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ELECTROMAGNETIC CORRECTIONS TO DEEP INELASTIC LEPTON-NUCLEON SCATTERING AT HIGH ENERGIES.
I. CONTRIBUTION OF THE RADIATIVE TAIL OF ELASTIC PEAK

1976

Ахундов А.А., Бардин Д.Ю., Шумейко Н.М. **E2 - 10147**

Электромагнитные поправки к глубоконеупругому лептон-нуклонному рассеянию при высоких энергиях. I. Вклад радиационного хвоста от упругого пика

Рассматривается вклад радиационного хваста от упругого пика в сечение глубоконеупругого μp-рассеяния при энергиях 150-250 ГэВ. Отмечается неприменимость Peaking Approximation при указанных энергиях.

Работа выполнена в Лаборатории теоретической физики ОИЯИ.

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Electromagnetic Corrections to Deep Inelastic Lepton-Nucleon Scattering at High Energies. I. Contribution of the Radiative Tail of Elastic Peak

The contribution of the radiative tail of the elastic peak to the deep inelastic μp-scattering at energies 150-250 GeV is considered. The inapplicability of Peaking Approximation at these energies is emphasized.

The investigation has been performed at the Laboratory of Theoretical Physics.

Communication of the Joint Institute for Nuclear Research

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ELECTROMAGNETIC CORRECTIONS TO DEEP INELASTIC LEPTON-NUCLEON SCATTERING AT HIGH ENERGIES. I. CONTRIBUTION OF THE RADIATIVE TAIL OF ELASTIC PEAK

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I. INTRODUCTION

High energy deep inelastic scattering of leptons from nucleons is a main source of information on the nucleon structure. For an unambiguous interpretation of the experimental data it is necessary to take account of the electromagnetic corrections (EC) to the process cross sections since the EC can be essential at high energies.

A thorough study of the EC to the deep inelastic $e(\mu)N$-scattering has been carried out in classical papers by L.W.Mo and Y.S.Tsai [1] and Y.S.Tsai [2]. Their results were used in the analysis of all the presently available experiments on ep-scattering at electron energy up to 20 GeV [3,4] and on μp-scattering at muon energy 7 GeV [5], 12 GeV [6], 56 GeV and 150 GeV [7,8].

In view of the planned in SPS experiment on deep inelastic μp-scattering at energy of the muon beam 50-280 GeV we attempt an additional study of the EC, the following purposes being pursued:

i) To obtain information on the magnitude and behaviour of EC in the new energy range;

ii) To single out the kinematical regions (if these exist) where the lowest order EC are so large that higher-order EC, certainly, cannot be neglected. In this case, evidently, no interpretation should be admitted for the data in the indicated regions until the higher order EC will be calculated;

iii) To analyse the validity of approximate formulae for evaluation of EC, obtained in the so-called Peaking Approximation (PA) [1].

Our analysis, like the one of paper [1], is based on the assumption of smallness of EC to the hadron current. This assumption is supported by the EC calculation within the parton model [9] where it is shown that the hadron EC do not exceed ±3% troughout the whole kinematical region of μ^+p-scattering and at $x, y \lesssim 0.8$ for μ^-p-scattering. If the hadron EC are really small, then it becomes possible to consider the EC in a model-independent way. Indeed, in this case it suffices to consider EC to the lepton current only, with the hadron block being described phenomenologically by means of form factors or structure functions.

In inclusive-type experiments when only the final lepton is detected the processes

$$\ell + N \to \ell + \gamma + N, \qquad (1)$$

$$\ell + N \to \ell + \gamma + N^*, \qquad (2)$$

$$\ell + N \to \ell + \gamma + \text{hadrons} \qquad (3)$$

(N^* is the nucleon resonance)
cannot be distinguished from the main reaction

$$\ell + N \to \ell + \text{hadrons}. \qquad (4)$$

Hence, the radiative tails of the elastic peak, resonances and continuous spectrum, corresponding to processes (1), (2) and (3), contribute to the observed cross section of the process (4)*.

Thus, the measured cross section of deep inelastic ℓN-scattering is a sum of inclusive cross sections of processes (1), (2), (3) and main process (4)

$$d^2\sigma^{exp} = d^2\sigma^{eltail} + \Sigma d^2\sigma^{Rtail} + d^2\sigma_0 (1+\delta), \qquad (5)$$

where $d^2\sigma_0$ is the cross section of reaction (4) in the Born approximation and δ is the EC to the cross section.

In the present paper we calculate the contribution of the elastic radiative tail to the measured cross section of deep inelastic ℓN-scattering. In subsequent papers the EC to continuous spectrum and effects of low lying resonances will be considered.

In the calculations we use the covariant procedure developed in refs. [9-11]. This method permits to gain for the inclusive-type experiments the lowest order EC without any approximations, without introducing "softness" parameter Λ and in a Lorenz-invariant form. Obviously, such an approach possesses evident advantages over the standard one.

For the completeness the calculations of each term in (5) are preceded by a short kinematical considerations.

The first paper is organized as follows.

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*We use the terminology of paper [1].

