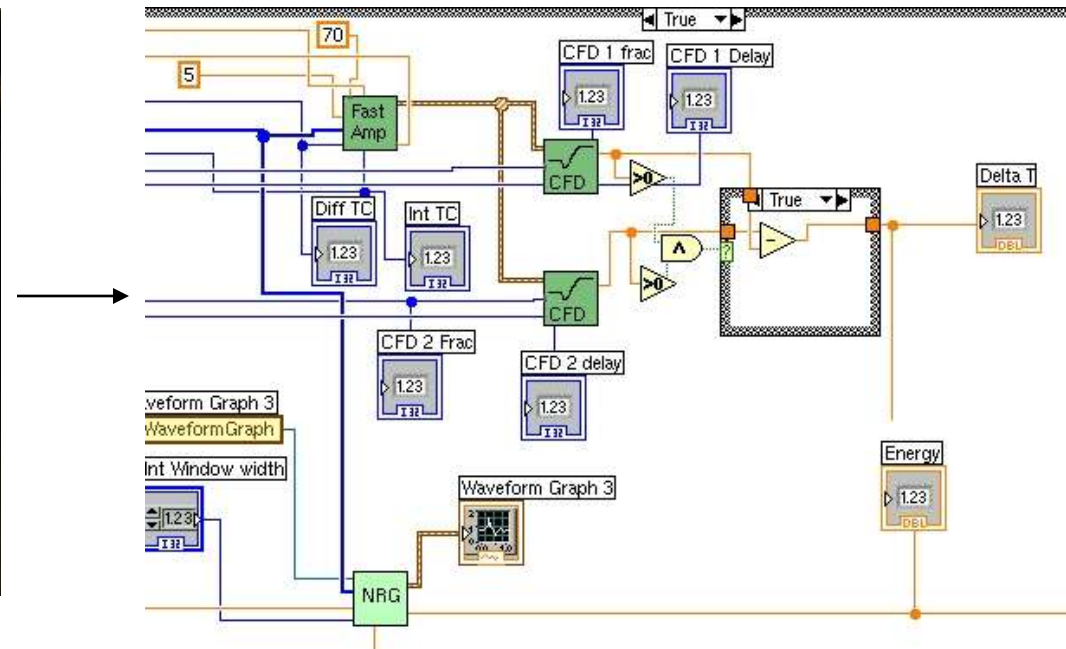
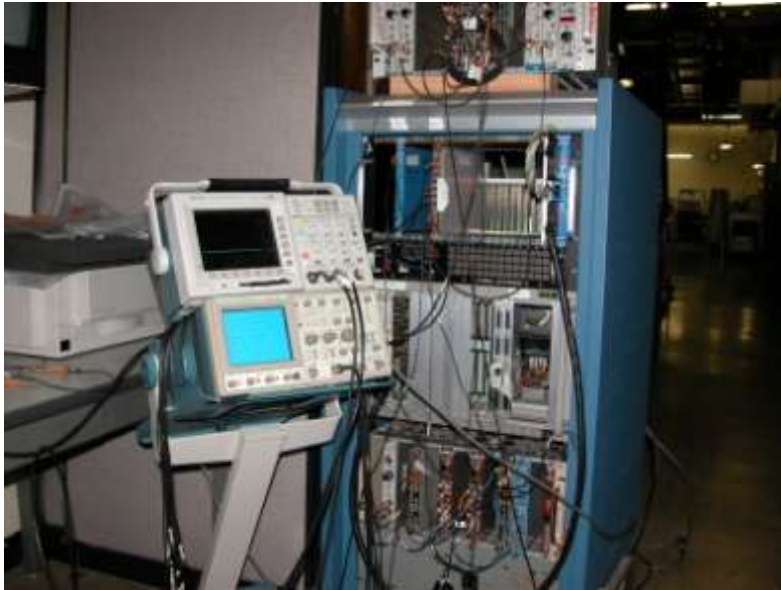


LabVIEW Simulation of Pulse Shape Discrimination Electronics



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Texas A&M University

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Supported by the Department of Energy and the Robert A. Welch Foundation.

