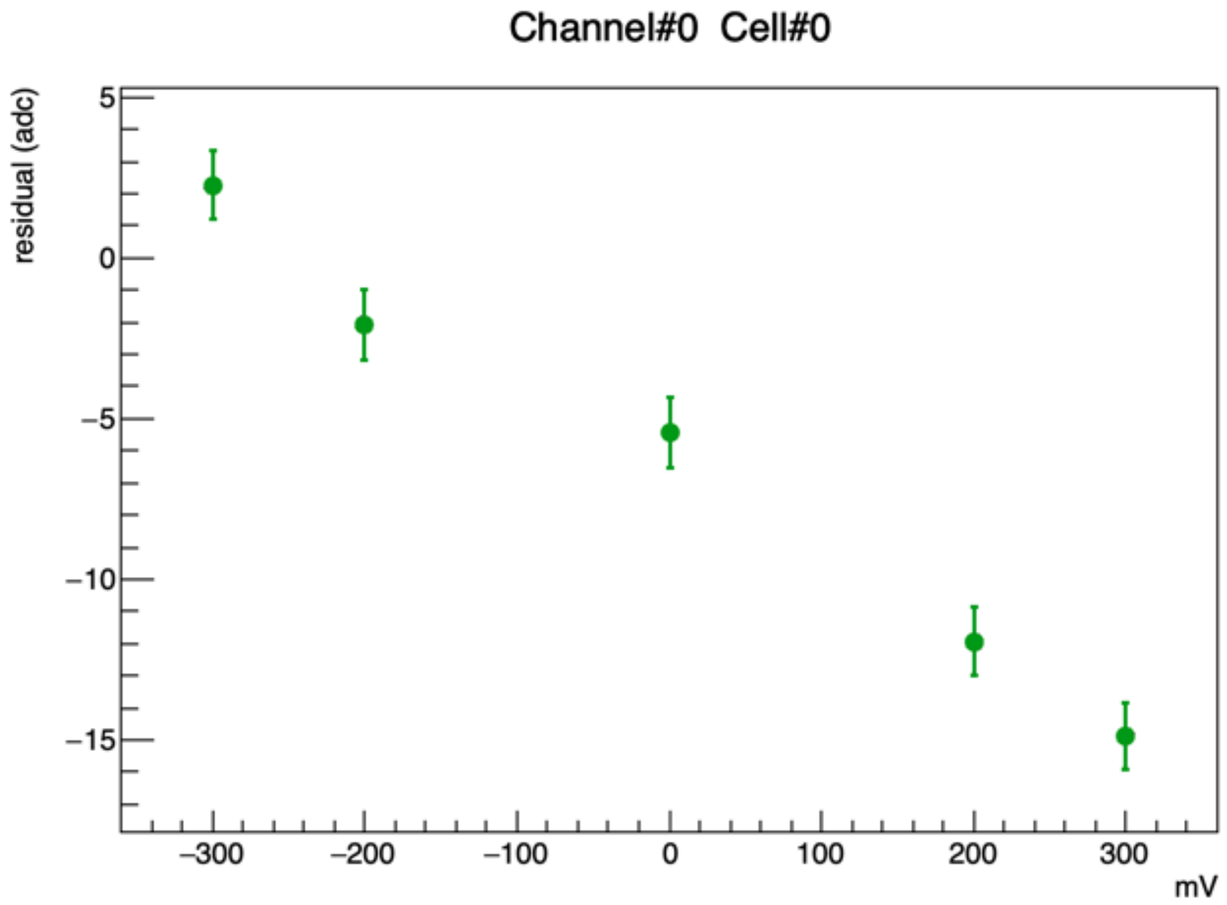


error = $\sigma/\sqrt{1024}$



Checking for any bias in the calibration

$$(\text{residual})_{X\_mV} = (\text{mean\_adc})_{X\_mV} - (\text{fit\_adc})_{X\_mV}$$ cell#i



A movie showing the distribution of residuals for the first 24 cells of channel 0

