New Calibrations and effects of removing bad hits

Gaurang B. Yodh

February 1 2000

1 Introduction

Milagro triggers are generated by showers, muons and single hadrons accompanied by accidentals. Accidentals can be of several types. Accidentals occur during the 'gate time'. I list these below:

1. They can be random small pulse height hits due to low energy photons and/or electrons or tube noise.
2. They can be due to single muons which give a single large hit when passing close to a PMT and which is out of time with the main event which triggers.
3. They can be due to single hadrons distinct from the main event in which case the large hit is accompanied by associated hits distributed along the speed of light line.
4. They can be accidental showers.

In my previous memos I have shown examples of each of these kinds of occurrences. I have also described procedures which will remove most of these hits before doing any shower fitting.

In this memo, I show the changes incurred due to:

1. The use of Tony's timing and Fleysher/Haines pulse heights - new tpeds etc.
2. I quantify effects on triggering and reconstruction which are due to the cuts of bad hits

This is done using a high rate raw GRB-1966-0007.dat data tape.

2 Results from using new calibrations:

I compare the difference between local angles, theta and phi, and ra and dec between on-line fits and new fits generated using parameters from new calibrations given to me by Tony. This is done without throwing out any hits before angle fitting. To minimize statistical spreads I only use events with nhit>100. There are 11500 events triggered with nhit larger than 100 hits.

In the following figures numeral 1 refers to on-line fits, 2 refers to fit with new calibrations with no hits removed and 3 refers to fit with new calibrations and bad hits removed.

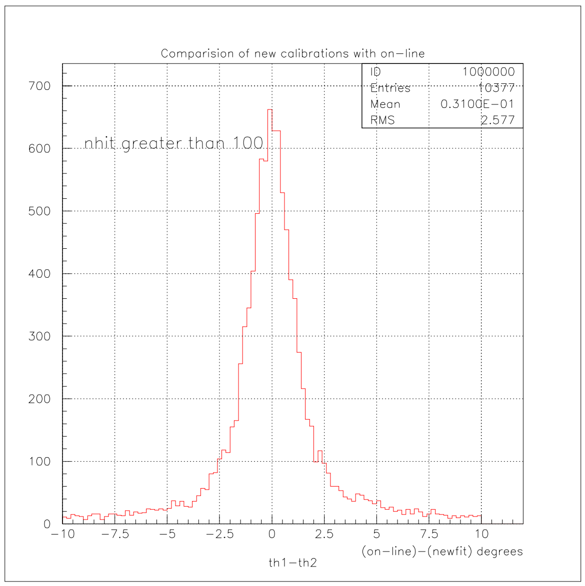

Figure 1:Zenith angle difference

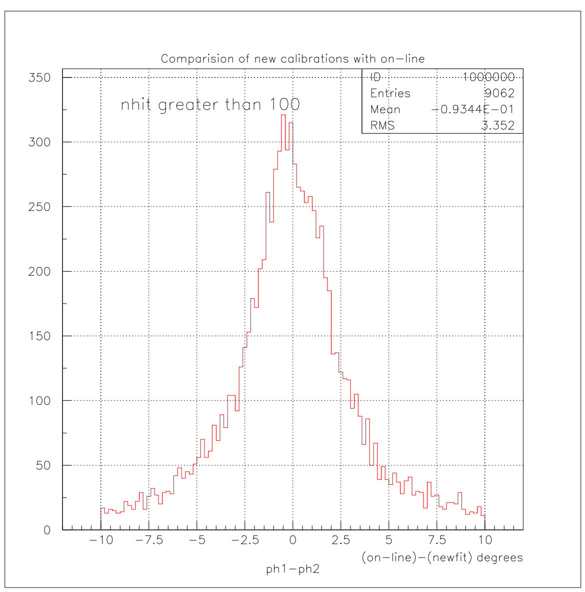

Figure 2:Azimuth angle difference

Figures 1 and 2 show the differences in the reconstructed local zenith and azimuth angles between on-line and new-calibration fits without removal of any hits. No signficant shifts in these distributions from being centered on zero is seen. The histogram contains 91 percent of triggers with nhit greater than 100.

Figure 3 shows a systematic shift of ra in the on-line fits as compared to fits using new-calibrations towards larger ra. This agrees with the shift between Tony's crab and Andy's crab positions. Figure 4 shows that there is no signficant deviation between on-line and new-calibration fits for declination. This may imply that the new-calibrations remove a tilt in east west direction.

