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INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

T O P I C A L S E M I N A R

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W E A K I N T E R A C T I O N S

26 - 29 June 1973

(SUMMARIES)

1973 MIRAMARE-TRIESTE

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International Atomic Energy Agency

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EXPERIMENTS ON HIGH-ENERGY NEUTRINO BEAMS

A SUMMARY OF RECENT RESULTS AT CERN

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Recent work on high-energy neutrino beams at CERN, using the giant heavy liquid bubble chamber (Gargamelle), is reported.

1. Single hyperon production by antineutrinos [1] has been detected and the cross-section σ_Λ for the process

$$\bar{\nu} + p \rightarrow \mu^+ + \Lambda \quad ,$$

averaged over the antineutrino spectrum, has been found to be

$$\langle\sigma_\Lambda\rangle = 1.3 \begin{matrix} + 0.9 \\ - 0.7 \end{matrix} \times 10^{-40} \text{ cm}^2/\text{prot.}$$

2. Neutral currents - The theoretical work by Salam and Ward (1959) [2], Salam (1962) [3] and Weinberg (1967) [4] (often referred to as the SWW model) has stimulated a search for experimental evidence of the existence of neutral currents, and the predictions by the above authors have been used to analyse the results.

One possible candidate for the reaction $\bar{\nu}_\mu + e^- \rightarrow \bar{\nu}_\mu + e^-$ has been observed so far in 360,000 pictures of an exposure to the $\bar{\nu}$ beam; on the other hand, no candidate for the reaction $\nu_\mu + e^- \rightarrow \nu_\mu + e^-$ has been reported after the scrutiny of 375,000 pictures of the exposure to the ν beam [5].

This corresponds (with 90% confidence) to the following limits of the cross-section:

$$\sigma(\nu_\mu + e^- \rightarrow \nu_\mu + e^-) \leq 0.26 \times E_\nu(\text{GeV}) \times 10^{-41} \text{ cm}^2/\text{el}$$

$$\sigma(\bar{\nu}_\mu + e^- \rightarrow \bar{\nu}_\mu + e^-) \leq 0.88 \times E_\nu(\text{GeV}) \times 10^{-41} \text{ cm}^2/\text{el} \quad ,$$

where E_ν is the primary neutrino energy in the laboratory system; and, with the same confidence as above,

$$0.1 \leq \sin^2\theta_W \leq 0.6 \quad ,$$

$\sin\theta_W = e/g$.

3. Total cross-sections for $\nu/\bar{\nu}$ -nucleon interactions

Fitting the experimental results with an equation of the type

$$\sigma = \alpha \, E_{\nu}(\mathrm{GeV}) \times 10^{-38} \ \mathrm{cm}^2 \ ,$$

one has

for neutrinos $\alpha = 0.7 \pm 0.74$

for antineutrinos $\bar{\alpha} = 0.27 \pm 0.05$

and also

$$\bar{\sigma}/\sigma = 0.38 \pm 0.02 \ .$$

In the Bjorken scaling limit, a number of relations have been proposed which can be tested experimentally. Work on these lines is still in progress.

REFERENCES

1) T. Eichten et al. (to be published in Phys. Letters).

2) A. Salam and J.C. Ward, Nuovo Cimento 11, 568 (1959); Phys. Letters. 13, 168 (1964).

3) A. Salam, Phys. Rev. 127, 331 (1962).

4) S. Weinberg, Phys. Rev. Letters 19, 1264 (1967).

5) H. Faissner et al. (to be published).