Electroweak corrections to the Drell-Yan process with large dilepton mass at the LHC

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- "Heavy" boxes: Asymptotic Approach
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Introduction

Despite the fact that the Standard Model (SM) more than twenty years keeps for oneself the status of consistent and experimentally confirmed theory, the search of New Physics (NP) manifestations is continued. The possible traces of NP can be the supersymmetry, the large extra dimensions, extra neutral gauge bosons, compositness of fermions, the anomalies in vertices and so on. Forthcoming experiments at the LHC probably will shed the light on these problems.

One of powerful tool in the experiments at LHC from the point of view for the NP exploration is the experimental investigation of the continuum for the Drell-Yan production of dilepton pair, i.e. data on the cross section and the forward-backward asymmetry of the reaction

$$pp \to \gamma, Z \to l^+l^-X \qquad (1)$$

at large invariant mass of dilepton pair.

The studies of NP effects is impossible without the exact knowledge of SM predictions including higher order ElectroWeak radiative Corrections (EWC):

- (I) EWC induced by gauge Boson Self-Energies (BSE),
- (II) the others QED corrections (i.e. radiative corrections induced by at least one additional photon: virtual or real),
- (III) the others Weak corrections (i.e. radiative corrections induced by additional heavy bosons: Z or W),

The (I) and (II) are studied well (see papers on pure QED corrections:
V. Mosolov and N. Shumeiko, Nucl.Phus. B **186**, 394 (1981),
A. Soroko and N. Shumeiko, Yad. Fiz **52**, 514 (1990))
as well as QED corrections and EWC in the Z peak region and above in paper
U. Baur et al., Phys. Rev. D **65**: 033007, (2002)
and calculation of SANC project:
A. Andonov, A. Arbuzov, D. Bardin et al., Comput. Phys. Commun. **174**, 481 (2006)

Both accurate and fast!

The important task is the insertion of this background into the Monte Carlo generators and they should be both accurate and fast. For the latter it is necessary to have the set of as more compact as possible formulas for the EWC.

Electroweak Sudakov Logarithms (vs. collinear logs?)

It is well known that (I) and (II) contributions discussed above do not contain the so-called Sudakov double logarithms (SDL) (V. Sudakov, Sov. Phys. JETP **3**, 65 (1956)), i.e. the expressions which are growing with the scale of energy, and therefore giving one of leading effect in the region of large invariant dilepton mass.

$$l_{i,x} = \log \frac{m_i^2}{|x|} \quad (i = Z, W; \;\; x = s, t, u). \tag{2}$$

On the contrary, the (III) contribution contains the SDL growing with dilepton mass M and, as it will be shown below, predominating in the region $M \gg m_Z$. Such results have been obtained also in paper U. Baur et al., Phys. Rev. D **65**: 033007, (2002).

Evidently, the collinear logarithms of (I) and (II) radiative corrections give the contribution to compete with the SDL in investigated region of large M. That is the object of other investigation (Dubna-Gomel-Minsk).

Notations and Born cross section

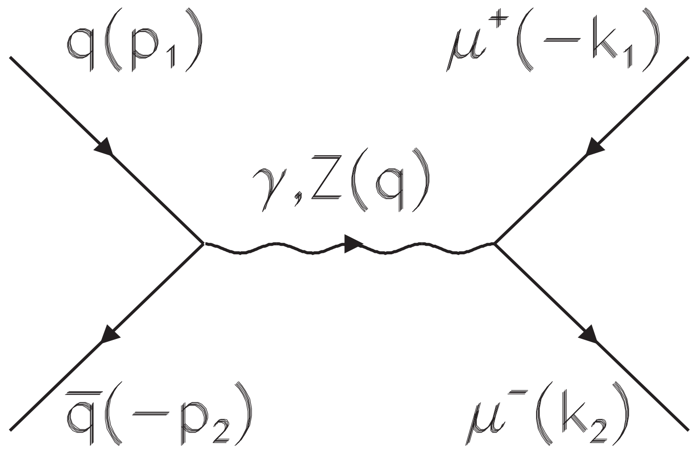


Figure 1: **The lowest order graph giving contribution to the DY scattering at parton level**

The Born cross section for the inclusive hadronic reaction $AB \to l^+l^-X$ is given in Quark Parton Model by formula

$$d\sigma_0 = \frac{4\alpha^2}{3S} \int d\Gamma \sum_{i,j=\gamma,Z} \mathrm{Re}\hat{D}^{is}\hat{D^{js}}^* \sum_{\chi=+,-} \hat{B}_\chi \sum_{q=u,d,s,\ldots} F_k^q(x_1,x_2)\lambda_{q_\chi}^{ij}\lambda_{l_\chi}^{ij}, \quad (3)$$

where our notations are following: $q = k_1 + k_2$ is the 4-momentum of the i-boson with mass m_i. Invariant mass of dilepton is $M = \sqrt{q^2}$. We use the standard set of Mandelstam invariants for the partonic elastic scattering $s,\ t,\ u$:

$$s = (p_1+p_2)^2,\ t = (p_1-k_1)^2,\ u = (k_1-p_2)^2 \quad (4)$$

and invariant $S = (P_A+P_B)^2$ for hadron scattering. The propagator for j-boson has the form

$$D^{js} = \frac{1}{s - m_j^2 + im_j\Gamma_j}, \quad (5)$$

where Γ_j is the j-boson width. The $B_\pm$ are the typical combinations for Drell-Yan process $B_\pm = t^2 \pm u^2$.

