Tracker Layer Multiplicity versus TACK Delay for Various Trigger Sources of the EM

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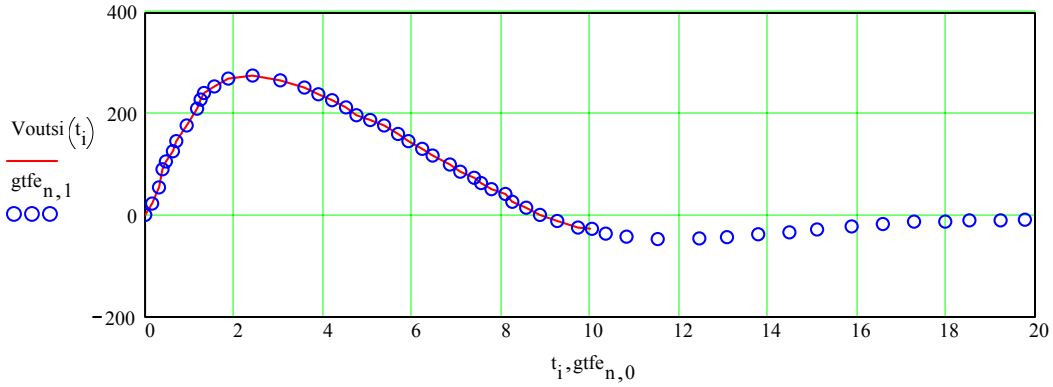
Use the measured preamp output shape to predict the strip efficiency as a function latch time.

gtfe :=

F:\DIGITIZE\GTFEG.DAT Digitized preamp output data from LAT-TD-01090 for G version of GTFE

$n := 0 .. rows(gtfe) - 1$ $i := 0 .. 1000$ $t_i := .01 \cdot i$ [usec] $zero := gtfe_{0,0}$ $gtfe_{n,0} := gtfe_{n,0} - zero$

$Voutsi(t) := linterp(gtfe^{<0>}, gtfe^{<1>}, t)$



tmx := 1. tsi_peak := Maximize(Voutsi, tmx) tsi_peak = 2.4125 [usec]

For a given time delay from the beginning of the pulse, how often does noise cause the output to dip below the discriminator threshold (and therefore not be latched) ? This is a question of what is the probability to exceed a certain number of sigmas in the negative going direction.

$$P(nsigma) := \left| \frac{1. - erf\left(\frac{|nsigma|}{\sqrt{2.}}\right)}{2.} \right|$$