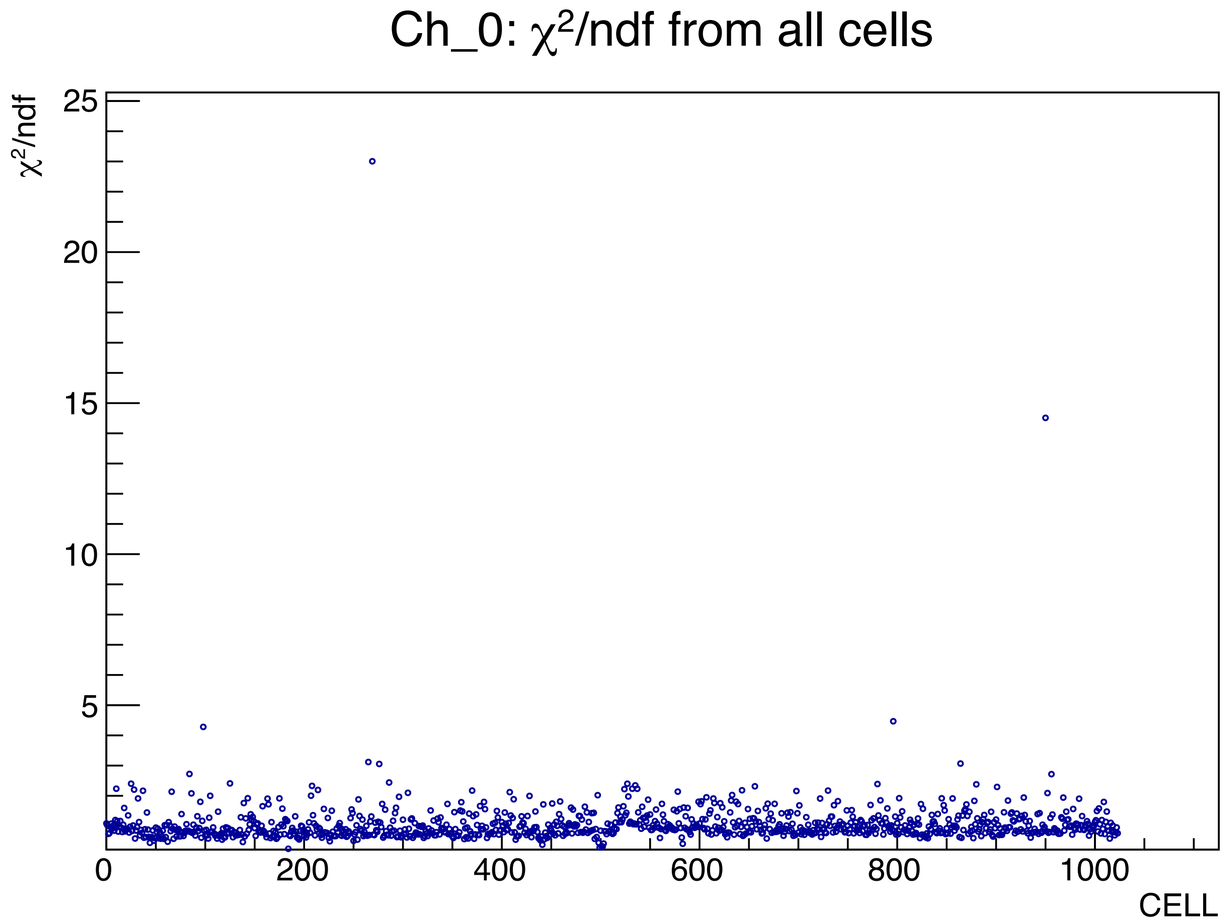
- I have done, so far, calibration for only 2 channels (Ch#0, Ch#1)
- All calibration data have been collected
- If the analysis is ok, I will complete it for the rest of the channels

Thank you!

Suggested results from the discussion on 19 Jan 2023

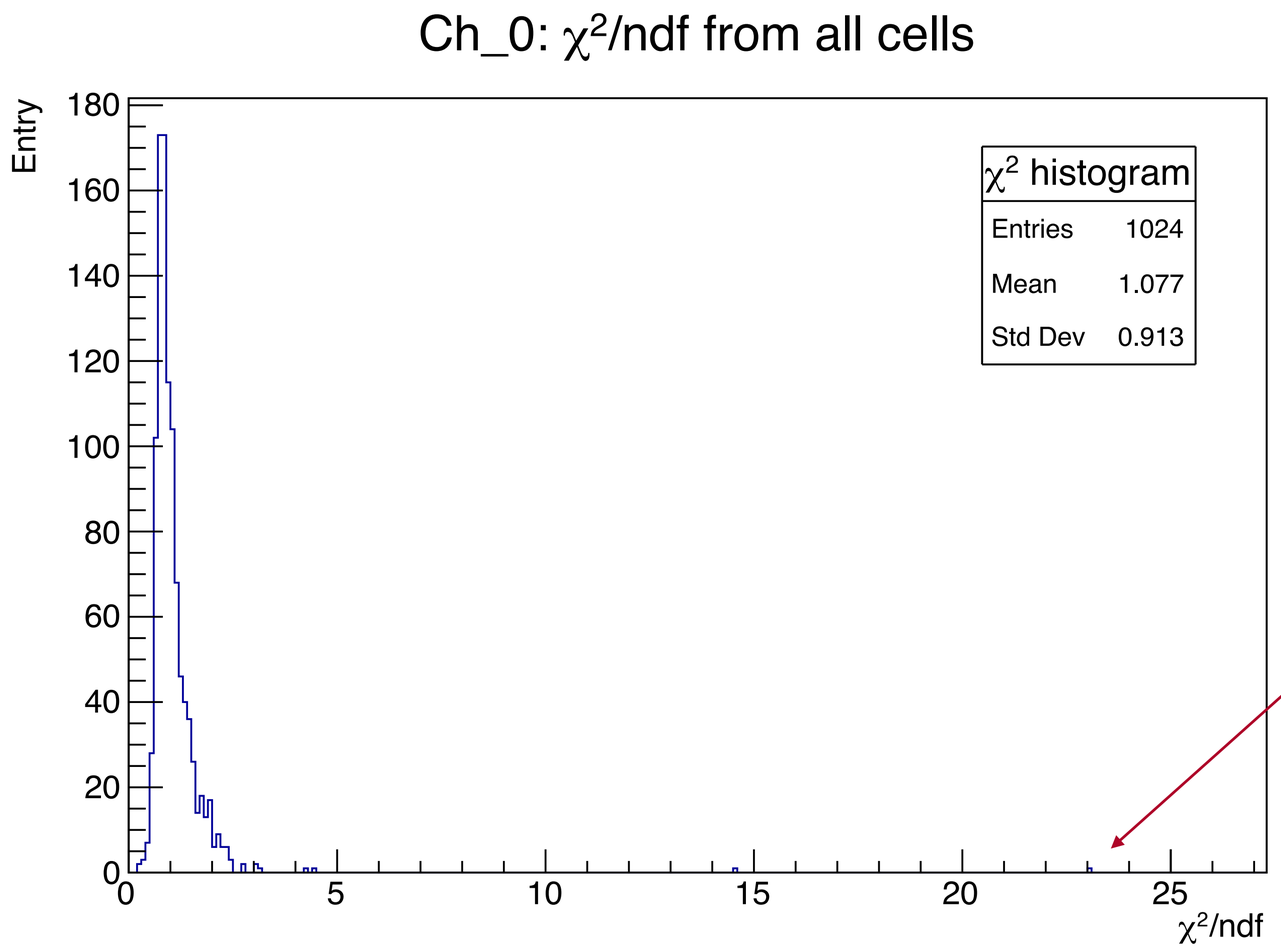
24 Jan 2023

(Chiˆ2 / ndf) for each cell



For a few cells, the calibration fits are away from ‘mean good quality’

distribution of (chi^2/ndf)

