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ИНСТИТУТ ЯДЕРНОЙ ФИЗИКИ
СО АН СССР

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Abstract

e^+e^- - annihilation has been studied at the electron-positron storage ring VEPP-2M in the c.m. energy range 0.64--1.40 GeV. Cross sections of the reactions $e^+e^- \rightarrow \pi^+\pi^-\pi^0$, $K_S K_L$, $\pi^+\pi^-$ have been measured.

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This work continues a series of papers presenting results of the experiments on e^+e^- annihilation into hadrons performed at the VEPP-2M collider /1/ with the OLYA detector. The c.m. energy range 0.64-1.40 GeV was scanned with a step approximately equal to an energy spread in the beam: $\Delta(2E) = 0.5$ MeV at $2E < 1.0$ GeV and $\Delta(2E) = 0.66$ MeV at $2E > 1.0$ GeV. The integrated luminosity in the experiment was 1.46 pb^{-1}. The OLYA detector has been described elsewhere /2/.

Here we present the results of the measurement of the ω - meson parameters as well as the data on the electromagnetic form factors of pions and kaons in the whole energy range under study.

1. Reaction $e^+e^- \rightarrow \omega \rightarrow \pi^+\pi^-\pi^0$

Investigation of the reaction $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ in the region of the ω - meson was performed earlier only at the ACO collider in Orsay /3-5/. We have investigated the ω - meson properties using the experimental data in the c.m. energy range 760-800 MeV in which the integrated luminosity of 78 nb^{-1} had been collected.

To study the reaction $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ events with two charged particles in coordinate chambers and one or two γ - quanta in the scintillation sandwich have been selected. The following requirements were imposed on such events: I/ both tracks come from one point in the interaction region, II/ the absolute value of the azimuthal acollinearity angle is larger than 6°, III/ the pulse height in the sandwich of a quadrant without tracks exceeds 0.75 of that for the minimum ionizing particle.

Events thus selected were further divided into two groups according to the trigger type: tracks in opposite quadrants and tracks in neighbouring quadrants. To suppress the background for events of the first group additional requirement of the photon in a shower chamber was imposed. 723 events have been found in this group. For events of the second group only sandwich triggering was necessary for photon identification. In this group 765 events have been selected. In each energy point the integrated luminosity was determined by the number of

Bhabha events at large angles. To obtain the detection efficiency the process $e^+e^-\to\pi^+\pi^-\pi^0$ has been simulated by the Monte Carlo method /6/, in which the process kinematics, interaction of the final particles with the detector material as well as radiation of photons by the initial particles (radiative corrections) was taken into account. In the energy range under study the detection efficiency for the process $e^+e^-\to\pi^+\pi^-\pi^0$ was energy independent for our selection criteria and equal to $(4.3 \pm 0.2)\%$. The accuracy of the efficiency calculation was determined by the systematical error connected with the uncertainty in the cross section of the pion interaction with nuclei. The absolute beam energy was calculated from the energy scale in the Φ -meson region in which the energy calibration was performed by the resonance depolarization method /7,8/. Results of the magnetic measurements as well as experimental data on the long-time stability of the energy were used in the calculation.

The amplitude of the process under study was parametrized by the resonance Breit-Wigner formula taking into account radiative corrections in the double logarithmic approximation /9,10/. In the energy range under study the effect of $\omega-\Phi$ interference was small and therefore was neglected. Four free parameters were found in the optimization: mass and width of the ω -meson, peak cross section $\sigma_{peak}(\omega\to\pi^+\pi^-\pi^0)$ and the level of uniform background. To obtain ω -meson parameters both types of selected events were treated independently that gave consistent results. The final data processing used all the events (table 1).

The ω -meson parameters found by the maximum likelihood method are:

$$M_\omega = 782.2 \pm 0.4 \text{ MeV}$$
$$\Gamma_\omega = 9.8 \pm 0.9 \text{ MeV}$$
$$\sigma_{peak} = 1.39 \pm 0.10 \text{ bn}$$

Using the relations $\Gamma(\omega\to e^+e^-) = 4\pi\alpha^2 m_\omega / 3g_\omega^2$,

$$\sigma_{peak}(e^+e^-\to\pi^+\pi^-\pi^0) = \frac{12\pi}{m_\omega^2}\cdot\frac{\Gamma(\omega\to e^+e^-)\Gamma(\omega\to\pi^+\pi^-\pi^0)}{\Gamma_\omega^2}$$

One obtains

$$B(\omega\to ee) = (6.4 \pm 0.4)\ 10^{-5}$$
$$\Gamma_{\omega\to ee} = 0.63 \pm 0.05 \text{ KeV}$$
$$g_\omega^2/4\pi = 22.1 \pm 1.9$$

Experimental values of the cross section as well as the theoretical curve approximating them are shown in Fig. 1. Comparison of the experiment with the calculation by the χ^2 criterion gives $P(\chi^2) = 14\%$. The obtained values of the ω -meson parameters are consistent with the corresponding world-average values /11/.

2. Study of the reaction $e^+e^-\to K_SK_L$ and interpretation of the charged and neutral kaon form factors

Events of the reaction $e^+e^-\to \underset{\llcorner\to\pi^+\pi^-}{K_S}K_L$ were detected by the Olya detector as events with two tracks and one neutral particle. The decay $K_S\to\pi^+\pi^-$ occured in the vacuum chamber of collider, tracks of charged pions being observed in the coordinate and shower-range systems of the detector.

The position of the K_S decay point was determined in the plane perpendicular to the beam with a good accuracy ($\sigma_y \sim 1$ mm). In our energy range the mean decay length of a short-lived kaon varies from 10 to 26 mm. Therefore events with a distance from the vertex of charged pions to the beam greater than 6 mm were selected. Background events with soft charged particles (two-photon processes, beam background etc.) were also suppressed by the requirement that at least one charged particle penetrated more than 16 G/cm^2.

Long-lived kaons subjected to the inelastic nuclear interaction in the shower-range system were observed by the signals from the scintillation counters and spark chambers. Although particle momenta were not measured directly, they could be reconstructed by the flight directions of π^+, π^-, K_L and the total energy. This allowed the selection of the K_SK_L events by the $\pi^+\pi^-$ invariant mass. Such a method of the kinematics reconstruction provided the resolution $\sigma_M \sim 10$ MeV.

