

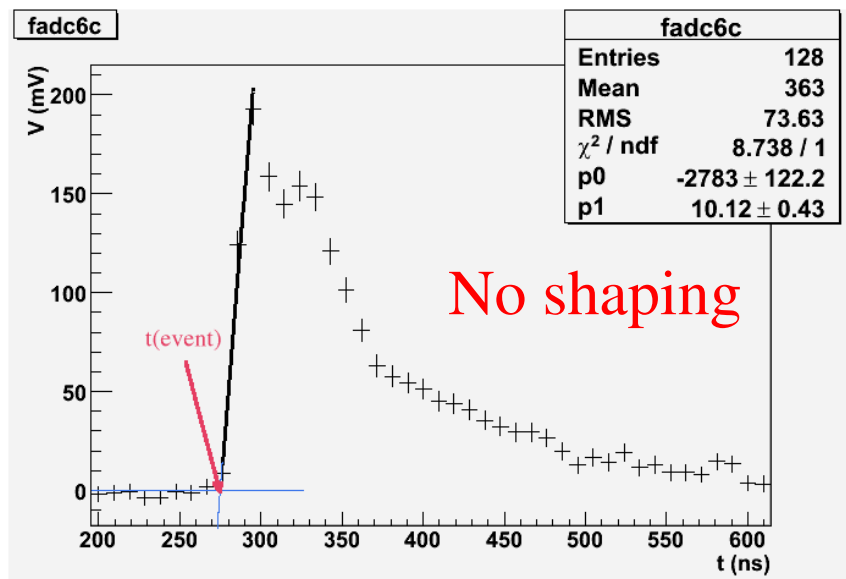
Update on Shaping Studies

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(in collaboration with Gerard Visser (IUCF))

- Motivation: determine optimum method for extracting time from FADC data
 - Determine slowest usable sampling rate to obtain ~ 1 ns resolution
 - Previous studies hampered by mismatch between sampling rate and rise time
- Method: compare FADC time to TDC time (from leading edge discriminator)



Previous results:

