

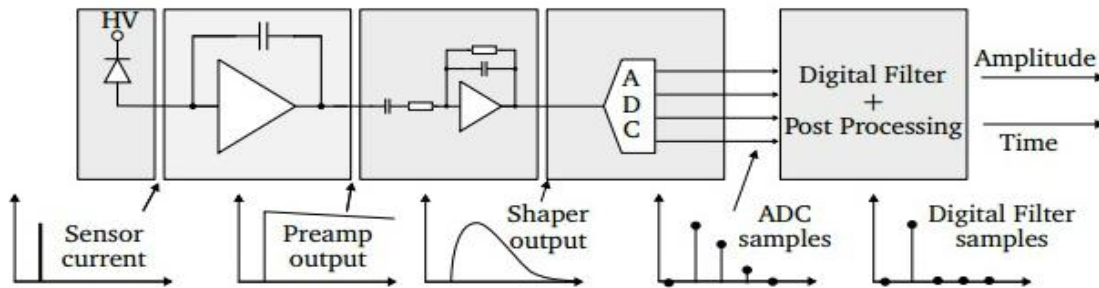
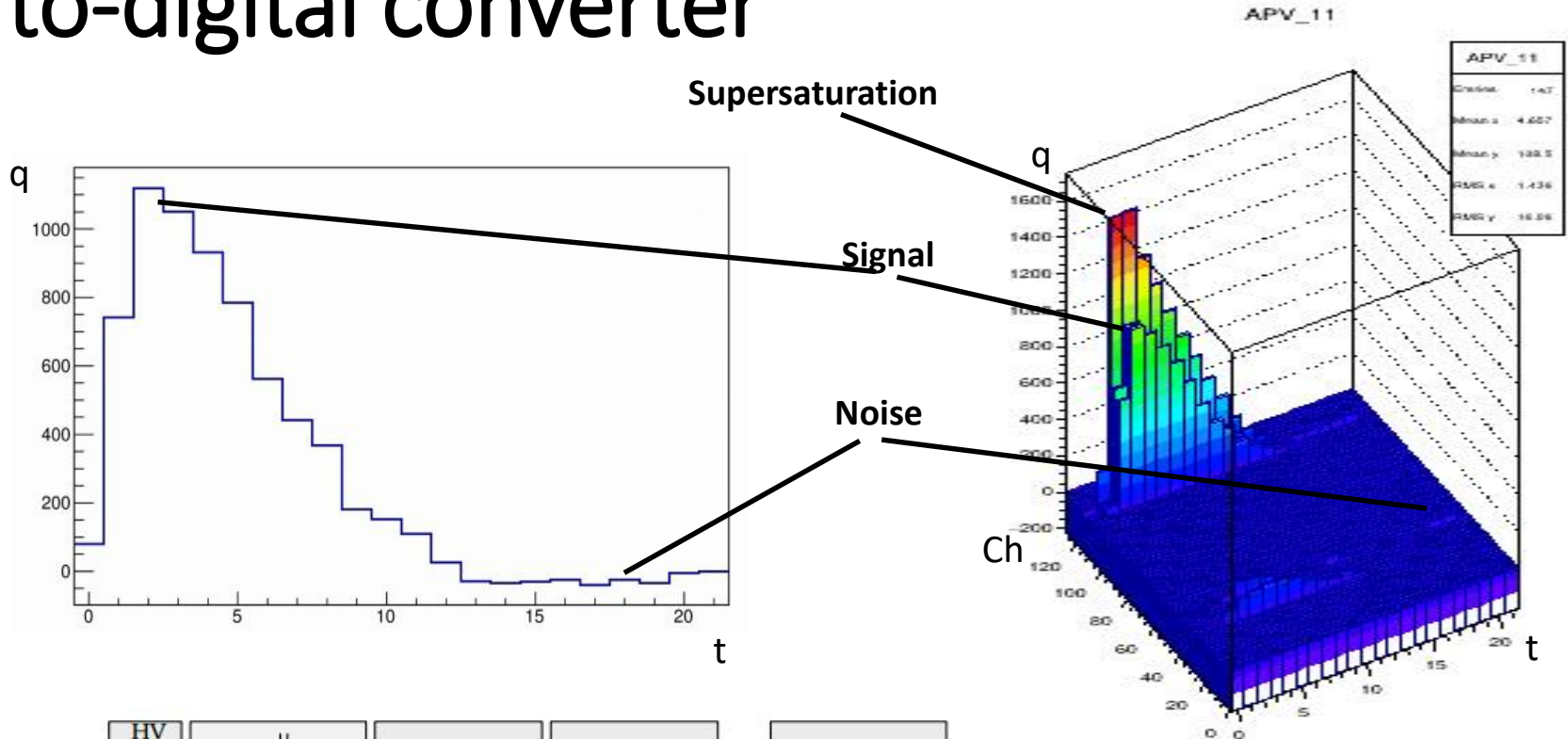


Alternative digital filter for LumiCal (TB2016)