The combinations of parton density functions look like

$$F^q_{\pm}(x_1,x_2) = f^A_q(x_1) f^B_{\bar{q}}(x_2) \pm f^A_{\bar{q}}(x_1) f^B_q(x_2), \tag{6}$$

where $f^H_q(x)$ is the probability of finding constituent q with the fraction x of the hadron's momentum in hadron H.

The combinations of coupling constants for f-fermion with i- (or j-) boson have a form

$$\lambda_{f\,+}^{\,i,j} = v^i_f v^j_f + a^i_f a^j_f,\ \lambda_{f\,-}^{\,i,j} = v^i_f a^j_f + a^i_f v^j_f, \tag{7}$$

where

$$v^\gamma_f = -Q_f,\ a^\gamma_f = 0,\ v^Z_f = \frac{I^3_f - 2s^2_W Q_f}{2s_W c_W},\ a^Z_f = \frac{I^3_f}{2s_W c_W}, \tag{8}$$

Q_f is the charge of fermion f, I^3_f is the third component of the weak isospin of fermion f, and s_W (c_W) is the sine(cosine) of the weak mixing angle: $s_W = \sqrt{1 - c^2_W}$, $c_W = m_W/m_Z$.

After reduction the phase space to variables M and y – rapidity of dilepton pair (also $\tau^2 = q^2/S$) we have a three-, two- and one-fold cross sections (yet without any experimental restrictions (!))

$$\sigma(M,y,\zeta) \equiv \frac{d^3\sigma}{dM\,dy\,d\zeta}, \tag{9}$$

$$\sigma(M,y) \equiv \frac{d^2\sigma}{dM\,dy} = \int\limits_{-1}^{+1} \sigma(M,y,\zeta)d\zeta, \tag{10}$$

and

$$\sigma(M) \equiv \frac{d\sigma}{dM} = \int\limits_{-\ln\frac{\sqrt{S}}{M}}^{+\ln\frac{\sqrt{S}}{M}} dy \int\limits_{-1}^{+1} d\zeta\, \sigma(M,y,\zeta). \tag{11}$$

Now the Born cross section looks like

$$\sigma_0(M,y,\zeta) = \frac{2\pi\alpha^2}{3SM}\mathrm{Re}\sum_{i,j=\gamma,Z} D^{is}D^{js*}\sum_{\chi=+,-}(t^2+\chi u^2)\lambda_{l\chi}^{ij}\sum_{q=u,d,s,\ldots} F_\chi^q(x_+,x_-)\lambda_{q\chi}^{ij}, \tag{12}$$

where the invariants s, t and u mean

$$s = M^2,\ t = -\frac{1}{2}s(1-\zeta),\ u = -\frac{1}{2}s(1+\zeta), \tag{13}$$

ζ is cosine of angle θ between $\vec{p}_1$ and $\vec{k}_1$ (i.e. θ is μ^+ zenith angle) in center mass system of hadrons $(\zeta = \cos\theta)$ and the arguments of parton distribution functions in (12) have a form

$$x_\pm = \tau e^{\pm y}. \tag{14}$$

Heavy Vertices (HV)

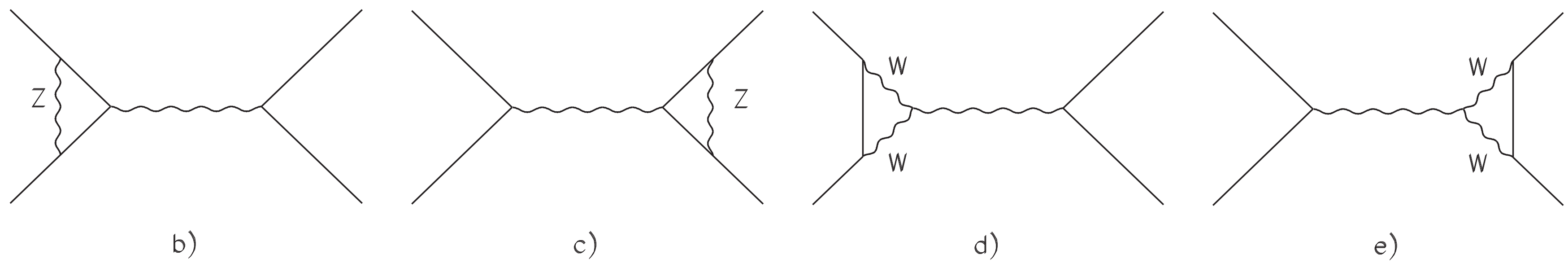


Figure 2: **Feynman graphs for Heavy Vertieces diagrams. Unsigned helix lines mean γ or Z.**

Main features of our calculation:

- the t'Hooft-Feynman gauge,
- on-mass renormalization scheme (α, m_W, m_Z, m_H and the fermion masses are independent parameters),
- ultrarelativistic limit.

