Tracker Layer Multiplicity versus TACK Delay for Various Trigger Sources of the EM (Version 2)

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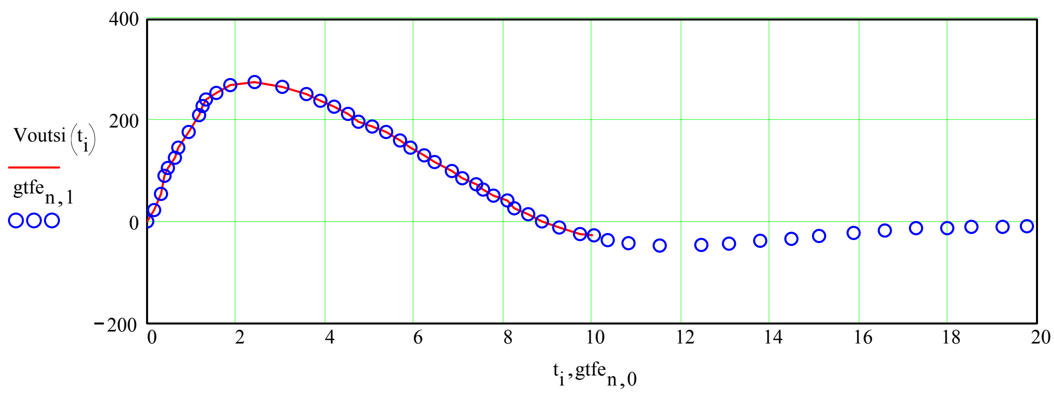
Use the measured preamp output shape to predict the strip efficiency as a function latch time.

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

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

$$Voutsi(t) := linterp\left(gtfe^{\langle 0 \rangle}, gtfe^{\langle 1 \rangle}, t\right)$$



$tmx := 1. \qquad tsi\_peak := Maximize(Voutsi, tmx) \qquad tsi\_peak = 2.4125$ [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.

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

This is the probability of exceeding nsigma

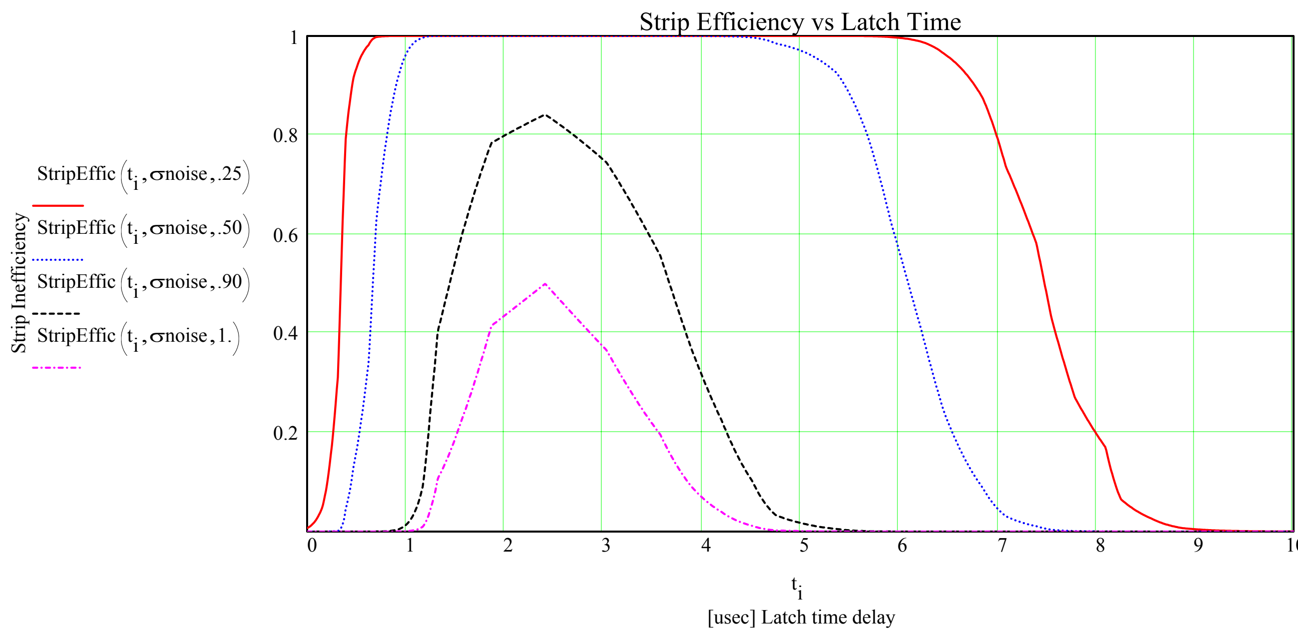
$$Plow(nsigma) := \begin{array}{|l} Plow \leftarrow P(nsigma) \quad \text{if } nsigma \geq 0 \\ Plow \leftarrow 1 - P(-nsigma) \quad \text{if } nsigma < 0 \\ Plow \end{array}$$

