Deconvolution

Novgorodova Olga

HELMHOLTZ ASSOCIATION

DESY

Method

required for single-bunch time resolution (Bingefors *et al.* 1993). The underlying notion is to use rather slow pulse shaping and then to apply a deconvolution algorithm to reconstruct the fast components of the input signal. For the sampled output of a CR-RC shaper with the step response

$$v(t) = \frac{t}{\tau} e^{-t/\tau} \tag{8.15}$$

this can be implemented by forming the weighted sum of three successive samples

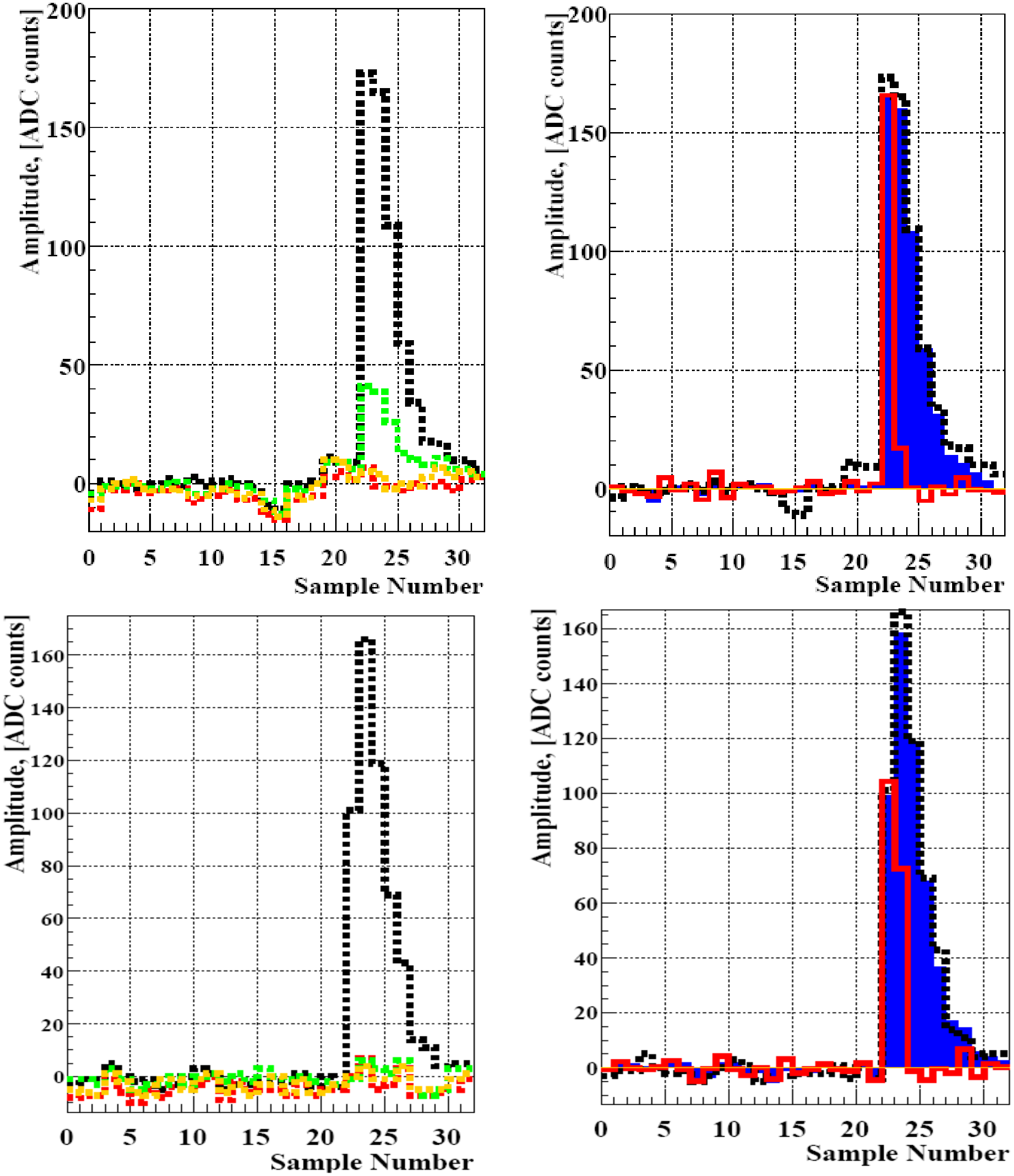
$$V_k = w_1 V_k + w_2 V_{k-1} + w_3 V_{k-2} \tag{8.16}$$