These results are presented as the form factor set to the Born vertices (M. Böhm *et al.*, Fortschr. Phys. **34**, 687 (1986)), so we can easily use they to construct the cross section: all that we need is to replace the coupling constants in Born vertex to the corresponding form factors:

$$v_f^j \to \delta F_V^{jf}, a_f^j \to \delta F_A^{jf}. \tag{15}$$

Then the cross section of Heavy Vertices (HV) contribution looks like

$$\sigma_{HV}(M, y, \zeta) = \frac{4\pi\alpha^2}{3SM} \quad \text{Re} \sum_{i,j=\gamma,Z} D^{is} D^{js*} \sum_{\chi=+,-} (t^2 + \chi u^2) \times \\ \times \sum_{q=u,d,s,\ldots} F_\chi^q(x_+, x_-)(\lambda_{q\ \chi}^{F^{ij}} \lambda_{l\chi}^{ij} + \lambda_{q\chi}^{ij} \lambda_{l\ \chi}^{F^{ij}}), \tag{16}$$

where combinations of couplings constants and form factors are

$$\lambda_{f\ +}^{F^{ij}} = \delta F_V^{if} v_f^j + \delta F_A^{if} a_f^j,\ \lambda_{f\ -}^{F^{ij}} = \delta F_V^{if} a_f^j + \delta F_A^{if} v_f^j,\ \ (f = q, l). \tag{17}$$

Electroweak form factors $\delta F_{V,A}^{if}$ even if in ultrarelativistic limit have a cumbersome form, for example :

$$\delta F_V^{\gamma l} = \frac{\alpha v_l^\gamma}{4\pi}[((v_l^Z)^2 + (a_l^Z)^2)\Lambda_2(m_Z) + \frac{3}{4s_W^2}\Lambda_3(m_W)], \tag{18}$$

$$\delta F_A^{\gamma l} = \frac{\alpha v_l^\gamma}{4\pi}[2v_l^Z a_l^Z \Lambda_2(m_Z) + \frac{3}{4s_W^2}\Lambda_3(m_W)], \tag{19}$$

and so on... Here we give the real part of expressions for functions $\Lambda_{2,3}(m_i)$ through the double and single Sudakov logarithms:

$$\Lambda_2(m_i) = \frac{\pi^2}{3} - \frac{7}{2} - l_{i,s}^2 - 3l_{i,s}, \quad \Lambda_3(m_i) = \frac{5}{6} - \frac{1}{3} l_{i,s}. \tag{20}$$

The self-energies of u-quarks diagrams give also non-zero contribution to the cross section. However, the results for u-self-energy are factorized absolutely in the manner of vertices. It gives possibility to sum both of contributions in general formula at that the u-self-energy contribution is completely cancelled with corresponding terms of heavy vertices.

Heavy Boxes

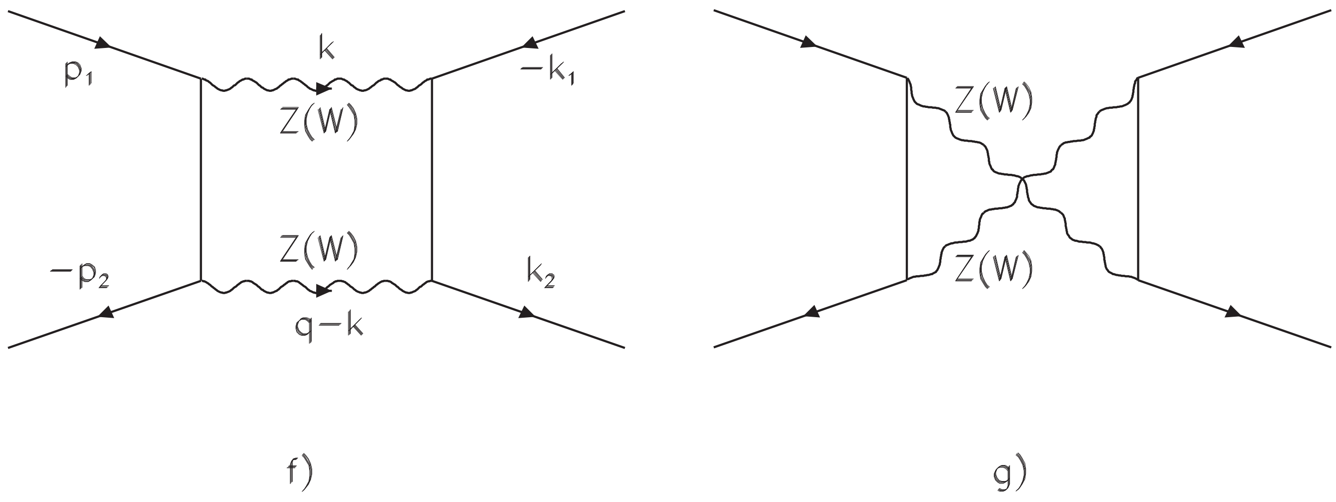


Figure 3: **Feynman graphs for Heavy Boxes. Unsigned helix lines mean γ or Z.**

The calculation of two heavy boson contribution is more complicate procedure since it demands the integration of 4-point functions with complex masses in unlimited from above kinematical region of invariants (see pioneer paper: G.'t Hooft and M. Veltman, Nucl. Phys. B **153**, 365 (1979)). Fortunately there is a way to avoid many of troubles with the integration all of terms in box contribution.

First of all we construct the box cross section for $q\bar{q} \to l^+l^-$ using the standard Feynman rules:

$$d\sigma_{ZZ} = -\frac{4\alpha^3}{\pi s}\delta(q-p_1-p_2)\frac{d^3k_1}{2k_1^0}\frac{d^3k_2}{2k_2^0}\mathrm{Re}\frac{i}{(2\pi)^2}\int d^4k \sum_{k=\gamma,Z} D^{ks*}(D^{ZZ}+C^{ZZ}), \quad (21)$$

here $D^{ZZ}(C^{ZZ})$ is contribution of direct (crossed) diagram.

