

Tagger Timing Window Calibration

PrimEx Collaboration

PrimEx Note 35

Eric Clinton, July 2005

The TJNAF Hall B tagger has been described many times before. For interested readers, I refer any of the numerous documents describing it. However, in this document I will describe how the timing windows for the overlap E Channels, T Channels, and the ET coincidences were calculated. I will attempt to always refer to the geometrically and temporally created E and T Channel bins as “Channels” and to the raw E and T Counter hardware bins as “Counter” to avoid any ambiguity.

The task is quite simple. Determine, for a given timing window, how many counts from a coincidence peak, survive the cut. For this, the data file /mss/hallb/primex/data/october_2004/primex05003.dat.00 served as the source data. To create the E Channel timing overlap peaks between adjacent E Counters, E Counter events whose ID’s were separated by 1 ID count, ie. adjacent Counters were selected. An identical technique was used for the T Channel timing overlap peak. For ET coincidences, the geometry map located in the primex_online.TAG_ET_map MySQL database was read into memory from tagger_brun.cc. This map was then used to assure that E and T Channel events close in time were also geometrically matched. Events that were geometrically allowed were then histogrammed to form timing peaks.

The end result of the above effort created 3 histograms of all possible

‘good’ events that would fall into the E Channel (EE Window), T Channel (TT Window), and ET coincidence (ET Window) overlap peaks. See Figure 1 for a typical overlap peak and Figure 2 for a sample timing window cut. Some of these histograms had a fairly large background, so a statistical background subtraction method was used where appropriate. Events were counted over a large time interval (± 20 ns) far away from the peaks. This event count was then used to determine an average number of background events/bin. Thus, as the timing cuts were made to the 3 histograms above, the flat background the timing peaks sat on could be subtracted away. This method tended to oversubtract the background, but it is far superior to leaving background counts in. Additionally, the only effect was to add a uniform negative shift in the calculated timing cut inefficiencies.

The specifics of the analysis really show the ‘inefficiency’ of the timing cuts. The analysis asks the question, “What percentage of the counts from the original overlap peaks survive the timing cut?” Thus, how inefficient is a given cut? In a number of discussions at the weekly PrimEx meetings, it was determined that an inefficiency of less than 1% is appropriate.

In all Figures, the data are presented in percentages. That is to say that ‘0.45’ or ‘6.47’ are percentages, and not raw decimal fractions. From these data, the timing window of 22 ns (± 11 ns) is a good, but not optimal cut (Figures 3, 4). A better EE timing window is 26 ns (± 13 ns) where 7 inefficiencies are over 1%. A EE timing window of 28 ns (± 14 ns) leaves only 2 inefficiencies over 1%. A timing window of 26 ns will be used.

Additionally, the timing cuts for the TT window and ET window

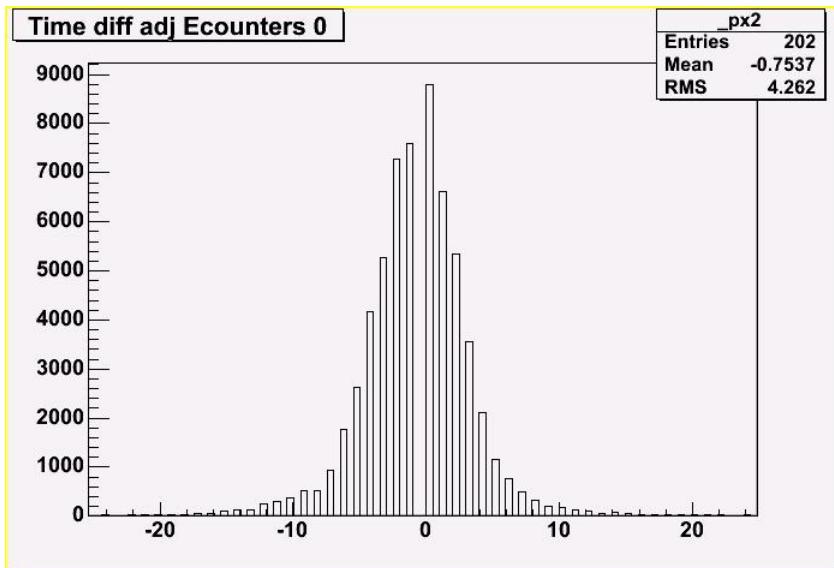


Figure 1: EE Overlap Timing Peak

are good but probably not optimal. For the TT Window data, please ignore the spuriously large percentages in any overlap with T Counter 9 as a member. There is a trigger cable timing length mis-match which is causing this anomaly. It also appears that the background subtraction was a little too aggressive, but manageable. Data in Figure 5 show that 13 ns is a very efficient timing cut. Significantly smaller inefficiencies are not gained by a larger time window.