Evgenii Lutsenko

31.01.2018

Time scanning of the signal in analog-to-digital converter

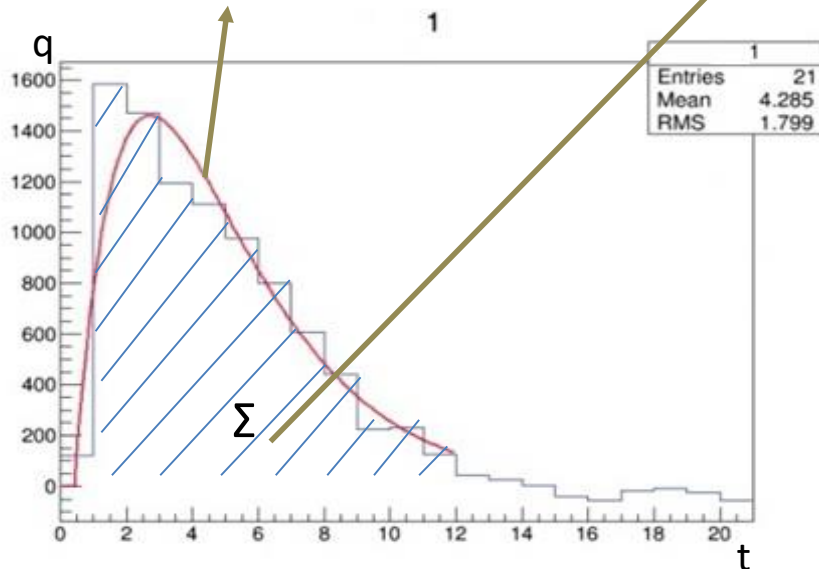


Digital signal filter

Standard scheme for digital filter – fitting time scan in a channel and definition maximum of the function (A_{fit}).

$$F(x) = \frac{A(x - t_0)}{\tau} * \exp\left(1 - (x - t_0)/\tau\right)$$

Alternative scheme: Parameterize a maximum value (A_{par}) with a sum signal value at the time (Σ) in each channel.



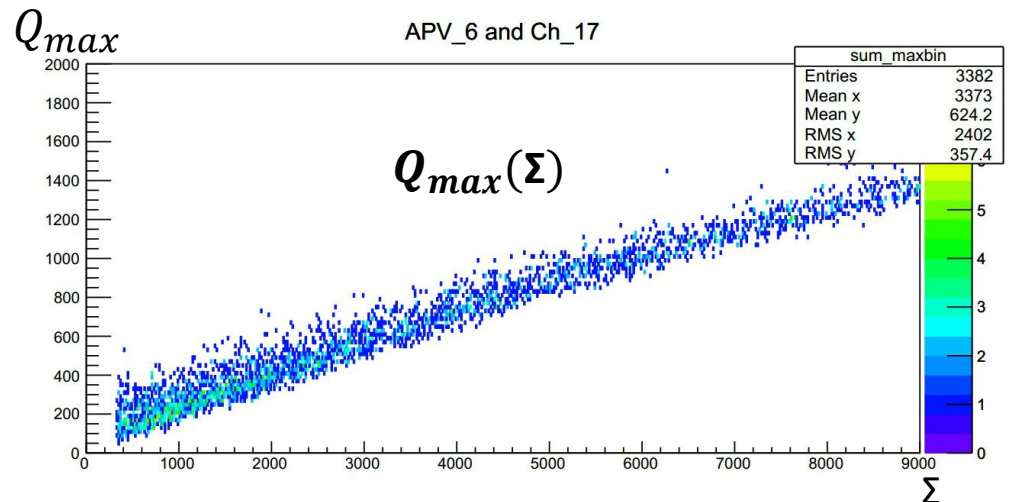
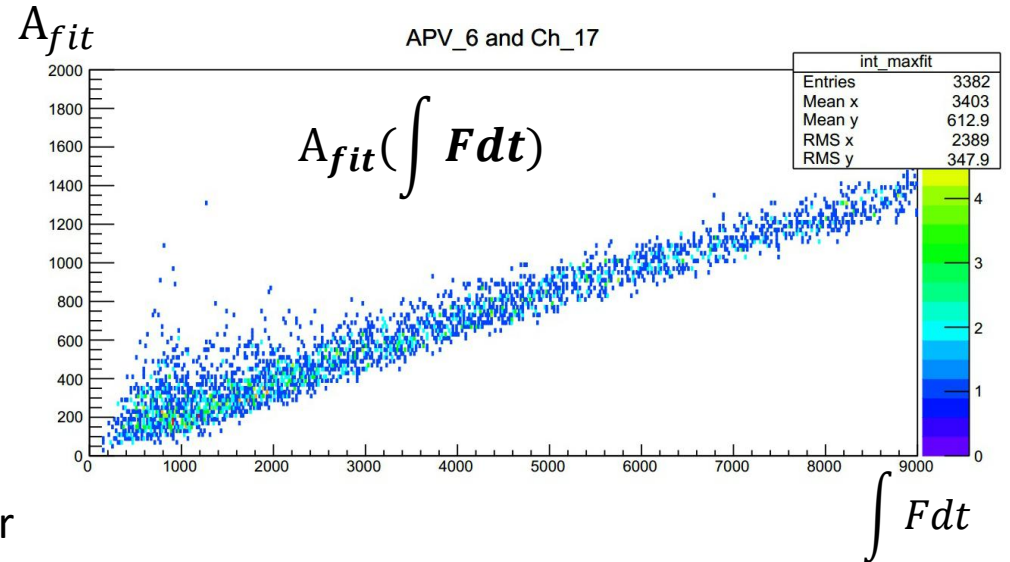
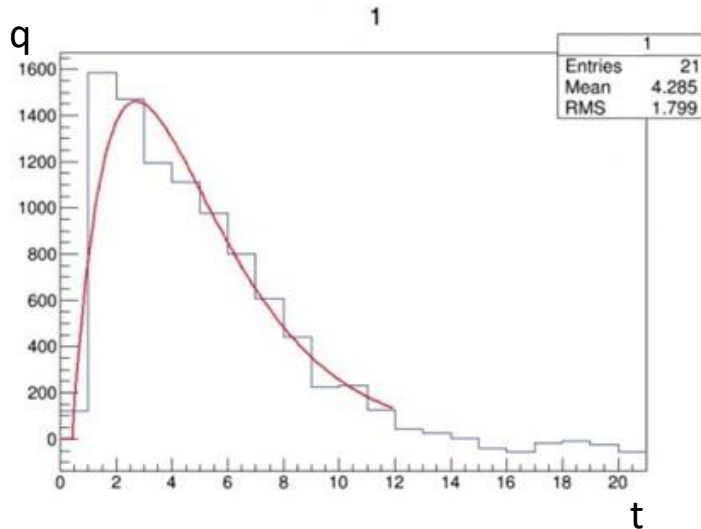
Motivation:

- stability
- less resource consuming
- can be hardware-based

Check digital filter schemas

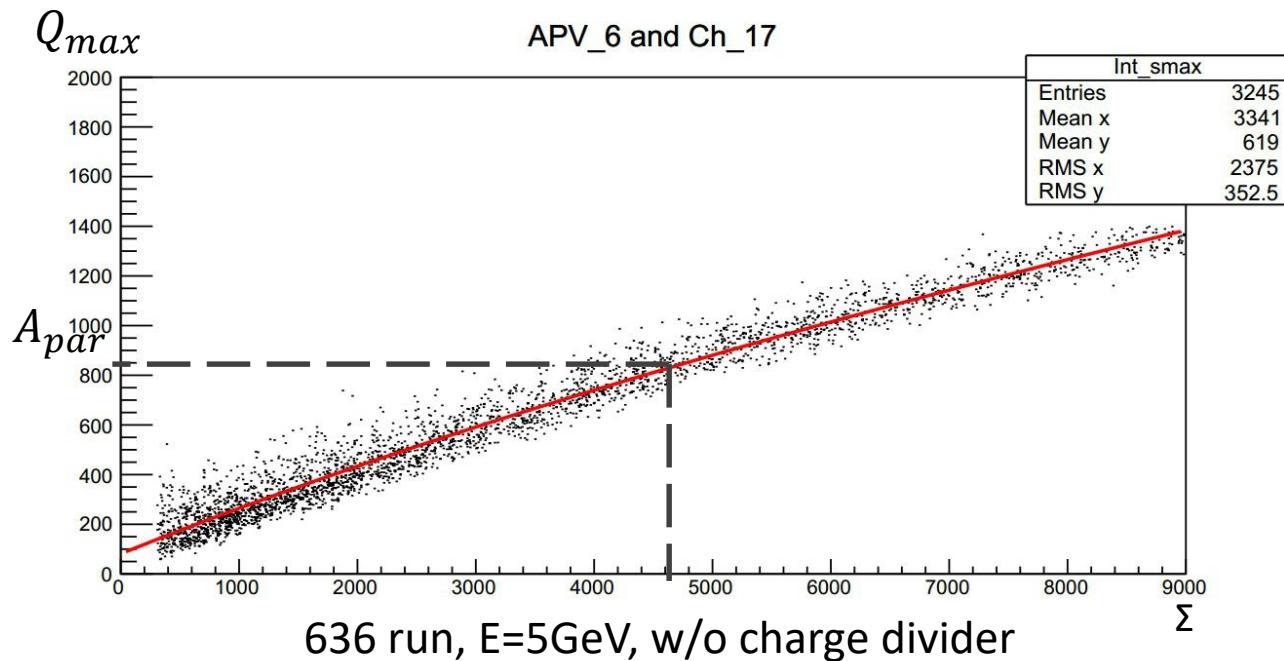
- Each point on the histograms on the right corresponds to the signal with h. 1
- Integral and sum was taken at the full time interval
- No cuts were used