Neglecting of fermion masses and polarization of particles we present the direct contribution in the form:

$$D^{ZZ} = \Pi^D_{ZZ}\mathrm{Tr}[\gamma^\alpha \hat{p}_2\gamma_\mu(\hat{p}_1-\hat{k})\gamma_\nu\rho_q^{ZZ,k}(p_1)]\mathrm{Tr}[\gamma_\alpha\hat{k}_2\gamma^\mu(\hat{k}-\hat{k}_1)\gamma^\nu\rho_l^{ZZ,k}(k_1)], \quad (22)$$

where integrand of 4-point scalar function looks like

$$\Pi^D_{ZZ} = \frac{1}{((q-k)^2-m_Z^2)(k^2-m_Z^2)(k^2-2k_1k)(k^2-2p_1k)}. \quad (23)$$

Combinations of the density matrices $\rho(p)$ and the coupling constants can be reduced to production of λ-factors (as in the "Born" formulas).

To extract the part of cross section which predominates in region $s,\ |t|,\ |u| \gg m_Z^2$ we should make equivalent transformation based on the close connection of infrared divergency and SDL terms:

$$D^{ZZ} = (D^{ZZ}|_{k\to 0} + D^{ZZ}|_{k\to q}) + (D^{ZZ} - D^{ZZ}|_{k\to 0} - D^{ZZ}|_{k\to q}) = D_1^{ZZ} + D_2^{ZZ}. \tag{24}$$

Integrating over k

$$\begin{aligned}
&\frac{i}{(2\pi)^2}\int \frac{d^4k}{(k^2-m_Z^2)(k^2-2k_2k)(k^2-2p_2k)} = \\
&= \frac{1}{4}\int_0^1 dx \int_0^x \frac{dy}{m_Z^2(x-y)+(p_2(1-x)+k_2y)^2} = \\
&= \frac{1}{4}\int_0^1 dx \frac{1}{t(x-1)-m_Z^2}\log\frac{t(x-1)}{m_Z^2} = \\
&= -\frac{1}{4t}\Big(\frac{\pi^2}{3}+\frac{1}{2}\log^2\frac{-t-m_Z^2}{m_Z^2}+\mathrm{Li}_2\frac{m_Z^2}{m_Z^2+t}\Big),
\end{aligned} \tag{25}$$

and saving in the calculation the terms which are proportional to the second ($\sim l_{i,x}^2$), first ($\sim l_{i,x}^1$) and zero ($\sim l_{i,x}^0$) power of Sudakov logarithms and thereby neglecting the terms which are inessential in the region of large dilepton mass we get the asymptotic expression

$$\frac{i}{(2\pi)^2}\int d^4k D_1^{ZZ} \approx -\frac{2}{s}B^{ZZ,k}(\frac{\pi^2}{3}+\frac{1}{2}l_{Z,t}^2). \qquad (26)$$

Here we used trivial correlation typical for Born cross section

$$B^{ZZ,k} = \frac{1}{2}\mathrm{Tr}[\gamma^\alpha \hat{p}_2 \gamma_\mu \rho_q^{ZZ,k}(p_1)]\mathrm{Tr}[\gamma_\alpha \hat{k}_2 \gamma^\mu \rho_l^{ZZ,k}(k_1)] \approx b_+^{ZZ,k}t^2 + b_-^{ZZ,k}u^2, \qquad (27)$$

where

$$b_\pm^{n,k} = \lambda_{q_+}^{n,k}\lambda_{l_+}^{n,k} \pm \lambda_{q_-}^{n,k}\lambda_{l_-}^{n,k}. \qquad (28)$$

Retaining only leading $\sim l_{i,x}^2$ term how it had been done in P. Ciafaloni and D. Comelli, Phys. Lett. B **446**, 278 (1999) we get coincidence with the results of this paper.

Then, using the methods of J. Kahane, Phys. Rev. B **135**, 975 (1964) we get

$$\frac{i}{(2\pi)^2}\int d^4k D_2^{ZZ} \approx b_-^{ZZ,k} l_s u + (b_-^{ZZ,k}(t^2+u^2) + 2b_+^{ZZ,k}t^2)\frac{1}{2s}l_s^2, \quad l_s = \log\frac{s}{|t|}. \tag{29}$$

The calculation contains two sort of parameters: masses of fermions and L – parameter which regulates the ultraviolet divergence, both of them are completely cancelled out in final expression.

And, finally, for crossed part:

$$C^{ZZ} = -D^{ZZ}\Big|_{t\leftrightarrow u}^{b_+^{ZZ,k}\leftrightarrow b_-^{ZZ,k}}. \tag{30}$$

So, the ZZ-box contribution to Drell-Yan process at large invariant dilepton mass is

$$\sigma_{ZZ}(M,y,\zeta) = \frac{2\alpha^3}{3SM}\mathrm{Re}\sum_{k=\gamma,Z} D^{ks^*} \times$$
$$\times \sum_{q=u,d,s,\dots} \Big[f_q^A(x_+) f_{\bar{q}}^B(x_-) \big(\delta^{ZZ,k}(t,u,b_+,b_-) - \delta^{ZZ,k}(u,t,b_-,b_+)\big) +$$
$$+ f_{\bar{q}}^A(x_+) f_q^B(x_-) \big(\delta^{ZZ,k}(u,t,b_+,b_-) - \delta^{ZZ,k}(t,u,b_-,b_+)\big)\Big], \quad (31)$$

where

$$\delta^{ZZ,k}(t,u,b_+,b_-) = \frac{B^{ZZ,k}}{s}\left(\frac{2\pi^2}{3} + l_{Z,t}^2\right) - b_-^{ZZ,k} u l_s - (b_-^{ZZ,k}(t^2+u^2) + 2b_+^{ZZ,k} t^2)\frac{l_s^2}{2s}. \quad (32)$$

