Calibration Status of the NTU Group

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ARA Collaboration Meeting
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Analysis status

- Goal: use the ARA2/3 data to search for UHECNs
- Starting with IRS2 calibrations
- Calibrations mostly followed the methods by Thomas Meures (presentations and thesis)

Calibration data

- NTU calibration data
- Run 440 to 463
- 4 pedestal runs
- 17 calibration runs with sine wave fixed at 214 MHz with various applied voltage

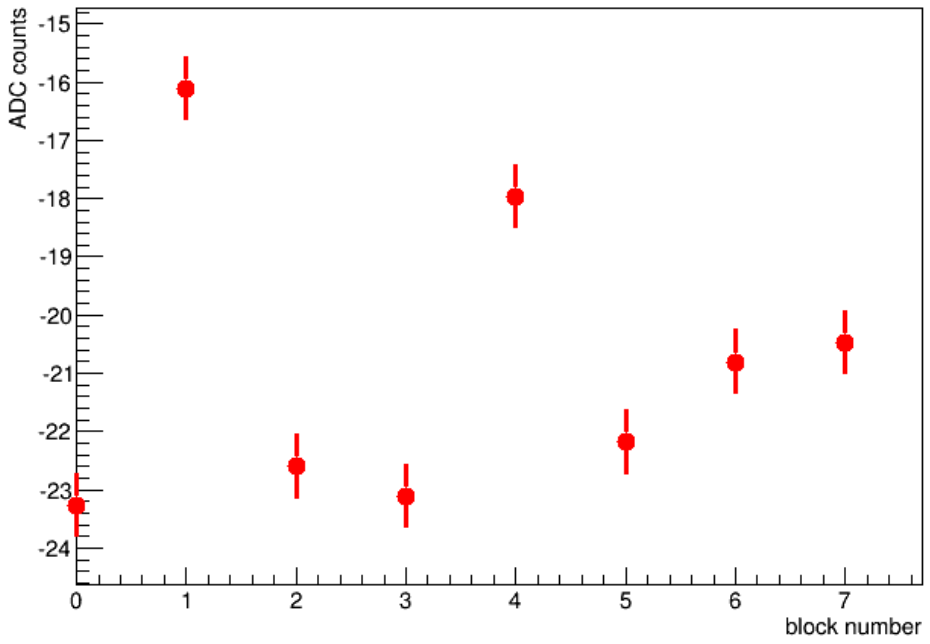
Pedestal correction

- Use 440 and calibrate
- Results are consistent between 440, 447, 453, 463

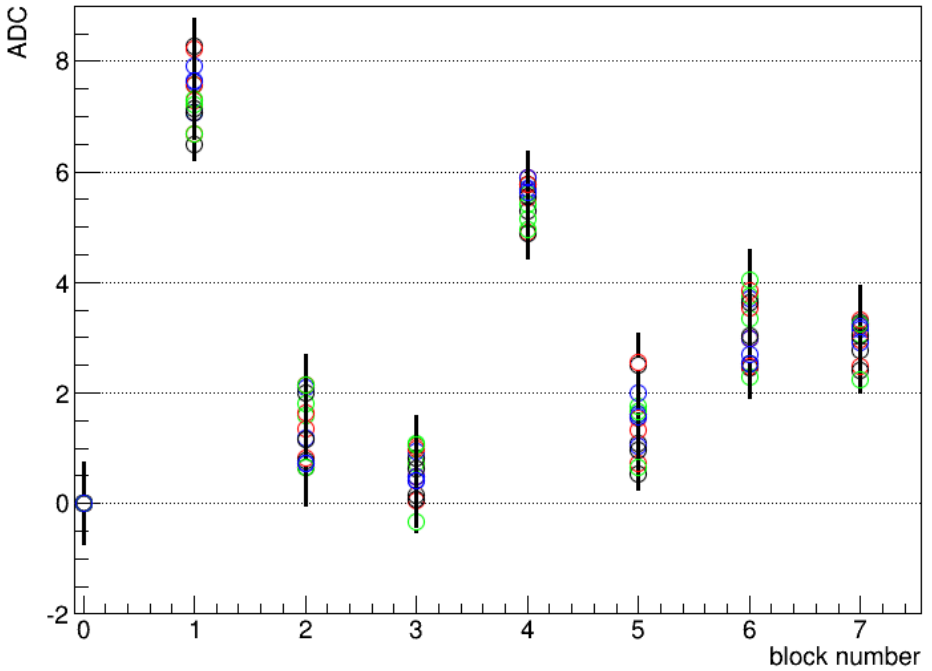
Block-dependent pedestal

Block-by-block pedestal difference

Run 441
dda 0
Chan 0



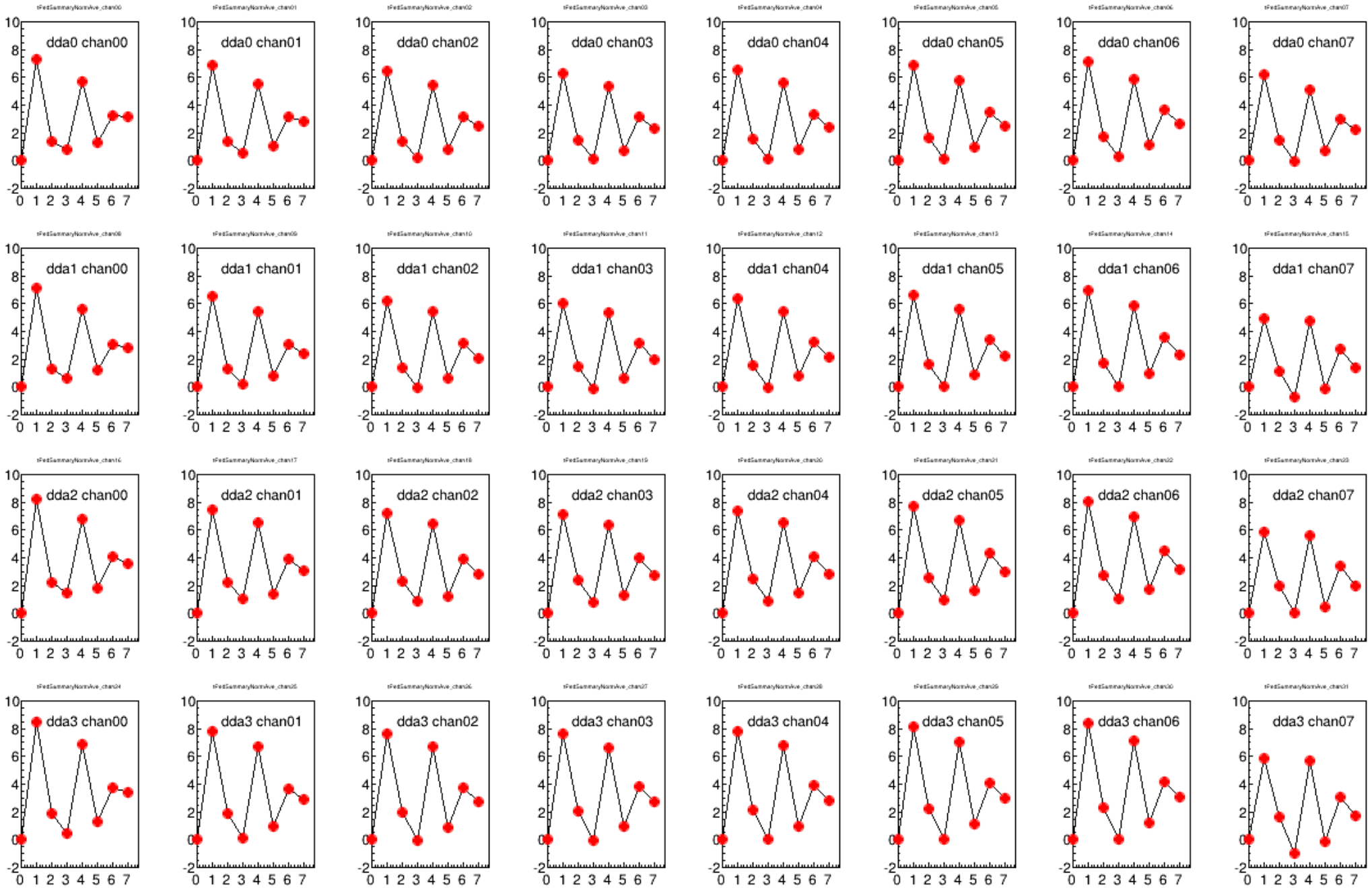
Run 441-462
dda 0
Chan 0



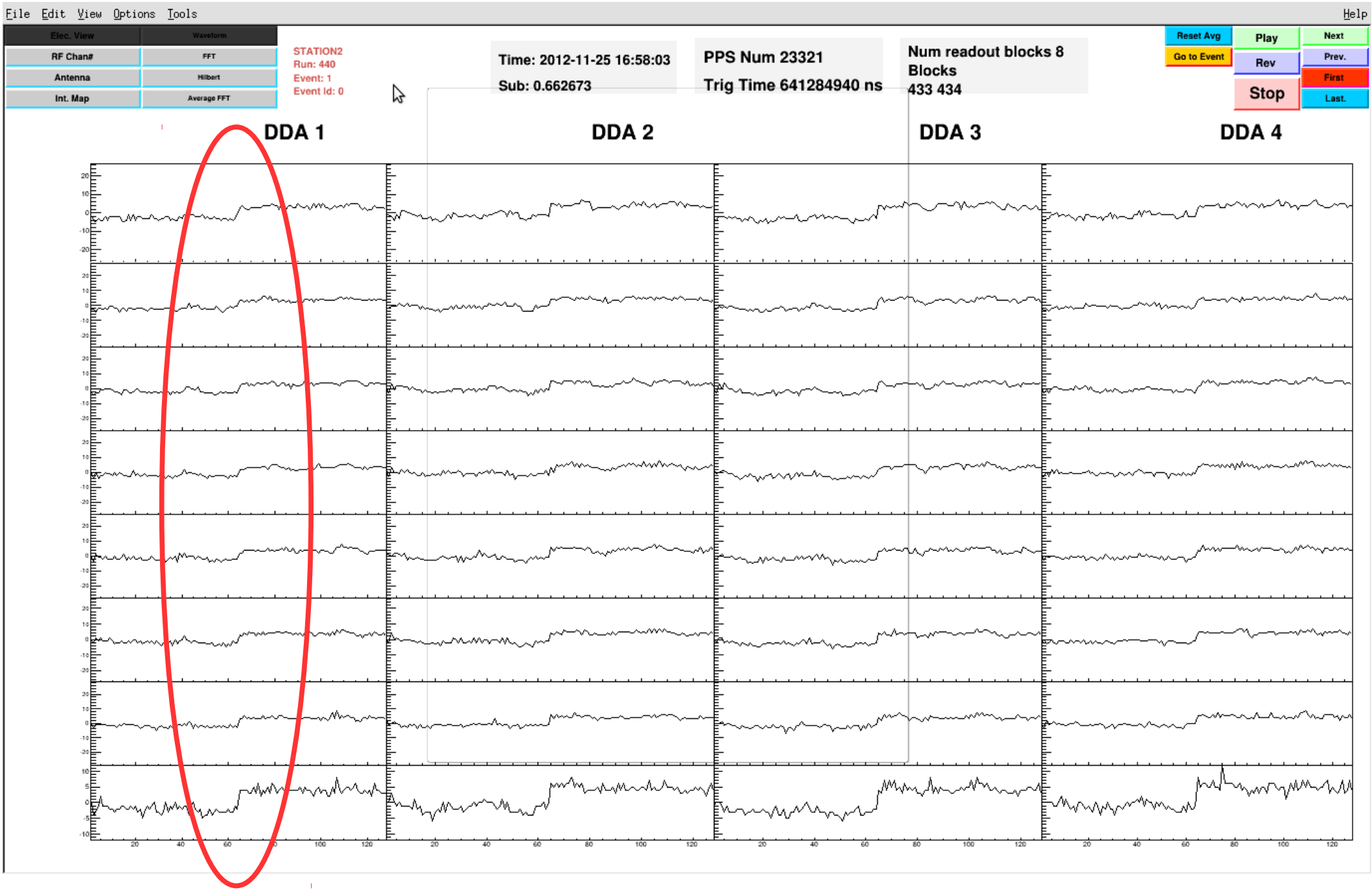
Block-by-block dependent pedestal difference

- Normalized by first block (ADC values relative to first block)
- Without significant run-by-run difference