636 run, E=5GeV, w/o charge divider



Parametrization $Q_{max}(\Sigma)$

A scheme with parameterization must be individually defined for each channel



$$S(x) = p1 + p2\sqrt{x + p3}$$

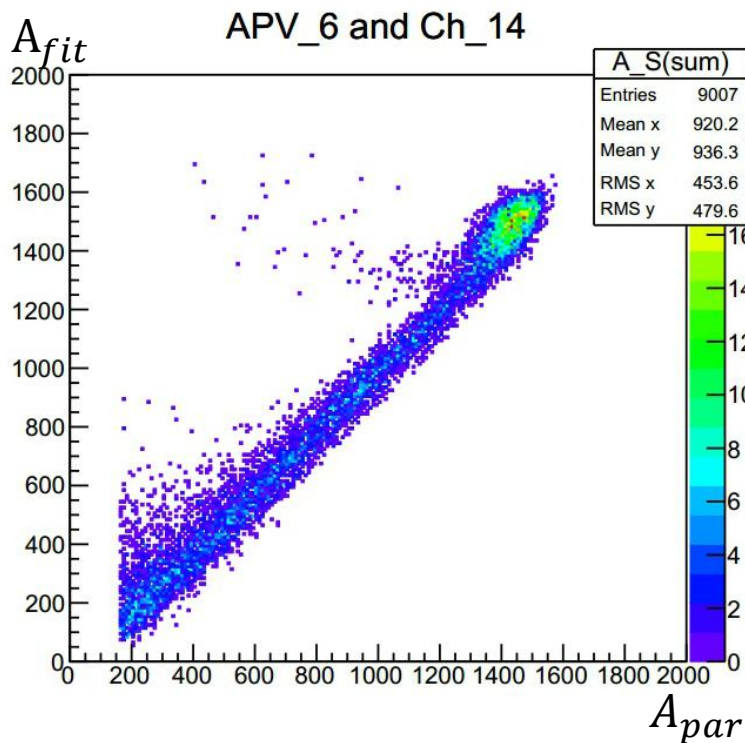
chi2=25738.8 NDF=1898 chi2/NDF=13.561

p1=-1580.38 p2=25.7465 p3=4162.02

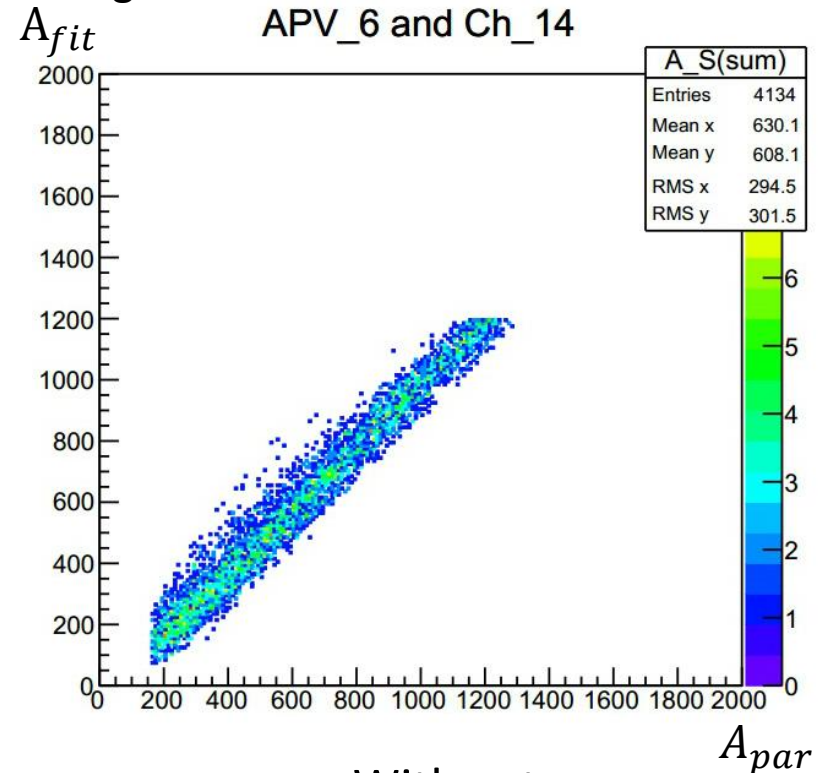
Correlations

The filtering schema with parametrization has no systematic deviation from the fitting schema

636 run, E=5GeV, w/o charge divider



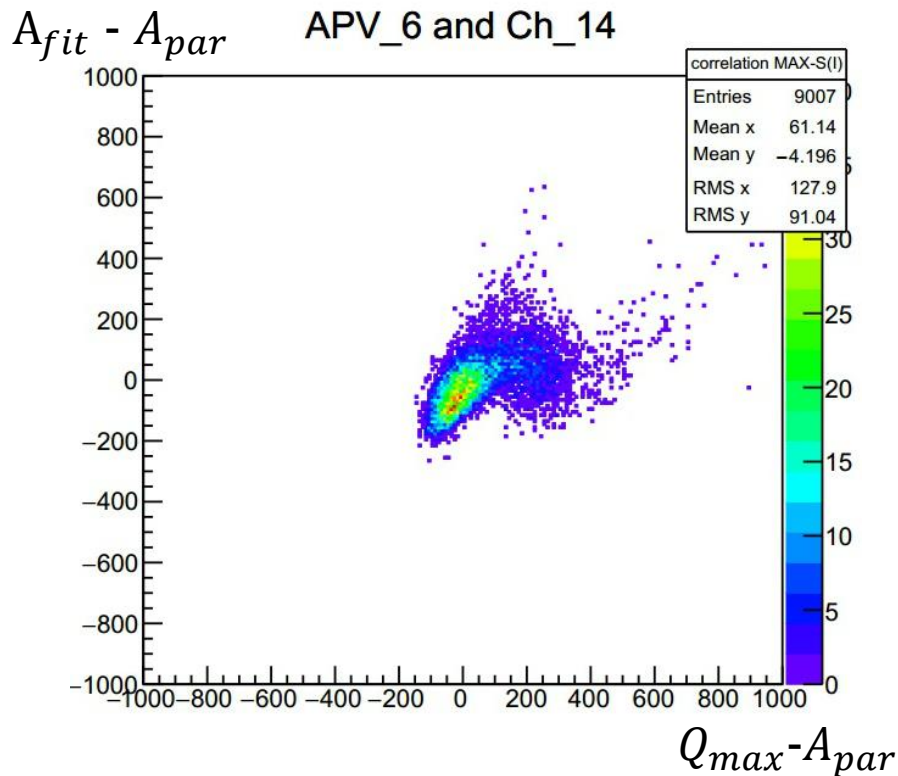
Correlation A_{fit} and parametrization A_{par}



