Waveform Deconvolution

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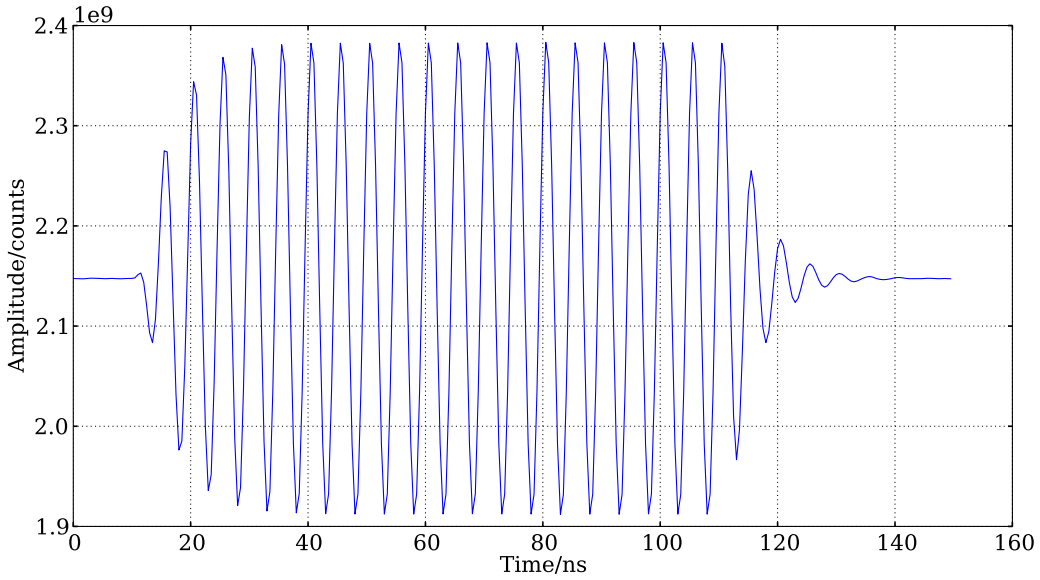
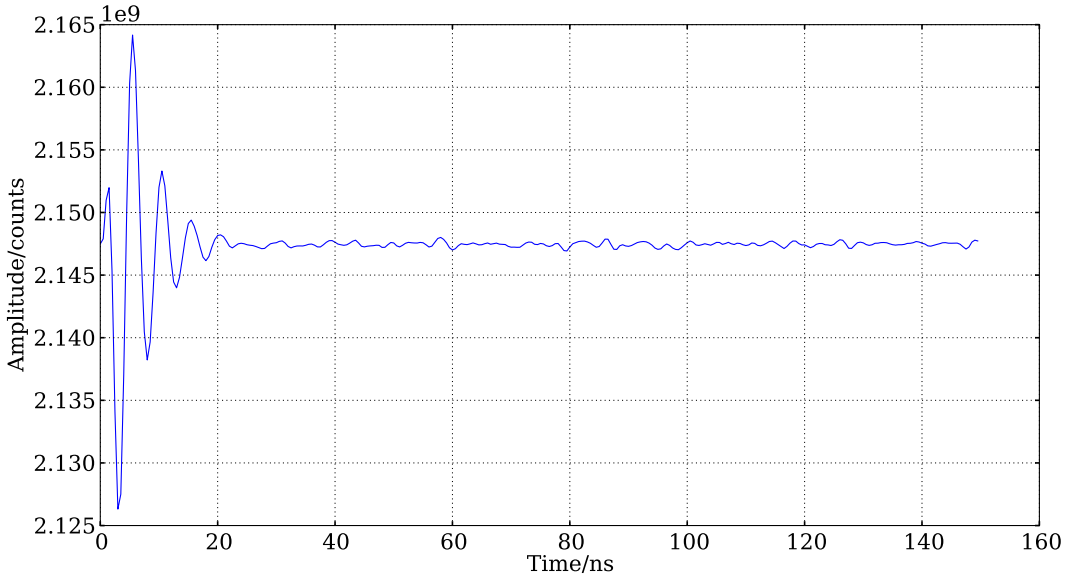
Simulation