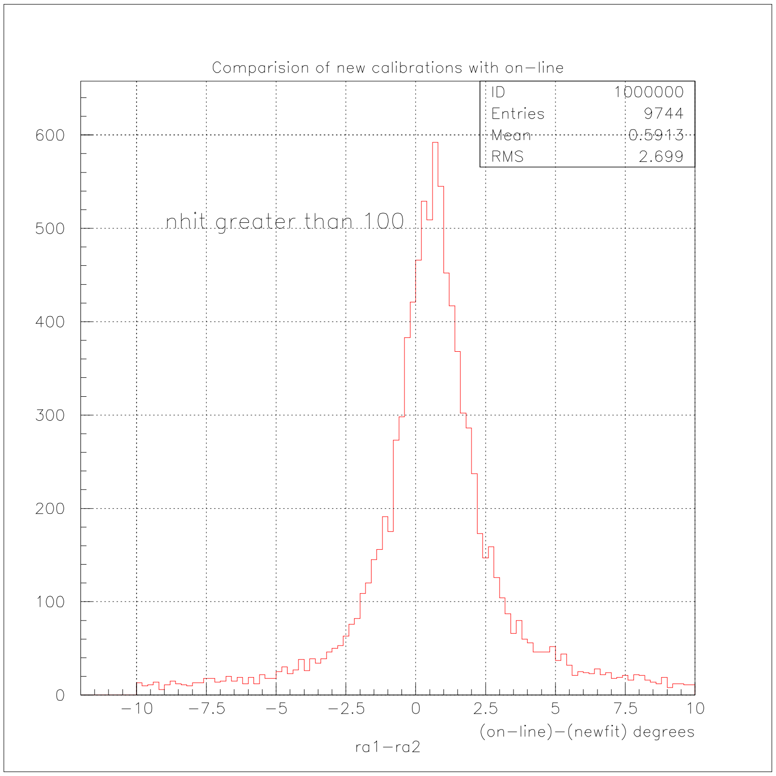

Figure 3:RA difference

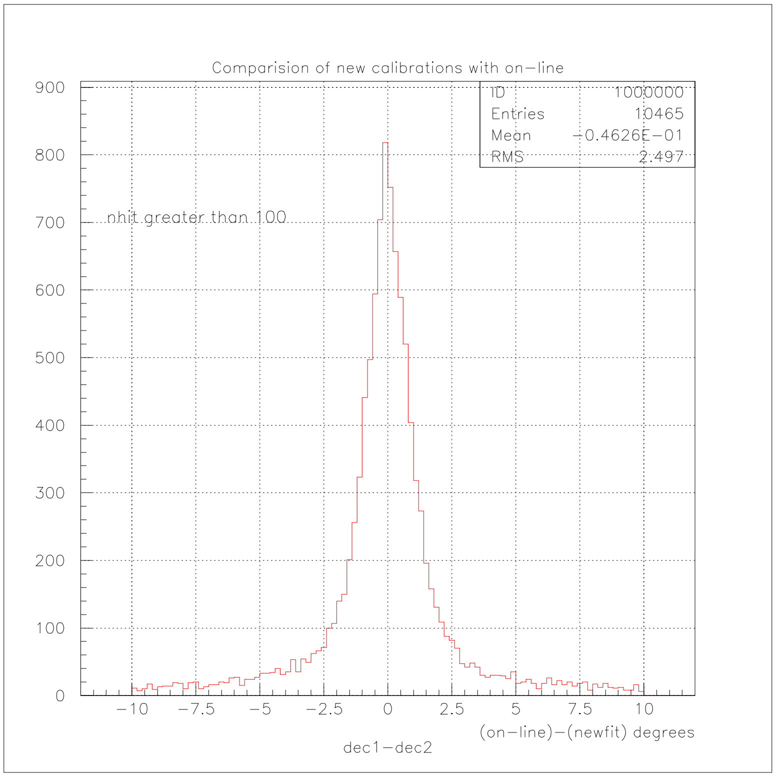

Figure 4:DEC angle difference

Now I discuss what the use of new-calibrations do to the no-fits without including the procedure for removing bad hits. My sample consists of 29491 triggers. The on-line fitter successfully fitted 21790 events out of this sample. With the use of new calibrations and not throwing out any hits 20073 triggers were fitted(not the same ones). The chisquared distribution for these two sets of fits is shown in Figure 5. One sees an improvement in chisq for a majority of the fits.