To obtain the WW-box contribution to Drell-Yan cross section using the expressions (31, 32) one should: 1) to do the trivial substitution in all of indices of coupling constants and boson masses $Z \to W$, 2) to take into consideration that some parton diagrams are forbidden by the charge conservation law (direct WW-box: $d\bar{d} \to l^+l^-$ and $\bar{u}u \to l^+l^-$; crossed WW-box: $u\bar{u} \to l^+l^-$ and $\bar{d}d \to l^+l^-$). This second feature of WW-boxes explains the fact of domination of WW-contribution to Drell-Yan cross section in comparison with ZZ (or γZ) -contribution (see below in numerical analysis). Point is that the leading term of ZZ-contribution is proportional to difference

$$\delta^{ZZ,k}(t,u,b_+,b_-) - \delta^{ZZ,k}(u,t,b_-,b_+) \sim l^2_{Z,t} - l^2_{Z,u} = \log\frac{u}{t}(l^1_{Z,t} + l^1_{Z,u}), \quad (33)$$

i.e. leading terms of ZZ-box contribution $\sim l^1_{Z,x}$, whereas the leading parts of WW–cross section do not contain the difference (33) and are proportional to $l^2_{W,x}$. Let us remark here that the factorization property (33) is absent in heavy vertex part and takes place for infrared finite part of γZ–box contribution.

Comparison with existing results: ZZ and WW

$\sqrt{s}$, TeV	ZZ, SANC	ZZ, ZGRAD	ZZ, AA	WW, SANC	WW, AA
0.1	-0.0186		0.0683	-0.329	-1.2690
0.2	-0.0908	-0.0907	-0.0073	-3.107	-4.8739
0.5	-0.2144	-0.2145	-0.1895	-10.777	-10.1087
1.0	-0.3346	-0.3346	-0.3251	-16.998	-16.5720
2.0	-0.4638	-0.465	-0.4612	-25.442	-25.2497
3.0	-0.5423	-0.543	-0.5410	-31.468	-31.3554
5.0	-0.6432	-0.643	-0.6416	-40.185	-40.1306
10.0	-0.7787	-0.779	-0.7782	-53.989	-53.9695

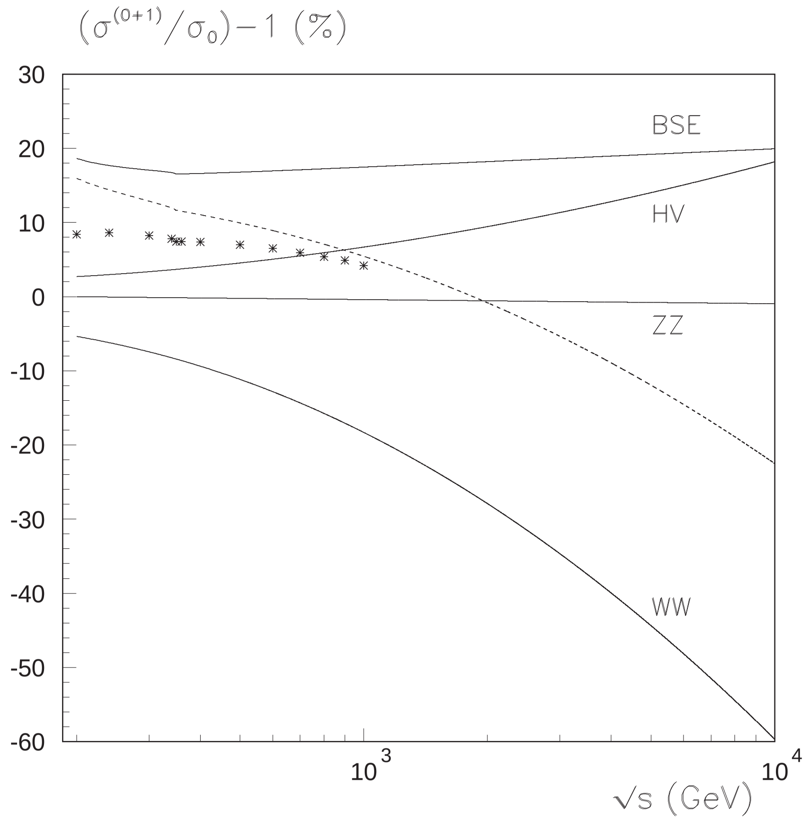
Table 1. The relative corrections (in per cents) to the ZZ- and WW-box cross section at the parton level for $u\bar{u} \to \mu^+\mu^-$ as a functions of $\sqrt{s}$, calculated by different groups: SANC, program ZGRAD (U. Baur et al. `http://ubhex.physics.buffalo.edu/~baur/zgrad2.tar.gz`) and using the asymptotic formulas (AA).

