

## SEARCH FOR DEEPLY PENETRATING PARTICLES IN EXTENSIVE AIR SHOWERS ABOVE $10^{17}$ eV

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### Abstract

Results are given of a search for deeply penetrating particles in the cosmic-ray flux above  $10^{17}$  eV using the Fly's Eye detector of the University of Utah/1/. Possible sources for such events are taus and other long-lived particles produced in the interaction of the cosmic ray flux with the atmosphere and weakly interacting particles of astrophysical origin such as neutrinos. Both types of sources are distinguished from normal hadronically produced EAS's by searching for EAS's with zenith angles greater than  $80^\circ$ . In addition, the second type of source was searched for by looking for upward going EAS's.

The sensitivity of the Fly's Eye detector to distant events has been improved since the previously published results/2/ of this search. The reconstructable data rate has been increased by a factor of approximately 2.5 (see paper OG-9 in this proceedings) We have searched through an additional  $2.6 \times 10^6$  seconds of data acquired with the filters in place and have found no unusual deeply penetrating events.

In light of the additional live time and increased data rate we set preliminary upper limits on  $\delta_{\tau}/\delta_{\text{tot}} n(X)$  where  $\delta_{\tau}/\delta_{\text{tot}}$  is the probability of producing a tau in a cosmic-ray interaction,  $n(X)$  is the normalized tau distribution function for such an interaction and  $X$  is  $E_{\tau}/E_{\text{primary}}$ . In the interval  $10^{18} < E < 10^{19}$  eV and  $0.1 < X < 1.0$ , the updated upper limits on this quantity are  $2.2 \times 10^{-2}$  and  $7.3 \times 10^{-2}$  for  $X=1.0$  and  $X=0.5$  respectively. Using our measured p-air cross section of 520 mb/3/ and assuming that the cosmic-ray flux is primarily composed of protons we calculate a  $< 11$  mb for and  $< 39$  mb for  $X=0.5$ . Preliminary updated upper limits tau ultra high energy neutrino flux based on the non-observation of upward going EAS's are presented in Table 1.

TABLE 1  
Preliminary Updated Limits on  $\nu$  Flux Based on Upward Events  
( $\delta/\text{cm}^2\text{sec str.}$ ) and  $\delta = 10^{-33}\text{cm}^2$

$E_0(\text{eV})$	$10^{17}$	$10^{18}$	$10^{19}$	$10^{20}$	$10^{21}$
Flux	$7.28 \times 10^{-13}$	$2.97 \times 10^{-14}$	$3.70 \times 10^{-15}$	$1.57 \times 10^{-16}$	$2.02 \times 10^{-17}$

A more complete calculation of the limits presented above based on the analysis of subsequent data from Fly' Eye 1 and from the recently completed Fly's Eye II will be presented at the conference. We will also present updated upper limits on the production cross sections for hypothetical weakly interacting particles.

### References

1. R.M. Baltrusaitis et al., NIM, A240 (1985),410.
2. R.M. Baltrusaitis et al., Phys. Rev., Da 2192 (1985).
3. R.M. Baltrusaitis. et al., Phys. Rev. Lett. z52 1380 (1984).



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