Events with $|M - m_{K_S}| < 20$ MeV have been selected. Their number N is shown in Table 2. Also shown there is the number of background events N_b determined by two 40 MeV adjacent intervals in the invariant mass spectrum.

The detection efficiency of charged pions as well as the probability for K_L to hit the shower system were calculated by the Monte Carlo simulation taking into account multiple scattering, ionization losses, decays and nuclear interaction of pions as well as radiation of photons by initial particles (radiative corrections) /6/. However, the simulation of the K_L interaction with matter is hampered by the lack of detailed experimental data. Therefore, we have calibrated the K_L detection efficiency by using experimental events of the $\Phi \to K_S K_L$ decay. To describe the energy dependence at higher energies data on the total cross section σ_L of the K_L interaction with matter in the energy range 525-615 MeV were used /12/. A possible 30% systematical uncertainty of the efficiency determination is connected with the extrapolation of the data on σ_L to the range 505-525 and 615-700 MeV.

The values of the integrated luminosity L, the detection efficiency ε of $\pi^+\pi^-K_L$ events, the cross section $\sigma_{K_S K_L}$ and the squared absolute values of the form factor of the neutral kaon are presented in table 2.

For comparison with theoretical models the joint analysis of the data on the form factors of charged and neutral kaons has been performed. To this end we have used the results of the measurements of OLYA (this work and ref. 13) for the energy range below 1.4 GeV as well as from Orsay /14,15/ and Frascati /16,17/ in the energy range 1.4-1.85 GeV. For convenience our data on the charged kaon form factor /13/ are presented in table 3.

As shown earlier /13,14/ experimental data are not described by the vector dominance model with the ρ, ω, Φ mesons only (Figs. 2,3). Therefore, an isovector resonance $\rho'(1600)$ with a free coupling to $K\bar{K}$ has been added in consideration. The contributions of the vector mesons to the kaon form factor were described by the following formula:

$$F_K = \sum \alpha_V \frac{g_{VKK}}{g_V} \frac{m_V^2}{\Delta_V},$$

where $\Delta_V = m_V^2 - s - i m_V \Gamma_V(s)$, α_V is a factor equal to 1 for ω, Φ mesons and ± 1 for ρ meson, in the case of K^+ and K^0 respectively. According to the table values of the ρ, ω, Φ parameters /11/ and the relation $g_{\rho KK} = g_{\omega KK} = \frac{1}{\sqrt{2}} g_{\Phi KK}$ (SU(3) with ideal mixing):

$$\frac{g_{\rho KK}}{g_\rho} = 0.62\ ; \quad \frac{g_{\omega KK}}{g_\omega} = 0.19\ ; \quad \frac{g_{\Phi KK}}{g_\Phi} = 0.33$$

The fit of the experimental data gave the following values: $m_{\rho'} = 1.52 \pm 0.02$ GeV, $\Gamma_{\rho'} = 0.37 \pm 0.04$ GeV, $|g_{\rho' KK}/g_{\rho'}| = 0.12 \pm 0.01$, the relative phase between $\rho'(1600)$ and the ρ meson equals 114° ± 9°. This fit allows the description of the kaon form factors up to 1.75 GeV. However, the small values of $|F_{K^+}|^2$ at 2E from 1.75 up to 1.85 GeV considerably increase the value of χ^2 up to 73 for 41 degrees of freedom.

The addition of one more resonance, an isoscalar one, allows to describe also a rapid decrease of the value of the kaon form factors in the energy range 1.75-1.85 GeV observed in Orsay /14,15/. Such a resonance has been detected by the DM1 group from Orsay via modes $e^+e^- \to K_S K^\pm \pi^\mp$ and $e^+e^- \to \omega\pi^+\pi^-$. At the present time it is considered as a candidate to the $\Phi'(1650)$ /18/. The fit shown in Figs. 2,3 uses the fixed value 180° of the phase between $\rho'(1600)$ and ρ as well as between $\Phi'(1650)$ and Φ. This fit gave the following results:

$$m_{\rho'} = 1.54 \pm 0.02 \text{ GeV}, \quad \Gamma_{\rho'} = 0.33 \pm 0.04, \quad \left|\frac{g_{\rho' KK}}{g_{\rho'}}\right| = 0.091 \pm 0.018,$$

$$m_{\Phi'} = 1.66 \pm 0.01 \text{ GeV}, \quad \Gamma_{\Phi'} = 0.20 \pm 0.04, \quad \left|\frac{g_{\Phi' KK}}{g_{\Phi'}}\right| = 0.057 \pm 0.016,$$

$\chi^2 = 54$ for 39 degrees of freedom.

Our analysis showed that taking into account the contributions of $\rho'(1600)$ and $\Phi'(1650)$ it is possible to describe the experimental data even below 1.4 GeV. These results differ from the fits made in Refs. 14,18, where only the range 1.4-1.85 GeV has been included.

3. Reaction $e^+e^- \to \pi^+\pi^-$

Preliminary results on this process for the c.m. energy range 1060-1400 MeV have been published earlier /19/. The main principles of data processing did not essentially change.

At the first stage of data processing events were selected with two tracks in coordinate chambers coming out of the interaction region and being collinear:

$$|\Delta\theta| < 7^\circ, \quad |\Delta\varphi| < 5^\circ, \quad \sigma_{\Delta\theta,\Delta\varphi} \sim 1^\circ$$

880 430 collinear events have been found.

Events thus selected were divided by the method of correlation matrix /20/ into "meson" events ($e^+e^- \to \mu^+\mu^-, \pi^+\pi^-$) and "electron" events ($e^+e^- \to e^+e^-$) using pulse heights from scintillation sandwiches. Events of the processes $e^+e^- \to \mu^+\mu^-$ and $e^+e^- \to \pi^+\pi^-$ were separated from each other by particle ranges in the shower-range system. The total number of selected events was $N(e^+e^-) = 697 \cdot 10^3$, $N(\mu^+\mu^-) = 43 \cdot 10^3$ and $N(\pi^+\pi^-) = 140 \cdot 10^3$. Events of the reaction $e^+e^- \to K^+K^-$ were rejected at the first stage by large ionization losses in triggering counters /13/.

Detection efficiencies for all the process under study were calculated by the detailed Monte Carlo simulation of the experiment /6/. Radiative corrections were applied according to Ref. 21.