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

Let Vsiout be the voltage generated by 16000 elec on one strip (ie: a 32000 elec minI track shares charge between 2 strips). A large fraction of tracks will share this way, so it is reasonable to consider the effic for these tracks. The disc is set at "disc" fraction of this 16000 elec pulse height.

$$StripEffic(t, \sigma noise, disc) := \begin{array}{|l} Vdisc \leftarrow disc \cdot Voutsi(tsi\_peak) \\ V\sigma noise \leftarrow \frac{\sigma noise}{16000} \cdot Voutsi(tsi\_peak) \\ nsg \leftarrow \frac{Voutsi(t) - Vdisc}{V\sigma noise} \\ StripEffic \leftarrow 1 - Plow(nsg) \\ StripEffic \end{array}$$

$\sigma noise := 1600$ rms electrons of noise (measured for the EM)



The dashed blue curve corresponds to our disc of 8000 elec. $\frac{8000}{\sigma noise} = 5.0$ = disc / noise

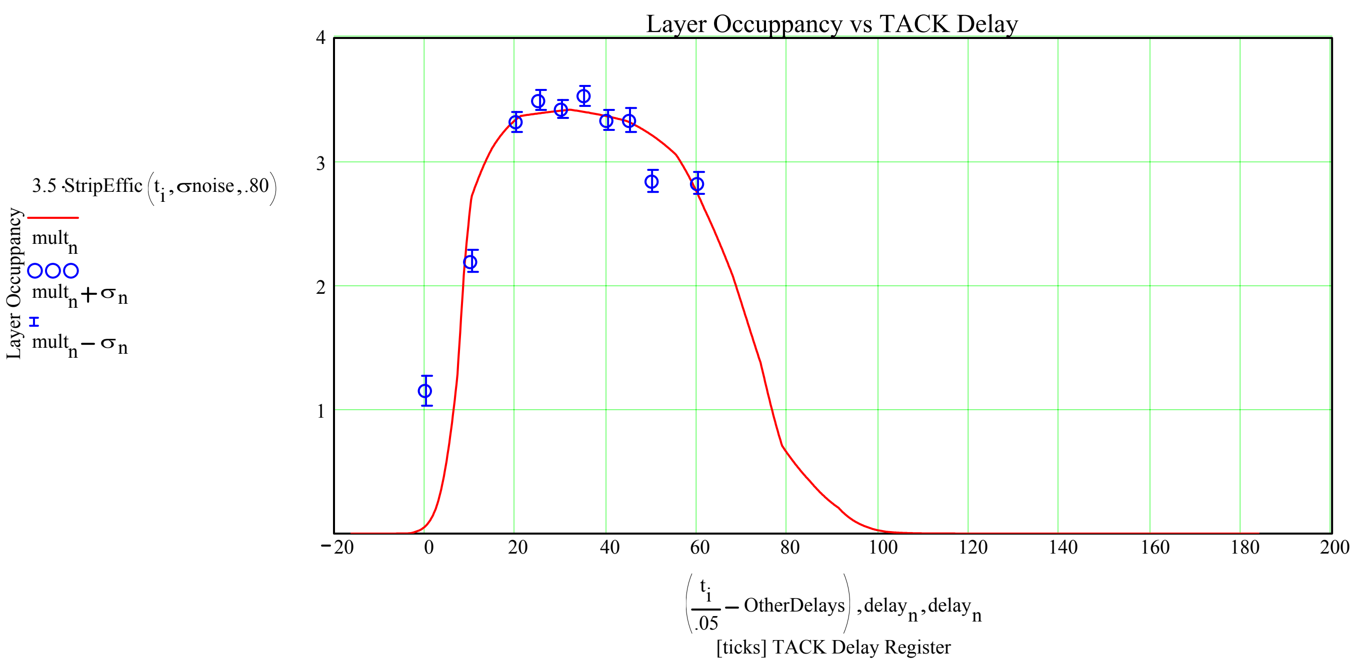
1) Type in some data taken (9/22/03) on the EM with a tracker disc threshold = 40 (in the high scale) ~ 120 on the low scale ~ 1.0 minI. 1K triggers per delay. The trigger is the External Scintillator Telescope.

