Trigger Register Efficiency

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1 Introduction

It has been observed that the array *tbit* (or equivalantly, the bitmask variable $trig[0]$) in the PiBeta analyzer is not the best register of the triggers which fired in a given event. These variables frequently fail to register triggers, especially when multiple triggers fired. A better method which looks at the TDC values in each channel corresponding to a trigger is proposed and the resulting trigger statistics are compared to those obtained using *tbit*.

2 *tbit* and $trig[0]$

There has been some confusion about the definition of the variables *tbit* and $trig[0]$. They are in fact the same thing in slightly different guises. $trig[0]$ is a bitmask variable in the raw data. It is 12 bits where each bit corresponds to one trigger. A bit is 0 if the trigger did not fire and 1 if it did fire. *tbit* is created in *beam.c* and is defined as an array of type $WORD$ with 12 elements. Each element corresponds to a bit from $trig[0]$ and is assigned the value of that bit (either 0 or 1 – with the same meaning as for the bits). Most members of the group prefer *tbit* to $trig[0]$ since it is easier to work with arrays than it is to manipulate variables at the level of individual bits.

3 Using TDC to Determine Which Triggers Fired

As pointed out in the introduction, *tbit* is not an efficient register of the triggers. However, trigger information can be restored by examing the TDC values corresponding to trigger channels. If a trigger did not fire its TDC value is defaulted to $INVALID$ in the analyzer ($INVALID$ is $\#define$d to be equal to -1000.0 ns). If the trigger fired it will have some other TDC value. This can be exploited to determine more accurately which triggers fired in an event. Figure 1 shows statistics about the triggers for one typical run. Figure 2 shows that *tbit* is particularly bad for events where multiple triggers were activated – a very common occurrence!

4 Conclusion

It is clear that the TDC method should be used to determine which triggers fired in a given event. Any time code which tests to see what triggers are present is inserted into the analyzer we run the risk of overlooking or misinterpreting events. In a high precision experiment like PiBeta this is unacceptable. Overlooking events might lead not only to a reduction in the total occurrences of a particular event but also could bias statistics if the failure to register triggers is not random (and it is not). It is proposed that the variable *tbit* be redefined in *beam.c* according to the TDC method. Thus, any uses of *tbit* elsewhere in the analyzer can be left alone.

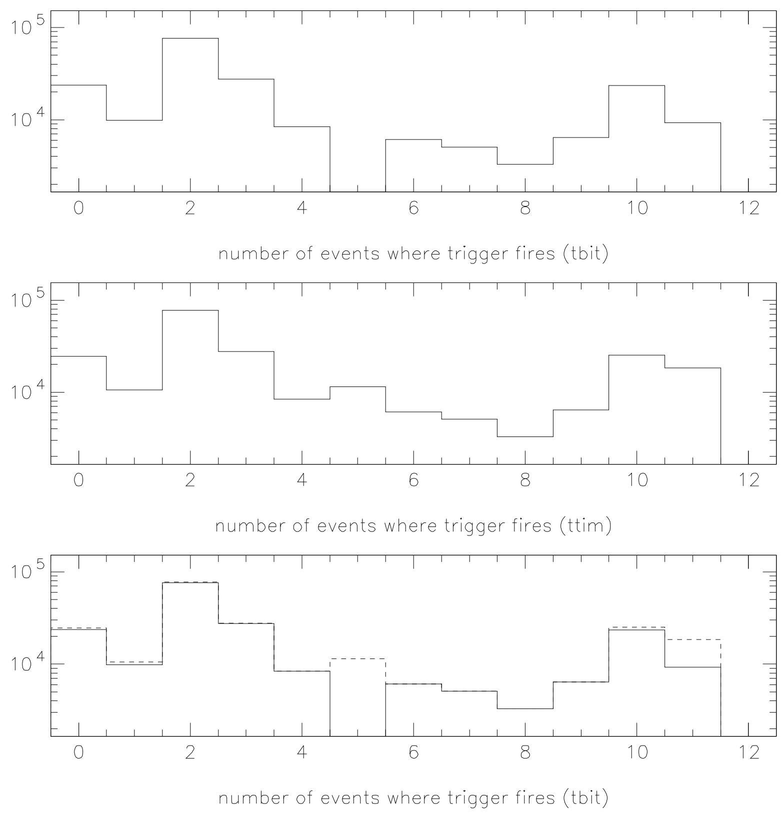

Figure 1: The top plot shows how many times each trigger fired during a single typical run according to *tbit*. The middle plot shows the same information determined by examining trigger TDCs. The bottom plot is merely a superposition of the 2 plots above shown to illustrate more clearly the difference.

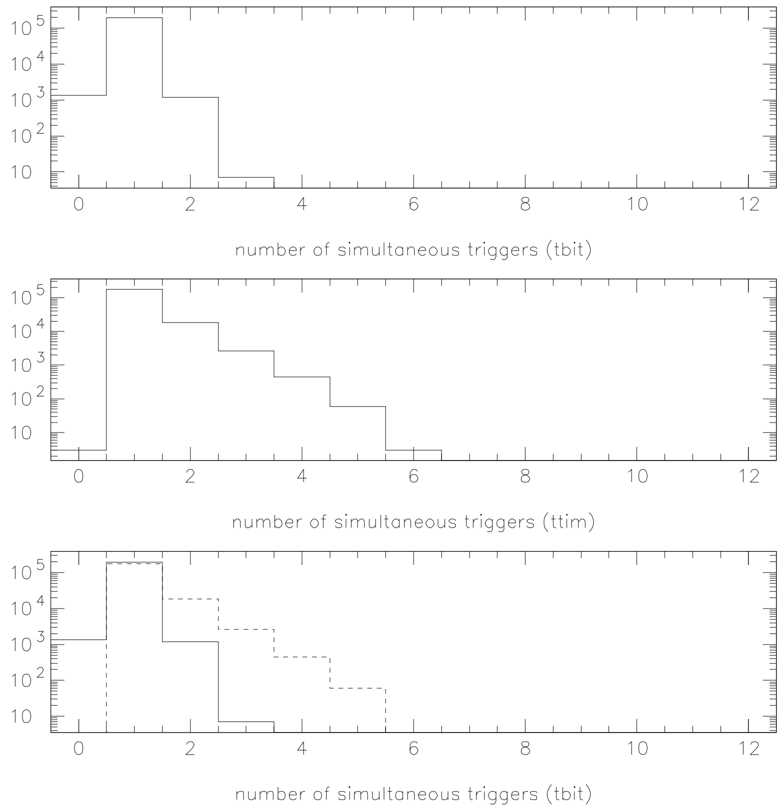

Figure 2: These plots show the distribution of multiple triggers according to *tbit*, trigger TDCs and a superpostion of the two (from top to bottom). The difference is drastic.