The main background for $e^+e^- \to \pi^+\pi^-$ events comes from the process $e^+e^- \to e^+e^- + e^+e^-$. The contribution of this process varying from 0.1% at $2E = m_\rho$ to 25% at $2E = 1400$ MeV was calculated by the Monte Carlo method and subtracted from the experimental $N(\pi^+\pi^-)$. Also subtracted was a small admixture of the events due to the reactions $e^+e^- \to 2\pi^+2\pi^-, \pi^+\pi^-2\pi^\circ$. The value of this admixture was calculated using the results of our experiment /22/.

Table 4 presents the energy dependence of the number of $e^+e^-, \mu^+\mu^-, \pi^+\pi^-$ events. Also given are the values of the pion form factor $|F_\pi|^2$. The cited errors of the $|F_\pi|^2$ values include both statistical errors and uncertainties due to the particle separation.

Analysis of possible systematical uncertainties in $|F_\pi|^2$ showed that it is about 4% at $2E = m_\rho$ and grows up to 15% at $2E = 2400$ MeV.

In Fig. 4 we show the energy dependence of the ratio K of the number of $\mu^+\mu^-$ events to that of e^+e^- events normalized to the same quantity obtained in QED:

$$K = \frac{[N(\mu\mu)/N(ee)]_{exp}}{[N(\mu\mu)/N(ee)]_{QED}}$$

Also shown are the values of K averaged over two energy ranges (640-1008 and 1060-1400 MeV). Both statistical and systematical uncertainties are given. Good agreement of the data and QED confirms the correctness of the chosen data processing procedure.

Energy dependence of $|F_\pi|^2$ is presented in Fig. 5. Our experimental values are consistent with those obtained in previous experiments of our and other groups /23-26/. Unfortunately it is impossible to show in one figure all available data.

To determine parameters of the ρ-meson and ρ-ω mixing data analysis was performed in the narrow region near these resonances (640-900 MeV), where one expects the effects not connected with the ρ- and ω-mesons to be small. Experimental values of $|F_\pi|^2$ were fitted by the formula

$$F_{\rho\omega} = F_{GS} + \xi e^{i\theta} A_\omega,$$

where F_{GS} is the term corresponding to the ρ-meson calculated by the Gounaris-Sakurai formula /27/, A_ω is the Breit-Wigner resonance corresponding to the ω-meson amplitude. The minimization of the likelihood function showed that the values of parameters vary essentially (by some statistical errors) when the considered energy range is slightly changed (by ±50 MeV). This fact indicates to the inadequacy of the chosen shape of $F_\pi(E)$ and experimental data. After numerous trials we decided to use the following empirical expression for the pion form factor

$$F_\pi = F_{\rho\omega}\,(1 + b\cdot s),$$

where b is a free (and rather small) parameter. Values of the parameters obtained with this expression depend slightly on the variation of the energy range. As a result the following values were obtained:

$$M_\rho = (776.4 \pm 1.0)\ \text{MeV},$$
$$\Gamma_\rho = (147.7 \pm 2.5)\ \text{MeV},$$
$$B_{\omega\pi\pi} = (1.73 \pm 0.38)\cdot 10^{-2},$$
$$\theta_{\rho\omega} = 104^\circ.3 \pm 6^\circ.3,$$
$$b = (1.44 \pm 0.34)\cdot 10^{-7}\ \text{MeV}^{-2}.$$

At 2E > 1000 MeV experimental values of $|F_\pi|^2$ considerably (by a factor about 2) exceed the ρ-meson "tail". One of the possible explanations is the $\rho'(1600)$ contribution, the existence of the latter with a decay mode $\rho'(1600)$ can be considered to be reliably confirmed /28/. Fitting of experimental data taking into account $\rho'(1600)$ did not give satisfactory description of the data. Addition of one more resonance $\rho'(1200)$ with free parameters can provide good consistence of the curve and experimental data, however this procedure is hardly well founded.

Another possible effect has been considered in Ref. 29, where it had first been noted that the rapid growth of the cross sections of multihadronic processes at the energy 2E > 1000 MeV can contribute to the pion form factor. In Refs. 30 and 31 expressions for F_π taking into account this effect but neglecting the $\rho'(1600)$ contribution were obtained. We have fitted our data on F_π by a simple formula of Ref. 31:

$$F_\pi = F_{\rho\omega}\left(\frac{m^2}{m^2 - s - im\Gamma}\right)^n,$$

where m, Γ, n are free parameters. This expression with optimal values of m, Γ, n well describes experimental data. However, neglection of the $\rho'(1600)$ contribution as well as the rapid growth of F_π at 2E > 1500 MeV($\sim 1/s^{1.2}$) in contrast with experimental data also makes this expression insufficiently grounded in the broad energy range. We conclude that the problem of pion and kaon form factor description requires further theoretical efforts as a result of which a correct model of overlapping resonances can be created taking into account their different decay modes.

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Figure captions

Fig. 1. Experimental values of the cross section of the reaction $e^+e^- \to \pi^+\pi^-\pi^0$. The solid line shows the theoretical curve, the dashed one gives the level of the non-resonance background.

Fig. 2. The squared form factor of the neutral kaon versus the total energy 2E:
dashed line - ρ, ω, Φ tail;
dashed-dotted line - ρ, ω, Φ tail and $\rho'(1600)$,
solid line - ρ, ω, Φ tail and $\rho'(1600)$, $\Phi'(1650)$.

Fig. 3. The squared form factor of the charged kaon versus the total energy 2E, designations are identical to Fig. 2.

Fig. 4. Energy dependence of the ratio of the total number of $\mu^+\mu^-$ events to that of e^+e^- events normalized to the same value obtained in QED.