In sect.2 we analyse the physical region of one-particle spectrum of inclusive reactions in those invariant variables which will be used in what follows. Section 3 deals with the kinematics of process (1). Section 4 calculates the invariant inclusive cross section of reaction (1) |diagrams in Fig.1|..

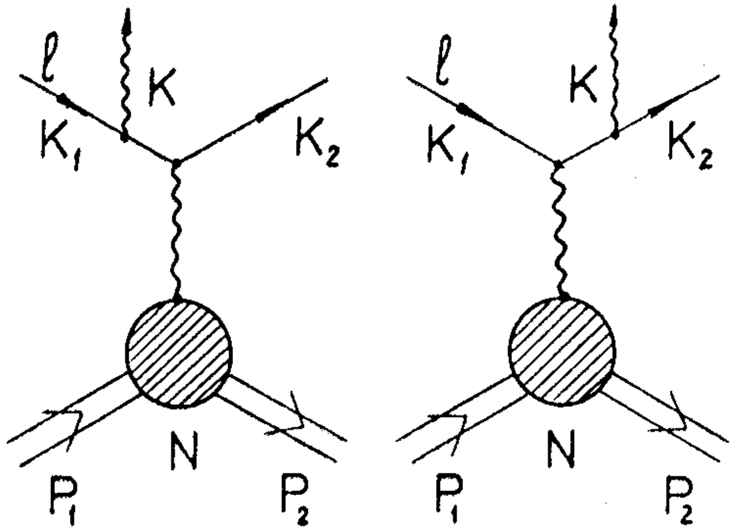

Fig. 1. The diagrams giving the dominant contribution to the cross section of the process (1).

2. PHYSICAL REGION OF THE ONE-PARTICLE DISTRIBUTION

Consider the inclusice process (4), which is characterized by the invariant one-particle distribution

$$E_2 \frac{d\sigma}{d\vec{k}_2} = f(\vec{k}_2, s) \qquad (6)$$

where $s=-(p_1+k_1)^2$; p_1, k_1 and k_2 are 4-momenta of a nucleon, initial and final lepton.

The one-particle spectrum (6) depends on three essential variables, one of these, the total c.m. energy of colliding particles $\sqrt{s}$ being usually fixed. As other two variables, any sets of independent variables may be used which uniquely define the energy and angle of scattering of the final lepton in the rest system of a target (lab.syst.).

For calculations it appears convenient to utilize the following two sets of invariant variables

$$X = -2p_1k_2, \quad Y = (k_1-k_2)^2 \qquad (7)$$

and the so-called scaling variables

$$x = \frac{(k_1-k_2)^2}{-2p_1(k_1-k_2)}, \quad y = \frac{p_1(k_1-k_2)}{p_1k_1}. \qquad (8)$$

Now let us establish the range of variation of each variable at fixed S* which is the physical region for the one-particle distribution (6) of inclusive reaction (4).

In the following consideration we shall often make use of the kinematical function

*Further instead of s, it is convenient to use the invariant $S=-2p_1k_1$.

$$\lambda(x,y,z) = x^2 + y^2 + z^2 - 2xy - 2xz - 2yz\,.$$

With notations

$$\lambda_S = \lambda(-(p_1+k_1)^2, -p_1^2, -k_1^2),\ \lambda_X = \lambda(-(p_1+k_2)^2, -p_1^2, -k_2^2),$$
$$\lambda_Y = \lambda(-(p_1+\Lambda)^2, -p_1^2, -\Lambda^2), \qquad (9)$$

where $\Lambda = k_1 - k_2$, for moduli of momenta $\vec{k}_1, \vec{k}_2$ and $\vec{\Lambda}$ in the lab.system we have

$$|\vec{k}_1| = \frac{1}{2M}\sqrt{\lambda_S},\ |\vec{k}_2| = \frac{1}{2M}\sqrt{\lambda_X},\ |\vec{\Lambda}| = \frac{1}{2M}\sqrt{\lambda_Y}\,. \qquad (10)$$

where M is the nucleon mass. Functions (9) can be easily expressed in terms of invariant variables (7) and S

$$\lambda_S = S^2 - 4m^2M^2,\ \lambda_X = X^2 - 4m^2M^2,\ \lambda_Y = S_Y^2 + 4M^2Y, \qquad (11)$$

where m is the lepton mass; $S_Y = S - X$. The physical region of invariants X and Y is established by the conditions

$$S + M^2 - (\sqrt{s} - m)^2 \le X + Y \le S\,, \qquad (12)$$

$$\lambda(\lambda_S, \lambda_X, \lambda_Y) \le 0\,, \qquad (13)$$

where $s = S + m^2 + M^2$.

Inequality (12) follows from the analysis of limiting values of the invariant mass squared W^2 of the non-observed system of particles. From the definition $W^2 = -(p_1 + k_1 - k_2)^2$ we have

$$X + Y = S + M^2 - W^2\,, \qquad (14)$$

then from

$$M^2 \le W^2 \le (\sqrt{s} - m)^2$$

and formula (14) we arrive at (12).

Inequality (13) is the condition of existence of the momentum triangle of inclusive process (4) in the lab.system (Fig. 2a).