Data in Figure 6 shows that 12 ns is a good time cut for our ET Window for most overlap regions, but a few overlaps only drop below the 1% efficiency after a 14 ns cut. Included are lower statistic ET coincidences binned by E channel ID. The data in these figures 7, 8, 9 also show that 14 ns is a more inclusive time window, and will be used.

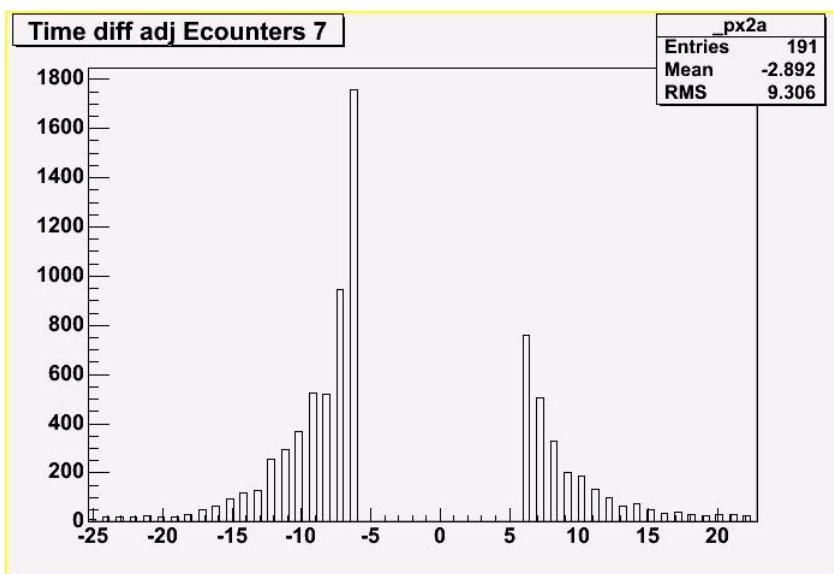


Figure 2: EE Timing Window cut of 12ns

EE Timing Window
currently set to 22 ns

data below are percentages of the events
 that survived the timing Window/Cut listed