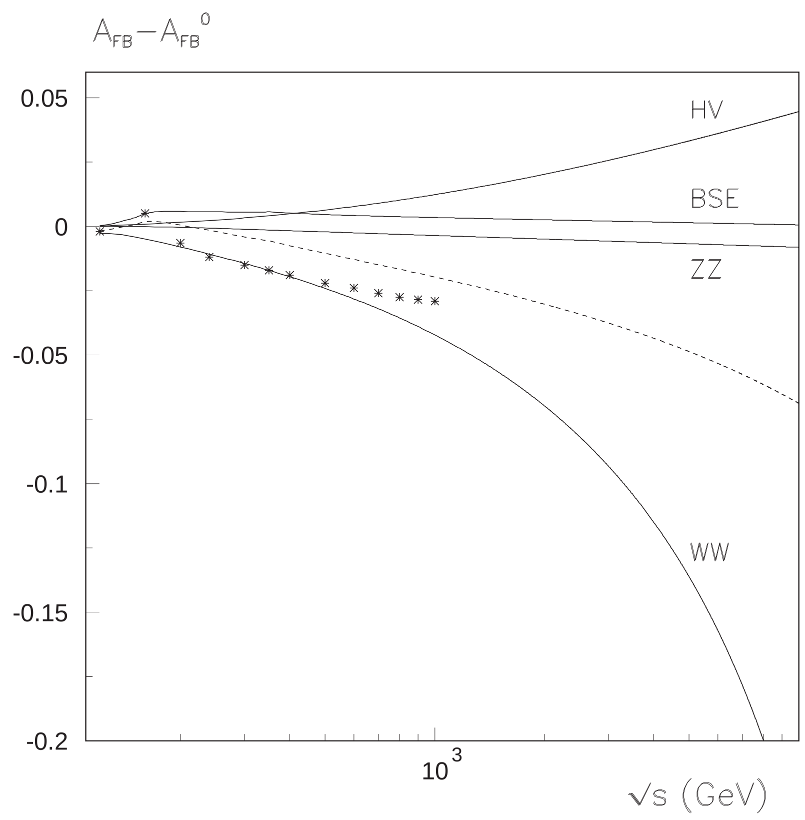
Comparison with existing results: HV

$\sqrt{s}$, TeV	HV, SANC	HV, AA
0.5	4.49	4.09
1.0	6.46	5.99
2.0	8.80	8.42
3.0	10.45	10.09
5.0	12.80	12.45
10.0	16.48	16.10

Table 2. The relative corrections (in per cents) to the HV- cross section at the parton level for $u\bar{u} \to \mu^+\mu^-$ as a functions of $\sqrt{s}$, calculated by different groups: SANC and using the asymptotic formulas (AA).

Comparison with existing results





The relative corrections to the total cross section (left picture) and the A_{FB} at the parton level (right picture). Dashed line correspons to sum of all contributions. The asterisks are the points taken from FIG. 3 and FIG. 4 of paper U. Baur et al., Phys. Rev. D **65**: 033007, (2002)

Discussion of numerical results

In the following the scale of radiative corrections and their effect on the observable cross section of the Drell-Yan processes will be discussed.

We used the following standard set of electroweak parameters:

$$\alpha = 1/137.036,\ m_W = 80.37399 \text{ GeV},\ m_Z = 91.1876 \text{ GeV}$$

and the energy of LHC

$$\sqrt{S} = 14 \text{ TeV}.$$

Our choice is the CTEQ6 set of unpolarized parton distribution functions (J. Pumplin et al., JHEP 0207:012 (2002), hep-ph/0201195). We have selected $Q^2 = M^2$ in these Q^2-dependent distributions, and have taken into consideration only $u-$, $d-$ and $s-$quarks (valence and sea).

Some experimental cuts

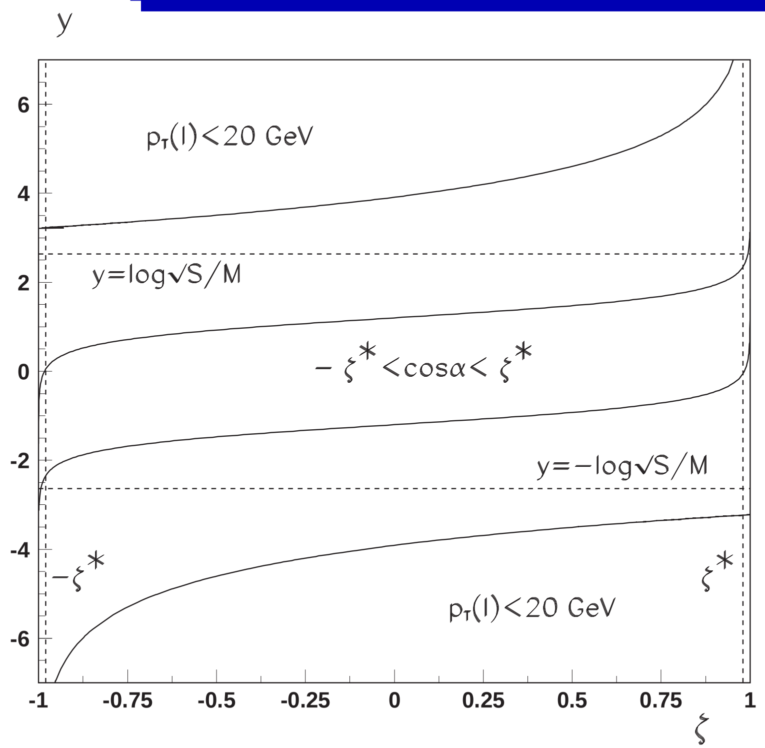


Figure 4: **The region of integration for cross section taking into consideration the experimental cuts of CMS at M=1 TeV.**

Standard (DY) experimental restriction conditions on detected lepton angle $-\zeta^* \le \zeta \le \zeta^*$ and on lepton rapidity $|y(l)| \le y(l)^*$. For CMS detector the values of ζ^* and $y(l)^*$ are determined as

$$y(l)^* = -\ln\,\tan\frac{\theta^*}{2} = 2.4, \quad \zeta^* = \cos\theta^* \approx 0.9837. \qquad (34)$$

Taking into consideration the experimental restrictions the cross section is modified to

$$\sigma(M) = \int\limits_{-\ln\sqrt{S}/M}^{+\ln\sqrt{S}/M} dy \int\limits_{-\zeta^*}^{\zeta^*} d\zeta\, \sigma(M,y,\zeta)\theta(\cos\alpha+\zeta^*)\theta(-\cos\alpha+\zeta^*), \qquad (35)$$

where α is the scattering angle of μ^- with the 4-momenta $\vec{k}_2$. This angle has a non-trivial relation to θ and y:

$$\alpha = \pi - \arccos\frac{\cos\theta - f}{\sqrt{1+f^2-2f\cos\theta}} - \arcsin\frac{f\sin\theta}{\sqrt{1+f^2-2f\cos\theta}},\ \ f = \frac{e^{2y}-1}{e^{2y}+1}. \qquad (36)$$

Let us remark here that the second standard CMS restriction

$$p_T(l) \ \geq\ 20\text{GeV}$$

in the region of large M is satisfied completely and automatically.