This is the probability of exceeding nsigma

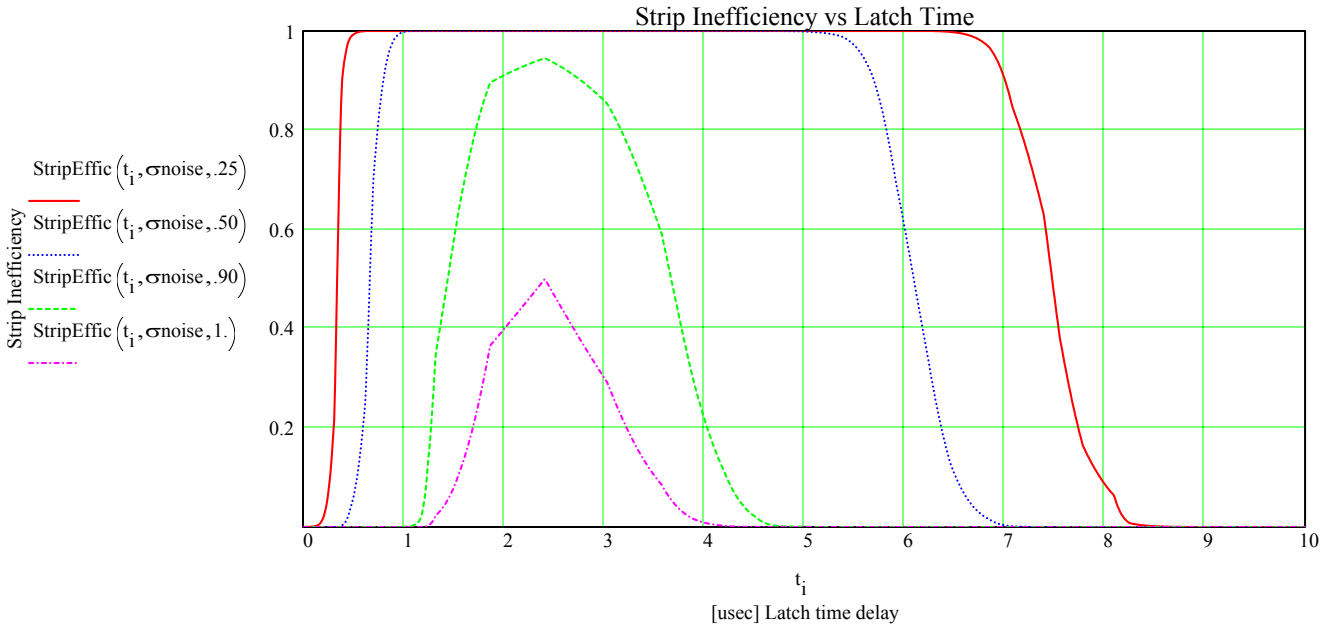
$$Plow(nsigma) := \begin{cases} Plow \leftarrow P(nsigma) \text{ if } nsigma \geq 0 \\ Plow \leftarrow 1 - P(-nsigma) \text{ if } nsigma < 0 \\ Plow \end{cases}$$

This is the probability of being below the disc which is nsigma away

Let Vsiout be the voltage generated by 32000 elec on one strip . The disc is set at "disc" fraction of the peak elec pulse height.

$$StripEffic(t, \sigma noise, disc) := \begin{cases} Vdisc \leftarrow disc \cdot Voutsi(tsi\_peak) \\ V\sigma noise \leftarrow \frac{\sigma noise}{32000} \cdot Voutsi(tsi\_peak) \\ nsg \leftarrow \frac{Voutsi(t) - Vdisc}{V\sigma noise} \\ StripEffic \leftarrow 1 - Plow(nsg) \\ StripEffic \end{cases}$$

$\sigma noise := 2000$ rms electrons of noise



We will trigger the tracker off a scintillator muon telescope using the external trigger input on the TEM. For a fixed time delay we will histogram the number of hits per layer per event. The mean of the histogram will be a maximum at the most efficient time delay. In order to see the peak in the efficiency with our statistics (~100 triggers), set the disc rather high (~.90). The time delay for max effic should not be a function of the disc setting.

The 5"x 5" scintillator and 24" x 24" scintillator spaced 65" apart will accept cosmics only up to 10 deg from the vertical. Thus (neglecting δ rays) assume all the scintillator telescope triggers deposit ionization in only one strip. We should typically see 1 hit per layer or 0 hits if the single strip signal fluctuates below the disc threshold at latch time.

$thick := 400$ $pitch := 200$

$$FracCosmicShare := \int_0^{\frac{10}{180}\cdot\pi} \frac{thick\cdot\tan(\theta)}{pitch - thick\cdot\tan(\theta)}\cdot\sin(\theta)\,d\theta \qquad FracCosmicShare = 0.0049$$

Mike says the time delay from TREQ to latching (for the EM) is:

.80/.050 clock cycles from TREQ to TACK + 4 clock cycles for GTRC decode =

=20 clock cycles = 1.0 usec (for 20 MHz clock) = 1.43 usec (for 14 MHz clock)

For the EM the LAT trigger box isn't there; there is some other trigger electronics. With Dave Nelson I see on a scope 1.0 usec between TREQ and TACK trailing edges (~consistent with Mike's .8 usec). Dave says that the GTRC takes 2 clock cycles to put out the latch pulse (~consistent with Mike's 4 clock cycles).

