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LETTER OF INTENT

PROPOSAL FOR MEASURING $\nu_\mu e$ -SCATTERING AT 300 GeV CERN ACCELERATOR

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A considerable interest to neutral currents in weak interactions is observed during the last years, mainly due to the possibility of constructing renormalizable gauge theories [1-3]. In particular renormalizable model of electromagnetic and weak interactions of leptons proposed by Weinberg [4] contains both charged and neutral currents. This leads to different from common predictions for the processes :

$$\nu_e(\bar{\nu}_e) + e^- \rightarrow \nu_e(\bar{\nu}_e) + e^- \qquad (1)$$

and to appearence of processes

$$\nu_\mu(\bar{\nu}_\mu) + e^- \rightarrow \nu_\mu(\bar{\nu}_\mu) + e^- . \qquad (2)$$

Up to now the process (1) was not observed, and an upper limit was obtained from experiment which did not contradict to Weiberg's model. As for the process (2), two events - candidates for it have been found in CERN Gargamelle experiment [5].

We are aware of two more experiments looking for $\nu_\mu e$ -scattering: Aachen-Padova experiment at the PS at CERN and ITEP-IHEP experiment, being prepared at Serpuckhov accelerator. Both are with optical spark chamber technique. The difference is that the ITEP-IHEP experiment uses thin-electrode spark chambers with larger gap (22 mm instead of 10 mm) with aluminium filters of 1/4 radiation length between them.

In this letter we propose an experiment on $\nu_\mu e$ -scattering at SPS with a set-up of ITEP-IHEP type having useful weight

The interest to such an experiment is mainly due to the transition from PS and Serpuckhov energies to the energies of SPS. For the total proton flux at the target during the experiment $5 \cdot 10^{18}$ the expected event rate, corresponding to the minimum $\nu_\mu e$ -scattering cross-section in Weinberg's model will be 100 ÷ 150 .

Most of the difficulties of this experiment are connected with the rejection of background processes from $\nu_\mu e$-scattering. The most serious of them is inverse β -decay:

$$\nu_e + n \rightarrow p + e^-$$

in case, when proton is not visible. This was confirmed in Gargamelle experiment [5] . Nevertheless, this background can be greatly suppressed by the use of the difference in kinematics and dynamics of ν_μ scattering on nucleon and electron [6] . Monte-Carlo calculations for the neutrino spectrum expected at SPS for the proton energy 400 Gev with detector resolution included have shown that there is a kinematical area, where the effect exceedes the background by an order of magnitude. This is illustrated by fig.1, where the results of calculations are shown in angle-energy variables. The parameters of angle and energy resolution, which hav been set in gaussian form, are also indicated there. In the region under the solid curve the background to effect ratio is 1 : 12, the efficiency for $\nu_\mu e$ -scattering ~ 80%. By studying the population of a chosen kinematical area, we can get the information on the dynamics of the process. We think statistics of ~ 150 events would be enough for it.

It must be noted that along with $\nu_\mu e$ -scattering $\nu_e e$ --scattering will be registrated practically with the same efficiency We can expect about 10-20 events of this process. But to distinguish it from the "background" of $\nu_\mu e$ -scattering seems to be

impossible. (Except the situation, when the $\nu_\mu e$ -scattering is suppressed in compare to $\nu_e e$ -scattering).

Apparatus

The scheme of the set-up is shown in fig.2. To exclude mirrors the spark chambers are combined in two fans. In this case the only matter between the camera and the spark is a thin mylar 70 micr, thick, which covers the front window of a chamber. Optical distotions of the object are practically absent. Each fan is photographed by its own pair of cameras. The set-up has no special trigger. So it is supposed to work in conditions of fast ejection. Memory time of spark chambers makes it possible to work with high efficiency at the times up to 10^{-5} sec.