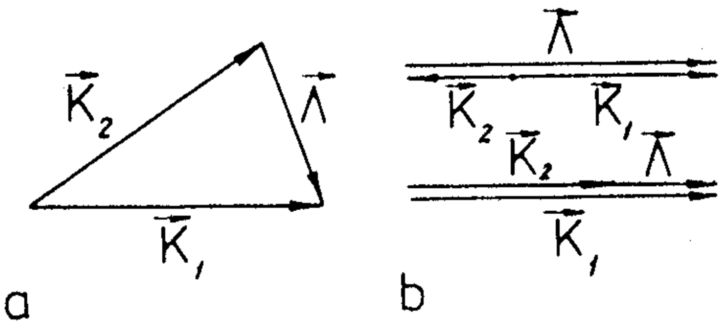

Fig. 2. Momentum triangle of the process (4) in the lab.system (a) and its extreme configurations (b).

Indeed, since the area of that triangle equals $\frac{1}{4}\sqrt{-\lambda(\vec{k}_1^{\,2}, \vec{k}_2^{\,2}, \vec{\Lambda}^2)}$ then it exists if $\lambda(\vec{k}_1^{\,2}, \vec{k}_2^{\,2}, \vec{\Lambda}^2) \le 0$, that, together with (10), gives inequality (13).

As follows from condition (12) the physical region of X and Y lies between two parallel straight lines

$$X + Y = S + M^2 - (\sqrt{s} - m)^2 \qquad (15)$$

and

$$X + Y = S. \qquad (16)$$

The boundary curve is the branch of hyperbola

$$\lambda(\lambda_S, \lambda_X, \lambda_Y) = 0$$

or

$$m^2X^2 - SXY + M^2Y^2 - 2m^2SX + 4m^2M^2Y + m^2S^2 = 0. \qquad (17)$$

Solving eq. (17) relative to X and Y we get

$$X_{1,2} = \frac{1}{2m^2}[S(Y + 2m^2) \pm \sqrt{\lambda_S Y(Y + 4m^2)}], \qquad (18)$$

$$Y_{1,2} = \frac{1}{2M^2}[SX - 4m^2M^2 \pm \sqrt{\lambda_S \lambda_X}] . \qquad (19)$$

Equations of curves (19) may be written implicitly as

$$\sqrt{\lambda_Y} = \sqrt{\lambda_S} + \sqrt{\lambda_X}, \qquad (20)$$

$$\sqrt{\lambda_Y} = \sqrt{\lambda_S} - \sqrt{\lambda_X}. \qquad (21)$$

Then it is clear that lines (19) correspond to two possible configurations of the momentum triangle (Fig. 2b).

Now let us find out the physical region of invariants x and y.

For this purpose it is sufficient to consider the map

$$X = S(1 - y), \quad Y = Sxy \qquad (22)$$

of the known region of X and Y onto the plane (x, y). Inserting (22) into (17) we obtain the equation of the boundary curve of the scaling variable region

$$M^2Sx^2y + S^2xy - \lambda_S x + m^2Sy = 0. \qquad (23)$$

Solving it with respect to y we get

$$y = x(1 - \frac{m^2}{E^2})/[x(1 + \frac{Mx}{2E}) + \frac{m^2}{2ME}], \qquad (24)$$

where $E = S/2M$ is the lab.system energy of the initial lepton. Function (24) has a maximum at the point c with the coordinates

$$x_c = \frac{m}{M}, \quad y_c = 1 - \frac{m}{E}.$$

The lines of level W^2 on the plane (x, y) are the hyperbolas

$$y = \frac{W^2 - M^2}{2ME} \frac{1}{1 - x}. \qquad (25)$$

In Fig.3 the physical region of distribution (6) in scaling variables x and y is represented for the case of reaction $\mu p \to \mu X$ at E= E=12 GeV.