linear extrapolation method

$$\sigma_t = 4.52 \text{ ns}$$

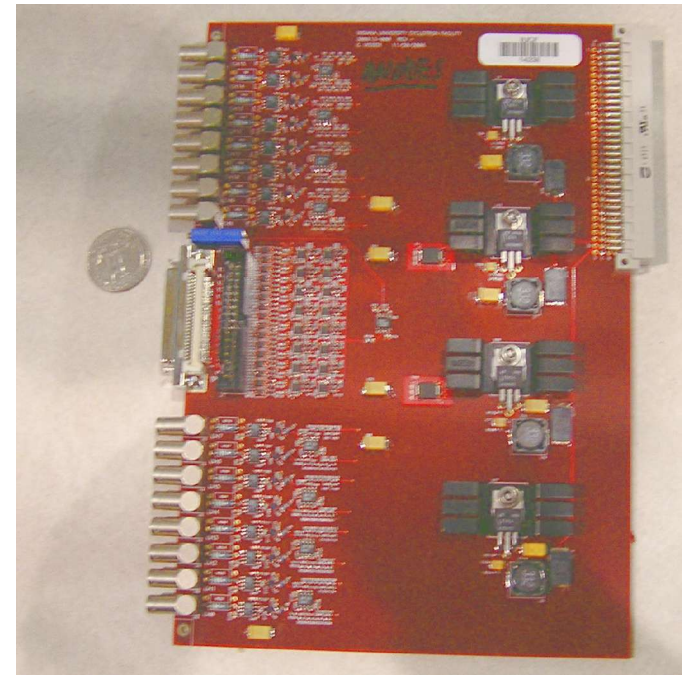
Pulse shape model

$$\sigma_t = 4.22 \text{ ns}$$

Shaping signals and FADC readout

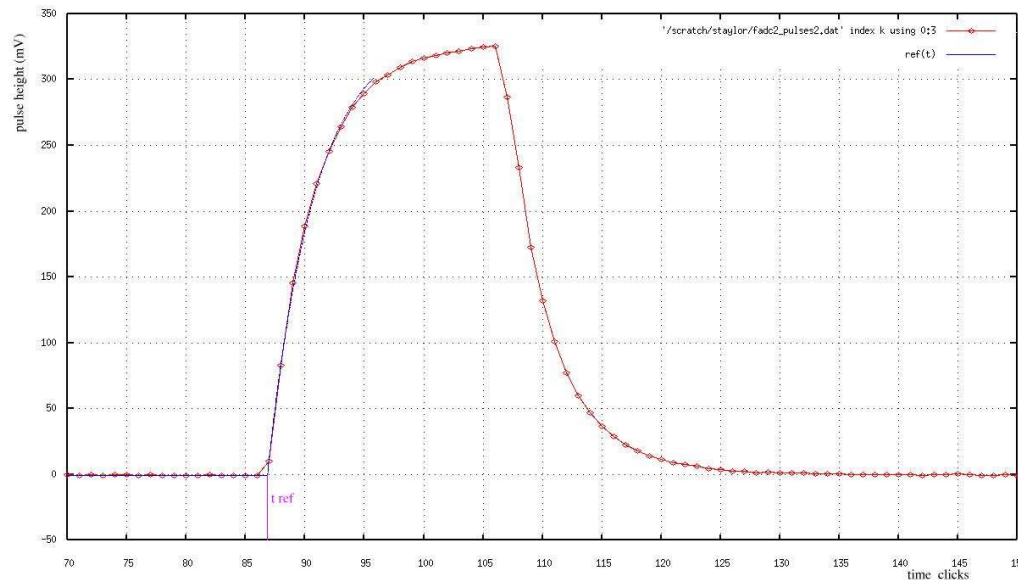
- Two 8-channel Struck Flash-ADC modules:
 - SIS3300 (100 MS/s internal clock): 7 adjacent strips
 - SIS3320 (200 MS/s internal clock): 7 adjacent wires
- External clock source (currently set to 100 MHz)

- Amplifier-shaper modules (Gerard Visser)
 - Shape pulse for more samples in leading edge
 - Two gain settings (cathode = $5 \times$ anode)
 - ~ 28 ns peaking time
 - Tail cancellation



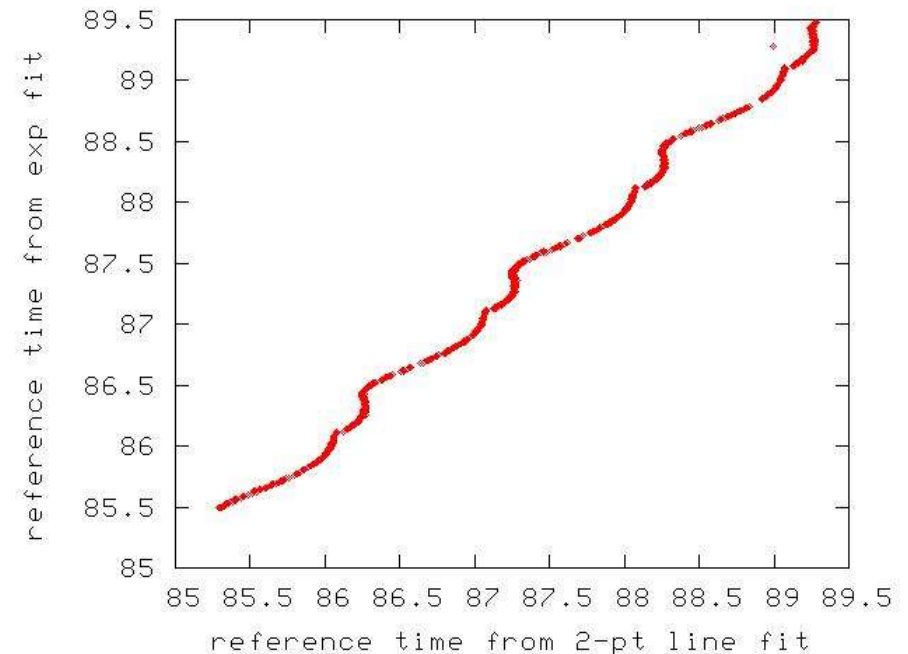
Reference Pulse

- Trigger signal connected to first readout channel in each FADC
 - Purpose: determine phase with respect to the FADC clock
 - NIM pulse shaped by filter to slow down leading edge



Linear method leads to clock-rate artifacts...

