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CORNELL UNIVERSITY

Laboratory of Nuclear Studies
Ithaca, New York

6th November, 1959.

Dear Gerry,

Have you heard of the suggestions of T. D. Lee, now at the Princeton Institute, for research into high energy neutrino interactions?

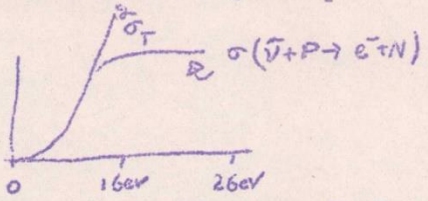
Suppose you take a beam of π^- mesons at about 2 GeV. The π^- will decay by $\pi^- \to \mu^- + \tilde{\nu}$, and in the laboratory system the antineutrinos will be thrown forward into a well-collimated beam. This is then filtered through 25 m. of steel (expensive!) which removes everything else so that quiet experiments can be done.

The antineutrinos could induce inverse β decay reactions like $\tilde{\nu} + P \to e^- + N$, which would be detected as a high energy shower. The cross-section for this reaction rises as $p_{\tilde{\nu}}^2$. The matrix element in the expression,

$$w = \sigma c = \frac{2\pi}{\hbar} |M|^2 \rho_E$$

w = transition rate
σ = X section
M = matrix element
ρ_E = final state density

would be constant, while ρ_E relativistically rises as $p_{\tilde{\nu}}^2$. In fact σ at 1 GeV reaches such a size that it might induce one reaction per hour per ton of detector, which should be observable. At 1 GeV the above cross-section would level off because of the finite size of the proton, but the total cross-section would go on up



because of such reactions as $\tilde{\nu} + P \to e^+ + P + \pi^-$, which start more slowly because of unfavourable ρ_E at low energies. It is said that σ_T would reach geometric proportions at 100 GeV. Not so weak interactions!

There is great excitement about all this here, and much talk of installing massive steel pill-boxes at Princeton and Argonne, so maybe you should think of having one at the 7 GeV machine. The general idea is that the neutrinos are 'the tool of the future for exploring the nucleon'. There really may be a good deal of truth in this.

Let me know your reactions, and those of John Bell for example.

Yours,

Jimmy.