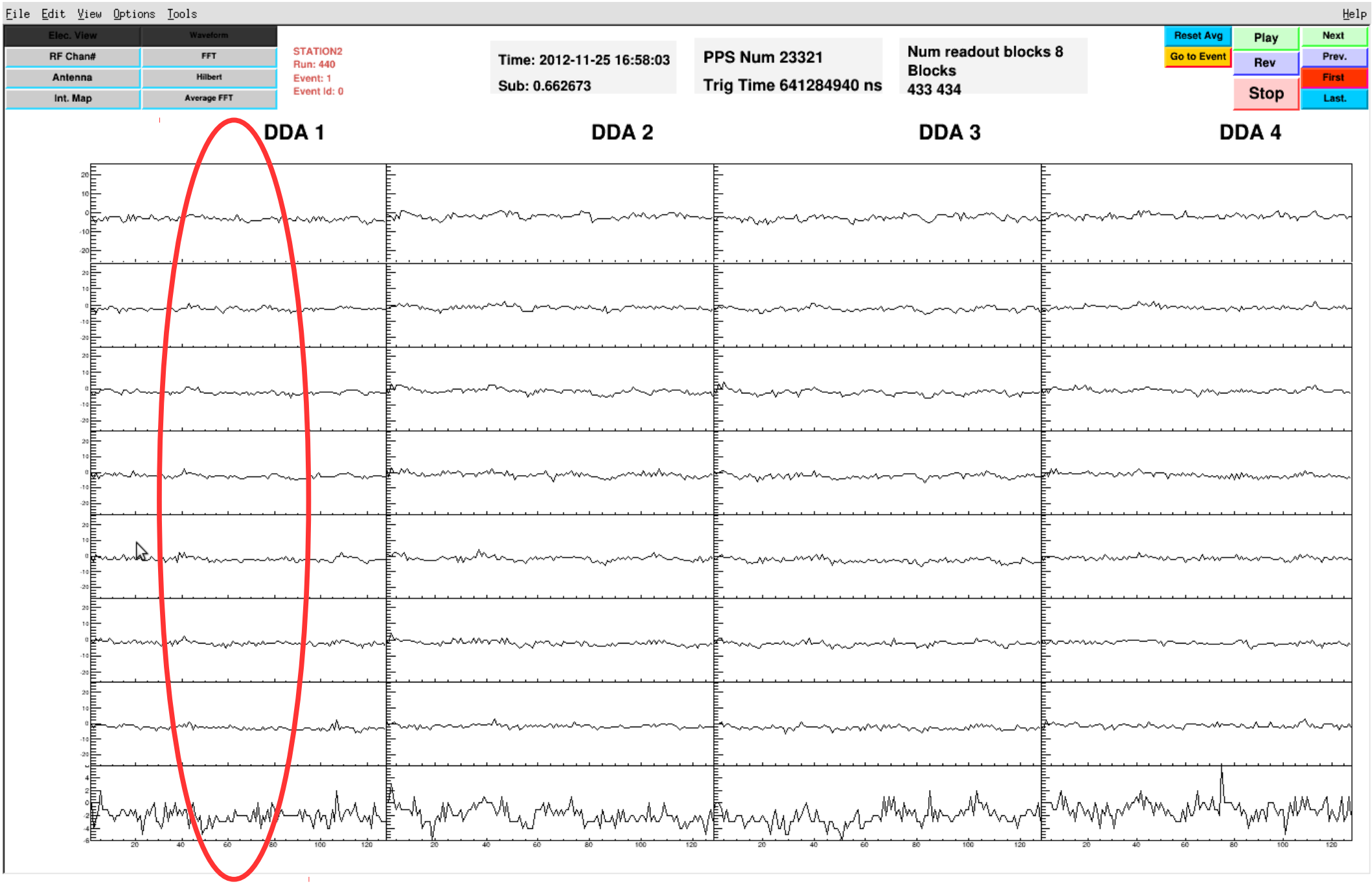
Block-by-block ADC shifts



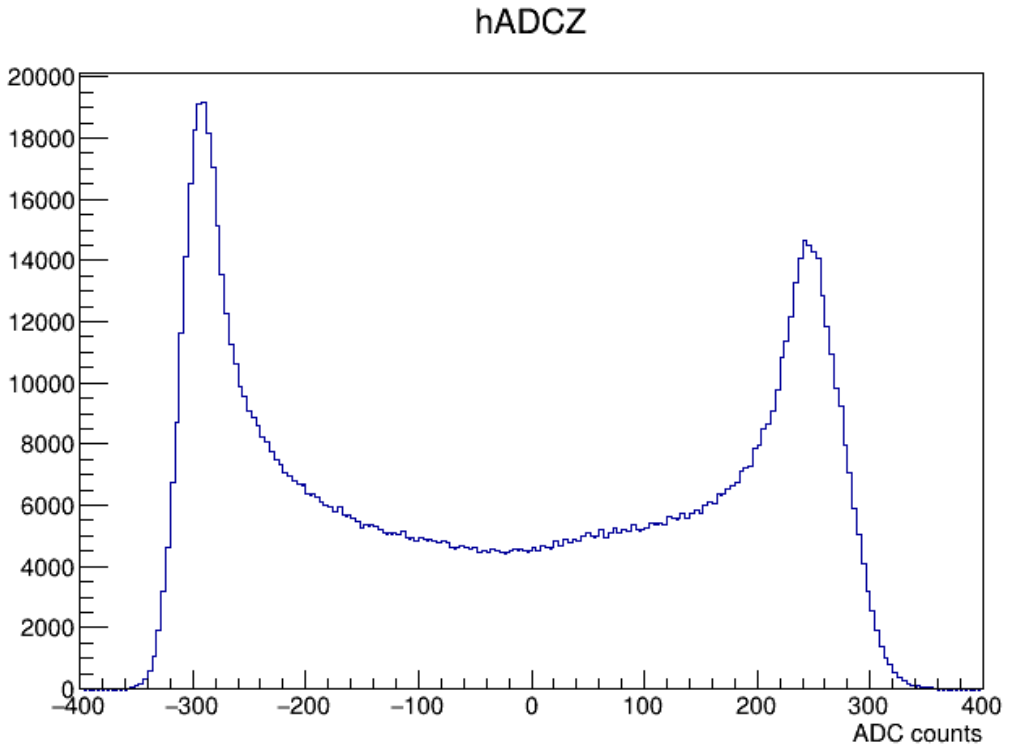
Run440 before correction



Run440 after correction



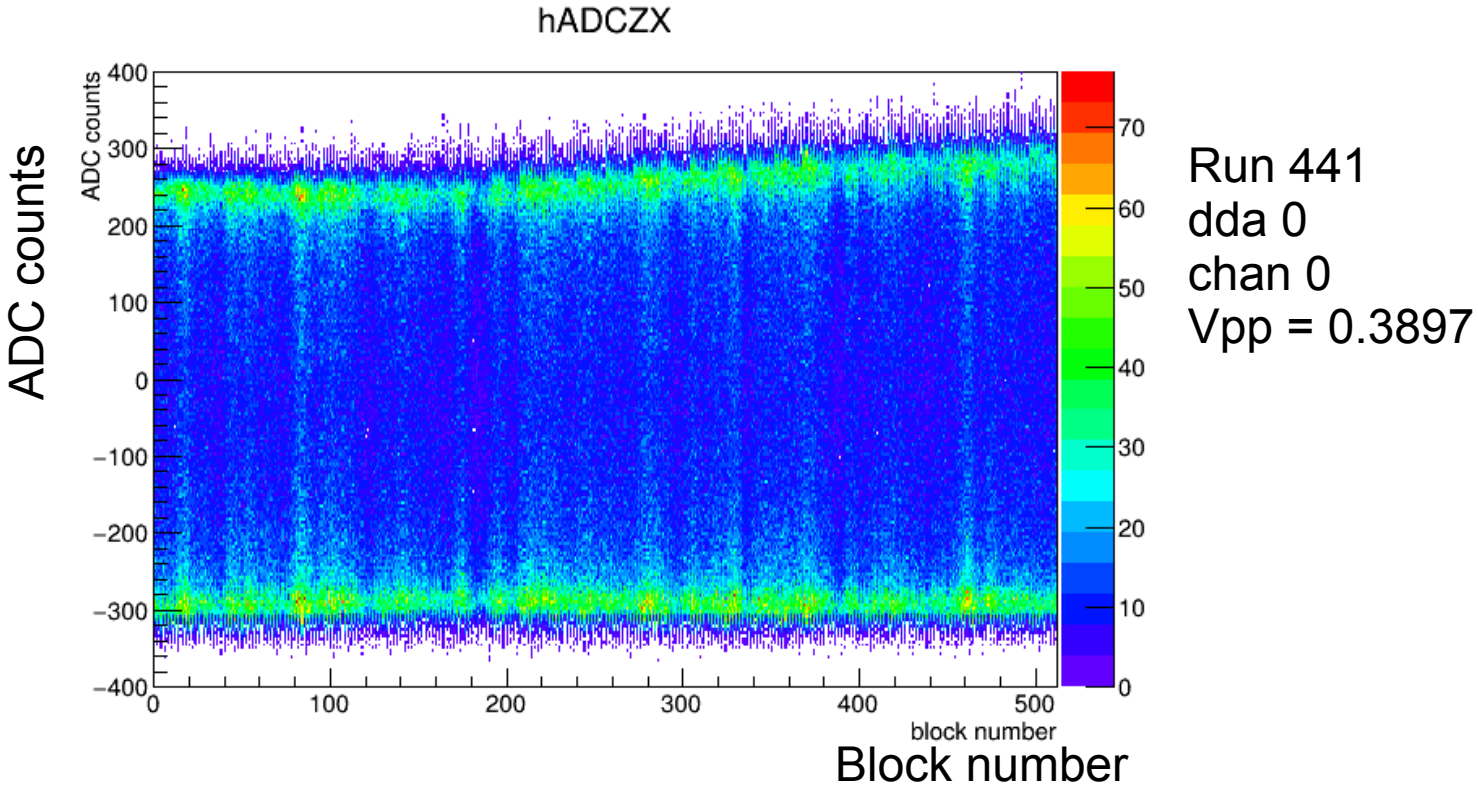
ADC distribution (1D)



Run 441
dda 0
chan 0
Vpp = 0.3897

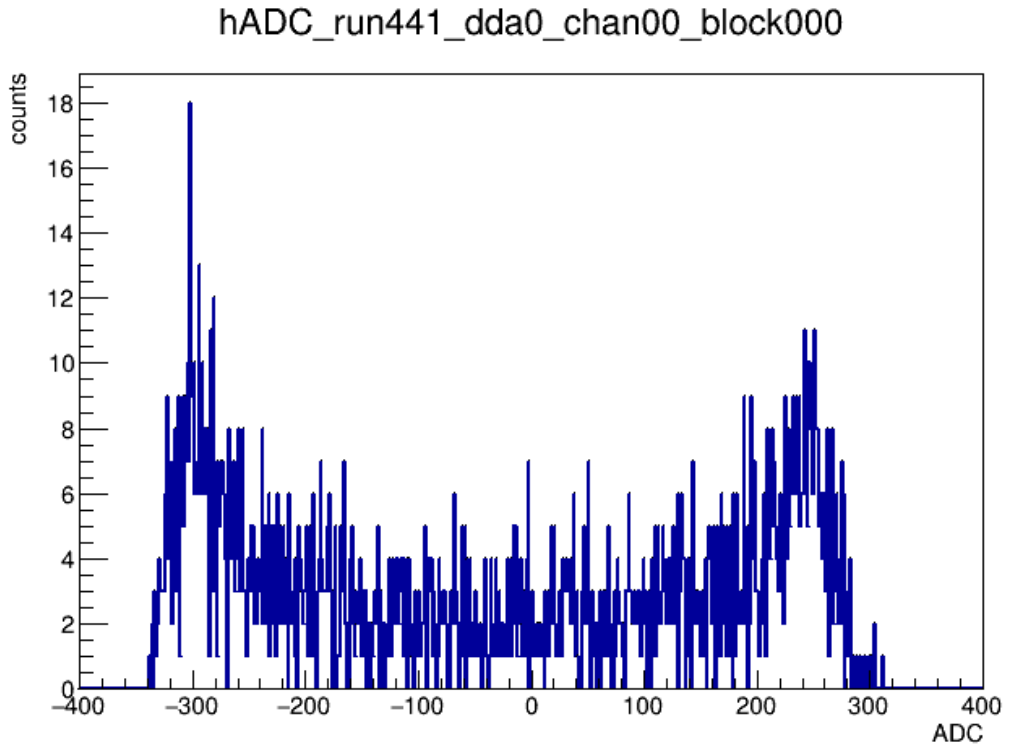
- For a sine wave distribution y = A sin(ω t), if we project the distribution to y-direction, the distribution will peak at +/- A
- This is basically what we see here, with the peaks not quite symmetric
- This one is designed to peak at ADC = 300