with the weights

$$w_1 = \frac{1}{x} e^{x-1}, \quad w_2 = -\frac{2}{x} e^{-1}, \quad w_3 = \frac{1}{x} e^{-(x+1)} \tag{8.17}$$

(Gadomski 1992, Bingefors *et al.* 1993). The weights depend on the sampling interval normalized to the shaping time constant $x = \Delta t/\tau$. For a step input the result of the deconvolution is zero. However, for a finite rise time the result is a short pulse with the duration of the rise time. The APV25 uses a time constant $\tau = 50\,\text{ns}$ in the CR-RC filter and samples the output at 40 MHz, so $x = 0.5$ and the weighting factors

Example



Signal Processing:

1. **CMN calculation from all non hit channels of the same chip**
2. **CMN subtracted (blue histogram)**
3. **Deconvolution method applied (red histogram)**

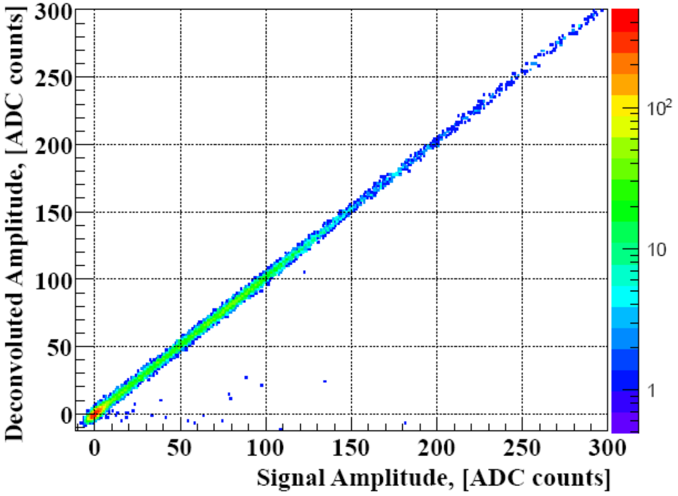
4. **Different signals examples are shown.**

5. **Deconvolution method repeats first signal bin.**

6. **In case of synchronized data should work better**

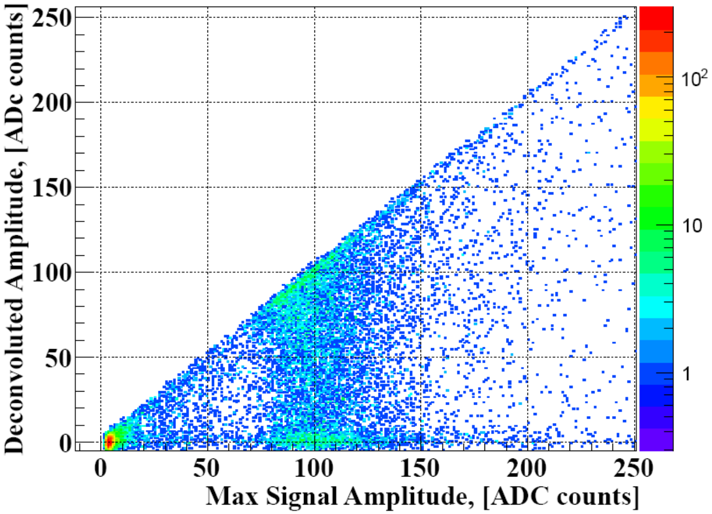
Correlations

- Bin with maximum deconvoluted value vs the same bin signal amplitude
- Full proportionality