- Cavity BPM signal is convolution of single particle response with bunch structure
- Simulation of CTF3 prototype system:
  - 15 GHz pick-up
  - 5 ns signal decay
  - Simple receiver electronics
  - 200 MHz IF
  - 2 GS (32 bit) digitiser
  - Thermal noise
  - 0.67 ns bunch separation





Simulation

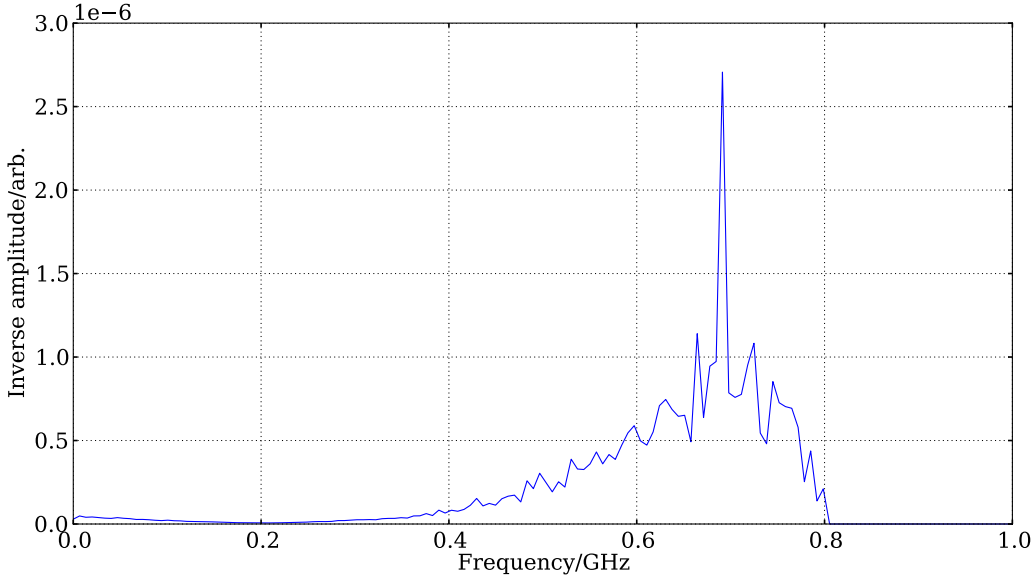
- Scale the inverse frequency response:

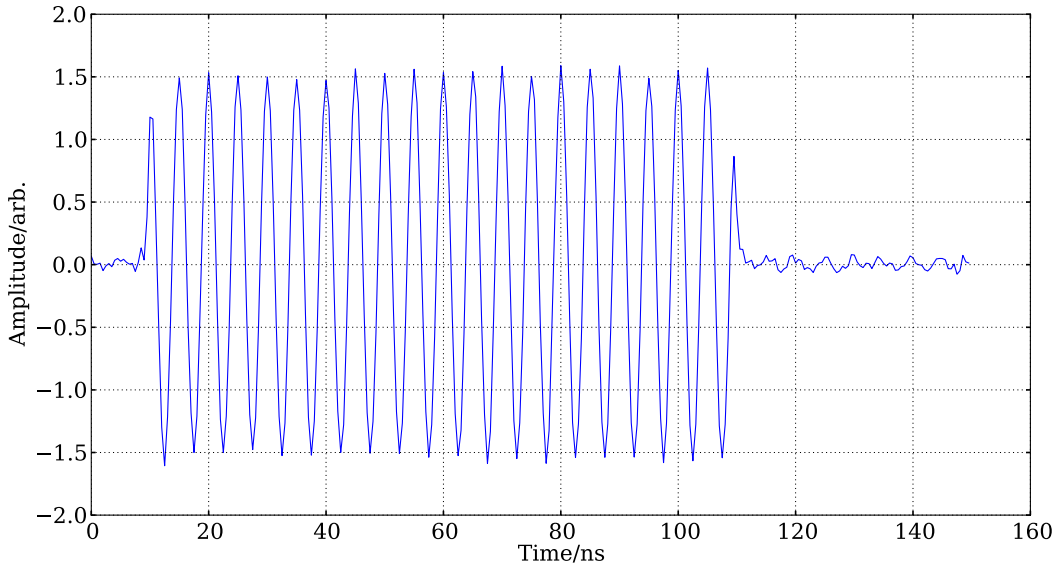
$$\frac{f_2 - f}{f_2 - f_1}$$

- f_1=670 MHz
- f_2=800 MHz

S. Smith et al., DIPAC2011

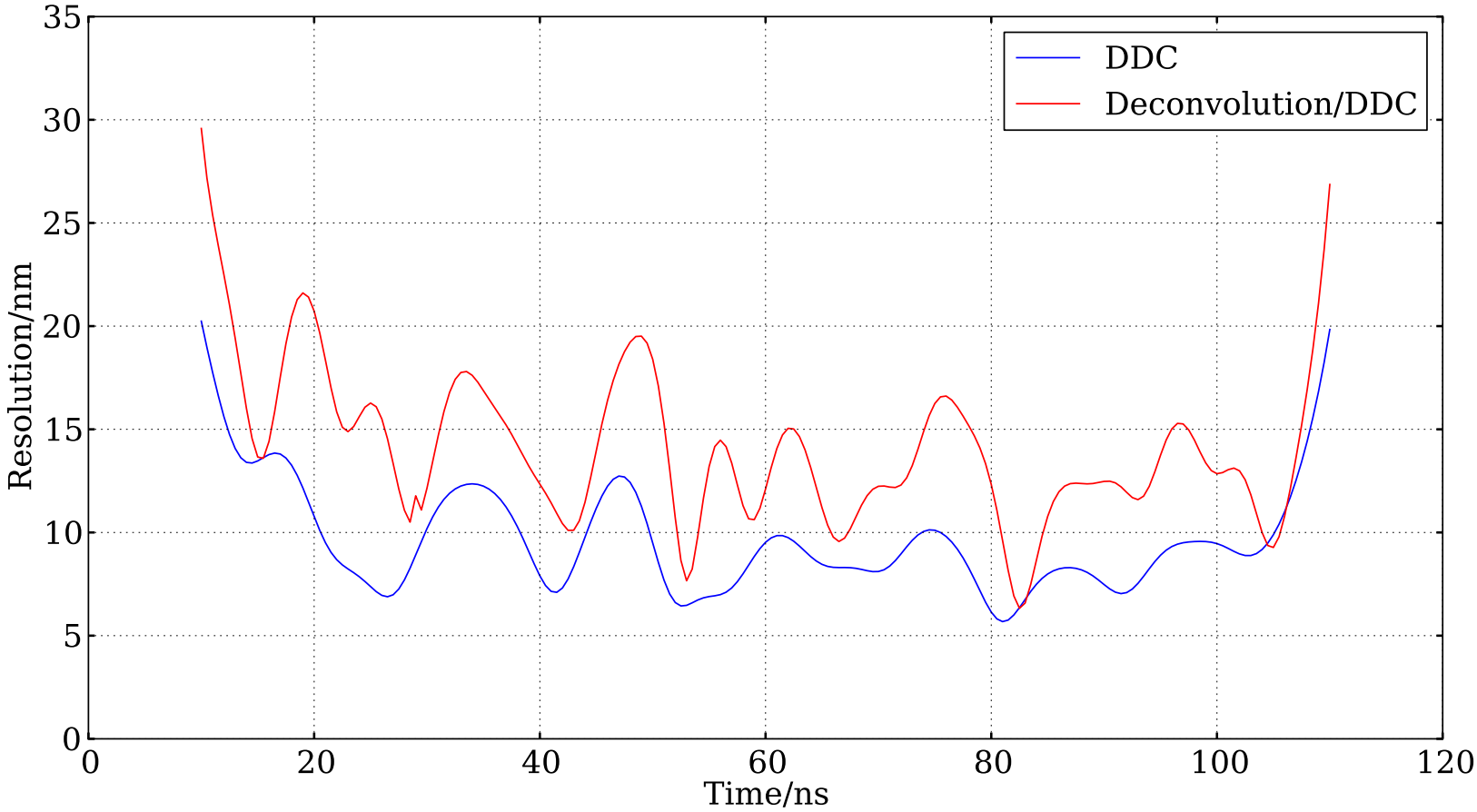
- Wiener deconvolution?