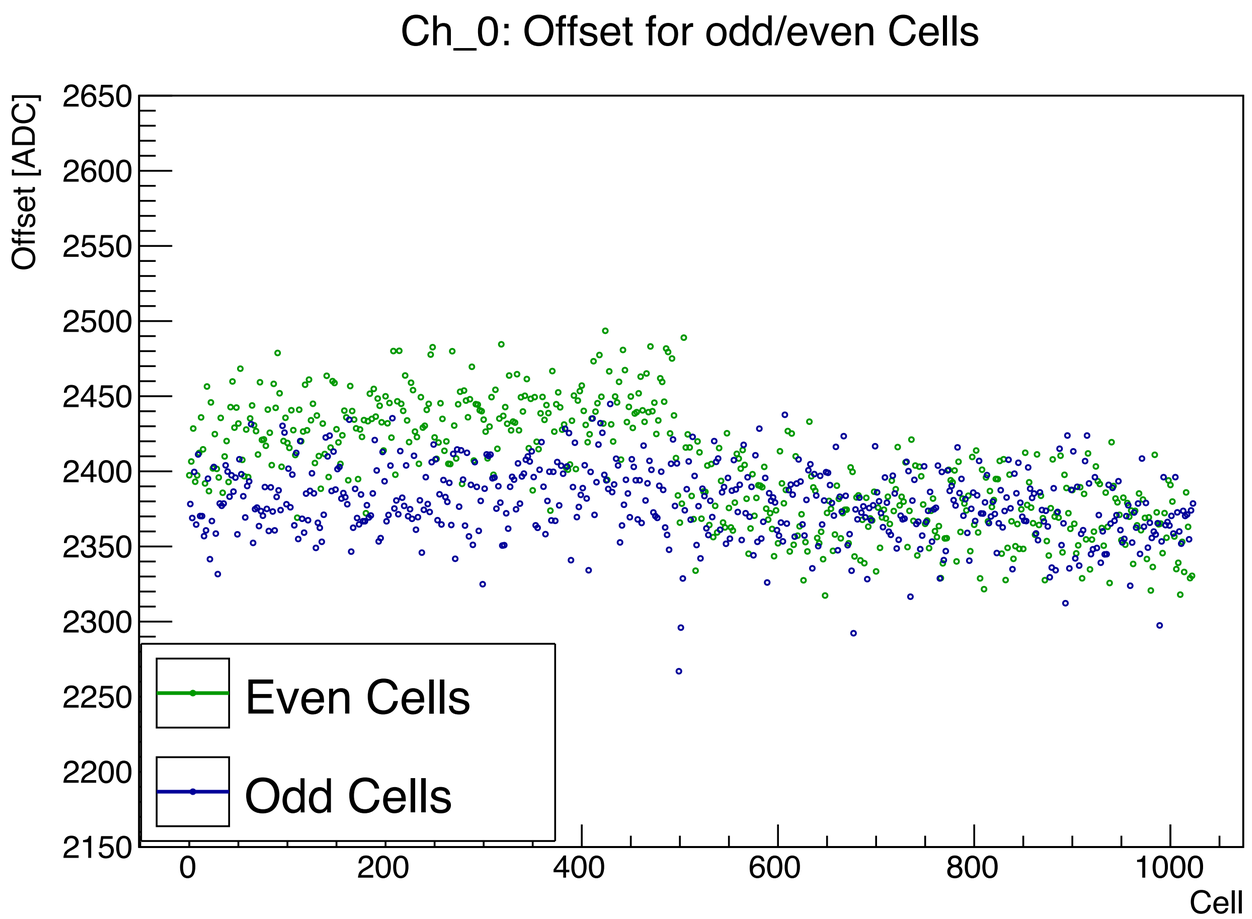


the error in 'chi^2/ndf' is not further propagated while calibrating individual cells.