ADC vs block number



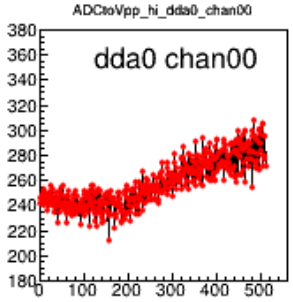
- It's easy to see that for negative region, ADC is peaked at -300, independent from block numbers
- For positive region, ADC peak is block-dependent, and is typically smaller than 300
- ADC is not symmetric

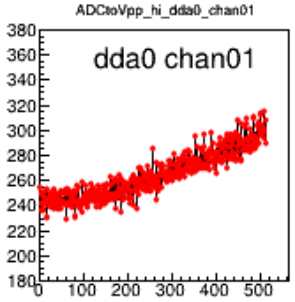
Find the peak via ADC distribution

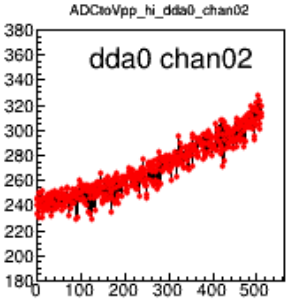


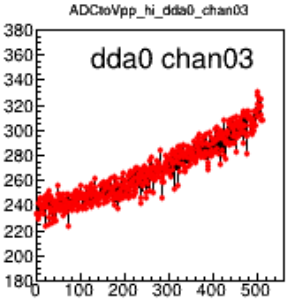
- A typical ADC distribution for a given block
- The statistics is not enough for finer simple-by-sample calibration
- Gaussian fitting is not reliable due to poor statistics
- Rebin can enhance the statistics, but the ADC-resolution will be poorer due to larger bin-width
- Use the bin which has the largest mean around the bin-center as the peak ADC