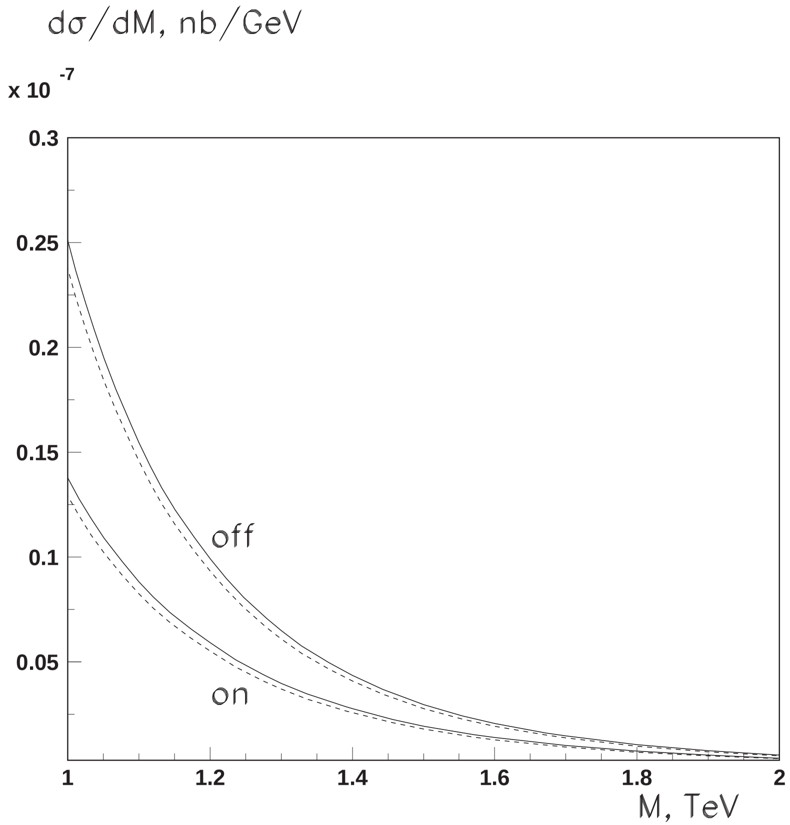
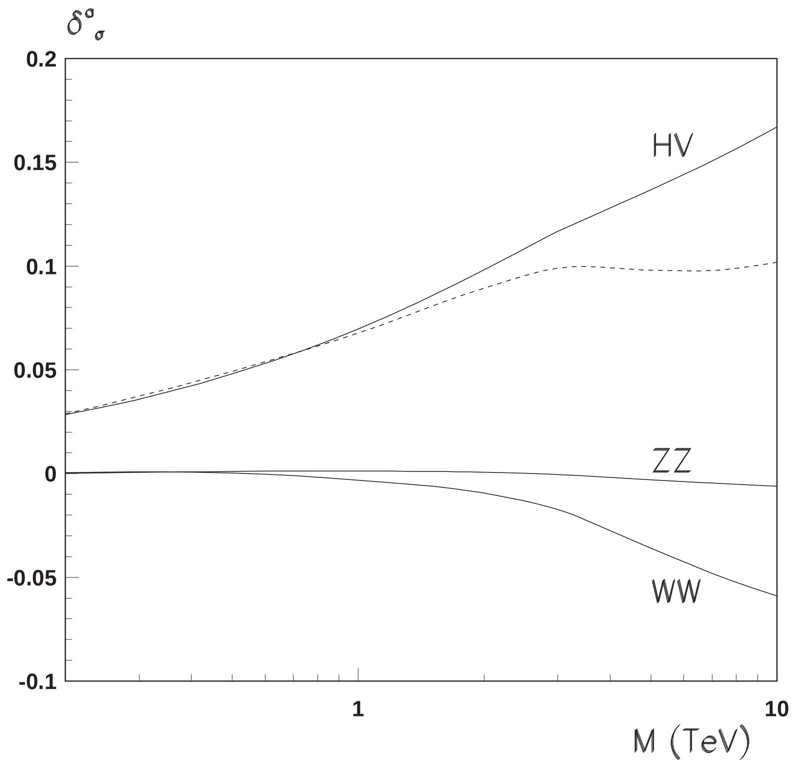
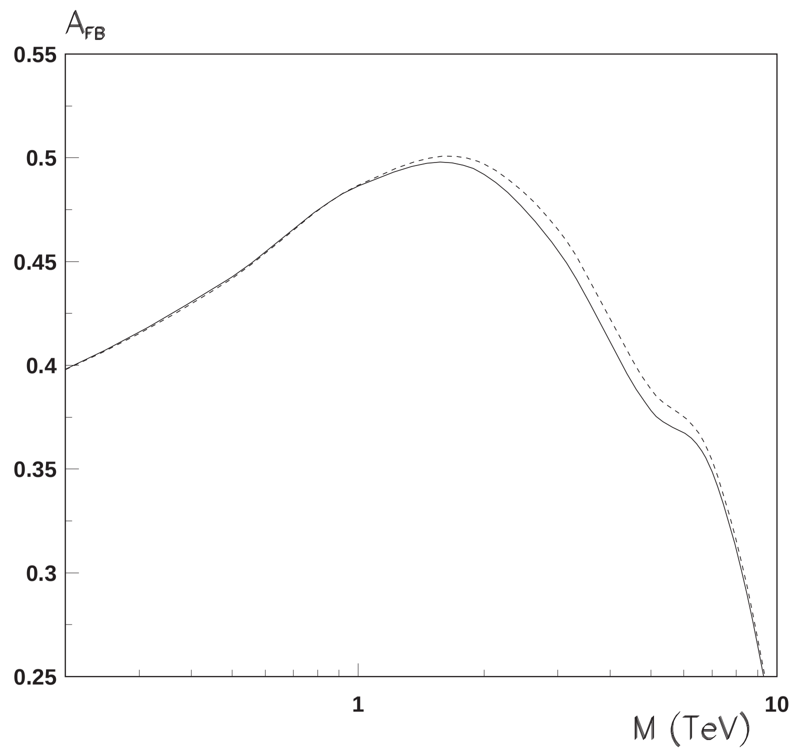


