short spikes turn out to be modulated up to 100%. The duration of the short spikes decreases and amounts to 0.1 - 0.07 of their repetition period, and is comparable with the time resolution of the instrument.

The results offer evidence that self-locking of the axial modes takes place. From the duration of the individual pulses it can be concluded that the number of phased modes is not less than 10 - 15.

It is interesting to note that in this case the effect of mode locking arises in a homogeneous semiconductor without introducing into the resonator a nonlinear element, and in spite of the appreciable dispersion of the refractive index, which leads to a noticeable non-equidistance in the axial-mode spectrum. In CdS crystals there is also observed a strong spiked generation regime, but no locking regime has yet been obtained, this being apparently connected with the much larger dispersion of the refractive index.

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ELECTROPRODUCTION OF PIONS ON A PROTON AT THE THRESHOLD AND THE STRUCTURE OF THE NUCLEON

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The cross section for the electroproduction of pions at the threshold is remarkable in that the Born terms make a dominating contribution compared with the Δ_{1236} isobar. The high sensitivity of the cross section in this region to the charge form factor of the neutron G_{En} was first pointed out in [1]. The current-algebra method in conjunction with the PCAC hypothesis [2, 3] also makes it possible to analyze the cross section at the threshold. Because of the established connection between strong, electromagnetic, and weak interactions, the amplitude of the electroproduction turns out to depend on the axial form factor F_A of the nucleon.

We have measured a number of spectra of inelastic scattering of electrons in the region at the electroproduction threshold. The measurement method was described earlier [4]. The radiative correction to the elastic scattering and the continuous spectrum was introduced in accordance with [5].

Figures 1 and 2 show the cross sections for inelastic scattering and at the threshold as functions of the pion 3-momentum q* in the c.m.s. of the pion and the recoil nucleon. The dashed curves show the magnitude of the systematic error, and the solid thin curves show the radiative correction, while the dotted curves show the contribution of the resonant M1 transition calculated in accordance with the isobar model [6].

In the analysis of the cross section on the basis of the isobar model we took into account the fact that the Born approximation describes poorly the π^0-meson production, and parameters chosen for the region of the maximum of the [33]-resonance should be refined at the threshold. The longitudinal cross section for the electroproduction of π^0 mesons was assumed to be equal to zero, and the transverse cross section was normalized to the total photoproduction cross section. The results of the determination of G_{En} by the χ^2 method are shown in Figs. 1 and 2, the errors in G_{En} amounting to 0.006. The uncertainty in the form factors of the nucleon and the pion results in an additional error of 0.04. The figures show also the cross sections calculated for G_{En} = 0.