Mikes says the real GASU will add ~6 clock cycles to TREQ-TACK. Thus for a real tower move the dots to the right by .30 usec (@20 Mhz) or .43 usec (@14 Mhz).

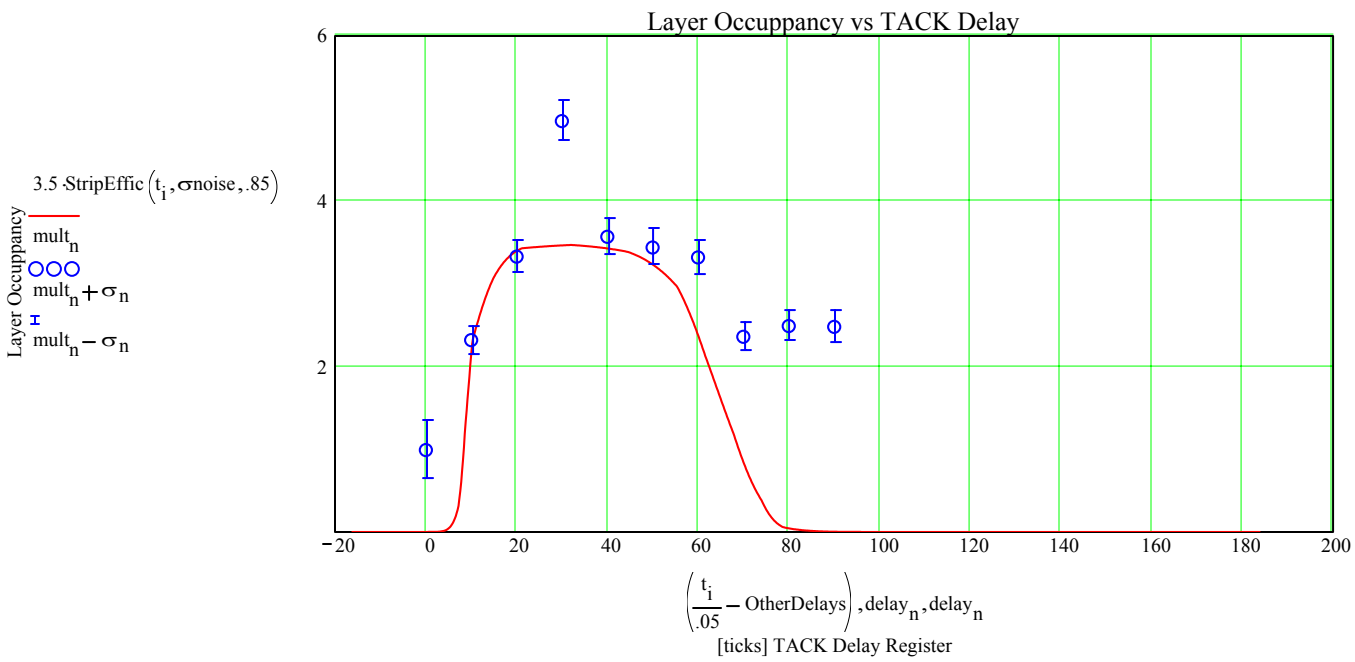
1) Type in some data taken (9/21/03) on the EM with a tracker disc threshold = 40 (in the high scale) ~ 120 on the low scale ~ 1.0 minI. 100 triggers per delay. The trigger is the External Scintillator Telescope.

$n := 0 .. 9$

$delay_n :=$	$mult_n :=$	$\sigma_n :=$
0	.99	.36
10	2.32	.17
20	3.33	.20
30	4.97	.25
40	3.57	.21
50	3.44	.22
60	3.32	.21
70	2.36	.17
80	2.49	.18
90	2.48	.19

There is .16 usec delay in the cosmic telescope electronics and it appears about 13 tick delay in the GLC, TEM, GRC, and delays to the latches.

