The magnetic moment measured in our experiments was approximately (3 - 5) x 10^{-2} Oe/cm^3. This dipole is apparently localized on the front of the shock wave moving toward the lens, for only in this region does the laser beam interact with the plasma. Supplementary experiments have shown that signals from the pickups are not the result of the crowding out of the earth's magnetic field by the plasma.

We did not observe in our experiments the magnetic field connected with the appearance of an electric dipole, reported by Askar'yan et al. [6]. This magnetic field is apparently much weaker than the field due to the magnetic dipole observed in our experiments.

At present the mechanism of occurrence of the magnetic dipole is not completely clear. It can be assumed that it is due to the turning of the shock-wave front moving towards the lens. The reasons for the turning may be distortion of the ray caustic and inhomogeneity of the angular distribution of the laser radiation [7].

In conclusion, the authors thank S. L. Mandel'shtam for continuous interest and a discussion of the present work, and G. A. Askar'yan and N. K. Sukhodrev for useful discussions.

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BREMSSTRAHLUNG OF ELECTRONS WITH $\bar{E}$ = 2.4 GeV

J. Bem, V. G. Grishin, and V. D. Ryabtsov
Joint Institute for Nuclear Research
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1. Bremsstrahlung of electrons with $E_1 \leq 100$ MeV was investigated in many experiments. A detailed analysis of the results of these experiments and a comparison with the theory are presented in [1]. At higher energies there are data for E = 500, 550, 247, and 1000 MeV [2-6]. A detailed study of the bremsstrahlung spectrum of 600-MeV electrons was made with the aid of a propane bubble chamber [7]. An advantage of this procedure is the possibility of observing each bremsstrahlung event and the exact localization of the interaction region ($\Delta \approx 3 \times 10^{-4} L_{rad}$, where L_{rad} is the radiation length for propane).

There are no experimental data at present for $E \geq 1000$ MeV. It is therefore of interest to investigate further the bremsstrahlung of electrons with higher energies.

2. The bremsstrahlung of electrons with $\bar{E} = 2.4$ GeV was investigated with the aid of the 24-liter propane chamber of the JINR High-energy Laboratory. The chamber was placed in a 13.7-kG magnetic field and bombarded with a beam of π^- and μ^- mesons and electrons with $pc = 4.00 \pm 0.06$ GeV [8]. The electron content of the primary beam was determined in separate experiments [9,10] and found to be $(2.0 \pm 0.6)\%$.

A characteristic criterion for the observation of a process of the type

$$e^- + z \to e^- + z + \gamma, \tag{1}$$

with $E_\gamma \approx E$, is a sharp reduction of the track curvature on the stereo photograph, without a visible kink. The interaction region was determined with accuracy better than $5 \times 10^{-3} L_{rad}$ for $v = E_\gamma/E \gtrsim 0.75$.

The selected events in the fiducial region of the chamber satisfied the following requirements: 1) the interaction was produced by the primary particle; 2) the particle energy prior to interaction was $E_1 \geq 1400$ MeV; 3) the particle energy after interaction was $E_2 \leq 500$ MeV. Altogether, 67,000 frames were scanned and 179 events found. The single-scanning efficiency was determined from a double scanning of 16,000 frames and found to be

$$\epsilon = (93 \pm 3.5)\%.$$

The procedure for measuring the electron energies in the propane chamber, with allowance for ionization and radiation losses, is described in the paper of Grishin et al. [11] The error in the determination of the electron energy is $\approx 20\%$.

Out of the 179 secondary particles, 112 were identified as electrons with the aid of the momentum-range ratio, the δ electrons, and the radiation losses. An analysis of the possible background events has shown their contribution not to exceed 1 - 3%.