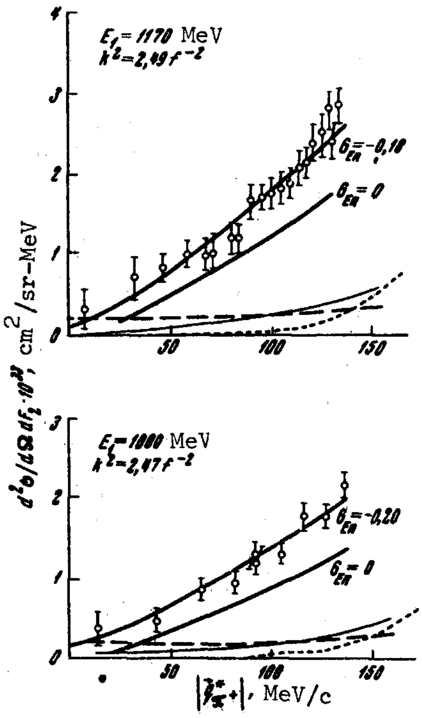

Fig. 1

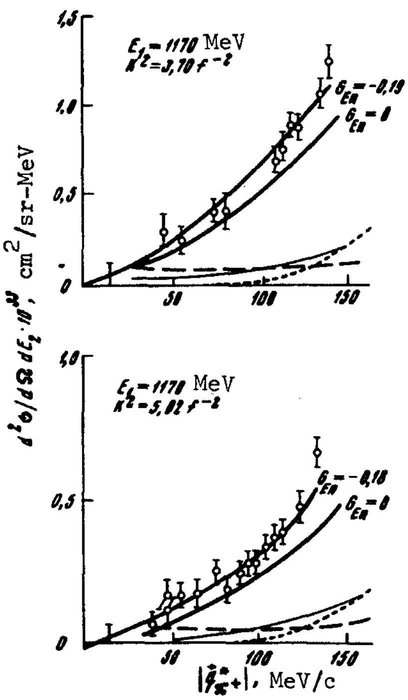

Fig. 2

An analysis of the cross sections at the threshold in accordance with the calculations of [1] also gives a negative value of G_{En} in the interval -(0.31 - 0.39). Allowance for the contribution of Δ_{1236} brings this value closer to the results of the analysis in accordance with the isobar model.

The cross section for the electroproduction of pions at the threahold, at a squared 4-momentum transfer r^2 = 5.02 F^{-2}, is compared by us with the results of the calculation by the method of current algebra assuming PCAC. In [2], the cross section at the threshold was calculated in the soft-pion approximation. In the present paper (Yu. Kulish), the cross section was obtained for the real mass of the pion by extrapolation of the non-Born part of the amplitude to the point q_μ = 0. This method was employed earlier [7] for pion photoproduction.

The cross section calculations in [2] contain a number of errors. We have repeated the derivation of the formulas, and the results of this calculation are shown by the dashed curves on Fig. 3. The axial form of the nucleon was specified in the form

$$F_A = 1/(1 + k^2/M_A^2)^2 .$$

The lower dashed curve is calculated for M_A = 1.05 GeV, corresponding to the data of the latest neutrino experiment [8]. The upper dashed curve corresponds to F_A = 1.

The solid curve on Fig. 3 is the result of calculation in accordance with the present work. To be able to compare with the experimental data far from threshold we have introduced phenomenologically the amplitude of the resonant M1 transition. As seen from Fig. 3, the agreement of the last calculation and experiment is good.

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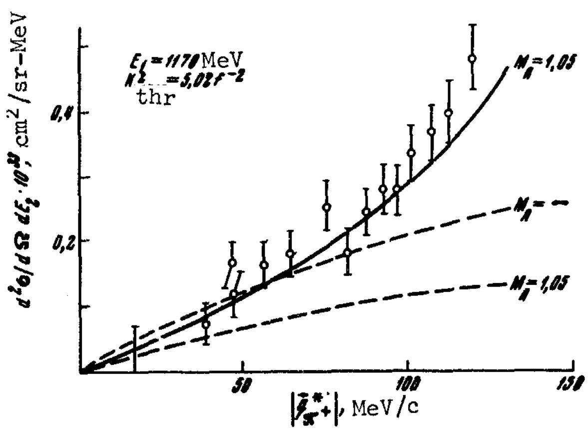

Fig. 3

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SYNCHROTRON HYPOTHESIS OF THE ORIGIN OF BACKGROUND RADIATIONS

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Recently much progress has been made on the research of isotropic cosmic radiation in a wide range of energies. The figure shows the summary experimental data on background isotropic radiation, borrowed from [1 - 6]. Investigation of the background radiations has acquired particular interest in connection with their probable connection with the radiation in the universe. In many papers (see, e.g., [7]), the soft (radio) part with V ≲ 1000 MHz was interpreted as a consequence of synchrotron radiation of cosmic electrons in the sources, and the hard (x-ray) part as a manifestation of the inverse Compton effect of these electrons on the relict radiation.

However, the curve shown in the figure has an important singularity: if we interpolate the energy dependences of the radio emission and of the x-ray background with energy 1 - 20 keV, then the interpolation curve (in a logarithmic scale) will be, with good accuracy, a straight line that is a continuation of both sections[1]. This circumstance leads to an alternate assumption, namely that the non-equilibrium background radiation is produced by a single

[1]It should be noted, nonetheless, that the accuracy and reproducibility of the experimental data are low.