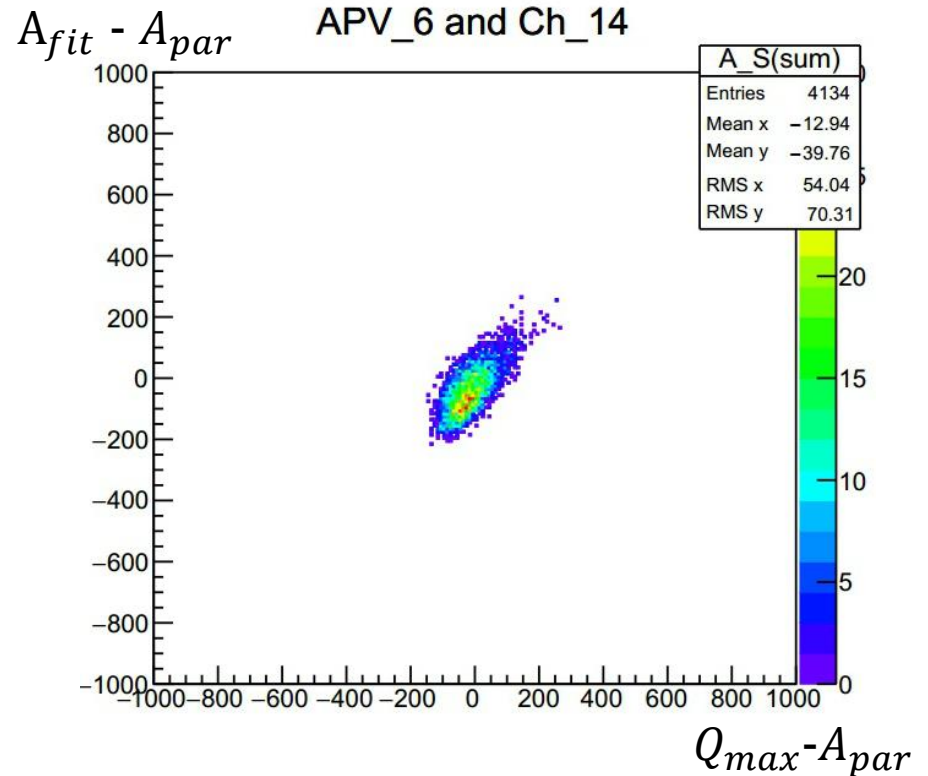
With cut

Correlations

636 run, E=5GeV, w/o charge divider



Correlation $A_{fit} - A_{par}$ and $Q_{max} - A_{par}$



With cut

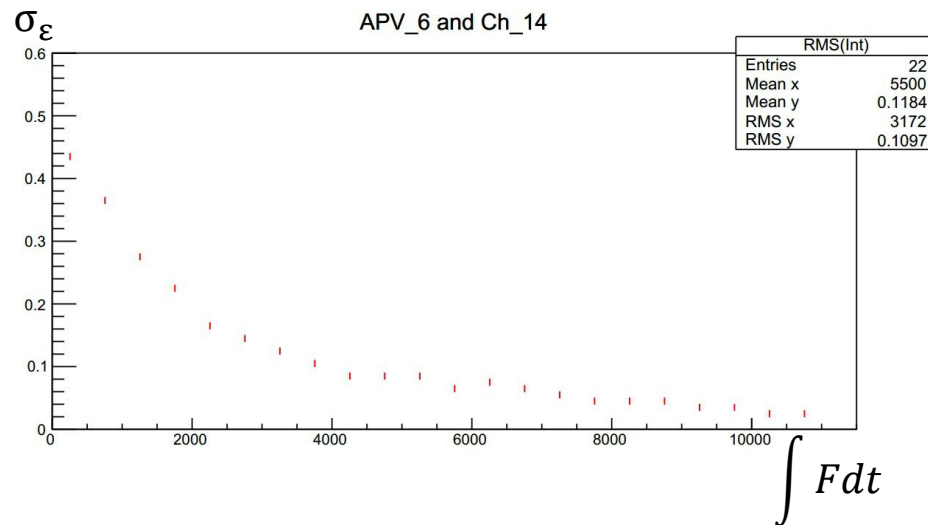
Relative fluctuations between digital filter schemas

$$\varepsilon = \frac{A_{par} - A_{fit}}{A_{fit}}$$

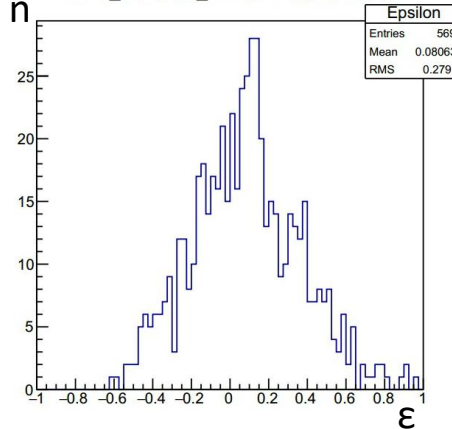
$$\sigma_{\varepsilon} = RMS(\varepsilon)$$

- Fluctuations in fitting scheme depend heavily on the amount of charge
- Fluctuations have statistical nature and don't have systematic deviations

