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MEASUREMENT OF ν_eN SCATTERING, TEST OF μ-e UNIVERSALITY AND SEARCH FOR ν_e OSCILLATIONS USING BEBC FILLED WITH A NEON-H_2 MIXTURE

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A great deal of experimental information is now available on the deep inelastic scattering of muon-neutrinos on nucleons. This information has proved invaluable in testing our ideas on the basic structure of hadrons and therefore in building a clear picture of the quark doublets.

In contrast to this understanding of the quark sector, very little experimental progress has been made in checking our basic prejudices on the structure of the lepton sector.

Questions like the validity of lepton-number conservation, the presence of neutrino oscillations, the invariance of weak interactions under the replacement of all electrons and their neutrinos with muons and their neutrinos, are today essentially unanswered at least for SPS energies.

We plan to perform an experiment at the CERN SPS in order to study some aspects of these problems, in particular the question of μ-e universality. The experiment would also help in clarifying the problem of neutrino oscillations. The best high energy investigation performed to date with a beam of electron-neutrinos [1] has been carried out at the PS several years ago. This was a by-product of an experiment done with muon-neutrinos in Gargamelle, and it used the $\nu_e(\bar{\nu}_e)$ contamination present in the $\nu_\mu(\bar{\nu}_\mu)$ beam. The experiment had only 82 $\bar{\nu}_e$ and 191 ν_e-induced events.

For the experiment that we are proposing, we need a special ν_e enhanced beam, obtained from $K_L^o \to \nu_e$ decays, sweeping away with a magnet all the charged particles produced in the primary interaction. The big advantage of such a beam will be the strongly suppressed contamination from ν_μ interactions in the ν_e sample, as compared to what can be obtained in a conventional wideband ν_μ beam; even though the total rate will be somewhat reduced.

Preliminary calculations for such a beam performed some time ago by Atherton [2], lead to the ν_e ($\bar{\nu}_e$) flux, shown in fig. 1. With such a flux, a run of 3×10^{18} protons, using BEBC filled with a 73 molar % neon-He mixture, would yield about 2500 ν_e and $\sim$ 1200 $\bar{\nu}_e$ events.

The expected numbers of events, computed assuming μ-e universality and lepton number conservation, are shown as function of energy by the dashed histogram in fig. 1 (right-hand scale).

A recent preprint [3] from a reactor experiment suggests the possible existence of ν_e oscillations with a squared-mass difference between two of the neutrino mass-eigenstates of $\sim$ 1 eV^2 or bigger. On the other hand, the results of the CERN beam dump experiment [4], if explained in terms of neutrino oscillations, suggest a large value [5] for Δm^2.

For illustrative reasons, we show in fig. 1 (shaded histogram), the expected numbers of ν_τ events in the proposed experiment, computed assuming $\nu_{e_2} \to \nu_\tau$ oscillations with $\sin^2 2\alpha = 1$ and $\Delta m^2_{13} = 10$ eV^2 [5(b)] and $\Delta m^2_{12} \ll 1$ eV^2. The proposed experiment will be able to check the

present interpretation of the beam dump results. This is in fact far easier in a wideband beam experiment than it may be in a beam-dump experiment, since only in the former case one can accurately predict the event yield as a function of energy.

Detailed calculations for the beam here envisaged are now being carried out, and a detailed proposal will be submitted shortly.

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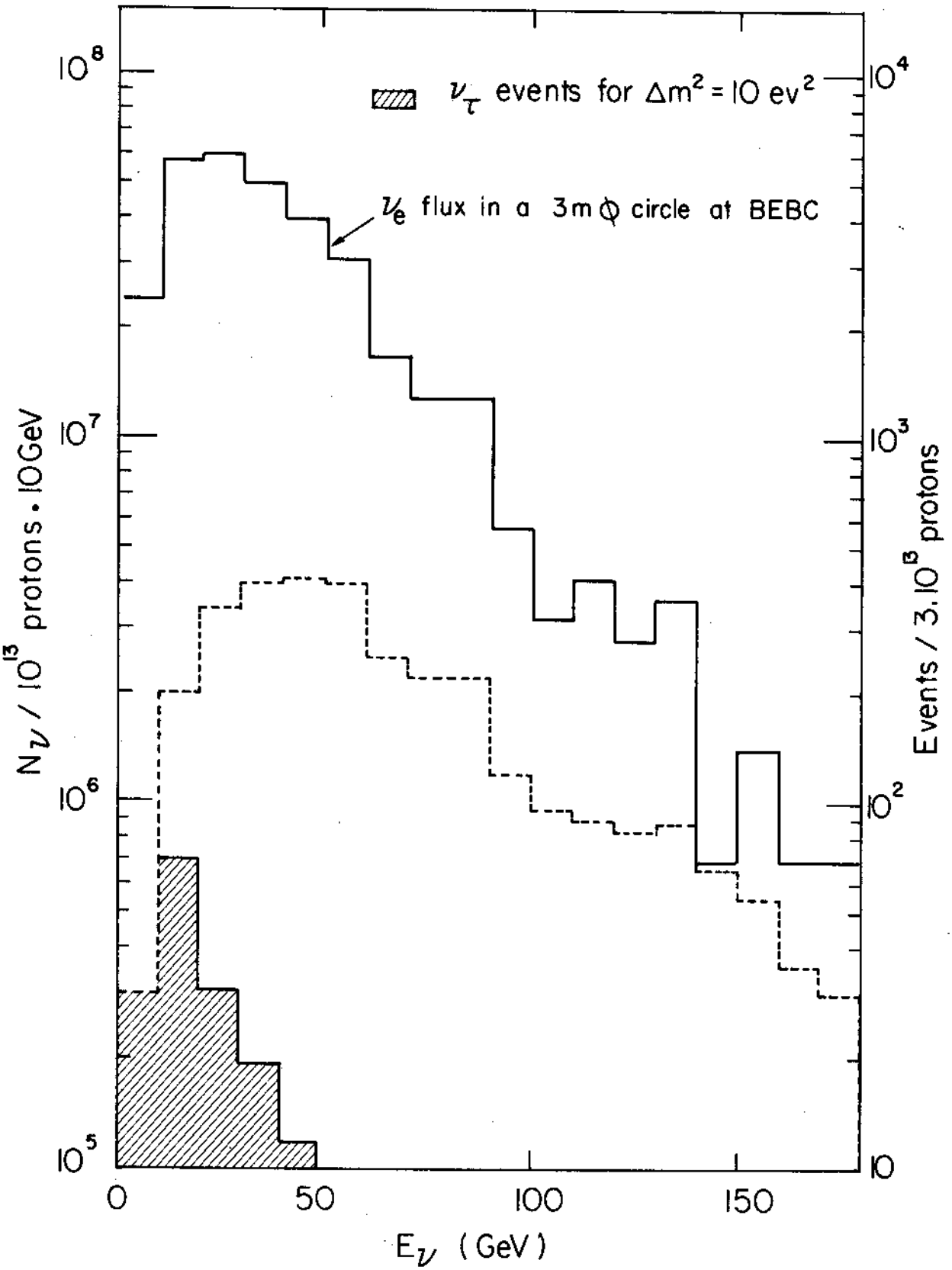
ν_τ events for $\Delta m^2 = 10$ ev^2
ν_e flux in a 3m ϕ circle at BEBC
$N_\nu / 10^{13}$ protons • 10GeV
Events / 3.10^{13} protons
E_ν (GeV)
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10
0
50
100
150

Fig. 1