Why shape signals anyway?
The goal is to measure the charge created in the detector by the primary radiation and to maintain the time relationships of signals.

Modular electronic components are available for “analogue” and “time” to digital conversion. Detectors vary by experiment.

Pulses from detectors are generally small and either:
• Step functions, sharp rise, long pedestal or tail
• Very fast (sharp in time)

Time differences are best measured with logic pulses.
Recall the effect of a poor quality cable on a step function signal: combination of high & low pass filters

Problem 16.11
In Knoll, 3rd Ed.

\[ V_{out} = V_{in} \left( \frac{\tau_2}{\tau_1 - \tau_2} \right) \left( e^{-t/\tau_1} - e^{-t/\tau_2} \right) \]

\[ V_{out} = V_{in} \left( \frac{t}{\tau} \right) e^{-t/\tau} \]

For \( \tau_{int} = \tau_{dif} = \tau \)

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Pulse Processing: Pole Zero

Common problem is that the input signal is not the step function signal that the amplifier is expecting ...

\[
\frac{V_{\text{undershoot}}}{V_{\text{diff}}} \approx \frac{\tau_{\text{dif}}}{\tau_{\text{in}}}
\]

Silicon preamplifier:
\(~50\ \mu s \rightarrow 2\% \text{ for } \tau = 1 \mu s\)

Organic Scintillator & Phototube:
\(~1 \mu s \rightarrow 100\% \text{ for } \tau = 1 \mu s\)
Pulse Processing: Baseline restoration

Charge injected onto $C_1$ must be cancelled (drained off) by current through $R_1$ (amp has $Z \sim \infty$)

Fig. 16.18 Knoll, 3rd Ed.
Pulse Processing: Making Bipolar Pulses

Add a stage to differentiate the unipolar signal.

Fig. 16.19 Knoll, 3rd Ed.
Pulse Processing: Delay-line Clipping

Fig. 16.19 Knoll, 3rd Ed.

Fig. 16.22 Knoll, 3rd Ed.

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Pulse Processing: timing-filter amp
The figure shown above is used by ORTEC to advertise the quality of the baseline restorer in a particular linear amplifier. The figure shows the peak shift (upper curve, right scale) and the resolution (lower curve, left scale) for the $^{60}\text{Co}$ line as a function of counting rate. Compare the indicated shaping time of the amplifier to the mean time between pulses arriving at the input at $10^5$ counts/s.