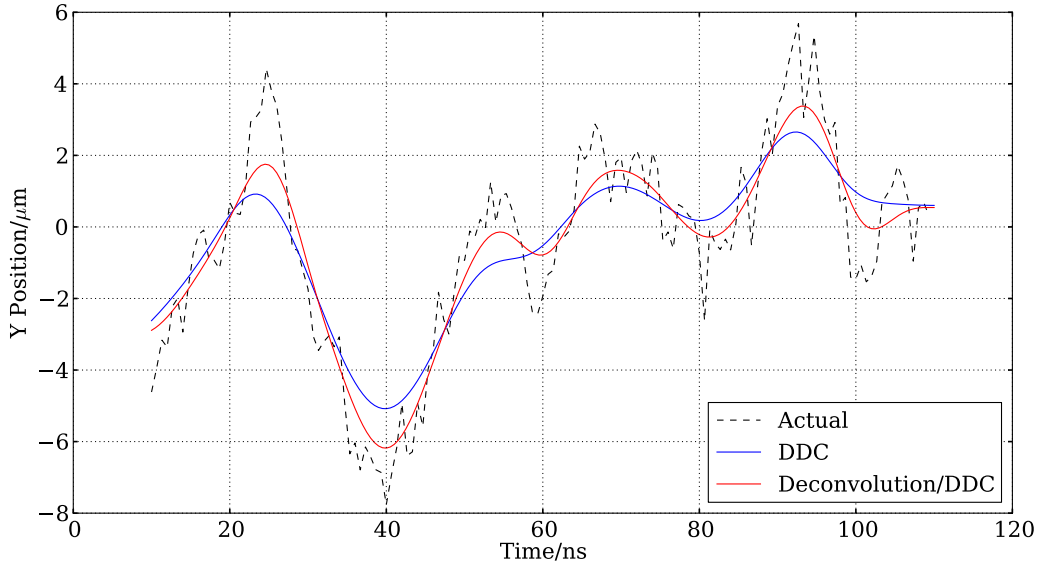
Resolution

- No bunch to bunch position jitter

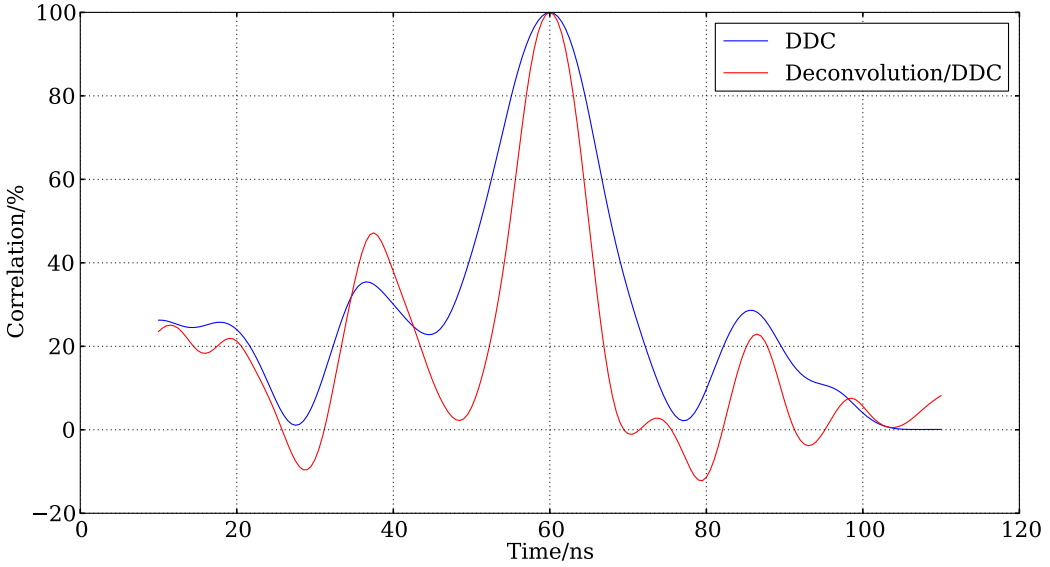


Results

- 53 MHz Gaussian filter