$n := 0 .. 9$

$delay_n :=$	$mult_n :=$	$\sigma_n :=$
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

There is .16 usec delay in the cosmic telescope electronics and it appears about 13 tick delay in the Mini GLT (5), TEM (5), and the GTRC (2) decode delay to the latches.

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



Find the maximum of the strip effic function:

$F(t) := StripEffic(t, \sigma noise, .80)$ $tguess := 2$ $tmax := Maximize(F, tguess)$ $tmax = 2.4125$ [usec]

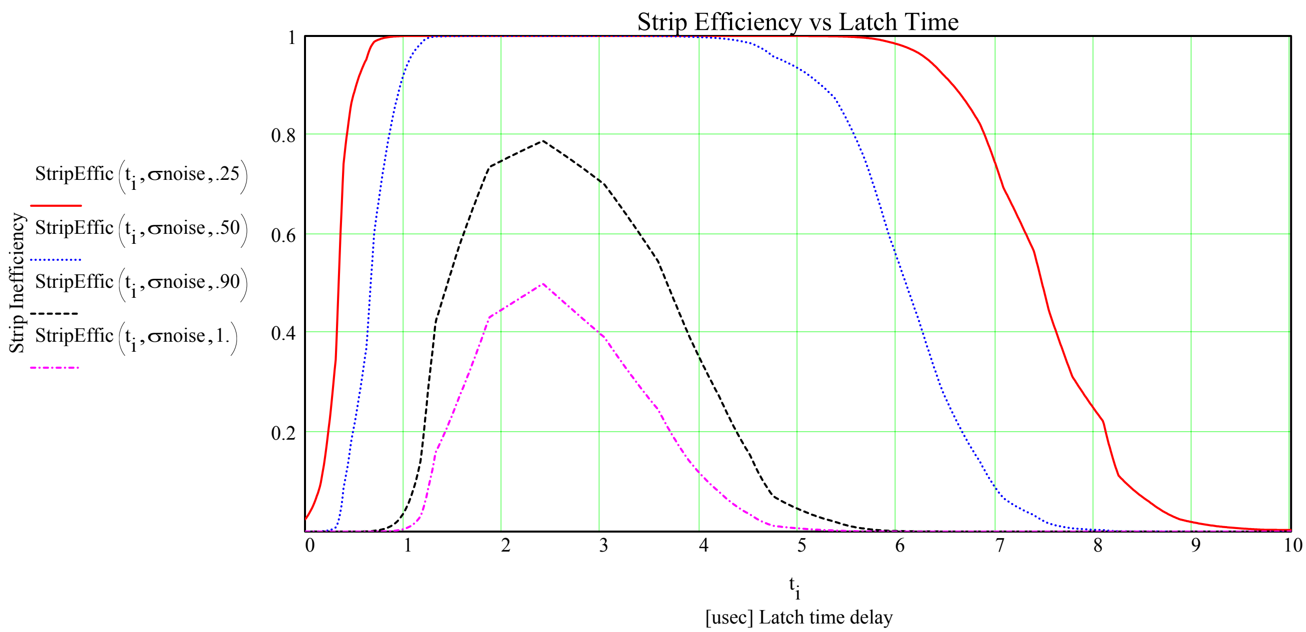
$tsi\_peak = 2.4125$ [usec]