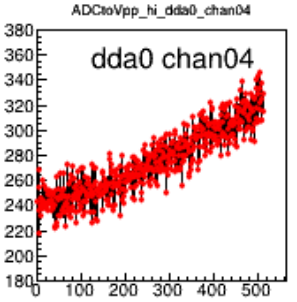
Peak ADC (+) vs block number

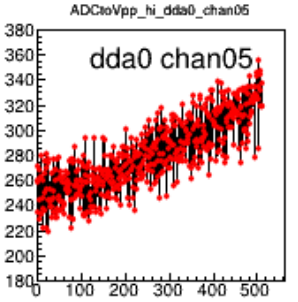


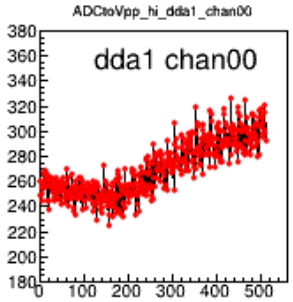


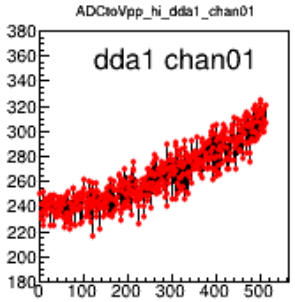


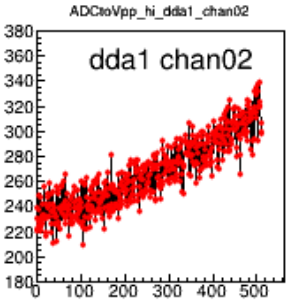


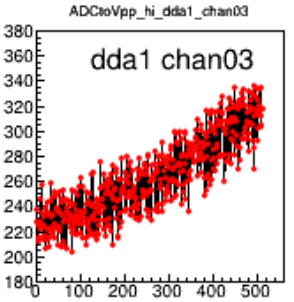




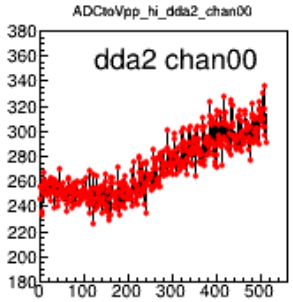


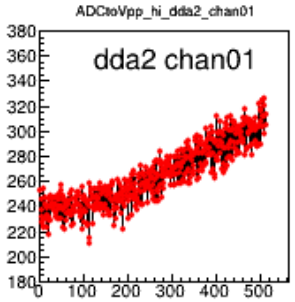


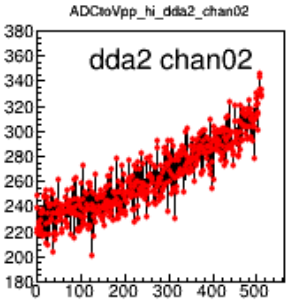


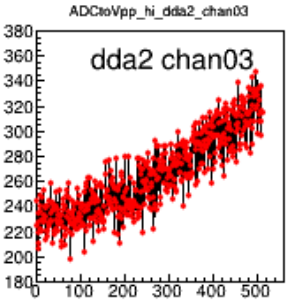


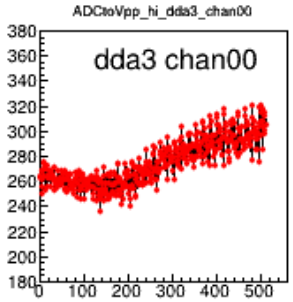
Run 441
dda 0
chan 0
Vpp = 0.3897

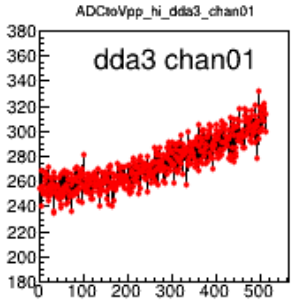


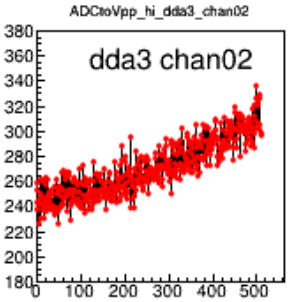


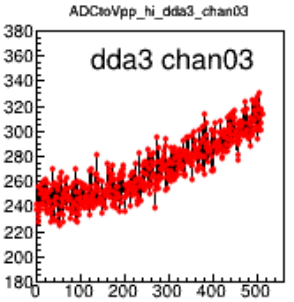


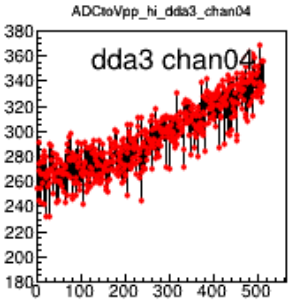


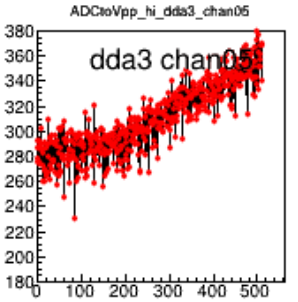




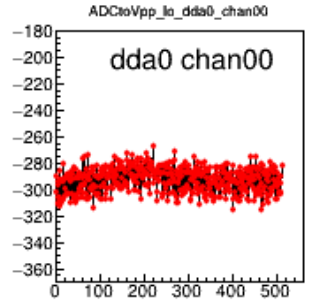