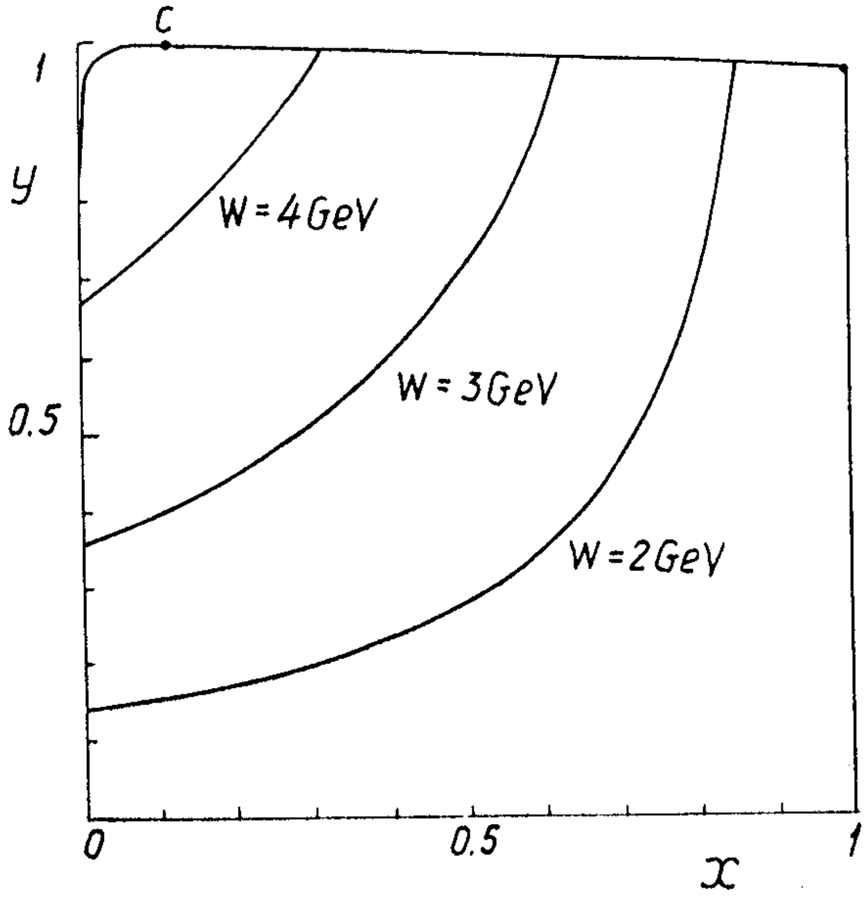

Fig. 3. The physical region of the process (4) in the scaling variables. Numerical values refer to the reaction $\mu p \to \mu X$ at E=12GeV.

3. KINEMATICS OF THE PROCESS

Reaction (1) is specified by five independent invariants. As these, basides S, X and Y it is convenient to take the following variables

$$t = (p_2 - p_1)^2, \quad z = -2k_2 k . \tag{26}$$

Introducing the λ-functions

$$\lambda_t = \lambda(-(p_1 + p_2)^2, -p_1^2, -p_2^2) = t(t + 4M^2),$$
$$\lambda_k = \lambda(-(p_1 + k)^2, -p_1^2, -k^2) = (S_X - t)^2 , \tag{27}$$

for moduli of vectors $\vec{p}_2$ and $\vec{k}$ in the lab. system we have

$$|\vec{p}_2| = \frac{1}{2M}\sqrt{\lambda_t}, \quad |\vec{k}| = \frac{1}{2M}\sqrt{\lambda_k}. \tag{28}$$

On passing to variables (7) and (26) the phase space element of process (1) takes the form

$$d\Gamma = \frac{d\vec{k}_2}{2k_{20}} \frac{d\vec{k}}{2k_0} \frac{d\vec{p}_2}{2p_{20}} \delta(k_2 + k + p_2 - k_1 - p_1) =$$
$$= \frac{\pi}{4\sqrt{\lambda_S}} dXdY \frac{dtdz}{\sqrt{R_z}} , \tag{29}$$

where $R_z = A_z z^2 + 2B_z z + C_z$ is the positive definite quadratic trinomial with

$$A_z = -\lambda_Y, \quad B_z = 2M^2 Y(Y-t) + Xt(S_X - Y) + SY(S_X - t),$$
$$-C_z = [Xt - Y(S-t)]^2 + 4m^2[t(S_X - t)(S_X - Y) - M^2(t-Y)^2]. \tag{30}$$

The discriminant of R_z equals

$$D_z = B_z^2 - A_z C_z = \frac{1}{64M^4}\lambda(\lambda_S,\lambda_X,\lambda_Y)\cdot\lambda(\lambda_Y,\lambda_t,\lambda_k). \quad (31)$$

In the physical region of invariant of X and Y one has

$$\lambda(\lambda_Y,\lambda_t,\lambda_k) \le 0. \quad (32)$$

Inequality (32) is the condition of existence of the triangle of momenta $\vec{\Lambda}$, $\vec{p}_2$ and $\vec{k}$ of reaction (1) (Fig.4a).

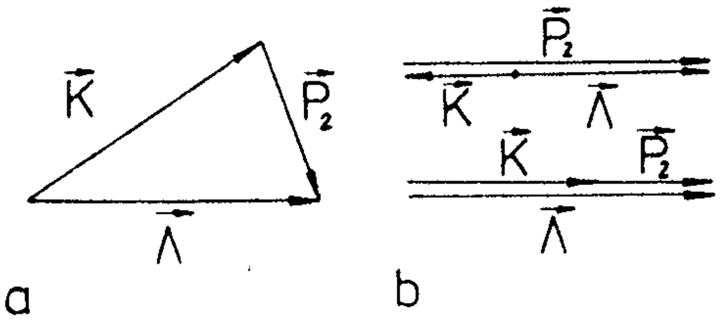

Fig. 4. Momentum triangle of the process (1) in the lab.system (a) and its extreme configurations (b).

From relations (13), (32) and (31) we get that $D_z \ge 0$. Because of the positive definiteness of invariant z and $A_z \le 0$ we have that $B_z \ge 0$, $-C_z \ge 0$.

To calculate the lepton inclusive spectrum of process (1) it is necessary to know the range of variation of t and z at fixed S, X and Y.