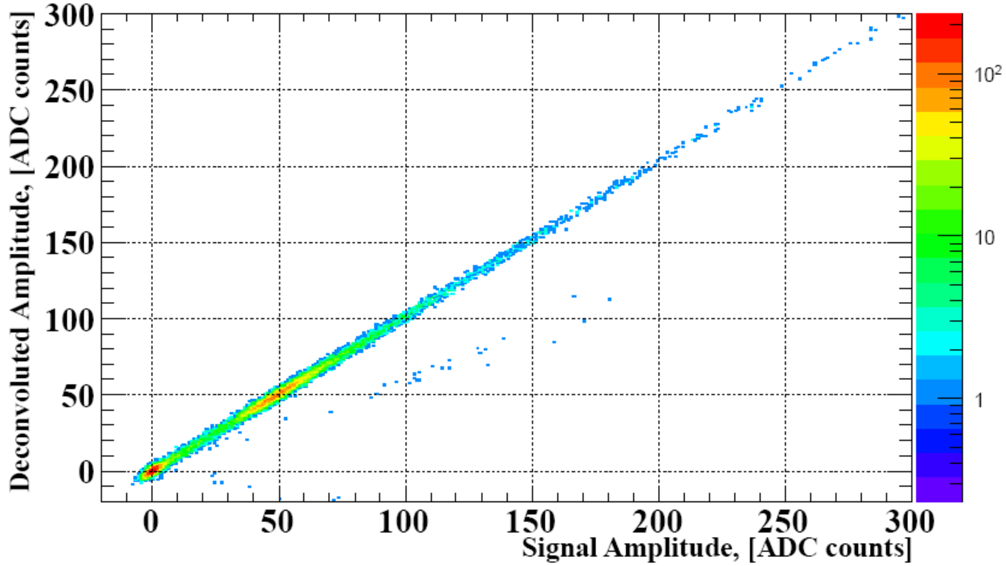
- Bin with maximum deconvoluted value vs the maximal signal amplitude

- Method depends on the first bin with the signal



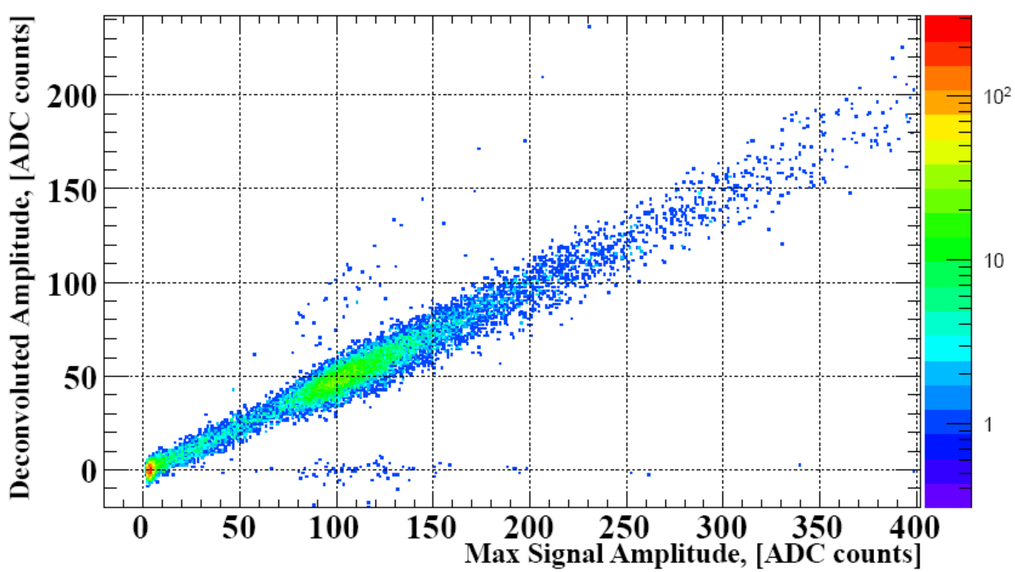
Synchronized data

- Bin with maximum deconvoluted value vs the same bin signal amplitude
- Full proportionality