| <u>Window/Cut</u> | <u>14 ns</u> | <u>16 ns</u> | <u>18 ns</u> | <u>20 ns</u> | <u>22 ns</u> | <u>24 ns</u> | <u>26 ns</u> | <u>28 ns</u> | <u>total # of events</u> | <u>total backgr</u> |
|--|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------------------|---------------------|
| <u>Overlap of</u> <u>E Counters</u> | | | | | | | | | | |
| <u>1,2</u> | 5.31 | 3.94 | 2.81 | 1.89 | 1.26 | 0.74 | 0.42 | 0.12 | 380910 | 3660 |
| <u>2,3</u> | 7.84 | 5.29 | 3.58 | 2.44 | 1.64 | 1.04 | 0.59 | 0.23 | 395406 | 4369 |
| <u>3,4</u> | 7.67 | 5.2 | 3.73 | 2.54 | 1.71 | 1.1 | 0.65 | 0.28 | 348242 | 3750 |
| <u>4,5</u> | 6.84 | 4.62 | 3.19 | 2.18 | 1.47 | 0.9 | 0.48 | 0.16 | 397057 | 5013 |
| <u>5,6</u> | 6.77 | 4.78 | 3.38 | 2.2 | 1.45 | 0.87 | 0.48 | 0.17 | 368484 | 4244 |
| : | 7.04 | 4.77 | 3.33 | 2.16 | 1.4 | 0.83 | 0.46 | 0.15 | 396648 | 4859 |
| : | 10.43 | 7.18 | 5.16 | 3.52 | 2.4 | 1.55 | 0.97 | 0.5 | 384355 | 5212 |
| : | 4.88 | 3.3 | 2.22 | 1.51 | 1 | 0.62 | 0.31 | 0.09 | 398686 | 4447 |
| : | 10.13 | 6.17 | 4.45 | 3.11 | 2.13 | 1.34 | 0.85 | 0.48 | 434889 | 3459 |
| : | 18.04 | 10.7 | 7.37 | 4.89 | 3.28 | 2.1 | 1.37 | 0.79 | 409669 | 4726 |
| : | 7.93 | 5.08 | 3.73 | 2.63 | 1.83 | 1.16 | 0.77 | 0.43 | 413010 | 3887 |
| | 9.88 | 5.97 | 4.01 | 2.69 | 1.84 | 1.09 | 0.61 | 0.16 | 470034 | 10019 |
| | 5.27 | 3.18 | 2.11 | 1.27 | 0.65 | 0.1 | -0.26 | -0.6 | 470421 | 15400 |
| | 5.05 | 3.19 | 2.25 | 1.45 | 0.89 | 0.4 | 0.04 | -0.29 | 426714 | 11083 |
| | 6.02 | 3.9 | 2.76 | 1.75 | 1.05 | 0.43 | 0.01 | -0.4 | 489472 | 14643 |
| | 20.1 | 13.84 | 9.3 | 6.21 | 4.08 | 2.61 | 1.56 | 0.8 | 422910 | 9847 |
| | 11.03 | 7.95 | 5.52 | 3.74 | 2.39 | 1.4 | 0.71 | 0.06 | 449664 | 13671 |
| | 8.66 | 6.19 | 4.42 | 3.04 | 2.01 | 1.15 | 0.46 | -0.1 | 438508 | 17290 |
| | 32.67 | 21.04 | 13.42 | 8.29 | 5 | 2.94 | 1.65 | 0.7 | 429327 | 10393 |
| | 7.55 | 5.16 | 3.66 | 2.57 | 1.76 | 1.1 | 0.62 | 0.23 | 460548 | 8157 |
| | 11.54 | 8.67 | 6.41 | 4.53 | 3.14 | 2.03 | 1.22 | 0.58 | 364021 | 8525 |
| | 10.95 | 7.73 | 5.71 | 3.95 | 2.7 | 1.79 | 1.11 | 0.58 | 342197 | 5354 |
| | 7.66 | 5.47 | 4.08 | 2.9 | 2 | 1.33 | 0.82 | 0.39 | 459875 | 7551 |
| | 9.52 | 6.23 | 4.03 | 2.65 | 1.71 | 1.03 | 0.5 | 0.11 | 421602 | 8752 |
| | 6.26 | 4.28 | 3.02 | 1.98 | 1.31 | 0.82 | 0.48 | 0.19 | 447174 | 3931 |
| | 6.82 | 4.61 | 3.34 | 2.27 | 1.55 | 1.01 | 0.64 | 0.34 | 450745 | 3710 |

