COMPARING GAMMA RAY MONTE CARLOS WITH SHOWER DATA IS LIKE COMPARING APPLES AND ORANGES IF YOU DON'T WATCH OUT

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We are at a distinct disadvantage in gamma ray imaging without Monte Carlo background events. The plan has been to compare the gamma ray MCs with the real data, the latter being mostly background. As I showed in DIR-3-83 the kinds of images one gets depends on the cuts you make. In particular, it is important to simulate the triggering logic and thresholds used in taking the data.

In Bangalore paper OG4-1 the quantity $\theta_{\perp}$ is defined as a measure of the compactness of the shower. In paper XG4-20 is is stated that 97% of the gamma ray simulations have $\theta_{\perp} < 0.425$ while $< 10\%$ of the cosmic ray showers meet this requirement. The conclusion is that gamma ray showers are more compact than proton showers. It is also stated that this analysis was done using the approprate triggering requirement.

It turns out that this is still not sufficient. It is necessary to also operate on the data in some way to remove the non shower-associated background in the data, which is apparently more than just the pedestal. Or, alternatively, one must simulate this background in the Monte Carlo.
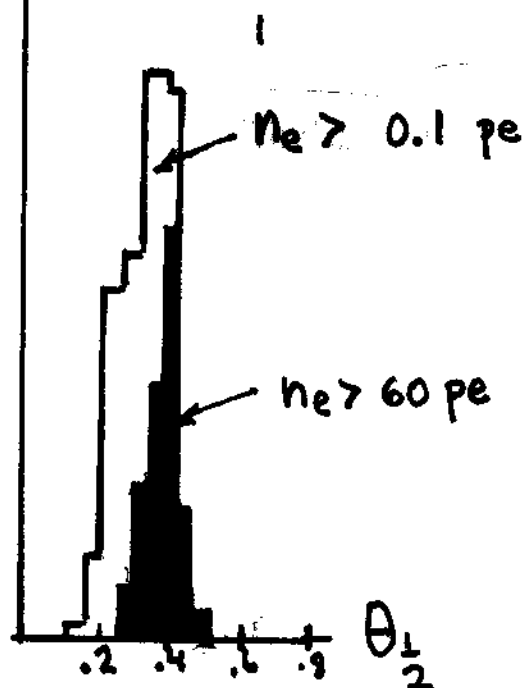
This is illustrated in the figure. Figure (a) shows the $\theta_{\perp}$ distribution for 3 TeV MC events (i.e., 3x1 TeV). The unshaded events have essentially no cut on the photoelectron count. The shaded events have 3/7 with at least 60 pe. We see that the effect of the threshold cut is to toss out the more compact showers. The shaded distribution is presumably what was the basis for

the statement in XG4-20 that 97% have $\theta_1 < 0.425$.

Figure (b) shows a sample of real data taken in May of this year. The pedestal has been already subtracted. The unshaded events are presumably the basis of the statement that less than 10% of the cosmic ray showers have $\theta_1 < 0.425$. The shaded events show what the distribution looks like when we take the average output of the 19 PMT s on each event and subtract it from the output of each tube (negative values set zero). This is an (over)correction for the general light level in the tube. Note that all the events now have $\theta_1 < 0.425$! What evidently happens is that the background light causes the shower to appear wider. Now I have overcorrected by subtracting the average, since this also includes the shower. This results in the shower appearing actually more compact than the Monte Carlo. If I was to subtract a more realistic background I would not be at all surprised if the data and Monte Carlo could be made to agree. As far as I can see, we have no basis to conclude that the Mont Carlo gamma showers are grossly different from the proton showers in the data.

$$\theta_{\frac{1}{2}} = \sqrt{\sigma_x \sigma_y 2 \ln 2}$$

(a)

3 TeV MONTE CARLO

$n_e > 0.1$ pe

$n_e > 60$ pe

$\theta_{\frac{1}{2}}$

.2   .4   .6   .8

(b)

DATA

14-APR-83

NO SUBTRACTION

WITH AVG. OF
19 PMT'S SUBTRACTED
FROM EACH PMT

$\theta_{\frac{1}{2}}$

.2   .4   .6   .8