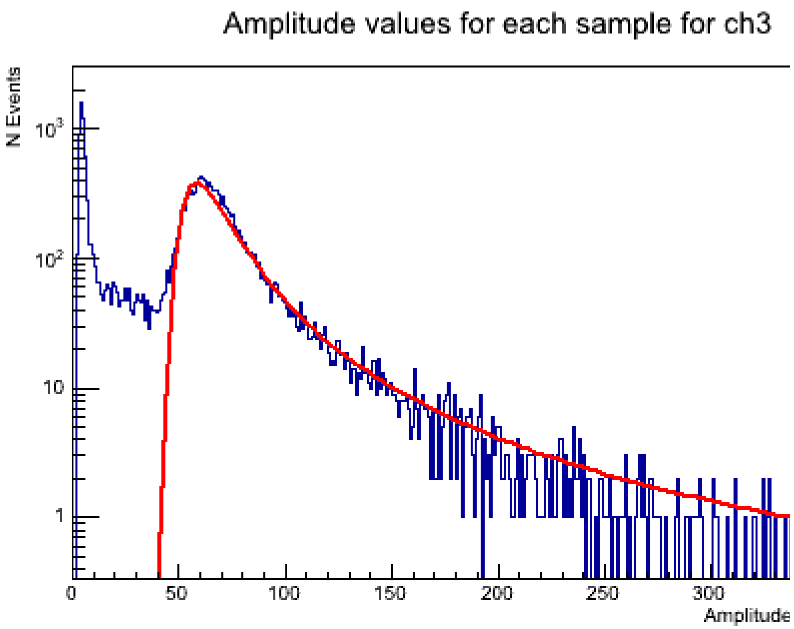


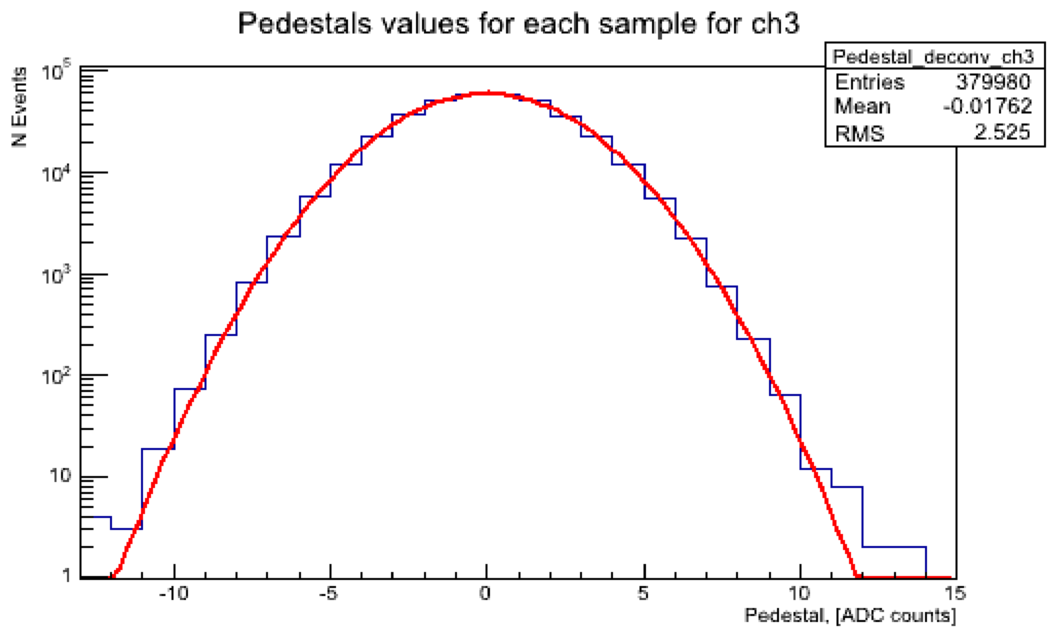
- Bin with maximum deconvoluted value vs the maximal signal amplitude

- Method works better on synchronized data



Conclusions





- Deconvolution Amplitude spectrum is distributed over Landau Gauss convolution
- Pedestal is calculated in the window before the signal coming (1-16 samples)
- S/N = 59.6/2.5 = 24