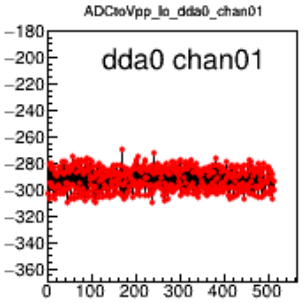


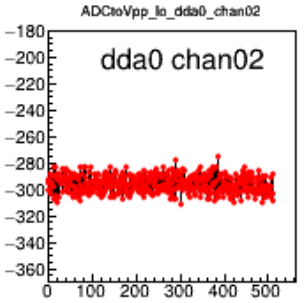


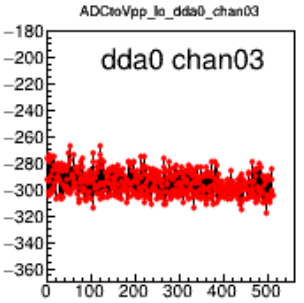


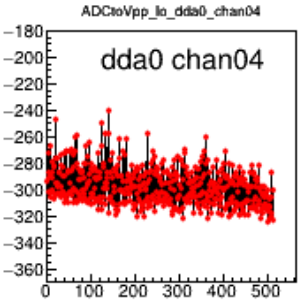
Peak ADC (-) vs block number

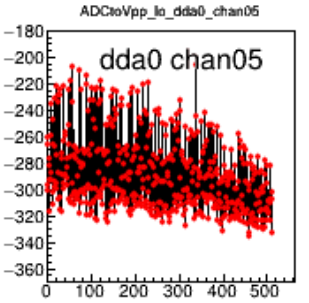


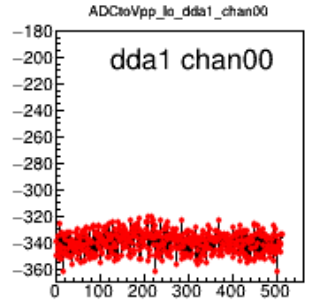


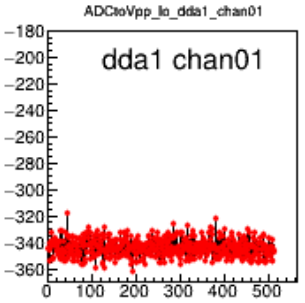


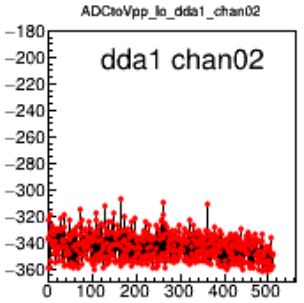


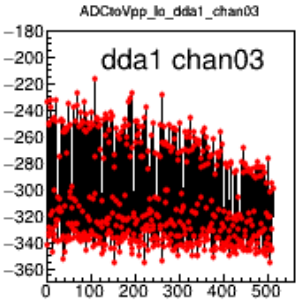




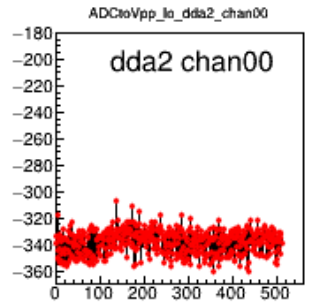


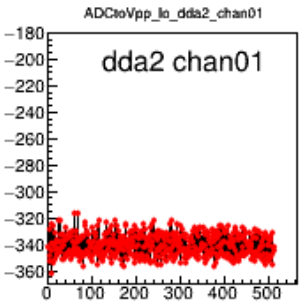


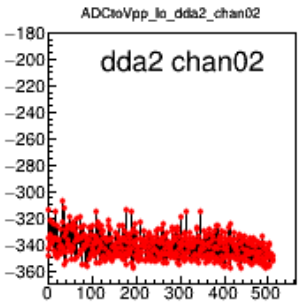


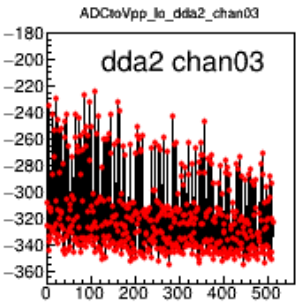


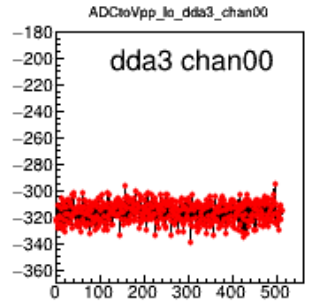
Run 441
dda 0
chan 0
Vpp = 0.3897

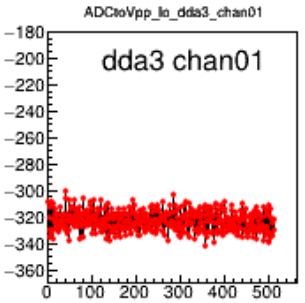


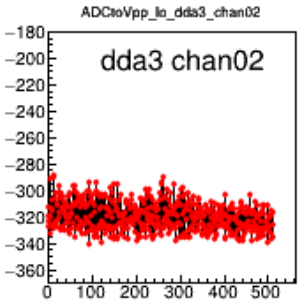