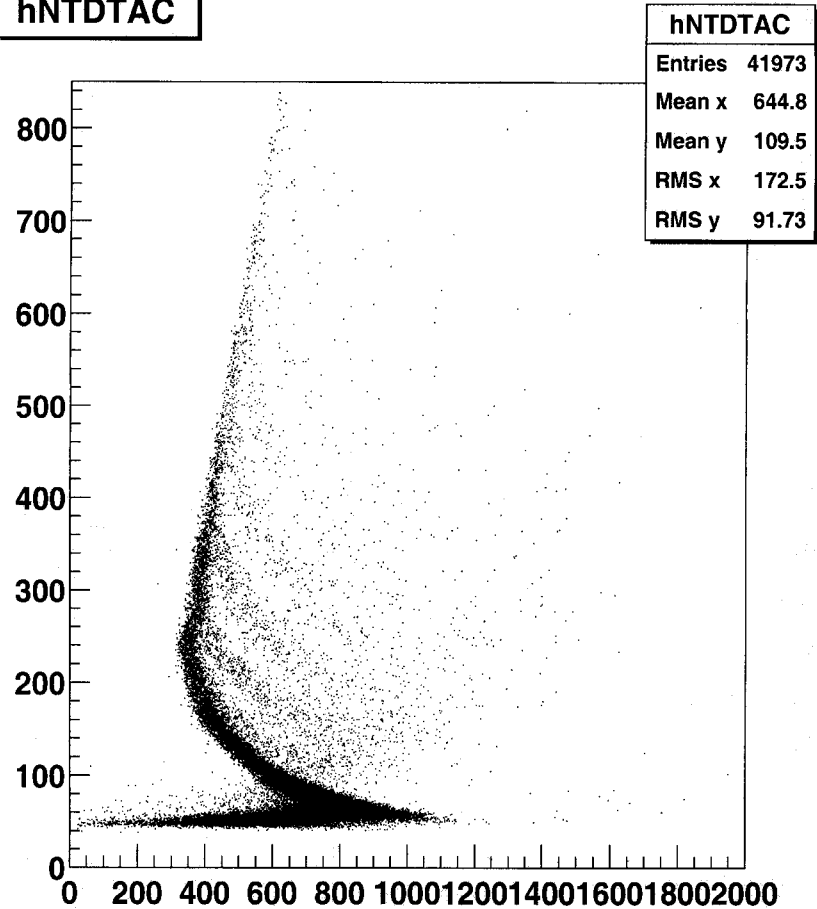
Goal

- Obtain maximum elemental and isotopic resolution on Energy vs. rise time plots when using actual pulse processing modules

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02-Oct-2004 19:03:00

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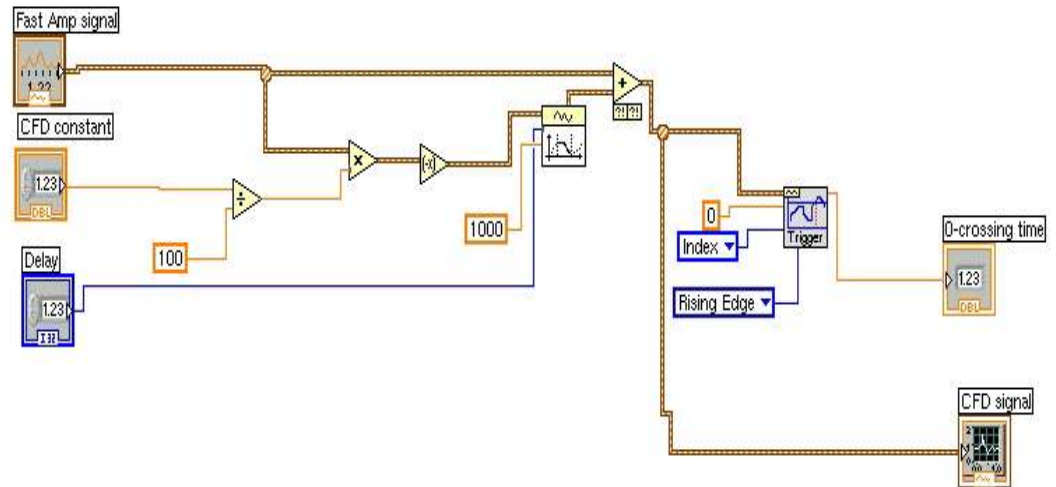
Energy vs. Risetime (actual electronics)