Figure 3: EE Timing Window results, page 1

Window/Cut

| <u>14 ns</u> | <u>16 ns</u> | <u>18 ns</u> | <u>20 ns</u> | <u>22 ns</u> | <u>24 ns</u> | <u>26 ns</u> | <u>28 ns</u> | <u>total # of events</u> | <u>total backlog</u> |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------------------|----------------------|
| 7.03 | 4.86 | 3.55 | 2.39 | 1.55 | 0.95 | 0.54 | 0.15 | 458242 | 7909 |
| 6.88 | 4.36 | 2.83 | 1.74 | 0.91 | 0.21 | -0.31 | -0.81 | 464993 | 21009 |
| 5.79 | 3.61 | 2.43 | 1.49 | 0.81 | 0.26 | -0.15 | -0.5 | 480846 | 14700 |
| 4.01 | 2.57 | 1.8 | 1.15 | 0.71 | 0.39 | 0.17 | -0.02 | 490736 | 4819 |
| 6.86 | 4.54 | 3.27 | 2.29 | 1.48 | 0.93 | 0.59 | 0.29 | 457545 | 3689 |
| 9.58 | 6.38 | 4.18 | 2.84 | 1.9 | 1.25 | 0.75 | 0.39 | 419562 | 4162 |
| 5.87 | 4.25 | 3.01 | 2.02 | 1.36 | 0.82 | 0.47 | 0.14 | 447026 | 4504 |
| 4.49 | 2.58 | 1.65 | 1.04 | 0.62 | 0.3 | 0.08 | -0.1 | 574109 | 6143 |
| 14.24 | 9.37 | 6.67 | 4.66 | 3.24 | 2.13 | 1.36 | 0.7 | 516608 | 8196 |
| 5.97 | 3.93 | 2.74 | 1.89 | 1.26 | 0.71 | 0.32 | -0.01 | 462253 | 8537 |
| 4.61 | 2.97 | 2.14 | 1.4 | 0.86 | 0.47 | 0.2 | -0.02 | 468159 | 5155 |
| 6.97 | 4.18 | 2.97 | 1.94 | 1.23 | 0.73 | 0.39 | 0.12 | 490892 | 4789 |
| 5.74 | 3.93 | 2.91 | 2.02 | 1.36 | 0.87 | 0.53 | 0.24 | 503753 | 4957 |
| 6.46 | 4.23 | 2.85 | 1.94 | 1.32 | 0.84 | 0.5 | 0.22 | 449179 | 4702 |
| 4.03 | 2.61 | 1.83 | 1.17 | 0.7 | 0.36 | 0.15 | -0.02 | 447397 | 4189 |
| 4.83 | 2.9 | 1.96 | 1.3 | 0.8 | 0.45 | 0.23 | 0.06 | 541563 | 4163 |
| 22.83 | 14.5 | 10.35 | 7.04 | 4.53 | 2.87 | 1.89 | 1.12 | 374237 | 3113 |
| 12.72 | 7.91 | 5.01 | 3.24 | 2.14 | 1.38 | 0.87 | 0.44 | 393456 | 3749 |
| 4.43 | 2.99 | 2.05 | 1.36 | 0.87 | 0.5 | 0.26 | 0.05 | 503766 | 5222 |
| 4.68 | 3.07 | 2.21 | 1.47 | 0.97 | 0.61 | 0.34 | 0.09 | 568100 | 6081 |
| 4.55 | 3.11 | 2.27 | 1.5 | 0.95 | 0.58 | 0.31 | 0.06 | 535559 | 5830 |
| 39.18 | 25.4 | 14.77 | 8.11 | 4.48 | 2.54 | 1.42 | 0.74 | 536498 | 5169 |
| 5.3 | 3.37 | 2.13 | 1.35 | 0.8 | 0.41 | 0.16 | -0.08 | 456692 | 5545 |
| 5.03 | 3.36 | 2.26 | 1.54 | 0.99 | 0.59 | 0.32 | 0.11 | 520572 | 4503 |
| 4.59 | 2.99 | 1.98 | 1.27 | 0.76 | 0.35 | 0.03 | -0.2 | 474594 | 7738 |
| 6.96 | 4.25 | 2.86 | 1.76 | 1.04 | 0.54 | 0.22 | -0.06 | 555692 | 9236 |
| 5.43 | 3.64 | 2.64 | 1.82 | 1.2 | 0.76 | 0.45 | 0.2 | 552539 | 5020 |
| 3.45 | 2.24 | 1.56 | 1.01 | 0.6 | 0.33 | 0.13 | -0.02 | 619009 | 5659 |
| 6.45 | 4.6 | 3.16 | 2.09 | 1.38 | 0.85 | 0.42 | 0.06 | 387345 | 7440 |
| 5.26 | 3.77 | 2.72 | 1.81 | 1.17 | 0.72 | 0.38 | 0.08 | 622261 | 9381 |
| 2.05 | 1.26 | 0.78 | 0.42 | 0.13 | -0.07 | -0.2 | -0.34 | 614579 | 9084 |
| 5.48 | 3.18 | 1.92 | 1.02 | 0.46 | 0.03 | -0.25 | -0.48 | 451501 | 10959 |

Figure 4: EE Timing Window results, page2

TT Timing Windows

Currently set to 13 ns, All

data below are percentages of the events
that survived the timing Window/Cut listed