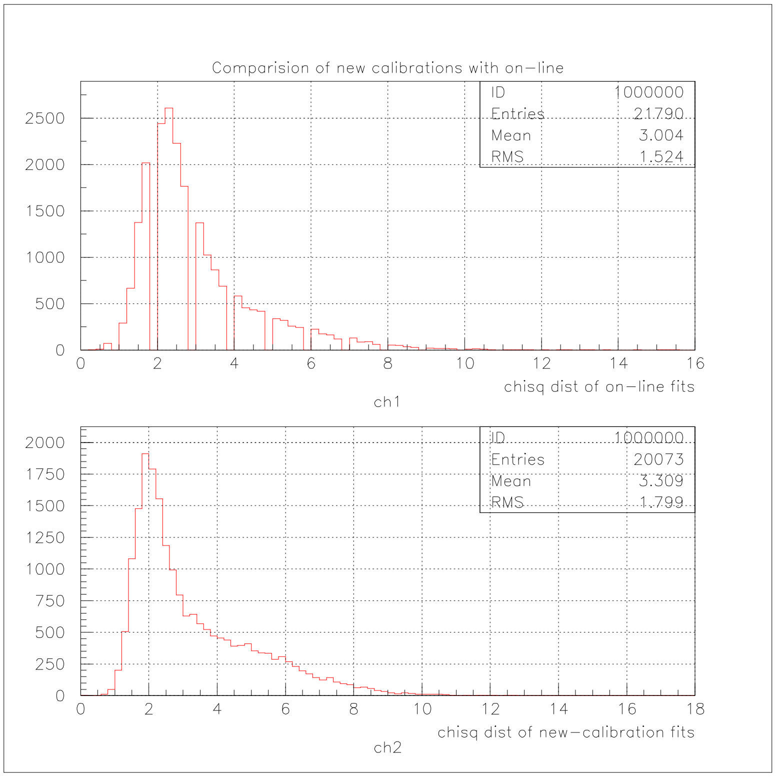

Figure 5: Chisq distribution of on-line and new fits

Next we compare the number of counters used in fits with on-line and new-calibrations. With calibrations we gain a substantial number of PMTS that are used in angle fits. This is shown in Figure 6.

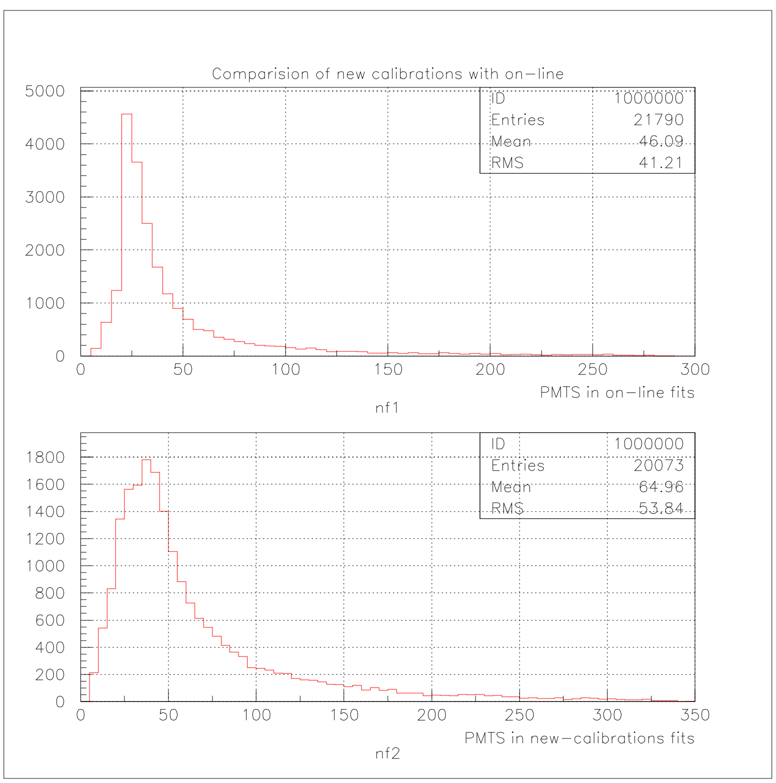

Figure 6: Nfit distributions for on-line and new fits

3 What bad hit cuts tell us:

Using my procedures for removing bad hits results in loss of PMTs to be used in fitting. Let us see how this effects various aspects of triggers.

First thing to note is that after cutting our bad hits we recover 6632 or about 25 percent more events! Figure 7 shows that the chisq distribution improves substantially.