Method

- Simulate electronic modules in National Instruments LabVIEW software



Actual CFD



CFD virtual instrument

Recording Signal

- In-beam events are observed on a Tektronix TDS-3052B oscilloscope, and sent to a LabVIEW program that accesses the oscilloscope data via the TCP/IP protocol.

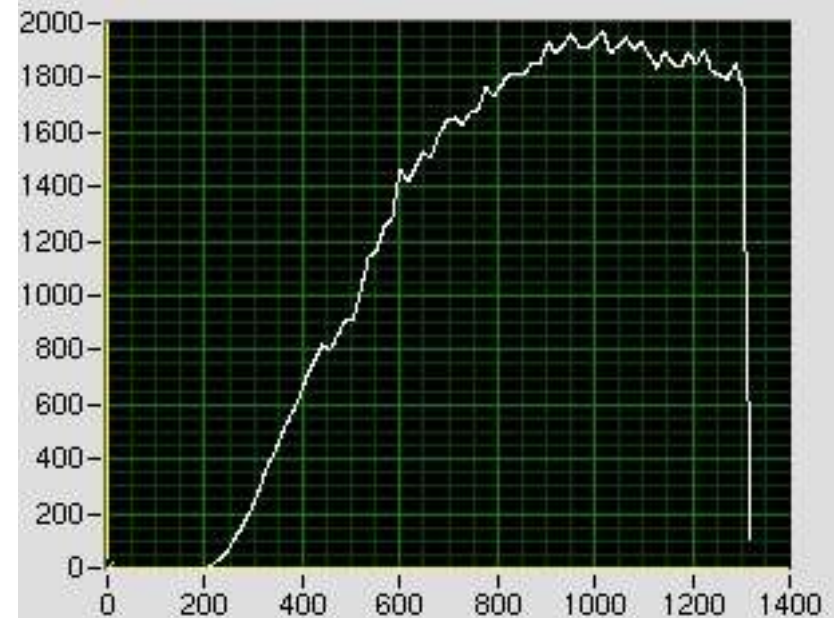


Fast Amp

- Preamp signal sent through fastamp that mimics RC circuitry to shape signal using exponential decay equations
- Differentiation time constant affects falling edge
- Integration time constant affects rising edge
- Interpolation used to increase number of points for later processes (improves accuracy of CFD level trigger)