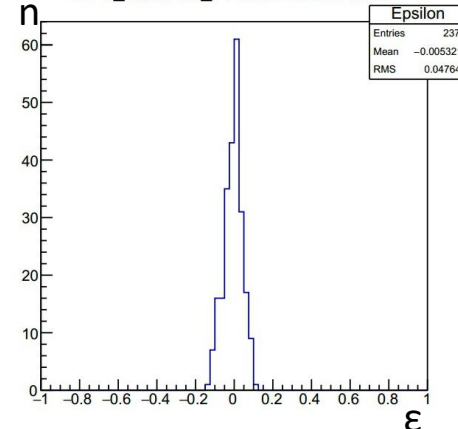
636 run, E=5GeV, w/o charge divider



APV_6 and Ch_14 from 1000 to 1500

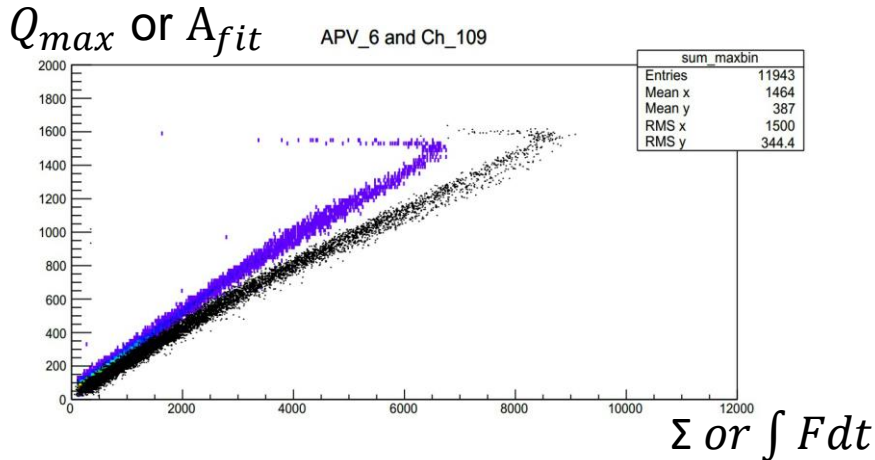


APV_6 and Ch_14 from 7500 to 8000

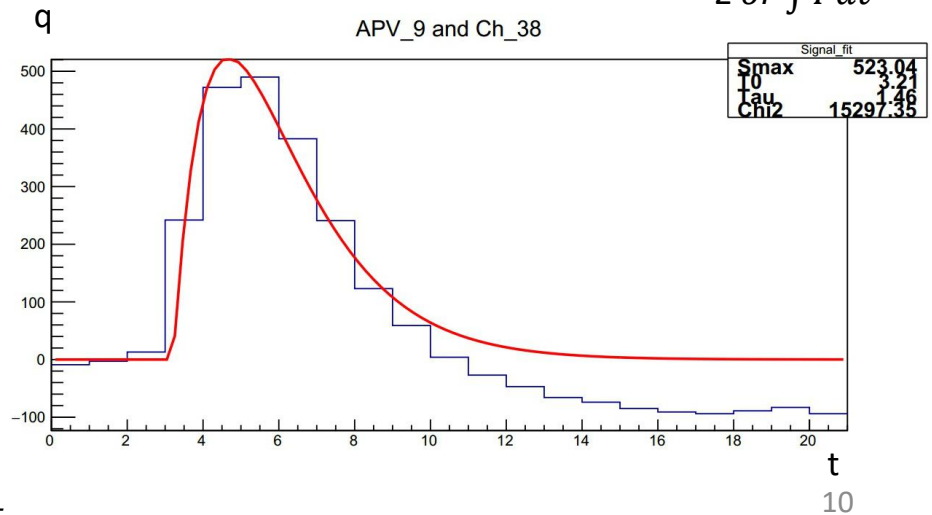
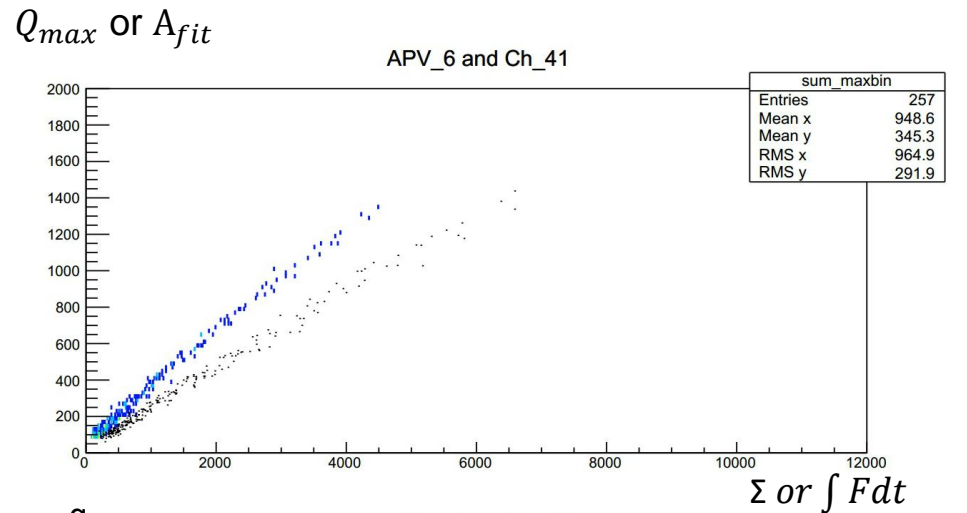


A negative values

- A discrepancy was found in the values of the sums and the integrals of fit
- Black points – integral fit, color points – sum of the values
- $\Sigma < \int F dt \Rightarrow$ large negative values in the bins
- Estimates of such events and channels around 10-20%