Fig. 5. Energy dependence of $|F_\pi|^2$.
Curve 1 shows the prediction of the Gounaris-Sakurai formula, curve 2 is the calculation taking into account ρ, ρ' and ρ'' interference with the following parameters:

$$M_{\rho'} = 1220 \text{ MeV}, \quad \Gamma_{\rho'} = 310 \text{ MeV},$$

$$M_{\rho''} = 1600 \text{ MeV}, \quad \Gamma_{\rho''} = 290 \text{ MeV}.$$

Table 1

2E , MeV	$N(e^+e^-)$	L, nb^{-1}	$N(\pi^+\pi^-\pi^0)$
762.8	I8I9	2.23	7
763.8	I525	I.87	I0
764.8	I693	2.09	I8
765.8	I579	I.95	9
766.8	I593	I.97	I4
767.8	I532	I.90	I4
768.8	I535	I.9I	I5
769.8	I534	I.92	I5
770.8	I608	2.0I	I3
77I.8	I526	I.92	20
772.8	I446	I.82	I4
773.8	I343	I.69	23
774.8	I342	I.70	27
775.8	I480	I.88	40
776.8	I387	I.76	48
777.8	I749	2.23	58
778.8	I4I4	I.8I	65
779.8	I375	I.76	86
780.8	I532	I.97	95
78I.8	I303	I.68	I06
782.8	I336	I.73	79
783.8	I455	I.88	76

2E , MeV	$N(e^+e^-)$	L, nb^{-1}	$N(\pi^+\pi^-\pi^0)$
784.8	I4I2	I.83	7I
785.8	I4I8	I.85	57
786.8	I437	I.87	57
787.8	I563	2.04	47
788.8	I4I3	I.85	62
789.8	I369	I.80	43
790.8	I385	I.83	27
79I.8	I4I0	I.86	38
792.8	I400	I.85	30
793.8	I352	I.80	25
794.8	I665	2.22	29
795.8	I744	2.33	29
796.8	I7I3	2.29	I9
797.8	I68I	2.25	30
798.8	I636	2.20	I3
799.8	I628	2.I9	22
800.8	I590	2.I5	I7
80I.8	I552	2.I0	20

Table 2

2E, GeV	L, nb^{-1}	ε, %	N	N_b	$\sigma_{K_SK_L}$, nb	$\lvert F_{K^0}\rvert^2$
I.06–I.I2	97	I.28	9	3	$7.0^{+4.I}_{-3.6}$	$5.7^{+3.3}_{-2.9}$
I.I2–I.20	I26	0.87	5	2	$4.0^{+3.6}_{-2.9}$	$I.8^{+I.6}_{-I.3}$
I.20–I.28	I60	0.76	2	0.5	$I.8^{+2.2}_{-I.6}$	$0.6^{+0.7}_{-0.5}$
I.28–I.40	309	0.66	2	I	$0.7^{+I.3}_{-0.7}$	$0.2^{+0.4}_{-0.2}$

Table 3

2E, GeV	L, nb^{-1}	$N(K^+K^-)$	$\sigma_{K^+K^-}$, nb	$\lvert F_{K^+}\rvert^2$
1.017	0.44	51.5±9.2	$(9.1 \pm 2.0)\cdot 10^2$	$(3.15 \pm 0.71)\cdot 10^3$
1.018	0.80	109.4±10.8	$(11.2 \pm 2.0)\cdot 10^2$	$(3.70 \pm 0.66)\cdot 10^3$
1.019	0.38	118.6±12.1	$(19.1 \pm 3.0)\cdot 10^2$	$(6.02 \pm 0.96)\cdot 10^3$
1.020	0.76	248.0±17.7	$(19.9 \pm 2.5)\cdot 10^2$	$(6.00 \pm 0.76)\cdot 10^3$
1.021	0.45	116.7±11.0	$(15.4 \pm 2.3)\cdot 10^2$	$(4.46 \pm 0.66)\cdot 10^3$
1.022	0.11	16.0± 4.0	$(8.0 \pm 2.4)\cdot 10^2$	$(2.24 \pm 0.68)\cdot 10^3$
1.023	0.31	49.2± 6.8	$(8.0 \pm 1.5)\cdot 10^2$	$(2.18 \pm 0.40)\cdot 10^3$
1.024	0.31	27.0± 5.0	360 ± 78	$(0.91 \pm 0.20)\cdot 10^3$
1.029	0.69	29.9± 5.6	154 ± 32	341 ± 70
1.032	0.61	10.5± 3.4	50 ± 17	99 ± 33
1.036	0.84	28.8± 5.2	95 ± 19	167 ± 33
1.040	0.71	12.5± 4.2	48 ± 17	77 ± 26
1.050	1.23	29.5± 6.3	57 ± 13	73 ± 16
1.060	1.59	25.3± 5.1	37.7 ± 8.1	40.6 ± 8.7
1.080	3.80	34.9± 5.8	22.9 ± 4.1	18.6 ± 3.3
1.099	0.58	2.0± 1.4	8.9 ± 6.2	5.8 ± 4.1
1.12–1.14	31.5	48.6± 7.0	9.95 ± 2.55	5.09 ± 1.31
1.14–1.16	29.5	69.1± 9.0	8.56 ± 1.34	3.87 ± 0.61
1.16–1.18	29.4	74.6± 9.0	7.98 ± 1.08	3.26 ± 0.44
1.18–1.20	35.6	99.3±10.0	8.14 ± 0.90	3.05 ± 0.34
1.20–1.22	36.4	66.9± 8.5	5.16 ± 0.70	1.80 ± 0.24
1.22–1.24	36.2	83.6± 9.5	6.39 ± 0.79	2.10 ± 0.26
1.24–1.26	38.3	83.6± 9.5	5.94 ± 0.73	1.85 ± 0.23
1.26–1.28	49.1	127.4±12.0	6.94 ± 0.73	2.07 ± 0.22
1.28–1.30	45.1	98.8±11.0	5.77 ± 0.71	1.66 ± 0.21
1.30–1.32	45.8	116.0±19.0	6.58 ± 1.13	1.83 ± 0.32
1.32–1.34	46.0	104.3±14.0	5.80 ± 0.83	1.57 ± 0.23
1.34–1.36	55.4	134.5±12.0	6.12 ± 0.62	1.62 ± 0.16
1.36–1.38	53.4	127.8±12.0	5.98 ± 0.63	1.55 ± 0.16
1.38–1.40	63.0	141.0±14.0	5.50 ± 0.60	1.40 ± 0.15

