Comments on the Recent Memo by Joe and Rich

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1 "Mis-calibrated tubes" and "flashers"

In their memo, Joe and Rich identify "flashers" and "mis-calibrated tubes" by the frequency that they are the hottest tube hit. For data collected at the time of the non-burst that Joe found (their figure 6), that there are clearly 2 populations of "flashers": those that grow with the increasing NFIT cut and those that disappear completely with an NFIT>40 cut. PMTs 154,156,159,225 and 226 are clearly the only candidates of the second kind. While the others, 63,109,175 and 211 are of the first kind. In the data from the time around GRB 6188, the data shows only the first kind of "flasher", and again, they are tubes 63,109,175 and 211. We explain below why we think that the "flashers" of the first kind are not only reasonable but an expected consequence of the calibration method. Such hits are in no way detrimental to the reconstruction of air showers.

As a consequence of the fact that an ADC was used to do the pulse height calibration for Milagrito, the effect of saturation was NOT taken into account. Typically tubes begin to saturate at about 70-100 PEs. After that the saturation effect kicks in rather rapidly. A pulse of 200 times the charge of a 1 PE pulse may due to a 1000 PE or larger hit although we will measure it to be 200 PEs. As Tony has shown in a memo from last year, the PMTs all saturate differently. Therefore, it makes sense that there are a handful of tubes that saturate later than the rest. When the pond is blasted, as a NFIT>100 cut requires, it is likely that many if not most most of the tubes are saturated. For this case, the PMTs which saturates the latest will likely be interpreted to have the highest pulse height. If the NFIT cut were increased past 100, We suspect that the fraction of the time that PMTs 63,109,175 and 211 are the hottest will further increase. As a rule, it seems contrary to us that tubes that preferentially contribute to well fit air showers (NFIT>100 cut) would be identified as bad.

2 "Flashers" and Air Showers

It is not clear from the memo how flashers affect air shower. It was suggested however that Joe's "burst" was a consequence of events caused by flashers. Our interpretation of this would be that a PMT flashes, and the flash is detected by >100 other PMTs causing a trigger. Such an event is much more likely to resemble a single hadron than an air shower. If the position of the flasher is near a corner, as in Joe's "burst", there will be more or less a plane formed in the pond. Should that plane be reconstructed, the result will certainly be a fit near the horizon. Joe's event excess had a zenith angle of 70 deg. We can not imagine how such an event could be be reconstructed as air shower with a zenith angle near 20 degrees as are the events coincident with GRB 6188.

It is possible that the if a tube is flashing randomly that it could add light to the pond during an air shower. We think that this hypothesis can be discounted as the singles rate, for the hottest tube within an hour of the burst was under 100kHz. The probability of a random activity happening sufficiently coincident in time to drastically affect the air shower reconstruction for many events is exceedingly small.

A third possibility is that a flasher can be "triggered". In this hypothesis, a PMT hit by a Cherenkov photon from a triggering air shower causes the tube to "flash". The light from the flash would be detected by neighboring PMT's and naturally wrongly interpreted as Cherenkov light. This might be a troubling effect if it does indeed happen. However, it is important to point out that as the air shower moves at the speed of light, and the flasher light moves at c/n, the light from the flasher will be delayed. As we already have prodigious amounts of late light in the pond, and we have take step to minimize its effect on air shower reconstruction, it is not at all clear that this phenomena would have a large or even noticeable effect on the shower plane reconstruction.

Finally, it is not clear to us that because a tube is known to flash, that it should be naturally removed from the fit, a point also noted by Joe and Rich. In plot 6 of the memo, the evidence for flashing goes away for PMTS 154,156,159,225 and 226 with the application of an NFIT cut. Furthermore, the rates for these PMTs do not go to zero, but rather they participate in showers as typical tubes. This indicates that, although they flash they are quite functional for air shower reconstruction. Also, it is not clear to us that removing a known flashing PMTs from events caused by flashers would be an effective way of minimizing backgrounds due to flashers. If a PMT flashes and induces hits in >99 other PMTs causing a trigger, removing only one PMT from the reconstruction should only have a small effect on the result. Identification and removal of such events as a whole is clearly the objective.

3 Event Reconstruction

We re-reconstructed the data excluding the 4 tube that Joe and Rich excluded. Table 3 show the RA, DEC and nfit of the original 18 events and table shows the same parameters when refit without tubes 63, 109, 175, 211.

This is in agreement with the results in Joe's and Rich's revised memo. We find that for most events, nfit, and hence the reconstructed angle does not change. It is also clear from these results that the total number of tubes fit 957 (before) 935 (after re-reconstruction) is not dominated by these 4 tubes.

We applied the same search technique as before, and now find that the the peak has dropped to 17 events, with a small decrease in the background, resulting in a final probability of 1.5×10^{-7} this is about a factor of 5 higher than before. The skymap associated with this analysis is shown in figure 1. Clearly the excess for grb 6188 does not disappear by removing these 4 tubes. These tubes do not have a large effect on the result. (the first time we refit the events excluding the 4 tubes we inadvertantly used the new Milagrito survey and found that we still had 18 events).

Joe and Rich are concerned that in 4 of the 18 events, a PMT that they identify as a "flasher" or as "mis-calibrated" was one of the 3 hottest in the pond. The expected number of times that one would expect this to happen for any 4 function PMTs is $4 \times (18*3)/228 = 0.95$. The Poisson probability of observing 4 by coincidence is 0.02. The actual probability is higher, as there are dead tubes in the pond and the candidate PMTs were selected by their propensity to have large pulses.