It is not difficult to show /11/ that the physical region of invariant z is limited by the roots of trinomial

$$z_{min,max} = (-B_z \pm \sqrt{D_z})/A_z. \quad (33)$$

The limits for t-region are defined from the extreme configurations of the momentum triangle of reaction (1) (Fig.4b). The configurations I and II give, resp., the maximum and minimum of λ_t throughout the whole region

$$(\sqrt{\lambda_t})_{max,min} = \sqrt{\lambda_Y} \pm \sqrt{\lambda_k}. \quad (34)$$

Therefore, using (10) and (27) we obtain the limits of t-variation

$$t_{max,min} = \frac{1}{2W^2}\{(W^2 - M^2)(S_X \pm \sqrt{\lambda_Y}) + 2M^2 Y\}, \quad (35)$$

4. INCLUSIVE CROSS SECTION

The differential cross-section of the process (1) for the scattering of unpolarized leptons from unpolarized nucleons can be represented in the form (see formulae (33) and (35) ref. /11/):

$$d\sigma^{eltail} = \frac{2\alpha^3}{\pi\lambda_S} S\,dX\,dY \frac{dt\,dz}{t^2\sqrt{R_z}}, \quad (36)$$

with

$$\mathcal{S} \quad \frac{1}{4} S_{\mu\nu} A_{\mu\nu} = t A_M(t) S_1 + A_E(t) S_2 ,$$

$$S_1 = \frac{1}{2}\left(\frac{z_1}{z} + \frac{z}{z_1}\right) + \frac{1}{z z_1}(t^2 - 4m^4) - (t-2m^2)\left(\frac{1}{z} - \frac{1}{z_1}\right) -$$

$$- m^2 (t-2m^2)\left(\frac{1}{z^2} + \frac{1}{z_1^2}\right), \qquad (37)$$

$$S_2 = -M^2\left(\frac{z_1}{z} + \frac{z}{z_1}\right) + \frac{1}{z z_1}[t(S(S-t) + X(X-t) - 2M^2(t+2m^2)) +$$

$$+ 2m^2((S-t)(X+t) + SX)] - t[\frac{1}{z}(X-2M^2) + \frac{1}{z_1}(S+2M^2)] -$$

$$- 2m^2[\frac{1}{z^2}(S(S-t) - M^2 t) + \frac{1}{z_1^2}(X(X+t) - M^2 t)].$$

Here

$$A_M(t) = G_M^2(t), \quad A_E(t) = \frac{G_E^2(t) + \tau G_M^2(t)}{1+\tau},$$

where $G_M(t)$ and $G_E(t)$ are the nucleon electromagnetic form factors, $\tau = t/4M^2$; $z_1 = -2k_1 k = z + t - Y$.

Integrating over invariant z in limits (33), we derive from (36) and (37) the following expression for the invariant spectrum of leptons in reaction (1):

$$\frac{d^2\sigma^{eltail}}{dxdy} = \frac{2\alpha^3}{\lambda_S} S^2 y \int \frac{dt}{t^2} \mathcal{S}(t) \qquad (38)$$

with

$$\mathcal{S}(t) = \frac{1}{\pi}\int \frac{dz}{\sqrt{R_z}} \mathcal{S} = t A_M(t) S_1(t) + A_E(t) S_2(t),$$

$$S_1(t) = \{\frac{1}{\sqrt{-C_z}}[\frac{t-Y}{2} + \frac{(t-2m^2)(Y+2m^2)}{t-Y}] - m^2(t-2m^2)\frac{B_z}{(-C_z)^{3/2}}\} -$$

$$- \{S \leftrightarrow -X\} + \frac{1}{\sqrt{\lambda_Y}},$$

$$S_2(t) = \{\frac{1}{\sqrt{-C_z}}[M^2(t+Y) - Xt] + \frac{1}{(t-Y)\sqrt{-C_z}}[t(S(S-t) + X(X+t) -$$

$$- 2M^2(t+2m^2)) + 2m^2((S-t)(X+t) + SX)] -$$

$$- 2m^2\frac{B_z}{(-C_z)^{3/2}}[S(S-t) - M^2 t]\} - \{S \leftrightarrow -X\} - \frac{2M^2}{\sqrt{\lambda_Y}}.$$

Our final formula (38) is analogous to the formula (B.5) of ref. /1/ but is more compact and is written in the covariant form. Using limits of t-variation (35) it is not difficult to calculate the single integral in (38) at computer.

5. CONCLUSIONS

Using final formula (38), we have performed the numerical calculation of the inclusive cross section of the reaction

$$\mu + p \to \mu + p + \gamma \qquad (39)$$

at E=150 and 250 GeV. The results are depicted in Figs.5 and 6.