References

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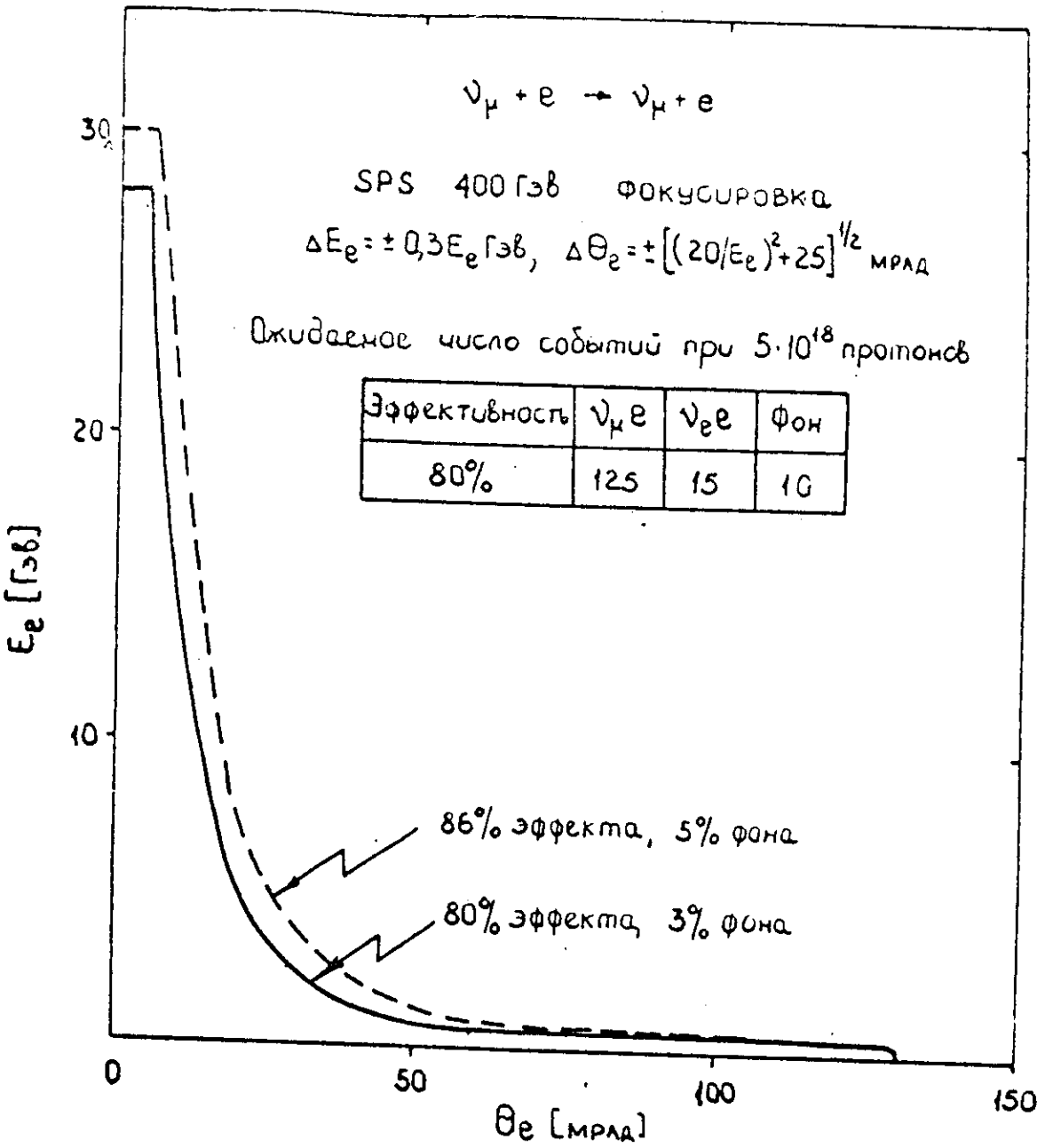
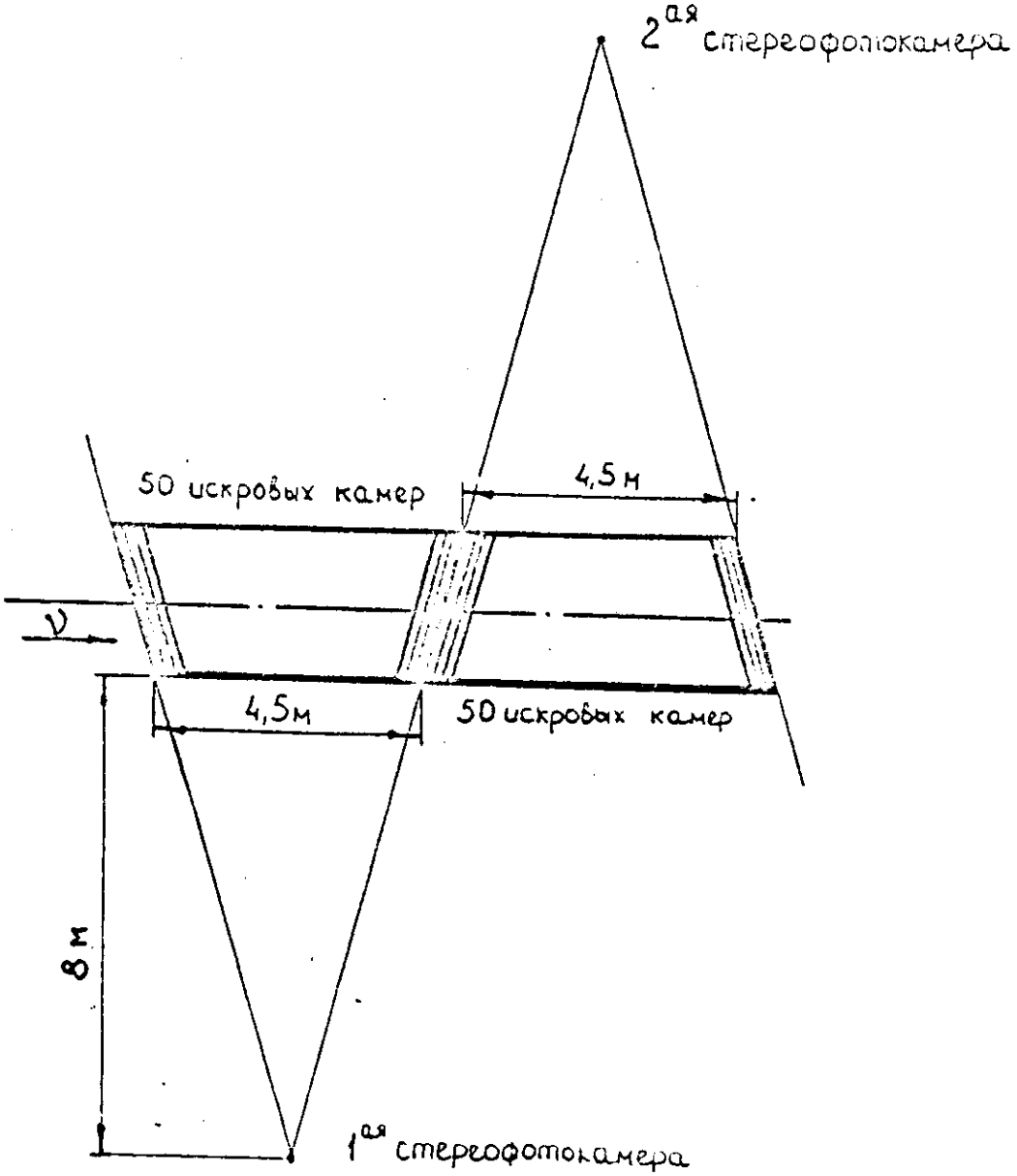

$\nu_\mu + e \rightarrow \nu_\mu + e$
SPS 400 ГэВ ФОКУСИРОВКА
$\Delta E_e = \pm 0{,}3 E_e$ ГэВ, $\Delta\theta_e = \pm\left[(20/E_e)^2 + 25\right]^{1/2}$ мрад
Ожидаемое число событий при $5 \cdot 10^{18}$ протонов
Эффективность | $\nu_\mu e$ | $\nu_e e$ | Фон
80% | 125 | 15 | 10
86% эффекта, 5% фона
80% эффекта 3% фона
E_e [ГэВ]
θ_e [мрад]
0
50
100
150
10
20
30

Схема расположения детектора на ν-пучке



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