Figure 5: **The Born (dashed lines) and radiatevely corrected (solid lines) cross sections for $\sqrt{S} = 14$ TeV and different integration over ζ and dilepton rapidity: without experimental restrictions (curves denoted by 'off') and with experimental restrictions corresponding to detected lepton rapidity condition $|y(l)| \leq 2.4$ (curves denoted by 'on'). The solid line corresponds to sum of all contributions to radiative corrections.**

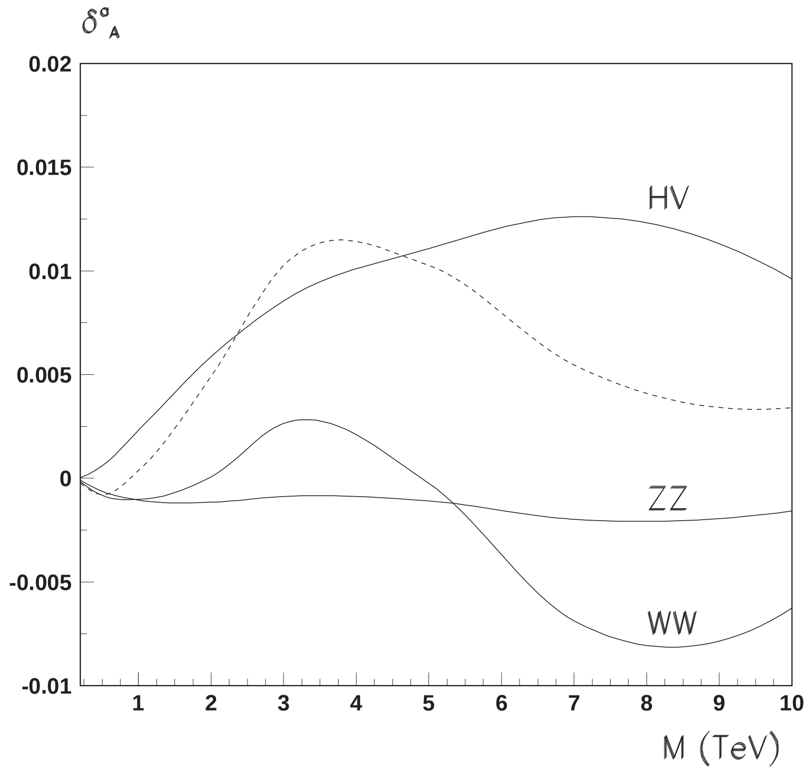


The relative corrections δ_σ^a corresponding to the $\mathrm{ZZ}, \mathrm{WW}, \mathrm{HV}$–contributions with experimental restrictions of the CMS as a functions of M. The dashed line corresponds to the sum of all the WRC contributions.

$$\delta_\sigma^a = \frac{\sigma_a(M)}{\sigma_0(M)}, \quad a = \mathrm{ZZ}, \mathrm{WW}, \mathrm{HV}, \mathrm{tot}; \quad \mathrm{tot} = \mathrm{ZZ} + \mathrm{WW} + \mathrm{HV}.$$



The forward-backward asymmetry $A_{\rm FB}$ in the Born approximation (solid line) and taking into consideration the total WRC (dashed line) as a functions of M.



The difference between the Born and the radiatively corrected asymmetries corresponding to the $\mathrm{ZZ}, \mathrm{WW}, \mathrm{HV}$–contributions as a functions of M. The dashed line corresponds to the sum of all contributions to the WRC.

Conclusions

- The electroweak radiative corrections to Drell-Yan process above the Z-peak have been studied.
- The results are the compact asymptotic expressions, they expand in the powers (zero, first and second) of electroweak Sudakov logarithms.
- At the parton level we compare the investigated radiative corrections with the existing results and obtain a rather good coincidence at energy higher than 0.5 TeV.
- The numerical analysis in the high energy region is performed. To simulate the detector acceptance we used the standard CMS rapidity cuts.
- It has been ascertained that the considered radiative corrections become large at high di-leptom mass M and increase the cross section. The scale of EWC is $\sim +7\%$ at LHC energies and $M =$1 TeV.
- The large scale of EWC does not permit to neglect the radiative correction procedure in the future experiments at LHC.

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