Table 4

2E, MeV	L, nb^{-1}	$N(e^+e^-)$	$N(\mu^+\mu^-)$	$N(\pi^+\pi^-)$	$\lvert F_\pi\rvert^2$
642.6	2.8	3257	191± 15	462± 46	12.23±1.24
662.6	3.8	4113	251± 20	731± 91	14.95±1.87
677.6	10.6	11013	703± 36	2360±117	17.70±0.90
687.6	9.2	9332	551± 48	2473±176	21.64±1.56
697.6	8.7	8531	510± 40	2530±106	23.95±1.04
707.6	19.5	18547	1171± 74	6035±181	26.00±0.82
717.6	18.6	17152	974± 84	6381±194	29.38±0.94
727.6	20.5	18385	1136±170	7929±422	33.65±1.82
737.6	20.3	17640	1047±138	8686±311	37.93±1.40
747.6	20.1	17031	1173± 95	9217±208	41.11±1.01
757.6	20.0	16484	953± 93	9386±190	42.57±0.96
767.6	20.2	16167	916±145	9614±292	43.78±1.41
773.6	3.5	2785	142± 47	1701± 90	44.56±2.59
775.6	3.7	2918	166± 46	1788± 67	44.51±1.99
777.6	4.1	3159	176± 40	1881± 70	43.05±1.88
779.6	3.6	2765	168± 37	1573± 68	40.50±2.01
781.6	3.6	2809	158± 33	1562± 52	38.42±1.58
783.6	3.6	2745	196± 33	1340± 65	32.73±1.77
785.6	3.8	2867	151± 38	1269± 60	29.38±1.55
787.6	4.0	3025	193± 41	1367± 72	30.13±1.73
789.6	3.7	2808	216± 31	1201± 57	28.82±1.53
791.6	2.7	2001	157± 23	908± 44	30.77±1.72
797.6	22.5	16584	1122±112	6820±238	27.98±1.01
807.6	20.2	14527	953±104	5640±190	26.13±0.91
817.6	22.1	15452	910±129	5321±144	22.88±0.65
827.6	25.5	17376	951±140	5312±191	20.06±0.74
837.6	24.9	16559	914±109	4509±119	17.65±0.50
847.6	24.8	16072	970± 40	3784±202	15.08±0.82
857.6	25.8	16340	1096± 39	3448±144	13.36±0.57
867.6	27.3	16829	1021± 40	3176±119	11.85±0.45

2E, MeV	L, нб$^{-1}$	$N(e^+e^-)$	$N(\mu^+\mu^-)$	$N(\pi^+\pi^-)$	$\lvert F_\pi \rvert^2$
877.6	26.2	15779	947± 38	2586± 81	10.22±0.33
887.6	28.0	16441	1024± 38	2352±116	8.86±0.45
897.6	27.9	15975	1007± 38	2022± 69	7.80±0.27
907.6	27.5	15421	1026± 37	1850± 64	7.35±0.26
917.6	24.1	13180	739± 36	1366± 71	6.32±0.33
927.6	25.0	13354	840± 36	1233± 82	5.61±0.38
937.6	25.9	13540	843± 34	1096± 58	4.90±0.27
947.6	26.7	13652	787± 33	992± 57	4.38±0.26
957.6	21.7	10811	645± 30	806± 41	4.48±0.23
967.6	22.4	10945	700± 30	697± 42	3.81±0.23
977.6	22.0	10518	616± 29	665± 35	3.78±0.20
987.6	21.6	10100	589± 27	536± 35	3.16±0.21
997.6	27.3	12486	742± 31	698± 35	3.32±0.17
1006.6	26.7	11982	716± 30	633± 34	3.13±0.17
1067.6	17.3	6814	421± 22	260± 20	2.22±0.18
1077.6	15.4	5939	344± 20	215± 24	2.11±0.24
1087.6	16.9	6422	393± 21	221± 18	2.00±0.17
1097.6	16.7	6207	402± 22	193± 18	1.81±0.17
1107.6	15.9	5776	335± 20	198± 18	1.99±0.18
1117.6	17.5	6253	427± 22	168± 18	1.55±0.17
1127.6	16.9	5925	337± 19	153± 17	1.49±0.16
1137.6	15.6	5347	342± 20	145± 16	1.57±0.17
1152.6	15.2	5085	332± 19	129± 16	1.46±0.18
1167.6	15.9	5175	316± 19	99± 14	1.10±0.16
1177.6	14.4	4593	270± 17	106± 14	1.32±0.18
1187.6	17.7	5530	351± 20	132± 21	1.37±0.22
1197.6	19.2	5880	382± 21	118± 17	1.14±0.16
1207.6	18.6	5611	355± 20	131± 22	1.33±0.22
1217.6	19.0	5632	339± 19	75± 14	0.76±0.14
1227.6	19.4	5627	358± 20	85± 18	0.86±0.18
1237.6	18.2	5186	320± 19	115± 18	1.26±0.20
1247.6	19.9	5568	363± 20	84± 15	0.85±0.15
1257.6	19.9	5484	300± 18	85± 13	0.87±0.14
1267.6	23.5	6356	389± 20	76± 15	0.67±0.14
1277.6	27.5	7319	454± 22	58± 13	0.44±0.10
1287.6	24.8	6472	391± 20	71± 13	0.62±0.11
1297.6	22.1	5687	338± 19	69± 15	0.69±0.15
1307.6	24.8	6251	448± 22	77± 14	0.69±0.13
1317.6	22.9	5693	373± 20	71± 14	0.70±0.14
1327.6	23.2	5670	336± 19	47± 14	0.47±0.13
1337.6	24.7	5930	359± 20	74± 16	0.70±0.15
1347.6	28.6	82.5	438± 22	41± 10	0.35±0.09
1357.6	29.3	6805	404± 21	51± 12	0.43±0.10
1367.6	31.8	7246	453± 22	33± 10	0.27±0.08
1377.6	24.1	5405	338± 19	29± 8	0.30±0.09
1387.6	30.7	6787	425± 21	47± 11	0.40±0.09
1397.6	35.3	7659	439± 21	28± 9	0.21±0.07