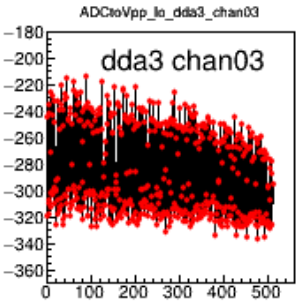


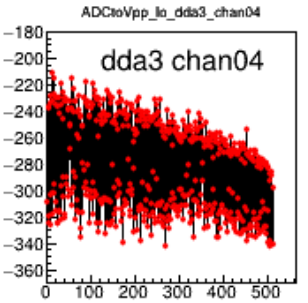


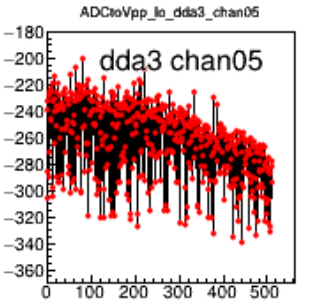




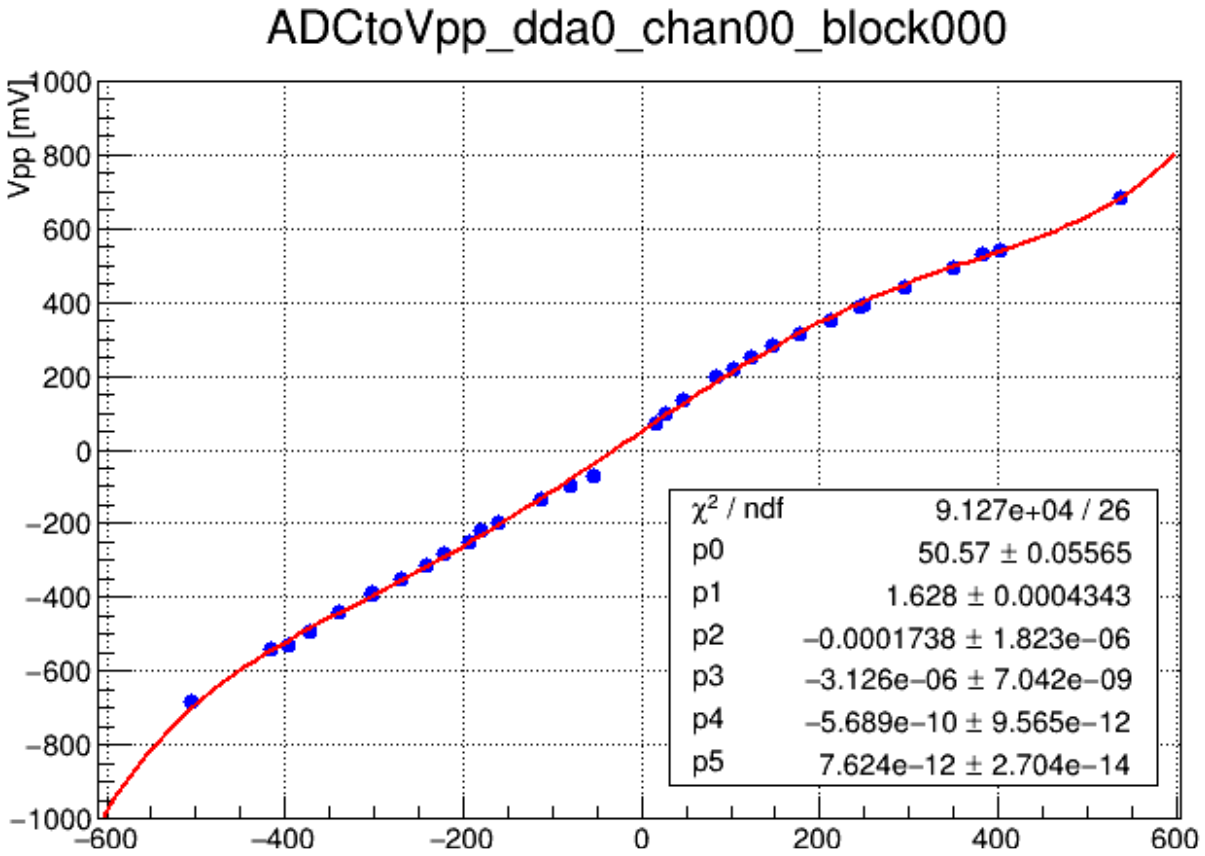






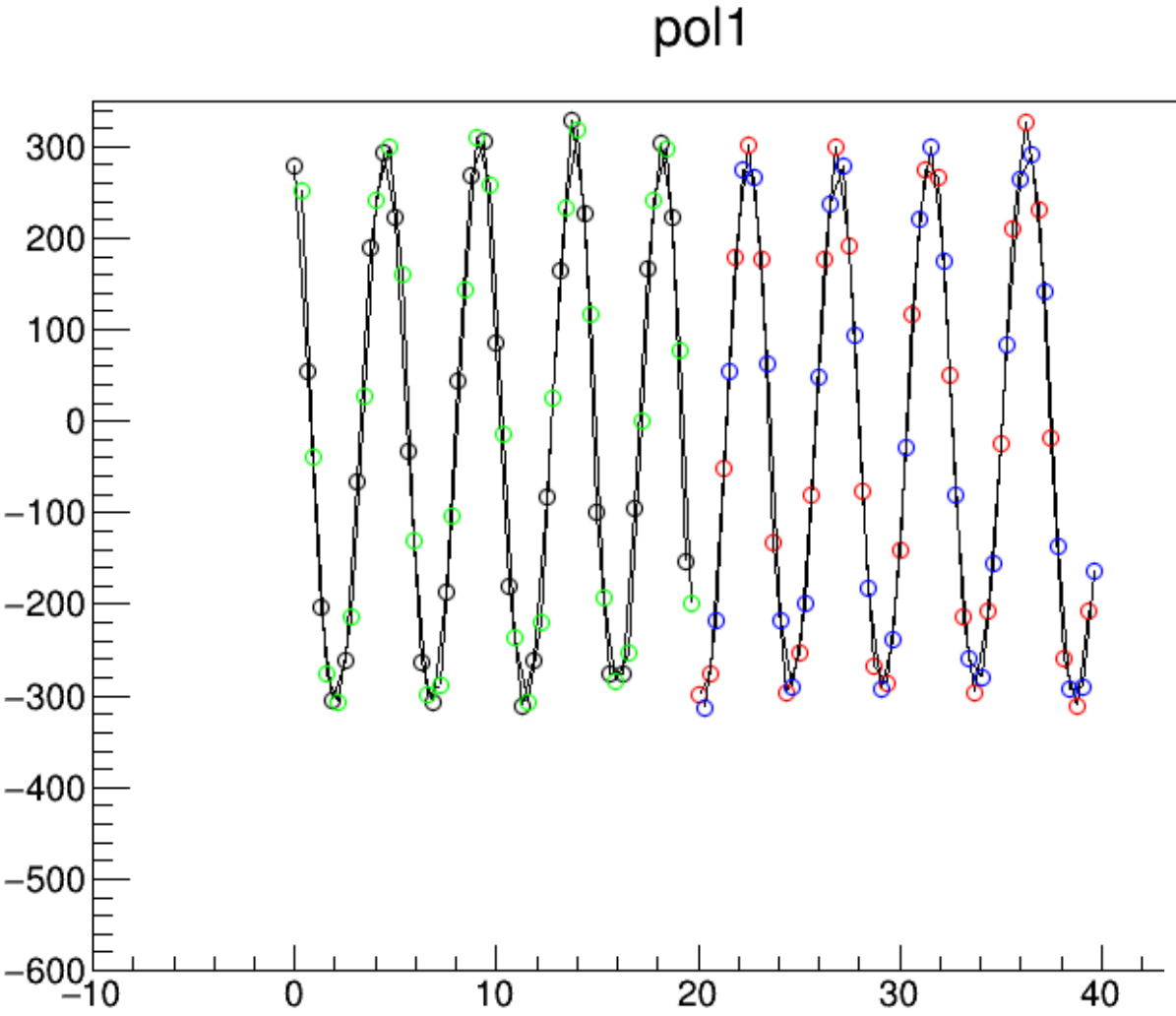


ADC vs Vpp



- 16 runs gives 32 data points
- Fit the distribution with pol5
- No data points for ADC around 0

Fitting the waveform



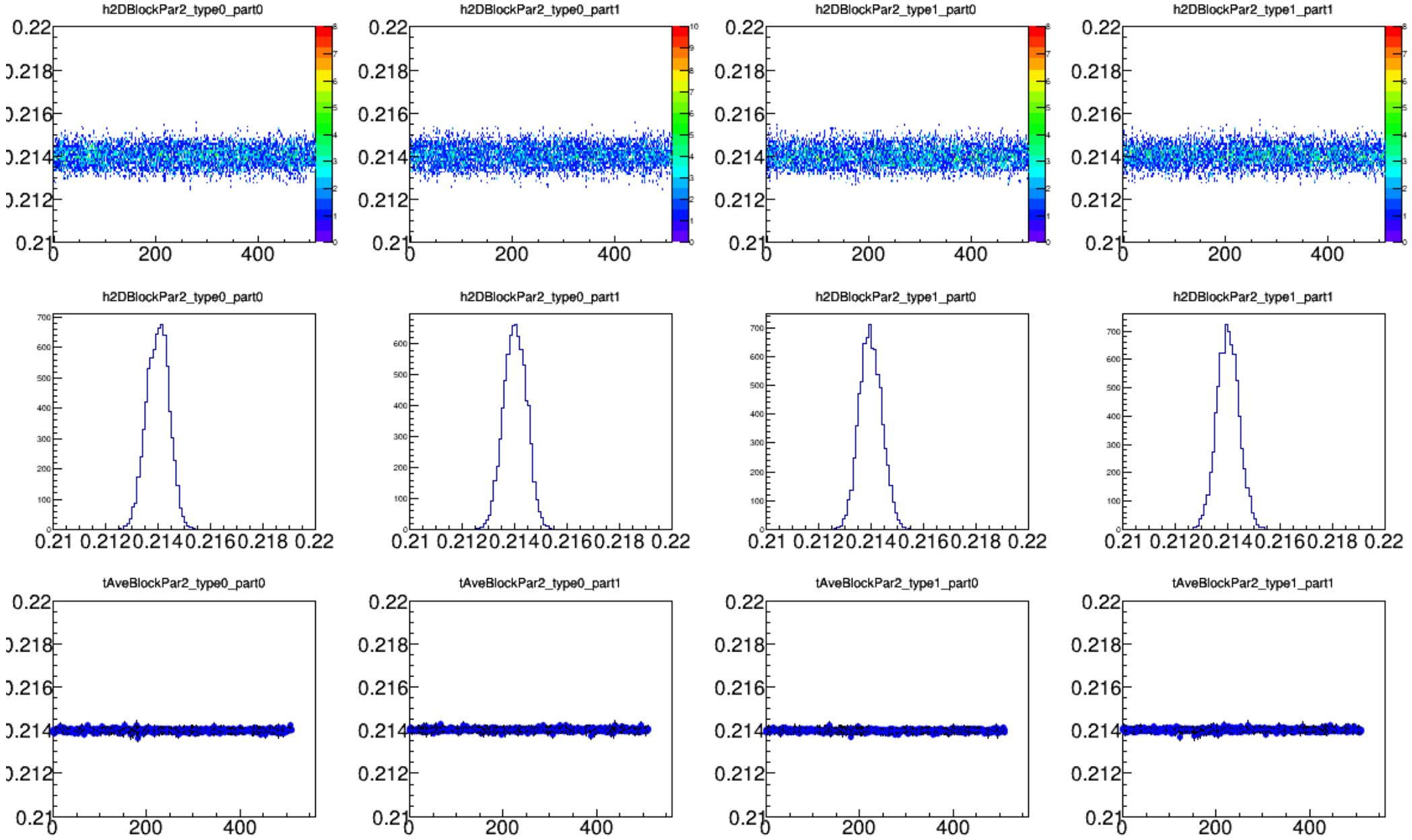
- Separate the waveform in to 4 parts:
  - even sample first block,
  - even sample second block,
  - odd sample first block,
  - odd sample second block
- Fit the waveform with a sine function
- F = [0] + [1] * sin(2π * [2] * (x – [3]))
- Fit each part separately
  - Extract frequency correction
  - Phase correction between blocks
  - Delay correction between even and odd samples