- Reference time algorithm:
 - Simple: linear fit
 - Better: exponential fit

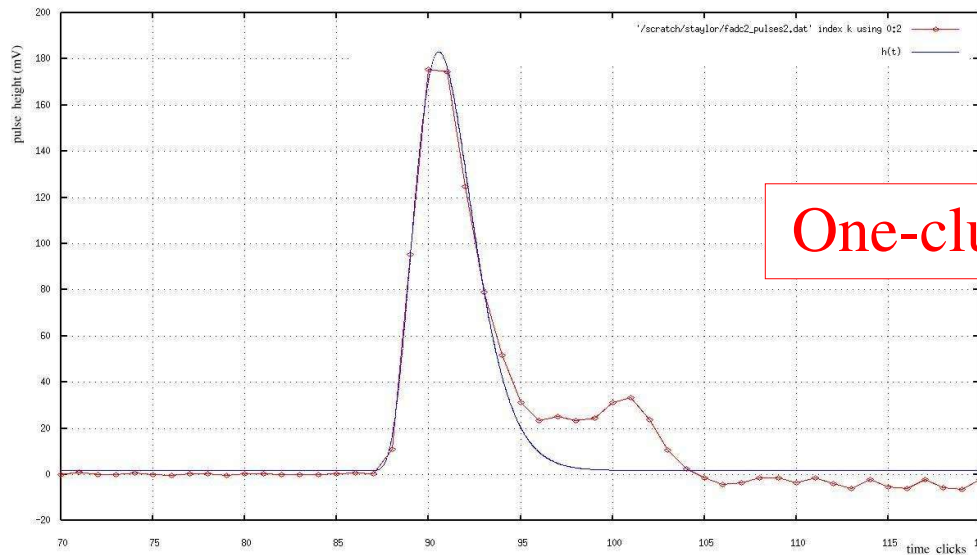


Shaped Anode Signals

Pulse shape model:

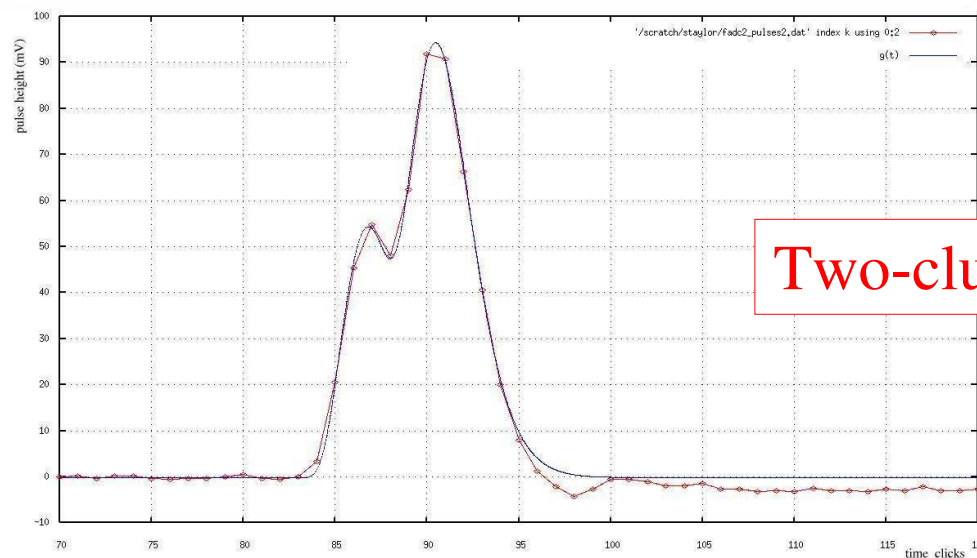
(each cluster)

$$V(t) = V_b + (V_{max} - V_b)e^{p-(t-t_0)/\tau} \left(\frac{t - t_0}{p\tau} \right)^p$$