| <u>Window/Cut</u> | <u>8 ns</u> | <u>10 ns</u> | <u>12 ns</u> | <u>14 ns</u> | <u>16 ns</u> | <u>18 ns</u> | <u>20 ns</u> | <u>22 ns</u> |
|--------------------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <u>T counter overlap</u> | | | | | | | | |
| <u>1,2</u> | 25.88 | 4 | 0.49 | 0.21 | -0.03 | -0.07 | 0.11 | 0.17 |
| <u>2,3</u> | 75.64 | 31.34 | 4.7 | 1.35 | 0.03 | -0.01 | 0.29 | 0.27 |
| <u>3,4</u> | 21.75 | 1.63 | 0.06 | -0.03 | -0.3 | -0.28 | -0.12 | -0.05 |
| <u>4,5</u> | 96.43 | 75.91 | 25.75 | 3.25 | 0.64 | 0.36 | -0.24 | -0.28 |
| <u>5,6</u> | -0.27 | -0.69 | -1.01 | -0.98 | -0.68 | -0.58 | -0.79 | -0.67 |
| <u>6,7</u> | -0.24 | -0.75 | -1.07 | -0.94 | -0.57 | -0.45 | -0.78 | -0.66 |
| <u>7,8</u> | -0.98 | -1.02 | -0.84 | -0.8 | -0.86 | -0.82 | -0.64 | -0.57 |
| <u>8,9</u> | 100.15 | 100.39 | 100.17 | 99.82 | 100.54 | 100.64 | 99.98 | 77.23 |
| <u>9,10</u> | 100.18 | 100.32 | 100.05 | 100.04 | 100.33 | 100.5 | 100.23 | 92.68 |
| <u>10,11</u> | 97.4 | 90.31 | 69.02 | 26.44 | 4.2 | 0.17 | -0.86 | -0.82 |

| | <u>total # events</u> | <u>Background</u> |
|--|-----------------------|-------------------|
| | 99343 | 9737 |
| | 95408 | 13475 |
| | 116703 | 11754 |
| | 76924 | 8524 |
| | 126117 | 9745 |
| | 90269 | 9483 |
| | 125238 | 8711 |
| | 44038 | 10116 |
| | 149799 | 11299 |
| | 42622 | 12566 |

Figure 5: TT Timing Window results

TE Timing Windows
Currently set to 14 ns, All

data below are percentages of the events
 that survived the timing Window/Cut listed

Non-overlap region
 Physical T counters

| <u>Window/</u> | <u>4 ns</u> | <u>6 ns</u> | <u>8 ns</u> | <u>10 ns</u> | <u>12 ns</u> | <u>14 ns</u> | <u>16 ns</u> | <u>18 ns</u> |
|-------------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|
| T Channels | | | | | | | | |
| <u>2</u> | 6.7724 | 2.6097 | 1.0812 | 0.3485 | -0.0296 | -0.1654 | -0.2115 | -0.2187 |
| <u>4</u> | 7.1672 | 2.6849 | 1.0755 | 0.3620 | 0.0310 | -0.1489 | -0.2224 | -0.2049 |
| <u>6</u> | 9.4416 | 4.4640 | 2.4222 | 1.3439 | 0.8209 | 0.5324 | 0.3706 | 0.3457 |
| <u>8</u> | 83.1472 | 70.1242 | 51.4971 | 24.1545 | 3.9900 | 0.2202 | 0.0104 | -0.0600 |
| <u>10</u> | 9.7057 | 1.9151 | 0.6610 | 0.1679 | -0.1116 | -0.1941 | -0.1951 | -0.1912 |
| <u>12</u> | 7.1024 | 2.4515 | 0.9476 | 0.2218 | -0.1680 | -0.3171 | -0.3315 | -0.3232 |
| <u>14</u> | 7.2310 | 2.8978 | 1.2373 | 0.4045 | 0.0532 | -0.0773 | -0.1217 | -0.1108 |
| <u>16</u> | 16.9399 | 12.5256 | 10.5474 | 8.4087 | 7.1416 | 6.5711 | 5.9969 | 5.0543 |
| <u>18</u> | 48.5298 | 46.3591 | 42.9694 | 31.3545 | 22.5795 | 19.9709 | 19.0886 | 16.6540 |
| <u>20</u> | 13.8178 | 8.3159 | 5.0936 | 2.8275 | 1.4763 | 0.7092 | 0.4073 | 0.1830 |

| | <u>total events</u> | <u>total BG</u> |
|--|---------------------|-----------------|
| | 67655 | 804 |
| | 65854 | 1007 |
| | 91520 | 2376 |
| | 52163 | 451 |
| | 105042 | 2020 |
| | 67092 | 1030 |
| | 106714 | 2069 |
| | 27932 | 511 |
| | 132362 | 1266 |
| | 19698 | 352 |

Figure 6: ET Timing Window results.