Even sample, first block

Even sample, second block

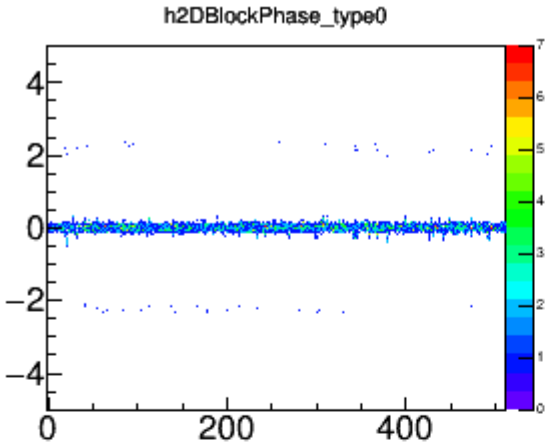
Odd sample, first block

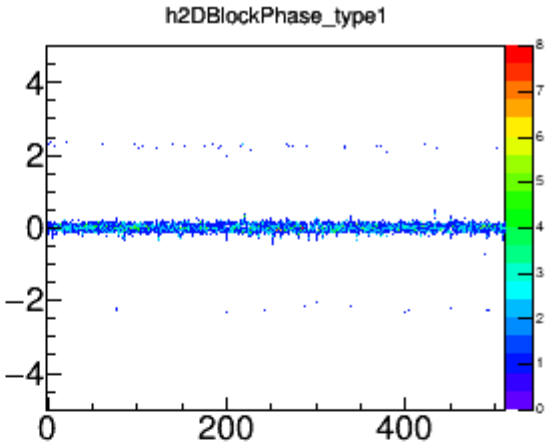
Odd sample, second block

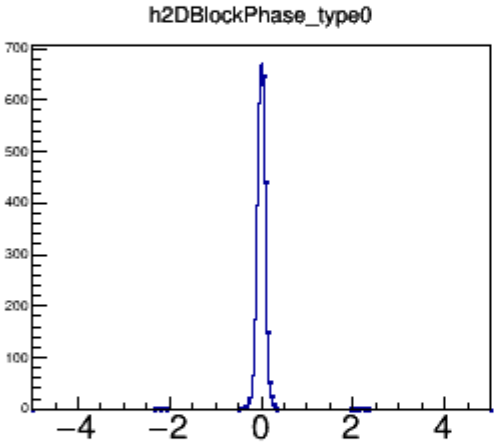


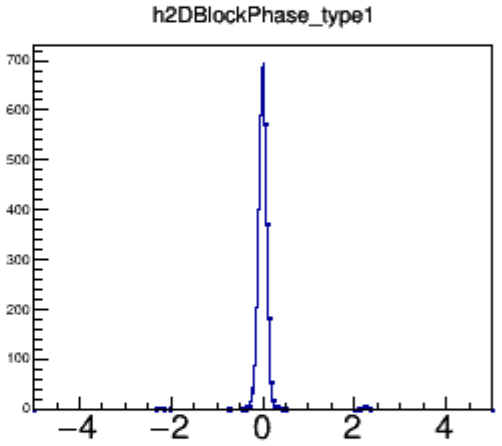
Iteration 1

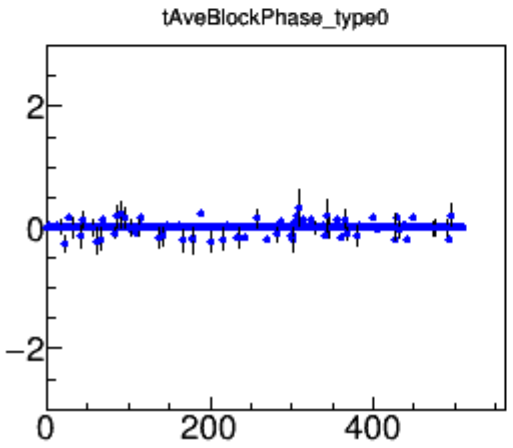
Phase calibration

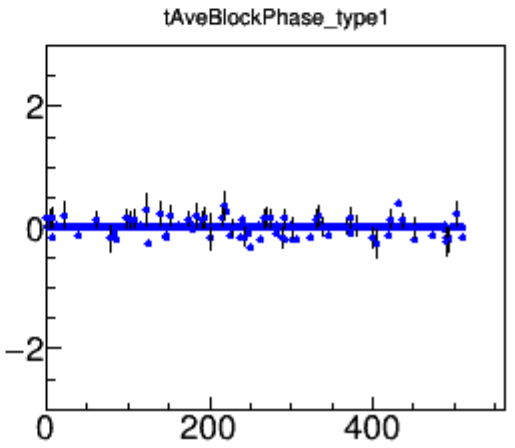




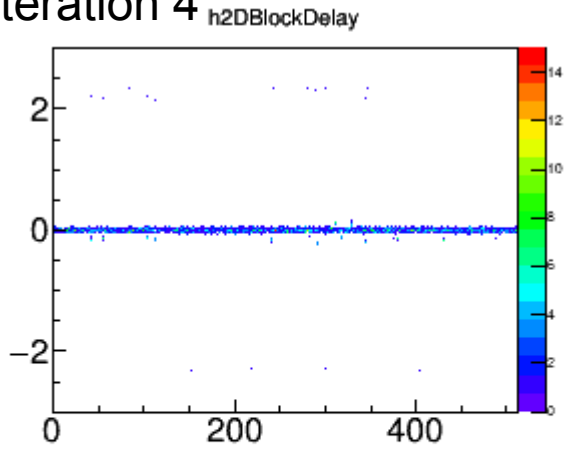


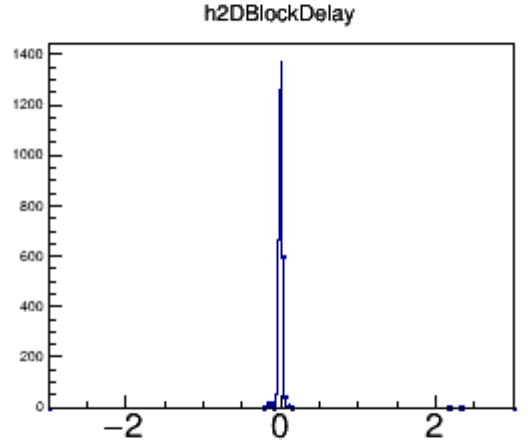


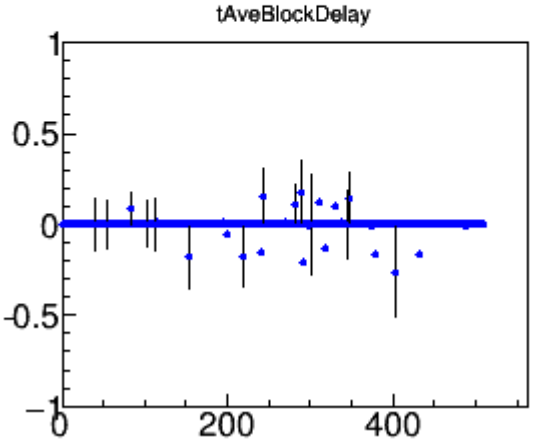




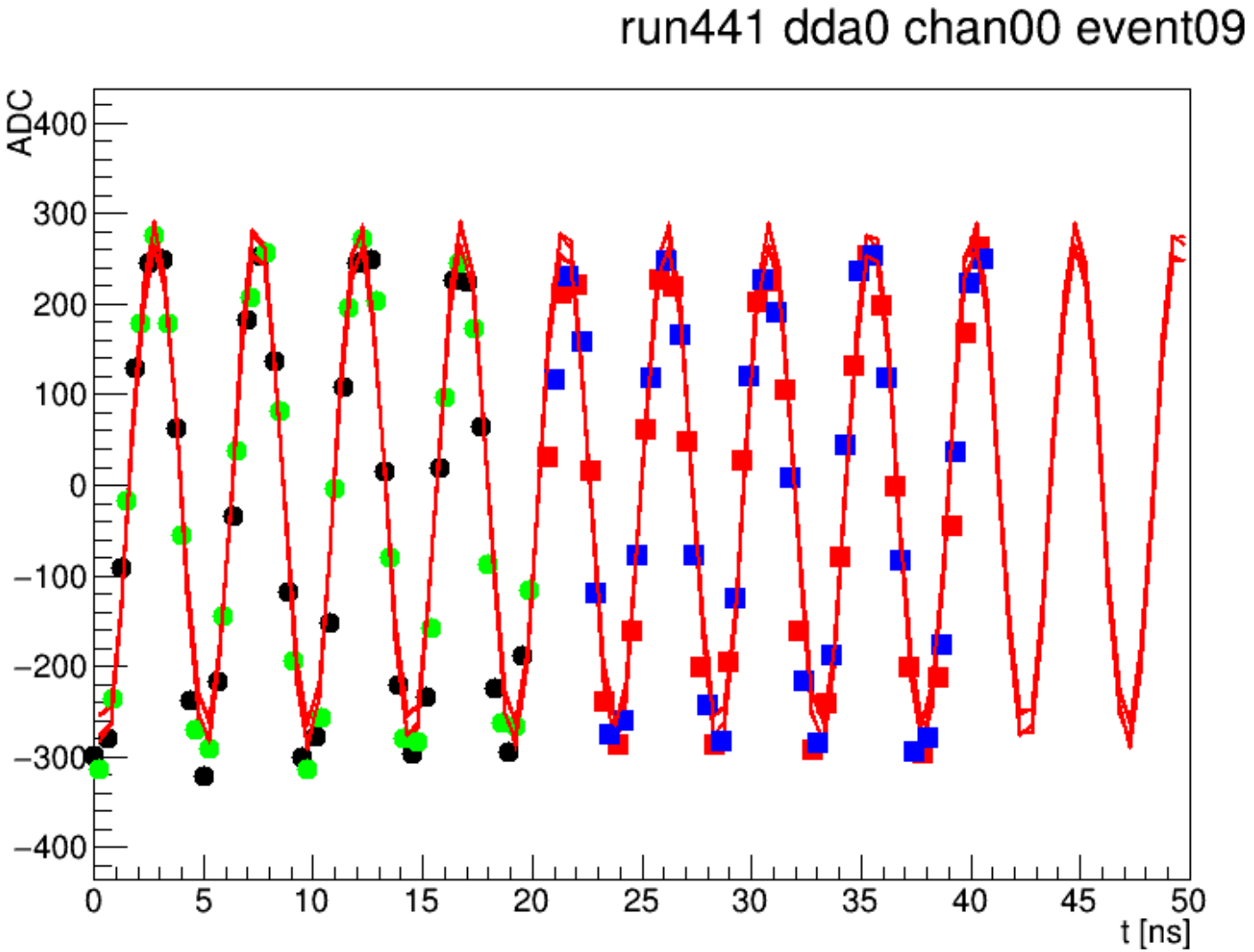