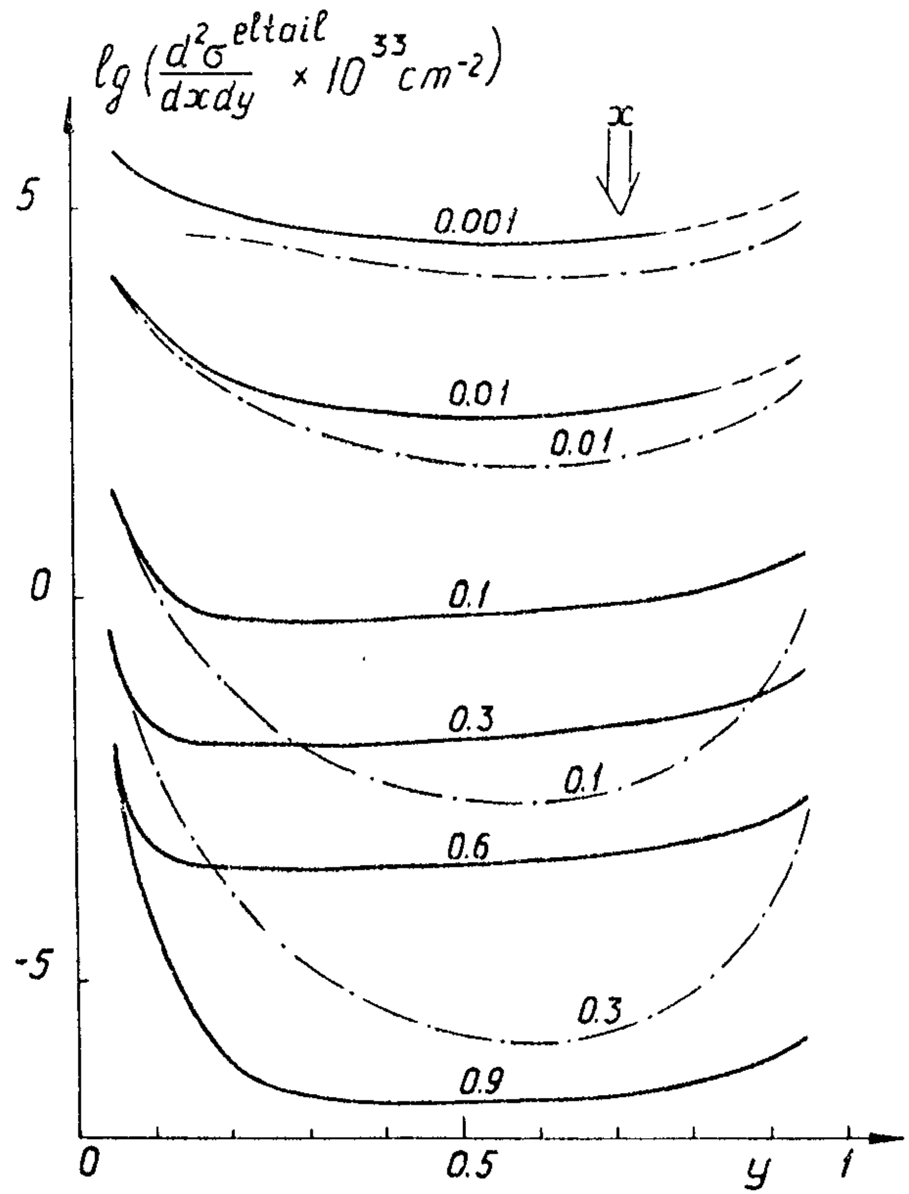

Fig. 5. Inclusive cross section of the process $\mu p \to \mu p \gamma$ at E=150 GeV.