small, long tail

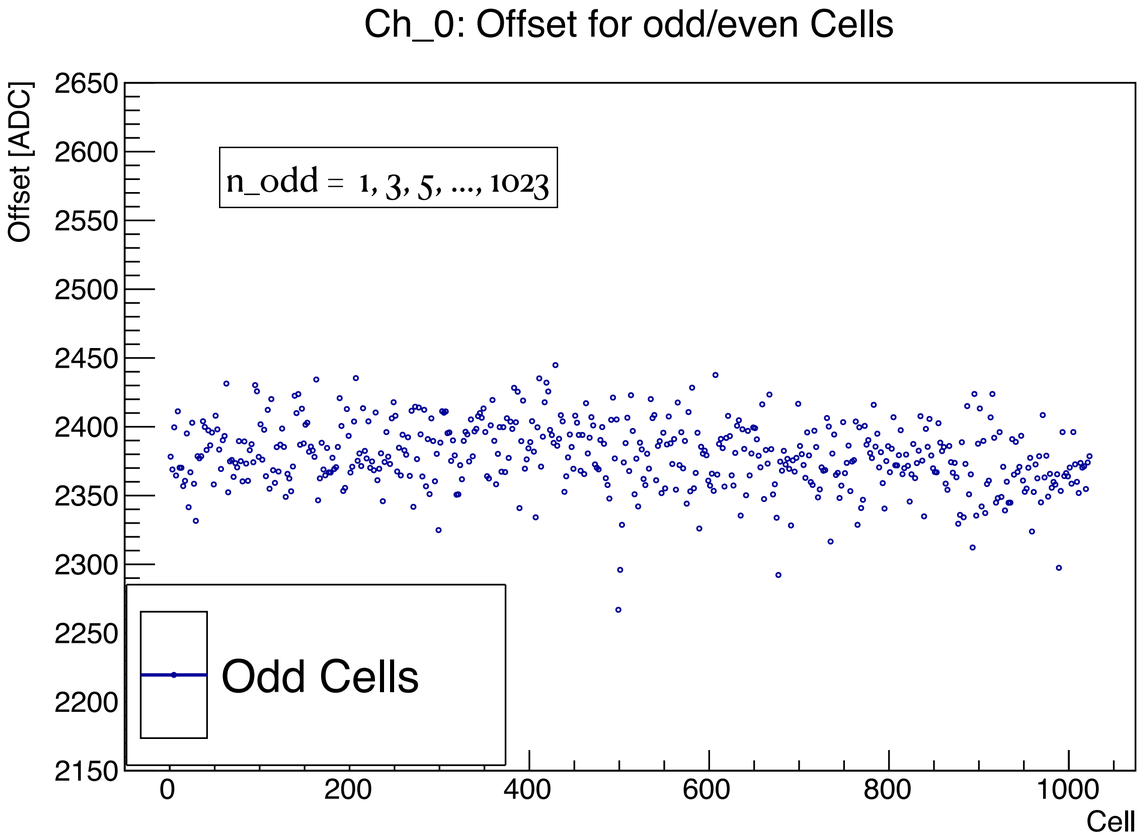
how ever the distribution seems to be quite expected

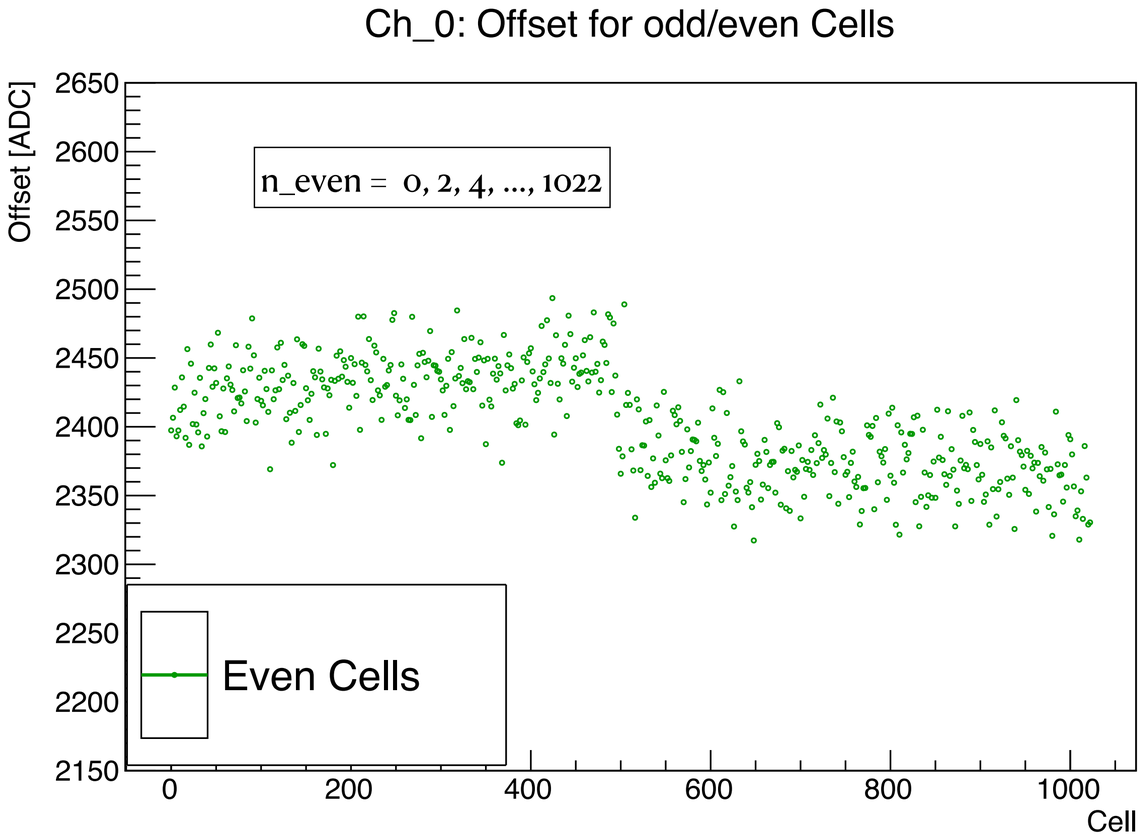
Offset for all odd/even cells in different colours



obviously, something is there!