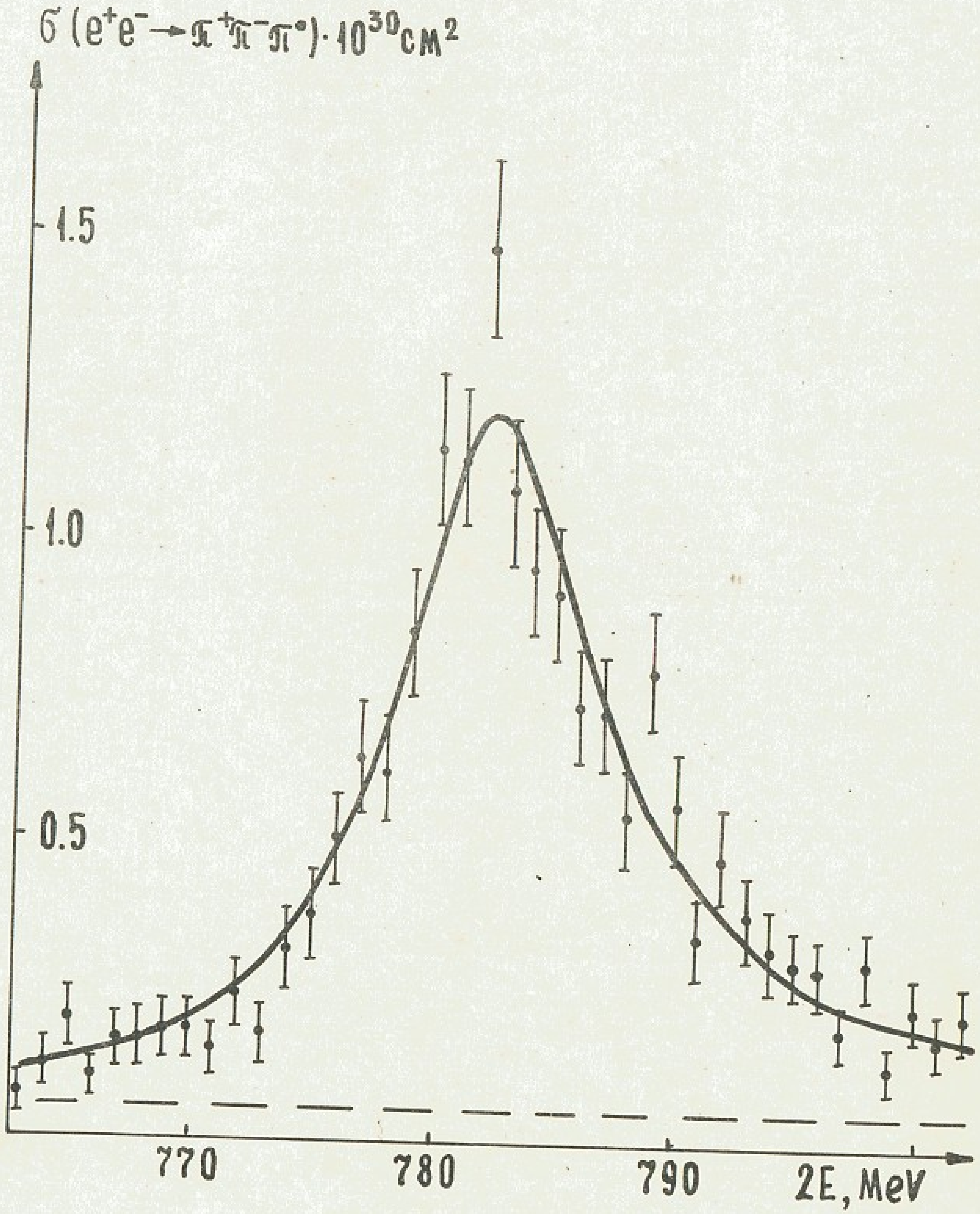

$\sigma(e^+e^- \to \pi^+\pi^-\pi^\circ)\cdot 10^{30}$ cm^2
1.5
1.0
0.5
770
780
790
2E, MeV