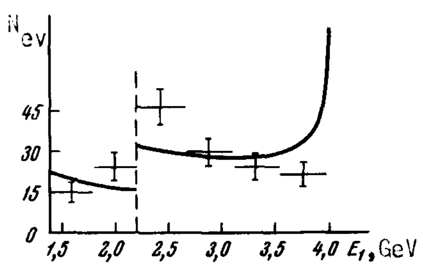

Fig. 1

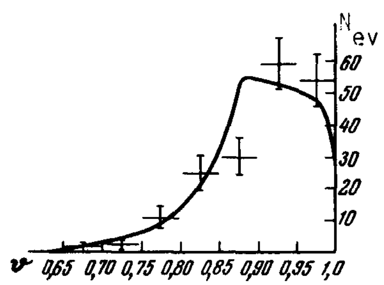

Fig. 2

3. The distribution of the obtained events relative to E_1 is shown in Fig. 1 [1)]. The theoretical curves were calculated from the formula

$$\frac{dN}{dE_1} = N_0 n \ell \bar{\omega}(E_0, t, E_1) \sigma(E_1). \tag{2}$$

Here N_0 is the number of electrons incident on the chamber, n the number of propane molecules per cm^3, ℓ the length of the fiducial region in cm, $\bar{\omega}(E_0, t, E_1)$ the probability density of the distribution of the electrons (E_0) relative to E_1 after traversing a thickness t of matter, averaged over the fiducial region, and

$$\sigma(E_1) = \int_{E_1 - 500\ \mathrm{MeV}}^{E_1 - m_e c^2} \sigma(E_1, E_\gamma)\, dE_\gamma, \qquad (3)$$

where $\sigma(E_1,E_\gamma)$ is the bremsstrahlung cross section of electrons with energy E_1 in propane [1] 2). The theoretical curves of Fig. 1 are normalized to the total area under the histogram. As seen from the figure, there is agreement, within the limits of statistical errors, between the theoretical calculations and the experimental results.

The total number of events, obtained by integrating (2), was found to be 288 ± 72, whereas the experiment yielded 192 ± 14 events, when allowance is made for the registration efficiency. The large error in the determination of the total number of events by formula (2) is connected with the inaccuracy in the determination of N_0 (40%).

The distribution of the obtained events relative to the quantity $v = E_\gamma/E_1$ is shown in Fig. 2. The solid curve was obtained by averaging over the theoretical spectrum dN/dE_1. As seen from Fig. 2, the agreement between the theoretical and experimental results is satisfactory.

Thus, the theoretical calculations agree with the experimental results within ±(15 - 20)%. To improve the experimental accuracy to ±(3 - 5)% it is necessary to use pure beams from proton or electron accelerators.

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1) For events with $1.4 \le E_1 \le 2.2$ GeV the length of the fiducial region of the chamber

was ℓ = 10 cm; ℓ = 20 cm for events with $E_1 \geq 2.2$ GeV.

2) The bremsstrahlung of electrons in the field of atomic electrons was calculated in accord with the theory of Wheeler and Lamb [13].

PHASE SHIFT ANALYSIS OF NUCLEON NUCLEON SCATTERING AT 400 MeV

Yu. M. Kazarinov, F. Lehar, and Z. Janout
Joint Institute for Nuclear Research
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A phase shift analysis at 400 MeV was carried out earlier [1] and yielded three sets of phase shifts of equal probability as gauged by the χ^2 criterion. The phase shift analysis was made at $\ell_{max} = 4$, i.e., starting with orbital angular momenta $\ell = 5$, and the scattering amplitude was taken in the one-meson approximation. It was assumed that meson production takes place only from initial P, D. and F states with isotopic spin equal to unity, and is characterized by the average absorption coefficient for the given state [2] 1).

Data on the triple-scattering polarization and parameters, used in the cited paper [1], were later refined and published by a group of foreign authors [3]. This has made it possible to carry out a more refined phase shift analysis, the results of which are presented below.

The use of more accurate data on the triple-scattering polarization and parameters has caused the first two solutions of [1] to merge, and the errors of the phase shifts have been slightly reduced. The two remaining ones are given in Table I. Both sets of phase shifts are characterized by the fact that an imaginary part is possessed only by the phase shift of the $^1D_2$ wave. The imaginary parts of the ^3P and ^3F phases are small and do not improve the description of the experimental material.

The experimental data employed are listed in Table II.

From the obtained sets of phase shifts we calculated the dependences of the experimental quantities on the scattering angle; these are given in the preprint [4]. It is seen from the results that to eliminate the ambiguity of the phase shift analysis at 400 MeV it is necessary to carry out at least one experiment on triple np scattering. The planning of such an experiment and the determination of the optimal angle at which the measurements must be made are described in the paper by Lehar et al. [5]. It turns out that under the existing conditions the most effective means of eliminating the aforementioned ambiguity is to measure the parameters D and A at c.m.s. angles 60 and 55° respectively.

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