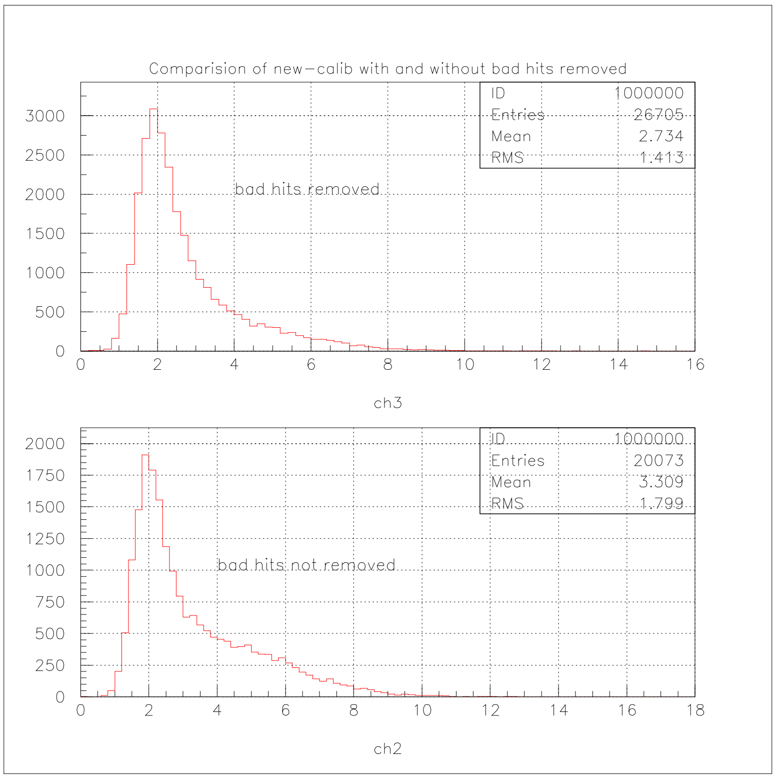

Figure 7: Chisq distributions new-calib with and without bad hits thrown out

Throwing out bad hits tells us that the our effective nhit threshold is lower than that given by hardware threshold value of nhit. We are triggering with smaller showers which are helped to overcome the hardware threshold requirment by the bad hits. This is shown in figure 8. Our energy threshold probably is lower than that given by MC which does not have correct fraction of bad hits. I have shown in an earlier memo that applying bad hit cuts to MC cuts out very few hits.

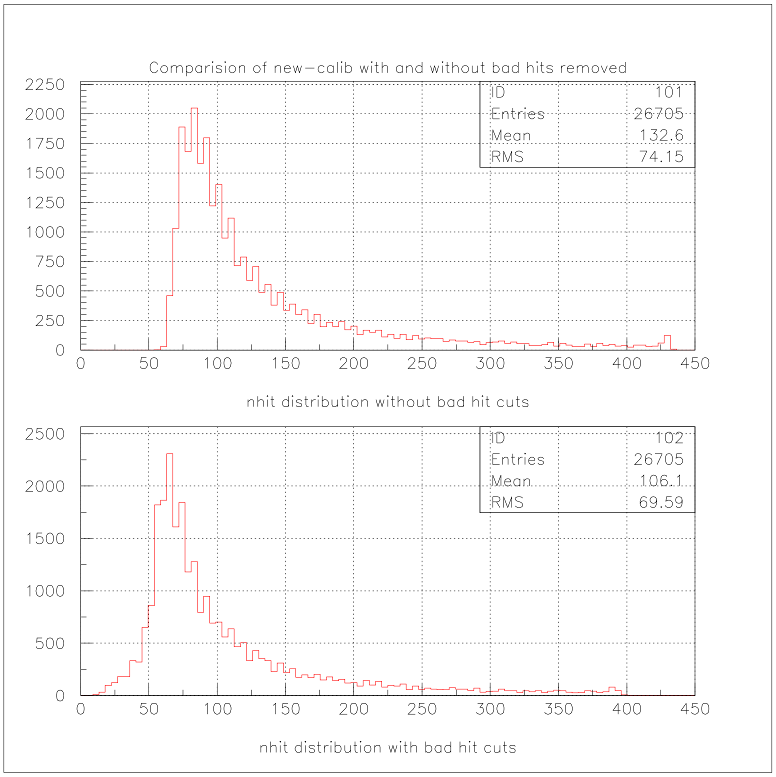

Figure 8: Effect on threshold nhit without and with bad hit cuts

Now how do we know that cutting out bad hits does not make for new systematic problems? I compare the ra and dec distributions using new-calibrations without and with bad hits cuts in Figures 9 and 10. Again for reducing statistical fluctuations a cut of nhit>100 is made on the data sample. No noticable shift is seen in these angle differences suggesting that cutting out bad hits does not produce systematic effects in the ra and dec distributions.