Fig. 1

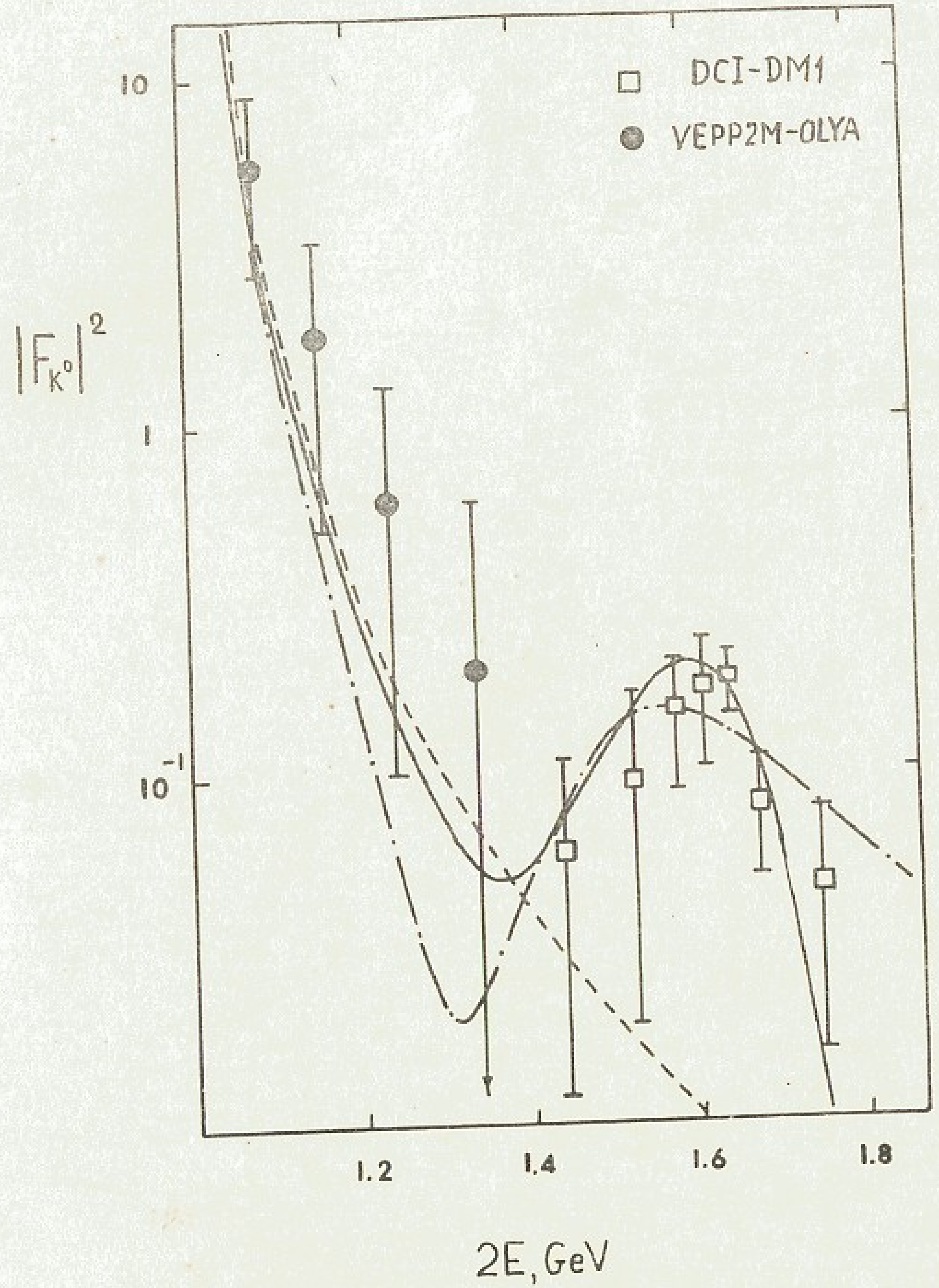

10
1
10^{-1}
$|F_{K^\circ}|^2$
□ DCI-DM1
● VEPP2M-OLYA
1.2
1.4
1.6
1.8
2E, GeV

Fig. 2

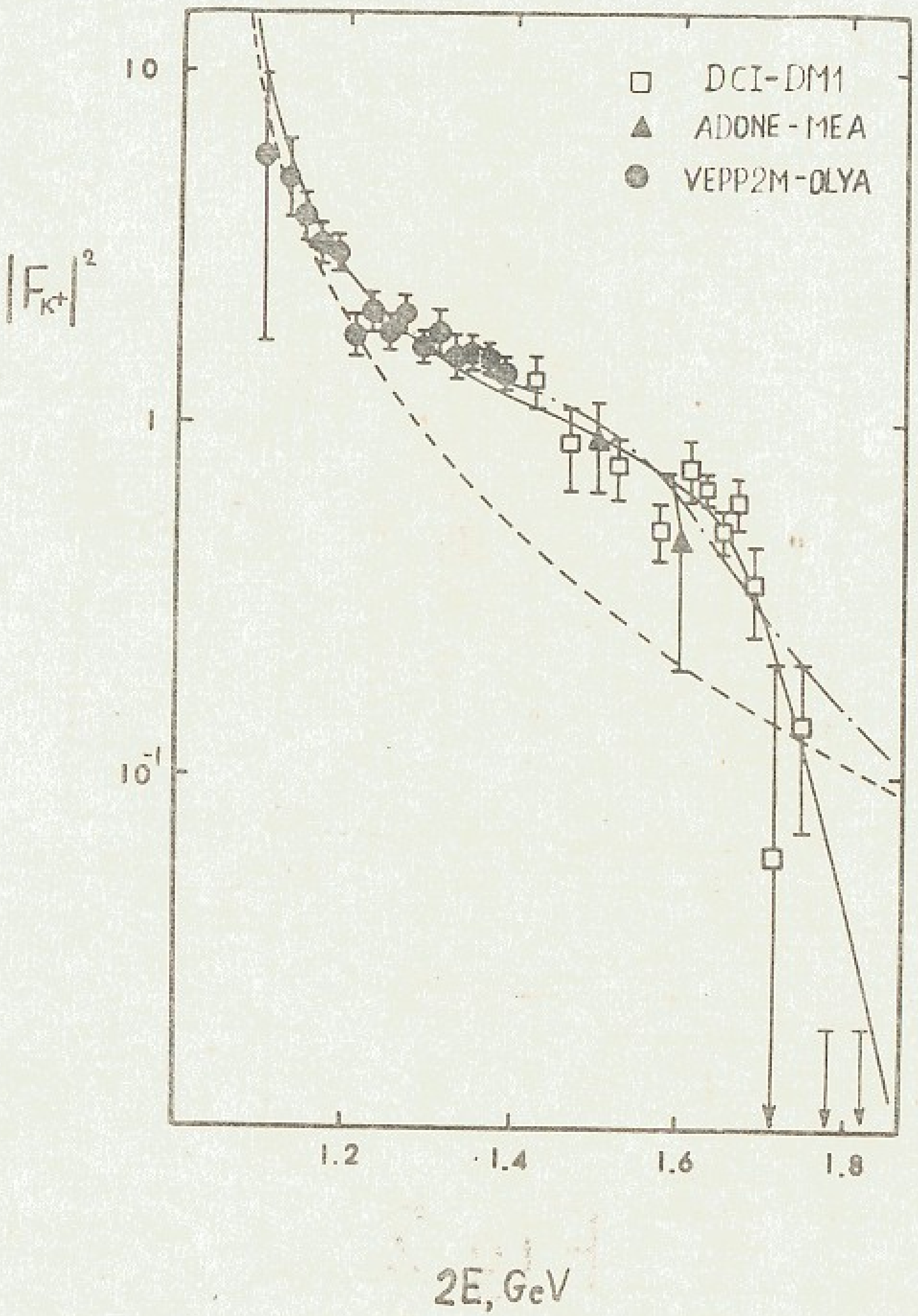
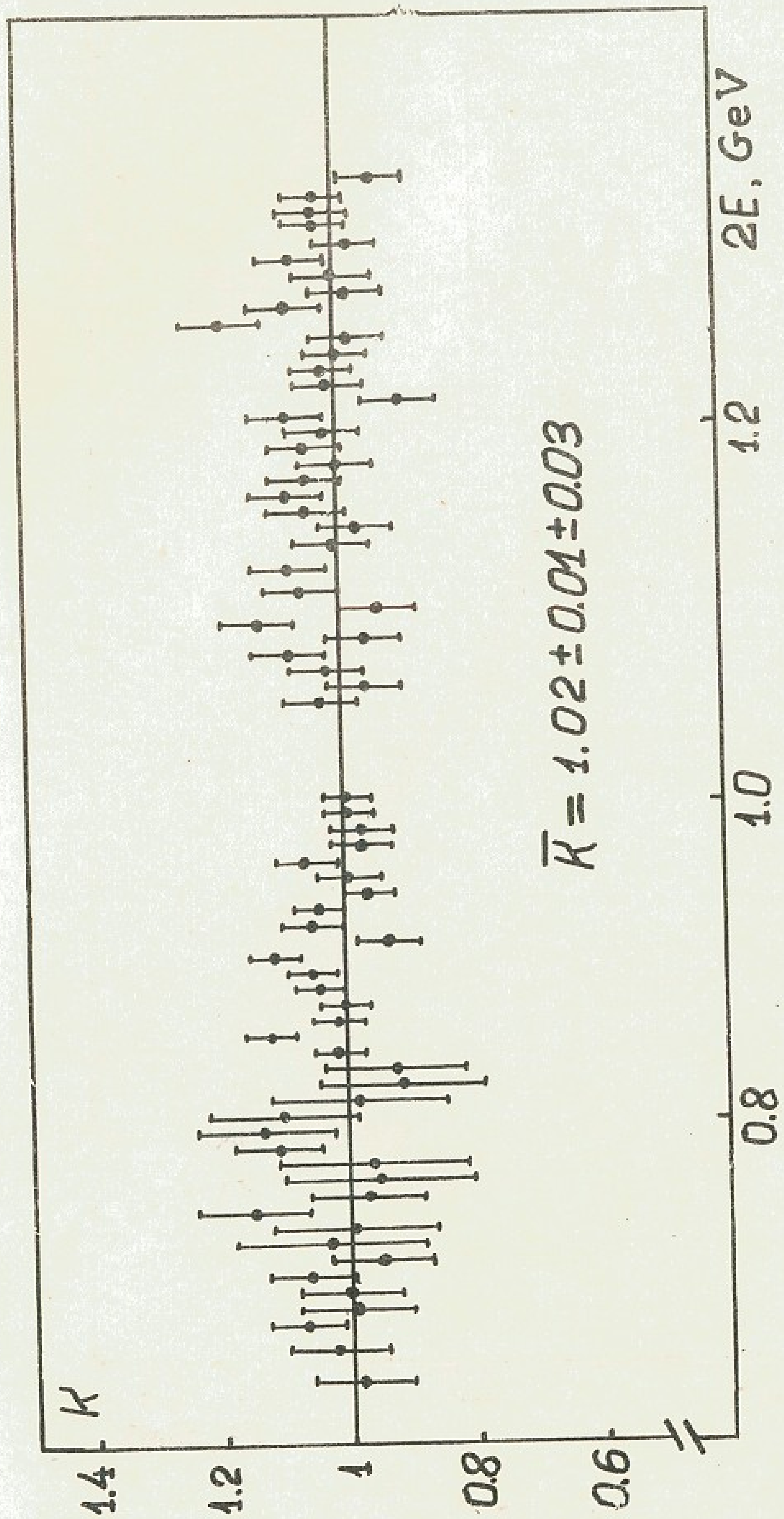