- 1 µm position jitter between bunches with random walk

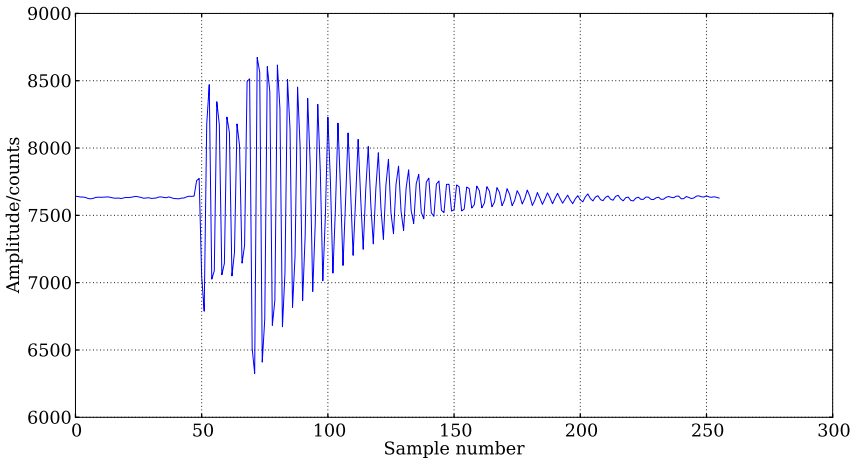


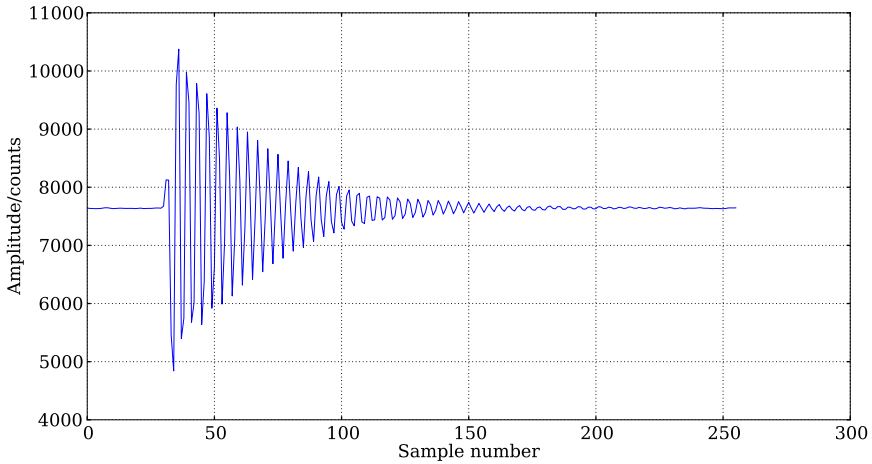
- 1 µm random position jitter
- 150 pulses