Offset for all odd and even cells separately



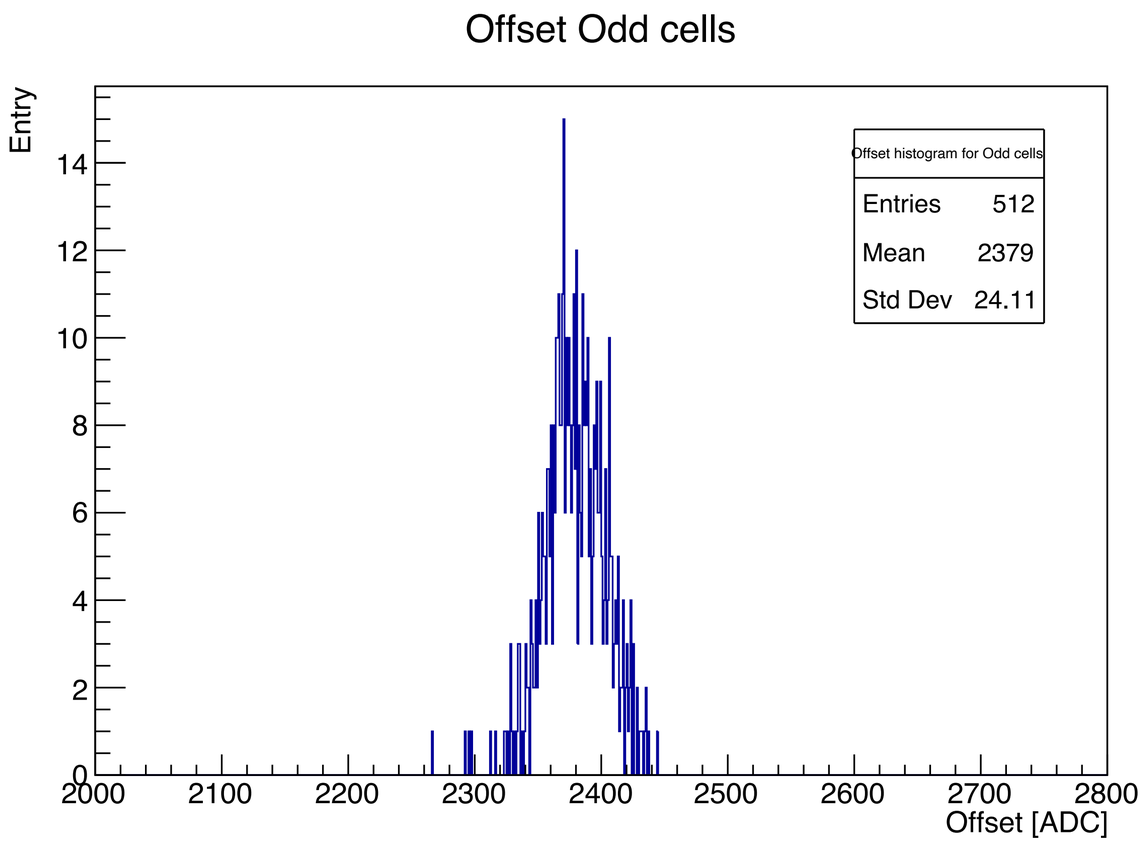


The band structure in offset exists only for the even cells!

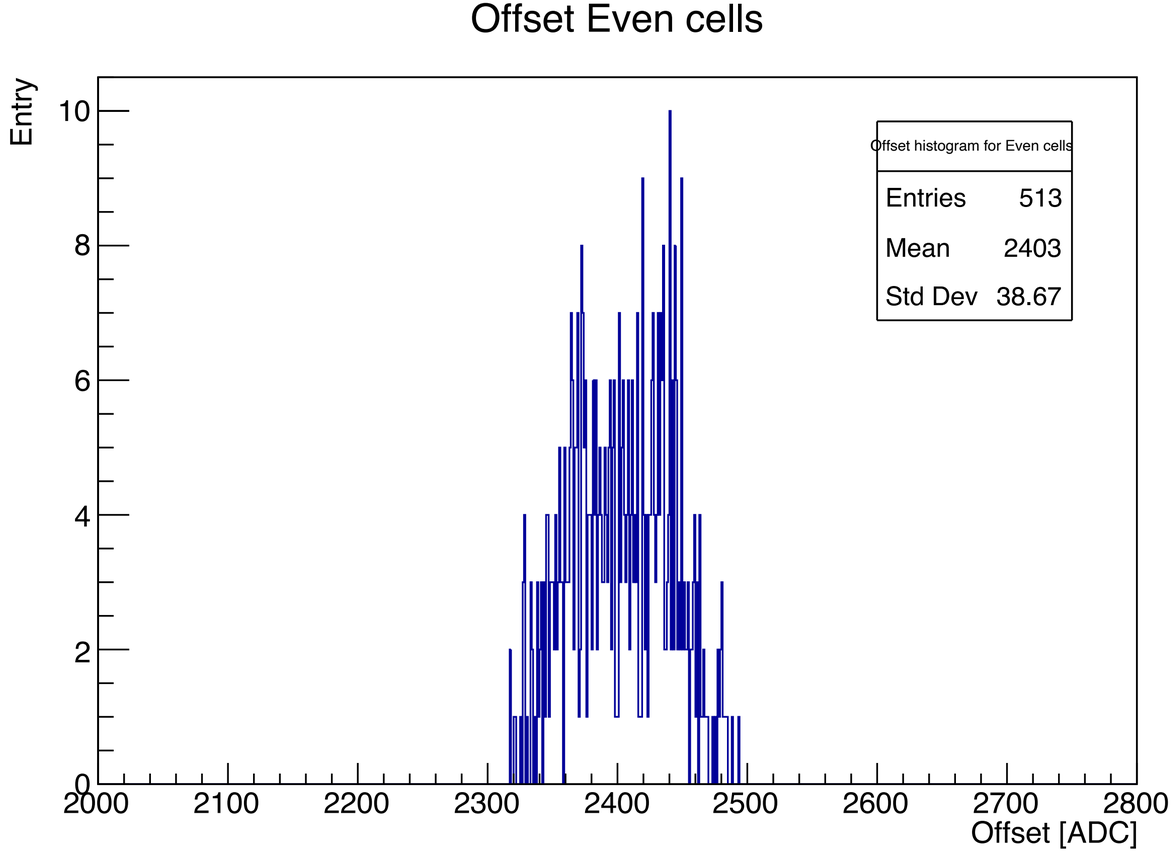
Why?