Fig. 3



$\overline{K} = 1.02 \pm 0.01 \pm 0.03$

Fig. 4

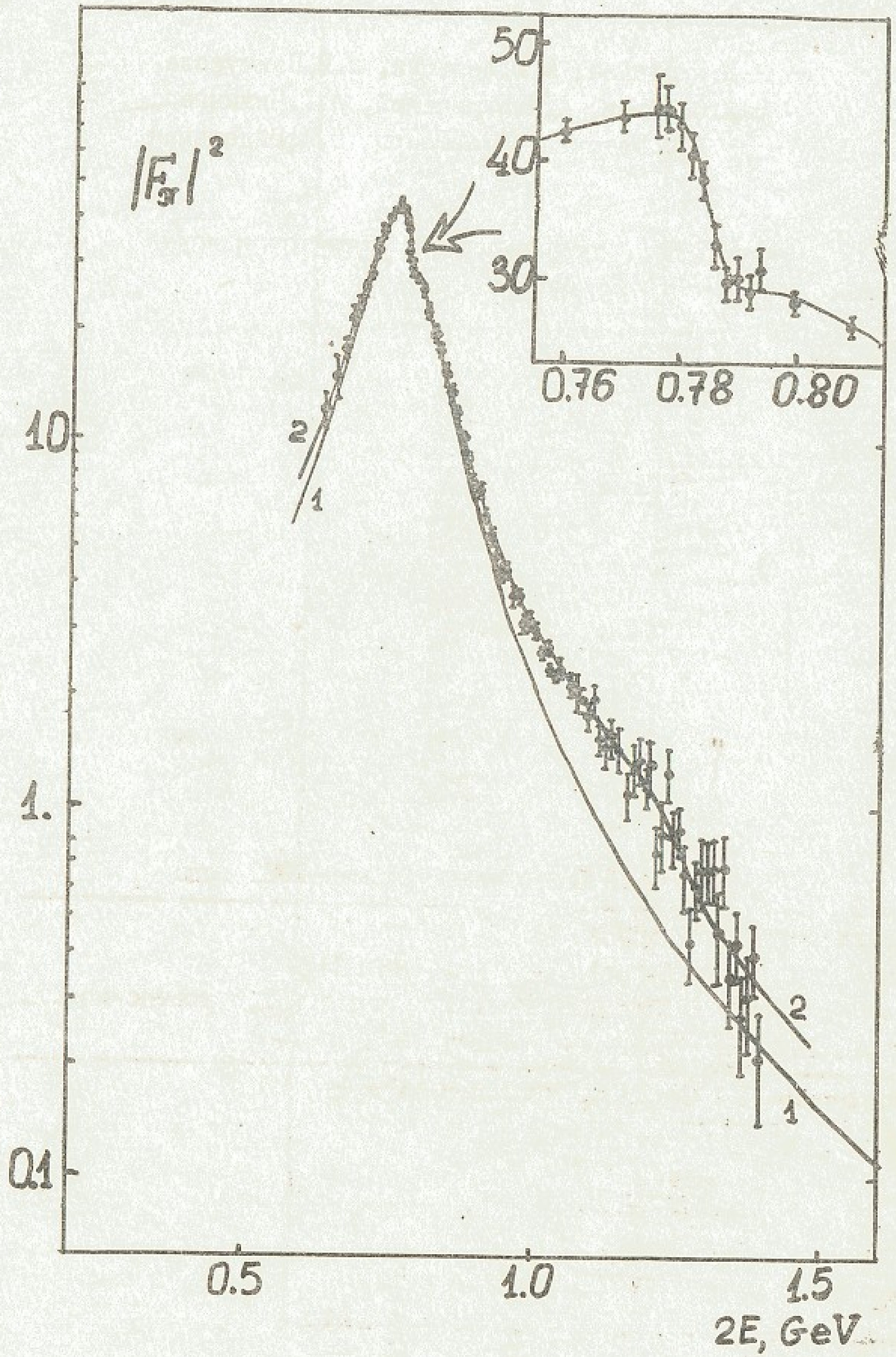


Fig. 5

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РЕЗУЛЬТАТЫ ЭКСПЕРИМЕНТОВ С ДЕТЕКТОРОМ "ОЛЯ" НА УСТАНОВКЕ ВЭПП-2М

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