delay calibration Iteration 4







Timing correction



- Four parts (even/odd samples, first/second block)
- After phase/delay calibration, timing is done “globally”

summary

- Detailed calibrations on ARA 2-3
  - Pedestal calibration
  - ADC-Vpp calibration
  - Timing calibration
- Physics analysis are coming up soon

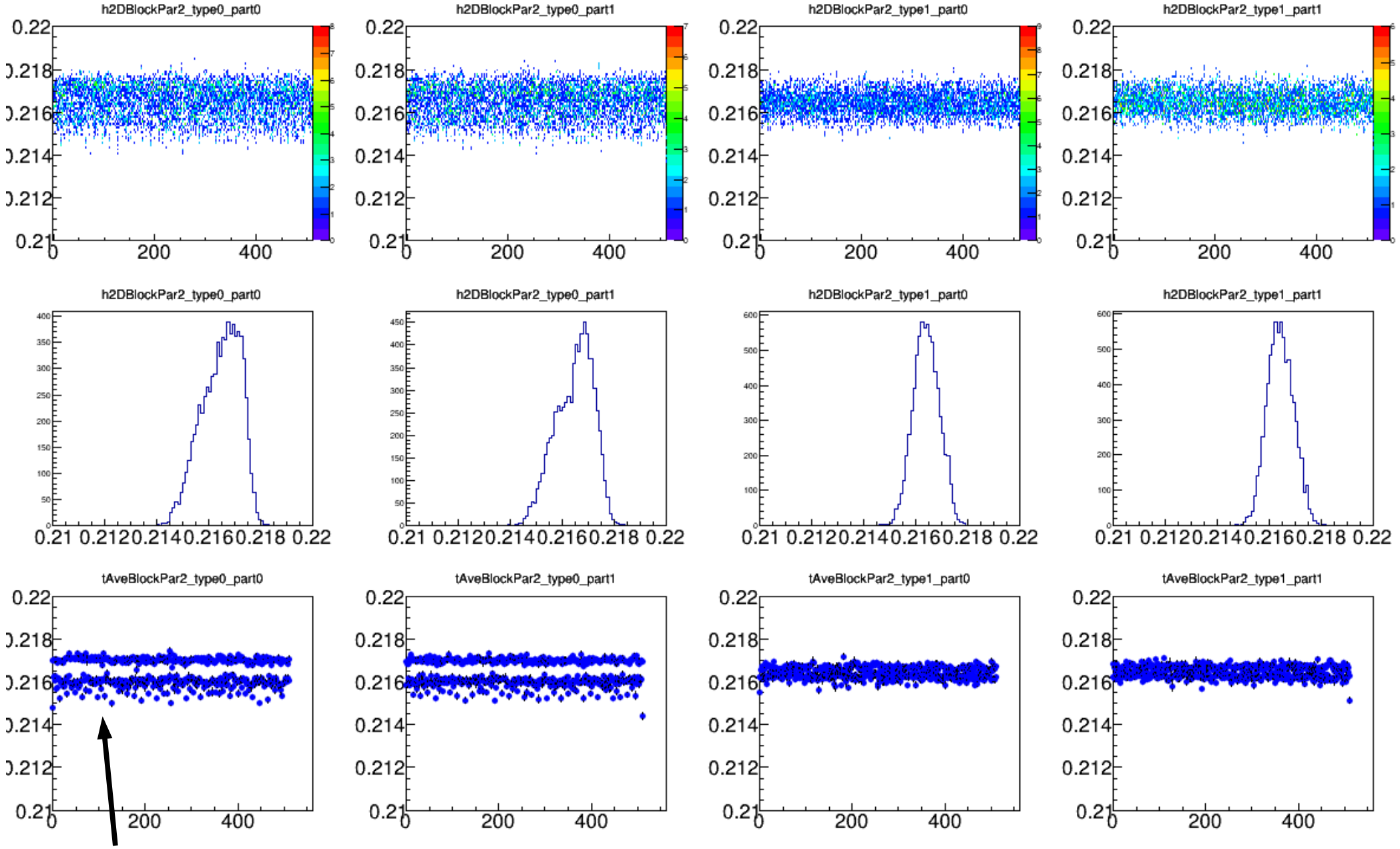
Backup slides

Even sample, first block

Even sample, second block

Odd sample, first block

Odd sample, second block



block-dependent

Iteration 0

Phase calibration
Iteration 0