distribution of Offset for all odd and even cells separately

n_odd = 1, 3, 5, ..., 1023

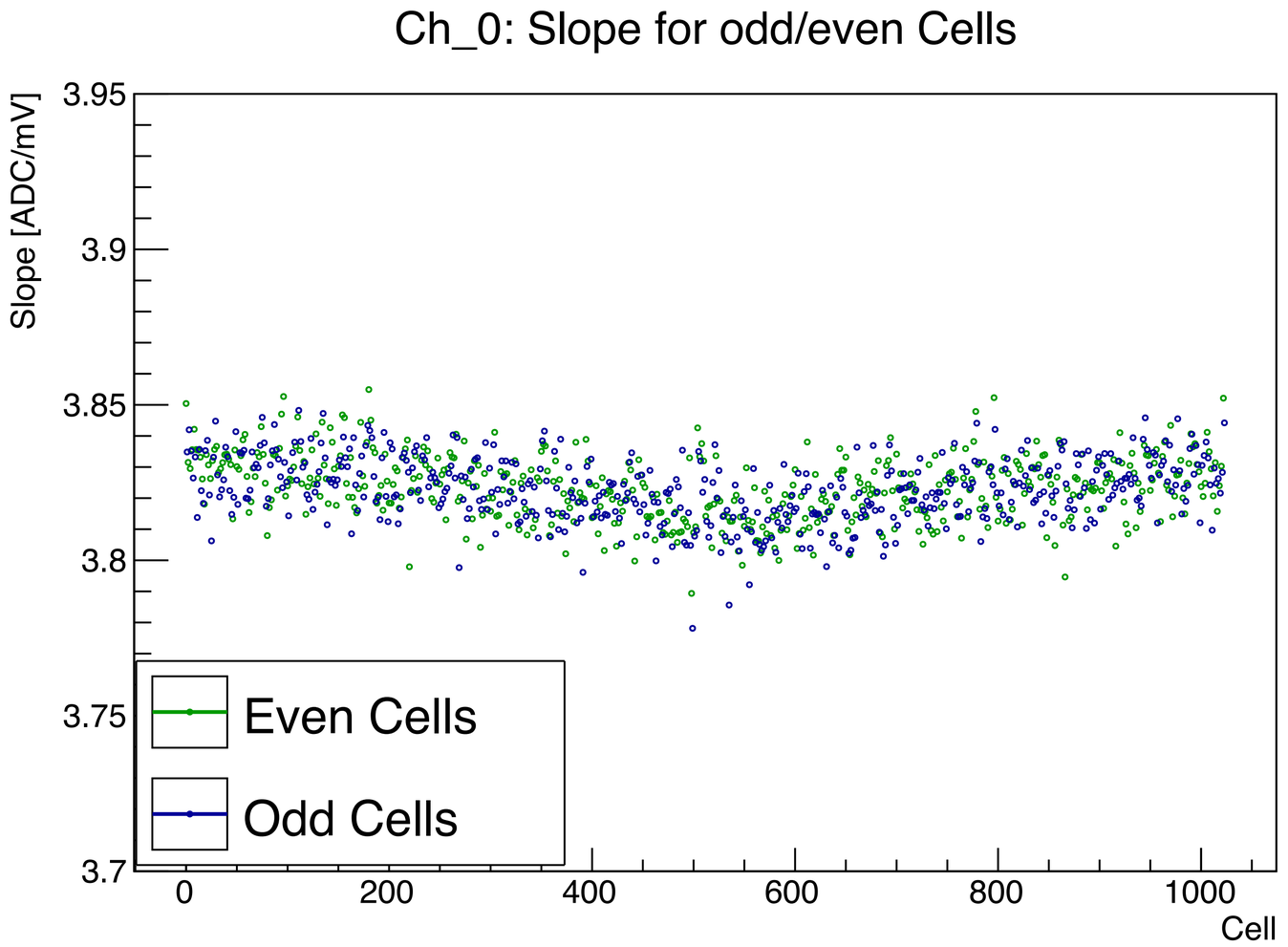


n_even = 0, 2, 4, ..., 1022



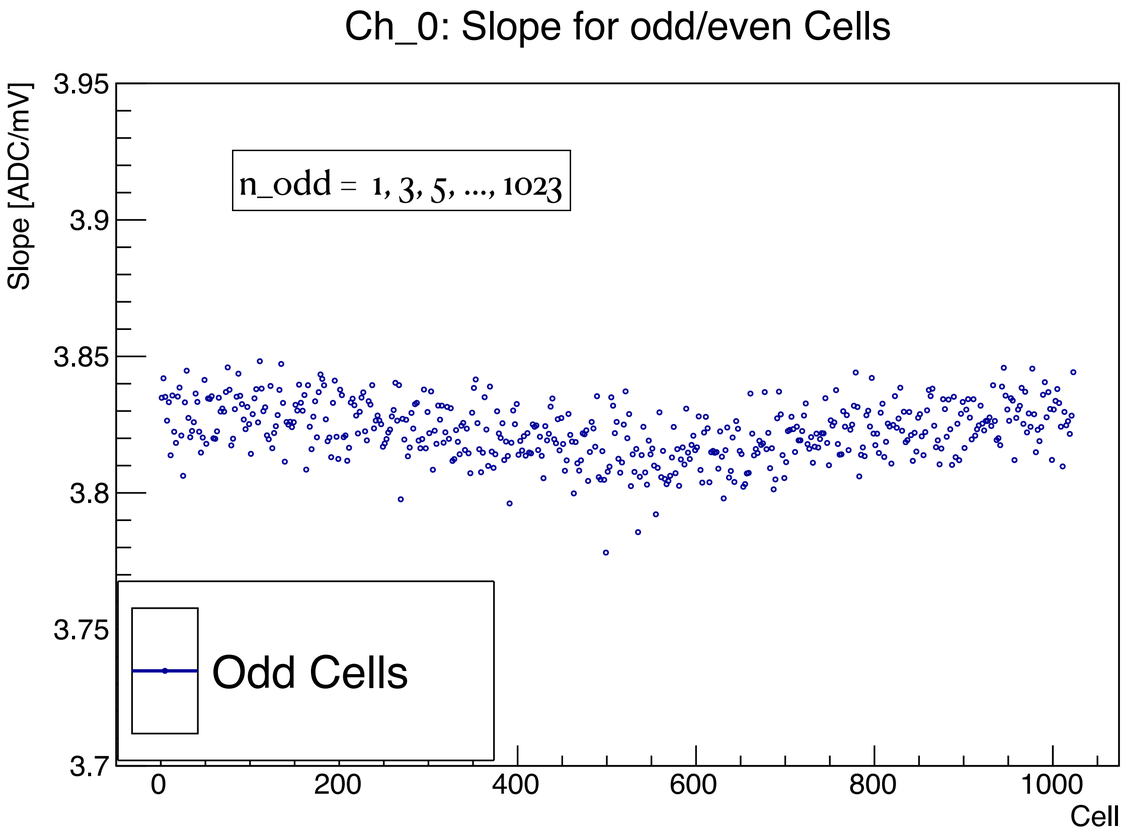
