

# Energy Spectrum Calculation

March 1, 2004

Previous experiments have found that in the range  $10^{15}$  to  $10^{17}$  eV, the energy spectrum is:  $F(E) \times E^3 \simeq 24.5 \text{ eV}^2 \text{ m}^{-2} \text{ sr}^{-1} \text{ s}^{-1}$ .

Here I have binned the energy data in log space, so the number of counts per bin is actually  $F(E_C) \times 0.46E_C$  (for 10 bins over 2 orders of magnitude in E), where  $E_C$  is the energy at the centre of the bin. What is actually being plotted is

$$\log \frac{F(E) \times 0.46E \times E^2}{0.46 \times A \times t}$$

where  $A$  is the aperture at energy  $E$  (assumed to be constant over time), and  $t$  is the time in seconds (in this case 50 days).

When this histogram vs.  $\log E$  is fit to a straight line, the slope is 0.74. (Where it is expected to be nearly 0.)

The absolute scale of the histogram data ranges from  $\sim 21.5 - 22.5$ , where other experiments have found a flat 24.5. This is on a log scale, so my calculated flux is down by a factor of 100 to 1000 from what I would have expected

The difference could be coming from either the aperture estimate or the reconstructor. The best way to test this would probably be to use the same program on a set of simulated data. For example, by feeding the showers used in the aperture calculation back into the reconstructor, one could see if there is a systematic bias in the reconstructor, and apply a statistical correction to the reconstructed data.

A few known problems with my latest aperture calculation: I am looking for 4 hits in Chiquita, which is equivalent to 1 trigger plus 3/5 nearest neighbours, while Chao's program looks for 3/4 nearest neighbours. Chris has written code which I am going to use to redo the calculation to match Chao's filter exactly. Also a preliminary look at reconstructions of simulated data seem to show a bias toward higher energies. The median energy of the reconstructions seems to be right, but there is a significant tail out to much higher energies, so that the average energy of the reconstructions is rather higher than the input energy. (Plots will be linked to my web page soon.) This could have an effect on the slope of the spectrum.

I appreciate all the thinking everyone is doing on this! If you have any more suggestions please drop by my office!