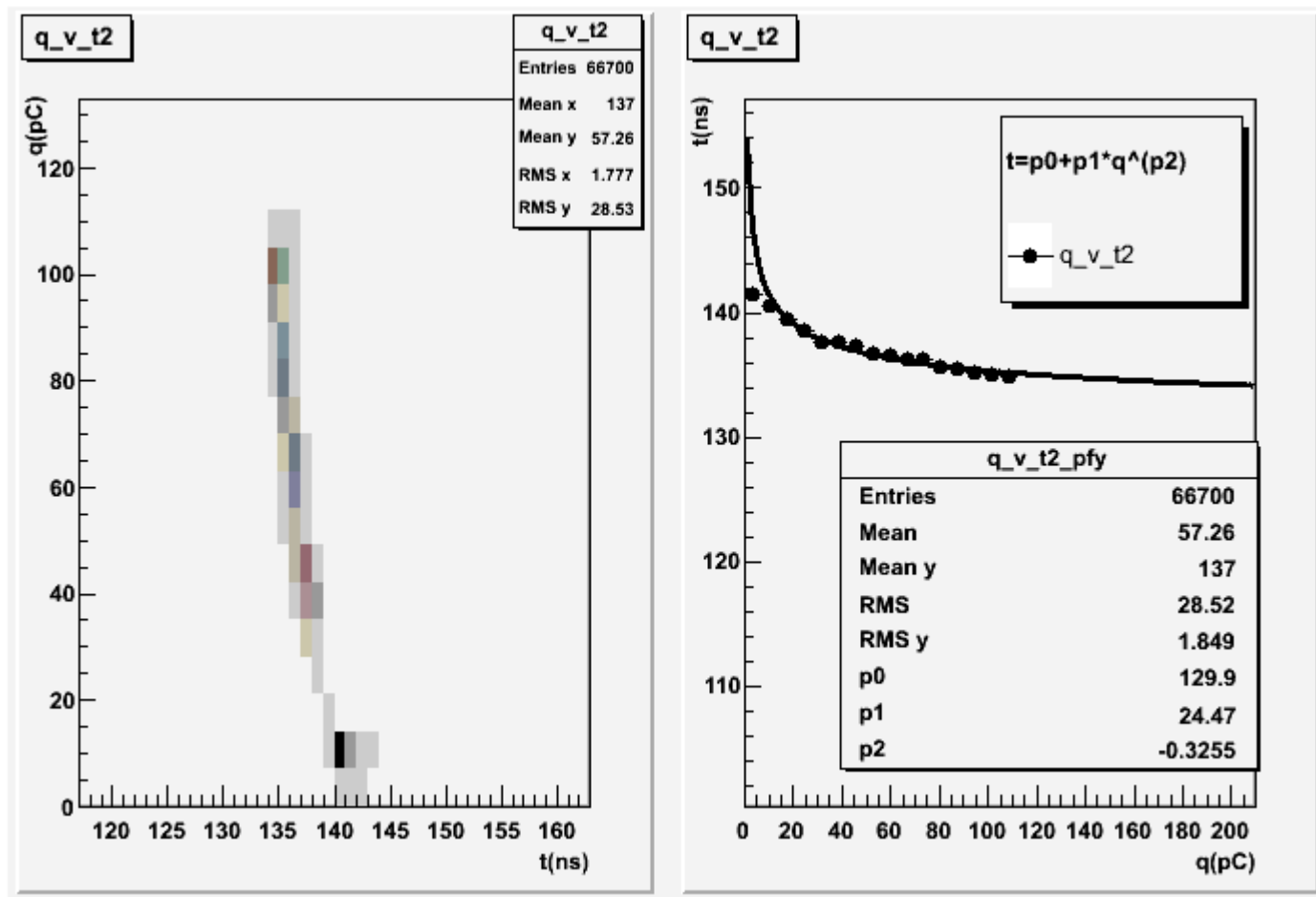
Gerard's studies:

$$p=5.79, \tau=6.59 \text{ ns}$$



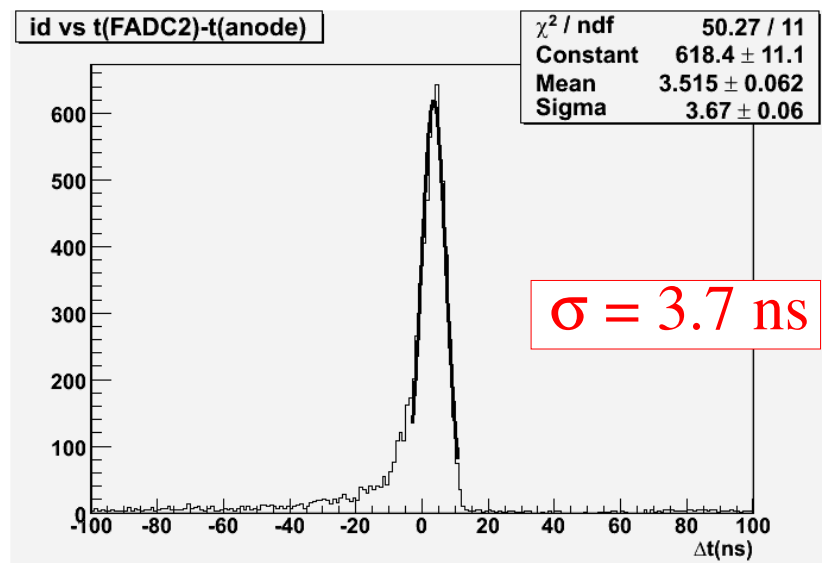
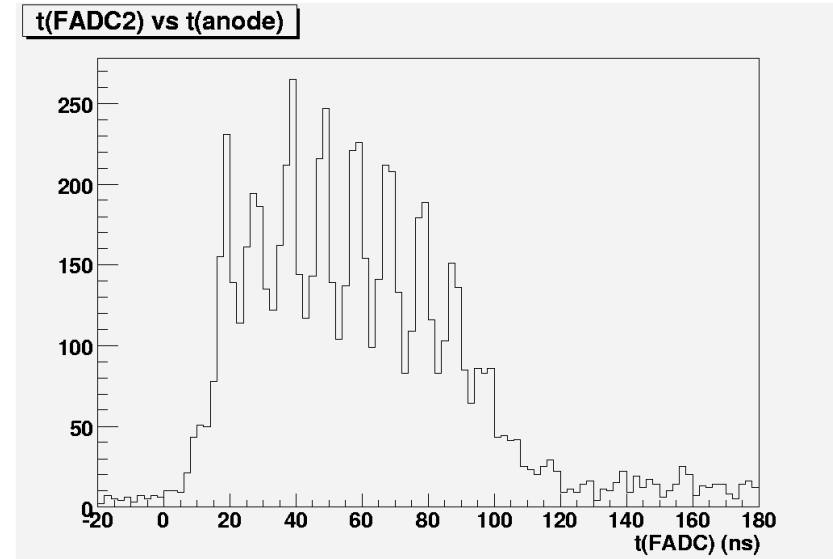
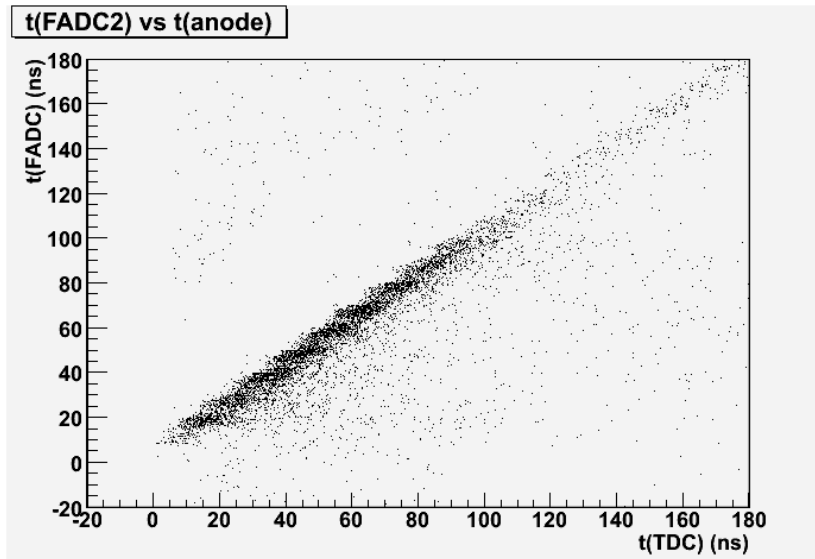
Time walk

- Timing from leading edge discriminators depends on pulse height
→ **time walk**
- FADC charge data can be used to correct the timing from the discriminator



Timing results, linear method

- Simple algorithm for both reference pulses and anode signals
 - Use first 3 samples in leading edge, extrapolate to crossing of baseline



- Echoes of clock time structure remain
 - Linear extrapolation method not sufficient