Clearly even cells contributes larger rms to the global offset distribution

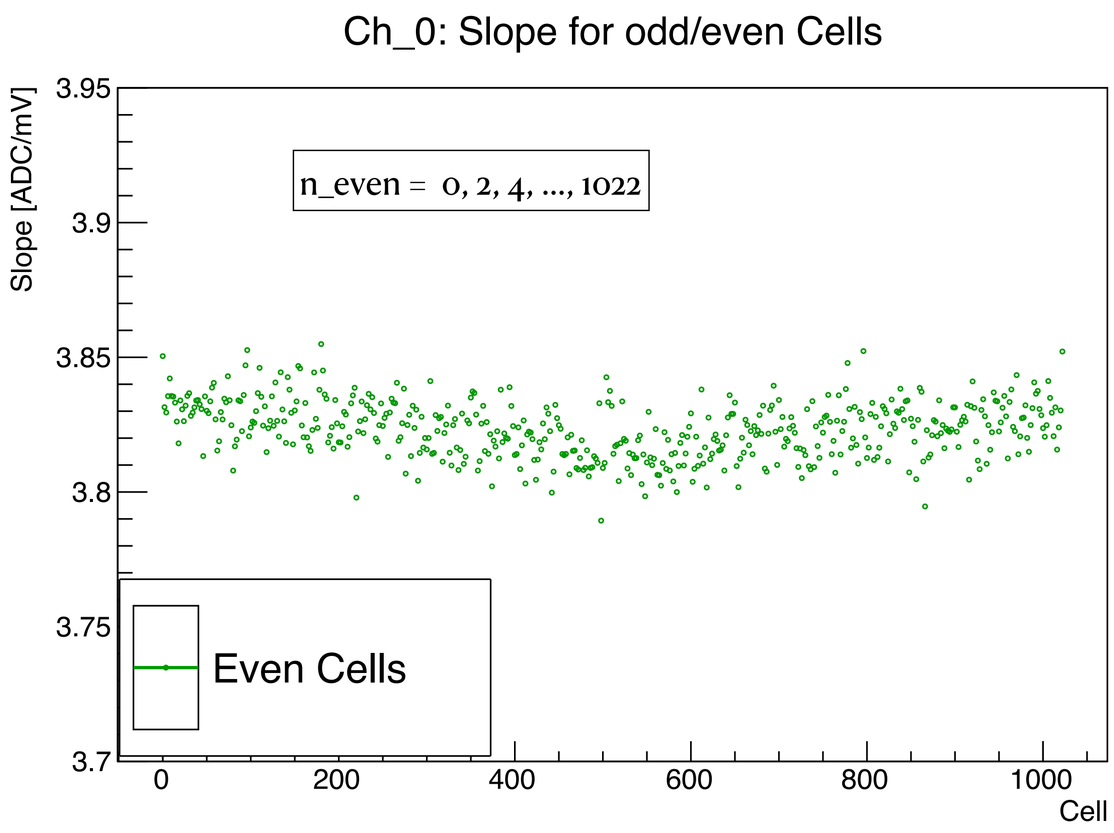
Slope for odd/even cells in different colours



