There is no compelling evidence for a threshold.

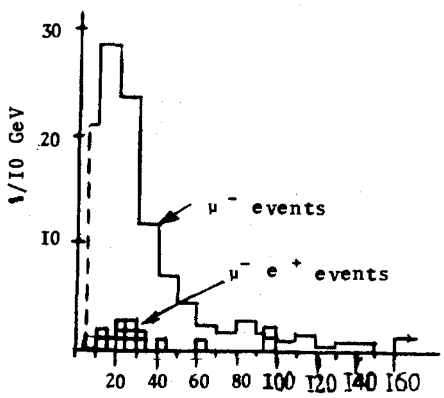

Fig.Ic - the distribution of energy E_ν(GeV)

5. Possible Neutral Current Events.

There are two or three events among the 15e$^+$ for which thr EMI information favors a hadron hypothesis over the muon one(#'s 7, 8, 16). There is a possibility of EMI inefficiency although one does not expect it at this level. The intent is to study the EMI performance during the times these events occured for evidence of possible malfunction One of the three events,16, could be an $\bar{\nu}_e \to e^+$ event but the others are not likely $\bar{\nu}_e$'s.

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THE OBSERVATION OF THE DIMUON PRODUCTION AT SERPUKHOV ACCELERATOR (IHEP - ITEP COLLABORATION)

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The first observation of dimuon events in the neutrino interactions was done at Batavia by the FHPW-collaboration[1] at neutrino energy above 30 GeV. We made the search for 2μ-events in the wide band neutrino and antineutrino beams with energy below 30 GeV at the Serpukhov accelerator.

The neutrino detector[2] with optical spark chambers consisted of two parts: production part and magnetised iron one to determine the sign of the muon and its momentum. The mass of the sensitive volume of the production part is 96 tons. The spark chambers were triggered every accelerator pulse.

Preliminary data on the first experiment in neutrino beam (80 k. pictures) were published elsewhere[2].

The second experiment was performed with different neutrino spectrum: we suppressed low energy part and enriched high energy one to improve the conditions for the search for 2μ -events. The results of both neutrino experiments alongside with antineutrino data are shown in the Table.

Table

N exp	Protons on the target	Number of pictures	Number of 1μ-events	Number of 2μ-candidates
NEUTRINO				
1	9.4 10^{16}	80 k.	11 k.	91
2	13.6 10^{16}	90 k.	8 k.	173
ANTINEUTRINO				
3	15.5 10^{16}	100 k.	3.6 k.	19

All numbers of events are given for fiducial volume of 34 tons. Any 1μ -event should have at least a track with a range in iron longer than 0.48 m in the production part. Dimuon candidates have two such tracks and a distance at the vertex less than 4 cm.

We did not observe any events in which both tracks passed through the magnet. Therefore subsequent analysis was carried out irrespective of the sign of the second muon. The longer track of the two we assign to the primary muon and the short one to the produced.

The penetration distribution of the short track particles is the most efficient way for separation of real dimuon events from background. Fig. 1a and 1b present integrated penetration distributions for the first and second experiments in neutrino beams together with the calculated background.