TE Timing Windows

Currently set to 14 ns, All

data below are percentages of the events
that survived the timing Window/Cut listed

| <u>Window/Cut</u> | <u>4 ns</u> | <u>6 ns</u> | <u>8 ns</u> | <u>10 ns</u> | <u>12 ns</u> | <u>14 ns</u> | <u>16 ns</u> | <u>18 ns</u> |
|-------------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|
| <u>T Channels</u> | | | | | | | | |
| <u>2</u> | <u>2.54</u> | <u>1.50</u> | <u>1.18</u> | <u>1.04</u> | <u>0.94</u> | <u>0.86</u> | <u>0.83</u> | <u>0.80</u> |
| <u>4</u> | <u>7.70</u> | <u>2.58</u> | <u>1.01</u> | <u>0.43</u> | <u>0.27</u> | <u>0.13</u> | <u>0.11</u> | <u>0.11</u> |
| <u>6</u> | 27.36 | 12.41 | 6.61 | 3.74 | 2.10 | 1.45 | 1.06 | 0.75 |
| <u>8</u> | 23.38 | 12.80 | 7.74 | 4.20 | 2.14 | 1.24 | 0.78 | 0.70 |
| <u>10</u> | <u>3.23</u> | <u>2.05</u> | <u>1.43</u> | <u>1.21</u> | <u>1.12</u> | <u>1.02</u> | <u>0.90</u> | <u>0.88</u> |
| <u>12</u> | <u>2.62</u> | <u>1.01</u> | <u>0.48</u> | <u>0.29</u> | <u>0.24</u> | <u>0.19</u> | <u>0.19</u> | <u>0.18</u> |
| <u>14</u> | <u>9.08</u> | <u>4.38</u> | <u>2.72</u> | <u>1.98</u> | <u>1.67</u> | <u>1.42</u> | <u>1.21</u> | <u>1.12</u> |
| <u>16</u> | 22.44 | 7.56 | 2.98 | 1.08 | 0.70 | 0.43 | 0.29 | 0.22 |
| <u>18</u> | 40.10 | 19.39 | 11.58 | 7.88 | 5.54 | 4.22 | 3.41 | 3.12 |
| <u>20</u> | 21.05 | 13.06 | 8.60 | 5.32 | 2.83 | 1.31 | 0.90 | 0.61 |
| | <u>3.76</u> | <u>2.68</u> | <u>2.23</u> | <u>1.98</u> | <u>1.81</u> | <u>1.72</u> | <u>1.57</u> | <u>1.50</u> |
| | <u>6.48</u> | <u>2.80</u> | <u>1.45</u> | <u>0.73</u> | <u>0.48</u> | <u>0.35</u> | <u>0.29</u> | <u>0.24</u> |
| | <u>7.98</u> | <u>4.62</u> | <u>3.40</u> | <u>2.74</u> | <u>2.31</u> | <u>2.04</u> | <u>1.79</u> | <u>1.63</u> |
| | 43.78 | 19.01 | 8.43 | 3.64 | 1.77 | 0.76 | 0.45 | 0.31 |
| | 10.75 | 7.44 | 5.80 | 4.68 | 3.96 | 3.40 | 2.99 | 2.79 |
| | <u>6.08</u> | <u>4.53</u> | <u>3.16</u> | <u>1.79</u> | <u>1.06</u> | <u>0.62</u> | <u>0.40</u> | <u>0.36</u> |
| | <u>8.19</u> | <u>3.86</u> | <u>3.07</u> | <u>2.50</u> | <u>2.13</u> | <u>1.66</u> | <u>1.31</u> | <u>1.01</u> |
| 114.11 | 51.61 | 6.74 | 0.81 | 0.47 | 0.40 | 0.25 | 0.18 | |
| 232.15 | 213.15 | 165.46 | 74.50 | 11.02 | 1.01 | 0.67 | 0.55 | |
| | 58.42 | 55.28 | 48.14 | 30.94 | 8.38 | 1.01 | 0.47 | 0.37 |
| | <u>3.79</u> | <u>2.19</u> | <u>1.79</u> | <u>1.65</u> | <u>1.53</u> | <u>1.48</u> | <u>1.44</u> | <u>1.37</u> |
| | <u>6.10</u> | <u>2.02</u> | <u>1.22</u> | <u>0.87</u> | <u>0.71</u> | <u>0.65</u> | <u>0.64</u> | <u>0.58</u> |
| | 25.98 | 8.69 | 5.15 | 3.92 | 2.92 | 2.56 | 2.35 | 2.08 |

Figure 7: TE Timing Window results, page 1.