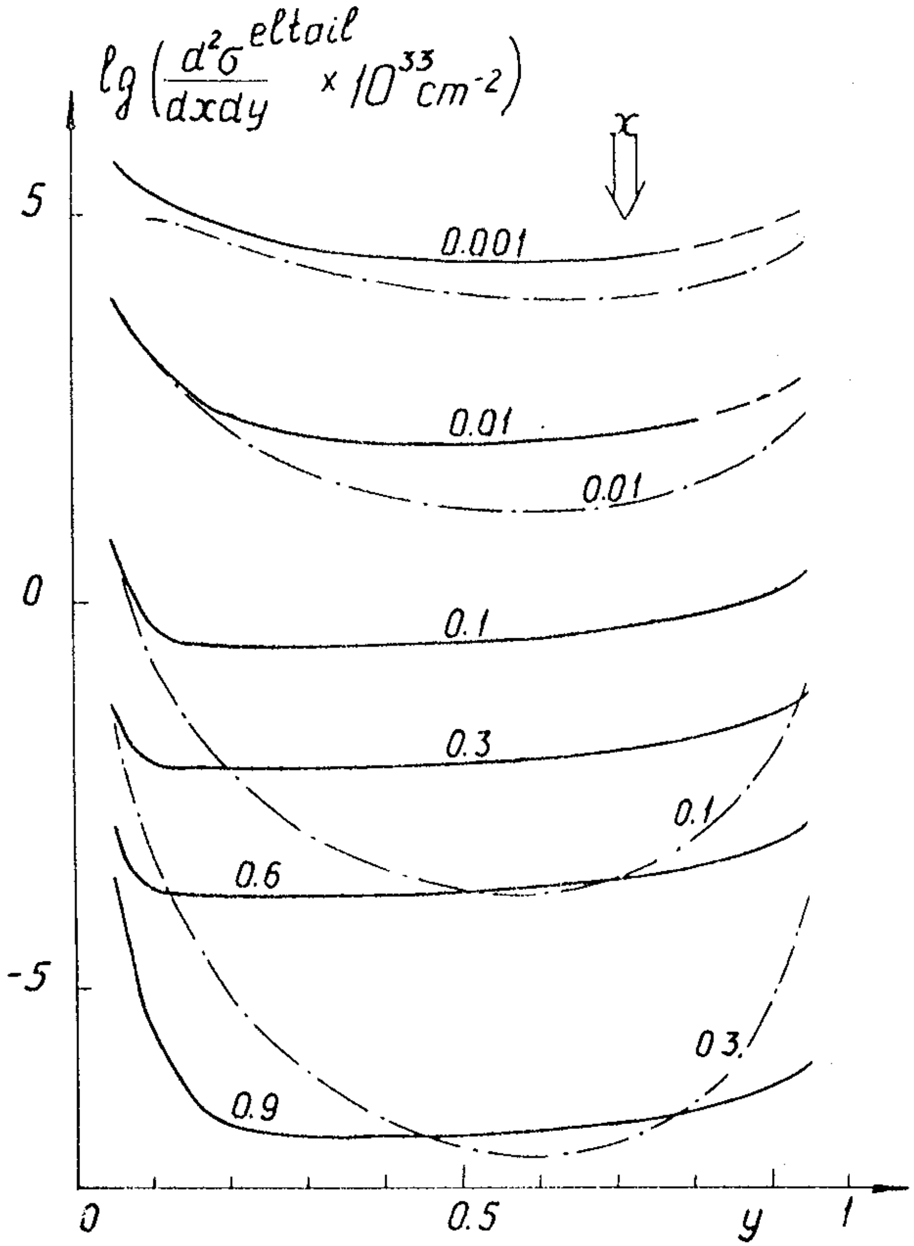

Fig. 6. Inclusive cross section of the process $\mu p \to \mu p \gamma$ at E=250 GeV.

For the proton form factors G_E and G_M we have used their experimental fit in t region up to 25 $(GeV)^2$ /12/ . To calculate the integral (38) at high energies it is necessary to know the behaviour of the electromagnetic form factors at larger q-squared. To this end we have extrapolated the formulae of ref./12/. As the dominant contribution to the integral (38) is due to low t region, the result is practically independent of the choice of the extrapolation.

As the radiative tail of elastic peak simulates the deep inelastic scattering it is interesting to compare the cross section of the reaction (1) with that of the process (4). In such a comparison we have used for the deep inelastic cross section the formula of a simple parton model

$$\frac{d^2\sigma_0}{dxdy} = \frac{\pi a^2}{ME} \frac{1+(1-y)^2}{xy^2}\left[\frac{4}{9}v_u(x)+\frac{1}{9}v_d(x)+\frac{4}{3}\xi(x)\right] \quad (40)$$

where $v_u(x)$, $v_d(x)$ and $\xi(x)$ are functions, describing the momentum distributions of valence u- and d-quarks and "sea" resp. For these functions we have put their experimental fit from ref./13/ , based on the analysis of the deep inelastic ep-scattering data up to E=20 GeV /14/ .

In Figs.5 and 6 the solid lines represent the elastic radiative tail in that kinematical region of x and y , where

$$R \equiv \frac{d^2\sigma^{eltail}}{dxdy} / \frac{d^2\sigma_0}{dxdy} < 0.3 \quad (41)$$

and dotted lines, where

$$R > 0.3, \quad (42)$$

that is in that region where the cross section of the reaction (39) is an essential part of the main cross section, point three say.

Since in data processing the cross section of the radiative tail of elastic peak is subtracted from the measured deep inelastic cross section, in the region (42),where these are comparable, the accuracy of the calculations may be insufficient, i.e., the account of hadron bremsstrahlung and EC to the process (1) will be needed.

Let us explain a possible necessity of the latter account. The elastic radiative tail is the α^3-order process, but the main cross section is the α^2-order one, therefore the equality of the cross sections (38) and (40) may indicate to the large EC. Furthermore the account of the EC to the elastic radiative tail in the indicated region is so necessary as to the cross section of the reaction (4).

Before making the quantitative analysis of these uncertainties it should be refused to interpret the data in the above region.

The boundary of this region in any experiment should be found from comparison of the cross section of the reaction (1) with the measured cross section of the main reaction (4). The region indicated in Figs.5 and 6 (dotted lines) may be considered only as an illustration of the discussed point, as for such a comparison we use the model-dependent formula (40).

Let us compare now our calculations of the process (39) with those by the often used ap-