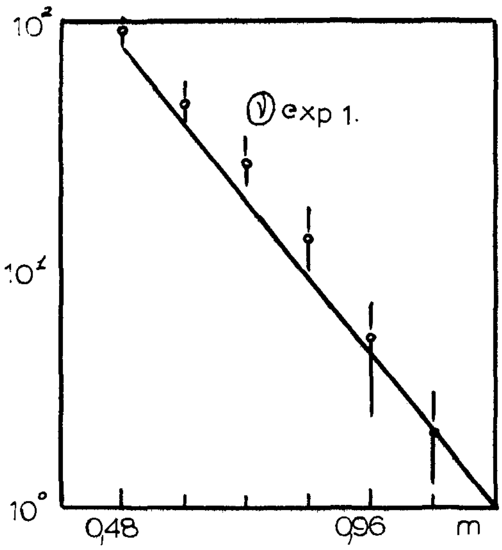

Fig. 1a

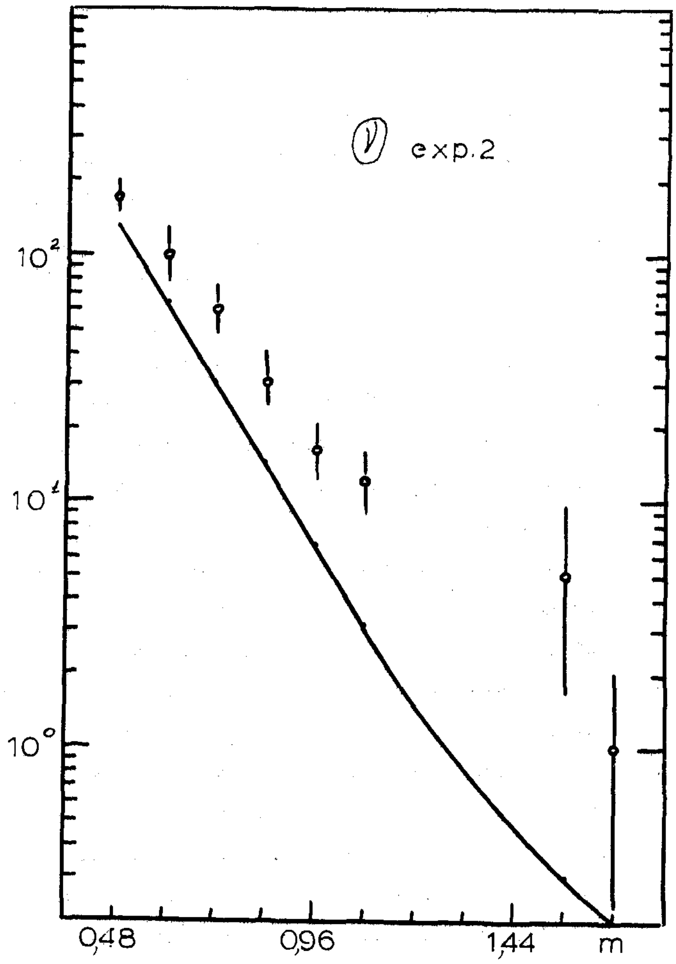

Fig. 1b

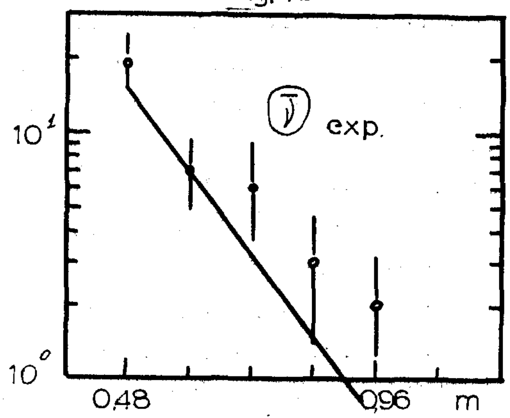

Fig. 1c

Fig. 1. The integrated penetration distributions for the three experiments in comparison with calculated background: a) – the first neutrino experiment, b) – the second neutrino experiment, c) – the antineutrino experiment.

A similar distribution in antineutrino beam is shown in Fig. 1e.

Comparing the experimental data with Monte-Carlo generation of deep inelastic neutrino and antineutrino interactions we reach the conclusion that the majority of dimuon candidates can be explained by inelastic neutrino events where pions or kaons either punch through of decay in flight. Calculations were performed under the assumption of scaling. Charged multiplicity was taken from neutrino and electroproduction data [3]: The knowledge of visible interaction length for pions in the detector is of primary importance here. Therefore the calibration was performed in pion beam ($2 \leq E \leq 8$ GeV) alongside with the extensive Monte-Carlo calculation for penetration of pions in iron plates.

The shape of the observed penetration distribution for the second neutrino experiment is in very strong disagreement with the expected one, whereas for the first experiment the agreement is satisfactory. By subtraction the calculated background from experimental penetration distribution we have effect (40 ± 10) dimuon events for the second neutrino experiment with energy of each muon greater than 0.75 GeV. (In this case we could only overestimate the background).

The shape of $P_\perp$ -distribution for dimuon candidates is consistent with that for pion background.

The absolute ratio $R = \sigma(\nu N \to 2\mu + X)/\sigma(\nu N \to \bar{\mu} X)$ of dimuon production depends on the detection efficiency which greatly influences by the production mechanism. Especially it is true for out neutrino spectrum which is peaked at 4-5 GeV and it is difficult to produce the heavy object. Nevertheless the tentative estimate was done in the following approximations: a) the energy of each muon in a pair is $E_\mu \geq 0.75$ GeV, b) the "effective" region of neutrino spectrum is $E_\nu \geq 10$ GeV. In this case

$$R_\nu = (1.0^{+0.4}_{-0.3})\,(1.6 \pm 0.4) \cdot 10^{-2}.$$

The normalization errors take into account the uncertainties in the neutrino spectrum and efficiency for 2μ-events.

The sensitivity of antineutrino experiment allows us to arrive at the conclusion that $R_{\bar{\nu}} \leq 10^{-2}$ under the similar assumptions.

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