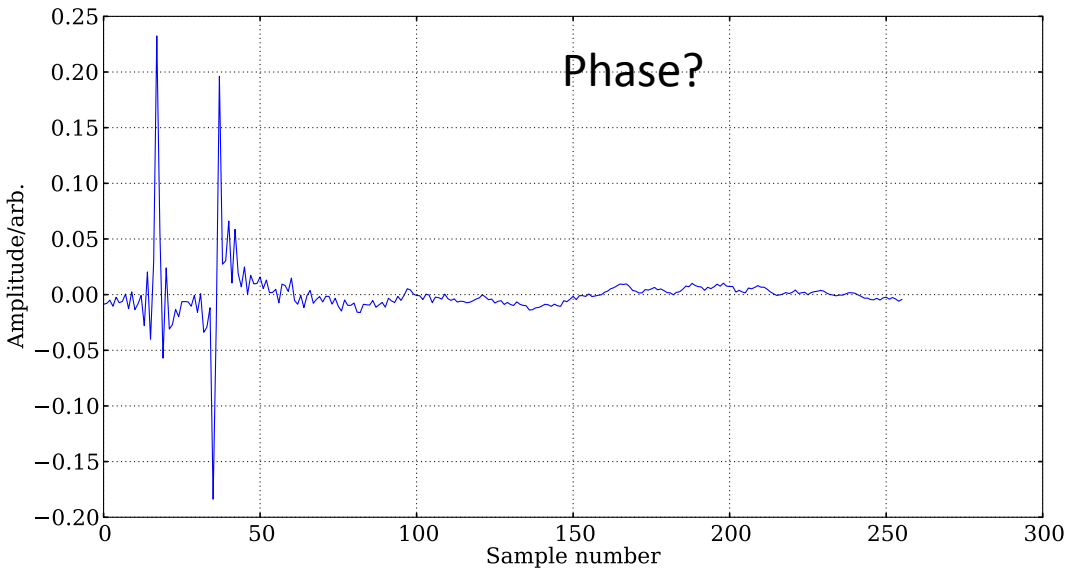
ATF2 Example

- 179 ns bunch separation
- ≈300 ns decay time





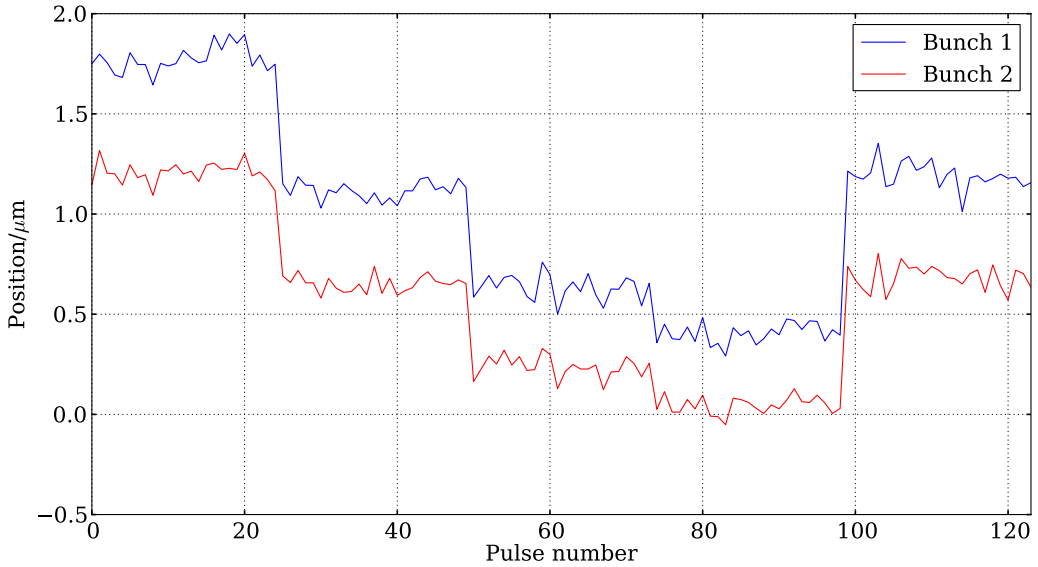
- Same for reference cavity
- Sample at peak



Data taken by N. Joshi

ATF2 Example

- Steps of 100 µm
- Position scale is about 200 µm



- Jitter 0.07 corresponds to about 14 µm