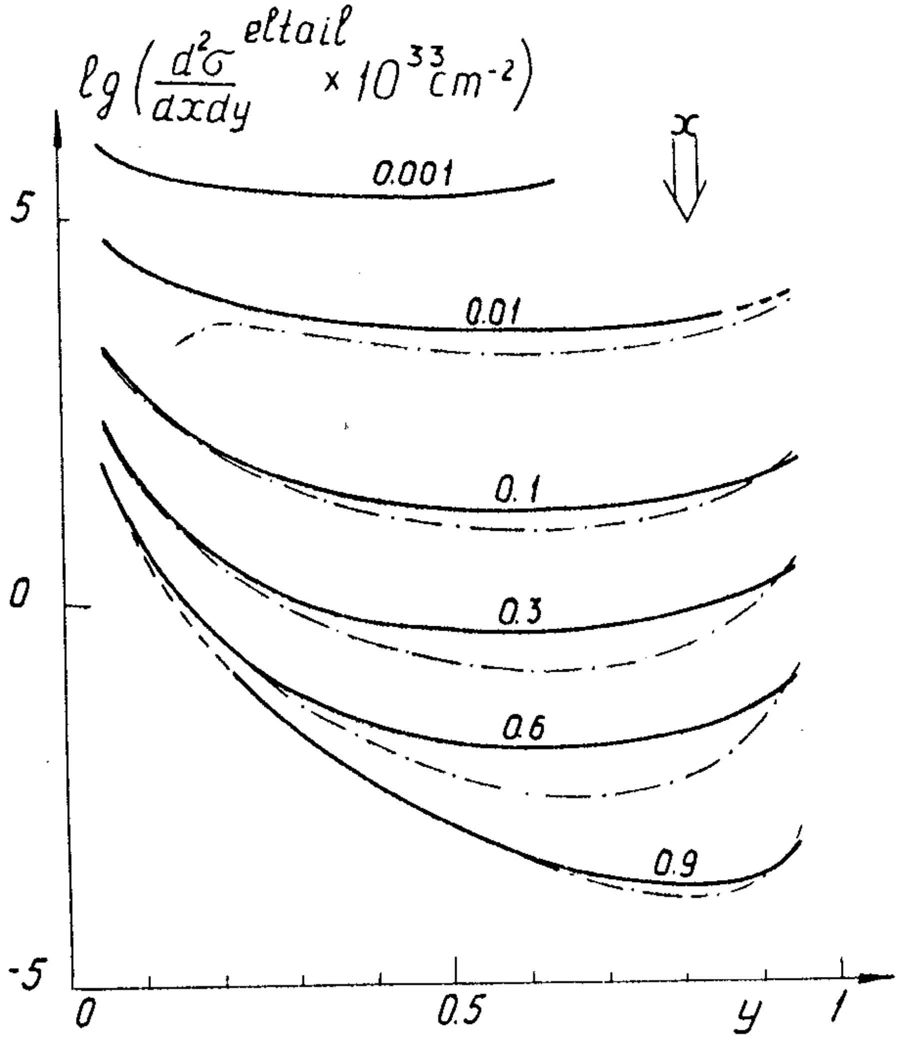

Fig. 7. Inclusive cross section of the process $\mu p \to \mu p \gamma$ at E=12 GeV.

proximate formula (C.11) of ref. /1/ , derived in PA.(Dash-dotted lines in Figs.5 and 6).As it is seen, PA fails to work at the considered energies. Only at very small y there is an agreement between two calculations. At small x and y dash-dotted lines are cut off,as PA gives negative result here. In the region, where $0.1 < R < 0.3$ results obtained in PA differ from the exact one by one-three order. We note, that for μp-scattering at 12 GeV (Fig.7) and for ep-scattering at 20 GeV PA works better. For instance, in the region where $0.1 < R < 0.3$ the distinction between two calculations does not exceed the factor 1.5÷2. At E=12 and 20 GeV in the region where $R > 0.3$ the distinction is the same as for lower R, but at high energies in this region it reaches the factor 3÷4. But in view of the above-mentioned uncertainties of calculations, which do not employ PA, the comparison of two calculations at large R seems to be senseless.

One of us (D.B.) is grateful to H.L.Anderson for the helpful discussion, which initiated the comparison of our calculations for the EC to the lepton current in the framework of a simple parton model /9/ with the results of ref. /1/.

REFERENCES:

1. L.W.Mo and Y.S.Tsai. Rev.Mod.Phys., 41, 205, (1969).
2. Y.S.Tsai. SLAC-PUB-848, 1971.
3. E.D.Bloom et al. Phys.Rev.Lett., 23, 930, (1969).
4. G.Miller et al. Phys.Rev., D5, 528, (1972).

5. A.Entenberg et al. Phys.Rev.Lett., 32, 486, (1974);
M.May et al. Phys.Rev.Lett., 35, 407, (1975).
6. T.J.Braunstein et al. Phys.Rev., D6, 106, 106, (1972).
7. Y.Watanabe et al. Phys.Rev.Lett., 35, 898, (1975);
C.Chang et al. Phys.Rev.Lett., 35, 901, (1975).
8. H.L.Anderson et al. Phys.Rev.Lett., 37, 4, (1976).
9. Д.Ю.Бардин, Н.М.Шумейко. Препринт ОИЯИ, Р2-9940, Дубна, 1976.
10. Д.Ю.Бардин, Н.М.Шумейко. Препринт ОИЯИ, Р2-10113, Дубна, 1976.
11. А.А.Ахундов, Д.Ю.Бардин. Сообщение ОИЯИ, Р2-9587, Дубна, 1976.
12. С.Н.Билеnькая, С.М.Биленький, Ю.Н.Казаринов, Л.И.Лапидус. Письма в ЖЭТФ, 19, 613 (1974).
13. V.Barger, R.J.N.Phillips. Nucl.Phys., B73, 269, (1974).
14. A.Bodek et al. Phys.Rev.Lett., 30, 1087, (1973).

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