739 run, E=5GeV, with charge divider



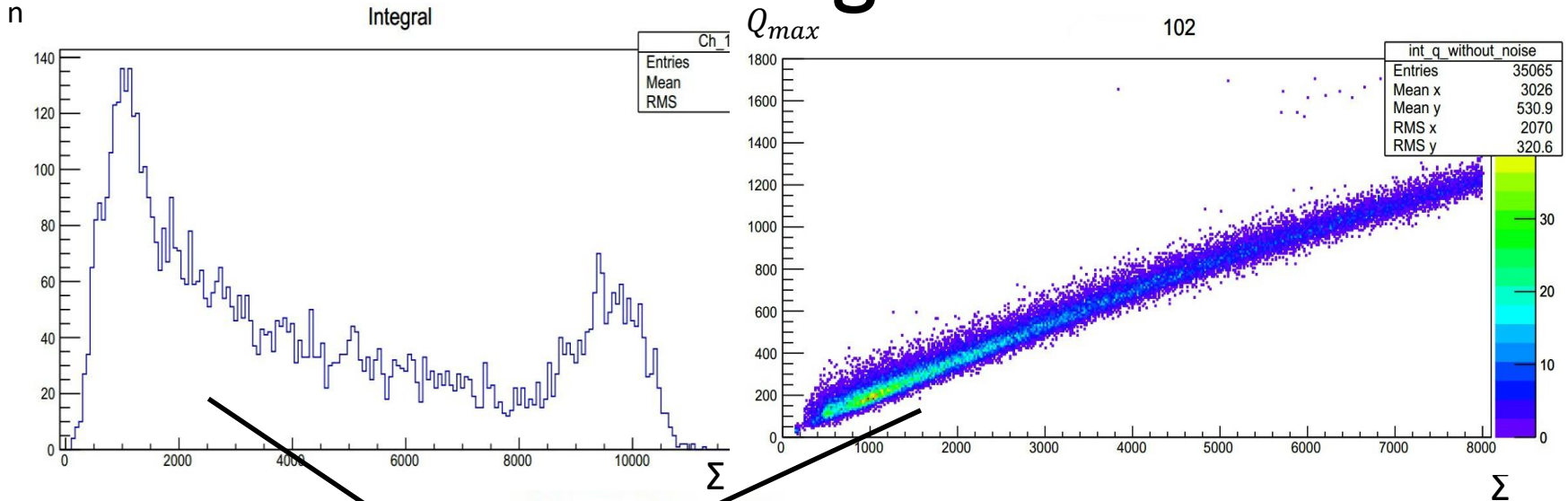
804 run, E=5GeV, with charge divider

Summary & Future plans

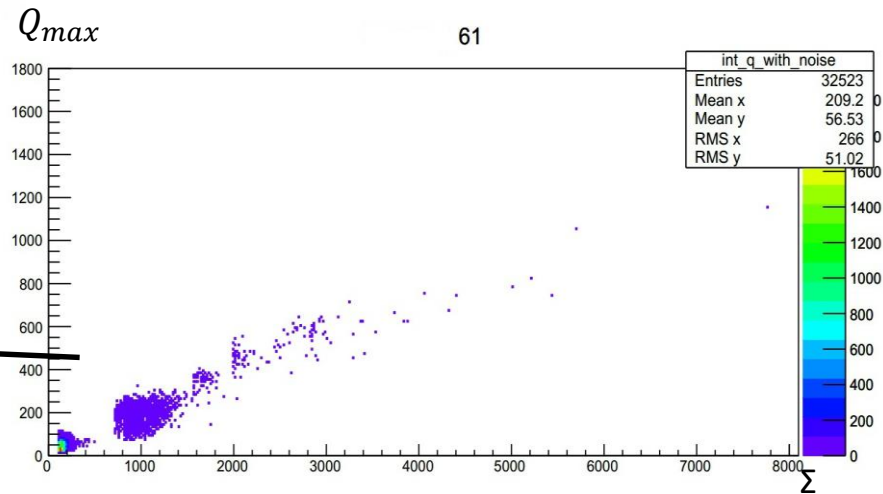
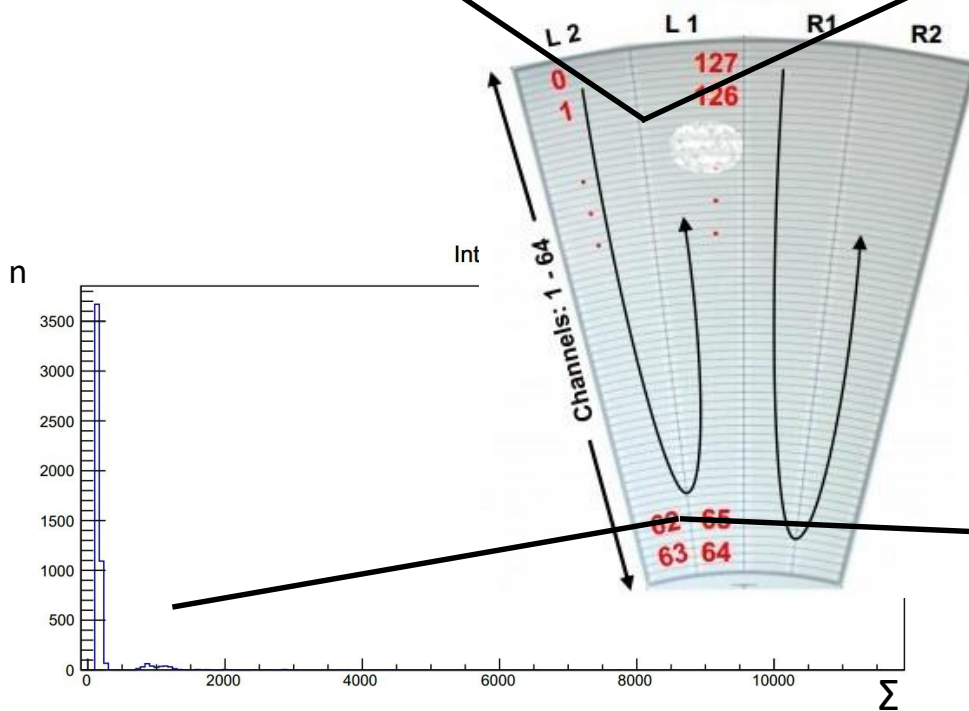
- ✓ **Developed the alternative scheme of digital signal filter**
- ✓ **Compared standard and alternative schemas**
- ✓ **Developed the scheme of digital filter approximately 15 times faster than the standard**
- ✓ **The negative values were detected for some runs**
- **To compare the alternative scheme with the standard in reconstruction of tracks**