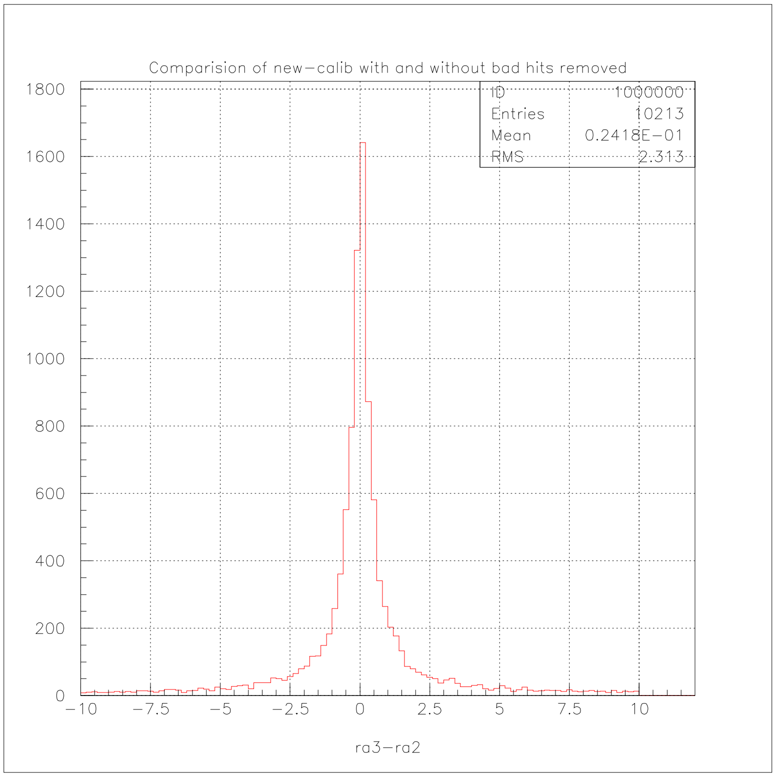

Figure 9:RA angle difference: Effect of bad hit cuts

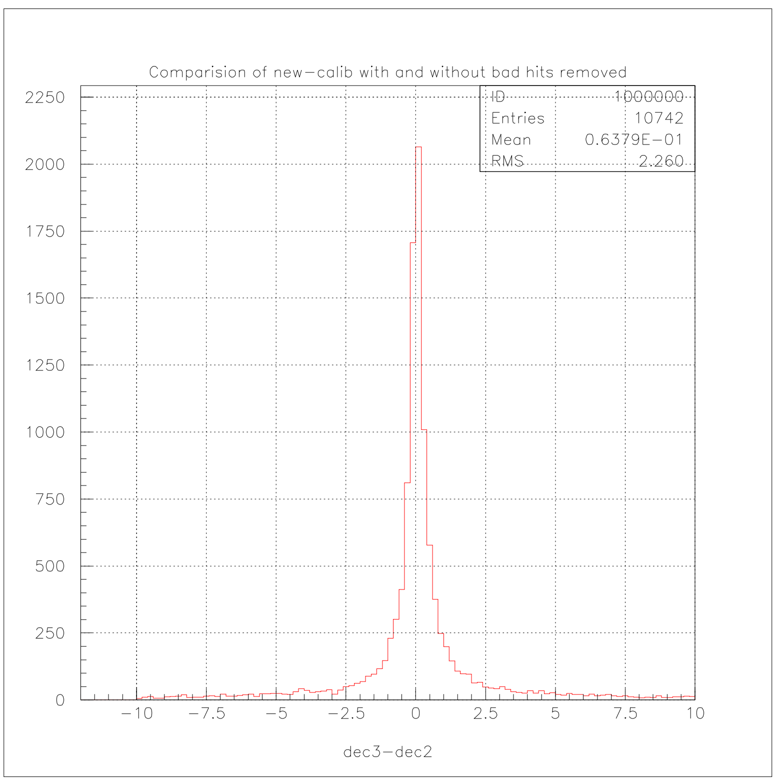

Figure 10:DEC angle difference: Effect of bad hit cuts