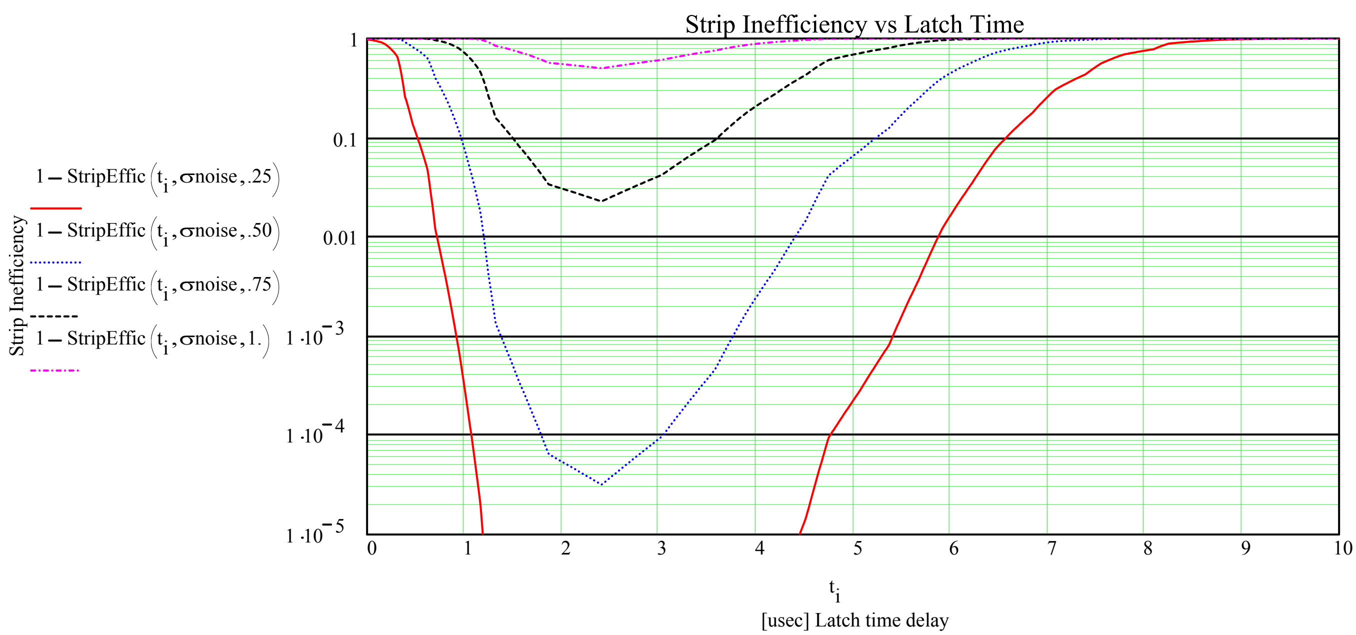
The number of ticks to load into the Tracker TACK delay register in the TEM for peak effic is then:

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

Now increase the noise by 25%, (as might happen at end of life from radiation damage - what is the real value ??).

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





The dashed blue curve corresponds to our disc of 8000 elec. $\frac{8000}{\sigma noise} = 4.0$ = disc / noise