**Thank you for your
attention!**

Σ and signal

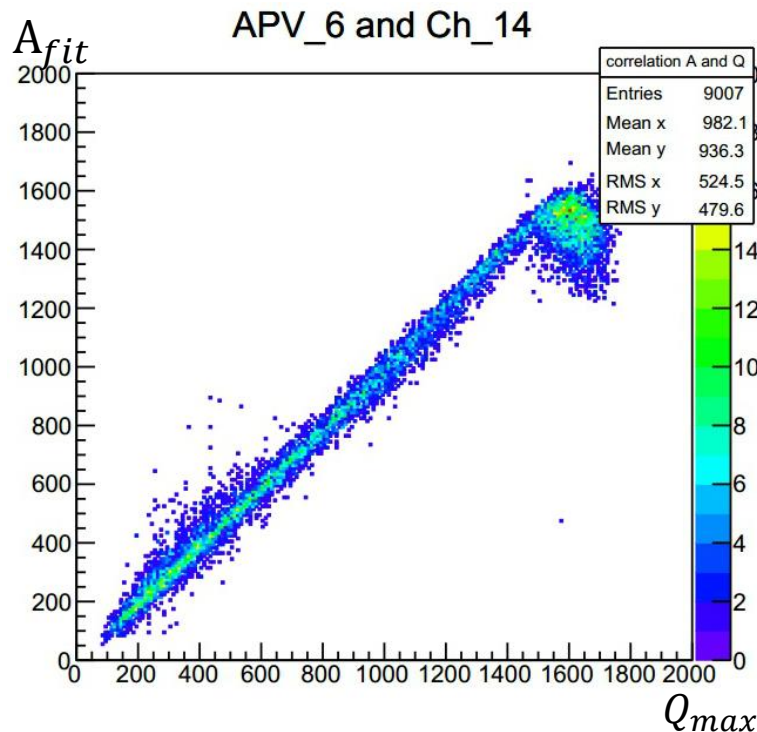


636 run, E=5GeV, w/o charge divider

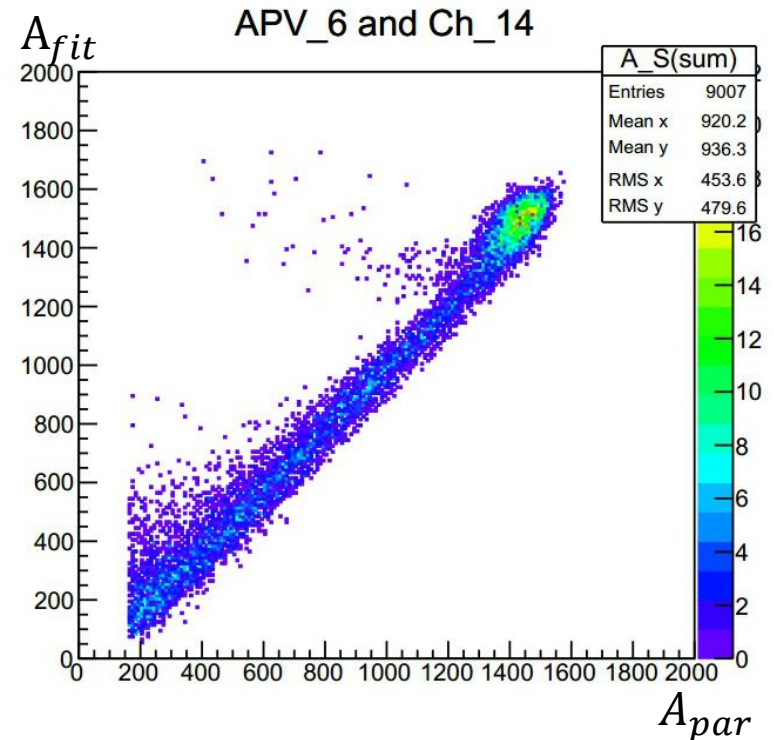


Correlations

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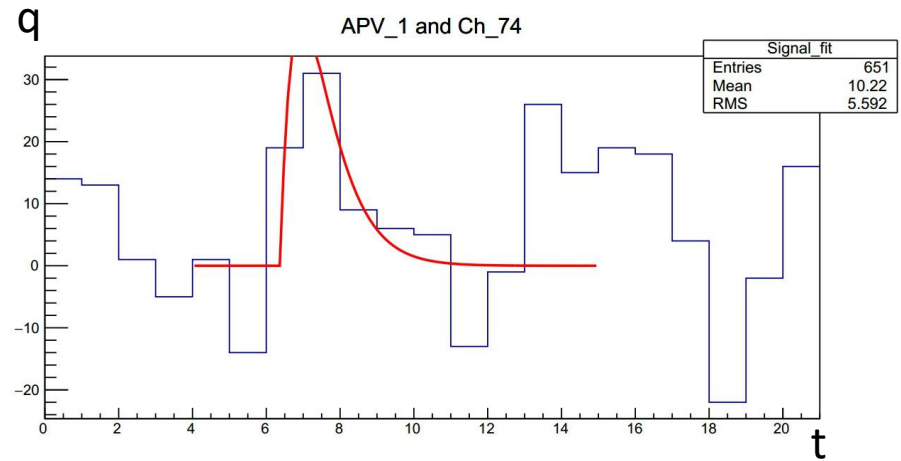
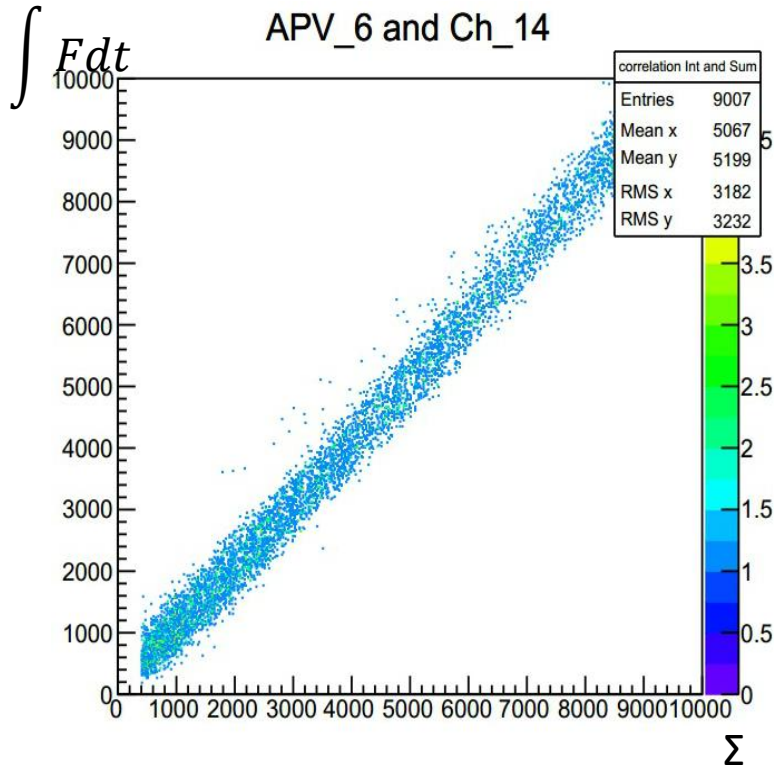
Correlation A_{fit} and Q_{max}



Correlation A_{fit} and parametrization A_{par}

636 run, E=5GeV, w/o charge divider

Correlation and fit of noise



636 run, E=5GeV, w/o charge divider

Schema TestBeam 2016