| <u>Window/Cut</u> | <u>4 ns</u> | <u>6 ns</u> | <u>8 ns</u> | <u>10 ns</u> | <u>12 ns</u> | <u>14 ns</u> | <u>16 ns</u> | <u>18 ns</u> |
|-------------------|--------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|
| | 53.32 | 9.48 | 3.79 | 1.70 | 0.89 | 0.53 | 0.41 | 0.38 |
| | 16.19 | 5.74 | 4.10 | 3.20 | 2.62 | 2.26 | 2.03 | 1.84 |
| | <u>9.70</u> | <u>5.51</u> | <u>3.60</u> | <u>2.41</u> | <u>1.41</u> | <u>1.00</u> | <u>0.83</u> | <u>0.68</u> |
| | <u>3.53</u> | <u>1.67</u> | <u>1.27</u> | <u>1.12</u> | <u>0.98</u> | <u>0.91</u> | <u>0.87</u> | <u>0.84</u> |
| | <u>4.96</u> | <u>1.74</u> | <u>0.81</u> | <u>0.48</u> | <u>0.35</u> | <u>0.33</u> | <u>0.28</u> | <u>0.28</u> |
| | 33.67 | 12.72 | 7.06 | 4.19 | 2.58 | 1.92 | 1.47 | 1.20 |
| | 20.86 | 8.33 | 3.65 | 1.56 | 0.87 | 0.41 | 0.38 | 0.34 |
| | <u>9.78</u> | <u>6.67</u> | <u>4.58</u> | <u>3.20</u> | <u>2.28</u> | <u>1.71</u> | <u>1.54</u> | <u>1.34</u> |
| | <u>5.22</u> | <u>3.77</u> | <u>2.61</u> | <u>1.93</u> | <u>1.12</u> | <u>0.77</u> | <u>0.73</u> | <u>0.70</u> |
| | <u>5.47</u> | <u>2.86</u> | <u>2.65</u> | <u>2.57</u> | <u>2.50</u> | <u>2.38</u> | <u>2.24</u> | <u>2.20</u> |
| | <u>10.82</u> | <u>4.49</u> | <u>2.55</u> | <u>1.51</u> | <u>1.12</u> | <u>1.00</u> | <u>0.87</u> | <u>0.82</u> |
| | 45.58 | 25.45 | 17.29 | 12.69 | 10.28 | 8.84 | 7.67 | 6.94 |
| | 112.98 | 44.48 | 18.36 | 7.64 | 3.28 | 1.90 | 1.27 | 1.15 |
| | 48.78 | 28.04 | 17.60 | 11.17 | 8.01 | 6.35 | 5.72 | 5.01 |
| | 20.44 | 13.94 | 9.58 | 5.87 | 3.72 | 2.67 | 2.32 | 2.21 |
| | 53.04 | 17.68 | 12.28 | 9.72 | 8.23 | 7.15 | 6.21 | 5.67 |
| | 78.15 | 21.85 | 9.68 | 5.86 | 4.28 | 3.15 | 2.93 | 2.70 |
| | 167.55 | 78.59 | 48.67 | 30.72 | 19.55 | 13.16 | 8.78 | 6.65 |

total # of events total background

| | |
|-------|-----|
| 21653 | 326 |
| 8906 | 96 |
| 12595 | 133 |
| 2429 | 26 |
| 10309 | 198 |
| 6268 | 97 |
| 9423 | 170 |
| 5843 | 95 |
| 5925 | 98 |

Figure 8: ET Timing Window results, page 2. Please ignore the spurious entries, as they suffer from a trigger cable timing mismatch much like T counter 9.

| <u>total # of events</u> | <u>total background</u> |
|--------------------------|-------------------------|
| 2442 | 52 |
| 12196 | 200 |
| 6292 | 89 |
| 44064 | 680 |
| 7389 | 116 |
| 23208 | 415 |
| 7281 | 137 |
| 10278 | 173 |
| 5551 | 88 |
| 13745 | 222 |
| 7391 | 112 |
| 9995 | 156 |
| 6885 | 113 |
| 11493 | 204 |
| 6838 | 117 |
| 23311 | 418 |
| 6297 | 101 |
| 8917 | 101 |
| 6047 | 66 |
| 8498 | 115 |
| 5308 | 70 |
| 7836 | 101 |
| 5177 | 45 |
| 10448 | 122 |
| 3917 | 58 |
| 6935 | 86 |
| 2527 | 30 |
| 4233 | 58 |
| 1722 | 29 |
| 741 | 16 |
| 444 | 5 |
| 752 | 13 |

Figure 9: ET Timing Window results, page 3.