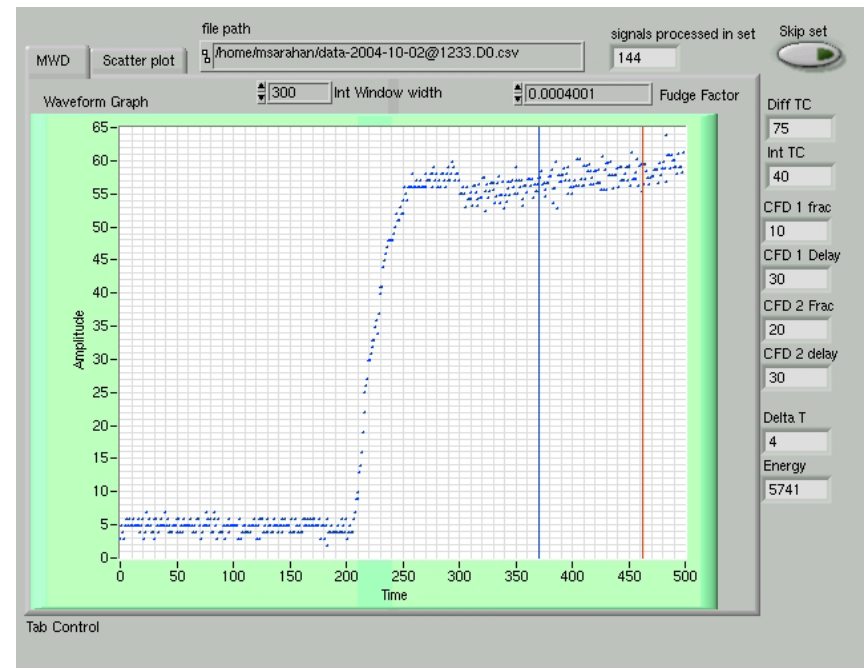
Before Fastamp



After Fastamp

Moving Window Deconvolution

- The scope signal is also put through a moving window deconvolution algorithm*.
- Energy is obtained from the average of the plateau observed.

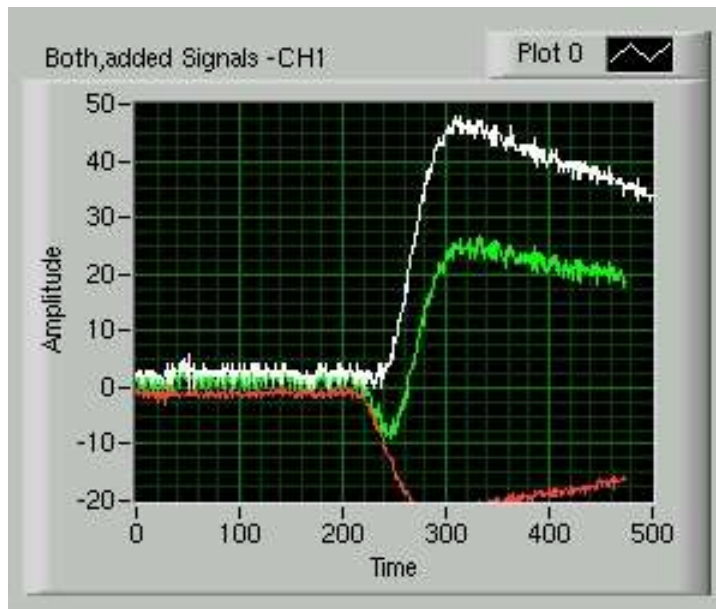


MWD in action

*A. Georgiev, *IEEE Transactions On Nuclear Science*, V41, No. 4 (1994)
Implemented by R. Burch

Constant Fraction Discriminators

Signal from fast amp goes to 2 individual constant fraction discriminators (CFD's). The difference between the zero crossing times from these CFD's is the risetime.



CFD Key:

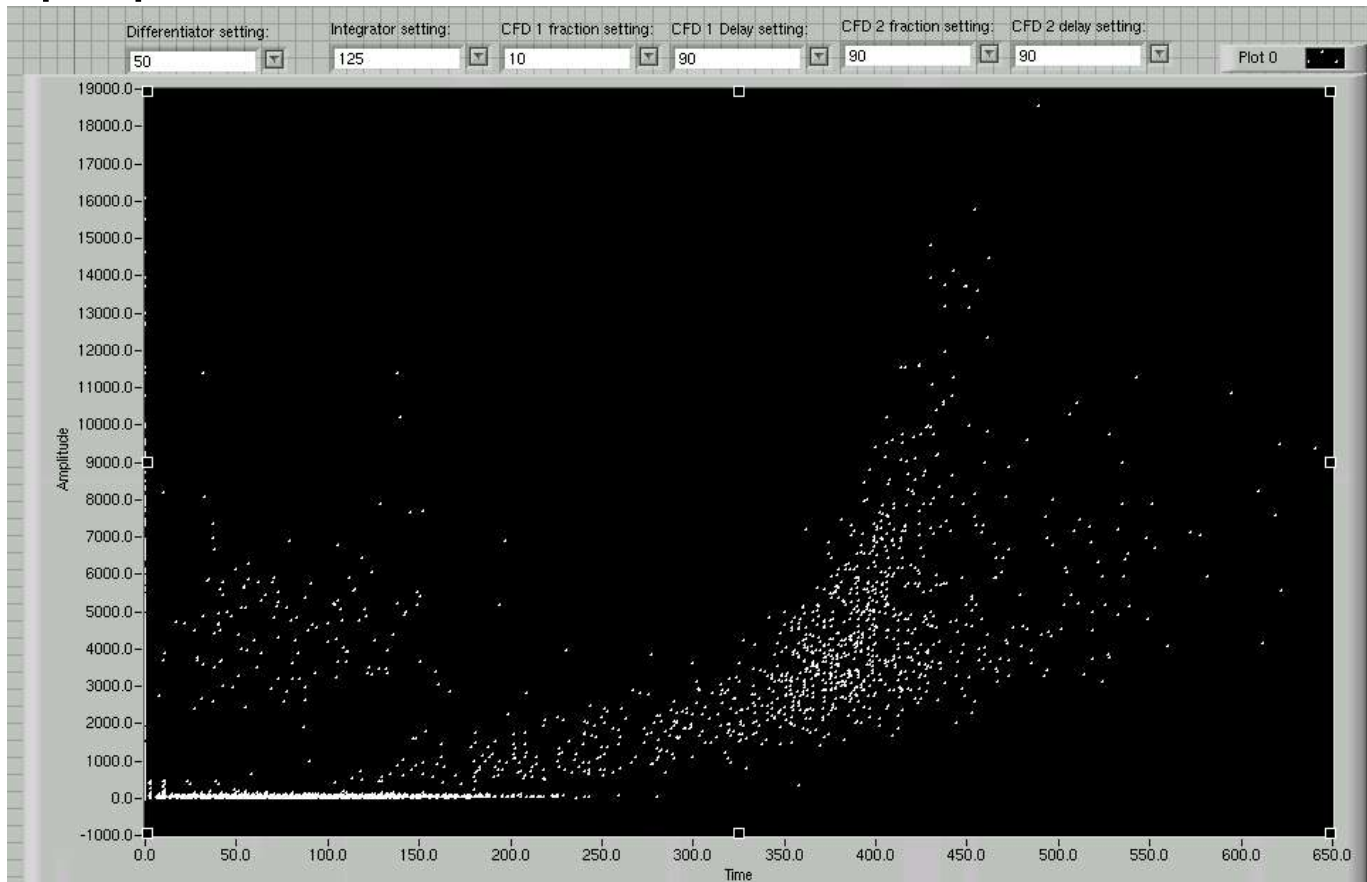
White: Delayed fast amp signal

Red: Inverted, attenuated fast amp signal

Green: Sum, from which 0-crossing time is observed

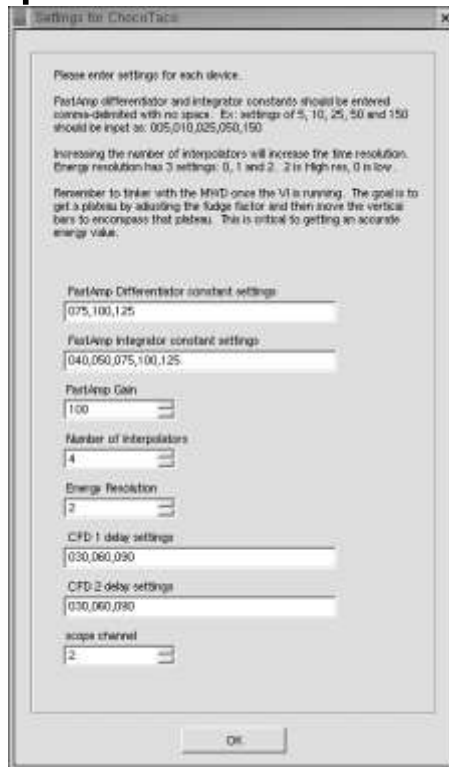
Plotting

- Energy and the corresponding risetime are written to a spreadsheet file, which can be viewed simultaneously with processing, or later, with a program dedicated to this purpose.

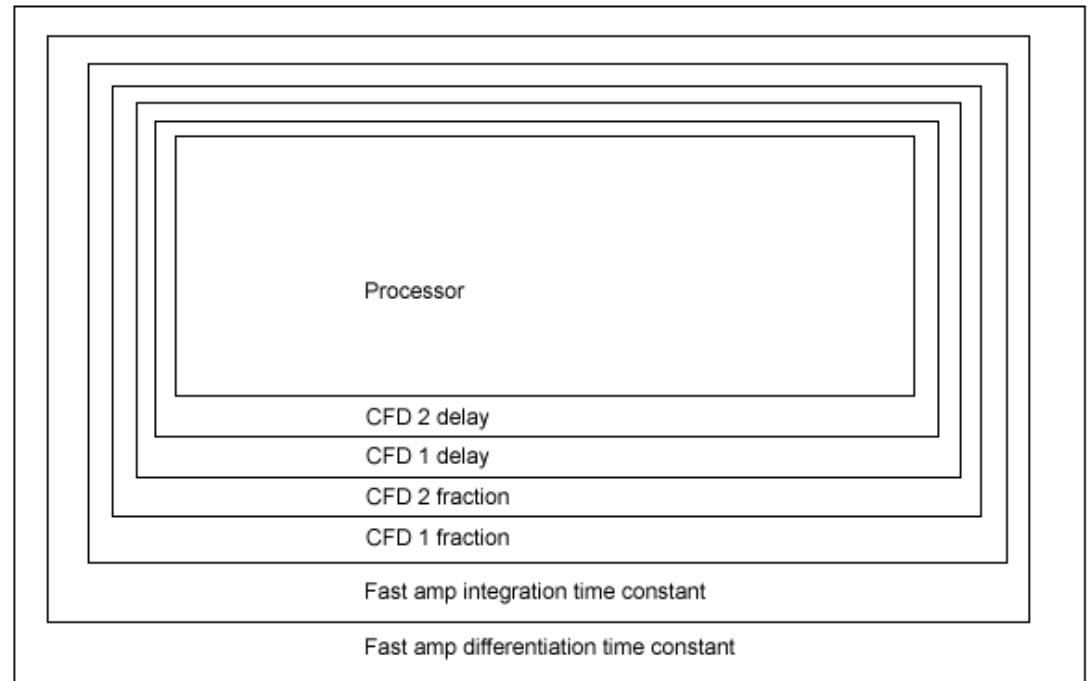


Settings

- These processing runs take time (~1.5 hours for 10,000 data points).
- Loops and logic are used to automatically run through all possible combinations of settings input by the user.



Settings Input



Loop Structure

Results

- Preliminary results show good agreement between simulated energy vs. risetime plots and actual plots, as far as rough plot shape.
 - Exception: the absence of the bend-over observed on the actual plots, likely due to detector punch-through. This would indicate that the bend-over is a result of a limitation in one or more of the pulse processing modules that the computer program does not share.
- Some resolution can be seen in the simulated processing runs, though it is not as good as actual plots.
 - Likely attributable to poor accuracy of CFD level triggers.
- No correlating experiment with electronics has been run yet. This will be the proof of the viability of the method.