RA	DEC	Nfit	time (secs)
291.399994	52.990002	14	50015.997995
289.010010	55.000000	49	50016.356101
290.470001	54.830002	72	50017.080402
290.970001	53.000000	40	50017.805099
290.070007	53.619999	55	50017.943541
290.970001	55.279999	66	50018.102901
291.779999	52.939999	34	50018.191072
288.339996	52.830002	32	50018.961461
290.049988	53.369999	30	50019.201808
291.250000	54.680000	36	50019.250670
292.140015	54.750000	53	50020.272981
292.290009	54.369999	34	50020.810826
290.869995	55.490002	34	50020.916718
289.089996	53.049999	73	50021.097841
289.549988	52.939999	22	50021.808933
289.130005	52.480000	157	50022.208053
289.399994	54.770000	65	50023.431967
290.480011	55.299999	91	50023.466030

Table 1: Original 18 events

RA	DEC	Nfit	time (secs)
291.399994	52.990002	14	50015.997995
289.709991	55.630001	48	50016.356101
290.410004	54.880001	71	50017.080402
290.970001	53.000000	40	50017.805099
290.070007	53.619999	55	50017.943541
290.700012	55.299999	65	50018.102901
291.010010	52.750000	33	50018.191072
287.700012	52.639999	30	50018.961461
290.049988	53.369999	30	50019.201808
291.209991	54.799999	34	50019.250670
291.700012	54.540001	52	50020.272981
292.049988	54.400002	32	50020.810826
290.869995	55.599998	33	50020.916718
289.010010	52.889999	72	50021.097841
291.959991	52.919998	19	50021.808933
289.309998	52.520000	153	50022.208053
288.170013	54.119999	63	50023.431967
290.480011	55.299999	91	50023.466030

Table 2: 18 events refitted excluding tube 63, 109, 175, 211

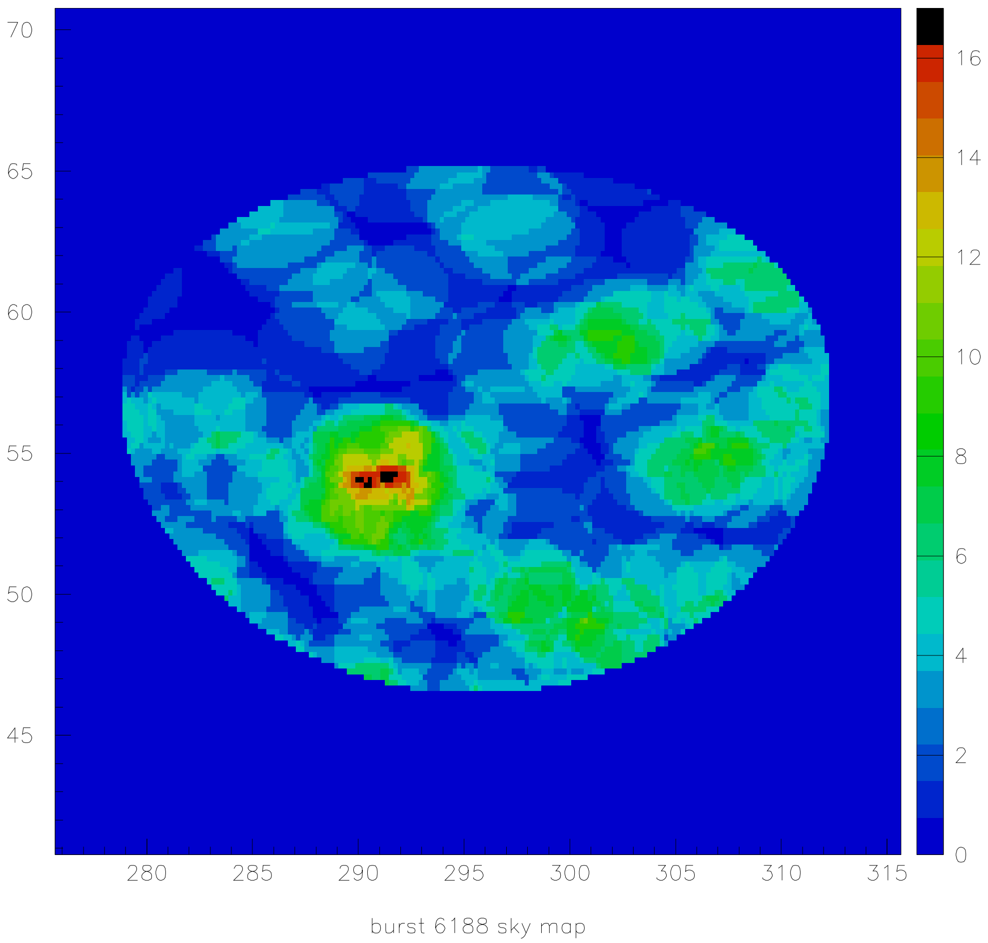

Figure 1: skymap for refitted data - peak at ra =290.0, dec = 54.0, nsignal = 17, background = 3.448, prob = 1.5e-07

4 Conclusions

There is no evidence that the flashing tubes, 154,156,159,225 and 226, coincident with Joe's fake burst are behaving in an unusual manner in the data collected around the time of BATSE trigger 6188.

There is no reason to identify PMTs that demonstrate increasing frequency as the hottest tube with increased NFIT cuts, tubes 63,109,175 and 211, as flashers. The presence of such tubes is both expected and reasonable and there exclusion is not justified.

If a PMT is identified as a flasher, it is not the case that removing the PMT from angle or core fits is sensible.

The exclusion of PMTs 63,109,175 and 211 from the event reconstruction has a small effect on the reconstructed angles and core positions for the events coincident with BATSE trigger number 6188. We don't believe the results on GRB 6188 are affected by the same effect as Joe's "burst".

We feel that it is important to understand the cause of the fake burst identified by Joe. We absolutely encourage and support future studies of flashers and the effect that they have on the data.