IS THE SIGNAL FROM CYG X-3, AS RECORDED IN SOME UNDERGROUND EXPERIMENTS, REAL?

(Introduction to the discussion at highlight session Aug 16, 1985)

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On the suggestion of the oganizing committee I shall summarize briefly the results of the discussion meeting held on the evening of August 13 and try to compare evidence from different detectors.

Most of the excitement concerning the underground detection of signals from Cyg X-3 comes not from astrophysical grounds (though it could be difficult to imagine such a powerful source), but from the contradiction with surface experimental data. Believing in the Cyg X-3 signal underground and also that the main processes of muon production are well known we come to the conclusion that the signal in EAS Cherenkov or counter experiments should be remarkably high, which is not the case.

Thus, we face severe alternatives: either there is something wrong in the interpretation of the underground evidence, or a quite new Physics is involved, the structure and importance of which we can not even evaluate. This requires us to examine the experimental data very carefully.

Generally speaking, there are two approaches in a search for a point-like sources in the sky: 1) To look for an excess from a given direction (angular domain) 2) To look for the intensity variation in time from a given direction (periodic, sporadic, complex - time domain). For me the first approach is more convincing. Certainly there is a difficult question of how many "sigma's" are convincing?

Unfortunately, there is only one EAS experiment (Kiel) in which Cyg X-3 has been seen in both domains, which is so far a unique case for UHE gamma-astronomy.

It is difficult to find out what could be wrong in the phase-analysis of Cyg X-3 data. The most convincing data comes from NUSEX-experiment. The visible weak point in the analysis for this case is the choice of the acceptance solid angle. This choice is made empirically on the basis of accumulated data to have the biggest signal to noise ratio. The chosen angle is an order of magnitude greater than apriori optimal one, which forces one to assume new physical processes. But such a choice should also inevitably affect the calculated probability to obtain the result due to Poisson fluctuations.

At the Tuesday 13 discussion meeting following the presentations were made:

	A	B
1. Learned-Introduction, nondirectional data (UTAH, SOUDAH)		
2. Ayres - SOUDAN	+	-
3. D'Ettore Piazzoli - NUSEX	+	+
4. Raupach - FREJUS	-	?
5. Chudakov - BAKSAN	-	-?
6. Krishnaswami - KGF	-	-
7. Cherry - HOMESTAKE	-	-?
8. Vander Velde - IMB > 70	-	-
9. Thornton - IMB Vertical	-	-
10. Ruddick		
11. Bazer Bachi - Old M. Blanc experiment		
12. Aprile - HPV (submitted later)	-	-

In each line the speaker and then code of his experiment is indicated. At the right side of each line the result of the experiment is indicated in a following way: first column A answers the question whether Cyg X-3 is seen in this experiment (+) or not, (-), authors opinion being the main criterion. Second column B corresponds to the phase interval .7-.8 in which the most sound positive result of NUSEX - experiment is concentrated. Column B shows that there is no confirmation of NUSEX result from other experiments. It does not necessarily mean a direct contradiction because of the differences in exposure time, depth, angular window and so on. By the question mark those experiments are indicated, in which similar to NUSEX, though statistically nonsignificant result was obtained.

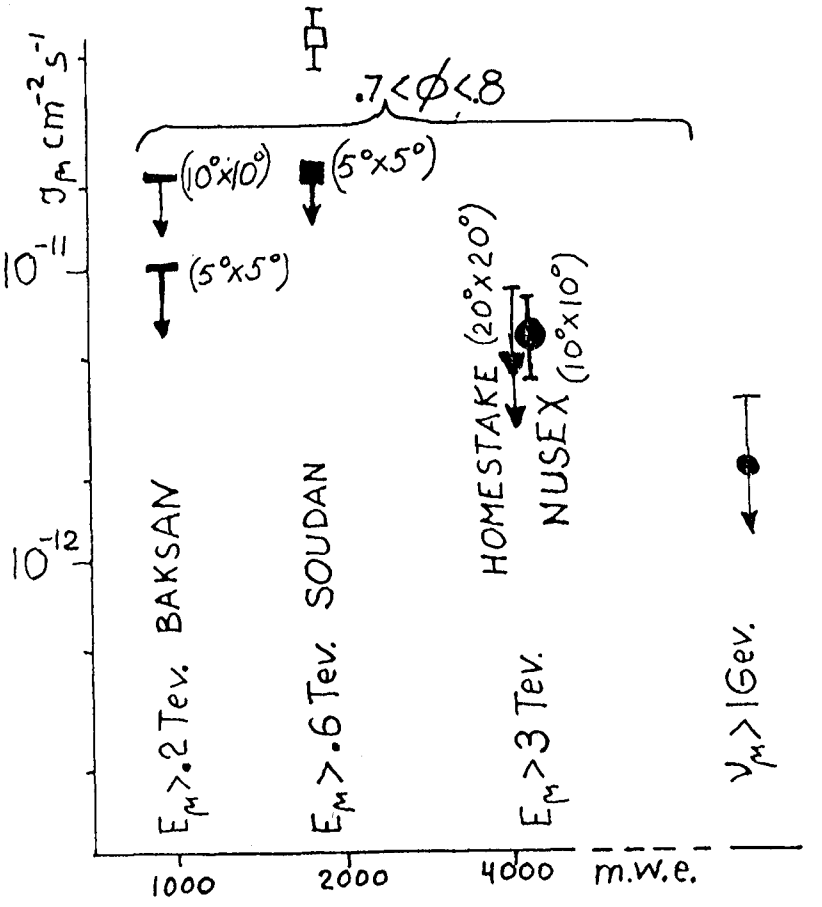

Figure 1: Cyg X-3 muon fluxes in phase internal 0.7 to 0.8 a diffeerent depths. BAKSAN data for neutrino-induced muons and Soudan data for "all phases" are also indicated.

The comparison of several experimental data in the phase interval .7-.8 is shown on the figure. One can see that there is no direct contradiction of NUSEX data with upper limits from other experiments. However, there is certainly a contradiction between NUSEX and BAKSAN for a conventional process of production of muons. In such a process muons are produced through pion decay in a hadronic cascade in the atmosphere and their energy spectrum in the range 200 - 3000 Gev should have an integral exponent no less than 1.7. Thus the flux at Baksan should be at least 15**1.7 = 100 times greater, than at NUSEX, but the experimental ratio is less than 4. Such a ratio can be explained only by nearly monochromatic muon beam, or some unknown neutral penetrating particle!? (not neutrino as is shown by NUSEX experiment itself).

To solve the puzzle new experimental data and better analysis of existing data is needed. The new FREJUS data will be most helpful as the experimental details of FREJUS and NUSEX experiments are quite

similar. Let us hope that Cyg X-3 will not stop its activity leaving us in the dark.