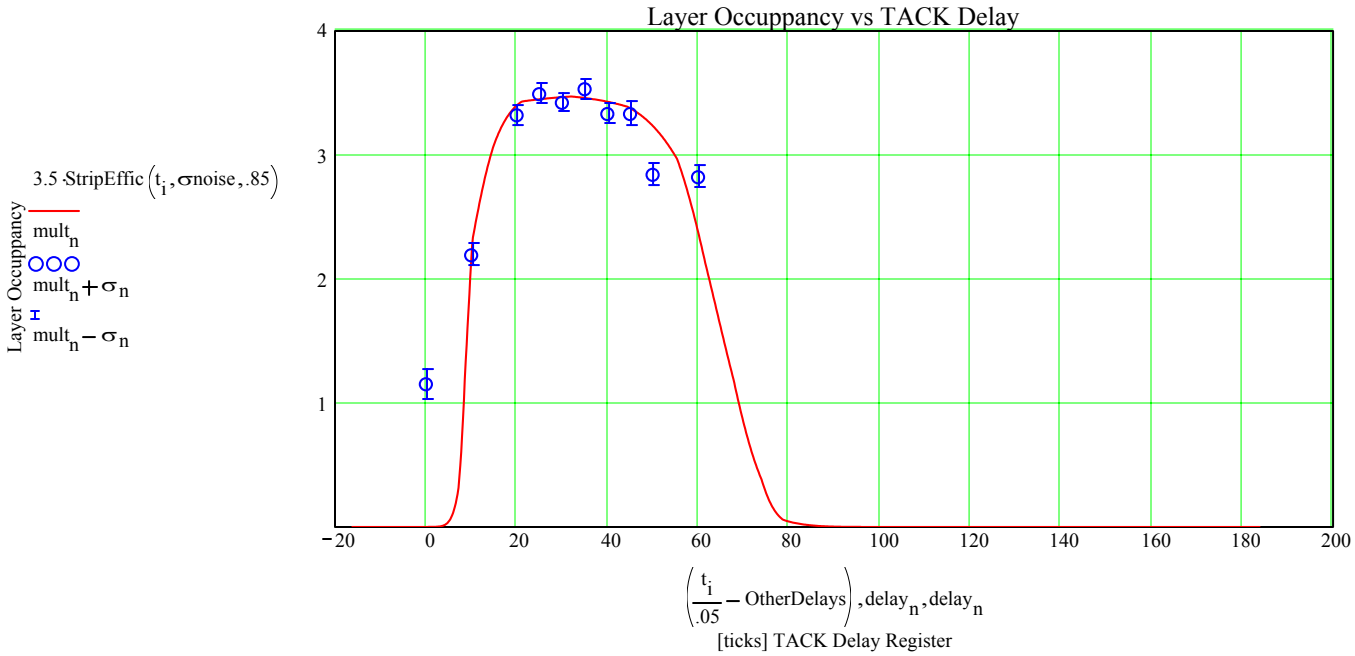
$$OtherDelays := \frac{.16}{.05} + 13$$



2) Type in some data taken (9/22/03) on the EM with a tracker disc threshold = 40 (in the high scale) ~ 120 on the low scale ~ 1.0 minI. 1K triggers per delay. The trigger is the External Scintillator Telescope.

$n := 0 .. 9$

$delay_n :=$	$mult_n :=$	$\sigma_n :=$
0	1.15	.12
10	2.19	.09
20	3.32	.08
25	3.49	.08
30	3.42	.08
35	3.53	.08
40	3.33	.08
45	3.33	.09
50	2.84	.09
60	2.82	.09



Find the maximum of the strip effic function:

$F(t) := StripEffic(t, \sigma noise, .86)$ $\quad tguess := 2$ $\quad tmax := Maximize(F, tguess)$ $\quad tmax = 2.4125$ [usec]

$tsi\_peak = 2.4125$ [usec]

The number of ticks to load into the Tracker TACK delay register in the TEM for peak effic is then:

$\frac{tmax}{.05} - OtherDelays = 32$ [ticks]