There is not much difference in odd/even cells for slopes

Slope for all odd and even cells separately

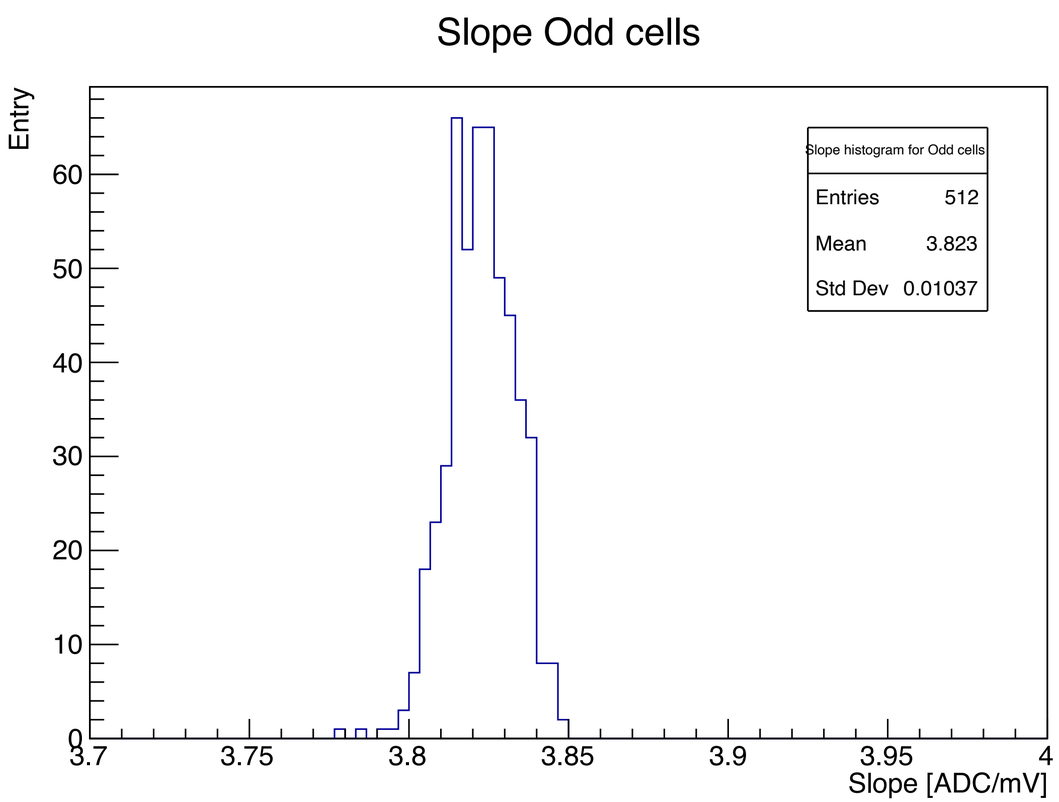




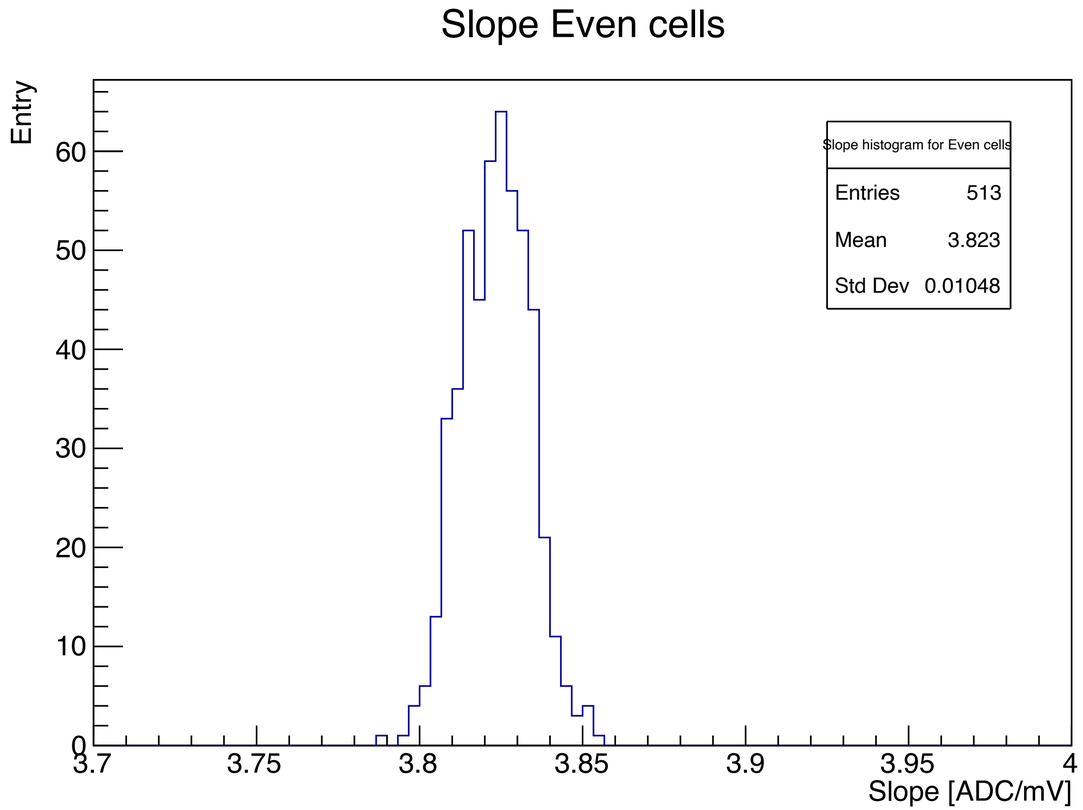
There is not much difference in odd/even cells for slopes

distribution of Slopes for all odd and even cells separately

n_odd = 1, 3, 5, ..., 1023



n_even = 0, 2, 4, ..., 1022



There is not much difference in odd/even cells for slopes

Thank you again !